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Water Supply at Los Alamos During 1980

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WATER SUPPLY AT LOS ALAMOS DURING 1980

by

W. D. Purtyman and Max Maes

ABSTRACT

The municipal and industrial water supply for Los Alamos during 1980 consisted of 1567×10^6 gal from wells in three fields and 32×10^6 gal from the gallery in Water Canyon. Another 0.1×10^6 gal of water were pumped to waste during testing of Well LA-6. About 5.0×10^6 gal of water from Guaje Reservoir and 2.3×10^6 gal of water from Los Alamos Reservoir were used for irrigation; thus, the total use was about 1606 $\times 10^6$ gal. Water level trends in the wells were as anticipated under current production practices. Well and distribution system rehabilitation should be continued. The rehabilitation of the older wells and drilling and development of new wells (PM-4 now being drilled) are necessary to ensure an adequate and reliable water supply for municipal and industrial use at Los Alamos. Chemical quality of water from the wells and distribution system is in compliance with state and federal regulations related to municipal use.

1. 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 the Los Alamos National Laboratory. The gallery in Water Canyon supplies the balance to the system. Also included is a summary of surface water from Guaje and Los Alamos Reservoirs used for irrigation. Chemical quality of water from the wells, gallery, and surface water sources is also included in this report. This report is a joint effort between Group H-8 of the Laboratory 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 nine annual reports have been issued as the result of these studies.[1-10] The eleventh report extrapolates water-level trends in the well fields to 1983 under current production.[11]

The Zia U/E, the Department of Energy (DOE) support contractor at the Laboratory, 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

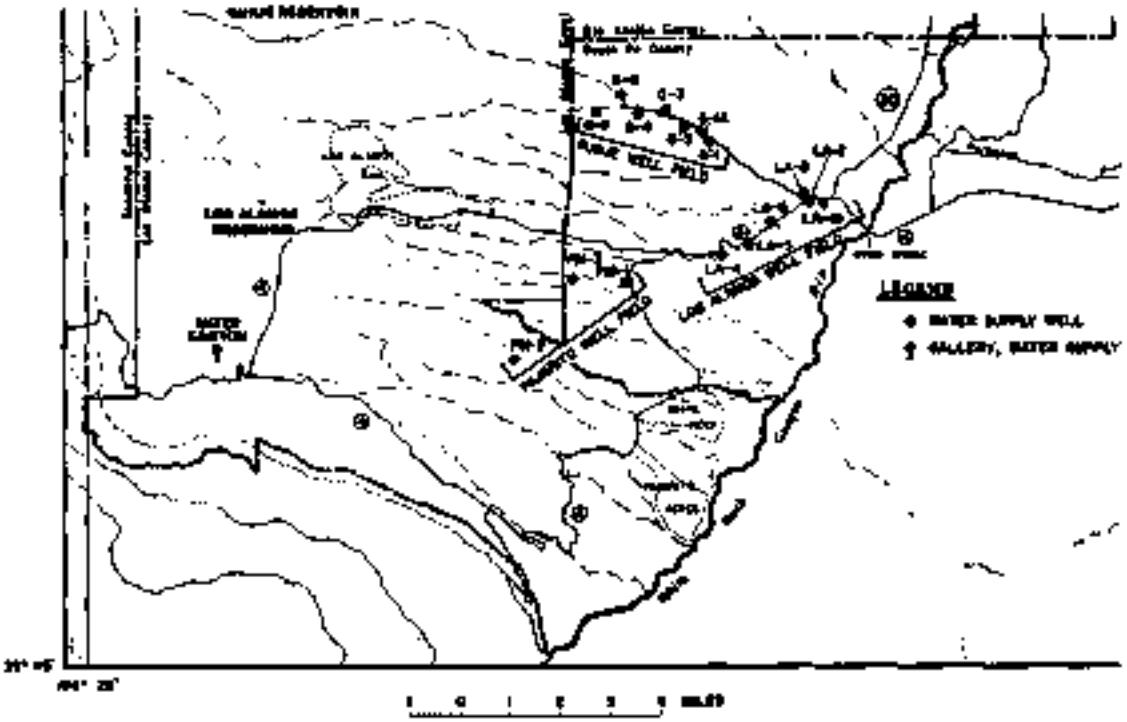

Fig. 1. Location of well fields, supply wells, and gallery water supply.

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, 1 standby supply well, 15 supply wells, and the gallery in Water Canyon. The hydrographs for the wells show annual nonpumping and pumping water levels, specific capacity, and annual pumpage for the years during which the wells have been in production. The hydrographs for the gallery present annual production and the annual average discharge rates. Appendix A contains basic pumping and production information for each supply well and gallery annually for the period of record. Chemical quality of water from wells, gallery, distribution systems, and reservoirs is shown in Appendix B.

II. WELL-FIELD CHARACTERISTICS

Production from the three well fields increased 160 × 10^6 gal, from 1407 × 10^6 gal in 1979 to 1567 × 10^6 gal in 1980 (Table 1). The months of heaviest pumpage in 1980 were June, July, and August. The production during these months was 631 × 10^6 gal, increasing from 526 × 10^6 gal for a similar period in 1979. The months of least pumpage were February, March, and December. The production for these three months was 264 × 10^6 gal, up from 255 × 10^6 gal for the similar period in 1979.

The difference in demand for periods of heavy-to-light production (summer to winter) is mainly the use of water for lawn and yard irrigation. As a result, the water levels in the wells fluctuate with production. The highest water levels were during months of least pumpage (February, March, and December), whereas the lowest water levels were during months of greatest production (June, July, and August).

The projected demands for water for the Laboratory and community were made for the period 1981 through 1990 based on past production (Fig. 2). The projection made in 1973 of production 1973-79 was above the actual production. For example, in 1979, the projected production was about 760 × 10^6 gal above the actual production.[11,12] The projected demand 1981-90 shows an annual increase of about 25 × 10^6 gal.

The actual annual water use is variable, dependent mainly on the amount of precipitation occurring during

TABLE I

PRODUCTION IN MILLIONS OF GALLONS
FROM WELLS AND GALLERY
1947-1980

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
1979	289	456	662	44	1451
1980	339	485	743	32	1599
Total	13 857	14 093	9 536	1 810	39 296

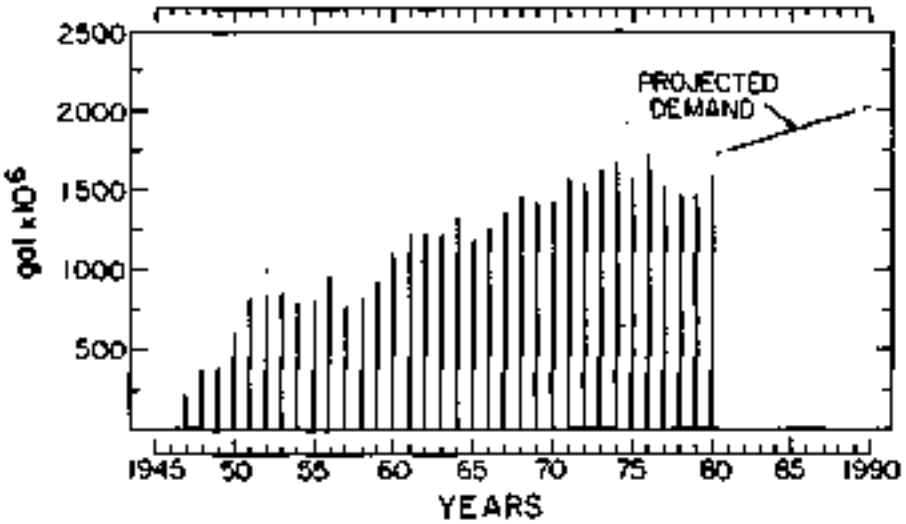

Fig. 2. Water production and use 1947-80 and projected demand 1981-90.

the summer. The precipitation reduces the amount of pumpage required for lawn and yard irrigation.

