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Progress Report

1

Water Supply at Los Alamos During 1978

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by

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ABSTRACT

The municipal and industrial water supply for Los Alamos for 1978 consisted of 1436 $\times$ 10^6 gal from wells in three fields and 45 $\times$ 10^6 gal from the gallery in Water Canyon. An additional 1.1 $\times$ 10^6 gal of water were pumped to waste during testing of well LA-6. About 3.3 $\times$ 10^6 gal of water in the Guaje Reservoir were used for irrigation, thus the total use was about 1485 $\times$ 10^6 gal. Water level trends in the wells were as anticipated under current production practices. Projected water level declines or recoveries were made to 1983. Suggestions are presented to reduce the rate of decline in the lower part of the Los Alamos field. Quality of water from wells, gallery, five stations on the distribution system, and Guaje Reservoir is presented. Quality of water is good and meets standards for municipal supply. Well and distribution system rehabilitation and replacement should be continued to ensure an adequate and reliable water supply from the wells and systems.

I. INTRODUCTION

This report summarizes pumpage and aquifer conditions for wells in the Los Alamos, Guaje, and Pajarito well fields (Fig. 1). These wells supply most of the water used for municipal and industrial purposes in Los Alamos and Los Alamos Scientific Laboratory (LASL). The gallery in Water Canyon that supplies the balance to the system is also discussed. This report is a joint effort between Group H-8 of LASL and the Utilities and Engineering Division of the Zia Company (Zia U/E). Its purpose is to ensure a continuing historical record and to provide guidance for management of water resources and long-range planning for the water supply system. One summary report and seven annual reports have been issued as the result of these studies.[1-8] The ninth report extrapolates water-level trends in the well fields to 1983 under current production.[9]

The Zia U/E, the Department of Energy (DOE) support contractor at LASL, maintains and operates the water supply system. Water is pumped from wells, through transmission lines, and lifted by booster pumps into reservoirs for storage and distribution to the community and Laboratory areas (Fig. 1). Water from the gallery flows by gravity through a microfilter station and is pumped into one of the system reservoirs for distribution. Zia U/E maintains monthly records of hours of operation on each well, along with daily and monthly production records. Monthly average nonpumping and pumping water levels are computed from air-line pressure data recorded continuously at each well. These data provide input for calculating pumping rates, drawdown (difference between nonpumping and pumping water levels), specific capacity (pump rate per unit drawdown), and other well-field statistics included in this report.

Hydrographs have been prepared for one observation well, one standby supply well, 15 supply wells, and the gallery in Water Canyon. The hydrographs for the wells show annual average nonpumping and pumping water levels, specific capacity, and annual pumpage for the years during which the wells have

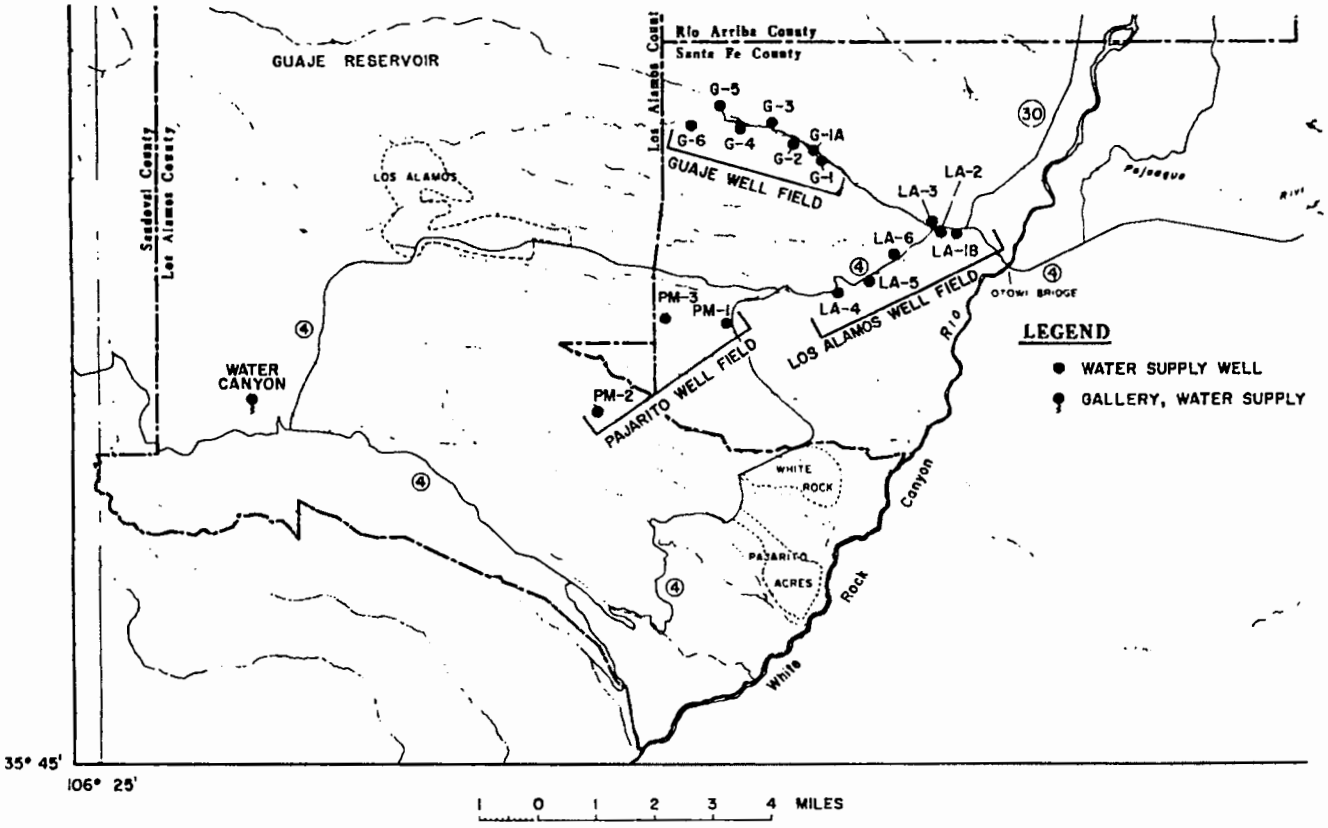

Fig. 1.
Location of well fields, supply wells, and gallery water supply.

been in production. The hydrographs for the gallery present annual production and the annual average discharge rates. Appendixes A and B contain basic pumping and production information for each supply well, monthly for 1978, and annually for the period of record.

Included in the report are projected water level declines in individual wells for 1983 with recommendations for production to reduce the rate of decline in the lower part of the Los Alamos field. A section has been added on the chemical, trace metals, and radioactivity in water from wells, gallery, and distribution system (Appendxes C, D, and E, respectively).

II. WELL-FIELD CHARACTERISTICS

Production from the three well fields decreased 38 $\times 10^6$ gal from 1474 $\times 10^6$ gal in 1977 to 1436 $\times 10^6$ gal in 1978 (Table I). The production into Los Alamos decreased 43 $\times 10^6$ gal from the Los Alamos field and 71 $\times 10^6$ gal from the Guaje field, while the production from the Pajarito field increased 76 $\times 10^6$ gals. Water production fell below the projected demand by 730 $\times 10^6$ gal (Fig. 2).[10]

The peak demand period in 1978 was for a 20-day period of June 9 through June 28 when pumpage was about 149 $\times 10^6$ gal or 7.4 $\times 10^6$ gal/day. It was quite similar to the peak demand period in 1977 which was for 19 days in which 149 $\times 10^6$ gals were produced or 7.8 $\times 10^6$ gal/day. The difference that occurred was that in 1978 the daily production exceeded 8 $\times 10^6$ gal for 7 days, while in 1977 the daily production exceeded 10 $\times 10^6$ gal for 2 days, 9 $\times 10^6$ gal for 4 days, and 8 $\times 10^6$ gal for 4 days (Table II). The number of demand days in 1978 increased in the range of lower daily production.

The months of heaviest production in 1978 were June, July, and August. The production for the three months was 559 $\times 10^6$ gal, declining from 578 $\times 10^6$ gal for a similar period in 1977. The months of least demand were December, January, and February.

TABLE I

PRODUCTION IN MILLIONS OF GALLONS FROM WELLS AND GALLERY

1947—1977

Year	Los Alamos Field	Guaje Field	Pajarito Field	Water Canyon Gallery	Production Total
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	1111
1961	546	624	0	54	1224
1962	577	597	0	67	1241
1963	539	654	0	51	1244
1964	627	665	0	45	1337
1965	447	571	99	72	1189
1966	450	613	127	82	1272
1967	373	464	481	56	1374
1968	345	474	584	65	1468
1969	331	435	569	80	1415
1970	360	423	595	65	1443
1971	412	484	657	37	1590
1972	380	467	662	40	1549
1973	406	475	685	49	1615
1974	369	453	802	35	1659
1975	356	431	749	42	1578
1976	343	531	817	41	1732
1977	345	515	614	57	1531
1978	302	444	690	45	1481
Total	13 229	13 152	8131	1734	36 246

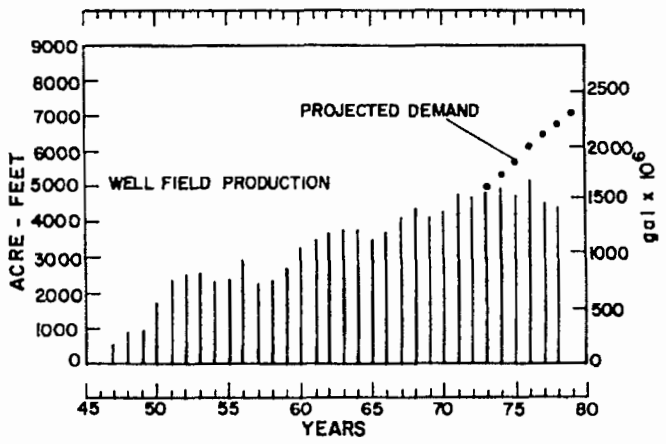

Fig. 2.
Well-field production 1947-78 and projected demand 1973-79.

The production in 1978 for the three months was 239 $\times$ 10^6 gal compared to 260 $\times$ 10^6 gal that were produced for the similar period in 1977. The difference in demand for periods of heavy to light production (summer to winter) is the use of water for lawn and yard irrigation. During 1978 an additional 248 housing units were completed in Los Alamos County. In spite of additional housing, the peak demand and production declined. These declines are due to water conservation by the residents of the County and by the Laboratory, probably brought about by the increasing cost of water.

Water levels in the wells fluctuate with production. The highest water levels were during months of least pumpage (December, January, and February), whereas the lowest water levels were during months of greatest production (June, July, and August).

The total production from the well fields and gallery since 1947 has been 36 246 $\times$ 10^6 gal. Of this, the wells have produced 34 512 $\times$ 10^6 gal, or 95% (Table I). The annual production, per cent pumpage by well fields, and per cent of pumpage by individual wells are given in Table III. The average annual pumping rates for individual wells for the period 1973 through 1978 are shown in Table IV.

A. Los Alamos Field

The Los Alamos well field is composed of six supply wells and one observation well. The production in 1978 was from five supply wells; the sixth is on standby status for emergency use only.[11] Pumpage from the field decreased by 43 $\times$ 10^6 gal, from 345 $\times$ 10^6 in 1977 to 302 $\times$ 10^6 gal in 1978. The production from the field declined to its lowest amount since 1949 (Table I). The decrease in production is due in part to rehabilitation of tanks on the Los Alamos line. Production was restricted for a few weeks period in the fall. The field produced about 20% of the total pumpage for the year (Table III).

Pumpage from the individual wells decreased from the 1977 production. As a result, the water

TABLE II

PEAK DEMAND PERIODS
1976—1978

	Demand Period		
	June 11-July 12 1976	**May 31-June 18 1977**	**June 9-June 28 1978**
No. of Day	32	19	20
Total production (gal)	299 $\times$ 10^6	149 $\times$ 10^6	149 $\times$ 10^6
Av. daily production (gal)	9.3 $\times$ 10^6	7.8 $\times$ 10^6	7.4 $\times$ 10^6
Number of days exceeding			
10 $\times$ 10^6	14	2	---
9 $\times$ 10^6	9	4	---
8 $\times$ 10^6	4	4	7
7 $\times$ 10^6	3	4	8
<7 $\times$ 10^6	2	5	5

TABLE III

PRODUCTION PERCENTAGES
1978

	Production in Million Gal	Per Cent by Well Field	Per Cent of Total Production
Los Alamos Well Field			
LA-1	0.0	0	0.0
LA-1B	75.6	25	5.1
LA-2	39.5	13	2.7
LA-3	42.4	14	2.9
LA-4	80.1	26	5.4
LA-5	64.9	22	4.4
LA-6	0.0	0	0.0
Subtotal	302.5	100	20.5
Guaje Well Field			
G-1	56.0	13	3.8
G-1A	77.9	18	5.2
G-2	71.6	16	4.8
G-3	66.4	15	4.5
G-4	49.5	11	3.3
G-5	84.2	19	5.7
G-6	38.4	8	2.6
Subtotal	444.0	100	29.9
Pajarito Well Field			
PM-1	90.6	13	6.1
PM-2	388.4	56	26.2
PM-3	211.0	31	14.2
Subtotal	690.0	100	46.5
Water Canyon Gallery			
Subtotal	45.3	100	3.1
Total	1481.8	---	100

levels in wells LA-1, LA-1B, LA-2, LA-3, LA-4, and LA-5 rose slightly when compared to those levels in 1977 (Figs. 3 through 8, respectively). Well LA-6, on standby status, pumped about 1.1×10^6 gal for testing and pump maintenance during the year. The restricted use of the well since 1975 resulted in a continued rise or higher water levels (Fig. 9).

The average annual pumping rate from the five producing wells increased 111 gpm from 2097 gpm in 1977 to 2208 gpm in 1978 (Table IV). The increase is due to less pumpage from the wells and higher water levels. The specific capacity of the five producing wells also showed no significant change in 1978 data. The sixth well, LA-6 on standby, had a decrease of specific capacity of about 6 gpm/ft of drawdown as the result of decreasing the depth of the well by about 600 ft.[11]

B. Guaje Well Field

The Guaje well field is composed of seven wells (Fig. 1). The pumpage from the field decreased 71×10^6 gal from 515×10^6 gal in 1977 to 444×10^6 gal in 1978 (Table I). The production from the field reached its lowest amount since 1970. The field produced about 30% of the total production (Table III).

