Comparison of 1972 and 1996 Water Levels in the Goleta Central Ground-Water Subbasin, Santa Barbara County, California

By Charles A. Kaehler, David A. Pratt, *and* Katherine S. Paybins

---

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 97–4109

Prepared in cooperation with the

GOLETA WATER DISTRICT

4004-25

Sacramento, California
1997

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Gordon P. Eaton, Director

For additional information write to:

District Chief
U.S. Geological Survey
Placer Hall, Suite 2012
6000 J Street
Sacramento, CA 95819-6129

Copies of this report can be purchased from:

U.S. Geological Survey
Information Services
Box 25286
Federal Center
Denver, CO 80225

CONTRIBUTING U.S. GEOLOGICAL SURVEY STAFF

TECHNICAL SUPPORT

Julia A. Huff, Technical Information Specialist
Charles E. Lamb, Hydrologist

GRAPHICS AND LAYOUT TEAM

James B. Baker, Layout Editor
Carmen A. Burton, Hydrologist
Rudolph R. Contreras, Scientific Illustrator

REPORT REVIEW AND APPROVAL TEAM

Tony Buono, Assistant District Chief for Program Support
Clark J. Londquist, District Ground-Water Specialist
Michael Moore (Goleta Water District)
Terry F. Rees, Programs Chief, Coastal and International Studies
Eileen F. Roybal, Hydrologist
Jerrald A. Woodcox, Technical Publications Editor

CONTENTS

FIGURES

TABLES

CONVERSION FACTORS, VERTICAL DATUM, ABBREVIATIONS, AND WELL-NUMBERING SYSTEM

Multiply	By	To obtain
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year
foot (ft)	0.3048	meter
mile (mi)	1.6094	kilometer

VERTICAL DATUM

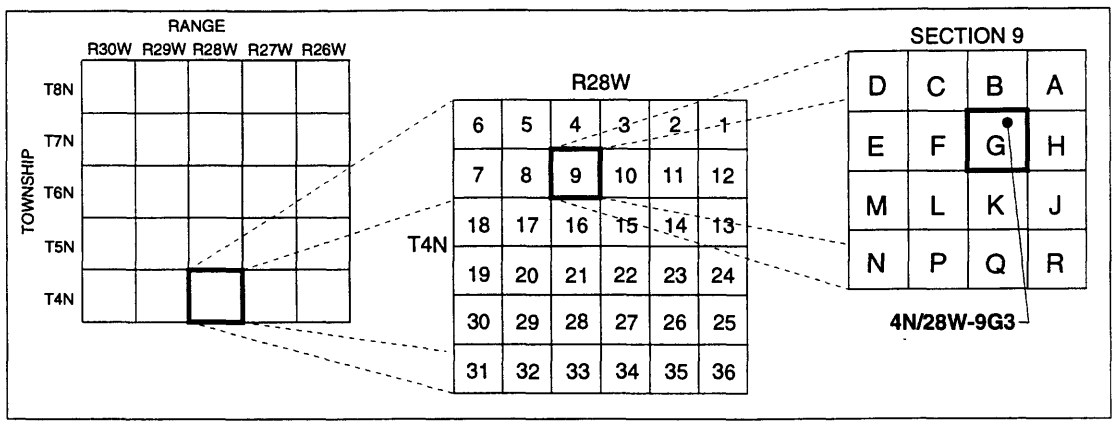
Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

ABBREVIATIONS

GWD Goleta Water District
USGS U.S. Geological Survey

Well-Numbering System

Wells are identified and numbered according to their location in the rectangular system for the subdivision of public lands. Identification consists of the township number, north or south; the range number, east or west; and the section numbers. Each section is divided into sixteen 40-acre tracts lettered consecutively (except I and O), beginning with "A" in the northeast corner of the section and progressing in a sinusoidal manner to "R" in the southeast corner. Within the 40-acre tract, wells are sequentially numbered in the order they are inventoried. The final letter refers to the base line and meridian. In California, there are three base lines and meridians; Humboldt (H), Mount Diablo (M), and San Bernardino (S). All wells in the study area are referenced to the San Bernardino base line and meridian (S). Well numbers consist of 15 characters and follow the format 004N028W09G003S. In this report, well numbers are abbreviated and written 4N/28W-9G3. Wells in the same township and range are further abbreviated and referred to by only their section designation, 9G3. The following diagram shows how the number for well 4N/28W-9G3 is derived.



Well-numbering diagram

Comparison of 1972 and 1996 Water Levels in the Goleta Central Ground-Water Subbasin, Santa Barbara County, California

By Charles A. Kaehler, David A. Pratt, *and* Katherine S. Paybins

ABSTRACT

Ground-water levels for 1996 were compared with 1972 water levels to determine if a "drought buffer" currently exists. The drought buffer was defined previously, in a litigated settlement involving the Goleta Water District, as the 1972 water level in the Central ground-water subbasin. To make this determination, a network of 15 well sites was selected, water levels were measured monthly from April through December 1996, and the 1996 water-level data were compared with1972 data. The study was done in cooperation with the Goleta Water District.

The 1972-1996 water-level-altitude changes for corresponding months of the comparison years were averaged for each network well. These averaged changes ranged from a rise of 9.4 ft for well 2N2 to a decline of 45.0 ft for well 8K8. The results of the comparison indicate a rise in water level at 1 site (well 2N2) and a decline at 14 sites. The mean of the 14 negative average values was a decline of 24.0 ft. The altitude of the bottom of well 2N2 was higher than the bottom altitudes at the other network sites, and this well is located a few feet from a fault that acts as a hydrologic barrier.

The results of the water-level comparison for the Central subbasin were influenced to some unknown degree by the areal distribution of the set of wells selected for the network and the vertical distribution of the perforated intervals of the wells. For this reason, the mean water-level change--a decline of 21.8 ft--calculated from the averages of the month-to-month changes for the 15 network sites, should be used with caution. In addition, the number of usable individual monthly comparison measurements available for an individual site ranged from one to nine, and averaged six. Therefore, a weighted mean of the monthly averages was calculated on the basis of the number of comparison measurements available for each site. The weighted mean is a decline of 20.9 ft. All Central subbasin wells that were idle (that is, were not being pumped) when measured in 1972 and that were measureable in 1996 were included in the network. Therefore, the network is the most inclusive possible, given the available data.

The objective of the study strictly was to compare 1972 and 1996 water levels in the Central subbasin, and the conclusion is that, overall, 1996 water levels are lower than 1972 levels. In general, hydrographs for selected network wells indicate stable or rising water levels during 1972-83, declining levels during 1984-92, and rising water levels during 1993-96.

INTRODUCTION

The Goleta Water District (GWD), located in Santa Barbara County, California, currently relies on local water supplies to meet its water demand. To help alleviate local water-supply shortages during recurring drought cycles, the GWD has entered into an agreement with the Santa Barbara County Flood and Water Conservation District entitling the Goleta Water District to 4,500 acre-ft /yr of water from the State Water Project. Deliveries are expected to begin in 1997. Ordinance No. 91 of the GWD (Goleta Water District, 1991), the Safe Water Supplies Ordinance, states that

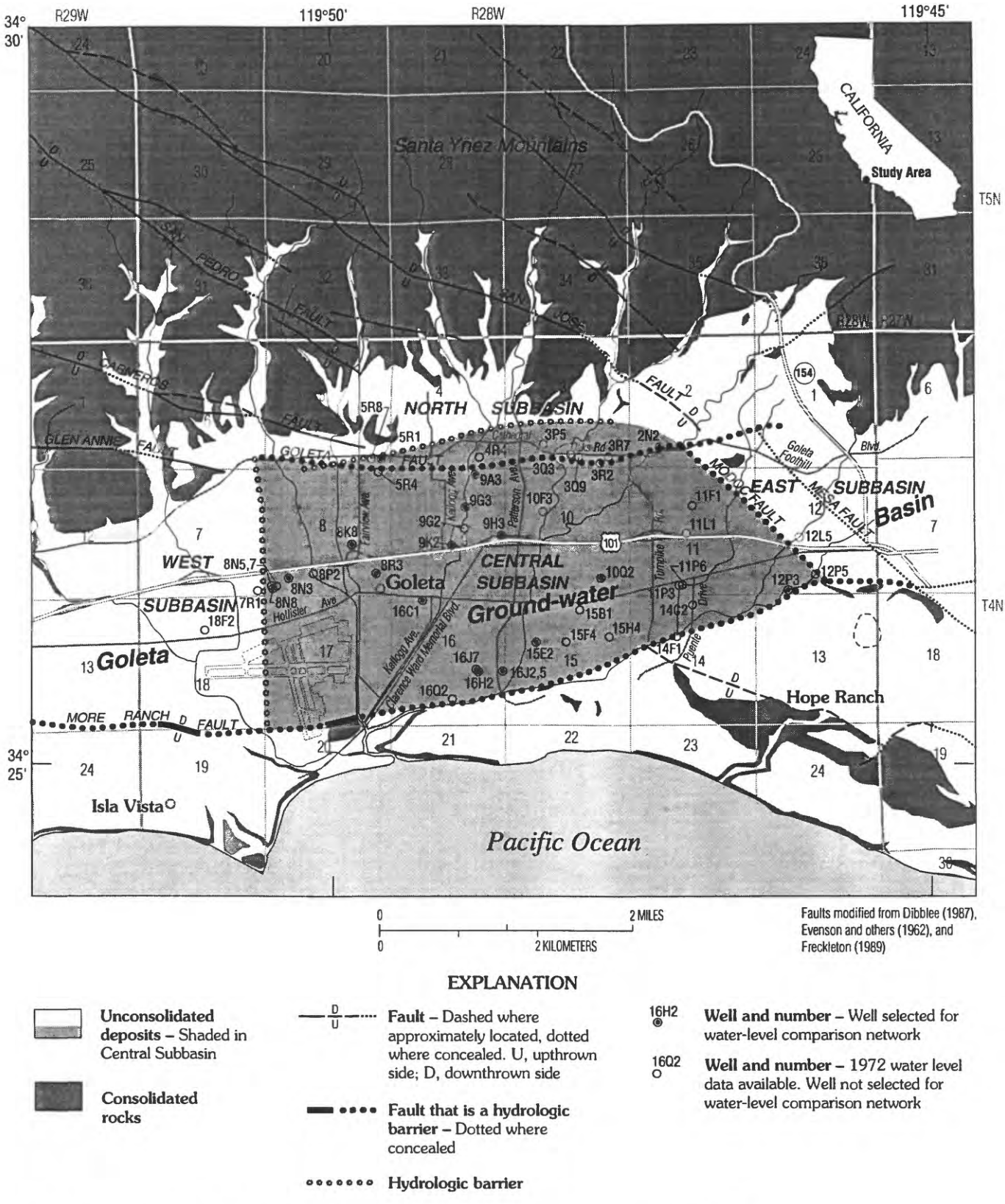


Figure 1. Location of the Goleta Central ground-water subbasin study area and selected wells.

the GWD shall establish a "drought buffer" by committing at least 2,000 acre-ft/yr of water, commencing in the first year the State Water Project makes deliveries to the GWD, to the Central subbasin of the Goleta ground-water basin (fig. 1). The commitment may be fulfilled either by direct injection of water or by reduction in ground-water pumpage. If ground-water levels in the Central subbasin rise to, and are maintained at or above, 1972 levels, the GWD shall not be required to make its annual drought-buffer commitment, and may utilize the yield of the Central subbasin to lower the cost of water services to existing customers. In addition, the GWD is not allowed to provide new water-service connections unless the annual drought-buffer commitment (as well as other conditions) has been met. The definition of "1972 water levels" is not known to have been specified in any existing documents. Given the importance of the drought-buffer commitment, a need exists to determine both 1972 and 1996 ground-water levels for the Central subbasin.

The purpose of this report is to compare 1972 and 1996 ground-water levels in the Goleta Central subbasin. The report includes (1) the method used to select wells for comparison of water levels; (2) historical (1972) and current (1996) water-level data for the Central subbasin; and (3) an evaluation of the change in water levels between 1972 and 1996.

Acknowledgments

The authors gratefully acknowledge the help of Robert Paul, Michael Moore, David Iverson, and Amanda Townsend of the Goleta Water District for providing well records, for providing access to wells, and for permitting use of GWD equipment. The authors also acknowledge the well owners for their cooperation in allowing water-level measurements to be made. In addition, we would like to thank Robert Paul and Michael Moore for their review of an early draft of this report.

DESCRIPTION OF THE STUDY AREA

The Goleta Central subbasin study area is within the Goleta ground-water basin in the coastal part of Santa Barbara County, California, immediately west of the Santa Barbara ground-water basin. The Goleta ground-water basin is in a narrow lowland between the Santa Ynez Mountains on the north and the Pacific Ocean on the south, and is approximately 8 mi long and 3 mi wide. The basin is subdivided into the Central, West, North, and East subbasins (fig. 1). The Central subbasin is approximately 4 mi long and 2 mi wide.