The peak demand period for 1980 was for the 33-day period of June 15 through July 18 when pumpage was 269 × 10^6 gal,or about 8.2 × 10^6 gal/day. The peak demand period was slightly less than a similar period in 1976 (Table II).

The total production from the well fields and gallery since 1947 has been about 39 296 × 10^6 gal. Of this, wells have produced 37 486 × 10^6 gal or about 95% (Table I). The annual production for 1980, per cent pumpage by well fields, and per cent pumpage by individual wells are given in Table III. The average annual pumping rates for individual wells for the period 1973 through 1980 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 1980 was from five supply wells. The sixth is on standby status for emergency use only.[17] Pumpage from the field increased 50 × 10^6 gal from 289 × 10^6 gal in 1979 to 339 × 10^6 gal in 1980. The field produced about 21% of the total production in 1980 (Table III).

About 40% of the production was from the lower part of the field (LA-1B, LA-2, and LA-3), and about 60% was from the upper part of the field (LA-4 and LA-5). The increased production in 1980, when compared to that of 1979, resulted in slight declines in the annual water levels in all of the wells (Figs. 3 through 9). The distribution of pumpage (40%, lower field; 60%, upper field) results in uniform water level declines throughout the field. The distribution of pumpage in 1980 from the individual wells has reduced excessive water level decline in the lower part of the well field.

Well LA-6, on standby status, pumped about 0.1 × 10^6 gal for testing and pump maintenance during the year. Water was pumped to waste, not into the system.

The annual average pumping rates from the five producing wells decreased about 132 gpm from 2296 gpm in 1979 to 2164 gpm in 1980. The pumping rate decline is due to decline in water levels caused by increased production from the field in 1980 when compared to 1979. The specific capacities of the wells showed no significant change in 1980 when compared to the 1979 data.

B. Guaje Well Field

The Guaje Well Field is composed of seven wells (Fig. 1). The pumpage from the field increased 29 × 10^6 gal, from 456 × 10^6 gal in 1979 to 485 × 10^6 gal in 1980 (Table I). The field produced about 30% of the total production in 1980 (Table III).

Water levels responded to amount of pumpage (Figs. 10 through 16). Production from wells G-1, G-1A, G-2, G-5, and G-6 increased in 1980 when compared to the

TABLE II

PEAK DEMAND PERIODS
1976-1980

	Demand Period				
	June 11-July 12 1976	May 31-June 18 1977	June 9-June 28 1978	July 24-Aug. 7 1979	June 15-July 18 1980
No. of Days	32	19	20	15	33
Total Production (gal)	299×10^6	149×10^6	149×10^6	115×10^6	269×10^6
Ave. Daily Production (gal)	9.3×10^6	7.8×10^6	7.4×10^6	7.7×10^6	8.2×10^6
No. of Days Exceeding (gal)					
10×10^6	14	2	---	---	—
9×10^6	9	4	---	---	7
8×10^6	4	4	7	4	15
7×10^6	3	4	8	6	6
$<7 \times 10^6$	2	5	5	5	5

production in 1979. As a result, water levels were slightly lower in 1980 than in 1979. Production from wells G-3 and G-4 decreased in 1980 when compared to 1979. Water levels declined slightly in well G-3 as the result of pumpage of G-2 (interference), and rose slightly in G-4.

Well G-4 was taken out of service in August 1980 when the pumping rate declined to about 228 gpm. The specific capacity remained about the same at 1.3 to 1.5 gpm/ft of drawdown indicating excessive wear of the pump.

Well G-5 was out of service in January because of electrical failure of connectors into the submersible pump. It was put back in service in February at a pumping rate of about 526 gpm. Hydrologic characteristics of the well did not change in 1980 when compared to data from 1979.

Well G-6 was out of service August 1979 through May 1980.[14] The well continued to pump a large amount of sand and gravel pack after the well was put back into operation. During the remainder of 1980, June through December, the average pumping rate was about 320 gpm, about the same as in 1977 when the pumping rate began to decline. Specific capacity of the well declined about 0.9 gpm/ft of drawdown from 4.2 in 1978 to 3.3 gpm/ft of drawdown in 1980 indicating deterioration of the well.

The average annual pumping rate of the wells in the field declined 115 gpm from 2780 gpm in 1979 to 2665 gpm in 1980. The largest decline occurred in well G-3 of about 83 gpm from 1979 to 1980. Specific capacity of well G-3 also declined about 1 gpm/ft of drawdown from 1979 to 1980. The data indicate both wear on the pump and deterioration of the well. The damage may have been caused by the back-flow preventer not closing properly, thus the well was receiving drainage from transmission line or pumpage from the other well if G-3 was not in operation.[14]

C. Pajarito Well Field

The Pajarito Well Field is composed of three wells (Fig. 1). The pumpage from the field increased 81×10^6 gal from 662×10^6 gal in 1979 to 743×10^6 gal in 1980 (Table I). The field produced 47% of the total production in 1980 (Table III).

TABLE III

PRODUCTION PERCENTAGES, 1980

	Production in Million Gal	Per Cent by Well Field	Per Cent by Total Production
Los Alamos Well Field			
LA-1	0.0	0	0
LA-1B	62.9	19	4
LA-2	33.8	10	2
LA-3	35.1	10	2
LA-4	115.3	34	7
LA-5	92.2	27	6
LA-6*	0.1	<1	<1
Subtotal	339.4	100	21
Guaje Well Field			
G-1	68.3	14	4
G-1A	103.2	21	6
G-2	92.4	19	6
G-3	61.8	13	4
G-4	35.6	7	2
G-5	89.0	19	6
G-6	34.5	7	2
Subtotal	484.8	100	30
Pajarito Well Field			
PM-1	98.7	13	6
PM-2	409.6	55	26
PM-3	234.4	32	15
Subtotal	742.7	100	47
Water Canyon Gallery			
Subtotal	31.7	100	2
Total	1598.6	—	100

*Well pumped to waste.

TABLE IV

AVERAGE ANNUAL PUMPING RATE OF WELLS AND DISCHARGE FROM GALLERY
1973-1980
(in gpm)

	1973	1974	1975	1976	1977	1978	1979	1980
Los Alamos Well Field								
LA-1	0	0	0	0	0	0	0	0
LA-1B	553	540	537	526	504	546	565	536
LA-2	297	302	290	267	255	286	323	287
LA-3	346	316	313	285	284	306	348	300
LA-4	589	594	591	584	586	594	588	578
LA-5	460	460	450	462	468	476	472	463
LA-6*	572	569	551	486	0	0	0	0
Subtotal	2817	2781	2742	2610	2097	2208	2296	2164
Guaje Well Field								
G-1	375	275	376	366	353	351	343	329
G-1A	531	520	519	512	502	494	494	494
G-2	429	447	456	452	450	452	448	443
G-3	277	273	273	463	444	428	382	299
G-4	206	214	346	337	352	316	296	266
G-5	541	560	549	536	541	538	522	512
G-6	364	360	348	325	307	289	295	322
Subtotal	2723	2750	2867	2991	2949	2868	2780	2665
Pajarito Well Field								
PM-1	459	606	616	607	592	593	592	591
PM-2	1388	1381	1383	1369	1375	1365	1362	1359
PM-3	1320	1313	1312	1410	1406	1398	1393	1397
Subtotal	3166	3299	3310	3386	3373	3356	3347	3347
Water Canyon Gallery								
Subtotal	93	67	80	78	108	86	84	61
Total	8800	8896	8999	9065	8528	8518	8507	8237

*Well on standby.