TABLE IV

AVERAGE ANNUAL PUMPING RATE OF WELLS AND DISCHARGE FROM GALLERY 1973-1978 (in gpm)

	1973	1974	1975	1976	1977	1978
Los Alamos Well Field						
LA-1	0	0	0	0	0	0
LA-1B	553	540	537	526	504	546
LA-2	297	302	290	267	255	286
LA-3	346	316	313	285	284	306
LA-4	589	594	591	584	586	594
LA-5	460	460	450	462	468	476
LA-6	572	569	551	486	0	0
Subtotal	2817	2781	2742	2610	2097	2208
Guaje Well Field						
G-1	375	275	376	366	353	351
G-1A	531	520	519	512	502	494
G-2	429	447	456	452	450	452
G-3	277	273	273	463	444	428
G-4	206	214	346	337	352	316
G-5	541	560	549	536	541	538
G-6	364	360	348	325	307	289
Subtotal	2723	2750	2867	2991	2949	2868
Pajarito Well Field						
PM-1	459	606	616	607	592	593
PM-2	1388	1381	1383	1369	1375	1365
PM-3	1320	1313	1312	1410	1406	1398
Subtotal	3166	3299	3310	3386	3373	3356
Water Canyon Gallery						
Subtotal	93	67	80	78	108	86
Total	8800	8896	8999	9065	8528	8518

Pumpage from the individual wells decreased from the 1977 production. As a result, the water levels in wells G-1, G-1A, G-2, G-3, G-4, G-5, and G-6 were higher in 1978 when compared to the water levels in 1977 (Figs. 10 through 16, respectively).

The average annual pumping rate from wells in the field decreased 81 gpm from 2949 gpm in 1977 to 2868 gpm in 1978 (Table IV). The largest declines occurred in G-3 (16 gpm), G-4 (36 gpm), and G-6 (18 gpm). The decline in pumping rate in G-3 and G-4 was accompanied by slight changes in specific capacity, which indicates some well deterioration because of sand covering some of the screen openings in the casings. The decline in pumping rate of G-6 is attributed to wear on the pump. Specific capacity increased slightly. Well G-6 was taken out

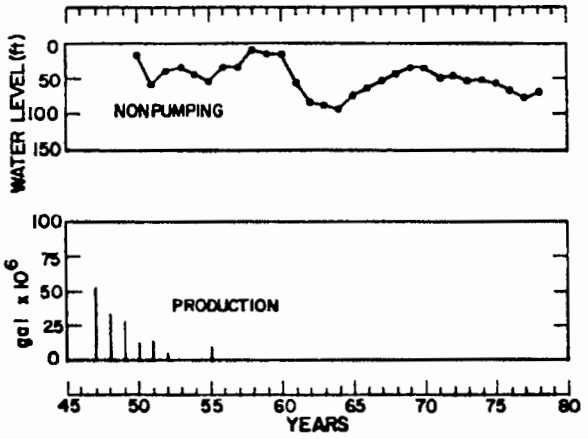

Fig. 3.
Annual average nonpumping water level and annual production, Los Alamos Well LA-1.

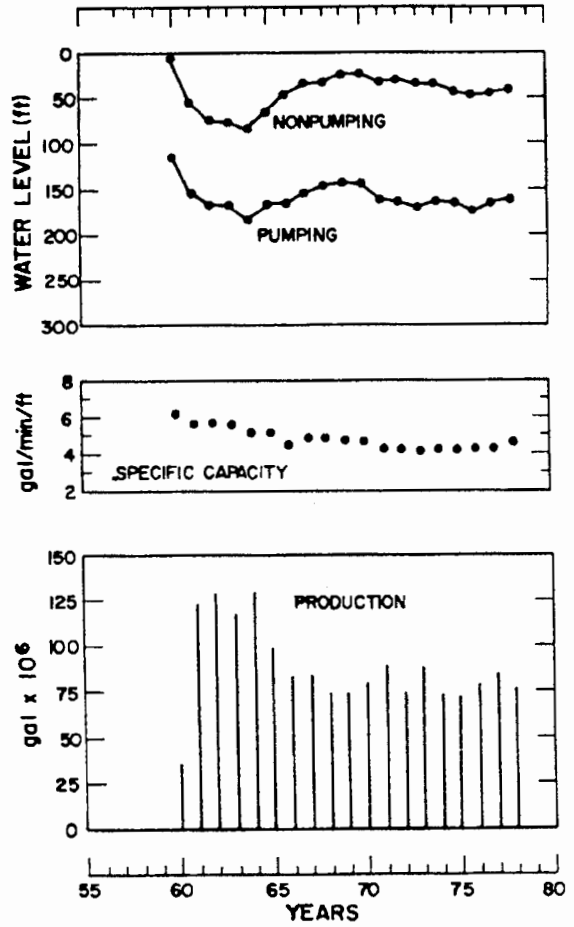

Fig. 4.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-1B.

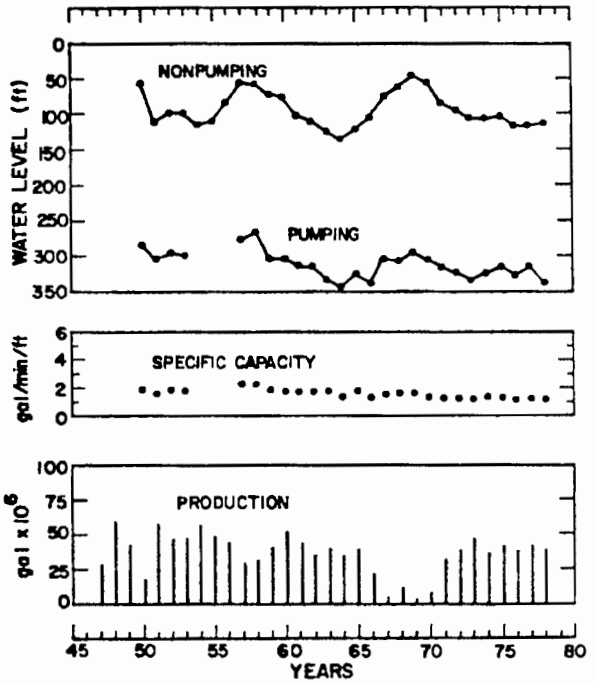

Fig. 5.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-2.

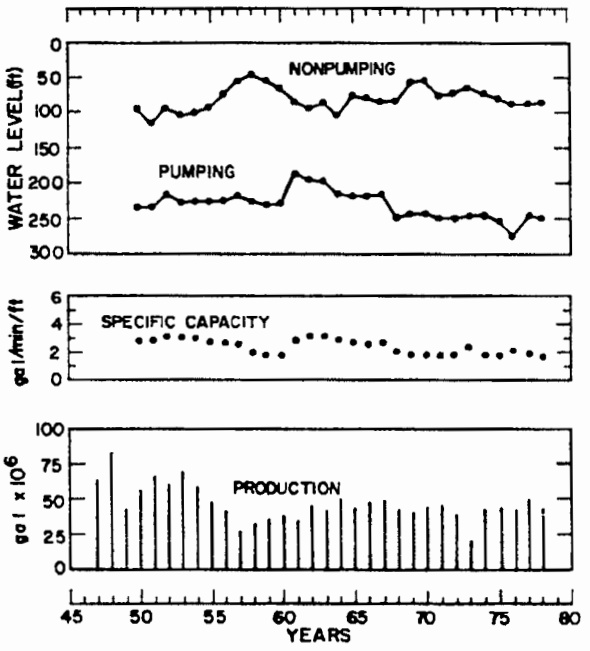

Fig. 6.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-3.

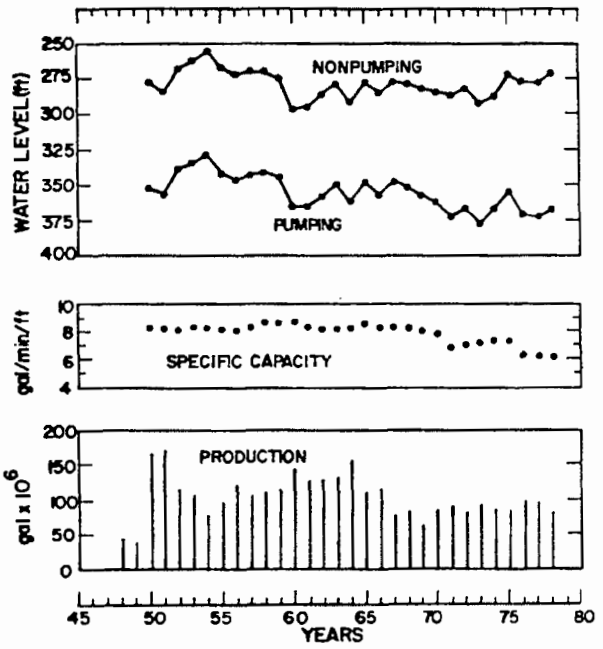

Fig. 7.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-4.

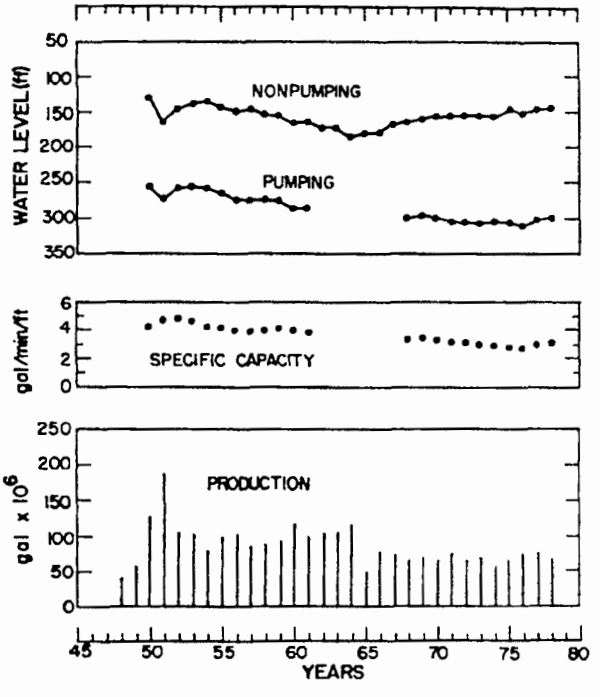

Fig. 8.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-5.

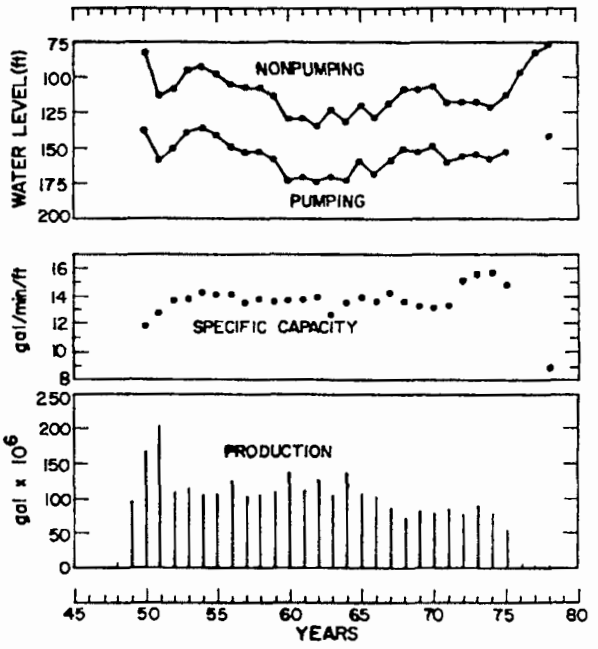

Fig. 9.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-6.

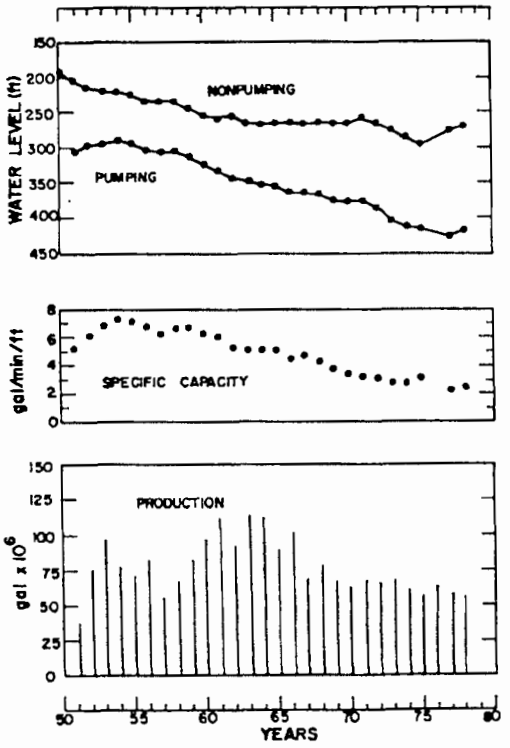

Fig. 10.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-1.

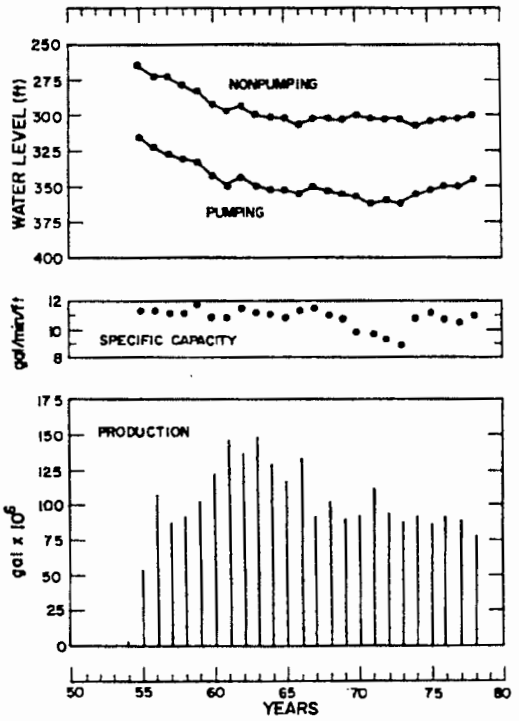

Fig. 11.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-1A.