The geohydrology of the Goleta ground-water basin has been described by Upson (1951) and by Evenson and others (1962). The Goleta ground-water basin is bounded by consolidated rocks of Tertiary age, which form the Santa Ynez Mountains to the north and are uplifted along the More Ranch Fault near the coast to the south. The principal water-bearing units in the Goleta ground-water basin are younger alluvium of Holocene age, terrace deposits and older alluvium of Pleistocene age, and the Santa Barbara Formation of Pleistocene age. Evenson and others (1962, p. 76) described a shallow water-bearing zone in the upper beds of the younger alluvium, and a deep water-bearing zone that includes the lower beds of the younger alluvium, the older alluvium, and the Santa Barbara Formation. The younger and older alluvium are generally less than 250 ft thick, and the Santa Barbara Formation is as much as 2,000 ft thick in the southern part of the basin (Upson, 1951, p. 86 and pl. 8). The Santa Barbara Formation, which is composed primarily of sand, silt, and clay, is the main source of water in the Goleta ground-water basin.

Definition of the Goleta Central Ground-Water Subbasin Boundaries

The lateral boundaries of the Central subbasin of the Goleta ground-water basin are defined by hydrologic barriers. With the exception of the boundary between the West and Central subbasins and the boundary between the North and Central subbasins, these hydrologic barriers are mapped faults.

The southern boundary of the Central subbasin, and of the entire Goleta ground-water basin, is the More Ranch Fault (fig. 1). Consolidated rocks of Tertiary age that are uplifted along the south side of the fault form a hydrologic barrier between the ocean and the water-bearing deposits of the ground-water basin.

The Modoc Fault is a hydrologic barrier that forms the boundary between the Central and East subbasins (fig. 1). The barrier was identified by Upson (1951, p. 27) on the basis of differences in water-level altitudes and the lack of transmission of pumping effects across the fault. Upson (1951, p. 95), as well as Evenson and others (1962, p. 74) and Mann (1976, p.

7), indicated that the quantity of ground water moving across the boundary historically has been small.

The north-south-trending boundary between the West and Central subbasins is a hydrologic barrier inferred by differences in water levels in wells (and in water-level trends over a period of years) (Evenson and others, 1962, p. 75) and by water-quality differences (Mann, 1976, p. 7) on opposite sides of the barrier. The barrier (fig. 1) is inferred at the boundary between sections 7 and 8 and between sections 17 and 18 (Township 4 N, Range 28 W). The barrier is attributed by Evenson and others (1962) to a lateral change in permeability caused by a facies change or by faulting in the unconsolidated sediments.

In this report, the boundary between the North and Central subbasins (fig. 1) is the hydrologic barrier mapped by Evenson and others (1962, fig. 3). The definition of this boundary is less certain than that of the other boundaries because more than one hydrologic barrier has been noted by previous investigators and because the barriers appear to be more permeable than those forming the other subbasin boundaries. Upson (1951, p. 27) stated that the Goleta Fault and extensions of the Carneros and Glen Annie Faults (fig. 1) all inhibit the movement of ground water in the Santa Barbara Formation. For example, Upson mapped the Goleta Fault on the basis of differences in water levels and lack of transmission of pumping effects across the inferred trace at several sites. An extension of the Carneros Fault shown by Upson (1951, pl. 2) may coincide in part with a hydrologic barrier mapped by Evenson and others (1962, fig. 3). The barrier is about 0.25 mi north of the Goleta Fault in section 3 and the east half of section 4 (fig. 1) and converges with the Goleta Fault in section 5. Evenson and others (1962, p. 74) noted that ground water moves across the hydrologic barrier in the upper part of the ground-water system, and stated that "this northern barrier probably is [a splay of] the Goleta Fault, but it may be related also to the Carneros and Glen Annie Fault systems." On the other hand, according to a report prepared by the County of Santa Barbara Office of Environmental Quality (1976, p. 7), "A hydrologic barrier north of the Goleta Fault may also be a fault which separates the North subbasin from the Central subbasin." In addition, in a 1988 ground-water modeling study done for the GWD by D.K. Todd Consulting Engineers, the same hydrologic barrier is used as the subbasin boundary (David Iverson, GWD, written commun., 1997). Although more than one hydrologic barrier has been mapped, the hydrologic barrier north of the Goleta Fault is considered to be, for this report, the north boundary of the Central subbasin, following the definition used by Evenson and others (1962), the Santa Barbara County Office of Environmental Quality (1976), and by D. K. Todd Engineers. The easternmost part of the boundary is defined as a curved line connecting the eastern end of the hydrologic barrier with the western end of the Modoc Fault (fig. 1).

SELECTION OF THE WELL NETWORK

The criteria chosen by the USGS for selection of wells for the comparison of 1972 and 1996 water levels were, in approximate order of importance: (1) the well is completed in the Santa Barbara Formation or younger deposits; (2) the well is located in the Central subbasin; (3) the well has water-level data for calendar-year 1972; (4) the well is measurable in 1996; (5) the 1972 and 1996 water-level measurements were made when the well was not being pumped; (6) the well has perforated intervals similar to those of a well measured in 1972 that was later destroyed, inaccessible, or could not be located; and (7) the wells that are selected provide a broad areal distribution of wells within the Central subbasin.

As a first step in the selection process, records (well-construction data, water-level data, and pertinent notes) for 42 wells located in, or within 0.5 mi of, the Central subbasin that have 1972 water-level data were compiled and summarized (table 1). Data and remarks for six additional wells, which are potential substitutes for pairing with 1972 wells that are not available in 1996, also are shown in table 1.

Second, a field search for the wells measured in 1972 was made and their current status and their suitability for water-level measurements were determined. Thirty-three wells were eliminated from consideration as network wells because they could not be located (most commonly because they have been destroyed), were no longer measurable owing to deterioration of condition or to inaccessability, or were measured only while being pumped in 1972. Two 1972 wells that were unavailable in 1996, 8N3 and 16H2, were retained as network wells after suitable substitute wells, 8N8 and 16J7, were found in which to make 1996 water-level measurements. Neither the total depth nor the perforated intervals for well 8N3 are known; therefore, the comparability of well 8N8 with well 8N3 is not known. Factors that adversly affected the suitability of a well

Table 1. Well-construction data for selected wells in the Goleta ground-water basin, Santa Barbara County, California

[Well No.: Asterisk and bold lettering identify well used for 1972-1996 water-level comparison. Site No.: Number based on latitude and longitude; first six digits are latitude, next seven digits are longitude, last two digits are a sequence number to uniquely identify each well. Well depth, Original: (H) indicates drilled depth of hole. Well-casing material: P, plastic; S, steel. Available well logs: D, driller's; E, electric. Well use: Ind, industrial supply; Inj, injection; Irr, irrigation; O, observation; Pub, public supply; U, unused. Well notes: Italic bold lettering identifies a factor affecting non-selection of well. LCMWC, La Cumbre Mutual Water Company; ft, foot; diam., diameter; in, inch; LSD, land-surface datum; (R), reported value; —, no data]

Well No.	Site No.	Other known descriptions	Well depth (ft)		Casing diameter (in.)	Perforations (ft below LSD)	Well-casing material	Date constructed	Altitude of LSD (± 5 ft)	Available well logs	Well use	Well notes
			Original	Sounded (date)								
***4N/28W-2N2**	**342707119471501**	**Tucker's Grove**		**100, 7/18/41**	**6**	—	**S**	**pre-1941**	177.9	—	U	**Very near Goleta Fault. 1972 monthly data.**
4N/28W-3P5	**342710119481401**	—		Reported collapsed at 160 ft, obstructed at 108 ft, 1977	—	—	—	pre-1948	120	—	—	***Reported collapsed at 160 ft.*** 1972 monthly data.
4N/28W-3Q3	**342706119480001**	—	416	—	12	Below 160 (reported)	S	8/1/40	120	D	—	1972 monthly data. ***Not located, 1996***
4N/28W-3Q9	**342705119475603**	—	—	—	—	—	—	—	117	—	—	1972 monthly data. ***Not located, 1996***
4N/28W-3R2	**342701119474502**	—	369	—	10.75	133–366	S	pre-1945	120	D	—	***Probably destroyed.*** 1972 monthly data. Pumping June, August.
4N/28W-3R7	**342705119474101**	—	511	—	12.75	79–511	S	1948	136	D	—	***Obstructions.*** 1972 monthly data. ***Not located, 1996***
4N/28W-4R4	**342705119484602**	Cavaletto	500	154, 6/12/95	12	—	S	pre-1942	90	D	U	***Well casing probably collapsed.*** 1972 monthly data, except September, December.
***4N/28W-5R1**	**342703119493601**	**Martini**	141	—	**10**	**100–135**	**S**	**pre-1941**	62 (1972) 70 (1996)	D	U	**1972 monthly data.**
4N/28W-5R4	**342659119493701**	—	—	—	—	—	—	—	—	—	U	***Probably destroyed.*** 1972 monthly data.
4N/28W-5R8	**342705119493501**	Schmandt	140	—	6	50–130	P	11/22/77	67	D, E	Inj, U	Possible substitute for 5R01, for April–August, 1996. ***Water levels not similar to 1996 5R1.***
4N/28W-7R1	**342611119503801**	Bardex	335		12, 10, 6	155–235, 275–325	P	3/5/79	13	D, E	U	Possible 1996 substitute for 8N3. (8N3 depth unknown) ***West subbasin.***
***4N/28W-8K8**	**342630119495001**	**Stow Ranch**	305 (H)	**281, 5/7/96**	**12**	—	—	**9/1/46**	27	D	U	**1972 monthly data, pumping April, July–December.**

Table 1. Well-construction data for selected wells in the Goleta ground-water basin, Santa Barbara County, California—Continued

Well No.	Site No.	Other known descriptions	Well depth (ft)		Casing diameter (in.)	Perforations (ft below LSD)	Well-casing material	Date constructed	Altitude of LSD (± 5 ft)	Available well logs	Well use	Well notes
			Original	Sounded (date)								
***4N/28W-8N3**	**342616119502201**	**Shrode Produce**	—	—	—	—	—	**pre-1953**	23	—	—	**Probably destroyed. 1972 monthly data. 8N8 used as 1996 substitute.**
4N/28W-8N7	342612119503002	Pacific Materials	350	—	6 ?	250–350	P	1/27/78	30	D, E	U	Possible 1996 substitute for 8N3. (8N3 depth unknown) ***Difficult access.***
***4N/28W-8N8**	**342612119503001**	**Bardex No. 2, Hydronautics**	385	—	**6**	**280–380**	**P**	**3/28/78**	29	D, E	Ind, U	**1996 substitute for 8N3. (8N3 depth unknown)**
4N/28W-8P2	342618119501001	—	507	—	12	—	—	8/42	20	—	—	***Probably destroyed.*** 1972 monthly data.
***4N/28W-8R3**	**342618119493801**	—	106	**82, 5/22/96**	**6**	—	—	**pre-1941**	22	—	U	**1972 monthly data. Can be difficult to measure.**
***4N/28W-9A3**	**342658119484801**	**Mulligan**	125 (R)	**119.5, 6/12/95**	**12**	—	**S**	**pre-1935**	85.09	—	U	**1972 monthly data, except December.**
4N/28W-9G2	342636119485401	—	290	—	10	—	—	7/37	64	—	—	1972 monthly data.
***4N/28W-9G3**	**342645119485301**	**Berkeley No. 1**	288	—	**16**	**168–288**	**S**	**8/21/64**	60.0	D	Pub, U	**1972 monthly data.**
***4N/28W-9H3**	**342635119490201**	—	—	—	—	—	—	**pre-1971**	75		Irr	**1972 monthly data.**
***4N/28W-9K2**	**342630119483601**	**Elks Lodge**	—	**319, 6/12/95**	—	—	—	—	58	—	U	**1972 monthly data.**
4N/28W-9Q6	342610119485301	Jubilee	283	—	8	238–283	—	pre-1952	42	D	—	***Probably destroyed.*** 1972 monthly data.
4N/28W-10F3	342643119481401	Barquero	300	—	16	150–300	—	6/7/67	90.6	D, E	Pub, U,	***1972—all pumping water levels.*** 1972 monthly data, except January.
4N/28W-10N8	342617119482701	—	—	—	—	—	—	pre-1948	70	—	—	***Destroyed 1973.*** 1972 monthly data.
***4N/28W-10Q2**	**342616119474501**	**Emmens, Sungate**	278	**207, 6/13/95**	**10**	**62–278**		**4/12/48**	67	D	U	**1972 monthly data, pumping April, July, October** (1914 well is older well with same well number)
			210 (R)	—	4 (R)	—	—	1914		—	—	
4N/28W-11F1	342645119465901	—	289	—	12	180–204, 213–222, 237–286	—	pre-1941	123	D	—	***May be destroyed.*** 1972 monthly data.
4N/28W-11L1	342634119470201	—	176 (R)	169, 1941	—	—	—	pre-1941	75.2	—	—	***Probably destroyed.*** 1972 monthly data.
4N/28W-11P3	342613119470601	LCMWC 5	523	—	14, 12	—	S	10/40	40	D	—	***Destroyed 1989.*** 1972 monthly data. No suitable well found for 1996 substitute.

