DEPARTMENT OF THE INTERIOR

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Contour map showing minimum depth to ground water, San Bernardino valley and vicinity, California, 1973-1983

by

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

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INTRODUCTION

The accompanying contour map shows minimum depth to ground water in the San Bernardino valley and vicinity for the period from September 1973 through December 1983. The map was prepared as part of our ongoing evaluation of seismically induced liquefaction in the valley region. In an earlier study (Carson and Matti, 1985) we targeted areas in the upper Santa Ana River valley where shallow ground-water conditions may be conducive to liquefaction; several zones of shallow ground water were identified in the San Bernardino valley area. In this study, we update our earlier evaluation of ground-water conditions in the San Bernardino valley by incorporating recent water-level data.

METHODOLOGY AND LIMITATIONS

Data source and usage

The procedures used to prepare the ground-water contour map are similar to those used by Carson and Matti (1985, p. 3-5). The map is based on water-level measurements recorded with the California Department of Water Resources (CDWR), which monitors ground-water levels and water quality in the state of California using an extensive grid of selected wells. Their Aerial Designation and State Well Numbering Systems enabled us to plot wells in the San Bernardino valley region in the appropriate tract (1/16 section) of the Public Land Survey. All wells in any given tract are located in the center of that tract, with the following exceptions: (1) where water-level data and the position within a tract of a ground-water barrier suggest that a well location cannot be in the center of that tract, we shifted its location to the appropriate side of the barrier and thus to some noncentral location; and (2) in order to evaluate how water levels along the southwest base of the San Bernardino Mountains are affected by local geologic features and sources of natural and artificial recharge, we plotted the three wells in this area according to their actual field locations (Discussion).

For our studies, all centrally located wells in each single tract are assigned the same map location number, and all non-centrally located wells are assigned a separate location number. These map location numbers match serial location numbers assigned in our earlier study (Carson and Matti, 1985). However, because that study incorporated many more wells from a large area of which the San Bernardino valley is only a part, the map-location numbers cited in this report are nonsequential.

We examined water-well records on file with CDWR to identify the shallowest 1973-1983 water-level measurement for each map location number (Table 1). These shallowest measurements usually were used for constructing the contour map, but we rejected some measurements if CDWR notation indicated that the shallowest value was questionable or if our own observations led us to question the accuracy or applicability of the value. To produce the depth-to-ground-water map, the shallowest acceptable water-level measurements were contoured using geometric-interpolation techniques. Locally, we modified these techniques if hydrogeologic, geomorphic, or topographic factors required a subjective rendering of the contours. For example, some contour patterns generated by geometric interpolation resulted in local ground-water highs that were not situated reasonably with respect to known sources of ground-water recharge, such as percolation basins or the mouths of stream canyons. In such cases, we would modify the interpolated contours to achieve a more reasonable interpretation of ground-water patterns without forcing the contours to contradict the available data.

Ground-water barriers

Previous workers have proposed numerous partial ground-water barriers in the San Bernardino valley and vicinity. Because two of these barriers help explain differences in water-level measurements between adjacent wells, we have incorporated them onto our ground-water map. These two barriers are modified from several sources: the San Jacinto barrier is modified from Dutcher and Garrett (1963), Fife (1976), Morton (1978a), and Miller (1979), and the Casa Blanca barrier is modified from Burnham and Dutcher (1960). The reader is referred to these studies for descriptions of the ground-water barriers.

In this study we also recognize the San Andreas fault as a partial barrier because our data suggest that this fault impedes the flow of ground water issuing from canyon mouths along the southwest side of the San Bernardino Mountains. The mapped position of this fault/barrier was determined from geologic relations and not by hydrologic evidence.

Limitations

The generalized regional scope of this study prevents its indiscriminate use as a site-specific guide. The contour map depicts the general distribution of minimum ground-water levels across the valley region but does not identify actual water levels for any specific site or for a particular time; thus, the map cannot be used as a definitive guide to local water conditions. This limitation stems from several factors discussed thoroughly in our earlier study (Carson and Matti, 1985): (1) Water levels throughout the valley fluctuate from season to season and from year to year, yet our contour map is based only on the single shallowest water level recorded at each map location during the 1973-1983 period and does not identify water levels for any other specific time; (2) interpolation of contours between data points inherently is not a site-specific procedure; (3) the accuracy with which the ground-water contours represent the actual water depth between data points depends on the spacing of the water wells, which varies considerably throughout the study area; (4) due to the well-location methods used in this study, some wells on the ground-water map could be mislocated by as much as half the diagonal width of a one-sixteenth section (about 930 ft); (5) some CDWR well records are incomplete or have questionable reliability; (6) sparse hydrogeologic data and scant information about the depth and length of perforated well casings hinder our ability to evaluate how closely water levels in a well correspond to water levels in the surrounding ground; and (7) because we obtained only limited hydrogeologic data and minimal information about the length and depth of perforated well casings, we were not able to evaluate the extent of perched ground water in the valley region.