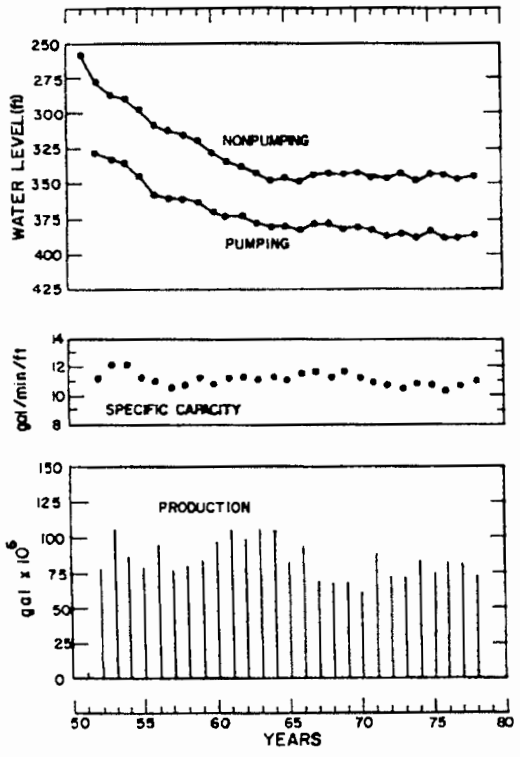

Fig. 12.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-2.

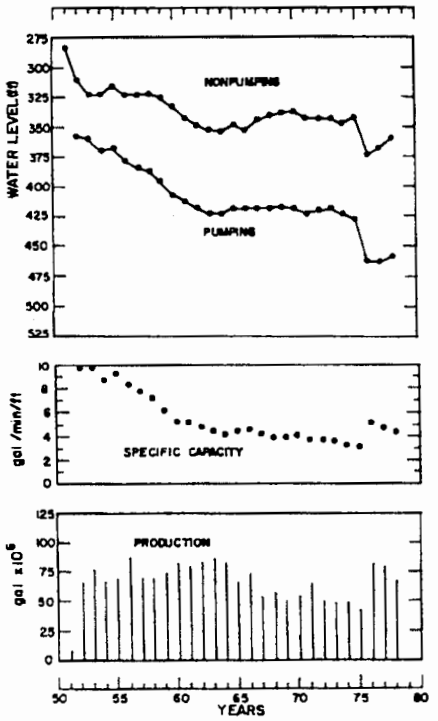

Fig. 13.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-3.

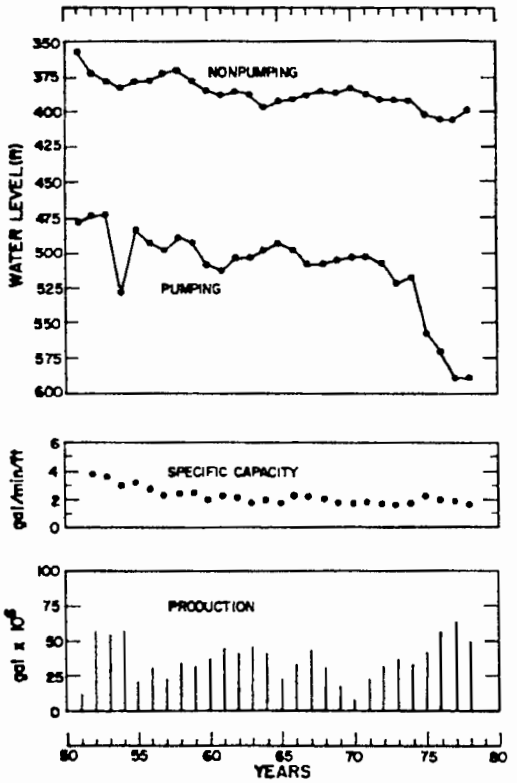

Fig. 14.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-4.

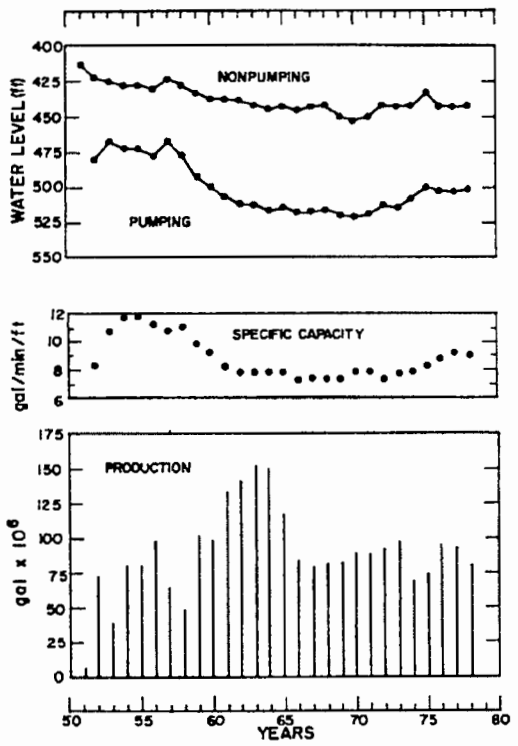

Fig. 15.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-5.

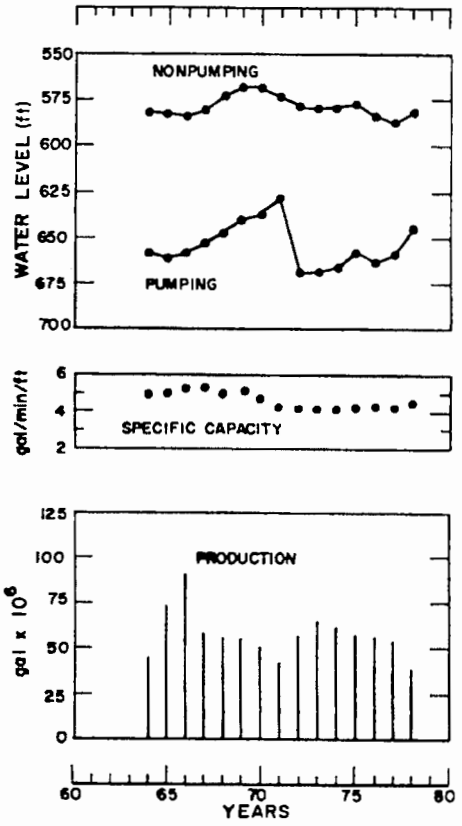

Fig. 16.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-6.

of production in early November when the pumping rate had declined to 235 gpm. The well is scheduled for rehabilitation in the spring of 1979. The specific capacity of the remaining wells G-1, G-1A, and G-5 varied slightly, but did not change significantly.

C. Pajarito Well Field

The Pajarito well field is composed of three wells (Fig. 1). The pumpage from the wells increased 76 × 10^6 gal, from 614 × 10^6 gal in 1977 to 690 × 10^6 gal in 1978 (Table IV). Pumpage decreased from PM-1 (15 × 10^6 gal) and PM-3 (29 × 10^6 gal) while the pumpage increased from PM-2 (116 × 10^6 gal). The increase in production from PM-2 was in part to offset restricted production from the Los Alamos well field during the fall when tanks on the Los Alamos line were being rehabilitated. The field produced about 46% of total production (Table IV).

Water levels remained about the same as in 1977 in wells PM-1, PM-2, and PM-3 (Figs. 17 through 19, respectively), though there was a slight decline (3 ft) in PM-2 because of increased production. The average pumping rate declined 17 gpm from 3373 in 1977 to 3356 gpm in 1978. The decline is not considered significant. There was no significant change in specific capacities of the three wells from 1977 to 1978.

D. Projected Water Levels

In 1973, nonpumping water levels in each of the supply wells were projected through 1983 by using the past records of water level changes and annual amount of production. A new projection of the average nonpumping water levels was made using a linear regression of the water levels for the past nine years (1970-1978) and projecting these levels to 1983 (Table V). This projection is based on the assumption that the average annual pumping rate, production, and well rehabilitation will affect the projection. The projected water levels are extrapolations of the trends of the nonpumping water levels on the well hydrographs (Figs. 4 through 19). Shown in

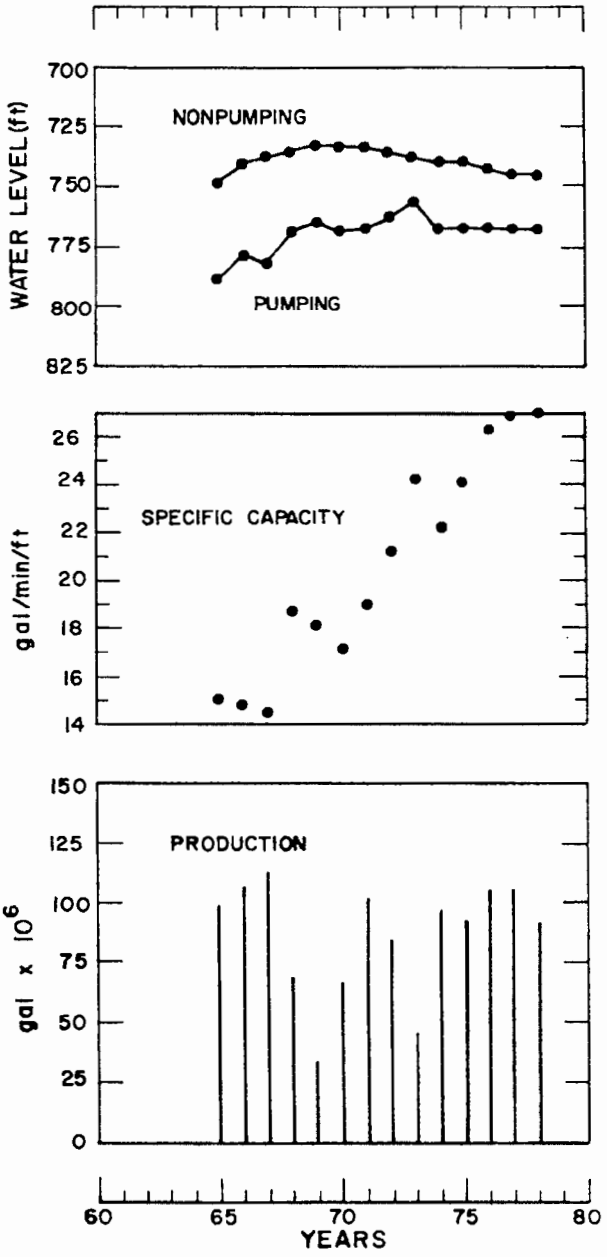

Fig. 17.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Pajarito Well PM-1.

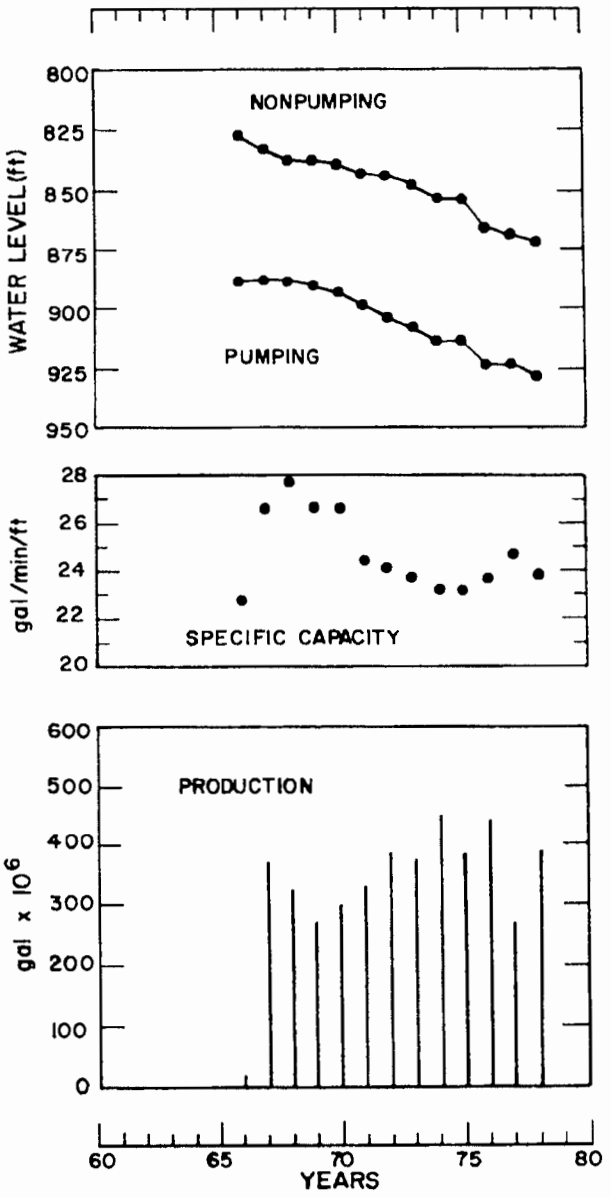

Fig. 18.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Pajarito Well PM-2.

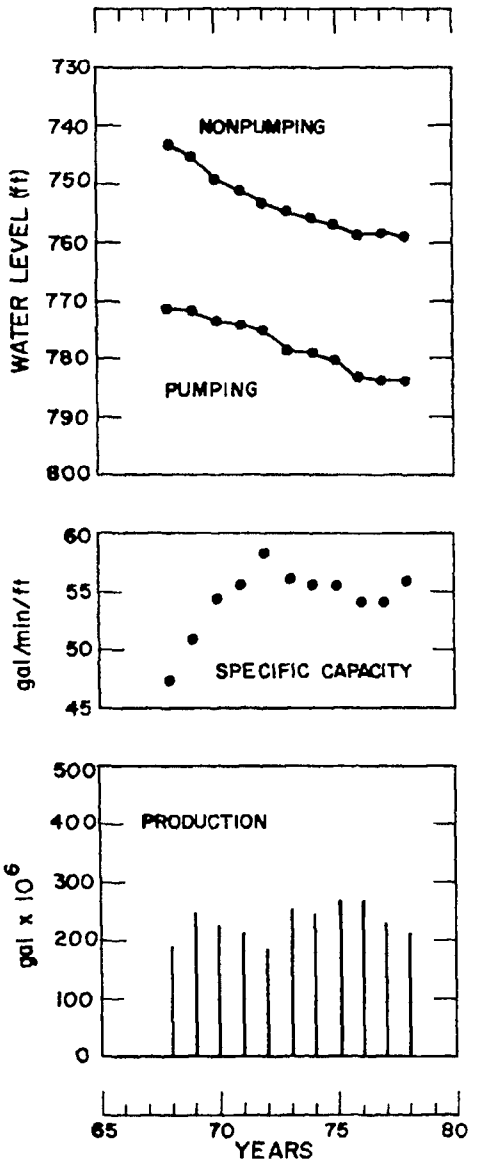

Fig. 19.
Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Pajarito Well PM-3.

Table V for comparison are the actual 1978 water levels, the 1973-projected 1978 water levels, and current projections of water level decline or recovery by 1983.

The current projection for the Los Alamos well field reflects declining water levels in the lower part of the field and water level recovery or rise in the upper part of the field. By 1983, the projected decline from 1978 water levels should be about 20 ft in LA-1B, 31 ft in LA-2, and 21 ft in LA-3. Water level recovery from 1978 levels is projected to be about 8 ft in LA-4, 6 ft in LA-5, and 13 ft in LA-6 by 1983.