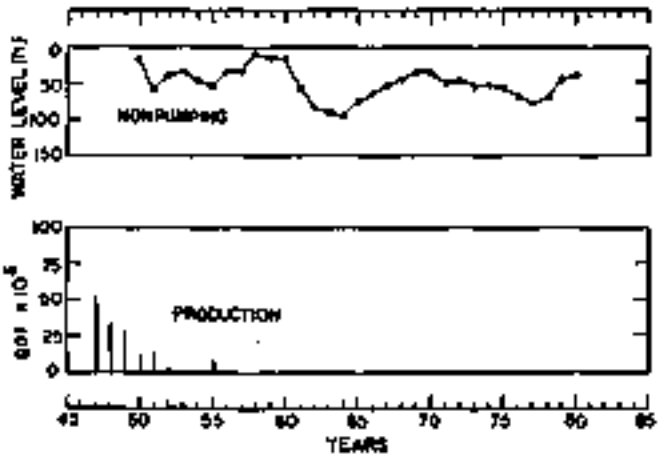

Fig. 3. Annual average nonpumping water level and annual production, Los Alamos Well LA-1.

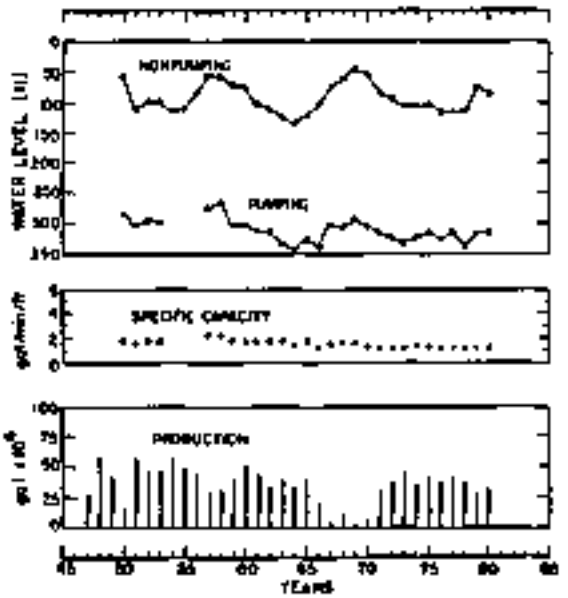

Fig. 5. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-2.

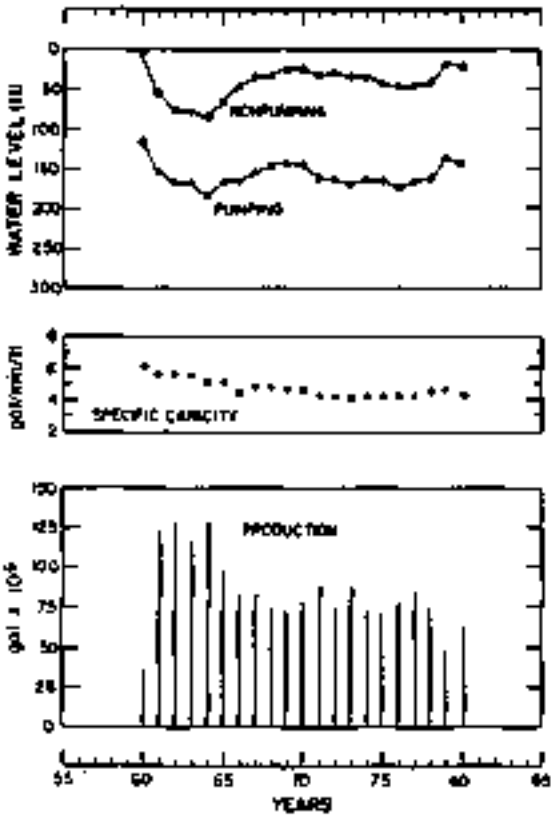

Fig. 4. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-1B.

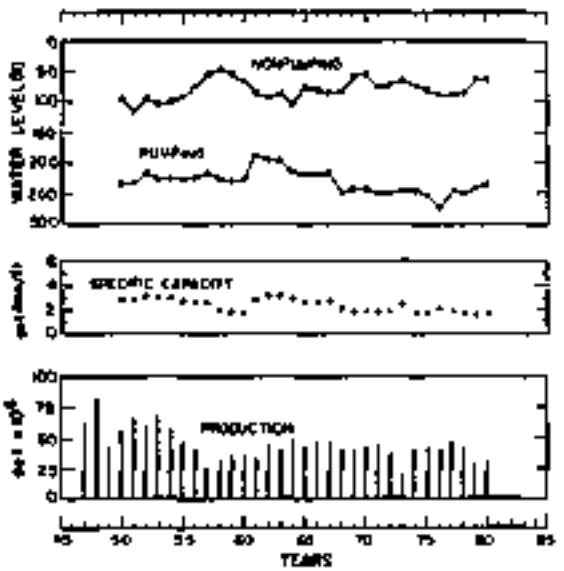

Fig. 6. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-3.

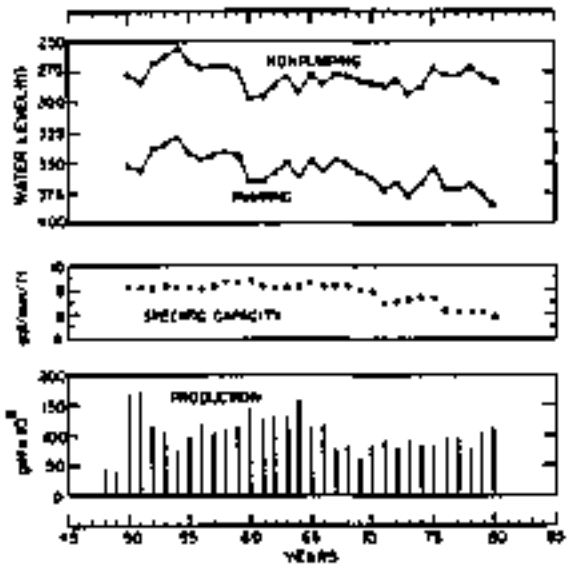

Fig. 7. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-4.

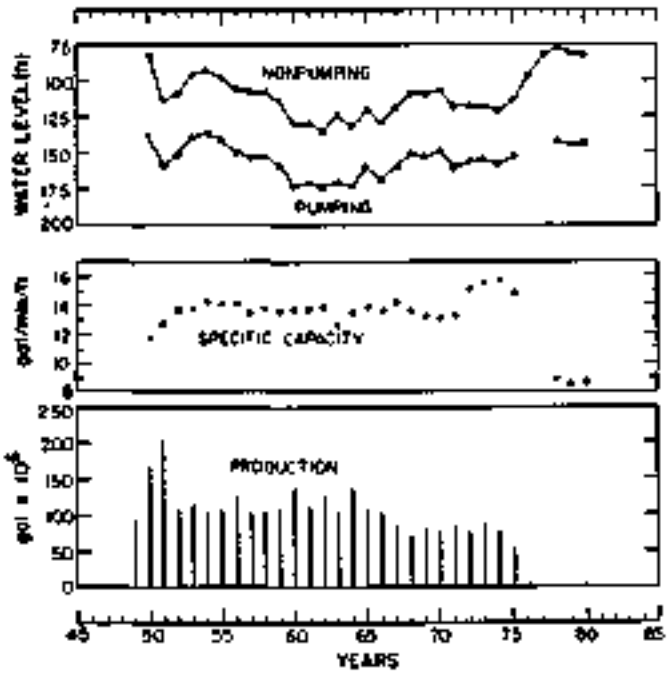

Fig. 9. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-6.