Table 1. Well-construction data for selected wells in the Goleta ground-water basin, Santa Barbara County, California—Continued

Well No.	Site No.	Other known descriptions	Well depth (ft)		Casing diameter (in.)	Perforations (ft below LSD)	Well-casing material	Date constructed	Altitude of LSD (± 5 ft)	Available well logs	Well use	Well notes
			Original	Sounded (date)								
4N/28W-11P6	342613119470401	San Marcos	1,101	—	12, 8	549–591, 637–741, 841–891, 952–1,065	S	1/15/73	40	D, E	Pub, U	Possible 1996 substitute for well 11P3. ***Perforated depths not comparable.***
4N/28W-12L5	342632119460602	—	240	—	8	62–240	S	10/1/51	120	D	—	**East subbasin.** 1972 monthly data.
***4N/28W-12P3**	**342610119461101**	**LCMWC 7**	626	—	**13**	**115–626**	—	**3/19/47**	80	D	Pub, U	**1972 monthly data, reported by LCMWC.**
4N/28W-12P5	342617119455801	LCMWC 6 Modoc	355	164.5, 6/13/95 355, 5/6/66	16	—	—	—	105	—	U	Near boundary with East subbasin. 1972 monthly data. ***Well casing probably collapsed.***
4N/28W-14C2	342605119465901	LCMWC 2A	500		16	100–472		6/25/38	40	D	Pub, U	**1996 pumping 14C3 frequently** 1972 monthly data, reported by LCMWC.
4N/28W-14F1	342552119470701	—	—	—	—	—	—	1946	38	—	—	On basin boundary. 1972 monthly data, ***(flowing)***
4N/28W-15A3	342605119473901	Van Rees	238	—	12	80–89, 110–120, 148–154, 156–164, 168–189, 206–212, 221–224	—	3/7/24	55	D	—	***Near well 10Q2. 1972—September data only.*** 1996 — did not measure
4N/28W-15B1	342603119475601	—	175 (R)	113, 5/21/96 Obstruction at 113 ft	12	—	—	pre-1941	50	—	U	***1996—obstruction at 113 ft.*** 1972 monthly data.
***4N/28W-15E2**	**342550119481802**	**San Ricardo**	1,290	—	**16**	**170–350, 630–730, 1,030–1,270**	S	**12/17/72**	35	D, E	Pub, U	**Drilled 12/17/72 1972 December data only.**
4N/28W-15F4	342550119480301	Gilbert	298	—	16	160–298	S	1963 ?	32.8	D, E	—	***1972—all pumping water levels.*** 1972 monthly data, except October–December
4N/28W-15H4	342552119474101	Anita 1	330	—	16	165–330	S	6/9/67	40	D, E	Pub, U	***1972—all pumping water levels.*** 1972 monthly data except January.
***4N/28W-16C1**	**342607119491501**	—	148 (R)	—	6	—	—	pre-1941	30	—	U	1972 monthly data.

Table 1. Well-construction data for selected wells in the Goleta ground-water basin, Santa Barbara County, California—Continued

Well No.	Site No.	Other known descriptions	Well depth (ft)		Casing diameter (in.)	Perforations (ft below LSD)	Well-casing material	Date constructed	Altitude of LSD (± 5 ft)	Available well logs	Well use	Well notes
			Original	Sounded (date)								
***4N/28W-16H2**	**342538119484701**	—	369	—	10	81–124, 200–369	S	3/48	20	D	Irr, U	**1996—well is capped. 1972 monthly data. Paired with well 16J7 1996 data.**
4N/28W-16J2	342539119483501	—	390	—	10	160–180, 210–250, 290–390	S	1946	26	D	U	**1972 monthly data.**
***4N/28W-16J5**	**342539119483504**	—	**20.2 62 (H)**	—	**1.25**	**18.2–20.2**	**P**	**12/13/62**	**25**	**D**	**O**	***1972—March data only. Near well 16J2.***
***4N/28W-16J7**	**342539119484801**	—	**314 (R)**	—	**12**	**124–144, 164–224, 244–304**	**P**	**5/95**	**19**	—	**Irr**	**1996 substitute for 16H2. 8/96—withdrawn by owner.**
4N/28W-16L1	342539119491901	—	276	—	12	—	—	1931	22	D	Ind	***1996—pumped daily.*** 1972 monthly data, except April.
4N/28W-16Q2	342524119490002	Pacific Gas	250 (R)	—	12	—	—	1940	15	—	U	At Basin boundary (fault). 1972 monthly data. ***Very difficult to measure.***
4N/28W-18F2	342555119510401	—	412	—	12	67–406	S	9/8/39	9	D	—	***West subbasin. 1972 monthly data, flowing.***

for inclusion in the comparison-well network are given in table 1 (in italic type in "Well notes" column).

After consideration of all the information given in table 1, 17 wells at 15 sites (2 sites have paired 1972/1996 wells) were selected for the well network. These wells are listed with an asterisk and in bold type in table 1, and their locations are shown in figure 1.

COMPARISON OF 1972 AND 1996 WATER LEVELS

Month-for-Month Comparison

Comparison of 1972 and 1996 water levels in the network wells was made on a month for month basis for May through December. In addition, data were collected from four of the wells (9A3, 9G3, 9K2, and 12P3) for April. A few wells are missing one or more months of comparison data for the May through December period. All of the available 1972 and 1996 monthly water-level data for network wells are given in table 2, depicted as hydrographs in figure 2, and shown on maps (for May, September, and December only) in figure 3.

The difference in water-level altitude from 1972 to 1996 for monthly measurements for 15 wells in the Central subbasin ranged from a rise of 11 ft for December for well 2N2 to a decline of 46 ft for both April and May for well 9G3. The monthly data show that the 1996 water levels were higher than 1972 levels at 1 site and lower than 1972 levels at 14 sites. At well 2N2, the site at which water levels were higher in 1996 than in 1972, the altitude at the bottom of the well is higher than bottom altitude at the other network sites (113 ft higher than the next highest altitude). (In fact, the bottom of this well is higher than the land surface at the other network wells.) In addition, well 2N2 is located a few feet from the Goleta Fault, which is a probable hydrologic barrier. (Well 2N2 was mapped as a few feet north of the Goleta Fault by Upson (1951, pl. 2), and as a few feet south of the Goleta Fault by Evenson and others (1962, fig. 11)).

The areal distribution of month-for-month 1972 to 1996 water-level changes for selected months (May, September, and December) is shown in figure 4. Areal coverage of data points is good except for the east-central and southeast parts of the Central subbasin. In these areas, wells that had 1972 water-level data have been destroyed, cannot be located, or are inaccessible; in addition, no comparable wells were found nearby in which to make 1996 water-level measurements.

Overall Comparison

The average of the 1972 to 1996 water-level changes for corresponding months of the comparison years for each network well ranged from a rise of 9.4 ft for well 2N2 to a decline of 45.0 ft for well 8K8 (fig. 5; table 2). As with the month-for-month data, these averages indicate a rise in water level at 1 site and a decline at 14 sites. The mean of the declines is 24.0 ft. As noted in the previous section, the altitude at the bottom of the well at the site of water-level rise is higher than bottom altitude at the other network sites, and the well is located a few feet from a probable hydrologic barrier.

The mean of all the monthly averages for the 15 network sites is a water-level decline of 21.8 ft. Several factors need to be kept in mind when evaluating the significance of this number. The magnitude of this value may be influenced by factors such as the areal distribution of the network wells and the vertical distribution of their perforated intervals. For example, most of the sites are located between Fairview and Patterson Avenues, and the network sites with the largest decline in water level from 1972 to 1996 (wells 8R3, 9G3, 9K2, and 16H2) are located within this part of the subbasin. A more widespread areal distribution of sites (for example, resulting from the inclusion of wells measured in calendar year 1973) probably would result in a different value of mean water-level change. Similarily, a network containing wells having a different vertical distribution of perforated intervals (for example, including a higher number of shallow wells in unconfined aquifers in the network) also probably would produce different results (unconfined aquifers respond differently than do confined aquifers to pumpage and recharge at any given site). The possible influence of areal and vertical distribution factors is difficult to quantify; however, the network selected is the most inclusive possible given the available data, and the basic conclusion that ground-water levels generally are lower in 1996 in comparison with 1972 water levels remains valid.

The number of usable individual monthly comparison measurements available for an individual site ranged from one (well 15E2) to nine (wells 9G3, 9K2, and 12P3), and averaged six. To account for this range, a weighted mean of the monthly averages was calculated on the basis of the number of comparison

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California

[Well number: Italics, well not used in comparison network. 1972 to 1996 change in water-level altitude: positive number indicates higher water level in 1996; Italics [in brackets], water level measured during pumping—value not included in average or shown in figures 2 and 4. Status: P, pumping; O, obstruction; S, nearby pumping. Method: A, airline; R, reported; S, calibrated steel tape. —, no data]

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-2N2	—	1/3/72	46.00	132	—	—	—	—	—	—	—	—
	—	2/1/72	44.91	133	—	—	—	—	—	—	—	—
	—	3/1/72	42.39	136	—	—	—	—	—	—	—	—
	—	4/6/72	41.86	136	—	—	—	—	—	—	—	—
	7	5/1/72	42.48	135	—	—	—	5/23/96	36.15	142	—	S
	8	6/1/72	43.56	134	—	—	—	6/13/96	35.76	142	—	S
	9	7/3/72	44.92	133	—	—	—	7/9/96	35.86	142	—	S
	9	8/1/72	46.27	132	—	—	—	8/20/96	37.28	141	—	S
	10	8/31/72	47.76	130	—	—	—	9/10/96	38.12	140	—	S
	11	10/2/72	49.43	128	—	—	—	10/1/96	39.09	139	—	S
	10	11/2/72	51.03	127	—	—	—	11/4/96	40.68	137	—	S
	11	12/4/72	52.45	125	—	—	—	12/2/96	41.79	136	—	S
Average	9.4											
4N/28W-4R4	—	1/3/72	111	−21	—	R	—	—	—	—	—	—
	—	2/2/72	109	−19	—	R	—	[Note: *Prior to 6/12/95, a partial collapse of the*			—	—
	—	3/1/72	105	−15	—	R	—	*casing of well 4R4 probably occurred.]*			—	—
	—	4/6/72	105	−15	—	R	—	—	—	—	—	—
	—	5/2/72	103	−13	—	R	—	5/8/96	50.23	40	—	S
	—	6/1/72	105	−15	—	R	—	6/13/96	50.10	40	—	S
	—	7/3/72	103	−13	—	R	—	7/9/96	49.92	40	—	S
	—	—	—	—	—	—	—	8/20/96	49.91	40	—	S
	—	8/31/72	105	−15	—	R	—	9/10/96	49.90	40	—	S
	—	10/4/72	105	−15	—	R	—	10/1/96	49.77	40	—	S
	—	11/2/72	101	−11	—	R	—	11/4/96	49.86	40	—	S
	—	—	—	—	—	—	—	12/2/96	49.66	40	—	S
Average	—											

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-5R1	—	1/19/72	17.50	45	—	S	—	—	—	—	—	—
	—	2/2/72	17.40	45	—	R		*[Note: 1996 water-level altitudes for well 5R1 were*				
	—	3/2/72	17.22	45	—	R		*calculated using land-surface datum of 70 feet above*				
	—	4/7/72	17.06	45	—	R	—	*sea level—land-surface datum changed from 62 feet*				
	—	5/1/72	17.27	45	—	R	—	*to 70 feet in 1987.]*		—	—	—
	—	6/2/72	17.54	44	—	R	—	—	—	—	—	—
	—	7/5/72	17.92	44	—	R	—	—	—	—	—	—
	–10	8/2/72	17.55	44	—	R	—	8/21/96	36.42	34	—	S
	–10	9/1/72	17.69	44	—	R	—	9/10/96	36.48	34	—	S
	–10	10/4/72	17.99	44	—	R	—	10/1/96	36.47	34	—	S
	–11	11/3/72	18.24	44	—	R	—	11/4/96	36.61	33	—	S
	–11	12/5/72	17.70	44	—	R	—	12/2/96	36.62	33	—	S
Average	–10.4											
4N/28W-5R8	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	5/7/96	22.82	44	—	S
	—	—	—	—	—	—	—	6/13/96	22.94	44	—	S
	—	—	—	—	—	—	—	7/9/96	23.03	44	—	S
	—	—	—	—	—	—	—	8/20/96	23.16	44	—	S
	—	—	—	—	—	—	—	9/10/96	23.22	44	—	S
	—	—	—	—	—	—	—	10/1/96	23.27	44	—	S
	—	—	—	—	—	—	—	11/4/96	23.11	44	—	S
	—	—	—	—	—	—	—	12/2/96	22.92	44	—	S
Average	—											

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-8K8	—	1/4/72	20	7	—	R	—	—	—	—	—	—
	—	2/2/72	19	8	—	R	—	—	—	—	—	—
	—	3/2/72	17	10	—	R	—	—	—	—	—	—
	—	4/7/72	46.5	–20	P	R	—	—	—	—	—	—
	–44	5/1/72	21	6	—	R	—	5/7/96	65.02	–38	—	S
	–46	6/2/72	20.16	7	—	R	—	6/13/96	66.49	–39	—	S
	[-20]	7/5/72	47	–20	P	R	—	7/9/96	66.50	–40	—	S
	[-20]	8/2/72	46	–19	P	R	—	8/20/96	66.32	–39	—	S
	[-18]	9/1/72	48	–21	P	R	—	9/10/96	65.91	–39	—	S
	[-13]	10/4/72	51	–24	P	R	—	10/1/96	63.53	–37	—	S
	[-12]	11/3/72	51	–24	P	R	—	11/4/96	63.09	–36	—	S
	[-14]	12/5/72	48	–21	P	R	—	12/2/96	62.34	–35	—	S
Average	–45.0											
4N/28W-8N3	—	1/4/72	12.13	11	—	—	4N/28W-8N08	—	—	—	—	—
	—	2/2/72	11.63	11	—	—	4N/28W-8N08	—	—	—	—	—
	—	3/2/72	11.24	12	—	—	4N/28W-8N08	—	—	—	—	—
	—	4/7/72	13.35	10	—	—	4N/28W-8N08	—	—	—	—	—
	—	5/2/72	12.81	10	—	—	4N/28W-8N08	—	—	—	—	—
	–5	6/2/72	13.27	10	—	—	4N/28W-8N08	6/25/96	24.00	5	—	S
	–5	7/5/72	13.54	9	—	—	4N/28W-8N08	7/10/96	24.20	5	—	S
	–3	8/2/72	14.69	8	—	—	4N/28W-8N08	8/20/96	23.69	5	—	S
	–3	9/1/72	15.17	8	—	—	4N/28W-8N08	9/10/96	24.17	5	—	S
	–3	10/4/72	15.26	8	—	—	4N/28W-8N08	10/1/96	24.37	5	—	S
	–3	11/3/72	15.79	7	—	—	4N/28W-8N08	11/4/96	24.77	4	—	S
	–4	12/5/72	14.27	9	—	—	4N/28W-8N08	12/2/96	24.37	5	—	S
Average	–3.7											