Projection of water level trends in the Guaje well field are probably overestimated because recent well rehabilitations have changed the well characteristics. The projected decline in well G-1 for 1978 levels is 18 ft. The well has shown a continued water level decline from 1950 to 1975. After the well was rehabilitated in 1976, the nonpumping level has shown a recovery or rise (Fig. 10).

The projected water levels for 1983 in wells G-1A and G-2 show little or no change from 1978 water levels (Table V, Figs. 11 and 12). The projected water levels in wells G-3 and G-4 show a decline of 25 ft and 20 ft, respectively, below the 1978 water levels. Both wells have been rehabilitated, and pumping rates and production increased. The past two years have seen some decline in pumping rates and water level recovery (Figs. 13 and 14). The decline will probably be much less than projected. Well G-5 was rehabilitated in 1975. The projection shows little if any water level change by 1983. Well G-6 shows a projected decline of 11 ft by 1983 when compared to 1978 water levels. The water levels have shown a continued decline since 1967, although the well was rehabilitated once in 1972 (Fig. 16).

The projected water level in the Pajarito well field shows continuing decline, which is reflected on the hydrographs of PM-1, PM-2, and PM-3 (Figs. 17 through 19). The projected decline from 1978 to 1983 is 10 ft in PM-1, 21 ft in PM-2, and 7 ft in PM-3.

In summary, water level declines can be expected in wells LA-1B, LA-2, LA-3, G-6, PM-1, PM-2, and PM-3, ranging from 7 to 31 ft by 1983. The projected declines for G-1, G-3, and G-4, ranging from 18 to 25 ft, will probably be much less as the wells in the past few years have been rehabilitated and water levels have shown a recovery or rise. There should be little or no change in water levels in wells G-1A, G-2, and G-5 with water level recovery or rise in wells LA-4, LA-5, and LA-6 by 1983.

To reduce the rate of decline in the lower part of the Los Alamos field, the pumpage from the wells in the upper part of the field should be increased. Wells LA-1B, LA-2, and LA-3 (lower field) produced 52% of the production in 1978, while LA-4 and LA-5 (upper field) produced the remaining 48%. Production from LA-4 and LA-5 should be increased to 60% and that of LA-1B, LA-2, and LA-3 reduced to the remaining 40%.

TABLE V

PROJECTED WATER LEVELS FOR 1978

	Average 1970-78		Nonpumping Water Levels (ft)		1978-1983 Projected Water Level Change (+Recovery; −Decline, in ft)
	Pumping Rate (gpm)	Production (× 10^6 gal)	1978 Actual	1978[a] Projected	1983
Los Alamos Field					
LA-1B	544	80	42	21	−20
LA-2	294	36	112.	90	−31
LA-3	307	41	87	63	−21
LA-4	591	87	271	286	+8
LA-5	465	67	145	151	+6
LA-6[b]	555	59	77	100	+13
Guaje Field					
G-1	374	63	270	278	−18 [c]
G-1A	527	91	300	301	−2
G-2	441	76	345	332	0
G-3	346	60	360	354	−25 [c]
G-4	266	38	398	384	−20 [c]
G-5	543	87	442	441	0
G-6	324	54	581	576	−11
Pajarito Field					
PM-1	588	88	745	742	−10
PM-2	1386	372	871	859	−21
PM-3	1342	237	759	763	−7

[a]Water level projection 1973.
[b]Production restricted since 1975
[c]Projected decline to high; wells have been rehabilitated.

The water level declines in the Pajarito field are not excessive to the amount of production. Additional wells in the field scheduled for the early 1980s will reduce the annual pumpage from existing wells thus reducing the rate of water level decline.

III. WATER CANYON GALLERY

Production from the gallery in Water Canyon declined 12 × 10^6 gal from 57 × 10^6 in 1977 to 45 × 10^6 gal in 1978 (Table I). The average annual discharge was 86 gpm (Fig. 20). The gallery produced about 3% of total water supply to Los Alamos during 1978.

The gallery is dug into the Bandelier Tuff, which forms the surface outcrops along the mountain flanks. Recharge to the gallery through the tuff is from precipitation on the mountains west of the gallery. The production from the gallery varies depending on the amount of precipitation, as shown in Fig. 20.

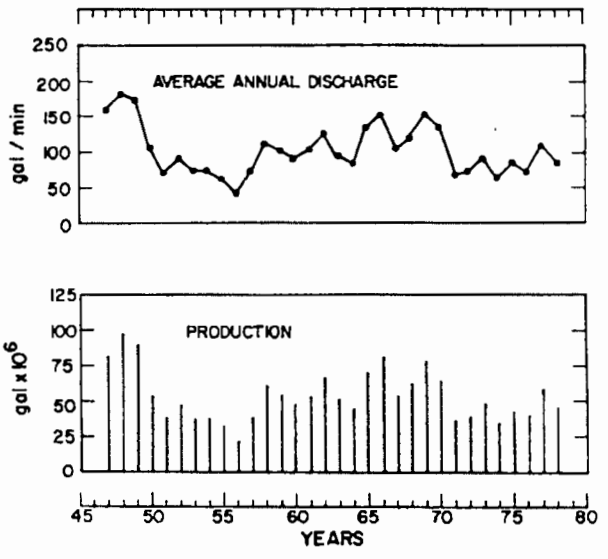

Fig. 20.
Annual average discharge and annual production from the gallery in Water Canyon.

IV. GUAJE RESERVOIR

Guaje Reservoir is located on the flanks of the mountains north of Los Alamos in Upper Guaje Canyon. The reservoir has a capacity of 0.25×10^6 gal with a drainage area above the intake of 5.6 mi^2. The reservoir is for diversion rather than storage as perennial flow is maintained by springs in the canyon above the reservoir. The water is conveyed by gravity flow through about 6.8 mi of transmission line for irrigation of lawns and shrubs at the Cumbres Jr. High School or Guaje Pines Cemetery. The line from the reservoir is not connected to the municipal distribution system. As the water is from a surface water source, it is not used for municipal or industrial supply.

The amount used for irrigation in 1978 was 3.3×10^6 gal, the lowest volume in the past five years. Diversion for the previous years has been 9.7×10^6 gal (1973), 5.1×10^6 gal (1974), 5.3×10^6 (1975), 4.4×10^6 gal (1976), and 3.8×10^6 gal (1977). No water was diverted from the Los Alamos Reservoir during 1978.

V. QUALITY OF WATER

As the water moves through the aquifer, soluble minerals from the aquifer are taken into solution. Chemical trace element, and radiochemical analyses monitor the amount of mineral and radioactivity in water from the individual wells, gallery, and the distribution system. The analyses are made to determine if there is any deterioration of water quality with continued production and distribution. Certain constituents are monitored to determine if the water meets Federal and State requirements for municipal supply.

Routine analyses are made for SiO_2, Ca, Mg, K, Na, CO_3, HCO_3, PO_4, Cl, F, NO_3, TDS (total dissolved solids), Hard (total hardness), Cond (specific conductance), and pH (see Appendix C). Trace element analyses were made for Ag, Al, As, Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, and Zn (Appendix D). Radiochemical analyses were made for gross alpha, gross beta ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{3}H, and total uranium (Appendix D). Routine analyses were performed as described in Ref. 12, trace elements as described in Ref. 13, and radiochemical analyses as described in Ref. 14. The samples from 15 supply wells, 1 standby well, gallery, 5 stations on the distribution system, and Guaje Reservoir were collected and analyzed in March 1978.

A. Well and Well Field Characteristics

The quality of water from a well or gallery depends on the depth of the well, lithology of the aquifer, and amount of yield to the well from individual beds within the aquifer. The quality of water from the individual wells will vary due to depth and local aquifer conditions in a well field. A graphic comparison of Cl, F, and TDS indicates slight to major changes in these constituents between the wells and gallery (Fig. 21).

The SiO_2 in water from the Los Alamos field ranges from 26 to 30 mg/ℓ, while that from Guaje and Pajarito fields ranges from 50 to 84 mg/ℓ. Hardness of water from the Los Alamos field is less than 27 mg/ℓ, while in the Guaje field the hardness ranges from 21 to 24 mg/ℓ in wells G-1, G-1A, G-2, and G-3, and ranges from 32 to 48 mg/ℓ in wells G-4, G-5, and G-6. Hardness in water from wells PM-1 and PM-3 (65 and 69 mg/ℓ) is about a factor of 3 greater than in PM-2 (28 mg/ℓ). The low TDS in water from Guaje Reservoir is typical of mountain streams in the area.

There is a slight, but not significant, change in the seasonal quality of water from periods of light (winter) and heavy (summer) production. The average increase of TDS from wells in the Los Alamos field from February to July 1974 was about 80 mg/ℓ, the Guaje field increase was about 20 mg/ℓ, and the Pajarito field increase was about 70 mg/ℓ.

Quality of water changes occurred in three of the wells with increased pumpage. At well LA-5 the conductance increased from 165 μmhos at 0.5 h to 260 μmhos at the end of 10 h of pumpage. The temperature also increased from 23.9°C to 25°C during the period. The trend was also evident at well G-2 where the conductance increased from 175 μmhos at 0.5 h to 225 μmhos at the end of 10 h of pumping with temperatures increasing from 23.9°C to 28.3°C during the same period. The inverse occurs at well LA-1B. The conductance decreased from 750 μmho at 0.5 h to 590 μmho at 10 h of pumping with temperatures decreasing from 29.4°C to 28.3°C. The remainder of the wells exhibited no significant changes in conductance or temperature over long periods of production.

The temperature of waters from the individual wells in each field varies, ranging from 24°C to 30°C in March when samples were collected (Appendix C). The temperature of the water from the gallery in Water Canyon was 9°C in March.

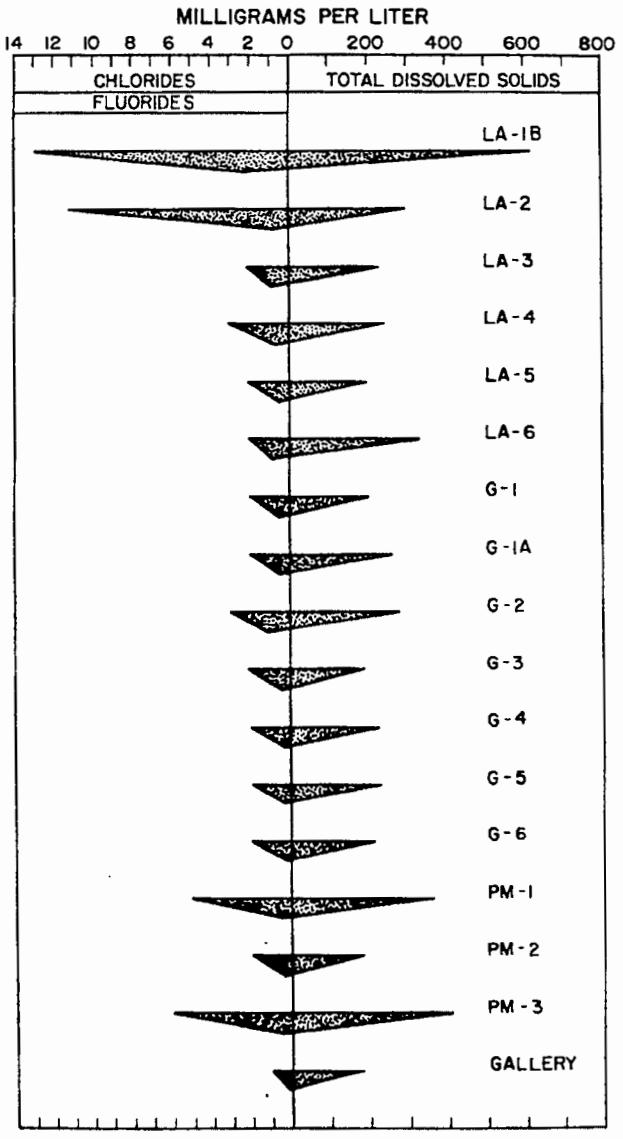

Fig. 21.
Graphic comparison of chlorides, fluorides, and total dissolved solids in water from wells and gallery.

Statistically significant changes in constituents as a function of time were determined for Ca, Mg, Na, CO_3, HCO_3, Cl, F, NO_3, TDS, and Hard of water from individual wells using the standard two-tailed Students' t test. Chemical analyses for most of these constituents are available for all the years of production. The tests indicate no significant changes in constituents in the water from wells during the period of productivity, except for wells PM-1, PM-2, and PM-3. The TDS in these three wells have increased slightly since they were completed. The increase projected for the next 5 years to 1983 is estimated to be about 20 to 30 mg/ℓ at each well.

Water samples from the distribution system are mixtures of water from the various wells and fields as follows.

Station	Source
FS-1 (TA-3)	Well PM-2, at times PM-1 and PM-3
FS-2 (DP Road)	Los Alamos and Guaje Fields
FS-3 (White Rock)	Wells PM-1 and PM-3, at times PM-2
FS-4 (Diamond Drive)	Guaje Field, at times Los Alamos Field
FS-5 (S-Site)	Water Canyon, Los Alamos, and Guaje Field

The differences in chemical quality shown by Cl, F, and TDS at the five stations are shown in Fig. 22, while complete analyses for routine chemical and trace metals are presented in Appendixes C and D. The quality of water at each station reflects the quality of water from wells or gallery that feed the storage tanks. The temperature of water at the stations (1976 to 1978) varies from winter to summer because of differential solar heating of water in the storage tanks (Table VI).

The gross alpha, gross beta, and total uranium found in water from wells, gallery, and distribution stations is from natural radioactivity in the aquifers. The man-made radionuclides ^{137}Cs, ^{238}Pu, ^{239}Pu, and ^{3}H were below limits of detection (Appendix E).

B. Federal and State Requirements

The National Interim Primary Drinking Water Regulations (NIPDWR) were promulgated by the Environmental Protection Agency (EPA) on December 24, 1975 in accordance with the Safe Drinking Water Act (Public Law 93-523). Additional regulations related to radioactivity in drinking water became effective in June 1977.[15] The State of New Mexico adopted a set of Water Supply Regulations in December 1977.[16] These regulations incorporate the basic Federal regulation in regard to water quality.

