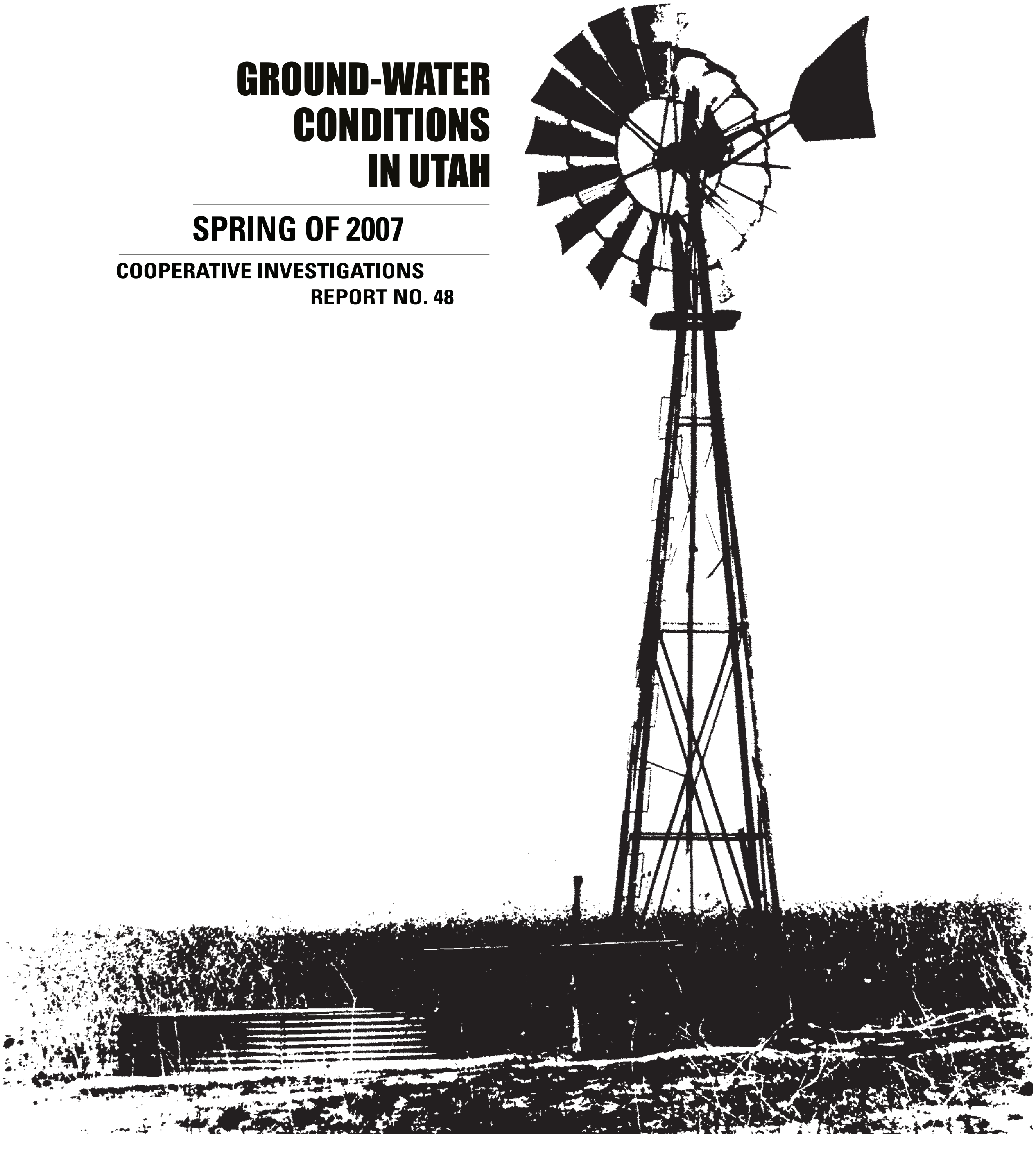
GROUND-WATER CONDITIONS IN UTAH

SPRING OF 2007

COOPERATIVE INVESTIGATIONS
REPORT NO. 48



UTAH DIVISION OF WATER RESOURCES • UTAH DIVISION OF WATER RIGHTS • UTAH DIVISION OF WATER QUALITY

U.S. GEOLOGICAL SURVEY

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 2007

By
C.B. Burden and others
U.S. Geological Survey

Prepared by the U.S. Geological Survey
in cooperation with the Utah Department of Natural Resources,
Division of Water Resources and
Division of Water Rights; and
Utah Department of Environmental Quality, Division of Water Quality

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CONVERSION FACTORS AND DATUMS

Multiply	By	To obtain
acre-foot	1,233	cubic meter
foot	0.3048	meter
gallon per minute	0.06308	liter per second
inch	25.4	millimeter
mile	1.609	kilometer
square mile	2.590	square kilometer

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 1929). Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Chemical concentration is reported only in metric units. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

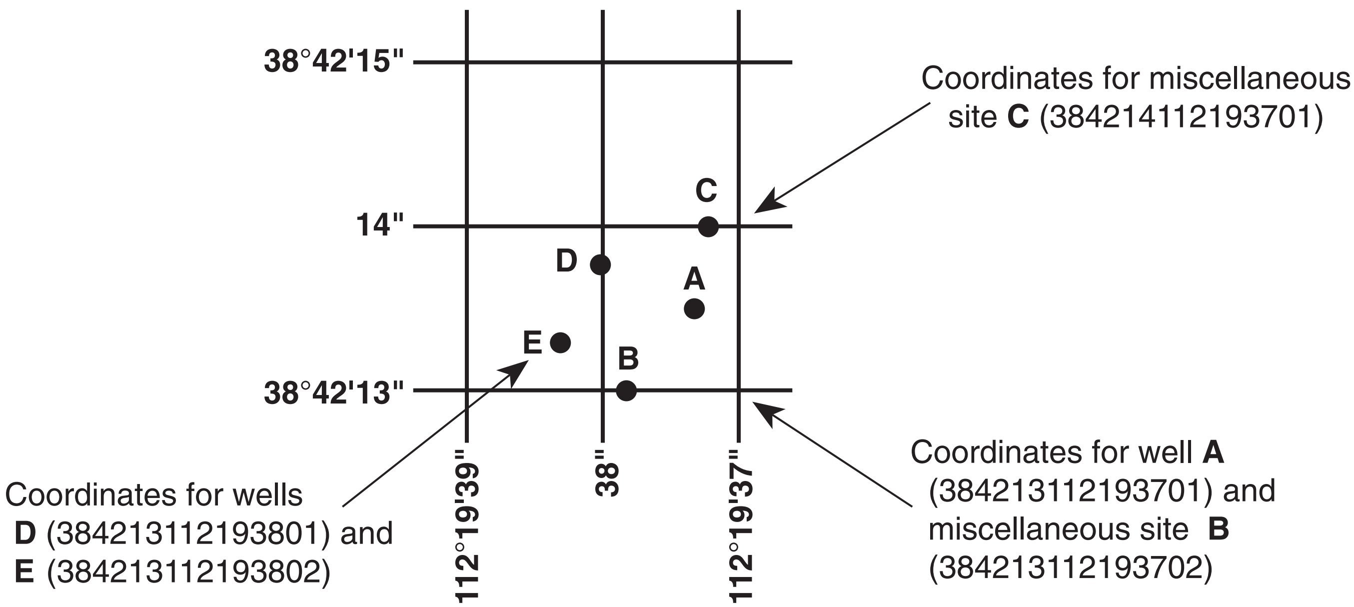
DEFINITION OF TERMS

Acre-foot—The quantity of water required to cover 1 acre to a depth of 1 foot; equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.
Aquifer—A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield substantial amounts of water to wells and springs.
Artesian—Describes a well in which the water level stands above the top of the aquifer tapped by the well (confined). A flowing artesian well is one in which the water level is above the land surface.
Average annual withdrawal—Calculated averages from estimated withdrawals, rounded to the nearest thousand acre-feet.
Cumulative departure from average annual precipitation—A graph of the departure or difference between the average annual precipitation and the value of precipitation for each year, plotted cumulatively. A cumulative plot is generated by adding the departure from average precipitation for the current year to the sum of departure values for all previous years in the period of record. A positive departure, or greater-than-average precipitation, for a year results in a graph segment trending upward; a negative departure results in a graph segment trending downward. A generally downward-trending graph for a period of years represents a period of generally less-than-average precipitation, which commonly causes and corresponds with declining water levels in wells. Likewise, a generally upward-trending graph for a period of years represents a period of greater-than-average precipitation, which commonly causes and corresponds with rising water levels in wells. However, increases or decreases in withdrawals of ground water from wells also affect water levels and can change or eliminate the correlation between water levels in wells and the graph of cumulative departure from average precipitation.
Dissolved—Material in a representative water sample that passes through a 0.45–micrometer membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.
Land-surface datum (lsd)—A datum plane that is approximately at land surface at each ground-water observation well.
Milligrams per liter—A unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represents the mass of solute per unit volume (liter) of water.
Precipitation—The total annual precipitation in inches, rounded to tenths of an inch. for selected locations is computed from monthly total precipitation (rain, sleet, hail, snow, etc.). Data supplied by the National Oceanic and Atmospheric Administration (NOAA) and the Utah Climate Center. Data may be provisional and/or estimated when used to compute annual total and long-term average precipitation values.
Specific conductance—A measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25 degrees Celsius. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids concentration of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in microsiemens). This relation is not constant in water from one well or stream to another, and it may vary for the same source with changes in the composition of the water.
USGS—U.S. Geological Survey.

NUMBERING SYSTEM FOR WELLS AND SURFACE-WATER SITES

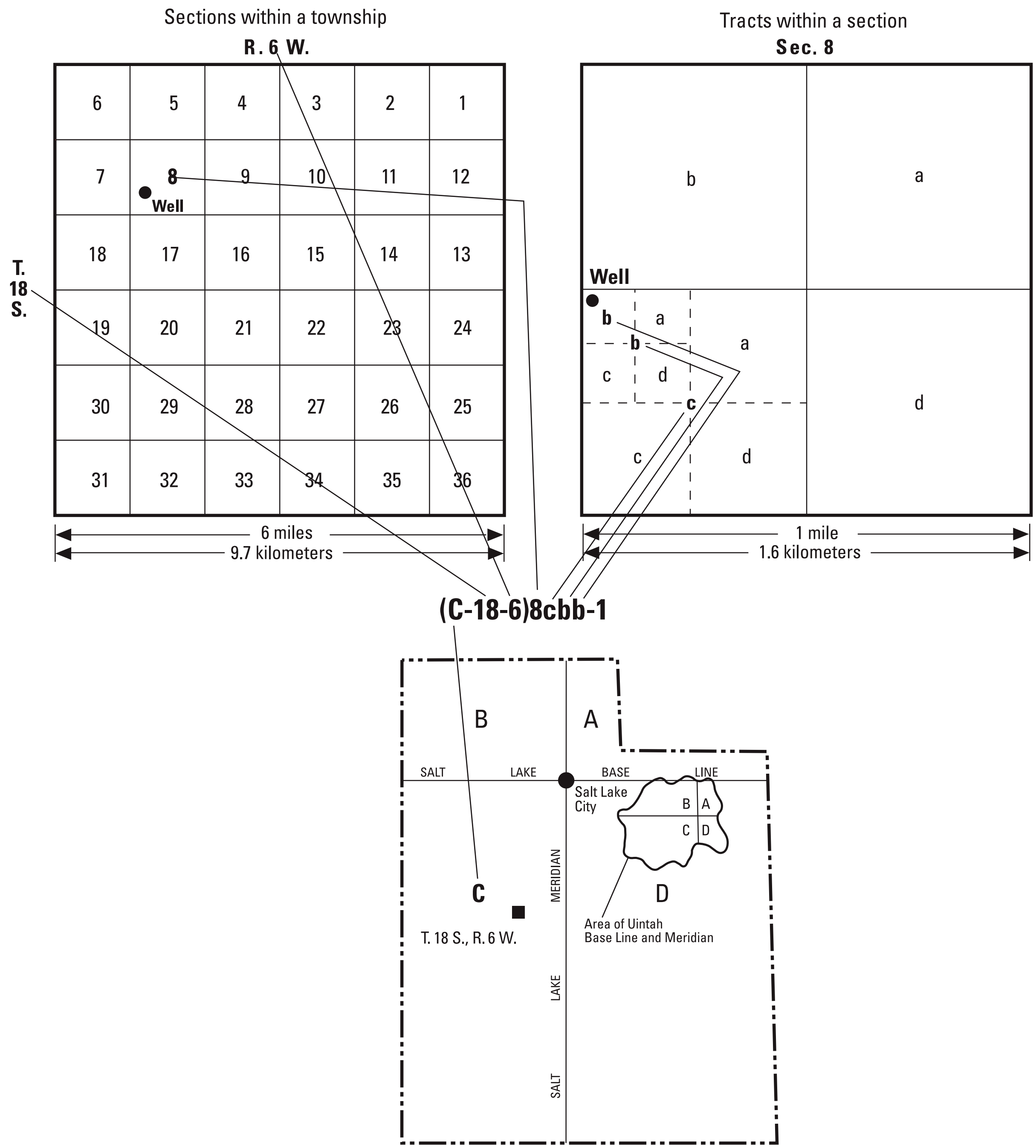
Wells by Latitude and Longitude

The USGS well and miscellaneous site-numbering system is based on the grid system of latitude and longitude. The system provides the geographic location of the well and a unique number for each site. The number consists of 15 digits. The first 6 digits denote the degrees, minutes, and seconds of latitude, and the next 7 digits denote degrees, minutes, and seconds of longitude; the last 2 digits are a sequential number for wells within a 1-second grid. In the event that the latitude-longitude coordinates for a well are the same, a sequential number such as “01,” “02,” and so forth, would be assigned as one would for wells. Even though the site number is based on latitude and longitude, it may not reflect the accurate location of the site. When error corrections or new technology locate a site more accurately, latitude-longitude coordinates will change but the site number will not. In addition to the well number that is based on latitude and longitude given for each well, another well number is assigned based on the U.S. Bureau of Land Management’s system of land subdivision.