We caution prospective users not to apply this contour map to site-specific investigations in the San Bernardino valley and vicinity. The map provides only a generalized picture of where we believe shallow ground water can be expected to occur based on the intermittent observation of shallow ground water during the 1973-1983 period.

GEOLOGY

The contour map includes a simplified representation of geologic relations among selected faults and various surficial-geology units. The geology was compiled from published sources and from 1:24,000-scale mapping by the U.S. Geological Survey (J.C. Matti, S.E. Carson, D.M. Morton, and B.F. Cox, unpubl. mapping, 1975-1986; see the geologic-mapping credit on the contour map).

The San Bernardino valley is an alluvial basin bounded on the west by the San Jacinto fault and the San Gabriel Mountains, on the northeast by the San Bernardino Mountains, and on the south by the San Timoteo Badlands. The upland areas are underlain by various kinds of bedrock, including metamorphic and granitic basement rocks and consolidated sedimentary materials. Lowlands of the San Bernardino valley are underlain by a thick fill of sedimentary deposits, the youngest of which are Quaternary in age. The sediments include gravel, sand, silt, and clay layers that have accumulated in various kinds of depositional environments. Most of the sediment was deposited by rivers and streams flowing down from the upland areas, but some clay and silt layers formed in lake and marshland environments.

The Quaternary depositional setting probably was similar to the modern setting, which is dominated by alluvial-fan and alluvial-plain processes. Alluvial fans emanating from canyons at the southwest base of the San Bernardino Mountains coalesce and extend southwestward to predominate in the central portion of the study area. South of the alluvial-fan complex the east-oriented alluvial plain of the Santa Ana River predominates; to the west, the north-oriented alluvial plain of Lytle and Cajon Creeks predominates. Where the alluvial-fan and alluvial-plain regimes come together, their respective sedimentary deposits either interfinger in a complex fashion or truncate each other--as where the flood plain of the Santa Ana River undercuts the toes of alluvial fans building south from the San Bernardino Mountains.

The geologic map distinguishes three Quaternary alluvial units having different ages of deposition. Younger Holocene deposits (Qh_2) include sedimentary material that we interpret to have accumulated within the last 500 to 1,000 years. Older Holocene deposits (Qh_1) include sedimentary material that we interpret to have accumulated between 500 or 1,000 years ago and 10,000 to 15,000 years ago. Pleistocene deposits (Qp) include sedimentary material that we interpret to have accumulated between 10,000 or 15,000 years ago and about 750,000 years ago. These age determinations are preliminary, and are based mainly on the degree of pedogenic-soil development on the upper surfaces of the units. The soil profiles are thin and slightly developed in younger alluvial deposits, but are progressively thicker and better developed in progressively older deposits. The age of an alluvial deposit in relation to another deposit can be determined by comparing the development of their respective soil profiles, and the numeric age of a soil profile can be determined from radiometric analysis of organic carbon or other materials associated with the soil. We have assigned ages to surficial-geologic units in the San Bernardino valley region by comparing their soil profiles with those being studied elsewhere in the region (R.J. Weldon and L.D. McFadden, unpubl. data, 1982-1986; J.W. Harden, unpubl. data, 1982-1986).

DISCUSSION

Contour Patterns

Contours on this map differ significantly from those shown for the San Bernardino valley region in our earlier study (Carson and Matti, 1985). These differences reflect changes in ground-water patterns that have occurred since that time as well as changes in the procedures used to generate the two studies. Some specific reasons for the contour differences include the following:

(1) A larger percentage of the San Bernardino valley region is underlain by shallow ground water now than during the 1973-1979 period for which we conducted our original study, mainly because the shallow zones we recognized earlier have increased in size in response to a region-wide shallowing trend which began in 1977 and has continued through late 1983. Water levels have risen mainly because of two factors. (A) Several wetter-than-normal years since 1977 resulted in increased surface runoff and natural recharge in the San Bernardino valley region and have contributed to increased water conservation stemming from accelerated water-spreading activities conducted by local water agencies. (B) Commencing in 1972, ground water in the valley region has been replenished by artificial recharge of imported water derived from the California State Water Project. Together, the accelerated natural and artifical recharge of ground-water basins since 1977 has resulted in rising water tables throughout the valley region. The contours on this map reflect this trend and therefore differ from those shown in our earlier study (Carson and Matti, 1985).

(2) We incorporated new well-location information and additional hydrogeologic analysis to construct a more reasonable interpretation of ground-water patterns along the base of the San Bernardino Mountains. In our previous study, we contoured ground water in this district based only on geometric interpolation between three wells located imprecisely by the Areal Designation and State Well Numbering Systems (Carson and Matti, 1985, locs. 45 and 50). Although appropriate for our earlier study, this procedure did not allow us to position the three wells accurately with respect to range-front faults and recharge sources--two factors that can affect the distribution of ground water. Interpolation without consideration of geologic and hydrologic factors forced a simplified portrayal of ground-water conditions, and led to our recognition of a narrow zone of shallow ground water that extended along much of the mountain front without being affected by geologic or geomorphic features.