Maximum contaminant levels have been established for Ag, As, Ba, Cd, Cr, F, Hg, NO_3, Pb, and Se (see Appendixes C and D). Limits for radioactivity in municipal supply have also been established for ^{137}Cs, ^{238}Pu, ^{239}Pu, and ^{3}H. Gross alpha concentrations are used to determine whether specific radium analyses must be performed.[15]

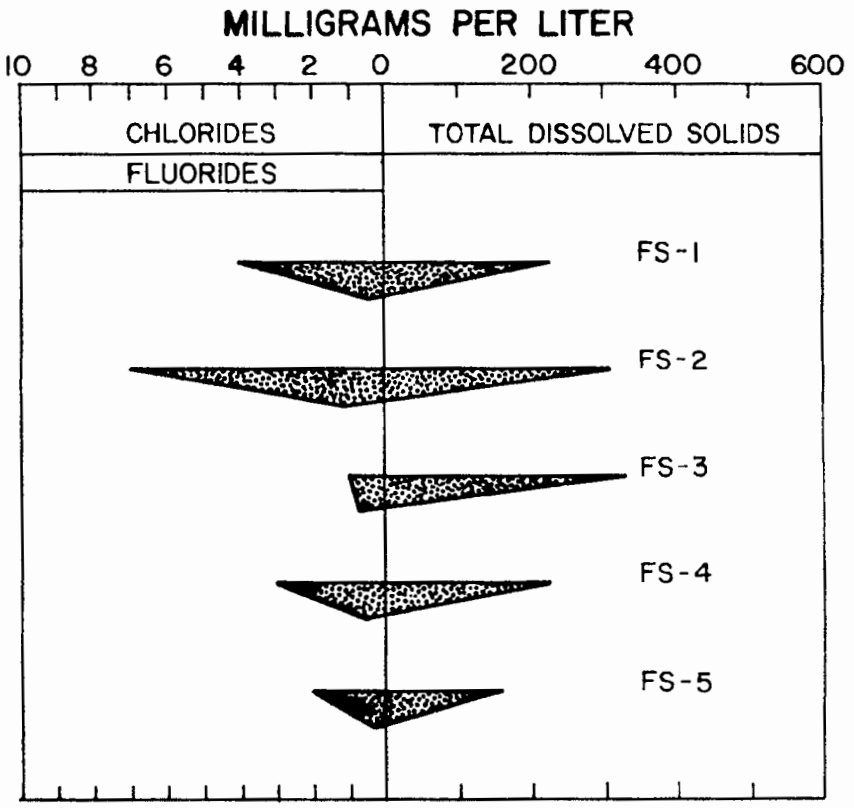

Fig. 22.
Graphic comparison of chlorides, fluorides, and total dissolved solids in water from the distribution system.

TABLE VI

WATER TEMPERATURES AT DISTRIBUTION FIRE STATIONS

	Temperature at Tap in °C					
Date	FS-1 (TA-3)	FS-2 (DP Road)	FS-3 (White Rock)	FS-4 (Diamond Dr)	FS-5 (S Site)	$\bar{x}$ and SD
3/76	17	17	---	21	17	18.0 ± 2.0
7/76	26	25	26	26	25	25.6 ± 0.6
10/76	23	24	24	24	23	23.6 ± 0.6
3/77	12	8	10	10	9	9.8 ± 1.5
8/77	23	29	26	23	27	25.6 ± 2.6
10/77	20	20	20	20	21	20.2 ± 0.5
3/78	18	16	15	16	15	16.0 ± 1.2

In comparing the maximum chemical and trace metal constituent levels of the NIPDW regulations with those analyses from wells, gallery, and the distribution system, only Ag (74 $\mu g/\ell$) from well LA-5, and As (78 $\mu g/\ell$) from well G-2 exceed the maximum levels of 50 $\mu g/\ell$ for each constituent. The water from these wells is mixed and thus diluted with pumpage from the remainder of wells in the field so that the levels in the distribution system meet the NIPDW regulations (Appendix D). The As (211 $\mu g/\ell$) in water from well LA-6 is a factor of four greater than the maximum level; however, the well has been placed on standby for use in extreme emergency and is not used as a part of the municipal supply.[11]

Gross alpha activity exceeds the screening limit of 5 pCi/ℓ at only one well, LA-1B (7 pCi/ℓ, Appendix D). As the water is mixed with other wells in the field, the gross alpha is below the limit at all times and locations in the distribution system. The ^{137}Cs, ^{238}Pu, ^{239}Pu, and ^{3}H are below limits of detection and maximum levels. Total uranium is present as naturally-occurring radioactivity in the aquifer and is well below standards (Appendix D).

VI. SUMMARY AND RECOMMENDATIONS

Well field operations in 1978 were very satisfactory. Production from the three well fields declined about 438×10^6 gal from 1977 to 1978. The past two years of decline should not be construed to mean that additional wells are not needed for the system. Continued expansion of the LASL facilities and increases in population and housing in the County will require more water. The additional wells are also needed to reduce water level declines in existing wells (PM-1, PM-2, and PM-3) and distribute withdrawal of water over a large area of the aquifer. This will prolong the life of the well field.

Projected declines of water levels in wells in the Los Alamos field indicate that production should be scheduled to reduce the water level declines in the lower part of the field (LA-1B, LA-2, and LA-3). About 60% of the production should be from the upper part of the field (LA-4 and LA-5) and 40% from the lower part of the field (LA-1B, LA-2, and LA-3).

The quality of water from the wells has not changed significantly since the wells first went into production, except for increase in TDS in water from wells in the Pajarito Field. The quality of water is good and meets Federal and State requirements for municipal supply in the distribution system.

Well rehabilitation should be continued. The pump at Well G-6 is to be pulled early in 1979. Other wells to be considered for rehabilitation are PM-2 and LA-5. PM-2 is a high yield well that has been in operation since 1966. The pumping characteristics indicate no obvious problem with the pump. However, the period of operation (35 000 h) has exceeded the manufacturer's recommended life of the pump and the well is a high yield producer (26% of the production). The pump should be pulled for inspection.

The pump at well LA-5 was pulled for inspection in 1962. Zia U/E reports a larger line shaft is needed to keep the pump in adjustment and that the motor needs to be rewound. Other recommendations by Zia U/E are (1) motor on G-1A should be rewound, (2) replace electric starters on pump motors on wells in the Los Alamos and Guaje fields, and (3) pump and motors in booster stations from the Los Alamos and Guaje fields should be replaced as they have had extended service, are obsolete, and when repairs are needed, parts are not available.

ACKNOWLEDGMENTS

Pumping statistics were compiled by Glenn Bryant (Zia U/E), Max Maes (H-8), and Charlene Wardlow (H-8). Word processing and compiling the finished report was done by Maxine Lewis (H-12).

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APPENDIX A

MONTHLY AQUIFER CHARACTERISTICS

Well LA-1
1978

Month	Water Level Non Pump (ft)
Jan	53
Feb	49
Mar	45
Apr	51
May	55
June	75
July	95
Aug	97
Sept	89
Oct	86
Nov	63
Dec	57

Well LA-1B
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	101	3164	519	27	142	115	4.5
Feb	84	2649	524	23	141	118	4.4
Mar	159	5176	543	20	146	126	4.3
Apr	131	4473	573	25	145	120	4.8
May	198	6775	569	30	149	119	4.8
June	335	11 108	552	50	175	125	4.4
July	320	10 363	539	67	191	124	4.3
Aug	318	10 184	534	70	192	122	4.3
Sept	270	8789	541	62	184	122	4.4
Oct	183	5944	544	60	175	115	4.7
Nov	79	2660	560	37	152	115	4.9
Dec	128	4301	560	31	147	116	4.8

Well LA-2
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	101	1970	323	81	307	226	1.4
Feb	84	1672	332	83	305	222	1.5
Mar	159	2728	286	83	382	299	1.0
Apr	130	2514	322	92	318	226	1.4
May	198	3754	315	100	328	228	1.4
June	335	5416	269	132	353	221	1.2
July	320	5006	260	152	366	214	1.7
Aug	319	4989	260	150	365	215	1.2
Sept	263	4316	273	140	355	215	1.2
Oct	183	3126	286	133	339	206	1.4
Nov	79	1526	321	99	319	220	1.5
Dec	128	2496	325	98	321	223	1.5

Well LA-3
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	101	2058	337	65	245	180	1.9
Feb	84	1779	353	60	242	182	1.9
Mar	159	3225	338	61	246	185	1.8
Apr	133	2784	348	69	245	176	2.0
May	198	3978	334	75	249	174	1.9
June	335	5696	283	132	254	122	2.3
July	320	5167	269	112	257	145	1.9
Aug	319	5231	273	116	260	144	1.9
Sept	270	4707	290	107	255	148	1.9
Oct	182	3403	311	101	254	153	2.0
Nov	79	1670	351	76	246	170	2.1
Dec	128	2735	356	73	245	172	2.1

Well LA-4
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	105	3802	603	261	360	99	6.1
Feb	74	2711	606	262	357	95	6.4
Mar	152	5524	605	260	357	97	6.2
Apr	135	4903	605	261	358	97	6.2
May	192	6938	600	266	360	94	6.4
June	335	11 763	585	277	374	97	6.0
July	321	11 172	580	289	388	99	5.9
Aug	280	9804	584	280	379	99	5.9
Sept	267	9375	585	285	384	99	5.9
Oct	182	6666	593	280	376	96	6.2
Nov	79	2885	603	267	362	95	6.4
Dec	126	4603	605	266	361	95	6.4

Well LA-5
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	106	3070	484	141	296	155	3.1
Feb	74	2175	486	140	296	156	3.1
Mar	152	4402	482	140	296	156	3.1
Apr	135	3907	482	138	297	159	3.0
May	191	5521	480	141	297	156	3.1
June	335	9418	469	147	307	160	2.9
July	326	9094	465	152	309	157	3.0
Aug	301	8419	466	150	306	156	2.9
Sept	267	7503	468	151	305	154	3.0
Oct	182	5382	478	149	299	150	3.2
Nov	79	2318	485	144	292	148	3.3
Dec	126	3702	489	143	292	149	3.3

Well LA-6
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan				79			
Feb				75			
Mar	10	328	552	75	149	74	7.5
Apr				74			
May				75			
June	3	108	530	71	133	62	8.5
July				80			
Aug				83			
Sept	5	173	545	80	147	67	8.1
Oct				80			
Nov	2	56	551	80	138	58	9.5
Dec	14	469	570	76	144	68	8.4

Well G-1
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	89	1985	369	269	415	146	2.5
Feb	100	2251	372	269	413	144	2.6
Mar	167	3660	365	269	414	145	2.5
Apr	166	3642	365	269	416	147	2.5
May	218	4780	365	266	416	150	2.4
June	335	7008	349	271	418	147	2.3
July	328	6762	343	272	422	150	2.3
Aug	410	8281	336	271	426	155	2.1
Sept	277	5652	340	272	422	150	2.2
Oct	235	4884	345	270	429	159	2.2
Nov	188	3993	353	270	420	150	2.4
Dec	143	3097	361	273	414	141	2.6

Well G-1A
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	89	2706	503	298	344	46	10.9
Feb	101	3071	507	295	345	50	10.1
Mar	145	4367	503	296	346	50	10.0
Apr	165	4945	497	297	340	43	11.6
May	218	6394	489	298	343	45	10.9
June	335	9775	487	301	347	46	10.5
July	327	9624	489	303	350	47	10.4
Aug	408	12 026	491	305	349	44	11.1
Sept	277	8169	491	304	348	44	11.1
Oct	235	6999	495	303	345	42	11.8
Nov	188	5606	496	302	341	39	12.7
Dec	143	4224	492	298	343	45	10.9

Well G-2
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	89	2490	462	342	384	42	11.0
Feb	100	2821	466	342	384	42	11.1
Mar	167	4643	462	341	383	42	11.0
Apr	166	4644	465	341	381	40	11.6
May	217	5923	456	341	383	42	10.8
June	335	8970	447	344	387	43	10.4
July	328	8736	443	348	390	42	10.5
Aug	408	10 789	441	352	391	39	11.3
Sept	232	7360	449	349	387	38	11.8
Oct	188	6267	451	346	386	40	11.3
Nov	188	5103	451	347	387	40	11.3
Dec	144	3879	452	343	384	41	11.0

Well G-3
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	84	2269	450	351	453	102	4.4
Feb	80	2166	449	344	436	92	4.9
Mar	180	5021	464	343	434	91	5.1
Apr	162	4480	460	349	447	98	4.7
May	197	5348	450	346	448	102	4.4
June	335	8644	430	357	452	95	4.5
July	314	7937	421	369	461	92	4.6
Aug	407	10 044	411	381	476	95	4.3
Sept	269	6467	401	382	476	94	4.2
Oct	235	5883	416	372	471	99	4.2
Nov	184	4640	410	367	471	104	3.9
Dec	143	3534	412	361	467	106	3.9

Well G-4
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	84	1700	337	395	589	194	1.7
Feb	80	1744	361	392	566	174	2.0
Mar	162	3434	348	388	577	189	1.8
Apr	163	3296	337	392	594	202	1.7
May	219	4654	354	394	580	186	1.9
June	335	6523	324	402	594	192	1.6
July	327	6042	308	407	595	188	1.6
Aug	408	7428	303	413	599	186	1.6
Sept	269	4728	293	409	594	185	1.5
Oct	235	4053	287	401	594	193	1.5
Nov	184	3340	301	394	593	199	1.5
Dec	141	2562	303	390	589	199	1.5

Well G-5
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	84	2771	549	437	495	58	9.4
Feb	80	2668	552	434	490	56	9.9
Mar	164	5354	543	435	495	60	9.0
Apr	162	5329	546	438	496	58	9.4
May	219	7167	545	440	496	56	9.7
June	335	10 733	534	447	508	61	8.7
July	327	10 436	532	450	512	62	8.6
Aug	408	12 985	530	451	515	64	8.2
Sept	269	8598	533	449	514	65	8.2
Oct	232	7519	539	445	505	60	8.9
Nov	184	6014	544	439	501	62	8.8
Dec	144	4669	544	438	496	58	9.4

Well G-6
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	84	1511	299	574	643	69	4.3
Feb	80	1460	302	571	639	68	4.4
Mar	164	3023	307	572	641	69	4.5
Apr	162	2942	302	575	642	67	4.5
May	219	3900	297	577	644	67	4.4
June	335	5869	292	586	652	66	4.4
July	327	5737	292	591	660	69	4.2
Aug	407	6913	283	595	657	62	4.5
Sept	269	4427	269	592	655	63	4.3
Oct	160	2509	260	584	633	49	5.3
Nov	11	153	235	579	625	46	5.1
Dec	---	---	---	574	---	---	---