Wells by Bureau of Land Management System of Land Subdivision

The well-numbering system used in Utah is based on the Bureau of Land Management’s system of land subdivision. The well-numbering system is familiar to most water users in Utah, and the well number shows the location of the well by quadrant, township, range, section, and position within the section. Well numbers for most of the State are derived from the Salt Lake Base Line and the Salt Lake Meridian. Well numbers for wells located inside the area of the Uintah Base Line and Meridian are designated in the same manner as those based on the Salt Lake Base Line and Meridian, with the addition of the “U” preceding the parentheses. The numbering system is illustrated on the following page.



Surface-Water Sites— Downstream Order and Station Number

Since October 1, 1950, hydrologic-station records in USGS reports have been listed in order of downstream direction along the main stream. All stations on a tributary entering upstream from a main-stream station are listed before that station. A station on a tributary entering between two main-stream stations is listed between those stations.

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 2007

By C.B. Burden and others
U.S. Geological Survey

INTRODUCTION

This is the forty-fourth in a series of annual reports that describe ground-water conditions in Utah. Reports in this series, published cooperatively by the U.S. Geological Survey and the Utah Department of Natural Resources, Division of Water Resources and Division of Water Rights, and the Utah Department of Environmental Quality, Division of Water Quality, provide data to enable interested parties to maintain awareness of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawal from wells, water-level changes, precipitation, streamflow, and chemical quality of water. Information on well construction included in this report refers only to wells constructed for new appropriations of ground water. Supplementary data are included in reports of this series only for those years or areas which are important to a discussion of changing ground-water conditions and for which applicable data are available.

This report includes individual discussions of selected significant areas of ground-water development in the State for calendar year 2006. Most of the reported data were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Resources and Division of Water Rights, and the Utah Department of Environmental Quality, Division of Water Quality. This report is available online at *http://www.waterrights.utah.gov/* and *http://ut.water.usgs.gov/newUTAH/GW2007.pdf*.

For comparison purposes in this report, discussions were included regarding Utah State maximum contaminant levels (MCLs) and secondary drinking-water standards of routinely measurable substances present in water supplies. These can be found at: *http://www.rules.utah.gov/publicat/code/r309/r309-200.htm#T5*. The U.S. Environmental protection Agency (EPA) drinking-water standards can be found at *http://www.epa.gov/safewater/mcl.html#mcls.*

The following reports deal with ground water in the State and were published by the U.S. Geological Survey or by cooperating agencies from May 2006 through April 2007:

Ground-water conditions in Utah, spring of 2006, by Burden, C.B., and others, Utah Division of Water Resources Cooperative Investigations Report No. 47.

Ground-water movement and water quality in Lake Point, Tooele County, Utah, 1999-2003, by Kenney, T.A., Wright, S.J., and Stolp, B.J., Scientific Investigations Report 2006-5124.

Hydrology and water quality in the Green River and surrounding agricultural areas near Green River in Emery and Grand Counties, Utah, 2004-05, by Gerner, S.J., Spangler, L.E., Kimball, B.A., Wilberg, D.E., and Naftz, D.L., Scientific Investigations Report 2006-5186.

Hydrology and simulation of ground-water flow, Lake Point, Tooele County, Utah, by Brooks, L.E., Scientific Investigations Report 2006-5310.

Methane gas concentration in soil and ground water, Carbon and Emery Counties, Utah, 1995-2003, by Stolp, B.J., Burr, A.L., and Johnson, K.K., Scientific Investigations Report 2006-5227.

Monitoring for methane gas in Carbon and Emery Counties, Utah, 1995-2003, by Burr, A.L., Stolp, B.J., Johnson, K.K., and Hunt, G.L., Fact Sheet 2006-3113.

Assessment of artificial recharge at Sand Hollow Reservoir, Washington County, Utah, updated to conditions through 2006, by Heilweil, V.M., and Susong, D.D., Scientific Investigations Report 2007-5023.

Hydrologic and water-quality conditions following underground coal mining in the North Fork of the Right Fork of Miller Creek drainage basin, Carbon and Emery Counties, Utah, 2004-2005, by Wilkowske, C.D., and Cillessen, J.L., Scientific Investigations Report 2007-5026.

Effects of climatic extremes on ground water in western Utah, 1930-2005, by Gates, J.S., Scientific Investigations Report 2007-5045.

UTAH'S GROUND-WATER RESERVOIR

Small amounts of ground water can be obtained from wells throughout most of Utah, but large amounts that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The areas of ground-water development discussed in this report are shown in figure 1 and listed in table 1. Relatively few wells outside of these areas yield large amounts of ground water of suitable chemical quality for the uses listed above, although some basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

A small percentage of wells in Utah yield water from consolidated rock. Consolidated rocks that have the highest yield are lava flows, such as basalt, which contain interconnected vesicular openings, fractures, or permeable weathered zones at the tops of flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most wells that penetrate consolidated rock are in the eastern and southern parts of the State in areas where water cannot be obtained readily from unconsolidated deposits.

Most wells in Utah yield water from unconsolidated deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. The largest yields are obtained from coarse materials that are sorted into deposits of uniform grain size. Most wells that yield water from unconsolidated deposits are in large intermountain basins that have been partly filled with rock material eroded from adjacent mountains.

SUMMARY OF CONDITIONS

The total estimated withdrawal of water from wells in Utah during 2006 was about 855,000 acre-feet (table 2), which is about 100,000 acre-feet more than the revised total for 2005 and 8,000 acre-feet more than the 1996-2005 revised average annual withdrawal (table 3). The increase in withdrawals mostly resulted from increased irrigation. The total estimated withdrawal for irrigation was about 466,000 acre-feet, which is 61,000 acre-feet more than the revised value for 2005. Withdrawal for industrial use increased about 10,000 acre-feet to about 80,000 acre-feet. Withdrawal for public supply was about 242,000 acre-feet, which is about 30,000 acre-feet more than the value for 2005. Withdrawal for domestic and stock use was about 64,000 acre-feet, which is about 2,000 acre-feet less than the value for 2005.

Ground-water withdrawal increased from 2005 to 2006 in 13 of the 16 areas of ground-water development discussed in this report (table 2). Withdrawal in Salt Lake Valley increased about 21,000 acre-feet, the largest increase of the ground-water development areas (fig. 1). The 2006 withdrawal was less than the average annual withdrawal for 1996-2005 in 7 of the 16 areas (tables 2 and 3).

The amount of water withdrawn from wells is related to demand and availability of water from other sources, which, in turn, are partly related to local climatic conditions. Precipitation during calendar year 2006 at 20 of 28 weather stations included in this report (National Oceanic and Atmospheric Administration, 2006), was greater than the long-term average. The greatest increase in precipitation from average was 10.1 inches at Pine View dam. The greatest decrease in precipitation from average was 4.5 inches at Heber City.

About 625 water-level measurements were made during February and March 2007 in wells for areas included in this report. Water-level data included in the hydrographs in this report are from measurements made during the spring months, generally February-March, but may include water-level measurements made in April and May. Many of the wells in this report have additional water-level measurements made throughout the year that are not included in this report. All water-level data are available online at *http://waterdata.usgs.gov/ut/nwis/gwlevels*.

In 2006, 549 wells were constructed for new appropriations of ground water, as determined by the Utah Division of Water Rights (table 2), which is 15 less wells than the total reported for 2005.[1] In 2006, 12 large-diameter wells (12 inches or more) were constructed for new appropriations of ground water (table 2). These are principally for withdrawal of water for public supply, irrigation, and industrial use.

[1]Prior to 2004, total includes some monitoring wells.

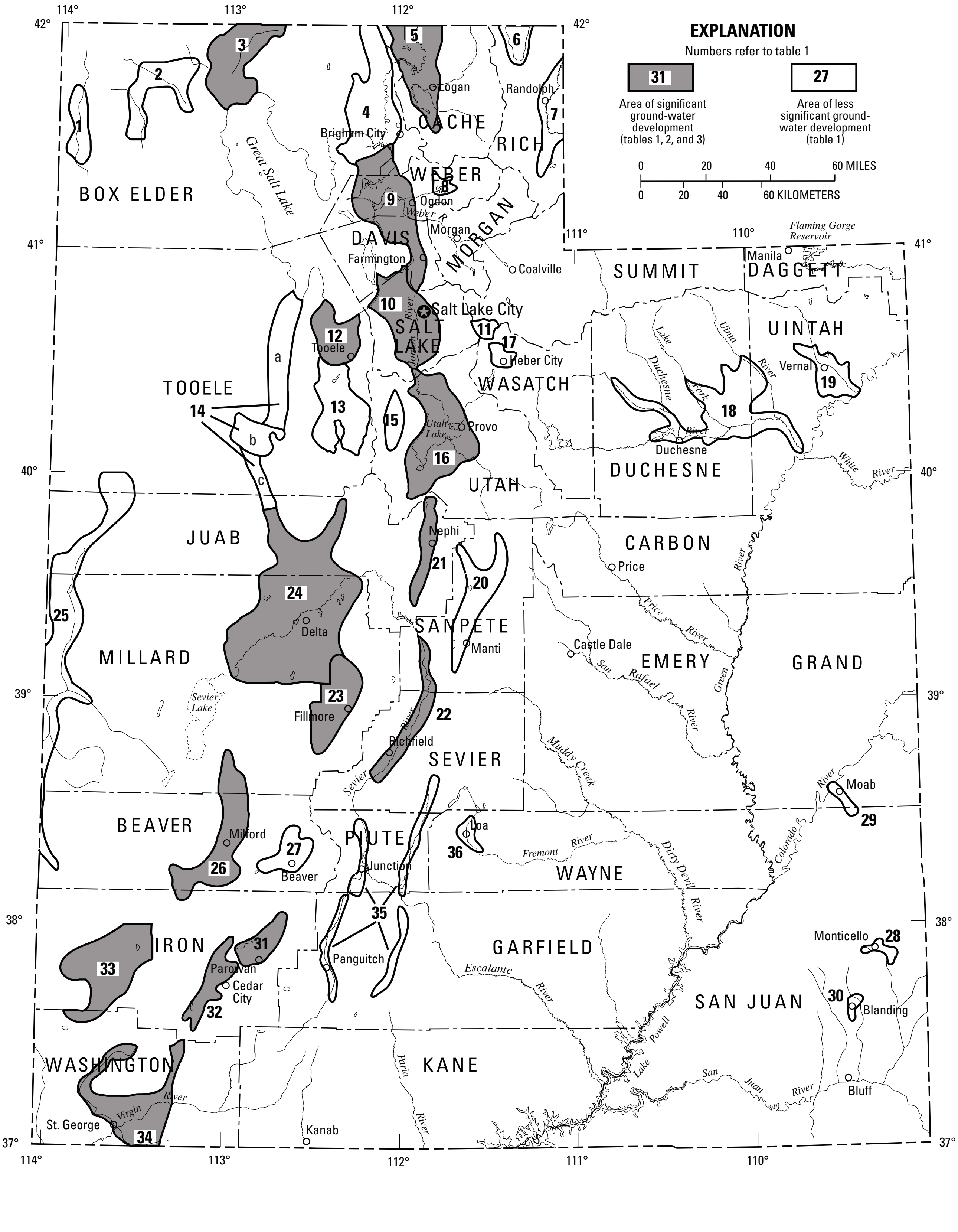


Figure 1. Areas of ground-water development in Utah specifically referred to in this report.

Table 1. Areas of ground-water development in Utah specifically referred to in this report.