In this update, we have repositioned the two wells at locations 45 (now shown as locations 45a and 45b) and the one well at location 50 by determining their exact locations (J. Stejskal, written commun., 1985). The accurate location of each well allowed us to evaluate how water levels might be affected by adjacent geologic features or sources of natural and artificial recharge, which in turn allowed us to re-contour ground-water data along the base of the San Bernardino Mountains using interpolation techniques modified by geologic and hydrologic constraints.

Our reinterpretation shows several isolated bodies of shallow ground water adjacent to the San Bernardino Mountains between Cajon Pass and Mill Creek Canyon. Each body is associated with a major stream that flows valleyward from canyons in the mountains, and consists of two parts. (1) Upslope of the San Andreas fault, a narrow tongue of ground water occurs in the active and intermittently active washes of the canyons (evidenced by shallow water levels at map locations 45a, 45b, 50, and 103). Here veneers of active and intermittently active sediment overlie impermeable bedrock of the canyon bottoms and become saturated at shallow depths with ground water recharged from surface water flowing in the canyons and from surface water and ground water flowing from tributaries and adjacent hillslopes; directly upslope from the San Andreas fault, water levels may remain shallow because of the barrier effect of the fault. (2) Downslope from the canyon mouths, shallow ground water extends valleyward beneath the alluvial fans and entrenched channels which emanate from the canyons (evidenced near Devils Canyon by water levels at map locations 46, 47, and 48, and evidenced near Waterman Canyon and East Twin Creek by water levels at map locations 57 and 60). Shallow water beneath the channels and alluvial fans is derived from natural recharge by surface water and ground water flowing out of the upslope canyons and from artificial recharge from percolation basins which commonly are sited near the canyon mouths. Water levels deepen laterally away from these zones of natural and artifical recharge.

These conclusions guided our interpolation of the symmetrical pattern of ground-water contours centered near canyon mouths and around modern alluvial washes. The lateral and downslope extent of these ground-water bodies probably is controlled by several factors, including seasonal variation in the discharge rate of surface streamflows, the amount and geographic distribution of artificial recharge within water-spreading basins, the barrier effect of the San Andreas fault zone which impedes the downslope flow of ground water, and the permeability of sediments occurring downslope from range-front canyons.

(3) To improve our interpretation of ground-water patterns around the margins of the study area, we enlarged the area of investigation to include three wells not originally evaluated by Carson and Matti (1985). Two of these wells (Y-01.E2 02N/05W-19K02 and Y-01.E2 02N/05W-19Q01) provide

water-level data for Cajon Wash; the third well (Y-01.F2 02S/03W-24B01) provides water-level data for San Timoteo Canyon. These new wells are labeled on the contour map using the last three numerals of their state well numbers. Contour patterns in Cajon Wash and San Timoteo Canyon reflect the additional data available from these wells.

Correspondence with historical areas of marshy ground

Bog, swamp, and marshland areas that formerly occurred in the San Bernardino valley and vicinity are shown by Fife (1976) on the basis of an irrigation map by Hall (1888). Fife (1976) indicates that these wetlands occurred in two general areas: (1) northeast of the San Jacinto barrier, in and adjacent to the city of San Bernardino; and (2) west of the city of Yucaipa in the Dunlap Acres area. No bogs, swamps, or marshlands exist in the San Bernardino area today, although very shallow ground-water bodies shown on the contour map occur where marshy ground has occurred historically. Small decreases in depth to ground water easily could re-establish surface wetlands and springs in these areas. Ground water in the vicinity of Dunlap Acres has remained at levels deeper than 100 ft subsurface, which indicates that geohydrologic conditions giving rise to wetlands there during historic times have not been restored. This probably can be attributed to prolonged ground-water withdrawal.

Water-level discrepancies in the San Bernardino municipal area

In this study we assumed that water levels occurring in CDWR wells fairly accurately depict water levels occurring in the adjacent ground, however, supplemental water-level data suggest that this assumption is not valid for all parts of the San Bernardino valley and vicinity. For example, in the San Bernardino metropolitan area, water wells monitored by the San Bernardino Municipal Water Department (SBMWD) provide a cross check between water levels occurring in CDWR wells and water levels occurring in the adjacent ground. On a weekly basis SBMWD measures water levels in a network of monitoring wells. These wells are shallow enough (less than 50 ft deep) that they do not penetrate confined aquifers known to occur at deeper levels; as a result, water levels in the SBMWD wells reflect the level of free ground water in the adjacent sediment rather than the potentiometric level of confined ground water occurring in a deeper aquifer. A cross check shows that in the San Bernardino metropolitan area water levels in wells monitored by SBMWD generally range from 0 to 10 ft deeper than water levels reported to CDWR. This difference indicates that CDWR wells in this area tap confined aquifers having potentiometric levels somewhat closer to the ground surface than actual local groundwater levels. As a result, water levels in the San Bernardino metropolitan area may be 0 to 10 ft deeper than indicated on our contour map.