Well PM-1
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	123	4359	587	742	762	20	29.4
Feb	109	3823	585	742	762	20	29.3
Mar	148	5245	591	742	762	20	29.5
Apr	186	6653	594	743	764	21	28.3
May	265	9427	594	744	767	23	25.8
June	390	14 040	599	750	771	21	28.5
July	314	11 244	596	750	774	24	24.8
Aug	336	11 989	594	749	771	22	27.0
Sept	265	9460	594	747	771	24	24.7
Oct	197	6979	589	746	768	22	26.7
Nov	118	4130	580	743	765	22	26.4
Dec	93	3214	578	742	763	21	27.5

Well PM-2
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	354	29 160	1369	867	923	56	24.4
Feb	449	36 731	1364	871	924	53	25.7
Mar	491	40 215	1364	872	929	57	24.0
Apr	334	27 415	1365	870	927	57	24.0
May	407	33 275	1361	870	926	56	24.3
June	648	52 960	1362	878	934	56	24.3
July	434	35 624	1367	873	935	62	22.0
Aug	367	30 038	1363	869	931	62	21.9
Sept	294	24 083	1365	870	929	59	23.1
Oct	246	20 175	1366	870	923	53	25.7
Nov	358	29 310	1364	871	925	54	25.3
Dec	361	29 417	1362	872	926	54	25.2

Well PM-3
1978

Month	Pump Time (h)	Pumpage (1000 gal)	Pump Rate (gpm)	Water Level		Draw Down (ft)	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
Jan	124	10 347	1386	757	782	25	55.4
Feb	110	9100	1384	757	781	24	57.7
Mar	133	11 045	1385	757	781	24	58.0
Apr	185	15 574	1399	757	784	27	52.0
May	261	21 956	1399	760	784	24	58.2
June	378	31 957	1406	761	786	25	56.2
July	309	25 986	1402	760	785	25	56.0
Aug	337	28 307	1400	760	785	25	56.0
Sept	266	22 317	1398	760	785	25	55.9
Oct	197	16 514	1391	760	785	25	55.6
Nov	122	10 117	1381	760	783	23	60.0
Dec	94	7758	1378	759	783	24	57.4

Water Canyon Gallery
1978

Month	Discharge Time (h)	Volume (1000 gal)	Discharge Rate (gpm)
Jan	744	3297	74
Feb	672	3039	75
Mar	744	3833	86
Apr	720	4831	112
May	744	6045	135
June	720	5360	124
July	744	3612	81
Aug	744	3721	83
Sept	720	3401	79
Oct	744	3362	75
Nov	720	2890	67
Dec	744	1903	43

APPENDIX B

ANNUAL AQUIFER CHARACTERISTICS

WELL LA-1

Year	Pump Time (h)	Pumpage (million (gal)	Pump Rate (gpm)	Water Level Non Pump (ft)
1947	3468	54.0	259.5	---
1948	2988	34.7	193.6	---
1949	1361	26.7	327.0	---
1950	563	10.5	310.8	19.0
1951	1215	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

APPENDIX B (cont)

WELL LA-1B

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1960	415	36.3	1457.8	7.0	111.0	104.0	14.0
1961	3727	124.7	557.6	54.0	154.0	100.0	5.6
1962	3936	129.1	546.7	72.0	169.0	97.0	5.6
1963	3649	117.4	536.2	74.0	170.0	96.0	5.6
1964	4174	130.3	520.3	81.0	183.0	102.0	5.1
1965	3007	97.9	542.6	63.0	170.0	107.0	5.1
1966	2589	83.9	540.1	50.0	169.0	119.0	4.5
1967	2519	84.9	561.7	39.0	153.0	114.0	4.9
1968	2183	74.0	565.0	32.0	147.0	115.0	4.9
1969	2244	75.7	562.2	22.0	142.0	120.0	4.7
1970	2369	79.7	560.7	22.0	143.0	121.0	4.6
1971	2633	89.1	564.0	31.0	162.0	131.0	4.3
1972	2215	75.3	566.6	31.0	163.0	132.0	4.3
1973	2628	87.2	553.0	37.0	170.0	133.0	4.2
1974	2282	73.9	539.7	35.0	161.0	126.0	4.3
1975	2308	74.4	537.3	42.0	168.0	126.0	4.3
1976	2521	79.6	526.2	50.0	176.0	126.0	4.2
1977	2782	84.2	504.4	47.0	167.0	120.0	4.2
1978	2306	75.6	546.3	42.0	162.0	120.0	4.6

APPENDIX B (cont)

WELL LA-2

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1947	963	27.6	477.7	---	---	---	---
1948	3659	59.3	270.1	---	---	---	---
1949	1654	41.8	421.2	---	---	---	---
1950	614	15.6	423.5	59.0	285.0	226.0	1.9
1951	2415	57.7	398.2	111.0	305.0	194.0	2.1
1952	1980	46.3	389.7	101.0	300.0	199.0	2.0
1953	2201	47.2	357.4	100.0	301.0	201.0	1.8
1954	2601	56.8	364.0	116.0	---	---	---
1955	2223	49.4	370.4	110.0	---	---	---
1956	1805	44.2	408.1	84.0	---	---	---
1957	1066	29.6	462.8	53.0	277.0	224.0	2.1
1958	1166	31.1	444.5	60.0	270.0	210.0	2.1
1959	1599	40.7	424.2	71.0	303.0	232.0	1.8
1960	2169	51.6	396.5	76.0	305.0	229.0	1.7
1961	2149	44.4	344.3	101.0	313.0	212.0	1.6
1962	1823	35.7	326.4	111.0	314.0	203.0	1.6
1963	1999	40.7	339.3	127.0	332.0	205.0	1.7
1964	1924	34.2	296.3	137.0	347.0	210.0	1.4
1965	1911	39.8	347.1	121.0	330.0	209.0	1.7
1966	1070	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	1787	31.8	296.6	88.0	318.0	230.0	1.3
1972	2189	39.3	299.2	96.0	322.0	226.0	1.3
1973	2625	46.7	296.5	106.0	334.0	228.0	1.3
1974	2033	36.8	301.7	109.0	325.0	216.0	1.4
1975	2310	40.2	290.0	103.0	320.0	217.0	1.3
1976	2488	39.9	267.3	113.0	322.0	209.0	1.3
1977	2775	42.5	255.3	118.0	314.0	196.0	1.3
1978	2299	39.5	286.4	112.0	338.0	226.0	1.3

APPENDIX B (cont)

WELL LA-3

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1947	1476	64.9	732.8	---	---	---	---
1948	3647	82.5	377.0	---	---	---	---
1949	1505	41.7	461.8	---	---	---	---
1950	2793	57.8	344.9	97.0	231.0	134.0	2.6
1951	3554	66.9	313.7	116.0	233.0	117.0	2.7
1952	2514	58.6	388.5	94.0	218.0	124.0	3.1
1953	3104	69.7	374.2	103.0	229.0	126.0	3.0
1954	2595	57.3	368.0	101.0	225.0	124.0	3.0
1955	2195	48.7	369.8	91.0	226.0	135.0	2.7
1956	1849	42.1	379.5	74.0	222.0	148.0	2.6
1957	1080	26.1	402.8	56.0	219.0	163.0	2.5
1958	1612	33.6	347.4	49.0	225.0	176.0	2.0
1959	1821	35.0	320.3	54.0	231.0	177.0	1.8
1960	2174	38.4	294.4	68.0	230.0	162.0	1.8
1961	1939	34.7	298.3	85.0	189.0	104.0	2.9
1962	2361	45.4	320.5	93.0	192.0	99.0	3.2
1963	2128	42.5	332.9	81.0	197.0	116.0	2.9
1964	2574	50.4	326.3	104.0	217.0	113.0	2.9
1965	1961	43.4	368.9	79.0	220.0	141.0	2.6
1966	2236	46.1	343.6	81.0	219.0	138.0	2.5
1967	2274	47.4	347.4	86.0	218.0	132.0	2.6
1968	2127	42.7	334.6	82.0	251.0	169.0	2.0
1969	2072	40.1	322.6	58.0	246.0	188.0	1.7
1970	2303	44.0	318.4	55.0	241.0	186.0	1.7
1971	2556	45.4	296.0	77.0	250.0	173.0	1.7
1972	2205	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	2291	43.5	316.5	73.0	244.0	171.0	1.9
1975	2306	43.3	313.0	80.0	253.0	173.0	1.8
1976	2474	42.3	285.0	88.0	260.0	172.0	1.7
1977	2779	47.3	283.7	89.0	248.0	159.0	1.8
1978	2308	42.4	306.4	87.0	250.0	163.0	1.9

WELL LA-4

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1948	1570	42.7	453.3	---	---	---	---
1949	940	37.5	664.9	---	---	---	---
1950	4350	164.9	631.8	278.0	353.0	75.0	8.4
1951	4909	173.6	589.4	285.0	357.0	72.0	8.2
1952	3429	119.6	581.3	267.0	339.0	72.0	8.1
1953	3034	109.1	599.3	264.0	335.0	71.0	8.4
1954	2133	78.2	611.0	255.0	329.0	74.0	8.3
1955	2647	94.5	595.0	268.0	341.0	73.0	8.2
1956	3402	120.2	588.9	273.0	346.0	73.0	8.1
1957	2844	105.4	617.7	270.0	345.0	75.0	8.2
1958	2973	110.3	618.3	270.0	342.0	72.0	8.6
1959	3084	113.5	613.4	275.0	346.0	71.0	8.6
1960	4084	145.6	594.2	296.0	365.0	69.0	8.6
1961	3687	129.7	586.3	296.0	365.0	69.0	8.5
1962	3688	129.3	584.3	286.0	359.0	73.0	8.0
1963	3718	130.5	585.0	280.0	351.0	71.0	8.2
1964	4500	155.0	574.1	291.0	361.0	70.0	8.2
1965	3110	111.4	597.0	279.0	349.0	70.0	8.5
1966	3279	115.6	587.6	285.0	356.0	71.0	8.3
1967	2127	77.1	604.1	278.0	350.0	72.0	8.4
1968	2276	81.7	598.3	280.0	351.0	71.0	8.4
1969	1694	61.8	608.0	282.0	358.0	76.0	8.0
1970	2333	83.5	596.5	286.0	363.0	77.0	7.7
1971	2519	89.0	588.9	287.0	373.0	86.0	6.8
1972	2322	82.6	592.9	282.0	367.0	85.0	7.0
1973	2616	92.4	588.7	294.0	377.0	83.0	7.1
1974	2306	82.2	594.1	286.0	367.0	81.0	7.3
1975	2319	82.3	591.5	272.0	355.0	83.0	7.1
1976	2802	98.2	584.1	277.0	373.0	96.0	6.1
1977	2741	96.4	586.2	278.0	374.0	96.0	6.1
1978	2248	80.1	594.2	271.0	368.0	97.0	6.1

APPENDIX B (cont)

WELL LA-5

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1948	1171	40.4	575.0	---	---	---	---
1949	1763	58.5	553.0	---	---	---	---
1950	4052	130.1	535.1	131.0	254.0	123.0	4.4
1951	6004	187.4	520.2	162.0	272.0	110.0	4.7
1952	3425	109.6	533.3	147.0	259.0	112.0	4.8
1953	3278	103.9	528.3	141.0	257.0	116.0	4.6
1954	2546	80.1	524.4	137.0	259.0	122.0	4.3
1955	3158	97.3	513.5	145.0	267.0	122.0	4.2
1956	3476	104.5	501.1	150.0	276.0	126.0	4.0
1957	2868	86.0	499.8	150.0	277.0	127.0	3.9
1958	3009	89.9	498.0	151.0	277.0	126.0	4.0
1959	3088	93.5	504.6	155.0	280.0	125.0	4.0
1960	4088	119.1	485.6	168.0	288.0	120.0	4.0
1961	3534	100.3	473.0	165.0	288.0	123.0	3.8
1962	3735	107.7	480.6	172.0	---	---	---
1963	3726	105.0	469.7	171.0	---	---	---
1964	4236	118.8	467.4	184.0	---	---	---
1965	1740	50.5	483.7	180.0	---	---	---
1966	2817	79.3	469.2	180.0	---	---	---
1967	2533	73.7	484.9	168.0	---	---	---
1968	2233	63.3	472.5	161.0	300.0	139.0	3.4
1969	2402	68.5	475.3	161.0	298.0	137.0	3.5
1970	2353	66.1	468.2	157.0	300.0	143.0	3.3
1971	2659	74.4	466.3	155.0	302.0	147.0	3.2
1972	2301	64.4	466.5	153.0	304.0	151.0	3.1
1973	2476	68.3	459.7	156.0	308.0	152.0	3.0
1974	1903	52.5	459.8	154.0	306.0	152.0	3.0
1975	2318	63.9	459.4	149.0	309.0	160.0	2.9
1976	2799	77.6	462.1	150.0	310.0	160.0	2.9
1977	2665	74.8	467.8	147.0	303.0	156.0	3.0
1978	2274	64.9	475.8	145.0	299.0	154.0	3.1

APPENDIX B (cont)

WELL LA-6

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1948	116	4.9	704.0	---	---	---	---
1949	2451	95.8	651.4	---	---	---	---
1950	4490	167.9	623.2	83.0	136.0	53.0	11.8
1951	5882	201.6	571.2	115.0	160.0	45.0	12.7
1952	3168	110.3	580.3	108.0	151.0	43.0	13.5
1953	3177	113.8	597.0	95.0	139.0	44.0	13.6
1954	2894	107.1	616.8	92.0	135.0	43.0	14.3
1955	2911	108.0	618.3	97.0	140.0	43.0	14.4
1956	3438	125.8	609.9	106.0	149.0	43.0	14.2
1957	2833	102.4	602.4	107.0	152.0	45.0	13.4
1958	2957	106.9	602.5	108.0	131.0	43.0	14.0
1959	3096	108.3	583.0	115.0	158.0	43.0	13.6
1960	4084	138.6	565.6	130.0	172.0	42.0	13.5
1961	3284	112.5	571.0	129.0	171.0	42.0	13.6
1962	3886	129.4	555.0	135.0	175.0	40.0	13.9
1963	2953	102.9	580.8	125.0	171.0	46.0	12.6
1964	4244	138.3	543.1	132.0	172.0	40.0	13.6
1965	3145	103.8	550.1	120.0	160.0	40.0	13.8
1966	3173	104.0	546.3	129.0	169.0	40.0	13.7
1967	2511	85.4	566.8	118.0	158.0	40.0	14.2
1968	2111	71.6	565.3	109.0	150.0	41.0	13.8
1969	2402	81.6	566.2	109.0	151.0	42.0	13.5
1970	2337	79.1	564.1	106.0	149.0	43.0	13.1
1971	2472	82.5	556.2	119.0	160.0	41.0	13.6
1972	2317	79.2	569.7	117.0	155.0	38.0	15.0
1973	2638	90.6	572.4	118.0	155.0	37.0	15.5
1974	2337	79.8	569.1	120.0	156.0	36.0	15.8
1975	1571	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