[Do., ditto]

Number in figure 1	Area	Principal types of water-bearing rock
1	Grouse Creek Valley	Unconsolidated
2	Park Valley	Do.
3	Curlew Valley	Unconsolidated and consolidated
4	Malad-lower Bear River Valley	Unconsolidated
5	Cache Valley	Do.
6	Bear Lake Valley	Do.
7	Upper Bear River Valley	Do.
8	Ogden Valley	Do.
9	East Shore area	Do.
10	Salt Lake Valley	Do.
11	Park City area	Unconsolidated and consolidated
12	Tooele Valley	Unconsolidated
13	Rush Valley	Do.
14a	Skull Valley	Do.
14b	Dugway area	Do.
14c	Old River Bed	Do.
15	Cedar Valley, Utah County	Do.
16	Utah and Goshen Valleys	Do.
17	Heber Valley	Do.
18	Duchesne River area	Unconsolidated and consolidated
19	Vernal area	Do.
20	Sanpete Valley	Do.
21	Juab Valley	Unconsolidated
22	Central Sevier Valley	Do.
23	Pahvant Valley	Unconsolidated and consolidated
24	Sevier Desert	Unconsolidated
25	Snake Valley	Do.
26	Milford area	Do.
27	Beaver Valley	Do.
28	Monticello area	Consolidated
29	Spanish Valley	Unconsolidated and consolidated
30	Blanding area	Consolidated
31	Parowan Valley	Unconsolidated and consolidated
32	Cedar Valley, Iron County	Unconsolidated
33	Beryl-Enterprise area	Do.
34	Central Virgin River area	Unconsolidated and consolidated
35	Upper Sevier Valleys	Unconsolidated
36	Upper Fremont River Valley	Unconsolidated and consolidated

Table 2. Number of wells constructed and estimated withdrawal of water from wells in Utah.

[Estimated withdrawal from wells-2005 total: from Burden and others (2006, table 2)]

Area	Number in figure 1	Number of wells[1] constructed in 2006		Estimated withdrawal from wells (acre-feet)					
				2006					2005 total (rounded)
		Total	Diameter of 12 inches or more	Irrigation	Industry[1]	Public supply[1]	Domestic and stock	Total (rounded)	
Curlew Valley	3	0	0	31,200	0	200	100	31,000	29,000
Cache Valley	5	33	0	13,300	6,700	8,600	2,000	31,000	29,000
East Shore area	9	5	2	12,600	3,900	24,500	5,000	46,000	41,000
Salt Lake Valley	10	6	1	800	[2]23,200	84,200	23,000	131,000	110,000
Tooele Valley	12	35	0	[3,4]9,500	1,500	6,700	1,000	19,000	[5]19,000
Utah and Goshen Valleys	16	37	2	34,900	5,200	41,900	17,600	100,000	[5]87,000
Juab Valley	21	9	0	20,700	0	[6]60	400	21,000	14,000
Sevier Desert	24	8	0	10,500	6,500	1,500	1,200	20,000	24,000
Central Sevier Valley	22	31	0	12,200	90	2,500	850	16,000	17,000
Pahvant Valley	23	4	0	84,300	0	1,000	320	86,000	80,000
Cedar Valley, Iron County	32	13	0	25,200	100	7,200	2,100	35,000	30,000
Parowan Valley	31	7	0	[7]32,600	0	300	330	33,000	27,000
Escalante Valley									
Milford area	26	3	1	36,400	[8]7,800	710	140	45,000	40,000
Beryl-Enterprise area	33	16	0	76,400	[9]1,600	430	640	79,000	68,000
Central Virgin River area	34	10	3	5,700	200	23,500	2,400	32,000	29,000
Other areas[10,11]		332	3	60,000	23,700	38,600	7,300	130,000	111,000
Total (rounded)		549	12	466,000	80,000	242,000	64,000	855,000	[5]755,000

[1] Data provided by Utah Department of Natural Resources, Division of Water Rights.

[2] Includes some use for air conditioning, about 2,800 acre-feet. About 95 percent was injected back into the aquifer.

[3] Includes some domestic and stock use.

[4] Includes some flowing well discharge.

[5] Revised.

[6] Prior to 1999 included some springs.

[7] Includes some stock use.

[8] Includes 5,830 acre-feet for geothermal power generation. About 99 percent was injected back into the aquifer.

[9] Includes 1,440 acre-feet used for heating greenhouses. About 95 percent was injected back into the aquifer.

[10] Withdrawal totals are estimated minimum. See "Other Areas" section of this report for withdrawal estimates for other areas.

[11] Includes withdrawals for upper Sevier Valley and upper Fremont River Valley that were included with central Sevier Valley in reports prior to number 31 of this series.

Table 3. Total annual withdrawal of water from wells in significant areas of ground-water development in Utah, 1996-2005.

[From previous reports of this series]

Area	Number in figure 1	Thousands of acre-feet (rounded)										1996-2005 average (rounded)
		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
Curlew Valley	3	39	36	29	29	41	36	[1]38	42	38	29	36
Cache Valley	5	24	25	26	24	30	32	33	27	27	29	28
East Shore area	9	57	62	56	61	60	57	49	49	46	41	54
Salt Lake Valley	10	138	123	122	126	145	151	[1]140	130	125	110	131
Tooele Valley	12	23	25	[1]19	21	24	21	21	22	21	[1]19	22
Utah and Goshen Valleys	16	[2]93	[2]84	[2]77	[2]103	[2]120	[2]111	[2]111	[2]108	[2]105	[2]87	100
Juab Valley	21	19	15	12	14	27	29	29	27	26	14	21
Sevier Desert	24	17	17	12	12	15	19	36	28	41	24	22
Central Sevier Valley	22	21	20	20	20	13	12	11	15	15	17	16
Pahvant Valley	23	83	67	66	76	80	80	89	86	85	80	79
Cedar Valley, Iron County	32	35	34	36	32	[1]35	32	42	39	40	30	36
Parowan Valley	31	29	25	28	[1]26	30	[1]33	39	31	37	27	30
Escalante Valley												
Milford area	26	52	52	41	41	49	42	52	50	44	40	46
Beryl-Enterprise area	33	92	81	74	79	84	81	99	92	98	68	85
Central Virgin River area	34	17	18	20	[1]18	[1]26	27	27	28	26	29	24
Other areas		113	107	99	106	[1]135	114	131	128	129	111	117
Total		[2]852	[2]791	[1,2]737	[1,2]788	[1,2]914	[1,2]877	[1,2]947	[2]902	[2]903	[2]755	847

[1] Revised.

[2] Revised annual total withdrawal from wells in Utah and Goshen Valleys. These revisions resulted from a change in the method used to estimate annual discharge from flowing wells in northern Utah Valley.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CURLEW VALLEY

By David V. Allen

The Curlew Valley drainage basin extends across the Utah-Idaho State line between latitudes 41°40' and 42°30' north and longitudes 112°30' and 113°20' west, and covers about 1,200 square miles. The valley is bounded on the west, north, and east by mountains that range in altitude from about 6,500 to nearly 10,000 feet and is open to the south, where water draining from the valley enters Great Salt Lake.

The Utah part of Curlew Valley (Utah subbasin) covers about 550 square miles. It is an arid to semiarid, largely uninhabited area, with a community center at Snowville. Average annual precipitation in the Utah subbasin is less than 8 inches on the valley floor and reaches a maximum that exceeds 35 inches on one of the highest mountain peaks.

The principal source of water in the Utah subbasin is ground water. The ground-water reservoir is primarily composed of confined aquifers in alluvial and lacustrine deposits and volcanic rocks. These formations yield several hundred to several thousand gallons of water per minute to individual large-diameter irrigation wells west of Snowville and near Kelton.

Total estimated withdrawal of water from wells in Curlew Valley in 2006 was about 31,000 acre-feet, which is 2,000 acre-feet more than the value for 2005 and 5,000 acre-feet less than the average annual withdrawal for 1996-2005 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2007 is shown in figure 2. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3.

Water levels in Curlew Valley generally rose less than 1 foot from March 2006 to March 2007. Since the mid-1980s, water levels have generally declined, probably the result of continued large withdrawals for irrigation.

Precipitation at Grouse Creek in 2006 was about 10.8 inches, which is about 7.0 inches less than in 2005 and about 0.5 inch less than the average annual precipitation for 1959-2006.

Physical properties and records of chemical analyses for water from three wells in Curlew Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 39. Specific conductance of waters from wells in Curlew Valley sampled during 2006 ranged from a low of 1,070 microsiemens per centimeter at 25 degrees Celsius to 3,100 microsiemens per centimeter at 25 degrees Celsius. Water from all three wells exceeded secondary drinking-water standards for dissolved-solids concentration and water from well (B-14-8)11bca-1 exceeded the secondary drinking-water standard for sulfate. The concentration of chloride in water from two of the three wells also exceeded secondary drinking-water standards.

The concentration of dissolved solids in water from well (B-12-11)4bcc-1, north of Kelton, has generally increased since 1972 (fig. 3). The concentration of dissolved solids in water from well (B-14-9)5bbb-1, located approximately 10 miles west of Snowville, has increased from about 320 milligrams per liter in 1972 to 822 milligrams per liter in 2006 (fig. 3, table 4). The dissolved-solids concentration for water from this well increased 22 percent, from 640 milligrams per liter in 2005 to 822 milligrams per liter in 2006. Water from well (B-14-8)11bca-1, located west of Snowville, had the highest dissolved-solids concentration of the three wells at 1,950 milligrams per liter and a hardness of 740 milligrams per liter (as $CaCO_3$). These increases may be a result of recharge from unconsumed irrigation water in which dissolved solids are concentrated by evaporation.

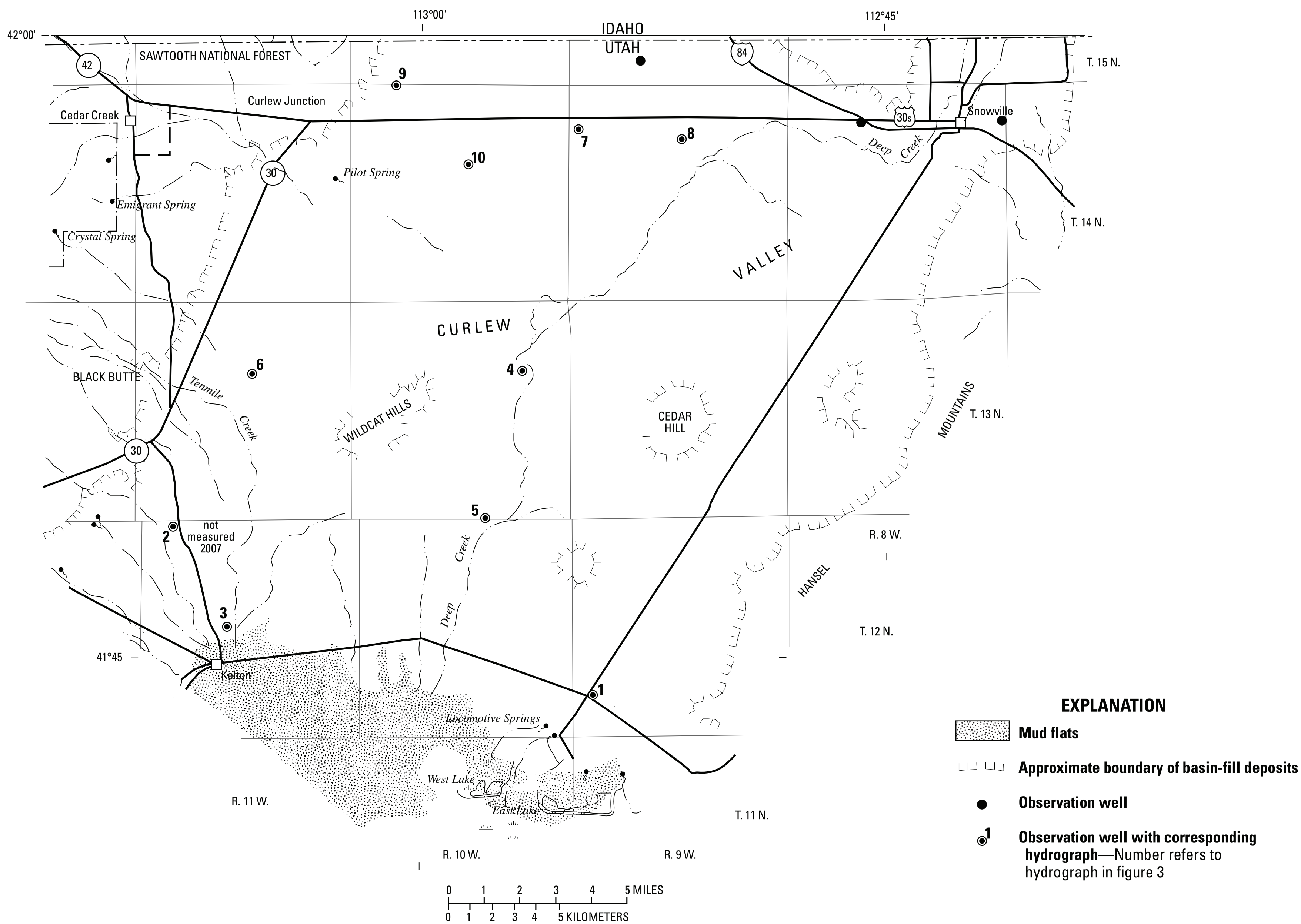


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2007.