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-----1978b, Geologic map of the Redlands 7.5' Quadrangle, California: U.S. Geological Survey Open-File Report 78-21, scale 1:24,000.

-----1978c, Geologic map of the Sunnymead 7.5' Quadrangle, California: U.S. Geological Survey Open-File Report 78-22, scale 1:24,000.

TABLE 1.--Well identification numbers and data showing minimum depth to ground water, 1973-1983

For map location numbers containing more than one well, the state well number of the well having the shallowest ground water is listed first, followed by additional wells having deeper water levels.

Map location No.[1]	Areal designation	State well No.[2]	Minimum depth to ground water (ft)[3]	Month(s) and year(s) measured
27	Y-01.E2	02N/05W-33K01	2.7	4/78
28	Y-01.D2	01N/05W-06G01	26.3	3/83
29	Y-01.E2	01N/05W-03H01,02	29.7	4/80
30	Y-01.D2	01N/05W-06K02	--	--
31	Y-01.D2	01N/05W-07H01	41.5	2/80
32	Y-01.D3	01N/05W-17G01	24.0	2/80
33	Y-01.D3	01N/05W-17K01,02	25.0	7/78, 4/80
34	Y-01.D2	01N/05W-16K01	113.1	3/83
35	Y-01.E9	01N/05W-15K01	--	--
36	Y-01.E9	01N/05W-15Q02	88.2	11/83
37	Y-01.D2	01N/05W-22C02	68.9	11/83
38	Y-01.E9	01N/05W-22A01	57.0	8/83, 10/83
39	Y-01.D2	01N/05W-22F03,01,02	51.0	11/83
42	Y-01.D4	01N/05W-28J01	419.0	11/75
45a	Y-01.E2	01N/04W-06H01	19.0	2/80
45b	Y-01.E2	01N/04W-06H02	16.2	3/80
46	Y-01.E2	01N/04W-07F01	68.0	6/80
47	Y-01.E2	01N/04W-08M01	76.9	6/80
48	Y-01.E2	01N/04W-08P01	97.0	3/82
49	Y-01.E2	01N/04W-16E02,01,03,04	104.0	3/81
50	Y-01.E2	01N/04W-14R08	8.0	3/80
51	Y-01.E9	01N/05W-23A01,02	32.0	1/81
52	Y-01.E2	01N/04W-21B02	75.4	11/81
53	Y-01.E2	01N/04W-23B01	--	--
54	Y-01.E9	01N/05W-23H01	38.2	5/81
55	Y-01.E9	01N/05W-24E01	--	--
56	Y-01.E2	01N/04W-23E01	--	--
57	Y-01.E2	01N/04W-23G01	44.5	5/82
58	Y-01.E9	01N/05W-23K01	5.0	11/83
59	Y-01.E2	01N/04W-23M01	184.6	6/83
60	Y-01.E2	01N/04W-23K01	182.6	7/74
61	Y-01.D2	01N/05W-23P04	Flow	4/80
62	Y-01.E9	01N/05W-23Q01	Flow	2/80, 4/80
63	Y-01.E2	01N/04W-20N01	157.0	7/81
64	Y-01.E2	01N/04W-23Q02	--	--
65	Y-01.E2	01N/04W-23R02	--	--
66	Y-01.E9	01N/05W-26A03	8.0	2/80
67	Y-01.E2	01N/04W-27B01	140.3	12/83
68	Y-01.E2	01N/04W-27A02,01	150.8	12/83
69	Y-01.E2	01N/04W-26A02,01,03	160.0	4/83
70	Y-01.E2	01N/04W-25C02,04	160.6	5/83
71	Y-01.E9	01N/05W-25E01	9.0	2/80
72	Y-01.E2	01N/04W-29E01	172.0	7/81
73	Y-01.E2	01N/04W-29F01	136.0	1/83
74	Y-01.E2	01N/04W-27G01	140.4	12/83
75	Y-01.E2	01N/04W-26E02	144.5	12/83
76	Y-01.E2	01N/04W-28J02	99.6	12/83
77	Y-01.E2	01N/04W-27M02,01	105.0	12/83
78	Y-01.E2	01N/04W-26M01	117.0	12/83
79	Y-01.E2	01N/04W-25M03	124.3	5/83
80	Y-01.E2	01N/04W-28R01	--	--

TABLE 1.--Well identification numbers and data showing minimum depth to ground water, 1973-1983--Continued