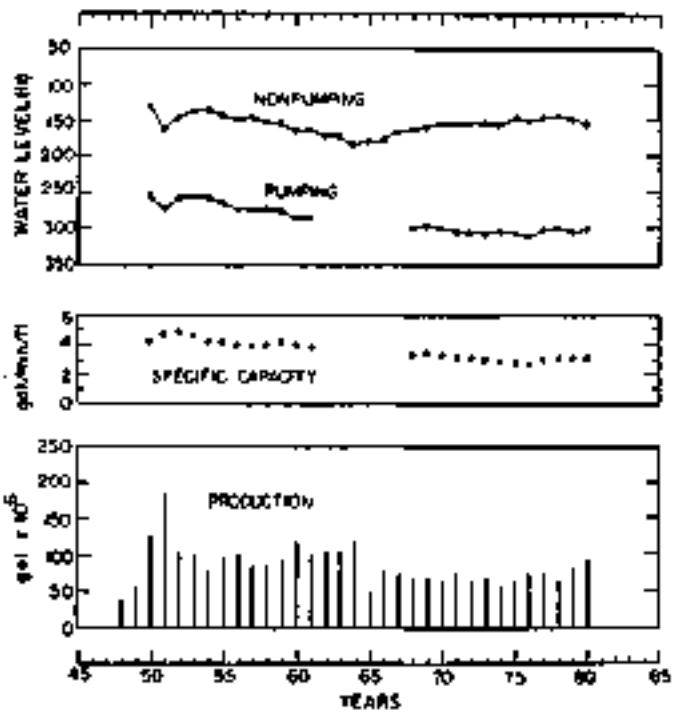

Fig. 8. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Los Alamos Well LA-5.

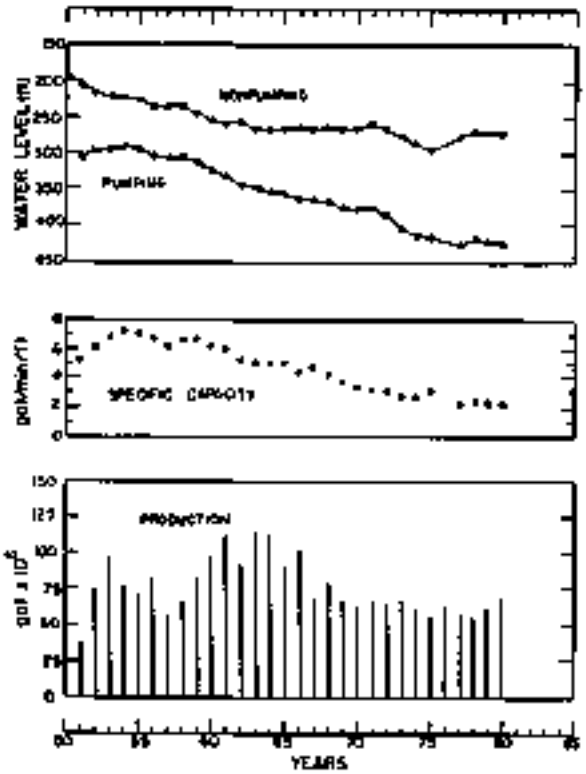

Fig. 10. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-1.

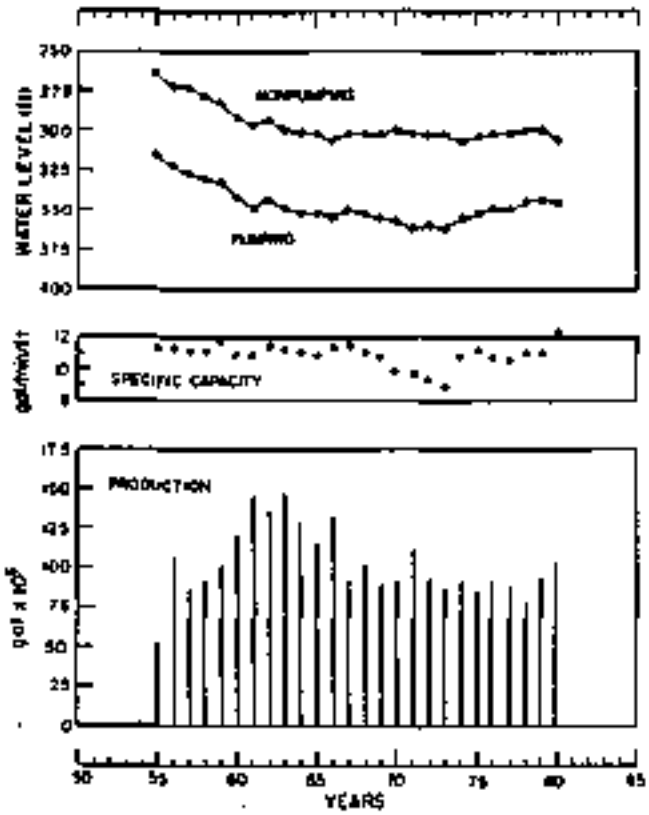

Fig. 11. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-1A.

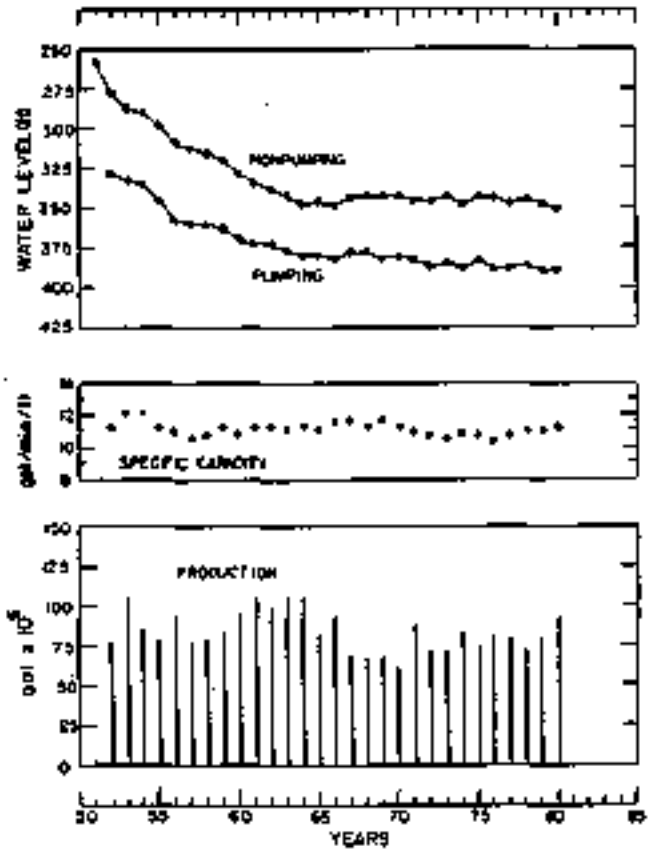

Fig. 12. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-2.

Water levels in wells PM-1, PM-2, and PM-3 remained about the same in 1980 as in 1979 (Figs. 17 through 19). There was no significant change in pumping rates or specific capacities in 1980 when compared to previous years.

III. WATER CANYON

The gallery in Water Canyon is dug into the Bandelier Tuff, which forms the surface outcrops along the mountains. The production from the gallery declined 12 x 10^6 gal, from 44 x 10^6 gal in 1979 to 32 x 10^6 gal in 1980 (Table I). The gallery produced about 2% of the water supply at Los Alamos during 1967. The annual discharge for 1980 was 61 gpm, down 23 gpm from the 1979 average of 84 gpm (Fig. 20).

IV. GUAJE AND LOS ALAMOS RESERVOIRS

Guaje Reservoir in Upper Guaje Canyon has a capacity of 0.25 x 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. 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. The amount used for irrigation in 1980 was 5.0 x 10^6 gal, an increase of 1.3 x 10^6 gal from 3.7 x 10^6 gal used in 1979.