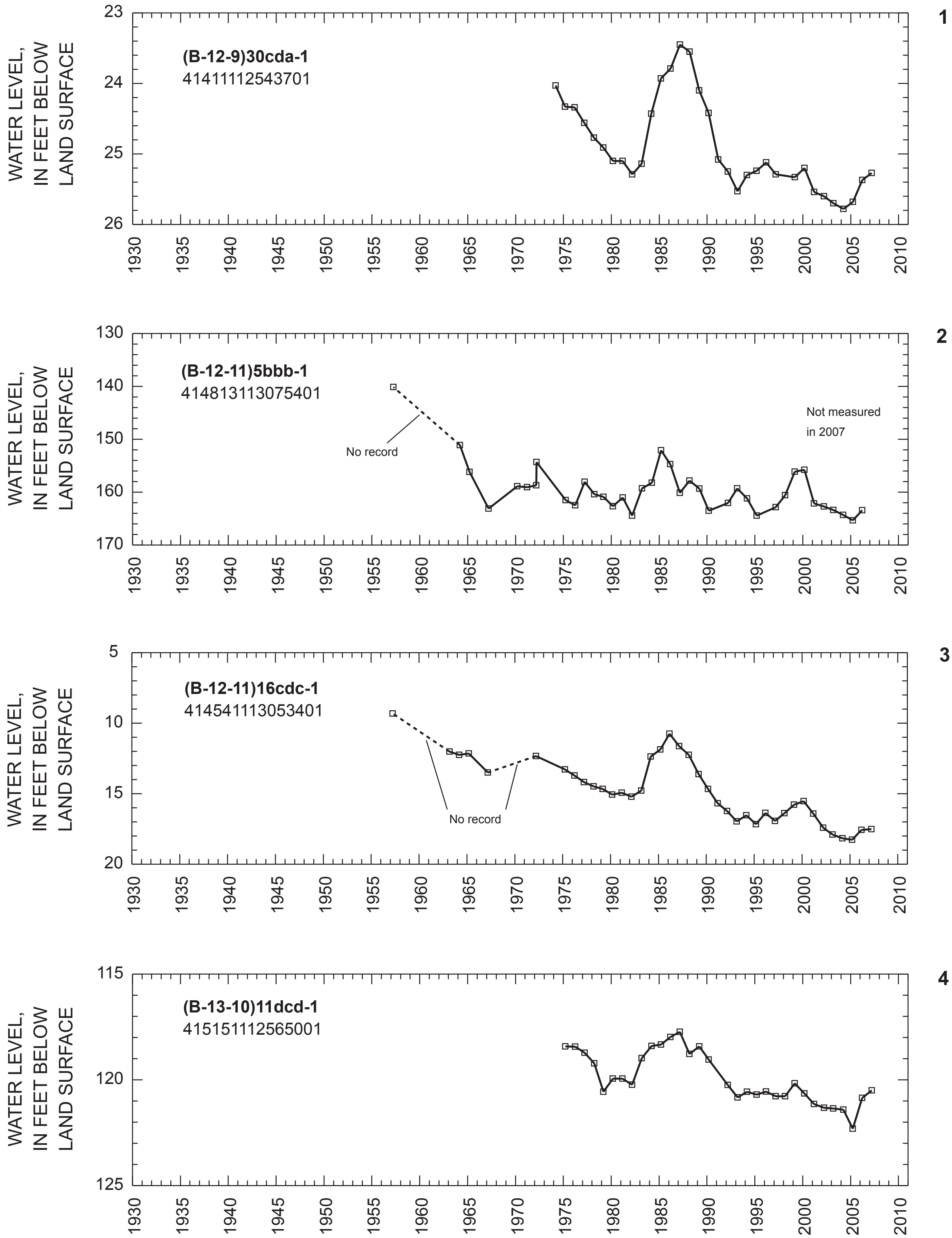


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

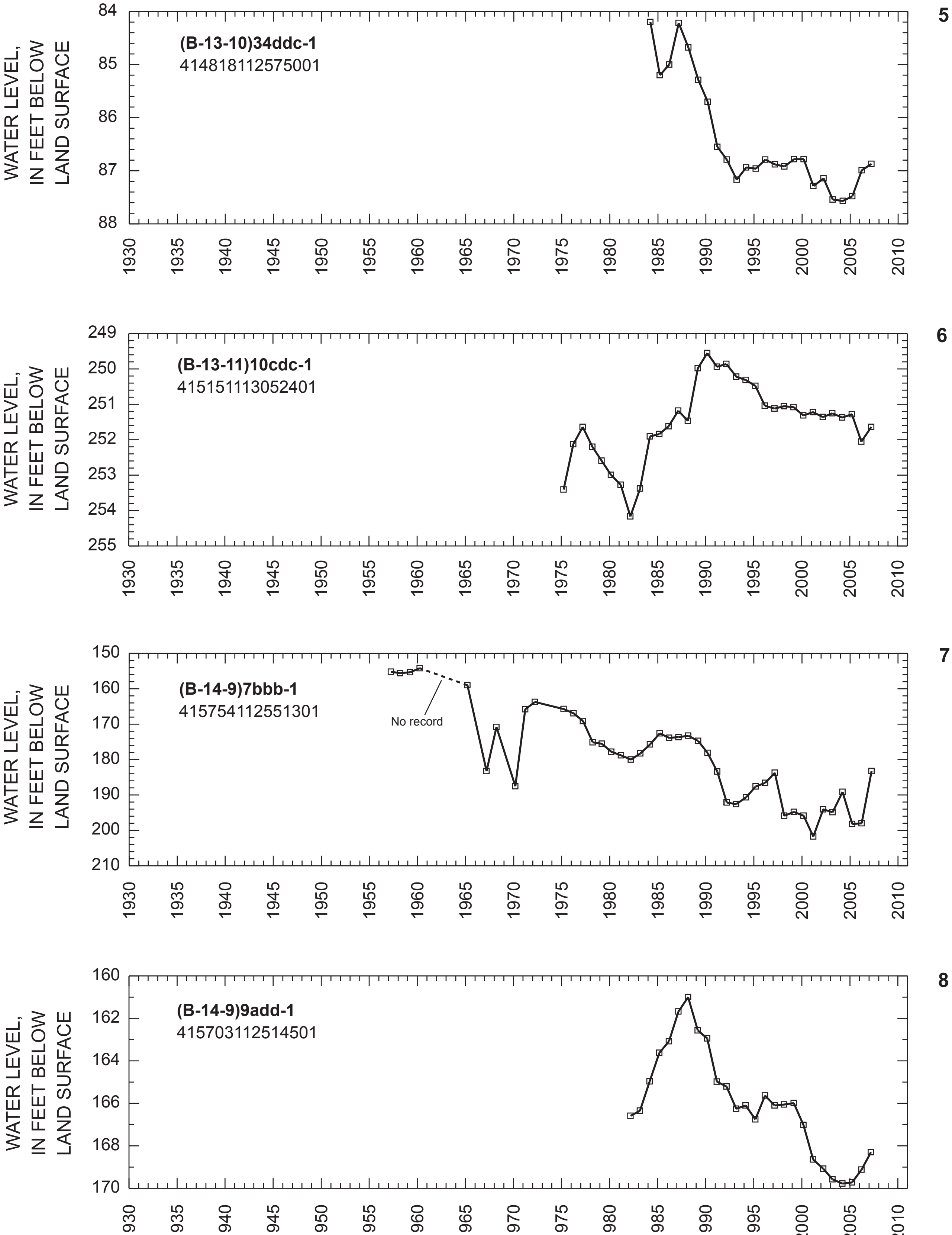
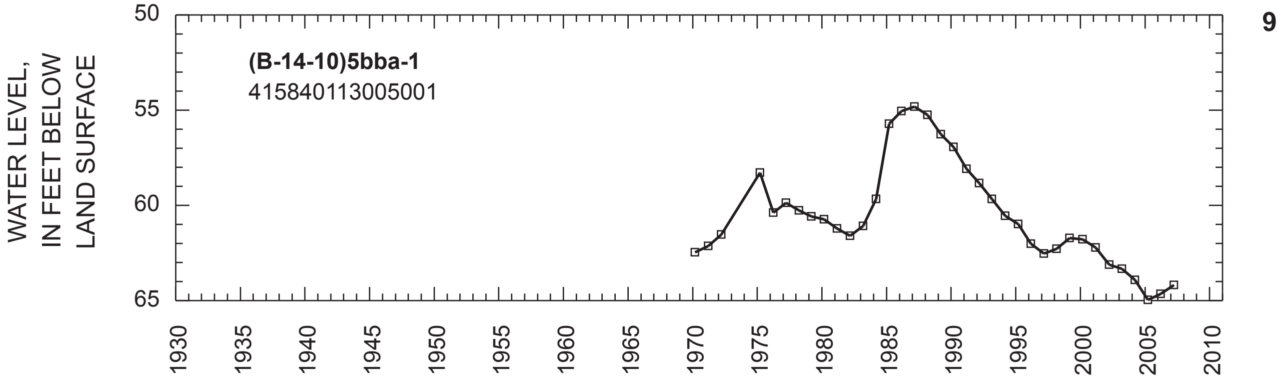


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.



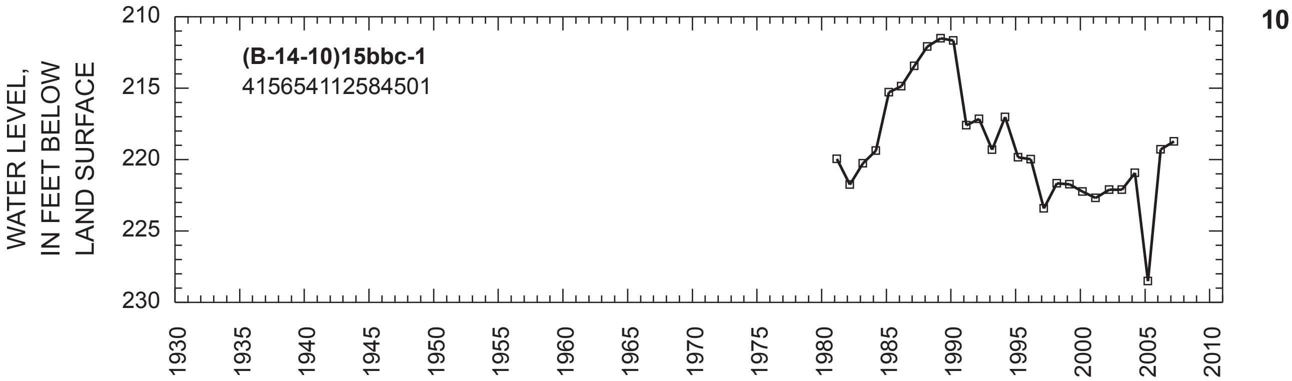


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

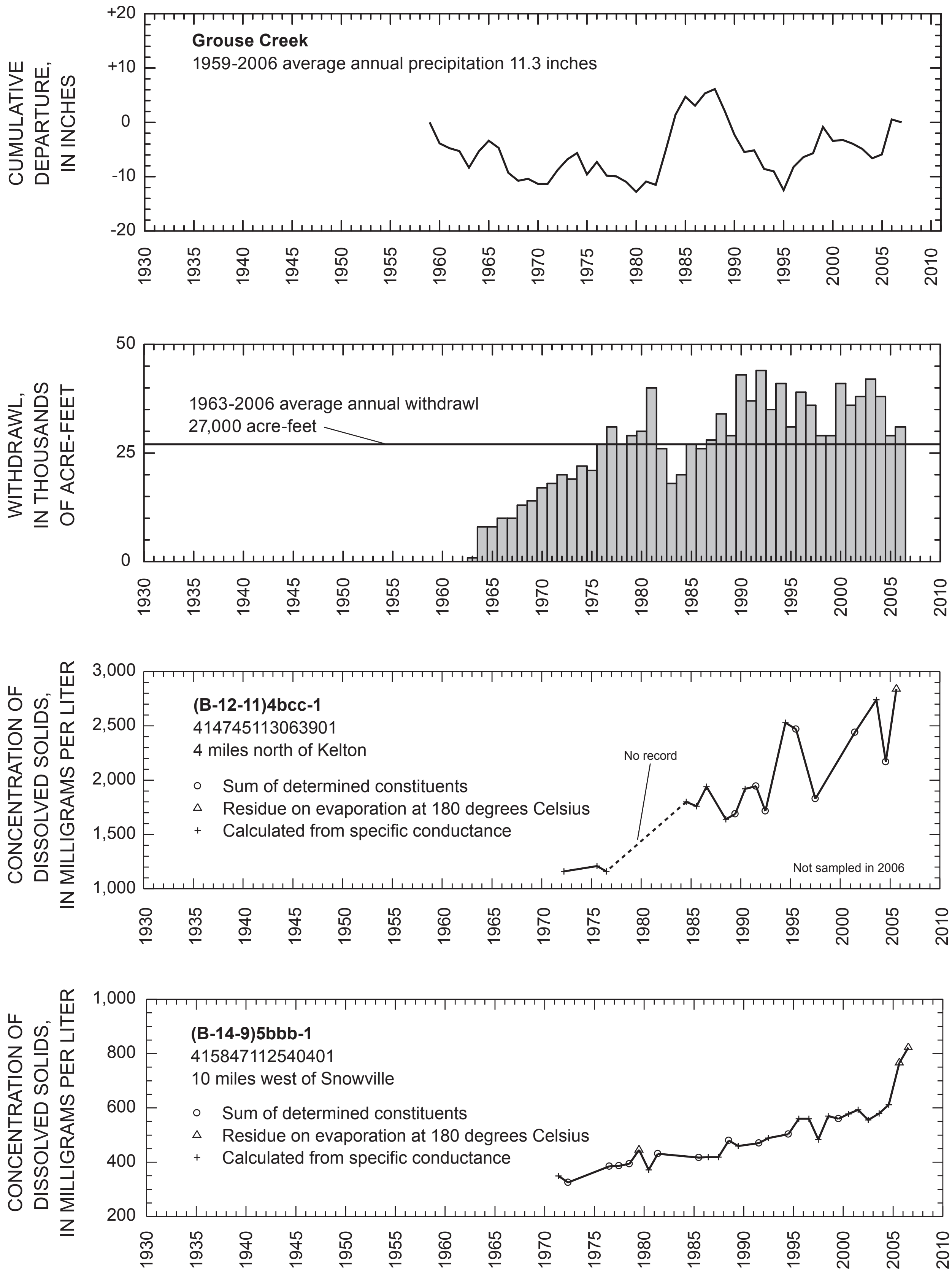


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

CACHE VALLEY

By M.R. Danner

Cache Valley, as referred to in this report, covers about 450 square miles in Utah. Ground water occurs in unconsolidated deposits in the valley, under both water-table and artesian conditions. Recharge to the ground-water system occurs principally at the margins of the valley, and ground water moves toward the center of the valley and west toward Cache Junction.