Map location No.[1]	Areal designation	State well No.[2]	Minimum depth to ground water (ft)[3]	Month(s) and year(s) measured
81	Y-01.E2	01N/04W-27N01	70.1	2/83
82	Y-01.E2	01N/04W-26N02	111.4	12/83
83	Y-01.E2	01N/04W-26P03	102.4	12/83
84	Y-01.E2	01N/04W-25P04	--	--
85	Y-01.E2	01N/04W-31A01	100.2	12/83
86	Y-01.E2	01N/04W-32D03,04	79.3	12/83
87	Y-01.E2	01N/04W-35C01,02,03	83.1	12/83
88	Y-01.E9	01N/05W-36H04	12.0	4/80
89	Y-01.E2	01N/04W-31E01	--	--
90	Y-01.E2	01N/04W-31H01	69.0	12/83
91	Y-01.E2	01N/04W-34G01,03	71.8	12/83
92	Y-01.E9	01N/05W-36J03	10.1	4/80
93	Y-01.E2	01N/04W-33M01	47.2	12/83
94	Y-01.E2	01N/04W-35M03	52.3	12/83
95	Y-01.E2	01N/04W-35L01,06	53.2	3/83
96	Y-01.E2	01N/04W-25A01	169.0	1/83
97	Y-01.E2	01N/03W-30C02	193.1	8/74
98	Y-01.E2	01N/03W-30J05	--	--
99	Y-01.E2	01N/03W-29M01	239.2	3/83
100	Y-01.E2	01N/03W-30N01	147.2	3/83
101	Y-01.E2	01N/03W-29N01	192.0	4/82
102	Y-01.E2	01N/03W-28P01	--	--
103	Y-01.E2	01N/03W-27N05,02	11.5	8/80
104	Y-01.E2	01N/03W-31C02	--	--
105	Y-01.E2	01N/03W-32C02	156.0	3/83
106	Y-01.E2	01N/03W-33C01	--	--
107	Y-01.E2	01N/04W-36K07	57.5	12/82
108	Y-01.E2	01N/03W-33M02,01	112.0	1/81
259	Y-01.D4	01S/05W-02C01	325.3	11/83
317	Y-01.E9	01N/05W-36R01	Flow	12/83
318	Y-01.E2	01N/04W-32N01	40.9	12/83
319	Y-01.E2	01S/04W-05C03	41.0	12/83
320	Y-01.E2	01S/04W-03D01	25.1	12/83
321	Y-01.E2	01S/04W-02A03,05	7.0	1/84
322	Y-01.E2	01S/04W-06H01	29.8	7/83
323	Y-01.E2	01S/04W-05E05	21.3	12/83
324	Y-01.E2	01S/04W-04E03	--	--
325	Y-01.E2	01S/04W-01E01,02	Flow	12/82, 1/83, 10/83, 12/83
326	Y-01.D4	01S/05W-02K01	276.9	11/83
327	Y-01.E2	01S/04W-06J01	--	--
328	Y-01.E2	01S/04W-03J05	0.1	11/83
329	Y-01.E2	01S/04W-02M01	18.0	12/83
330	Y-01.E2	01S/04W-02L07	--	--
331	Y-01.E2	01S/04W-02K02,01,03,08	Flow	2/82, 2/83-5/83, 8/83, 10/83-12/83
332	Y-01.E2	01S/04W-03Q01	Flow	12/83
333	Y-01.E2	01S/04W-02N01	10.8	7/80
334	Y-01.E2	01S/04W-02P002,03,and 06, 05	Flow	12/83, 1/84
335	Y-01.E2	01S/04W-02Q09,03,04,05, 06,08	2.1	3/83, 4/83
336	Y-01.D4	01S/04W-07C01	158.4	12/83

TABLE 1.--Well identification numbers and data showing minimum depth to ground water, 1973-1983--Continued