Los Alamos Reservoir in upper Los Alamos Canyon has a capacity of 13.4 x 10^6 gal, with a drainage area above the intake of 6.4 mi^2. The reservoir is used for

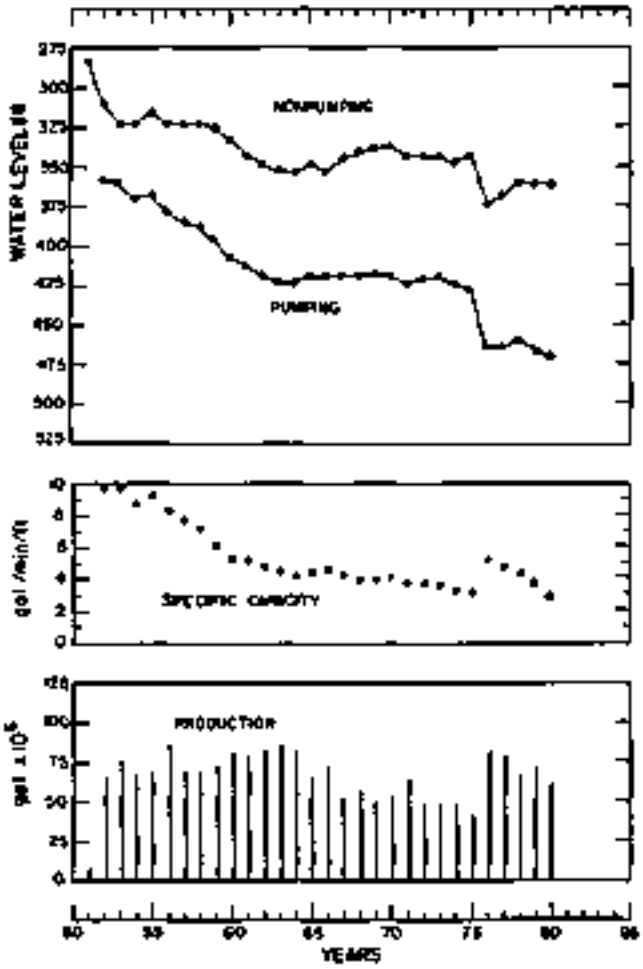

Fig. 13. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-3.

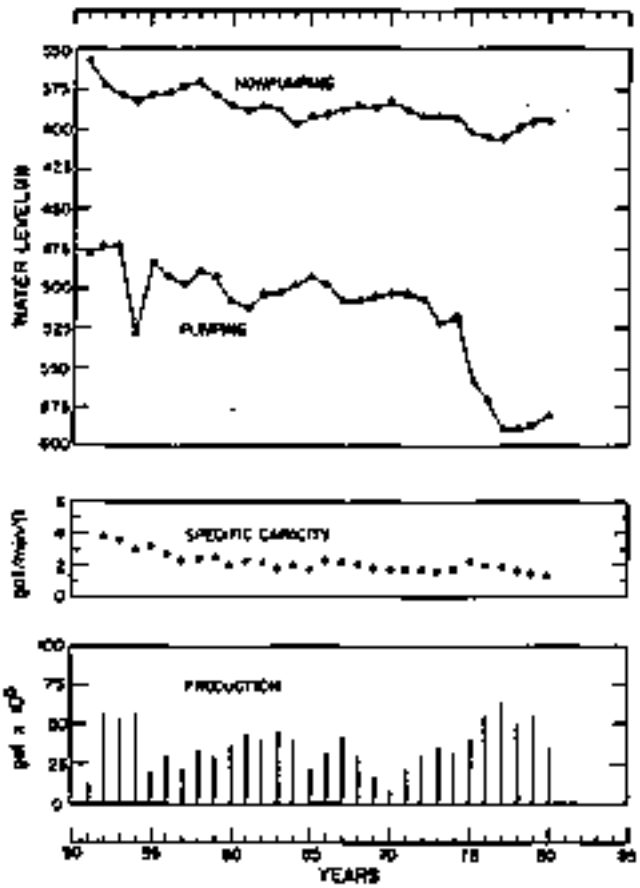

Fig. 14. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-4.

storage and recreation. The water is conveyed by gravity flow through about 2.6 mi of transmission line for irrigation of lawns and shrubs at the Los Alamos High School and Mesa School. The line from the reservoir is not connected to the municipal distribution system. The amount used for irrigation in 1980 was 2.3×10^6 gal, an increase of 1.0×10^6 gal from 1.3×10^6 gal used in 1979.

V. QUALITY OF WATER

The quality of water is monitored to determine if the water from the wells meets State and Federal requirements for municipal supplies.[14,15] Water samples are collected at the wellhead and at six stations on the distribution (five fire stations and at Bandelier National Monument). Bandelier National Monument water is supplied from the Los Alamos system. Comparing the maximum chemical concentrations from the wells and distribution system with standards or criteria shows that all constituents were below the standards with the exception of fluoride (Table V). Fluoride of 2.5 mg/ℓ occurred in well LA-1B (Appendix B). Mixing with water from other wells lowers the fluoride concentration below the standards within the distribution system.

Water from well LA-6 is not used for municipal supply because of arsenic concentrations in the water that exceed the standards. The water could not be mixed with other waters from the well field to reduce the arsenic concentration in the distribution system to a level below the standards. Arsenic concentrations in water from well LA-6 in 1980 were still high at 0.263 mg/ℓ.

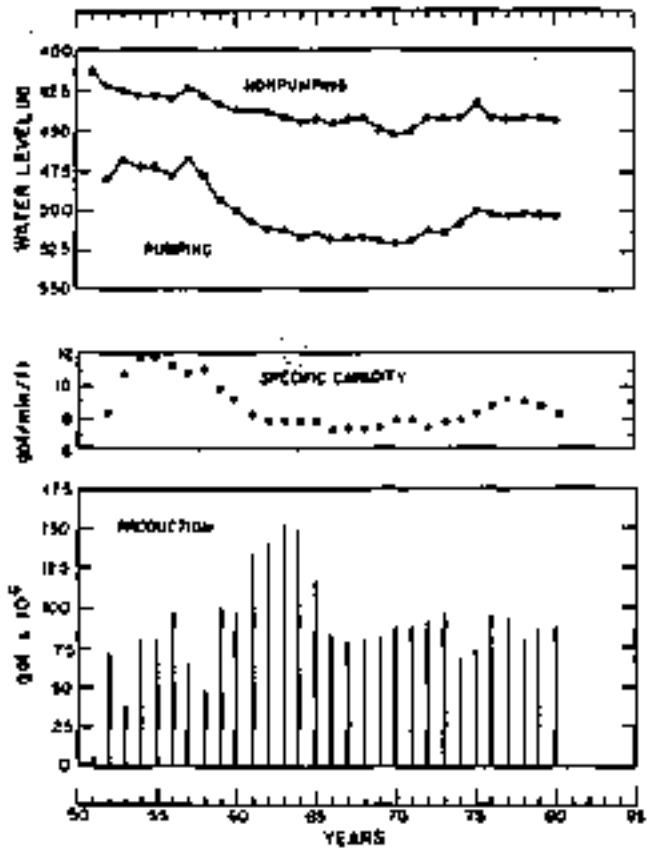

Fig. 15. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-5.