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-8R3	—	1/4/72	29.73	–8	—	—	—	—	—	—	—	—
	—	2/2/72	29.39	–7	—	—	—	—	—	—	—	—
	—	3/2/72	29.43	–7	—	—	—	—	—	—	—	—
	—	4/7/72	29.97	–8	—	—	—	—	—	—	—	—
	–47	5/2/72	30.35	–8	—	—	—	5/22/96	76.50	–55	—	S
	–46	6/2/72	30.98	–9	—	—	—	6/12/96	76.62	–55	—	S
	—	7/5/72	31.49	–9	—	—	—	7/10/96	—	—	O	S
	–45	8/2/72	31.63	–10	—	—	—	8/20/96	76.58	–55	—	S
	–45	9/1/72	32.23	–10	—	—	—	9/10/96	76.64	–55	—	S
	–44	10/4/72	32.74	–11	—	—	—	10/1/96	76.53	–55	—	S
	–43	11/3/72	33.03	–11	—	—	—	11/4/96	76.40	–54	—	S
	–43	12/5/72	32.77	–11	—	—	—	12/2/96	76.20	–54	—	S
Average	–44.7											
4N/28W-9A3	—	1/3/72	42.54	43	—	R	—	—	—	—	—	—
	—	2/2/72	41.68	43	—	R	—	—	—	—	—	—
	—	3/1/72	40.98	44	—	R	—	—	—	—	—	—
	–14	4/6/72	40.43	45	—	R	—	4/11/96	53.92	31	—	S
	–14	5/1/72	40.55	45	—	R	—	5/8/96	53.77	31	—	S
	–12	6/1/72	41.30	44	—	R	—	6/13/96	53.48	32	—	S
	–11	7/3/72	41.87	43	—	R	—	7/9/96	53.33	32	—	S
	—	—	—	—	—	—	—	8/20/96	53.17	32	—	S
	–10	8/31/72	43.47	42	—	R	—	9/10/96	53.10	32	—	S
	–9	10/4/72	44.33	41	—	R	—	10/1/96	53.10	32	—	S
	–8	11/2/72	44.74	40	—	R	—	11/4/96	53.05	32	—	S
	—	—	—	—	—	—	—	12/2/96	53.03	32	—	S
Average	–11.1											

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-9G3	—	1/4/72	50.08	10	—	R	—	—	—	—	—	—
	—	2/2/72	49.85	10	—	R	—	—	—	—	—	—
	—	3/1/72	49.35	11	—	R	—	—	—	—	—	—
	–46	4/6/72	49.84	10	—	R	—	4/10/96	96.19	–36	—	S
	–46	5/1/72	49.91	10	—	R	—	5/7/96	95.74	–36	—	S
	–45	6/2/72	50.06	10	—	R	—	6/13/96	94.87	–35	—	S
	–43	7/5/72	50.58	9	—	R	—	7/9/96	94.45	–34	—	S
	–43	8/2/72	51.29	9	—	R	—	8/20/96	94.30	–34	—	S
	–42	9/1/72	51.97	8	—	R	—	9/10/96	94.10	–34	—	S
	–42	10/4/72	52.27	8	—	R	—	10/1/96	93.52	–34	—	S
	–40	11/2/72	53.04	7	—	R	—	11/4/96	93.26	–33	—	S
	–40	12/5/72	52.68	7	—	R	—	12/2/96	93.12	–33	—	S
Average	–43.0											
4N/28W-9H3	—	1/4/72	80	–5	—	R	—	—	—	—	—	—
	—	2/2/72	79	–4	—	R	—	—	—	—	—	—
	—	3/2/72	79	–4	—	R	—	—	—	—	—	—
	—	4/6/72	82	–7	—	R	—	—	—	—	—	—
	–31	5/1/72	83	–8	—	R	—	5/24/96	113.60	–39	—	S
	–29	6/2/72	84	–9	—	R	—	6/14/96	113.45	–38	—	S
	—	—	—	—	P	R	—	7/9/96	113.08	–38	—	S
	–16	8/1/72	97	–22	—	R	—	8/20/96	112.72	–38	—	S
	–21	9/1/72	92	–17	—	R	—	9/10/96	112.51	–38	—	S
	–22	10/4/72	90	–15	—	R	—	10/1/96	112.09	–37	—	S
	–21	11/2/72	91	–16	—	R	—	11/4/96	111.75	–37	—	S
	–22	12/5/72	89	–14	—	R	—	12/2/96	111.36	–36	—	S
Average	–23.1											

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-9K2	—	1/4/72	55	3	—	R	—	—	—	—	—	
	—	2/2/72	53	5	—	R	—	—	—	—	—	
	—	3/9/72	55	3	—	R	—	—	—	—	—	
	–33	4/6/72	57	1	—	R	—	4/10/96	92.33	–32	—	
	–36	5/1/72	55	3	—	R	—	5/8/96	93.07	–33	—	
	–34	6/2/72	55	3	—	R	—	6/13/96	90.97	–31	—	
	–36	7/5/72	53	5	—	R	—	7/9/96	90.60	–31	—	
	–33	8/2/72	57	1	—	R	—	8/20/96	91.51	–32	—	
	–14	9/1/72	75	–17	—	R	—	9/10/96	91.43	–31	—	
	–15	10/4/72	73	–15	—	R	—	10/1/96	89.54	–30	—	
	0	11/2/72	87	–29	—	R	—	11/4/96	89.36	–29	—	
	1	12/5/72	89	–31	—	R	—	12/2/96	90.31	–30	—	
Average	–22.4											
4N/28W-10F3	—	—	—	—	—	—	—	—	—	—	—	—
	—	2/2/72	160	–69	P	R	—	—	—	—	—	—
	—	3/2/72	147	–56	P	R	—	—	—	—	—	—
	[2]	4/6/72	138	–47	P	R	—	4/11/96	135.29	–45	—	S
	—	5/1/72	141	–50	P	R	—	—	—	—	—	—
	[4]	6/2/72	138	–47	P	R	—	6/26/96	133.97	–43	—	S
	[7]	7/3/72	141	–50	P	R	—	7/9/96	133.82	–43	—	S
	[8]	8/2/72	142	–51	P	R	—	8/20/96	133.50	–43	—	S
	[14]	9/1/72	148	–57	P	R	—	9/10/96	133.25	–43	—	S
	[14]	10/4/72	147	–56	P	R	—	10/1/96	132.97	–42	—	S
	[16]	11/2/72	149	–58	P	R	—	11/4/96	132.70	–42	—	S
	[14]	12/5/72	147	–56	P	R	—	12/2/96	132.29	–42	—	S
Average	—											

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-10Q2	—	1/4/72	101.19	–34	—	—	—	—	—	—	—	—
	—	2/2/72	105.97	–39	—	—	—	[Note: *A change in land-surface datum may*			—	—
	—	3/2/72	108.60	–42	—	—	—	*have occurred between 1972 and 1996.*			—	—
	—	4/7/72	—	—	P	R	—	*The amount of change is unknown.]*			—	—
	–13	5/2/72	112.68	–46	—	—	—	5/8/96	126.42	–59	—	S
	–12	6/2/72	114.29	–47	—	—	—	6/12/96	126.31	–59	—	S
	—	7/5/72	—	—	P	—	—	7/10/96	126.49	–59	—	S
	–10	8/2/72	116.46	–49	—	—	—	8/20/96	126.27	–59	—	S
	–9	9/1/72	117.00	–50	—	—	—	9/10/96	126.21	–59	—	S
	—	10/4/72	—	—	P	—	—	10/1/96	126.25	–59	—	S
	–10	11/3/72	116.11	–49	—	—	—	11/4/96	126.15	–59	—	S
	–10	12/5/72	115.96	–49	—	—	—	12/2/96	125.97	–59	—	S
Average	–10.7											
4N/28W-12P3	—	1/4/72	167.25	–87	S	R	—					
	—	2/7/72	171.42	–91	S	R	—	—	—	—	—	—
	—	3/2/72	165.5	–85	S	R	—	—	—	—	—	—
	–32	4/7/72	159.5	–79	S	R	—	4/9/96	191.21	–111	—	S
	–23	5/3/72	167.83	–88	S	R	—	5/8/96	191.18	–111	—	S
	–23	6/5/72	167.6	–88	S	R	—	6/13/96	190.60	–111	—	S
	–19	7/3/72	170.83	–91	S	R	—	7/23/96	190.32	–110	—	S
	–27	8/2/72	163.5	–83	S	R	—	8/20/96	189.99	–110	—	S
	–21	9/5/72	169.5	–89	S	R	—	9/10/96	189.66	–110	—	S
	–22	10/1/72	167.5	–87	S	R	—	10/1/96	189.45	–109	—	S
	–16	11/3/72	172.5	–93	S	R	—	11/4/96	189.02	–109	—	S
	–23	12/5/72	163.8	–84	S	R	—	12/2/96	187.40	–107	—	S
Average	–22.9											

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-12P5	—	1/3/72	161.20	–56	—	R	—	1/18/96	138.58	–34	—	R
	—	2/1/72	157.70	–53	—	R	—	2/14/96	137.78	–33	—	R
	—	3/1/72	159.05	–54	—	R	—	3/21/96	137.30	–32	—	R
	—	4/6/72	161.36	–56	—	R	—	4/11/96	137.03	–32	—	R
	—	5/1/72	162.26	–57	—	R	—	5/9/96	136.78	–32	—	S
	—	6/1/72	162.31	–57	—	R	—	6/13/96	136.81	–32	—	S
	—	7/3/72	164.17	–59	—	R	—	7/23/96	136.85	–32	—	S
	—	8/1/72	162.04	–57	—	R	—	8/20/96	136.74	–32	—	S
	—	8/31/72	161.57	–57	—	R	—	9/10/96	136.72	–32	—	S
	—	10/2/72	161.87	–57	—	R	—	10/1/96	136.66	–32	—	S
	—	11/2/72	162.58	–58	—	R	—	11/4/96	136.39	–31	—	S
	—	12/4/72	161.32	–56	—	R	—	12/2/96	135.86	–31	—	S
Average	—							[Note: *Prior to 6/13/95, a partial collapse of the casing of well 12P5 probably occurred.*]				
4N/28W-15E2	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	4/11/96	89.12	–54	—	S
	—	—	—	—	—	—	—	5/8/96	88.42	–53	—	S
	—	—	—	—	—	—	—	6/14/96	87.42	–52	—	S
	—	—	—	—	—	—	—	7/10/96	86.95	–52	—	S
	—	—	—	—	—	—	—	8/20/96	91.22	–56	—	S
	—	—	—	—	—	—	—	9/10/96	90.45	–55	—	S
	—	—	—	—	—	—	—	10/1/96	90.37	–55	—	S
	—	—	—	—	—	—	—	11/4/96	90.14	–55	—	S
	–19	12/17/72	71	–36	—	R	—	12/2/96	89.78	–55	—	S
Average	–19											

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements				Well number, 1996 substitute wells	1996 water-level measurements			
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method
4N/28W-16C1	—	1/4/72	35.58	–6	— —	—	—	—	—	— —
	—	2/2/72	35.33	–5	— —	—	—	—	—	— —
	—	3/2/72	35.69	–6	— —	—	—	—	—	— —
	—	4/7/72	37.20	–7	— —	—	—	—	—	— —
	–28	5/2/72	37.77	–8	— —	—	5/9/96	65.79	–36	— S
	–27	6/2/72	38.83	–9	— —	—	6/14/96	66.08	–36	— S
	–26	7/5/72	39.65	–10	— —	—	7/10/96	66.38	–36	— S
	–26	8/2/72	40.44	–10	— —	—	8/20/96	66.41	–36	— S
	–25	9/1/72	40.90	–11	— —	—	9/10/96	66.47	–36	— S
	–25	10/4/72	41.04	–11	— —	—	10/1/96	66.41	–36	— S
	–25	11/3/72	41.13	–11	— —	—	11/4/96	66.05	–36	— S
	–26	12/5/72	40.03	–10	— —	—	12/2/96	65.52	–36	— S
Average	–26.0									
4N/28W-16H2	—	1/4/72	39.86	–20	— —	4N/28W-16J07	—	—	—	— —
	—	2/2/72	42.75	–23	— —	4N/28W-16J07	—	—	—	— —
	—	3/2/72	44.02	–24	— —	4N/28W-16J07	—	—	—	— —
	—	4/7/72	45.88	–26	— —	4N/28W-16J07	—	—	—	— —
	–30	5/2/72	53.06	–33	— —	4N/28W-16J07	5/9/96	82.36	–63	— S
	–33	6/2/72	49.00	–29	— —	4N/28W-16J07	6/12/96	80.66	–62	— S
	–31	7/5/72	50.62	–31	— —	4N/28W-16J07	7/10/96	81.21	–62	— S
	—	8/2/72	57.18	–37	— —	4N/28W-16J07	—	—	—	— —
	—	9/1/72	52.54	–33	— —	4N/28W-16J07	—	—	—	— —
	—	10/4/72	50.77	–31	— —	4N/28W-16J07	—	—	—	— —
	—	11/3/72	50.43	–30	— —	4N/28W-16J07	—	—	—	— —
	—	12/5/72	48.91	–29	— —	4N/28W-16J07	—	—	—	— —
Average	–31.3									