APPENDIX B (cont)

WELL G-1

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1950	0	2.8	0.0	195.0	---	---	---
1951	1168	37.7	538.0	202.0	309.0	107.0	5.0
1952	2476	75.5	508.2	213.0	295.0	82.0	6.2
1953	3275	97.3	495.2	221.0	292.0	71.0	7.0
1954	2616	77.8	495.7	221.0	290.0	69.0	7.2
1955	2406	70.5	488.4	226.0	295.0	69.0	7.1
1956	2958	83.2	468.8	235.0	303.0	68.0	6.9
1957	2098	55.9	444.1	236.0	307.0	71.0	6.3
1958	2460	68.1	461.4	238.0	308.0	70.0	6.6
1959	2952	82.4	465.2	245.0	314.0	69.0	6.7
1960	3564	96.0	448.9	254.0	325.0	71.0	6.3
1961	4236	112.4	442.2	260.0	333.0	73.0	6.1
1962	3431	93.6	454.7	258.0	342.0	84.0	5.4
1963	4519	114.9	423.8	265.0	348.0	83.0	5.1
1964	4374	113.8	433.6	269.0	352.0	83.0	5.2
1965	3530	90.7	428.2	268.0	352.0	84.0	5.1
1966	4074	102.6	419.7	269.0	363.0	94.0	4.5
1967	2615	69.9	445.5	266.0	362.0	96.0	4.6
1968	2996	78.9	438.9	264.0	366.0	102.0	4.3
1969	2657	68.3	428.4	266.0	376.0	110.0	3.9
1970	2712	64.7	397.6	264.0	377.0	113.0	3.5
1971	2908	67.9	389.2	258.0	378.0	120.0	3.2
1972	2865	66.1	384.5	264.0	389.0	125.0	3.1
1973	2997	67.5	375.4	271.0	403.0	132.0	2.8
1974	2767	62.3	375.3	283.0	412.0	129.0	2.9
1975	2467	55.7	376.3	293.0	411.0	118.0	3.2
1976	2962	65.1	366.3	---	---	---	---
1977	2734	57.9	353.0	275.0	426.0	151.0	2.3
1978	2656	56.0	351.4	270.0	419.0	149.0	2.4

APPENDIX B (cont)

WELL G-1A

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1954	108	4.6	709.9	---	---	---	---
1955	1531	53.0	577.0	265.0	316.0	51.0	11.3
1956	3130	107.7	573.5	273.0	323.0	50.0	11.5
1957	2470	87.0	587.0	274.0	327.0	53.0	11.1
1958	2670	92.5	577.4	279.0	331.0	52.0	11.1
1959	2965	102.7	577.3	284.0	333.0	49.0	11.8
1960	3641	122.8	562.1	291.0	342.0	51.0	11.0
1961	4297	147.3	571.3	298.0	350.0	52.0	11.0
1962	3972	136.1	571.1	295.0	344.0	49.0	11.7
1963	4525	149.7	551.4	301.0	350.0	49.0	11.3
1964	3852	129.3	559.4	302.0	353.0	51.0	11.0
1965	3505	116.5	554.0	302.0	353.0	51.0	10.9
1966	3964	133.4	560.9	306.0	355.0	49.0	11.4
1967	2720	91.3	559.4	302.0	351.0	49.0	11.4
1968	3089	103.2	556.8	302.0	352.0	50.0	11.1
1969	2695	90.7	560.9	303.0	356.0	53.0	10.6
1970	2772	92.5	556.2	300.0	357.0	57.0	9.8
1971	3313	111.8	562.4	303.0	361.0	58.0	9.7
1972	2879	94.0	544.2	302.0	361.0	59.0	9.2
1973	2760	87.9	530.8	302.0	362.0	60.0	8.8
1974	2974	92.7	519.5	307.0	355.0	48.0	10.8
1975	2740	85.3	518.9	304.0	351.0	47.0	11.0
1976	2983	91.6	511.8	302.0	350.0	48.0	10.7
1977	2942	88.7	502.5	302.0	350.0	48.0	10.5
1978	2631	77.9	493.5	300.0	345.0	45.0	11.0

APPENDIX B (cont)

WELL G-2

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1951	123	3.9	528.5	259.0	---	---	---
1952	2372	78.3	550.2	279.0	327.0	48.0	11.5
1953	3254	105.6	540.9	290.0	334.0	44.0	12.3
1954	2682	86.3	536.3	291.0	335.0	44.0	12.2
1955	2487	78.8	528.1	299.0	345.0	46.0	11.5
1956	3109	95.8	513.6	310.0	357.0	47.0	10.9
1957	2458	76.1	516.0	311.0	360.0	49.0	10.5
1958	2707	80.1	493.2	315.0	361.0	46.0	10.7
1959	2938	84.6	479.9	320.0	363.0	43.0	11.2
1960	3535	96.6	455.4	328.0	370.0	42.0	10.8
1961	3982	105.3	440.7	336.0	375.0	39.0	11.3
1962	4076	99.8	408.1	338.0	374.0	36.0	11.3
1963	4563	105.7	386.1	344.0	379.0	35.0	11.0
1964	4541	105.3	386.5	346.0	380.0	34.0	11.4
1965	3535	82.6	389.4	346.0	381.0	35.0	11.1
1966	3994	94.7	395.2	349.0	383.0	34.0	11.6
1967	2743	67.6	410.7	344.0	379.0	35.0	11.7
1968	2732	66.5	405.7	344.0	379.0	35.0	11.6
1969	2679	68.6	426.8	344.0	381.0	37.0	11.5
1970	2431	62.8	430.5	343.0	381.0	38.0	11.3
1971	3420	87.4	425.9	345.0	384.0	39.0	10.9
1972	2887	73.4	423.7	348.0	388.0	40.0	10.6
1973	2816	72.4	428.5	344.0	385.0	41.0	10.5
1974	3056	82.0	447.2	347.0	390.0	43.0	10.4
1975	2724	74.5	455.8	341.0	384.0	43.0	10.6
1976	2990	81.1	452.1	344.0	388.0	44.0	10.3
1977	2981	80.4	449.5	346.0	388.0	42.0	10.7
1978	2562	71.6	451.9	345.0	386.0	41.0	11.0

APPENDIX B (cont)

WELL G-3

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1951	192	7.3	633.7	281.0	---	---	---
1952	2379	65.4	458.2	310.0	358.0	48.0	9.5
1953	3192	76.4	398.9	322.0	360.0	38.0	10.5
1954	2675	66.1	411.8	322.0	370.0	48.0	8.6
1955	2369	69.4	488.3	316.0	368.0	52.0	9.4
1956	3149	87.9	465.2	324.0	380.0	56.0	8.3
1957	2517	70.2	464.8	324.0	385.0	61.0	7.6
1958	2562	69.5	452.1	323.0	386.0	63.0	7.2
1959	2931	74.6	424.2	326.0	395.0	69.0	6.1
1960	3591	82.5	382.9	335.0	407.0	72.0	5.3
1961	3612	79.9	368.7	343.0	414.0	71.0	5.2
1962	4057	83.7	343.9	348.0	418.0	70.0	4.9
1963	4555	86.7	317.2	352.0	422.0	70.0	4.5
1964	4487	78.6	292.0	355.0	424.0	69.0	4.2
1965	3498	65.6	312.6	350.0	419.0	69.0	4.5
1966	3991	73.7	307.8	353.0	420.0	67.0	4.6
1967	2752	52.9	320.4	344.0	418.0	74.0	4.3
1968	3086	56.5	305.1	341.0	418.0	77.0	4.0
1969	2672	50.8	316.9	338.0	417.0	79.0	4.0
1970	2736	55.4	337.5	336.0	419.0	83.0	4.1
1971	3337	64.2	320.6	342.0	423.0	81.0	4.0
1972	2838	50.9	298.9	341.0	421.0	80.0	3.7
1973	2843	47.3	277.3	341.0	418.0	77.0	3.6
1974	3006	49.3	273.3	342.0	424.0	82.0	3.3
1975	2632	43.1	272.9	341.0	428.0	87.0	3.1
1976	2971	82.6	463.4	374.0	462.0	88.0	5.3
1977	2961	78.9	444.1	368.0	463.0	95.0	4.7
1978	2590	66.4	427.5	360.0	458.0	98.0	4.4

APPENDIX B (cont)

WELL G-4

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1951	---	12.5	---	357.0	477.0	120.0	---
1952	2401	56.9	395.0	374.0	474.0	100.0	3.9
1953	2677	55.2	343.7	380.0	472.0	92.0	3.7
1954	2256	58.8	434.4	383.0	526.0	143.0	3.0
1955	1172	22.7	322.8	378.0	481.0	103.0	3.1
1956	1800	33.9	313.9	377.0	491.0	114.0	2.8
1957	1324	24.2	304.6	373.0	498.0	125.0	2.4
1958	1970	35.9	303.7	370.0	490.0	120.0	2.5
1959	1819	31.6	289.5	378.0	494.0	116.0	2.5
1960	2457	37.0	251.0	385.0	509.0	124.0	2.0
1961	2787	45.0	269.1	389.0	512.0	123.0	2.2
1962	2738	41.7	253.8	386.0	505.0	119.0	2.1
1963	3519	46.4	219.8	388.0	504.0	116.0	1.9
1964	3561	42.9	200.8	396.0	499.0	103.0	1.9
1965	2100	23.8	188.9	394.0	492.0	98.0	1.9
1966	2219	33.6	252.4	391.0	498.0	107.0	2.4
1967	2690	44.8	277.6	388.0	509.0	121.0	2.3
1968	2083	31.4	251.2	386.0	509.0	123.0	2.0
1969	1309	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	1640	21.0	213.4	389.0	503.0	114.0	1.9
1972	2840	33.3	195.4	391.0	507.0	116.0	1.7
1973	3006	37.2	206.3	392.0	521.0	129.0	1.6
1974	2672	34.3	213.9	392.0	519.0	127.0	1.7
1975	1977	41.0	345.6	403.0	559.0	156.0	2.2
1976	2859	57.8	336.9	406.0	571.0	165.0	2.0
1977	2954	62.4	352.1	406.0	589.0	183.0	1.9
1978	2607	49.5	316.5	398.0	589.0	191.0	1.7

WELL G-5

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1951	---	6.7	---	414.0	---	---	---
1952	2579	73.8	476.9	422.0	480.0	58.0	8.2
1953	1433	37.8	439.6	425.0	467.0	42.0	10.5
1954	2617	80.9	515.2	429.0	473.0	44.0	11.7
1955	2529	80.4	529.9	427.0	472.0	45.0	11.8
1956	3052	97.0	529.7	431.0	478.0	47.0	11.3
1957	2385	64.1	447.9	424.0	466.0	42.0	10.7
1958	1523	49.1	537.3	428.0	477.0	49.0	11.0
1959	2917	101.7	581.1	435.0	495.0	60.0	9.7
1960	2828	98.0	577.6	437.0	501.0	64.0	9.0
1961	3908	134.0	571.5	438.0	507.0	69.0	8.3
1962	4186	142.0	565.4	440.0	511.0	71.0	8.0
1963	4528	151.0	555.8	441.0	513.0	72.0	7.7
1964	4532	150.4	553.1	446.0	516.0	70.0	7.9
1965	3520	117.1	554.5	443.0	516.0	73.0	7.6
1966	2555	83.2	542.7	445.0	520.0	75.0	7.2
1967	2405	80.0	554.4	444.0	519.0	75.0	7.4
1968	2513	81.2	538.5	443.0	517.0	74.0	7.3
1969	2649	83.3	524.1	450.0	520.0	70.0	7.5
1970	2771	88.9	534.7	453.0	521.0	68.0	7.9
1971	2657	88.3	553.9	450.0	521.0	71.0	7.8
1972	2902	92.4	530.7	441.0	514.0	73.0	7.3
1973	3003	97.5	541.1	444.0	515.0	71.0	7.6
1974	2054	69.0	559.9	440.0	513.0	73.0	7.7
1975	2266	74.7	549.4	433.0	500.0	67.0	8.2
1976	2955	95.0	535.8	442.0	504.0	62.0	8.6
1977	2836	92.1	541.3	444.0	504.0	60.0	9.0
1978	2608	84.2	538.4	442.0	502.0	60.0	9.0

WELL G-6

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1964	1912	45.0	392.3	581.0	659.0	78.0	5.0
1965	3200	74.9	390.1	582.0	660.0	78.0	5.0
1966	3931	92.2	390.9	585.0	658.0	73.0	5.4
1967	2454	57.8	392.6	580.0	653.0	73.0	5.4
1968	2597	56.2	360.7	574.0	647.0	73.0	4.9
1969	2698	55.6	343.5	568.0	636.0	68.0	5.1
1970	2765	51.0	307.4	569.0	634.0	65.0	4.7
1971	2932	42.8	243.3	573.0	629.0	56.0	4.3
1972	2516	57.0	377.6	578.0	670.0	92.0	4.1
1973	2991	65.3	363.9	579.0	667.0	88.0	4.1
1974	2950	63.8	360.5	579.0	665.0	86.0	4.2
1975	2717	56.7	347.8	577.0	659.0	82.0	4.2
1976	2966	57.8	324.8	584.0	662.0	78.0	4.2
1977	2954	54.4	306.9	586.0	659.0	73.0	4.2
1978	2218	38.4	288.9	581.0	645.0	64.0	4.5

WELL PM-1

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump ft)		
1965	2754	99.2	600.3	746.0	786.0	40.0	15.0
1966	3086	108.0	583.3	740.0	779.0	39.0	15.0
1967	2870	111.0	644.6	737.0	781.0	44.0	14.6
1968	1846	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	1781	66.2	619.5	733.0	769.0	36.0	17.2
1971	2728	101.0	617.1	733.0	766.0	33.0	18.7
1972	2415	84.9	585.9	735.0	762.0	27.0	21.7
1973	1688	46.5	459.1	736.0	755.0	19.0	24.2
1974	2649	96.3	605.9	740.0	768.0	28.0	21.6
1975	2567	94.8	615.5	741.0	766.0	25.0	24.6
1976	2933	106.8	606.9	744.0	767.0	23.0	26.4
1977	2969	105.4	591.7	745.0	767.0	22.0	26.9
1978	2544	90.6	593.3	745.0	767.0	22.0	27.0