Total estimated withdrawal of water from wells in Cache Valley in 2006 was about 31,000 acre-feet, which is 2,000 acre-feet more than 2005 and 3,000 acre-feet more than the average annual withdrawal for 1996-2005 (tables 2 and 3). Withdrawal for irrigation was 13,300 acre-feet, which is 700 acre-feet more than in 2005. Withdrawal for public supply was 8,600 acre-feet, 300 acre-feet less than 2005.

The location of wells in Cache Valley in which the water level was measured during March 2007 is shown in figure 4. The relation of the water level in selected observation wells to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1 is shown in figure 5.

Water levels throughout the valley changed only slightly from March 2006 to March 2007. From about 1935 to about 1983 water levels fluctuated with no apparent trend. Levels generally declined from 1985 to 1993, rose from 1993 to 1999, and declined from 1999 to 2004, when they began rising again.

Total discharge of the Logan River (combined flow from the Logan River above State Dam, near Logan, and Logan, Hyde Park, and Smithfield Canal at Head, near Logan) during 2006 was about 240,500 acre-feet, which is 27,900 acre-feet more than the 2005 total of 212,600 acre-feet and 59,500 acre-feet more than the 1941-2006 average annual discharge.

Precipitation at Logan, Utah State University, was about 21.6 inches in 2006. This is about 4.9 inches less than for 2005 and about 3.3 inches more than the average annual precipitation for 1930-2006. The concentration of dissolved solids in water from well (A-13-1)29bcd-1 fluctuated during 1970-2005 with no apparent trend.

The physical properties and records of chemical analyses for water from one well in Cache Valley are listed in tables 4 and 5, and the location of the well is plotted in figure 39. One water-quality sample was collected during 2006 at well (A-13-1)29bcd-1. The dissolved-solids concentration of water from this well has remained relatively constant since 1970, varying between a minimum of about 220 milligrams per liter (in 2002) to a maximum of about 270 milligrams per liter (in 1978). Water from this well had the lowest specific conductance of any of the samples collected. The concentration of dissolved manganese exceeded secondary drinking-water standards for the State of Utah.

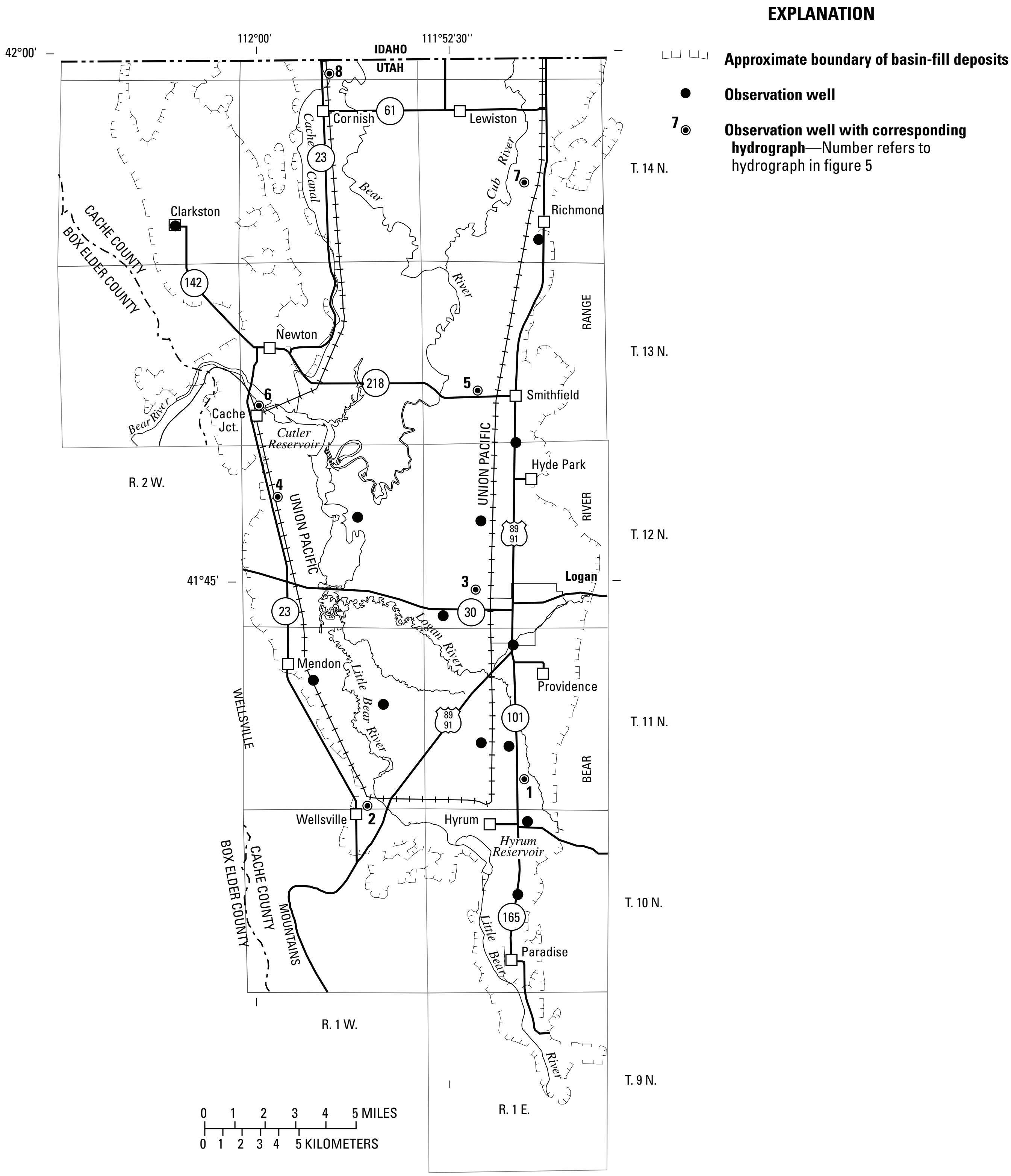


Figure 4. Location of wells in Cache Valley in which the water level was measured during March 2007.

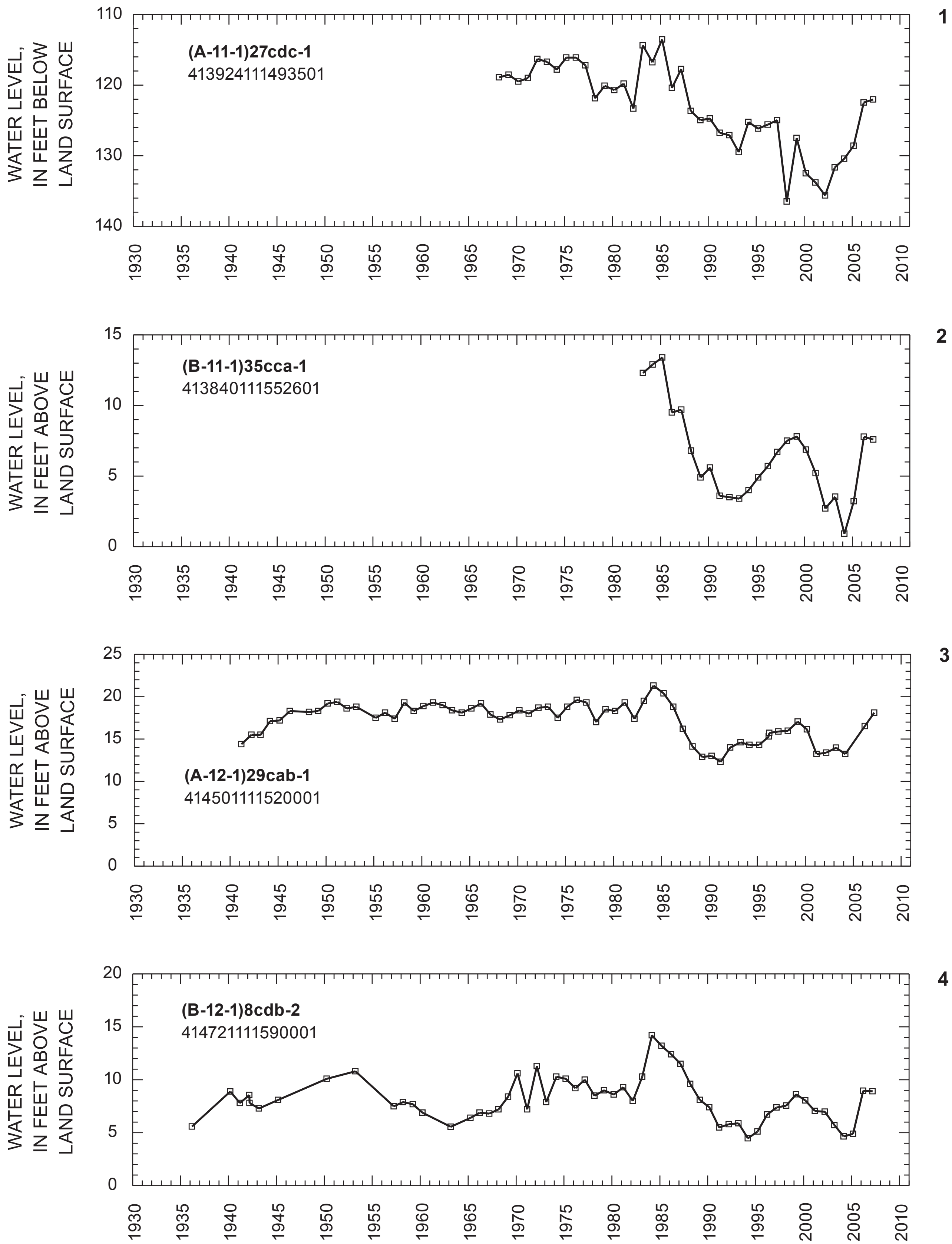


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.