Table 2. 1972 and 1996 water-level data for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California—Continued

Well number	1972 to 1986 change in water-level altitude, in feet	1972 water-level measurements					Well number, 1996 substitute wells	1996 water-level measurements				
		Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method			Date	Depth to water, in feet below land surface	Water-level altitude, in feet above sea level	Status/ method	
4N/28W-16J2	—	1/4/72	51.57	–26	—	R	—	—	—	—	—	—
	—	2/2/72	57.07	–31	—	R	—	—	—	—	—	—
	—	3/2/72	58.60	–33	—	R	—	—	—	—	—	—
	—	4/7/72	61.01	–35	—	R	—	—	—	—	—	—
	–21	5/2/72	66.31	–40	—	R	—	5/8/96	86.98	–61	—	S
	–24	6/2/72	63.00	–37	—	R	—	6/13/96	87.43	–61	—	S
	–23	7/5/72	65.68	–40	—	R	—	7/10/96	88.76	–63	—	S
	–19	8/2/72	70.29	–44	—	R	—	8/19/96	89.26	–63	—	S
	–24	9/1/72	64.97	–39	—	R	—	9/10/96	89.03	–63	—	S
	–25	10/4/72	63.98	–38	—	R	—	10/1/96	89.38	–63	—	S
	–24	11/3/72	63.57	–38	—	R	—	11/4/96	87.63	–62	—	S
	–24	12/5/72	62.42	–36	—	R	—	12/2/96	86.03	–60	—	S
Average	–23.0					R						

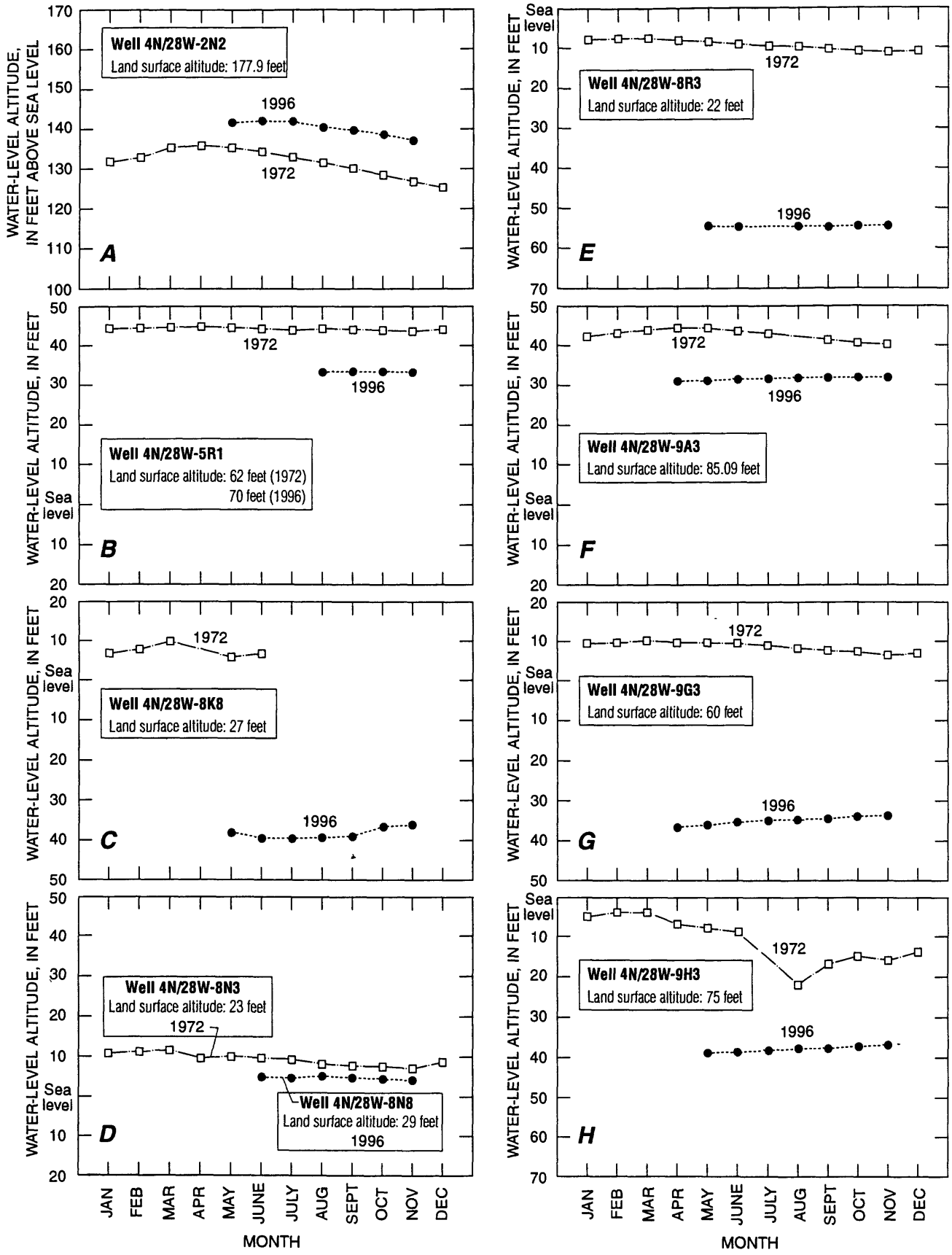


Figure 2. 1972 and 1996 water-level altitudes at comparison-network wells, Goleta Central ground-water subbasin, Santa Barbara County, California.

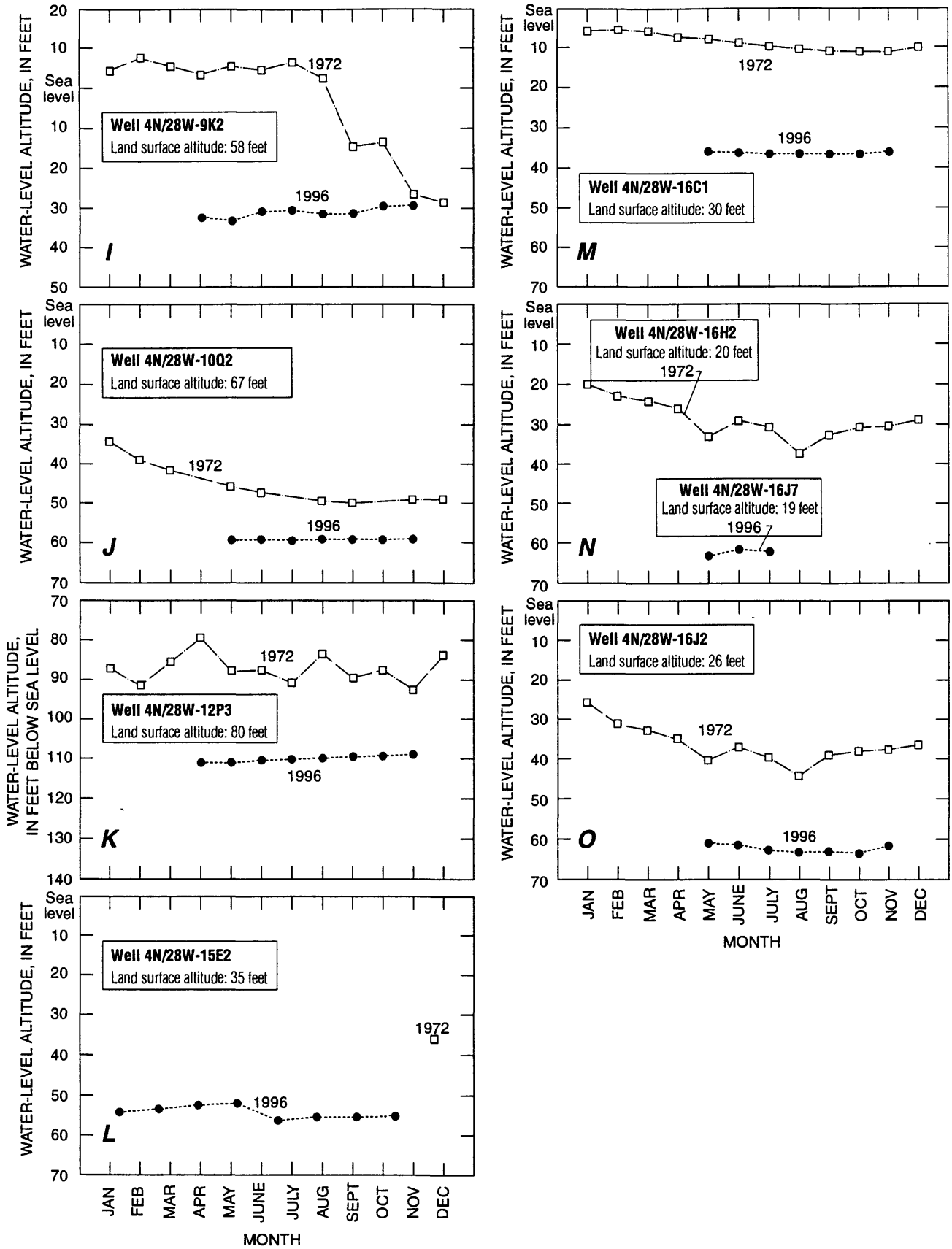
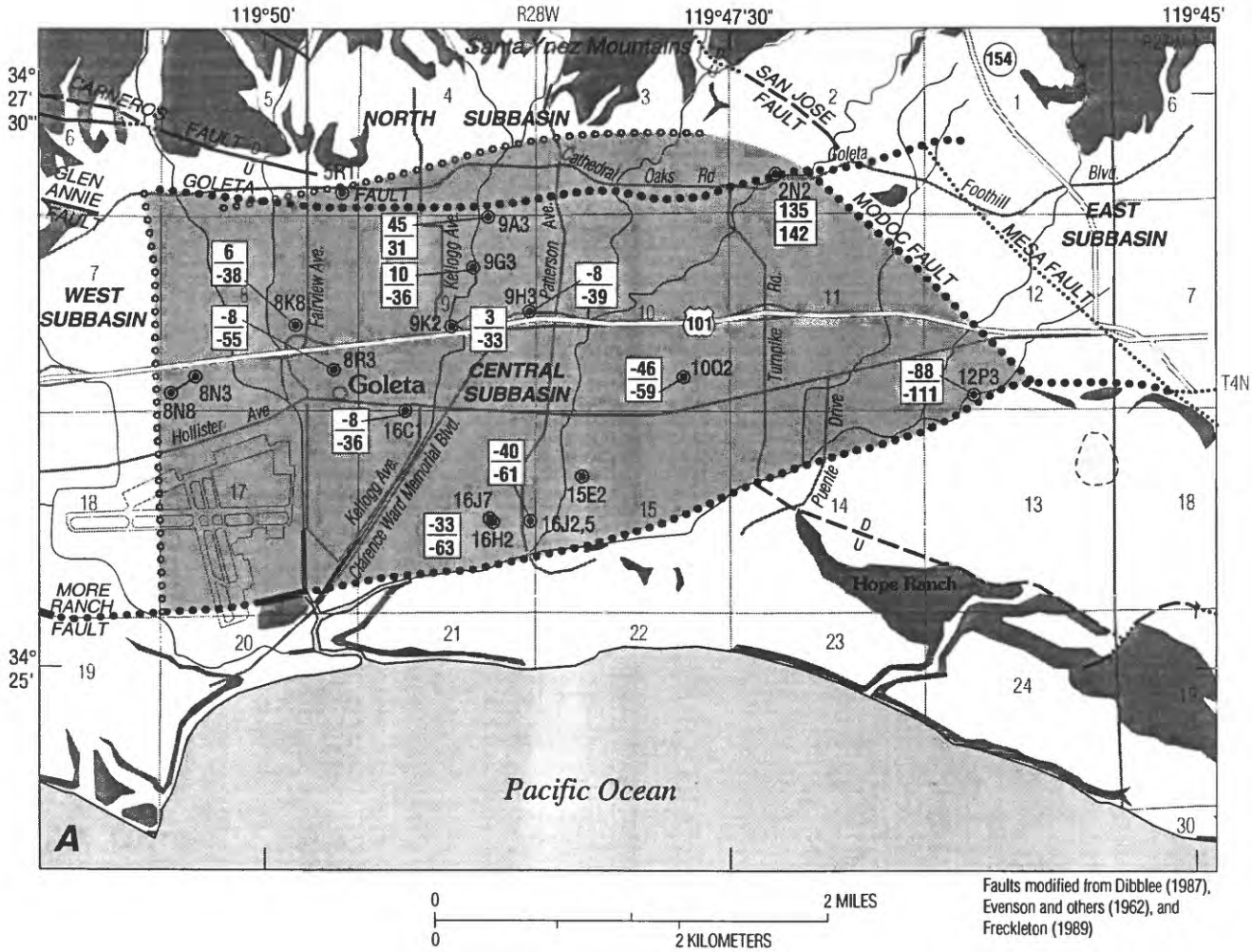


Figure 2.—Continued.