Map location No.[1]	Areal designation	State well No.[2]	Minimum depth to ground water (ft)[3]	Month(s) and year(s) measured
337	Y-01.E2	01S/04W-08C01	5.5	11/83
338	Y-01.E2	01S/04W-08A01	27.9	12/83
339	Y-01.E2	01S/04W-09B01,03	13.7	11/83
340	Y-01.E2	01S/04W-11D02 and 03	Flow	12/81, 3/82, 4/82, 12/82, 5/83, 12/83, 1/84
341	Y-01.E2	01S/04W-08F07,01,02,08, 10	30.0	10/83, 11/83
342	Y-01.E2	01S/04W-08G01	--	--
343	Y-01.E2	01S/04W-09E02	24.0	10/83
344	Y-01.E2	01S/04W-10F01	Flow	12/83
345	Y-01.E2	01S/04W-11H01	Flow	1/82, 12/83
346	Y-01.D4	01S/05W-12L01	219.8	11/83
347	Y-01.E2	01S/04W-09J01	Flow	8/83, 12/83
348	Y-01.D4	01S/05W-12N01	213.9	12/83
349	Y-01.E2	01S/04W-08Q01,03	24.0	10/83
350	Y-01.E2	01S/04W-08R05,01,04	24.5	4/83
351	Y-01.E2	01S/04W-09N01,06	Flow	5/80
352	Y-01.E2	01S/04W-09P01	16.3	12/83
353	Y-01.E2	01S/04W-10N06	Flow	12/80-11/81, 12/83
354	Y-01.E2	01S/04W-11Q01	--	--
355	Y-01.D4	01S/04W-18B01	--	--
356	Y-01.D4	01S/04W-18E01	--	--
357	Y-01.D4	01S/04W-18F01	174.0	11/83
358	Y-01.D4	01S/04W-18G01	174.0	11/83
359	Y-01.E2	01S/04W-15F05	Flow	9/80-12/83
360	Y-01.E2	01S/04W-14H03	16.2	1/84
361	Y-01.E2	01S/04W-13F02	16.3	5/83
362	Y-01.D4	01S/04W-17M01	155.2	12/83
363	Y-01.E2	01S/04W-16J09	1.8	5/83, 12/83
364	Y-01.E2	01S/04W-15M02	6.6	5/83
365	Y-01.E2	01S/04W-15L03	Flow	4/81, 4/83
366	Y-01.E2	01S/04W-13M02	7.3	5/83
367	Y-01.E2	01S/04W-13L02	4.0	1/84
368	Y-01.E2	01S/04W-16R04	--	--
369	Y-01.E2	01S/04W-15N05	7.0	5/83, 12/83
370	Y-01.E2	01S/04W-14P02 and 06	Flow	2/83, 4/83, 5/83, 7/83, 12/83
371	Y-01.E2	01S/04W-13N02,01	15.1	5/83
372	Y-01.E2	01S/04W-13P03	11.8	12/83
373	Y-01.E2	01S/04W-21B05	2.8	5/83
374	Y-01.E2	01S/04W-21A01	--	--
375	Y-01.E2	01S/04W-22D02,01	4.2	5/81
376	Y-01.E2	01S/04W-22C02	4.3	12/83
377	Y-01.E2	01S/04W-22B01,03, and 07, 05	Flow	2/82-5/82, 12/82-5/83, 12/83
378	Y-01.E2	01S/04W-23C02 and 03	Flow	4/82, 2/83, 4/83, 5/83, 12/83
379	Y-01.E2	01S/04W-23A05,01,02	10.8	5/83

TABLE 1.--Well identification numbers and data showing minimum depth to ground water, 1973-1983--Continued

Map location No.[1]	Areal designation	State well No.[2]	Minimum depth to ground water (ft)[3]	Month(s) and year(s) measured
381	Y-01.E2	01S/04W-22E05	Flow	12/83
382	Y-01.E2	01S/04W-22G16,17, and 18, 14,19	Flow	4/82, 5/82, 12/82, 1/83-4/83 9/83, 12/83
383	Y-01.E2	01S/04W-22H01,02,03, and 04	Flow	12/80, 12/81, 3/82, 5/82, 9/82-5/83, 7/83, 10/83, 12/83, 1/84,
384	Y-01.E2	01S/04W-23G03,01	14.5	5/83
385	Y-01.E2	01S/04W-23H01	17.2	1/84
386	Y-01.D4	01S/04W-21L01	31.0	3/80
387	Y-01.D4	01S/04W-21K11,01,06,09, 10	13.1	3/82
388	Y-01.D4	01S/04W-21J04,01,05,06	0.2	5/82
389	Y-01.E2	01S/04W-22M06	Flow	2/82, 3/83, 5/83, 12/83
390	Y-01.E2	01S/04W-22L05,09,and 12, 08,15	Flow	2/81-4/81, 1/82, 2/82, 12/82, 3/83, 5/83, 10/83-12/83
391	Y-01.E2	01S/04W-23K03,01,02	12.3	5/83
393	Y-01.D4	01S/04W-21N01	44.7	12/83
394	Y-01.D4	01S/04W-21Q03	30.7	12/83
395	Y-01.E2	01S/04W-22P05	Flow	2/82, 3/83, 5/83
396	Y-01.E2	01S/04W-23Q01	25.4	3/81
400	Y-01.D4	01S/04W-28D01	18.5	4/83
401	Y-01.D4	01S/04W-28C01	22.4	6/83
402	Y-01.D4	01S/04W-28A05	--	--
403	Y-01.E2	01S/04W-27A08,09,10, and 11,07,13,19	Flow	12/82, 1/84
404	Y-01.B7	01S/04W-29H02,01	18.4	12/83
405	Y-01.D4	01S/04W-28E01	8.2	12/81
406	Y-01.D4	01S/04W-28G01	26.9	12/83
407	Y-01.E2	01S/04W-27H01	Flow	3/82, 12/82-7/83, 10/83, 12/83
410	Y-01.B7	01S/04W-28M01	--	--
411	Y-01.B7	01S/04W-28L02,01	23.3	5/83
412	Y-01.D4	01S/04W-28K02,01	14.1	3/81
413	Y-01.D4	01S/04W-27L01	81.9	4/74
414	Y-01.E2	01S/04W-26J01	--	--
417	Y-01.B7	01S/04W-29Q01,03,04	Flow	4/80
418	Y-01.B7	01S/04W-29R01	19.7	3/82
419	Y-01.B7	01S/04W-28N05	19.1	12/83
420	Y-01.B7	01S/04W-28R01	39.9	1/79
423	Y-01.B7	01S/04W-32B02,01	17.1	5/83
424	Y-01.B7	01S/04W-33B05,03	22.2	4/81
425	Y-01.D5	01S/04W-34B01	--	--
428	Y-01.B7	01S/04W-32G04	14.9	4/81
432	Y-01.D5	01S/04W-34Q01	46.0	9/73
453	Y-01.D5	02S/04W-12P02	22.6	4/80
454	Y-01.E2	01N/04W-36Q01	22.9	2/83
455	Y-01.E2	01N/03W-33R02	--	--