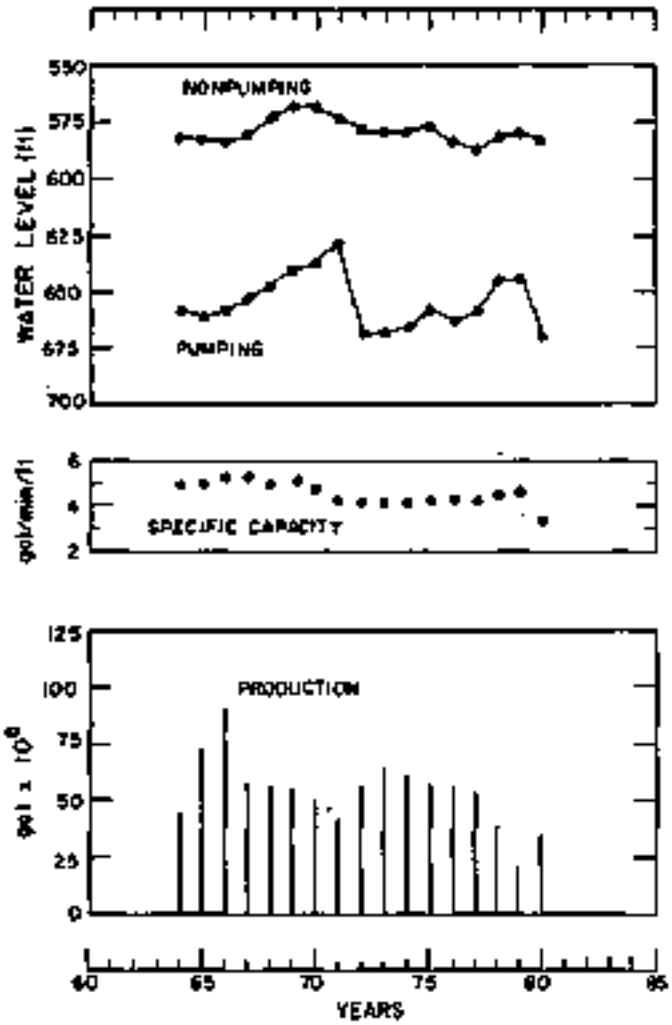

Fig. 16. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Guaje Well G-6.

Radioactivity in the water supply is low and naturally occurring. One ^{239}Pu analysis from well LA-1B contained a detectable amount ($0.125 \pm 0.060 \times 10^{-9}$ μCi/ml) of plutonium that is attributed to contamination of the sample during collection, or processing during analysis. Water from the well has shown no previous detectable levels of plutonium. Other plutonium analyses were at, or below, limits of detection.

Samples from the distribution system showed gross alpha activity lower than EPA screening limits. One well (LA-1B, Los Alamos field) contained 80% greater than the screening limits. Dilution by water from other wells resulted in concentrations at point of use (distribution system) that meet the EPA's criteria for municipal supply.[16]

Routine chemical analyses of water are made from the individual well and the six stations on the distribution system to determine if there is any deterioration of water quality with continued production and distribution (Appendix B). Slight changes in water quality occur seasonally from periods of light pumpage (winter) to heavy pumpage (summer). Quality of water data collected in 1980, when compared to data collected in previous years, is within the expected levels caused by the seasonal variations.

VI. SUMMARY AND CONCLUSIONS

Production from the three well fields increased 160×10^6 gal from 1979 to 1980. The production and demand for water is expected to increase with continued growth of the Laboratory and community. The construction and

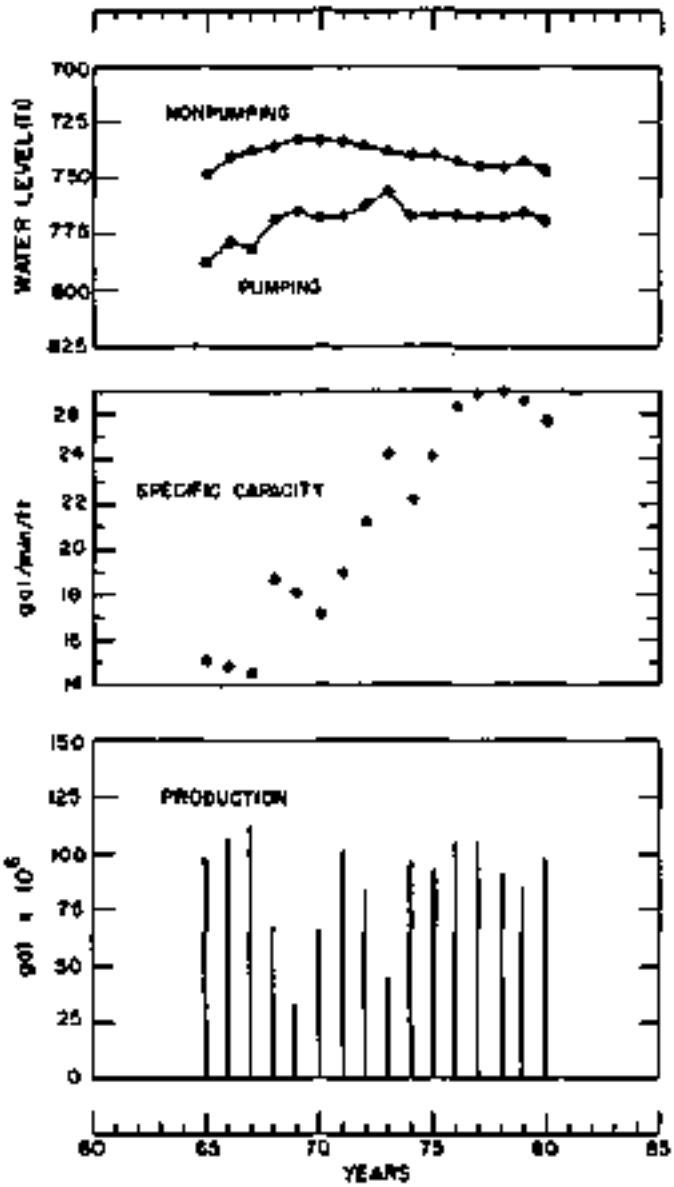

Fig. 17. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Pajarito Well PM-1.

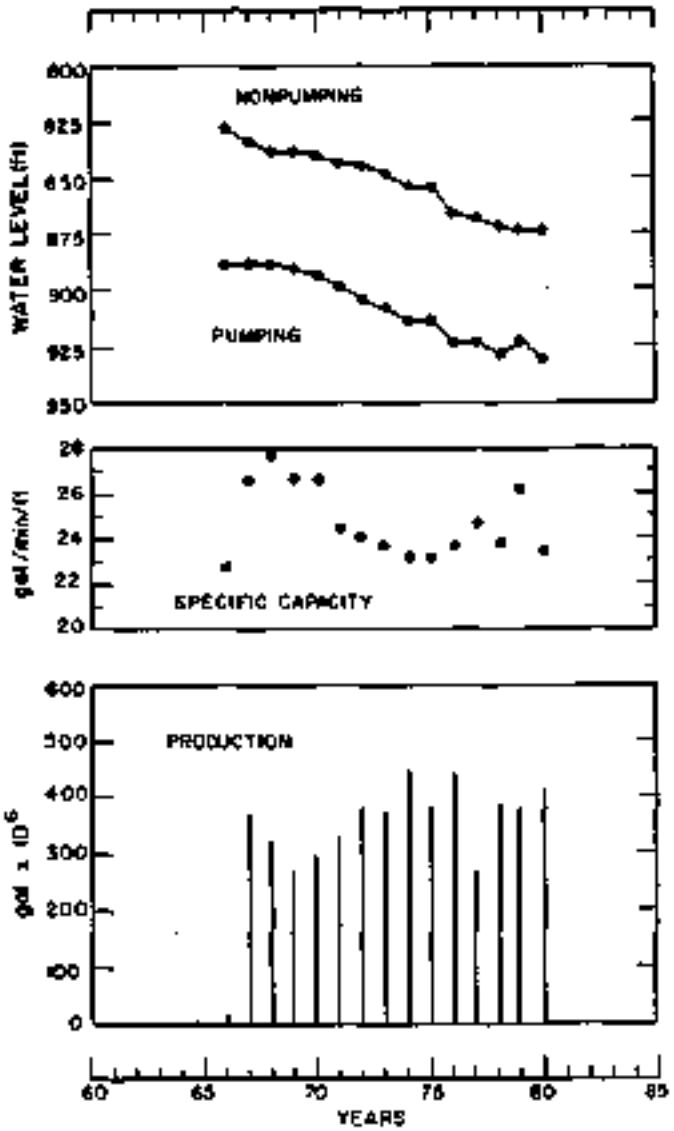

Fig. 18. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Pajarito Well PM-2.

drilling of an additional well (PM-4) began in December and is expected to be complete by July 1981. A second well is scheduled for construction in late 1981-82.