EXPLANATION

Unconsolidated deposits – Shaded in Central Subbasin

Consolidated rocks

Fault – Dashed where approximately located, dotted where concealed. U, upthrown side; D, downthrown side

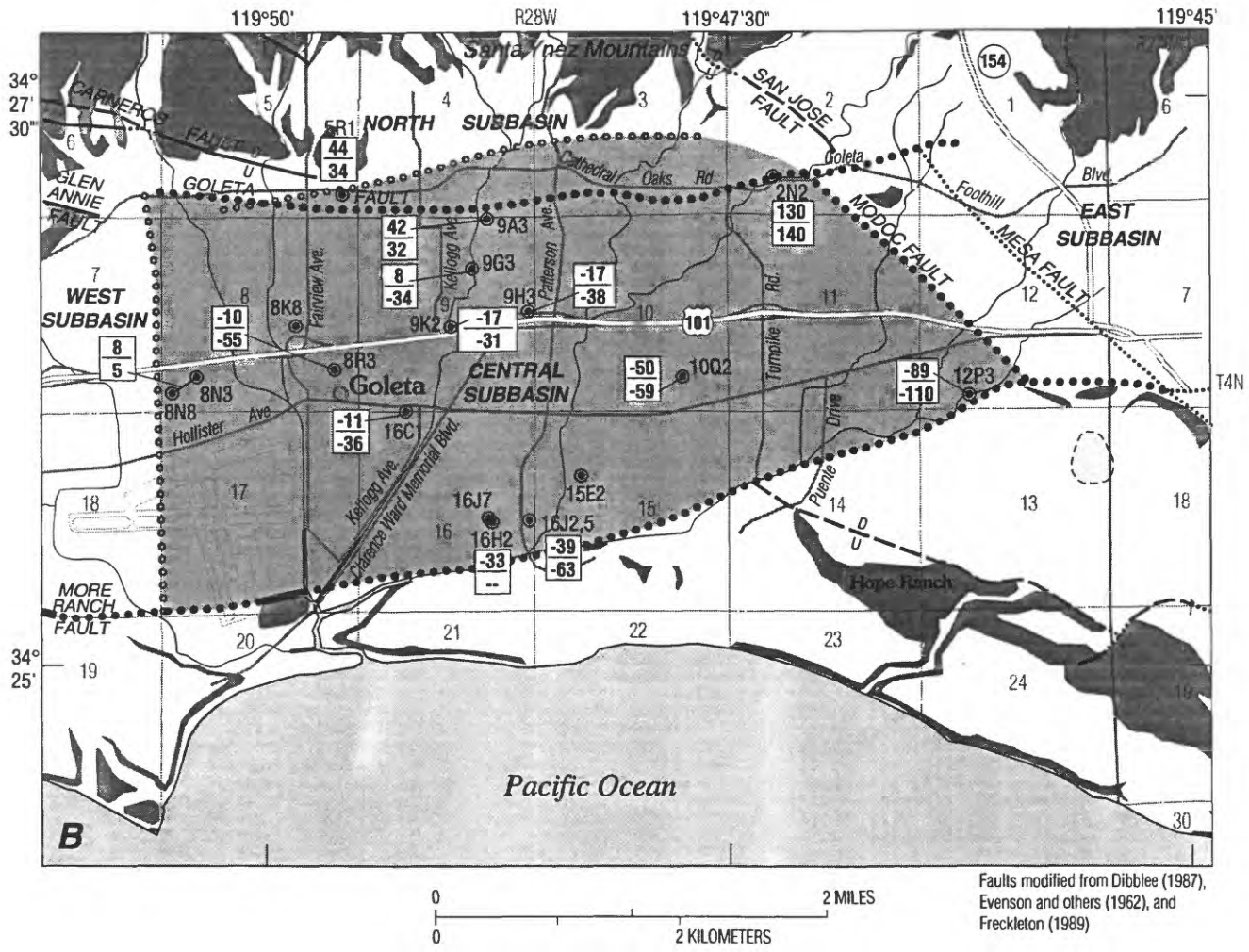
Fault that is a hydrologic barrier – Dotted where concealed

Hydrologic barrier

9K2
3 / -33 Well and number – Values in box are water-level altitudes: above line-May 1972; below line-May 1996, in feet. Datum is sea level.

Paired wells – One well with 1972 data and one with 1996 data

Figure 3. Water-level altitudes at network wells, by month, Goleta Central ground-water subbasin, Santa Barbara County, California, ***A,*** May 1972 and May 1996; ***B,*** September 1972 and September 1996; and ***C,*** December 1972 and December 1996.



EXPLANATION

Unconsolidated deposits – Shaded in Central Subbasin

Consolidated rocks

Fault – Dashed where approximately located, dotted where concealed. U, upthrown side; D, downthrown side

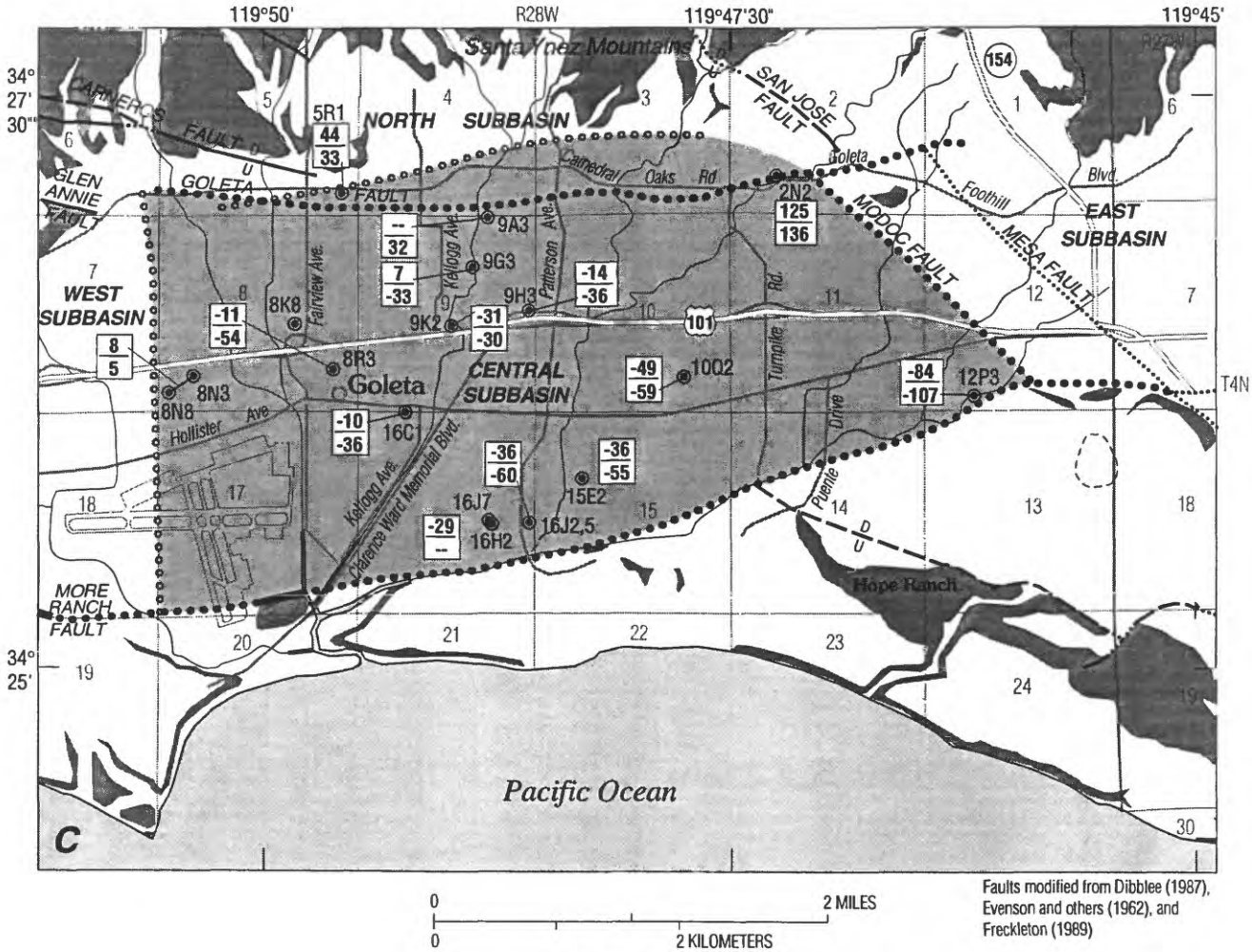
Fault that is a hydrologic barrier – Dotted where concealed

Hydrologic barrier

9K2
-17 / -31 **Well and number** – Values in box are water-level altitudes: above line-September 1972; below line-September 1996, in feet. Datum is sea level

Paired wells – One well with 1972 data and one with 1996 data

Figure 3.—Continued.



EXPLANATION

Unconsolidated deposits – Shaded in Central Subbasin

Consolidated rocks

Fault – Dashed where approximately located, dotted where concealed. U, upthrown side; D, downthrown side

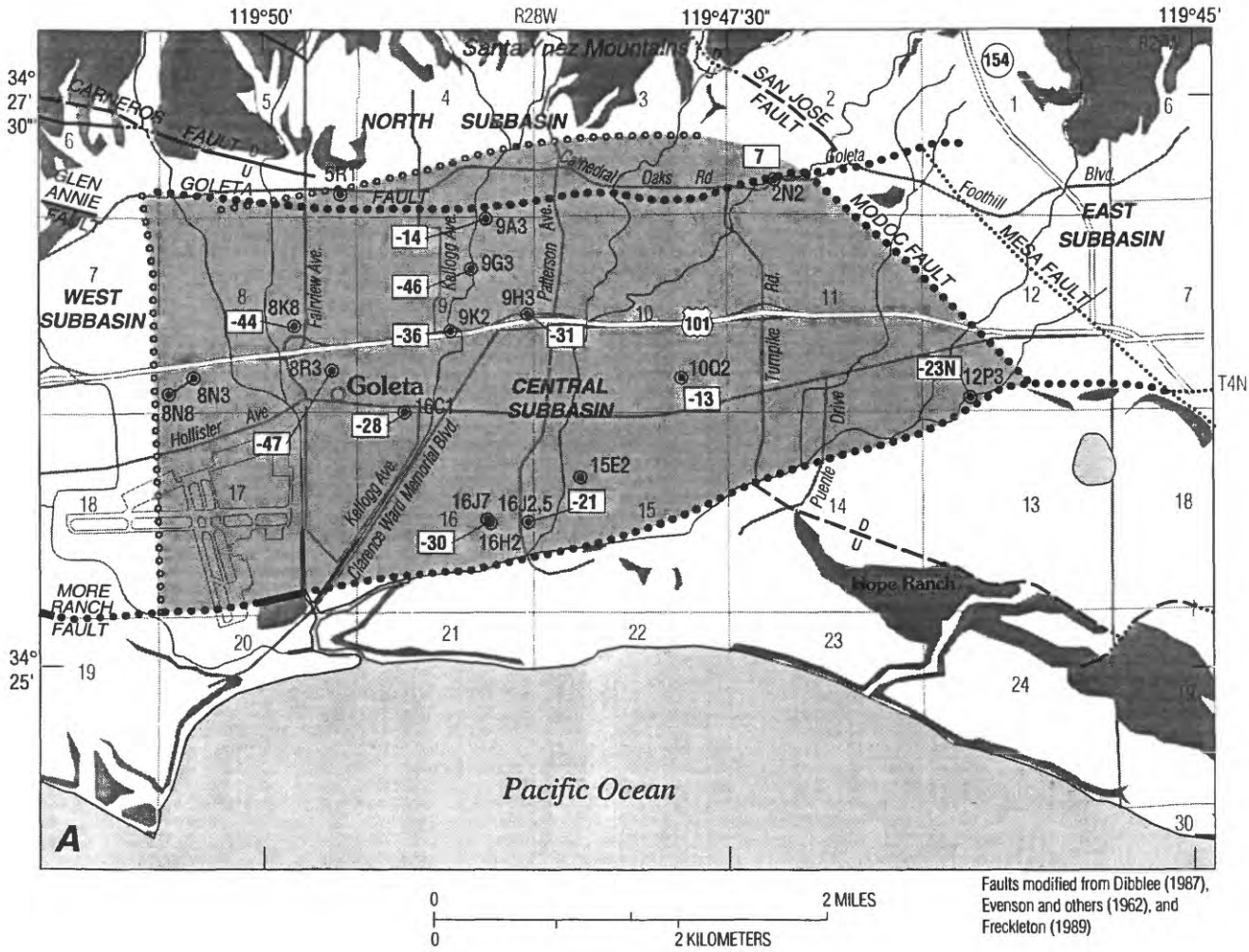
Fault that is a hydrologic barrier – Dotted where concealed

Hydrologic barrier

9K2
-31
-30
Well and number – Values in box are water-level altitudes: above line-December 1972; below line-December 1996, in feet. Datum is sea level. --, indicates no data

Paired wells – One well with 1972 data and one with 1996 data

Figure 3.—Continued.