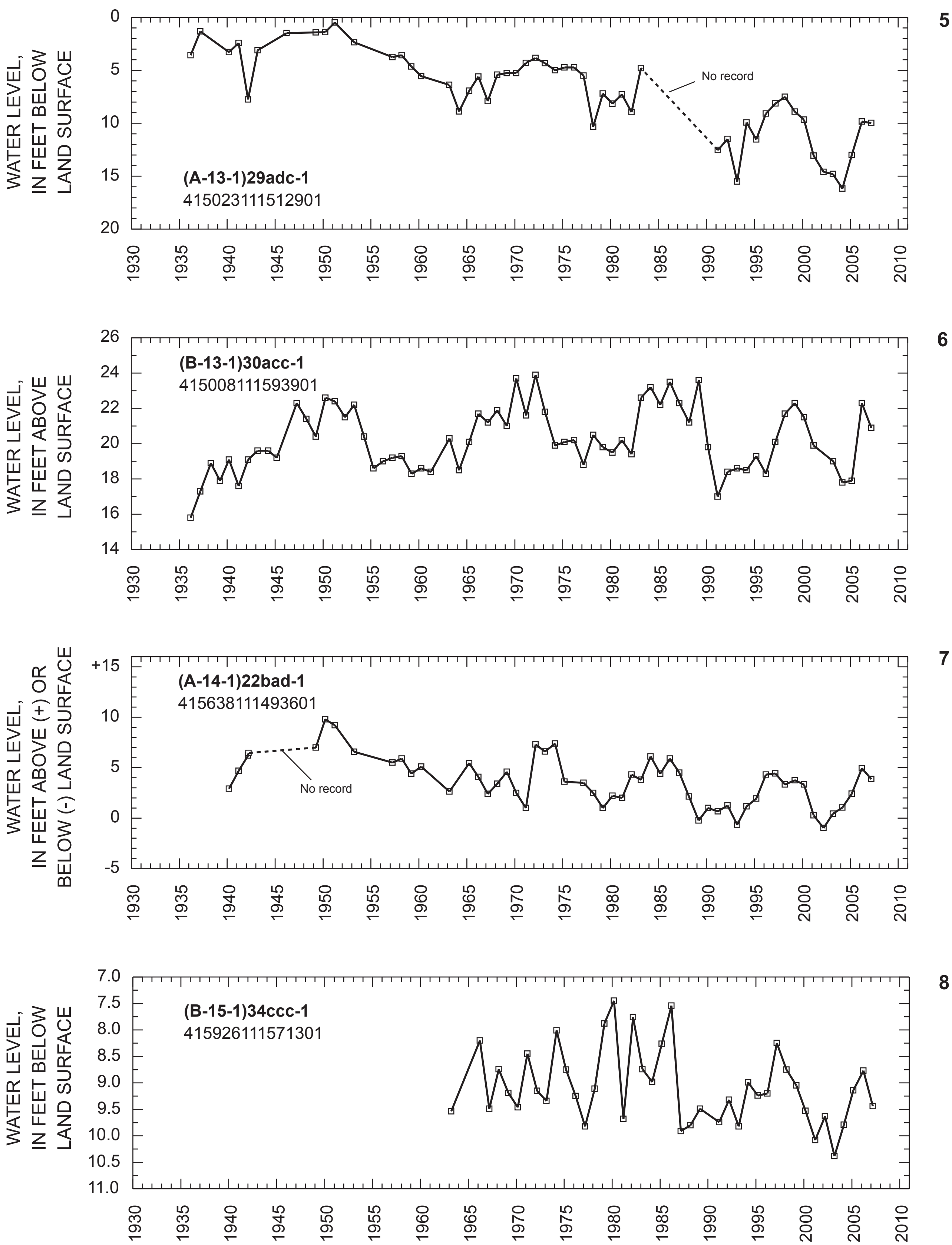


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1—Continued.

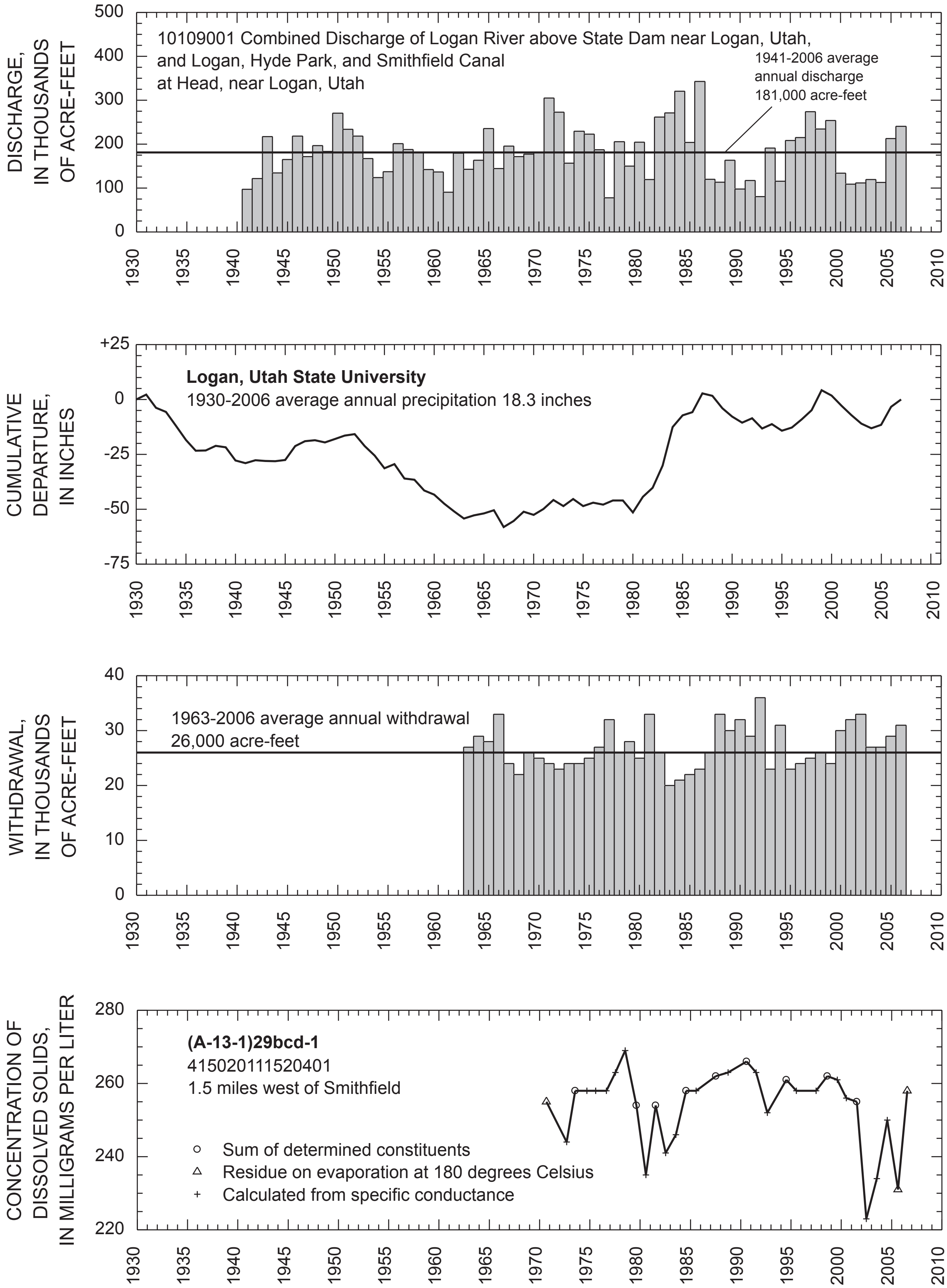


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1—Continued.

EAST SHORE AREA

By Michael Enright

The East Shore area is in north-central Utah between the Wasatch Range and Great Salt Lake. Ground water occurs in unconsolidated deposits under both water-table and artesian conditions, but most of the water withdrawn by wells is from the artesian aquifers. Water enters the artesian aquifers along the eastern edge of the basin-fill deposits and generally moves westward toward Great Salt Lake.

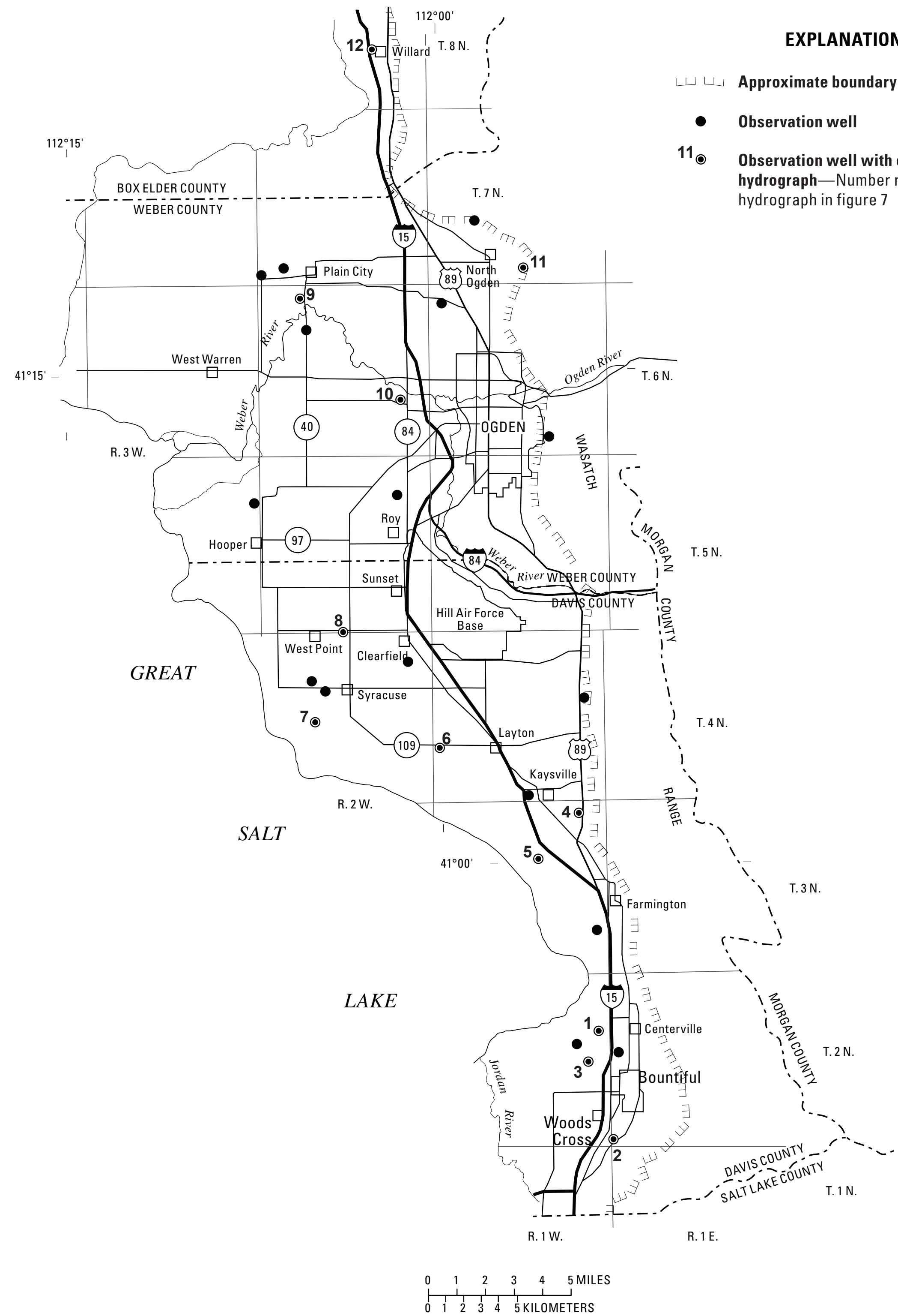
Total estimated withdrawal of water from wells in the East Shore area in 2006 was about 46,000 acre-feet, which is 5,000 acre-feet more than was reported for 2005 and 8,000 acre-feet less than the average annual withdrawal for 1996-2005 (tables 2 and 3). Withdrawal for public supply was about 1,700 acre-feet more than in 2005. Withdrawal for irrigation was about 2,500 acre-feet more than in 2005.

The location of wells in the East Shore area in which the water level was measured during March 2007 is shown in figure 6. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 7.

Water levels changed only slightly from 2006 to 2007 in most of the wells measured in the East Shore area. Water levels generally declined during 1999-2005 throughout the area. Declines probably resulted from less recharge due to less-than-average precipitation and continued large withdrawals for public supply (table 3). Water levels have generally declined in most of the East Shore area from the mid-1950s to 2005.

Precipitation at Ogden Pioneer Powerhouse in 2006 was about 22.1 inches, which is about 0.8 inch more than the average annual precipitation for 1930-2006, and about 5.3 inches less than in 2005.

The physical properties and records of chemical analyses for water from one well in the East Shore area are listed in tables 4 and 5, and the location of the well is plotted in figure 39. One water-quality sample was collected during 2006 at well (B-7-2)32bbb-1, located just northwest of Plain City. The dissolved-solids concentration of water from this well was reported as 1,370 milligrams per liter with a specific conductance of 2,440 microsiemens per centimeter at 25 degrees Celsius. The water from this well exceeded secondary drinking-water standards for the State of Utah for concentrations of chloride (674 milligrams per liter), dissolved solids (1,370 milligrams per liter), and manganese (286 micrograms per liter). Hardness, as calcium carbonate, was 350 milligrams per liter.



EXPLANATION

Approximate boundary of basin-fill deposits

Observation well

11 **Observation well with corresponding hydrograph**—Number refers to hydrograph in figure 7

Figure 6. Location of wells in the East Shore area in which the water level was measured during March 2007.