Well-field operations in 1980 were satisfactory. The distribution of pumpage (60% from well LA-4 and 5; 40% from wells LA-1B, 2, and 3) has stabilized the rapid decline of water levels in the upper part of the well field, thus extending the life of the field. As previously recommended, the 60%-40% distribution of pumpage should be continued.

Well and pump rehabilitation should be continued. Pump and equipment have been pulled from wells G-4 and G-5 for repair and well rehabilitation (Feb. 1981). The holes have been logged with a bore-hole TV camera prior to bailing and cleaning casing and screen. Well G-4 was open to 1160 ft and G-5 to 700 ft.

Other wells to be considered for rehabilitation and inspection are LA-5, G-3, and PM-2. The sequence of the listing does not indicate priority.

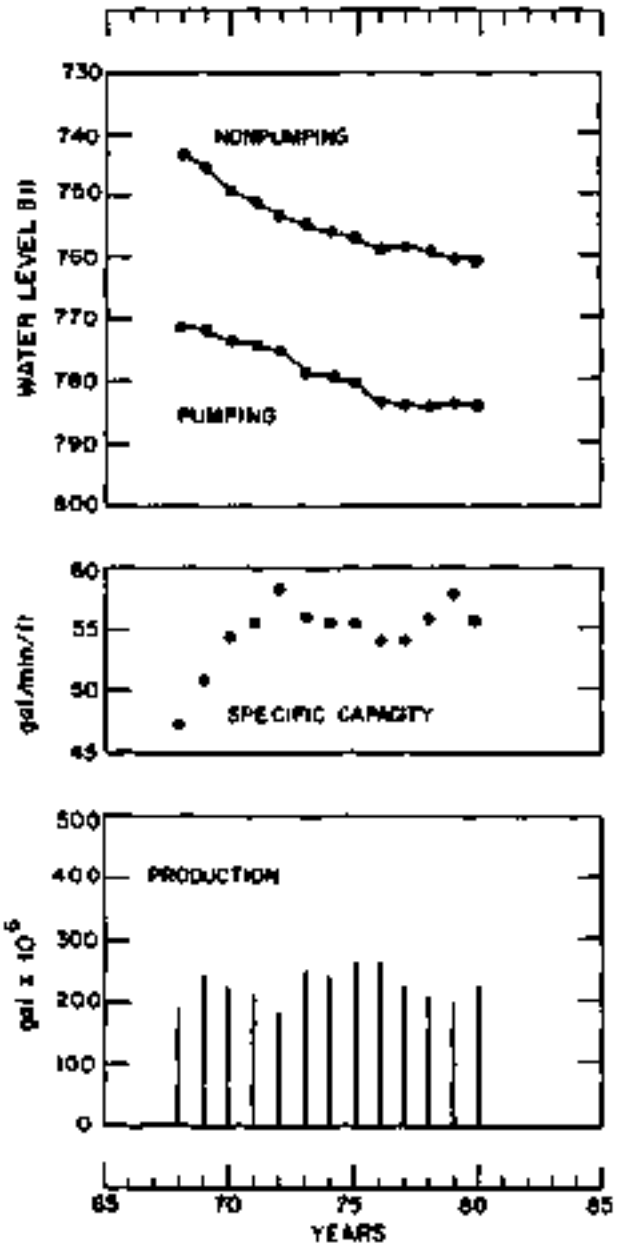

Fig. 19. Annual average nonpumping and pumping water levels, annual average specific capacity, and annual production, Pajarito Well PM-3.

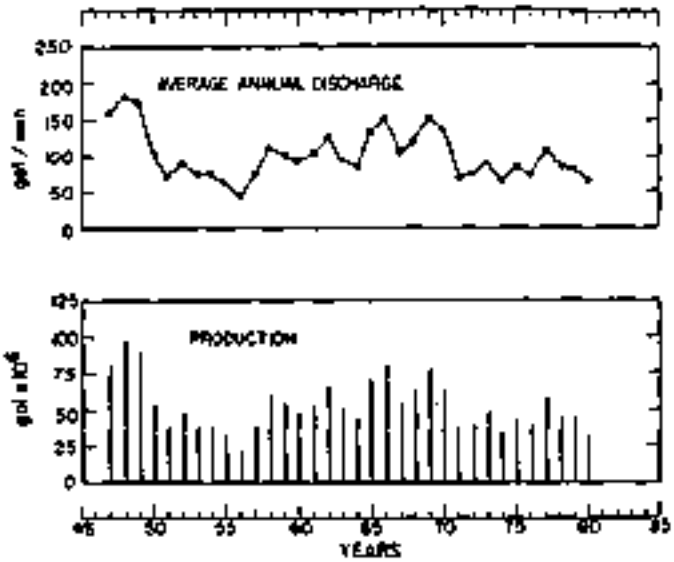

Fig. 20. Annual average discharge and annual production from the gallery in Water Canyon.

The pump at well LA-5 was pulled for inspection and repair in 1962. Zia U/E reports a larger line shaft is needed to keep the pump in adjustment, and the motor needs to be rewound.

The pumping rate of well G-3 has declined, indicating wear on the pump and some well deterioration. The pump was pulled from G-3 in 1976. Since that time, the pumping rate has decreased from 463 gpm to 299 gpm in 1980. The specific capacity has also declined from 5.3 to 2.8 gpm/ft of drawdown.

Well PM-2 is a high-yield well that has been in operation since 1966. The pumping characteristics indicate no obvious problems with the pump; however, the period of operation (62 000 h) has exceeded the manufacturer's recommended life (35 000 h) of the pump. Because the well is a high-yield producer (26% of total production), failure during the summer could cause a short-term water shortage.

ACKNOWLEDGMENTS

Pumping statistics were compiled by Glenn Bryant (Zia U/E) and Shannon Burgess (H-8). Typesetting and compiling the finished report were done by Kathy Derouin (H-8).

TABLE V

QUALITY OF WATER REQUIRED FOR MUNICIPAL USE

Analysis	Units	Maximum Concentration: Supply Wells and Gallery	Maximum Concentration: Distribution	Standard of Criteria[a]
Chemical				
Ag	mg/ℓ	0.0004	<0.0004	0.05
As	mg/ℓ	0.045	0.012	0.05
Ba	mg/ℓ	0.013	0.096	1.0
Cd	mg/ℓ	0.0002	0.007	0.010
Cℓ	mg/ℓ	15	15	250
Cr	mg/ℓ	0.023	0.007	0.05
F	mg/ℓ	2.5	0.7	2.0
Hg	mg/ℓ	<0.00005	<0.00005	0.002
Na	mg/ℓ	50	33	250
NO_3	mg/ℓ	2.9	2.3	45
Pb	mg/ℓ	0.005	0.003	0.05
Se	mg/ℓ	<0.005	<0.005	0.01
TDS	mg/ℓ	514	236	1000
Radiochemical				
^{137}Cs	10^{-9} μCi/mℓ	<130	<140	200
^{90}Sr	10^{-9} μCi/mℓ	1.1	1.2	8
^{238}Pu	10^{-9} μCi/mℓ	<0.047	<0.029	15
^{239}Pu	10^{-9} μCi/mℓ	0.125	0.060	15
Gross Alpha	10^{-9} μCi/mℓ	10	<4.2	15[b]
Gross Beta	10^{-9} μCi/mℓ	5.6	3.4	---
^{3}H	10^{-6} μCi/mℓ	0.9	0.6	20
Total U	μg/ℓ	6.4	3.2	1800

[a] References 14 and 15.