TABLE 1.--Well identification numbers and data showing minimum depth to ground water, 1973-1983--Continued

Map location No.[1]	Areal designation	State well No.[2]	Minimum depth to ground water (ft)[3]	Month(s) and year(s) measured
456	Y-01.E2	01S/04W-01B04	14.0	4/83
457	Y-01.E2	01S/04W-01A06	--	--
458	Y-01.E2	01S/03W-05D06,01,04,05	54.0	11/83
459	Y-01.E2	01S/03W-03D03	110.0	4/81
460	Y-01.E2	01S/04W-01G01	19.5	3/83
461	Y-01.E2	01S/04W-01H01	--	--
462	Y-01.E2	01S/03W-06H04,03	55.3	8/83
463	Y-01.E2	01S/03W-04G02	96.0	12/83
464	Y-01.E2	01S/03W-01H01	--	--
465	Y-01.E2	01S/04W-01K04	34.9	12/82
466	Y-01.E2	01S/03W-06K01	--	--
467	Y-01.E2	01S/03W-02J01	13.9	5/80
468	Y-01.E2	01S/02W-06M01	--	--
469	Y-01.E2	01S/03W-04N03,01	63.0	6/83
470	Y-01.E2	01S/03W-03N07	--	--
471	Y-01.E2	01S/03W-02P02	--	--
472	Y-01.E2	01S/04W-12B06,05	24.5	3/81
473	Y-01.E2	01S/03W-09D01	48.1	5/83
474	Y-01.E2	01S/03W-10D01	71.7	10/80
475	Y-01.E2	01S/02W-07B01	--	--
476	Y-01.E2	01S/03W-09E02	--	--
477	Y-01.E2	01S/03W-11H01	10.3	5/80
478	Y-01.E2	01S/03W-12J01	11.0	6/80
479	Y-01.E2	01S/02W-07K01	10.0	6/80
480	Y-01.E2	01S/03W-17C03	50.9	2/84
481	Y-01.E2	01S/04W-13G03,02	3.0	11/83
482	Y-01.E2	01S/03W-17H03	--	--
483	Y-01.E2	01S/03W-16F01	--	--
484	Y-01.E2	01S/03W-15F01	29.8	9/80
485	Y-01.E2	01S/03W-16J01	--	--
486	Y-01.E2	01S/03W-15M03	94.0	4/82
487	Y-01.E3	01S/03W-13P01	--	--
488	Y-01.E2	01S/03W-22A02	--	--
489	Y-01.E2	01S/03W-23A03	122.2	4/82
490	Y-01.E3	01S/03W-24C01	118.7	4/82
491	Y-01.E4	01S/02W-19D01	143.9	11/80
492	Y-01.E2	01S/03W-19G02	--	--
493	Y-01.E2	01S/03W-20F01	91.7	2/83
494	Y-01.E2	01S/03W-21E02	--	--
495	Y-01.E2	01S/03W-21H07,01,06	87.9	4/81
496	Y-01.E2	01S/04W-24K01	52.7	2/82
497	Y-01.E2	01S/03W-24K01	--	--
498	Y-01.E4	01S/02W-19K01	49.9	9/78
499	Y-01.E2	01S/03W-20P01	--	--
500	Y-01.E3	01S/03W-26C01	128.7	4/81
501	Y-01.E4	01S/02W-30C01	78.7	12/80
502	Y-01.E2	01S/04W-25G01	38.8	4/83
503	Y-01.E2	01S/03W-28E02	--	--
504	Y-01.E2	01S/03W-28H01	79.8	5/83
505	Y-01.E2	01S/03W-27E02	77.2	4/83
506	Y-01.E2	01S/03W-28K01	57.0	12/81
507	Y-01.E2	01S/03W-32D01	116.3	12/83
508	Y-01.E2	01S/03W-33C01	--	--