EXPLANATION

Unconsolidated deposits – Shaded in Central Subbasin

Consolidated rocks

Fault – Dashed where approximately located, dotted where concealed. U, upthrown side; D, downthrown side

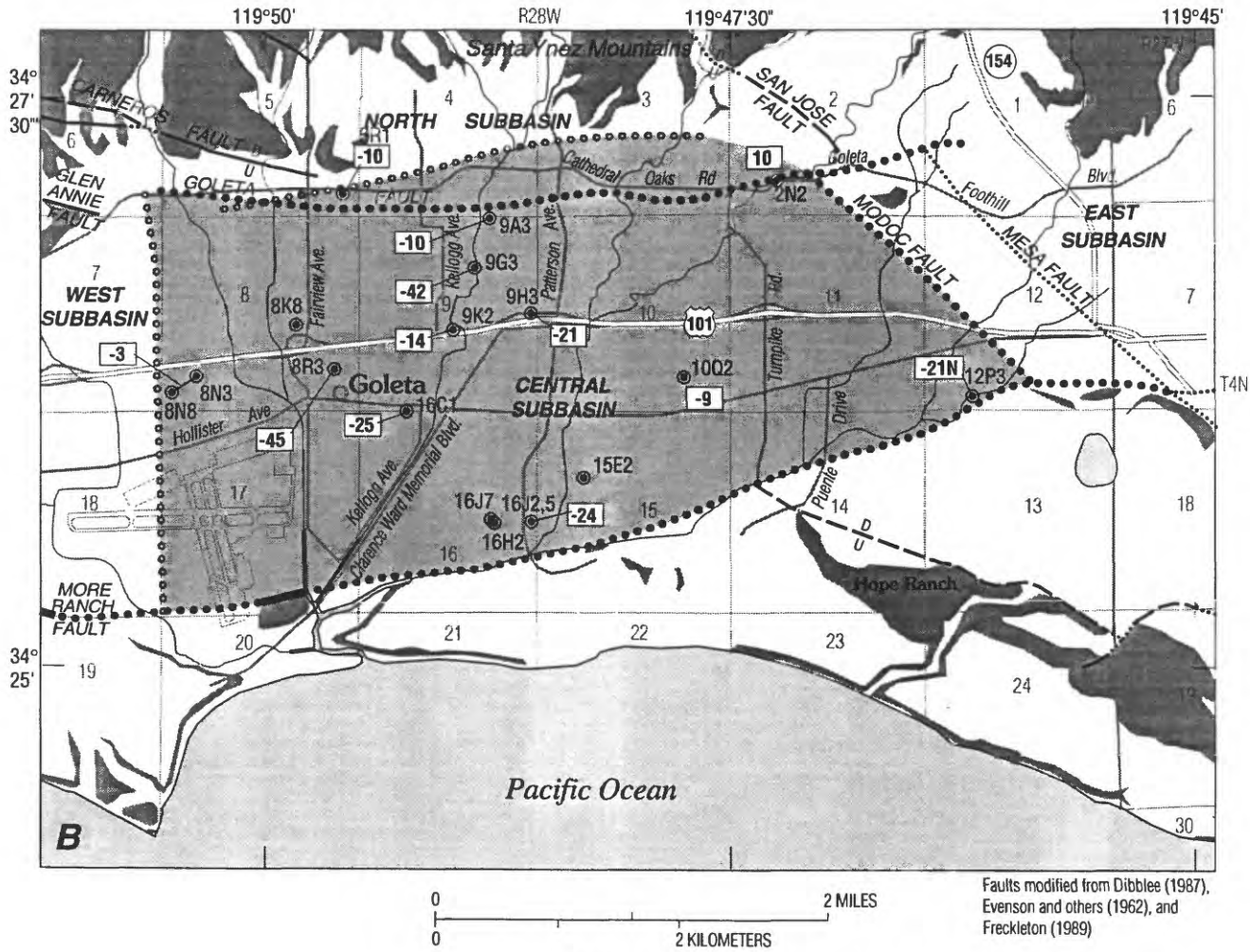
Fault that is a hydrologic barrier – Dotted where concealed

Hydrologic barrier

9K2
-36 **Well and number** – Value in box is the change in water-level altitude, in feet, from May 1972 to May 1996. Datum is sea level. N–value includes 1972 nearby well pumping

Paired well – One well with 1972 data and one with 1996 data

Figure 4. Water-level change at network wells for corresponding months, Goleta Central ground-water subbasin, Santa Barbara County, California, ***A,*** May 1972 and May 1996; ***B,*** September 1972 and September 1996; and ***C,*** December 1972 and December 1996.



EXPLANATION

Unconsolidated rocks – Shaded in Central Subbasin

Consolidated rocks

Fault – Dashed where approximately located, dotted where concealed. U, upthrown side; D, downthrown side

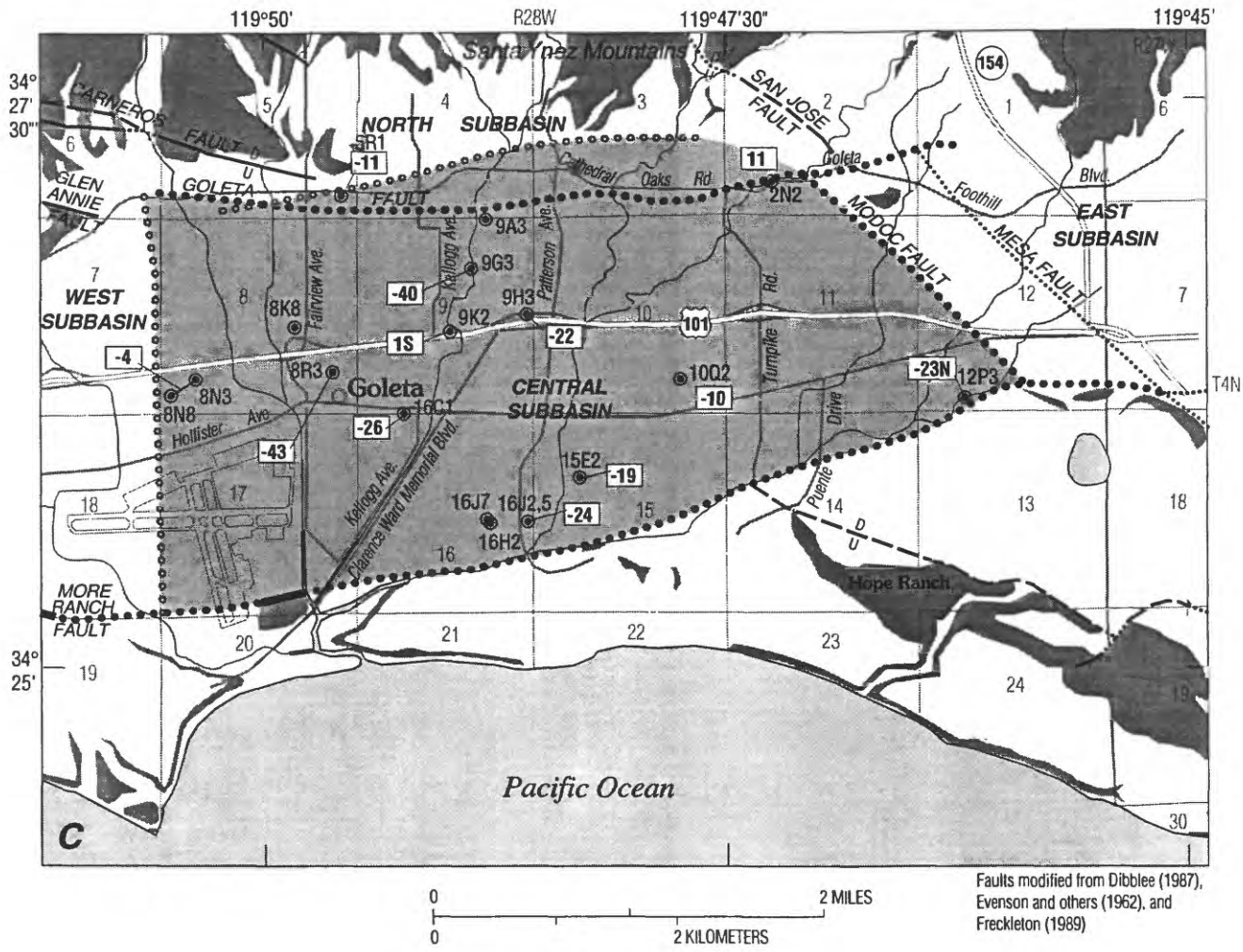
Fault that is a hydrologic barrier – Dotted where concealed

Hydrologic barrier

9K2
-14 **Well and number** – Value in box is the change in water-level altitude, in feet, from September 1972 to September 1996. Datum is sea level. N–value includes 1972 nearby well pumping

Paired wells–One well with 1972 data and one with 1996 data

Figure 4.—Continued.



EXPLANATION

Unconsolidated deposits – Shaded in Central Subbasin

Consolidated rocks

Fault – Dashed where approximately located, dotted where concealed. U, upthrown side; D, downthrown side

Fault that is a hydrologic barrier – Dotted where concealed

Hydrologic barrier

9K2
1S **Well and number** – Value in box is the change in water-level altitude, in feet, from December 1972 to December 1996. Datum is sea level. N–value includes 1972 nearby well pumping; S–value includes 1996 nearby well pumping

Paired wells – One well with 1972 data and one with 1996 data

Figure 4.—Continued.

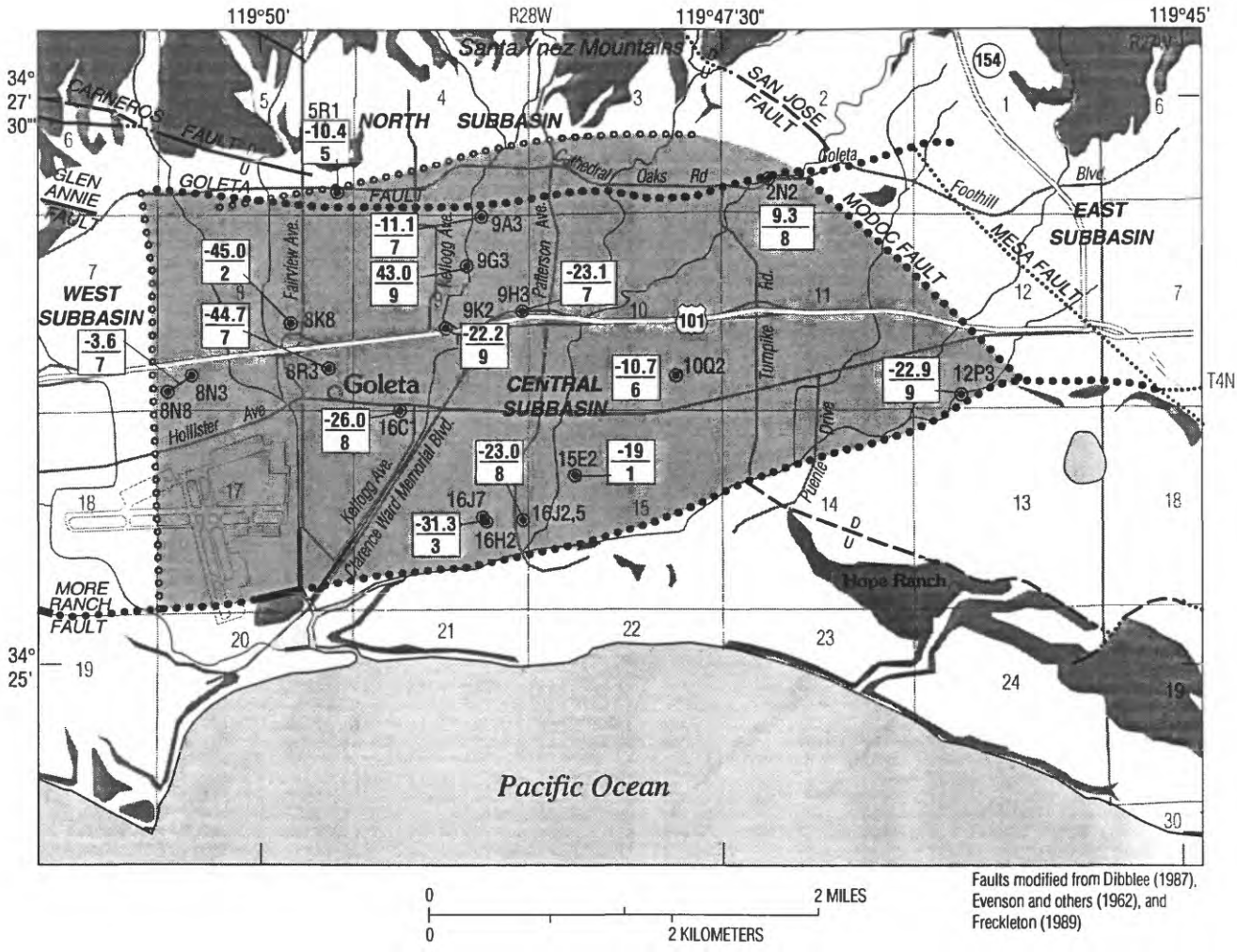


Figure 5. Average net water-level change at network wells, Goleta Central ground-water subbasin, Santa Barbara County, California, 1972 to 1996.