WELL PM-2

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1966	221	18.9	1425.3	826.0	889.0	63.0	22.6
1967	4336	370.0	1422.2	834.0	888.0	54.0	26.3
1968	3865	328.2	1415.3	838.0	889.0	51.0	27.8
1969	3304	279.9	1411.9	838.0	890.0	52.0	27.2
1970	3529	300.6	1419.7	839.0	893.0	54.0	26.3
1971	4035	339.5	1402.3	841.0	898.0	57.0	24.6
1972	4611	385.3	1392.7	845.0	902.0	57.0	24.4
1973	4571	380.6	1387.7	849.0	907.0	58.0	23.9
1974	5443	450.9	1380.7	853.0	912.0	59.0	23.4
1975	4644	385.3	1382.8	854.0	913.0	59.0	23.4
1976	5382	442.0	1368.8	866.0	924.0	58.0	23.6
1977	3306	272.8	1375.3	868.0	924.0	56.0	24.6
1978	4743	388.4	1364.9	871.0	928.0	57.0	23.9

WELL PM-3

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw Down	Specific Capacity (gpm/ft)
				Non Pump (ft)	Pump (ft)		
1968	2327	187.4	1342.2	743.0	771.0	28.0	47.9
1969	3241	254.7	1309.8	746.0	772.0	26.0	50.4
1970	2905	227.8	1306.9	750.0	774.0	24.0	54.5
1971	2774	216.3	1299.6	751.0	774.0	23.0	56.5
1972	2445	192.1	1309.5	752.0	775.0	23.0	56.9
1973	3256	257.8	1319.6	755.0	778.0	23.0	57.4
1974	3241	255.3	1312.9	756.0	779.0	23.0	57.1
1975	3421	269.3	1312.0	757.0	780.0	23.0	57.0
1976	3171	268.3	1410.2	758.0	784.0	26.0	54.2
1977	2792	235.5	1405.8	758.0	784.0	26.0	54.1
1978	2516	211.0	1397.6	759.0	784.0	25.0	55.9

WATER CANYON GALLERY

Year	Pump Time (h)	Pumpage (million gal)	Rate (gpm)
1947	8760	84.0	159.8
1948	8784	97.0	184.0
1949	8760	92.0	175.0
1950	8760	54.0	102.7
1951	8760	39.0	74.2
1952	8784	48.0	91.1
1953	8760	39.0	74.2
1954	8760	40.0	76.1
1955	8760	33.0	62.8
1956	8784	23.0	43.6
1957	8760	40.0	76.1
1958	8760	60.0	114.2
1959	8760	54.0	102.7
1960	8784	48.0	91.1
1961	8760	54.0	102.7
1962	8760	67.0	127.5
1963	8760	51.0	97.0
1964	8784	45.0	85.4
1965	8760	72.0	137.0
1966	8760	82.0	156.0
1967	8760	56.0	106.5
1968	8784	65.0	123.3
1969	8760	80.0	152.2
1970	8760	65.0	123.7
1971	8760	37.0	70.4
1972	8784	40.0	75.9
1973	8760	49.0	93.2
1974	8760	35.0	66.6
1975	8760	42.0	79.9
1976	8784	41.0	77.8
1977	8760	57.0	108.4
1978	8760	45.0	86.2

APPENDIX C

ROUTINE CHEMICAL ANALYSES

	Concentrations in mg/ℓ																
	SiO_2	Ca	Mg	K	Na	CO_3	HCO_3	PO_4	SO_4	Cl	F	NO_3	TDS	Hard	pH	Cond. (μmho)	Temp. (°C)
Los Alamos Field																	
LA-1B	29	6	<0.3	3	152	0	376	<2	34	13	2.2	<2	624	15	8.6	640	30
LA-2	26	6	<0.3	1	65	0	159	<2	13	11	0.7	<2	298	14	8.8	300	24
LA-3	29	10	<0.3	2	34	0	90	<2	7	3	0.7	<2	234	27	8.6	200	20
LA-4	30	9	<0.3	2	22	0	93	<2	<2	2	0.5	<2	196	22	8.6	150	27
LA-5	30	6	<0.3	1	53	0	176	<2	5	2	0.9	<2	248	15	8.9	240	26
LA-6[a]	29	3	<0.3	1	74	0	163	<2	4	2	1.8	<2	324	7	9.1	300	25
Guaje Field																	
G-1	84	8	<0.3	3	22	0	85	<2	4	2	0.5	<2	198	23	8.6	160	24
G-1A	78	8	0.4	3	23	0	85	<2	4	2	0.5	<2	254	21	8.6	160	26
G-2	70	8	0.5	2	44	0	132	<2	5	3	1.1	<2	274	22	8.7	230	28
G-3	60	8	1.0	2	26	0	100	<2	3	2	0.5	<2	190	24	8.6	160	28
G-4	56	11	2.6	2	16	3	95	<2	4	2	0.4	<2	236	38	8.5	160	25
G-5	60	12	3.7	2	12	0	112	<2	4	2	0.4	<2	228	44	8.5	160	24
G-6	50	10	2.0	2	18	0	93	<2	3	2	0.4	<2	220	32	8.6	160	30
PM-1	76	16	3.2	4	21	5	139	<2	5	5	0.3	<2	362	65	8.3	240	26
PM-2	74	6	8.1	2	12	4	88	<2	2	2	0.4	<2	178	28	8.1	120	28
PM-3	74	14	3.0	4	18	2	146	<2	6	6	0.4	<2	402	69	8.1	250	29
Water Canyon																	
Gallery	34	5	3.0	2	6	2	54	<2	2	<1	0.2	<2	176	25	8.1	120	9
Guaje Canyon[b]																	
Reservoir	44	3	2	2	6	5	54	<2	2	1	0.3	<2	122	16	7.7	80	2
Distribution[c]																	
FS-1 (TA-3)	72	6	2.9	2	11	2	73	<2	3	4	0.4	<2	230	26	8.2	120	18
FS-2 (DP Road)	32	8	0.4	2	66	0	198	<2	14	7	1.1	<2	304	20	8.4	320	16
FS-3 (White Rock)	72	16	7.7	4	19	4	144	<2	5	<1	0.7	<2	326	71	8.0	250	15
FS-4 (Diamond Dr.	56	10	2.3	2	18	0	242	<2	3	3	0.5	<2	222	34	8.3	160	16
FS-5 (S-Site)	44	5	3.1	2	7	2	49	<2	2	2	0.3	<2	166	26	8.0	96	15
USEPA-NIPDW Regulation	---	---	---	---	---	---	---	---	---	---	2.0	45	---	---	---	---	---

[a]Well on standby for emergency use only.
[b]Irrigation use only.
[c]Collected at fire station.

APPENDIX D

TRACE METAL ANALYSES

	Concentrations in μg/ℓ											
	Ag	Al	As	Ba	Cd	Co	Cr	Hg	Mo	Ni	Pb	Se
Los Alamos Field												
LA-1B	10	<10	42	90	3	<5	32	<0.2	<10	10	9	<5
LA-2	18	<10	9	150	4	<5	23	<0.2	<10	8	8	<5
LA-3	39	<10	5	110	4	<5	12	<0.2	<10	8	20	<5
LA-4	15	<10	<5	50	4	<5	6	<0.2	<10	8	5	<5
LA-5	74	10	26	100	4	<5	16	<0.2	<10	8	8	<5
LA-6[a]	7	10	211	40	3	<5	19	<0.2	<10	8	10	<5
Guaje Field												
G-1	6	10	3	100	4	<5	5	<0.2	<10	7	7	<5
G-1A	<10	<10	<5	100	4	<5	5	<0.2	<10	7	6	<5
G-2	16	12	78	90	8	<5	16	<0.2	<10	7	5	<5
G-3	17	<10	9	20	5	<5	8	<0.2	<10	6	5	<5
G-4	12	<10	<5	30	5	<5	5	<0.2	<10	7	3	<5
G-5	10	<10	<5	40	4	<5	3	---	<10	7	4	<5
G-6	13	<10	<5	30	5	<5	5	---	<10	6	3	<5
Pajarito Field												
PM-1	12	<10	<5	140	3	<5	5	<0.2	<10	6	3	<5
PM-2	<10	14	<5	60	4	<5	5	<0.2	<10	7	5	<5
PM-3	<10	11	<5	90	4	<5	6	<0.2	<10	7	3	<5
Water Canyon												
Gallery	<10	35	<5	30	7	<5	<3	<0.2	<10	8	5	<5
Guaje Canyon[b]												
Reservoir	<10	71	<5	30	7	<5	<3	---	<10	8	4	<5
Distribution[c]												
FS-1 (TA-3)	16	11	<5	80	3	<5	6	<0.2	<10	12	9	<5
FS-2 (DP Road)	19	12	13	120	3	<5	17	<0.2	<10	11	9	<5
FS-3 (White Rock)	17	12	<5	140	3	<5	6	<0.2	<10	11	6	<5
FS-4 (Diamond Dr.)	19	10	8	70	3	<5	6	<0.2	<10	10	5	<5
FS-5 (S-Site)	19	83	<5	40	6	<5	3	<0.2	<10	9	8	<5
USEPA-NIPDW Standards	50	---	50	1000	10	---	50	2	---	---	50	10

[a]Well on standby for emergency use only.

[b]Irrigation use only.

[c]Collected at fire stations.

NOTE: Br <2000 μg/ℓ; Cu, Fe, Mn, and Zn <300 μg/ℓ in water from wells, gallery, reservoir, distribution.

APPENDIX E

RADIOCHEMICAL ANALYSES

	Gross Alpha (10^{-9} μCi/mℓ)	Gross Beta (10^{-9} μCi/mℓ)	^{137}Cs (10^{-6} μCi/mℓ)	^{238}Pu (10^{-9} μCi/mℓ)	^{239}Pu (10^{-9} μCi/mℓ)	^{3}H (10^{-6} μCi/mℓ)	Total U (μg/ℓ)
Los Alamos Field							
LA-1B	7.0 ± 4.0	4.1 ± 2.0	30 ± 80	−0.001 ± 0.028	−0.021 ± 0.022	0.2 ± 0.6	5.4 ± 10
LA-2	2.2 ± 1.8	2.7 ± 1.6	60 ± 60	−0.049 ± 0.028	−0.033 ± 0.034	0.3 ± 0.6	4.5 ± 0.8
LA-3	0.9 ± 1.2	2.4 ± 1.4	70 ± 200	−0.030 ± 0.022	0.003 ± 0.026	1.0 ± 0.6	2.3 ± 0.4
LA-4	0.3 ± 1.0	2.9 ± 0.7	30 ± 120	−0.007 ± 0.018	−0.014 ± 0.020	0.6 ± 0.6	0.5 ± 0.2
LA-5	2.1 ± 1.6	4.2 ± 1.6	11 ± 22	−0.020 ± 0.020	−0.008 ± 0.016	0.1 ± 0.6	6.3 ± 1.2
LA-6[a]	1.6 ± 1.6	4.6 ± 1.8	50 ± 80	−0.021 ± 0.034	−0.017 ± 0.018	0.2 ± 0.6	1.6 ± 0.4
Guaje Field							
G-1	0.2 ± 1.0	3.8 ± 1.6	−10 ± 40	−0.038 ± 0.030	−0.014 ± 0.026	0.6 ± 0.6	0.5 ± 0.2
G-1A	−0.1 ± 1.0	2.4 ± 1.4	0 ± 60	−0.009 ± 0.024	−0.009 ± 0.020	0.4 ± 0.6	0.3 ± 0.2
G-2	0.1 ± 1.2	2.3 ± 1.4	5 ± 30	−0.030 ± 0.020	0.003 ± 0.026	0.1 ± 0.6	1.1 ± 0.2
G-3	−0.1 ± 1.0	2.6 ± 1.4	−10 ± 140	−0.026 ± 0.036	−0.014 ± 0.026	−0.1 ± 0.6	0.5 ± 0.2
G-4	0.4 ± 1.0	1.0 ± 1.4	80 ± 80	−0.026 ± 0.024	−0.010 ± 0.020	0.1 ± 0.6	0.6 ± 0.2
G-5	0.4 ± 1.0	2.0 ± 1.4	0 ± 60	−0.025 ± 0.020	0.003 ± 0.024	0.4 ± 0.6	0.8 ± 0.2
G-6	0.3 ± 1.0	2.8 ± 1.4	52 ± 36	−0.025 ± 0.032	−0.017 ± 0.018	0.3 ± 0.6	0.4 ± 0.2
Pajarito Field							
PM-1	1.7 ± 1.6	5.2 ± 2.0	8 ± 16	−0.010 ± 0.060	−0.016 ± 0.036	0.5 ± 0.6	2.0 ± 0.4
PM-2	0.6 ± 1.2	1.4 ± 1.6	−100 ± 80	−0.013 ± 0.022	−0.017 ± 0.020	0.2 ± 0.6	0.3 ± 0.2
PM-3	0.8 ± 1.9	4.4 ± 1.8	−10 ± 40	−0.001 ± 0.030	0.003 ± 0.020	0.4 ± 0.6	1.2 ± 0.2
Water Canyon							
Gallery	−0.1 ± 1.0	1.9 ± 1.6	−10 ± 40	−0.030 ± 0.022	−0.023 ± 0.020	0.5 ± 0.6	0.0 ± 0.2
Guaje Canyon[b]							
Reservoir	0.0 ± 1.0	3.1 ± 1.6	90 ± 100	−0.036 ± 0.030	0.004 ± 0.030	1.4 ± 0.6	0.0 ± 0.2
Distribution[c]							
FS-1	−0.1 ± 1.0	2.5 ± 1.4	30 ± 80	−0.040 ± 0.026	0.005 ± 0.024	0.2 ± 0.6	0.9 ± 0.2
FS-2	2.3 ± 1	3.5 ± 1.6	20 ± 40	0.008 ± 0.018	0.003 ± 0.024	0.7 ± 0.6	4.2 ± 0.8
FS-3	−0.4 ± 1.4	5.9 ± 1.0	−20 ± 80	−0.007 ± 0.026	−0.013 ± 0.026	−0.2 ± 0.6	1.1 ± 0.2
FS-4	−0.6 ± 1.0	2.9 ± 1.4	−60 ± 60	0.014 ± 0.018	0.002 ± 0.014	0.9 ± 0.6	0.8 ± 0.2
FS-5	−0.3 ± 0.8	3.3 ± 1.4	5 ± 36	0.015 ± 0.024	0.003 ± 0.028	0.6 ± 0.6	0.0 ± 0.2
USEPA-NIPDW Standards	5.0	---	200	7.5	7.5	20	1800

[a]Well on standby for emergency use only.

[b]Irrigation use only.

[c]Collected at fire stations.

NOTE: ± value represents twice the error term for that analysis.

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