TABLE 1.--Well identification numbers and data showing minimum depth to ground water, 1973-1983--Continued

Map location No.[1]	Areal designation	State well No.[2]	Minimum depth to ground water (ft)[3]	Month(s) and year(s) measured
509	Y-01.E5	01S/03W-35G11,07,08,09, 13	31.8	12/82
510	Y-01.E5	01S/03W-35H02,03,04	49.6	12/83
511	Y-01.E3	02S/03W-05A02	--	--
512	Y-01.E6	02S/03W-01D01	157.6	12/82
513	Y-01.F2	02S/03W-10B01	58.3	5/80
514	Y-01.D5	02S/03W-18D02	37.0	4/74
515	Y-01.E7	01S/02W-08C01	18.9	3/78
	Y-01.E2	01S/02W-08C02		
516	Y-01.E8	01S/02W-09Q01	99.2	5/82
517	Y-01.E7	01S/02W-13A01	6.0	3/78-5/78
518	Y-01.E4	01S/02W-18R01	61.7	5/80
519	Y-01.E4	01S/02W-21D01	9.9	3/79
520	Y-01.E8	01S/02W-21B02	9.5	6/78
521	Y-01.E8	01S/02W-22C02	15.0	3/78, 4/78
522	Y-01.E8	01S/02W-21E01	14.7	7/79
523	Y-01.E4	01S/02W-19J01	78.9	6/79
524	Y-01.E8	01S/02W-21M01	9.6	4/79, 5/83
525	Y-01.F5	01S/01W-30E01	220.0	7/83
526	Y-01.F5	01S/01W-30G01	187.0	1/75
527	Y-01.E5	01S/02W-29M01	176.4	9/80
528	Y-01.F5	01S/02W-25M02	152.0	5/81
529	Y-01.F5	01S/02W-25K02	212.0	6/83
530	Y-01.F6	01S/02W-25R02	--	--
531	Y-01.F6	01S/02W-36C04	--	--
532	Y-01.F7	01S/01W-32C01	15.0	6/80
533	Y-01.F7	01S/01W-32A01	12.0	3/81, 4/81, 3/83, 4/83
534	Y-01.F6	01S/02W-36F01	--	--
535	Y-01.F1	01S/02W-34N02	245.0	2/81
536	Y-01.F6	01S/02W-36N01	170.0	11/83
537	Y-01.F6	01S/02W-36R01	273.0	7/83
538	Y-01.F4	02S/02W-02D02	249.0	11/83
539	Y-01.F6	02S/02W-01F01	194.0	6/83
540	Y-01.F4	02S/02W-03L01	132.8	6/83
541	Y-01.F4	02S/02W-02M02	234.0	6/83, 10/83-12/83
542	Y-01.F4	02S/02W-02N01	202.0	8/83, 11/83
543	Y-01.F4	02S/02W-10C01	155.1	6/83
544	Y-01.F4	02S/02W-11D02	160.0	6/83
545	Y-01.F7	02S/02W-11B02,01	210.0	6/83, 12/83
546	Y-01.F7	02S/02W-11A01	253.0	5/83
547	Y-01.F7	02S/01W-08C01	--	--
548	Y-01.F1	02S/01W-08E01	47.0	9/80-12/80
549	Y-01.F4	02S/02W-10K01	--	--
550	Y-01.F1	02S/02W-15A03	--	--
551	Y-01.F7	02S/02W-14B01	242.0	12/83
697	Y-01.F3	02S/02W-14J02	159.5	12/83
698	Y-01.F7	02S/02W-14R01	111.0	12/83

TABLE 1.--Well identification numbers and data showing minimum depth to ground water, 1973-1983--Continued

Map location No.[1]	Areal designation	State well No.[2]	Minimum depth to ground water (ft)[3]	Month(s) and year(s) measured
Cajon Wash				
K02	Y-01.E2	02N/05W-19K02	Flow	5/78
Q01	Y-01.E2	02N/05W-19Q01	Flow	2/83, 5/83
San Timoteo Canyon				
B01	Y-01.F2	02S/03W-24B01	32.6	4/74

[1] Map location numbers correspond to location numbers assigned sequentially by Carson and Matti (1985) for wells they evaluated in the upper Santa Ana River valley. Because we have incorporated only some of their original wells, location numbers used in this study are not sequential. To facilitate correlations between water wells used here and water wells used by others, for each map location number, we have included corresponding Areal Designation and State Well numbers.

[2] All wells occur in the San Bernardino Base and Meridian (S).

[3] A dash indicates well locations not having an acceptable value for minimum depth to ground water.