[b] EPA's standard for gross alpha is 15×10^{-9} μCi/mℓ; however, EPA's screening limit of 5×10^{-9} μCi/mℓ gross alpha in distribution system would require isotopic analyses to determine radium content.

Note: Analyses of Well LA-6 was not included in tabulation because water from that well was not used as part of water supply.

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APPENDIX A

ANNUAL AQUIFER CHARACTERISTICS

Well LA-1

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (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
1979	0	0.0	0.0	38.0
1980	0	0.0	0.0	40.0

APPENDIX A (cont)

Well LA-18

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	1354	45.9	564.6	13.0	134.0	121.0	4.7
1980	1955	62.9	536.3	21.0	146.0	125.0	4.3

APPENDIX A (cont)

Well LA-2

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	1353	26.2	323.0	75.0	316.0	241.0	1.3
1980	1960	33.8	287.4	84.0	318.0	234.0	1.2

APPENDIX A (cont)

Well LA-3

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	1343	28.1	348.1	58.0	243.0	185.0	1.9
1980	1952	35.1	299.9	61.0	237.0	176.0	1.7

APPENDIX A (cont)

Well LA-4

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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	2884	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
1979	2964	104.6	587.9	280.0	376.0	96.0	6.1
1980	3322	115.3	578.5	284.0	385.0	101.0	5.7

APPENDIX A (cont)

Well LA-5

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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	2663	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
1979	2964	84.0	472.4	149.0	301.0	152.0	3.1
1980	3316	92.2	463.6	153.0	300.0	147.0	3.2

APPENDIX A (cont)

Well LA-6

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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	5862	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	151.0	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
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

APPENDIX A (cont)

Well G-1

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	2998	61.7	342.9	271.0	422.0	151.0	2.3
1980	3459	68.3	329.0	273.0	428.0	155.0	2.1

APPENDIX A (cont)

Well G-1A

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	2974	88.0	493.9	301.0	345.0	44.0	11.0
1980	3480	103.2	494.4	305.0	345.0	40.0	12.4

APPENDIX A (cont)

Well G-2

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	2975	80.0	448.0	347.0	388.0	41.0	11.0
1980	3478	92.4	443.0	350.0	389.0	39.0	11.4

APPENDIX A (cont)

Well G-3

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	3014	69.0	381.6	360.0	465.0	105.0	3.6
1980	3448	61.8	298.6	363.0	468.0	105.0	2.8

APPENDIX A (cont)

Well G-4

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	2974	52.9	296.4	395.0	586.0	191.0	1.6
1980	2235	35.6	265.7	394.0	580.0	186.0	1.4

APPENDIX A (cont)

Well G-5

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	2766	86.5	521.5	442.0	502.0	60.0	8.7
1980	2896	89.0	512.4	442.0	502.0	60.0	8.5

APPENDIX A (cont)

Well G-6

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	1030	18.2	295.1	579.0	645.0	66.0	4.8
1980	1789	34.5	321.5	583.0	670.0	99.0	3.3

APPENDIX A (cont)

Well PM-1

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	2350	83.4	591.5	744.0	766.0	22.0	26.9
1980	2786	98.7	590.7	746.0	769.0	23.0	25.7

APPENDIX A (cont)

Well PM-2

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	4671	381.8	1362.2	872.0	924.0	52.0	26.2
1980	5023	409.6	1359.2	873.0	931.0	58.0	23.4

Well PM-3

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level Nonpump (ft)	Water Level Pump (ft)	Draw Down	Specific Capacity (gpm/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
1979	2359	197.2	1393.0	760.0	784.0	24.0	58.0
1980	2796	234.4	1397.2	760.0	785.0	25.0	55.9

APPENDIX A (cont)

Water Canyon Gallery

Year	Time (h)	Production (million gal)	Discharge 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
1979	8760	44.0	83.7
1980	8784	32.0	60.7

APPENDIX B

CHEMICAL QUALITY OF WATER FROM WELLS, GALLERY AND RESERVOIRS

	mg/l														Cond.
	SiO_2	Ca	Mg	K	Na	CO_3	HCO_3	SO_4	Cl	F	NO_3	TDS	Hard	pH	(µmho)
Supply Wells															
Los Alamos Field															
LA-1B	40	7	0.4	3.0	25	0	320	37	15	2.5	2.3	514	16	8.4	330
LA-2	26	7	0.2	1.6	50	0	134	13	11	1.2	2.5	330	16	8.5	270
LA-3	24	11	0.2	1.9	30	0	96	7	3	0.5	2.4	112	20	8.4	550
LA-4	30	10	0.2	2.2	20	0	60	3	2	0.4	2.0	70	24	8.5	200
LA-5	36	7	0.2	1.8	30	0	140	5	2	0.9	2.5	198	20	8.7	200
LA-6*	26	8	0.2	2.4	10	0	220	22	10	1.6	2.3	364	18	8.7	300
Guaje Field															
G-1	86	10	0.5	3.3	23	0	84	4	2	0.5	2.1	172	34	8.3	130
G-1A	78	9	0.5	3.2	26	0	124	4	2	0.5	2.1	334	30	8.4	200
G-2	78	9	0.6	3.4	36	0	116	4	2	0.8	1.9	222	24	8.5	200
G-3	54	12	1.5	2.3	48	0	84	4	2	0.3	2.5	144	36	8.3	300
G-4	52	14	2.5	2.1	14	0	96	3	2	0.2	2.7	150	48	8.2	160
G-5	64	15	3.7	2.4	11	0	88	4	3	0.2	2.9	162	54	8.2	130
G-6	70	16	3.6	2.6	12	0	88	3	2	0.2	1.8	190	54	7.9	200
Pajarito Field															
PM-1	84	20	5.9	3.6	19	0	136	5	6	0.2	2.6	236	84	8.2	170
PM-2	100	8	3.2	2.4	11	0	64	2	2	0.2	1.7	172	38	7.9	120
PM-3	98	18	7.3	3.6	18	0	130	5	6	0.2	2.2	248	92	8.1	200
Distribution															
Fire Station 1 (TA-3)	102	9	3.1	2.2	10	0	60	2	2	0.3	1.5	124	40	8.2	120
Fire Station 2 (DP-Road)	42	9	0.4	2.1	33	0	100	5	3	0.6	2.1	172	20	8.4	170
Fire Station 3 (White Rock)	96	20	7.3	3.7	19	0	124	5	7	0.7	2.1	260	86	8.4	200
Fire Station 4 (Diamond Drive)	74	11	1.7	2.5	22	0	88	4	3	0.5	2.3	172	36	8.5	170
Fire Station 5 (S-Site)	44	8	2.4	2.0	14	0	60	3	2	0.3	1.4	86	24	8.3	90
Bandelier National Monument	44	9	2.0	2.2	21	0	80	4	3	0.4	1.8	81	32	8.4	120
Reservoirs															
Guaje	48	6	2.3	2.5	7	0	40	4	1	0.1	4.4	86	22	7.8	70
Los Alamos	48	5	2.2	2.2	6	0	52	3	1	<0.1	0.5	92	22	7.7	75

*Water from well pumped to waste.