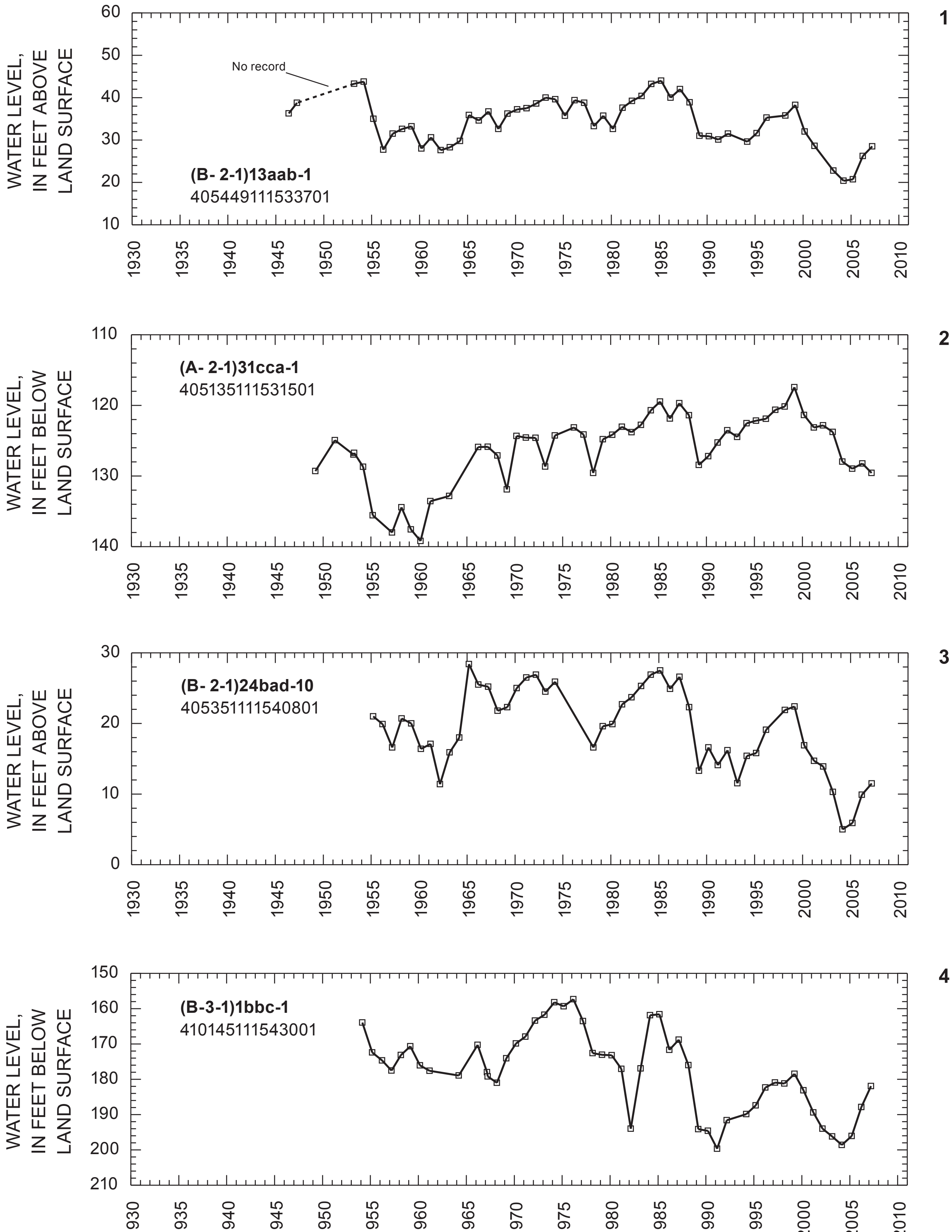


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

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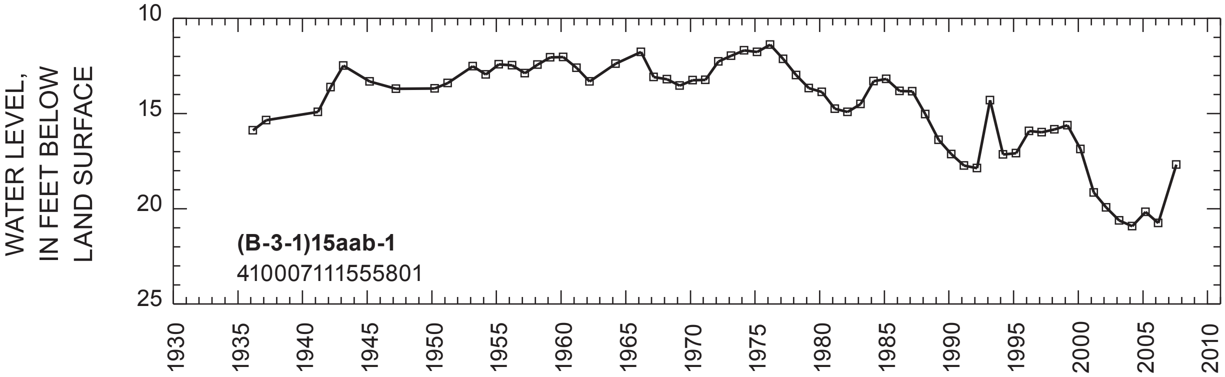

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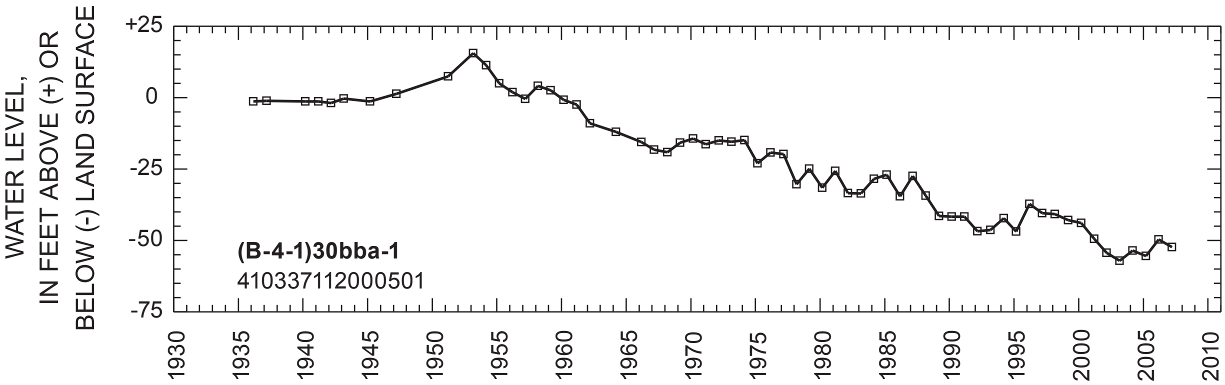

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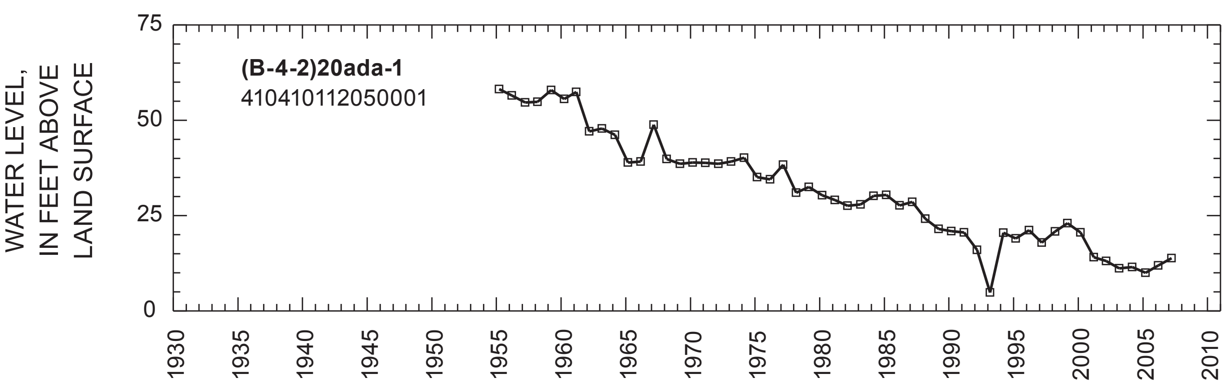

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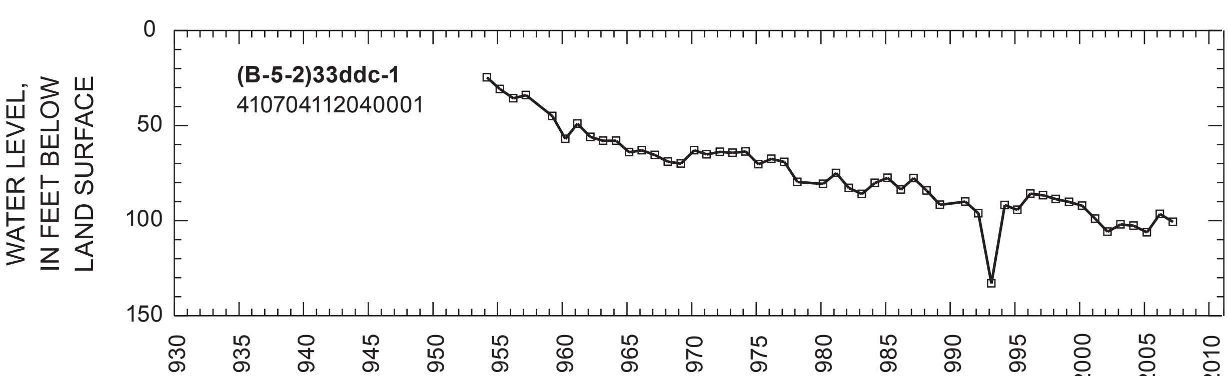
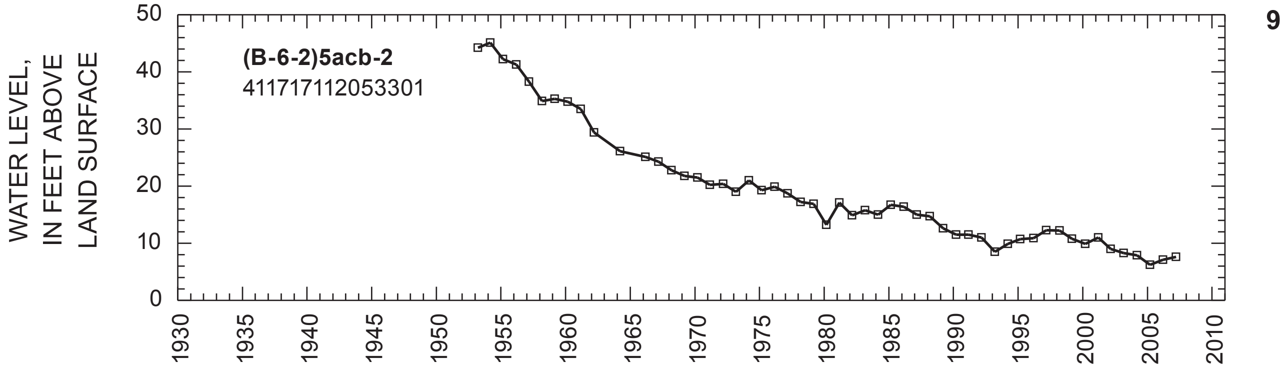
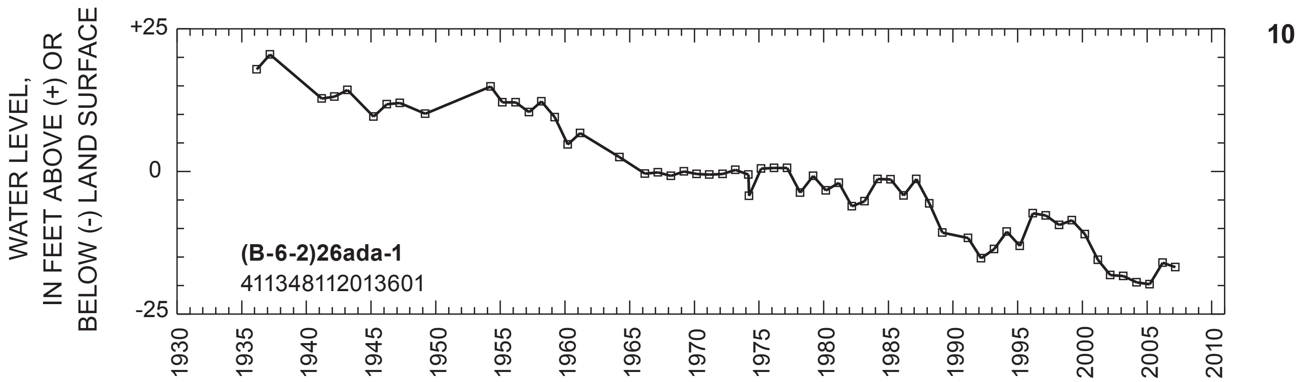
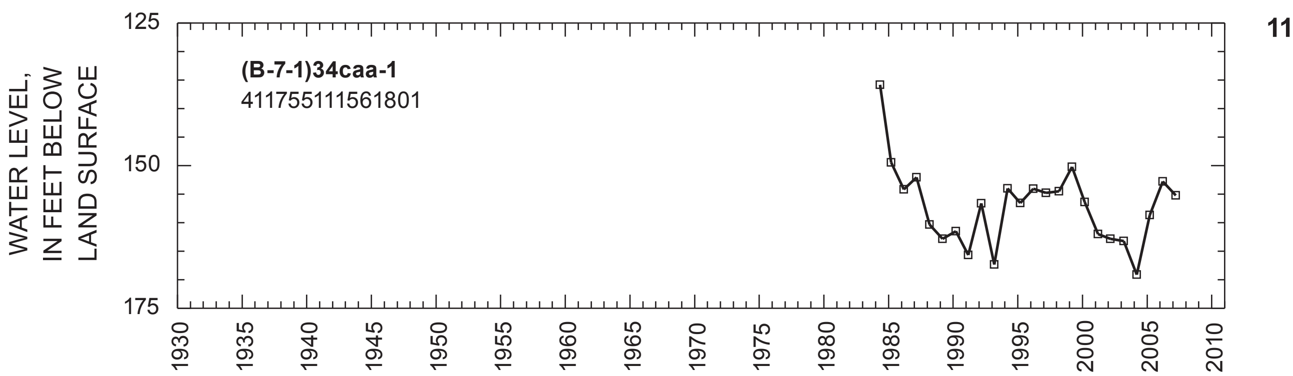


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.