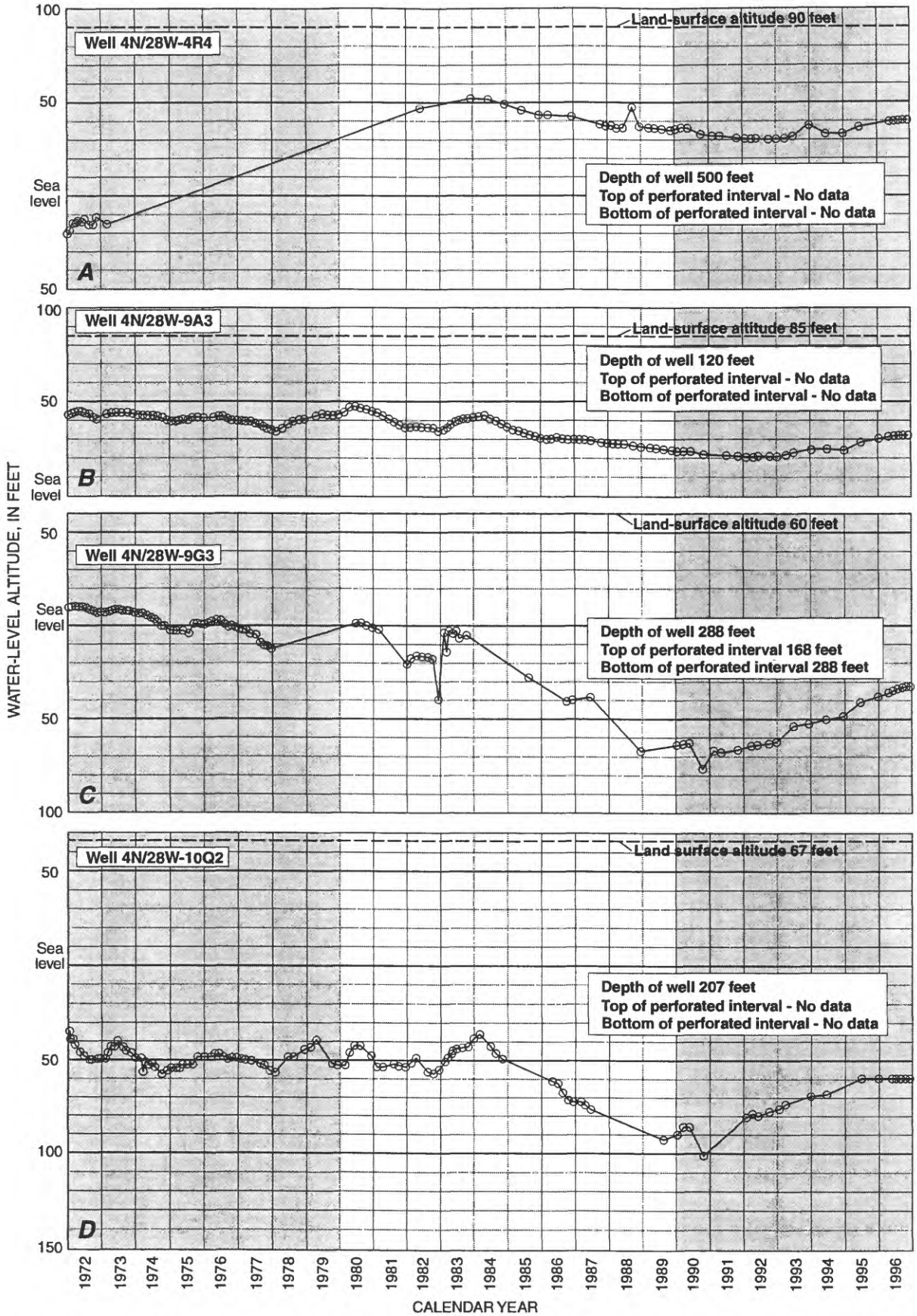


Figure 6. Water levels for selected wells in the Goleta Central ground-water subbasin, Santa Barbara County, California, 1972–96. (Water-level measurements made when well was not pumped.)

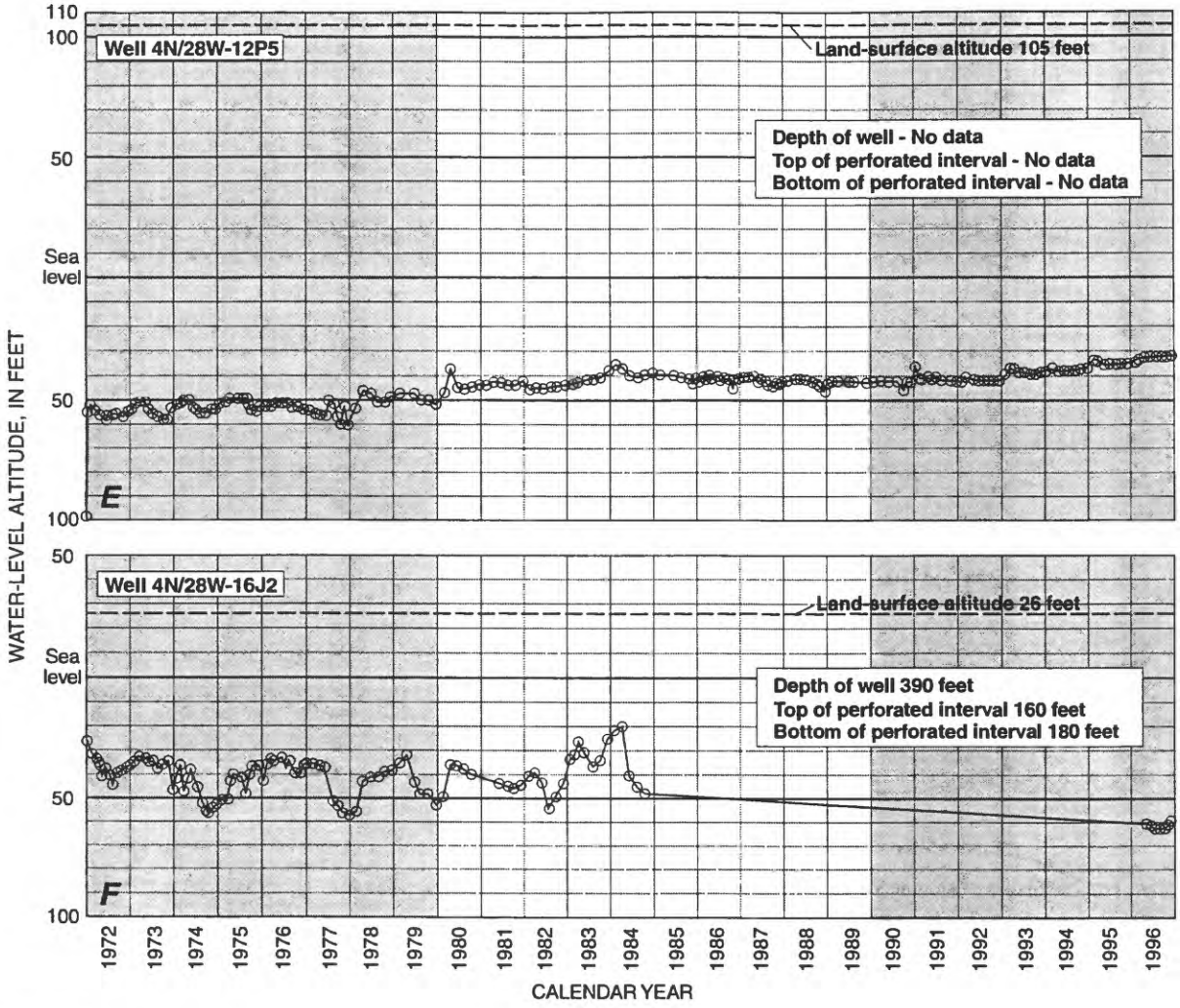


Figure 6.—Continued.

measurements available for each site. The weighted mean is a decline in water level of 20.9 ft.

Another possible influence on the results of the water-level comparison may result from any effects of pumping that were not noted under the "status" heading in the data set (table 2) (and therefore not deleted from the data set). For example, network wells 9H3 and 16J7 (1996 substitute for 16H2) periodically were in use during 1996 but were not measured during pumping. Well 9H3 generally was pumped one day per week for about 8 hours. Measurements were made in this well a minimum of 1.7 days after pumping, which probably allowed enough time for water levels to recover to static conditions. Well 16J7 generally was pumped on a more frequent and irregular schedule, but measurements were made after about 18 hours, or more, since cessation of pumping.

Overall, in the Goleta Central ground-water subbasin, 1996 water levels were lower than 1972 levels. However, this leaves a question about the history of water-level changes in the intervening years. To evaluate this question, hydrographs (with water-level measurements made during pumping deleted) were plotted for selected network wells for 1972 through 1996 (fig. 6). For 1972-83 the trend was either a general rise in water level (well 4R4, fig. 6 *A*), a general decline in water level (well 9G3, fig. 6 *C*), or a relatively flat trend (wells 9A3, 10Q2, and 16J2; fig. 6 *B, D, F*). For most of the selected wells, the hydrographs show a peak in water levels in 1983-84, a decline during 1984-92, and a gradual rise during 1993-96. For most of the selected wells, the 1993-96 rise in water level was not sufficient to return water levels to the 1972 altitudes. Exceptions are well 4R4 (fig. 6 *A*), which had a significant 1973-84 rise, and well 12P5 (fig. 6 *E*), which had a relatively

stable water level during 1972-77 and then a gradual rise during 1978-96. Both wells 4R4 and 12P5 appear, on the basis of evidence from well-depth soundings, to have collapsed sometime prior to 1995 and therefore were not included in the network.

SUMMARY AND CONCLUSIONS

Goleta Water District (GWD) Ordinance No. 91, the Safe Water Supplies Ordinance, states that the GWD shall establish a "drought buffer" by committing at least 2,000 acre-ft/yr, commencing in the first year the State Water Project makes deliveries to the GWD, to the Central subbasin of the Goleta ground-water basin. If ground-water levels in the Central subbasin rise to, and are maintained at or above, 1972 levels, the GWD shall not be required to make its annual drought buffer commitment, and may utilize the yield of the Central subbasin to lower the cost of water services to existing customers. Therefore, a need exists to compare current (1996 and future years) ground-water levels with 1972 water levels to help determine if a commitment by the Goleta Water District to establish a drought buffer must be complied with. To meet this need, a network of 15 well sites was selected, and April to December 1996 water-level data were collected monthly and compared with 1972 data. All Central subbasin wells that had nonpumping status when measured in 1972 and that were measurable in 1996 were included in the network.

The 1972 to 1996 water-level changes for corresponding months of the comparison years were averaged for each network well. These averaged changes ranged from a rise of 9.4 ft for well 2N2 to a decline of 45.0 ft for well 8K8. The comparison results indicate a rise in water level at 1 site and a decline at 14 sites. The mean of the declines is 24.0 ft. The altitude at the bottom of the well at the site of water-level rise is higher than bottom altitude at the other network sites, and the well is located a few feet from a probable hydrologic barrier.

The results of the water-level comparison for the Central subbasin may be influenced to some unknown degree by the areal distribution of the network wells and the vertical distribution of their perforated intervals. For this reason, the magnitude of the value of water-level decline calculated from the mean of all the monthly averages for the 15 network sites, 21.8 ft, should be used with caution. The network of wells selected for comparison of 1972 and 1996 water levels is the most inclusive possible given the available data.

In addition, the number of usable individual monthly comparison measurements available for an individual site ranged from one (well 15E2) to nine (wells 9G3, 9K2, and 12P3), and averaged six. Therefore, a weighted mean of the monthly averages was calculated on the basis of the number of comparison measurements available for each site. The weighted mean is a decline in water level of 20.9 ft.

The objective of the study strictly was to compare 1972 and 1996 water levels in the Central subbasin, and the conclusion is that, overall, 1996 water levels are lower than 1972 levels. In general, hydrographs for selected network wells indicate stable or rising water levels for 1972–83, declining levels for 1984–92, and rising levels for 1993–96.

REFERENCES CITED

County of Santa Barbara Office of Environmental Quality, 1976, Impact of urbanization on recharge potential of the Goleta ground-water basin: Prepared in cooperation with Geotechnical Consultants, Inc., 52 p.

Dibblee, T.W., 1987, Geologic map of the Goleta quadrangle, Santa Barbara County, California: Dibblee Foundation Map DF-07, Santa Barbara, California.

Evenson, R.E., Wilson, H.D. Jr., and Muir, K.S., 1962, Yield of the Carpinteria and Goleta ground-water basins, Santa Barbara, California, 1941-58: U.S. Geological Survey Open-File Report, 112 p.

Freckleton, J.R., 1989, Geohydrology of the Foothill ground-water basin near Santa Barbara, California: U.S. Geological Survey Water-Resources Investigations Report 89-4017, 46 p.

Goleta Water District, 1991, Safe water supplies ordinance: Ordinance No. 91-01, 5 p.

Mann, J.F., Jr., 1976, Safe yield of the Goleta ground water basin: Consultants report for the Goleta County Water District, 20 p.

Upson, J.E., 1951 [1952], Geology and ground-water resources of the south-coast basins of Santa Barbara County, California, *with a section on* Surface-water resources, by H.G. Thomasson, Jr.: U.S. Geological Survey Water-Supply Paper 1108, 144 p.