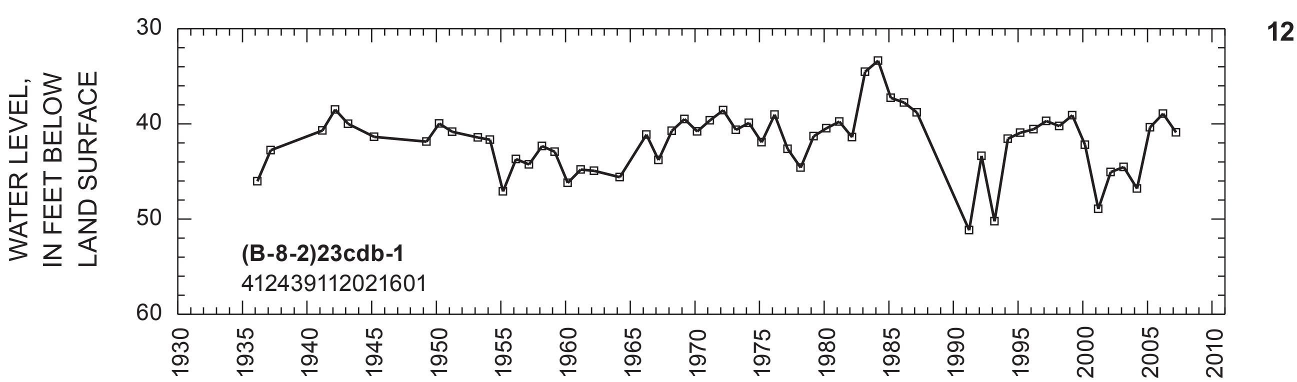


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

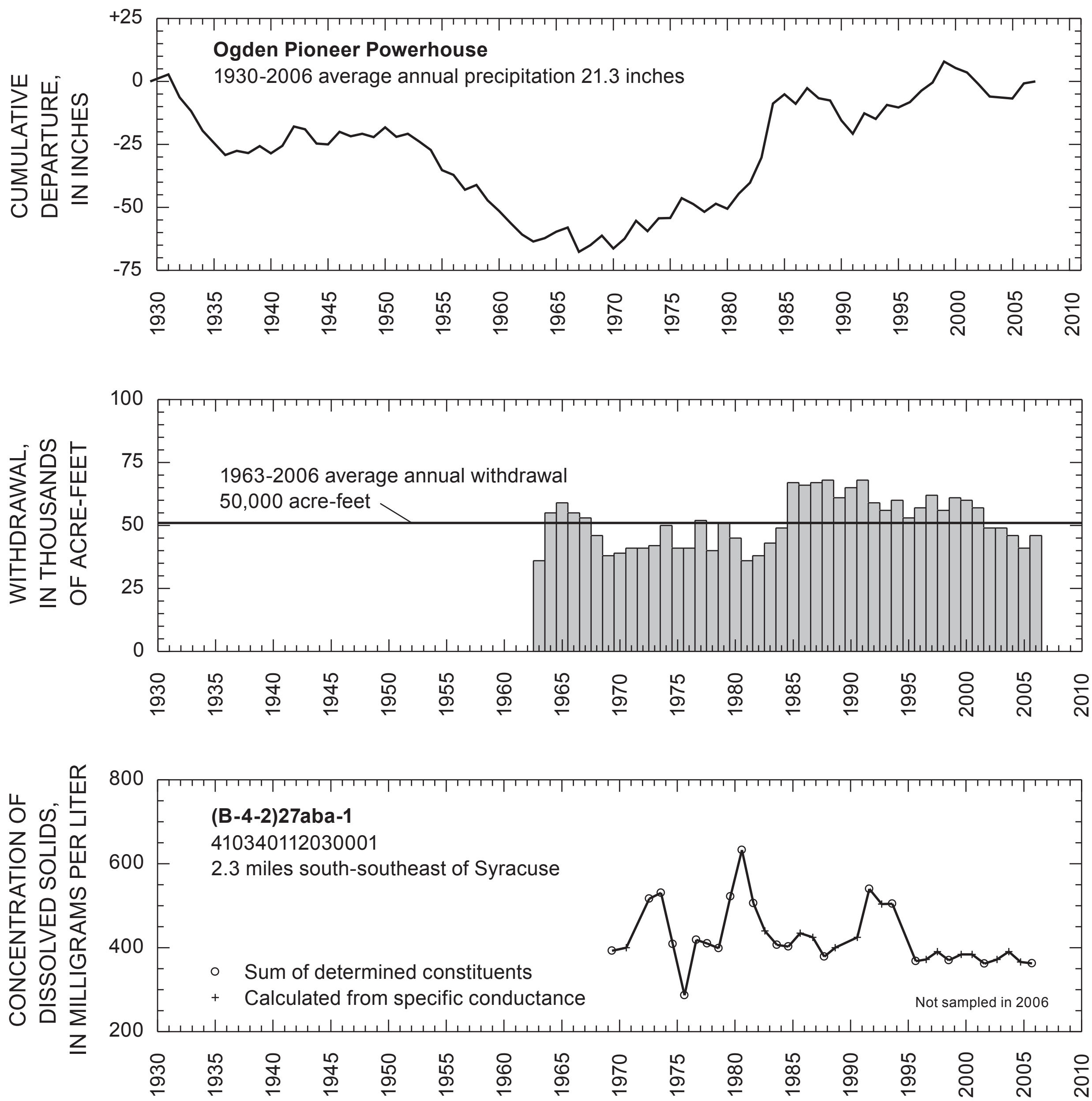


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

SALT LAKE VALLEY

By J.L. Cillessen

Salt Lake Valley covers about 400 square miles in the lowlands of Salt Lake County. Ground water occurs in unconsolidated deposits in the valley under water-table and artesian conditions. Recharge to the aquifers occurs mainly along the area where the mountains border the valley. In the southwestern part of the valley, ground water moves from the base of the Oquirrh Mountains eastward toward the Jordan River. In the northwestern part of the valley, the direction of movement is mostly toward Great Salt Lake. In the eastern half of the valley, ground water moves westward from the base of the Wasatch Range toward the Jordan River. The Jordan River drains both surface and ground water from the valley.

Total estimated withdrawal of water from wells in Salt Lake Valley in 2006 was about 131,000 acre-feet, which is 21,000 acre-feet more than in 2005 and the same as the average annual withdrawal for 1996-2005 (tables 2 and 3). Withdrawal for public supply was about 84,200 acre-feet, which is 18,800 acre-feet more than the total for 2005. Withdrawal for industrial use was about 23,200 acre-feet, which is 2,800 acre-feet more than the total for 2005.

The location of wells in Salt Lake Valley in which the water level was measured during February 2007 is shown in figure 8. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (WSO) (International Airport) are shown in figure 9. Precipitation at Salt Lake City WSO during 2006 was about 16.1 inches, about 0.8 inch less than in 2005 and about 0.8 inch more than the average annual precipitation for 1931-2006.

The relation of the water level in selected observation wells completed in the principal aquifer to cumulative departure from average annual precipitation at Silver Lake near Brighton, and the relation of the water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well are shown in figure 10. Precipitation at Silver Lake near Brighton was about 44.2 inches in 2006, which is about 4.0 inches more than in 2005 and about 1.8 inches more than the average annual precipitation for 1931-2006.

Water levels changed only slightly from February 2006 to February 2007 in most of the wells measured in Salt Lake Valley. The water level in most of the observation wells was highest during 1985-87, which corresponds to a period of much-greater-than-average precipitation. Levels have generally declined since 1987, although substantial rises occurred in the northeastern parts of the valley from 1994 to 1999.

Physical properties and records of chemical analyses for water from one well in the Salt Lake Valley are listed in tables 4 and 5, and the location of the well is plotted in figure 39. The dissolved-solids concentration of water from well (D-1-1)7abd-6, located in the Salt Lake City area, has increased from about 550 milligrams per liter in 1947 to 837 milligrams per liter in 2006. This concentration exceeded the secondary drinking-water standards for the State of Utah. Chloride concentrations in water from this well have increased from about 45 milligrams per liter in 1945 to 160 milligrams per liter in 2006. This flowing well is located at 800 South and 500 East and is routinely used as a drinking-water source.

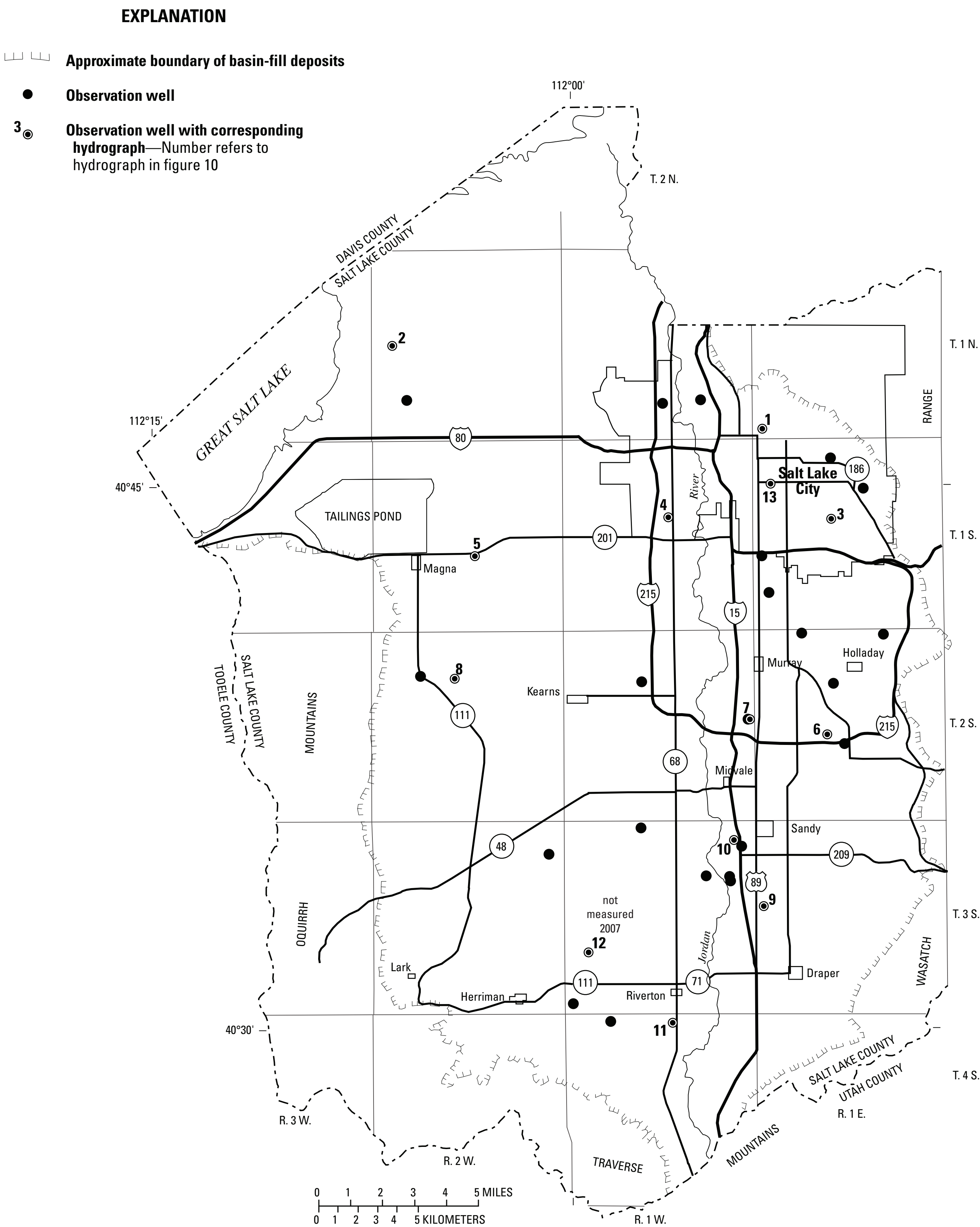


Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 2007.

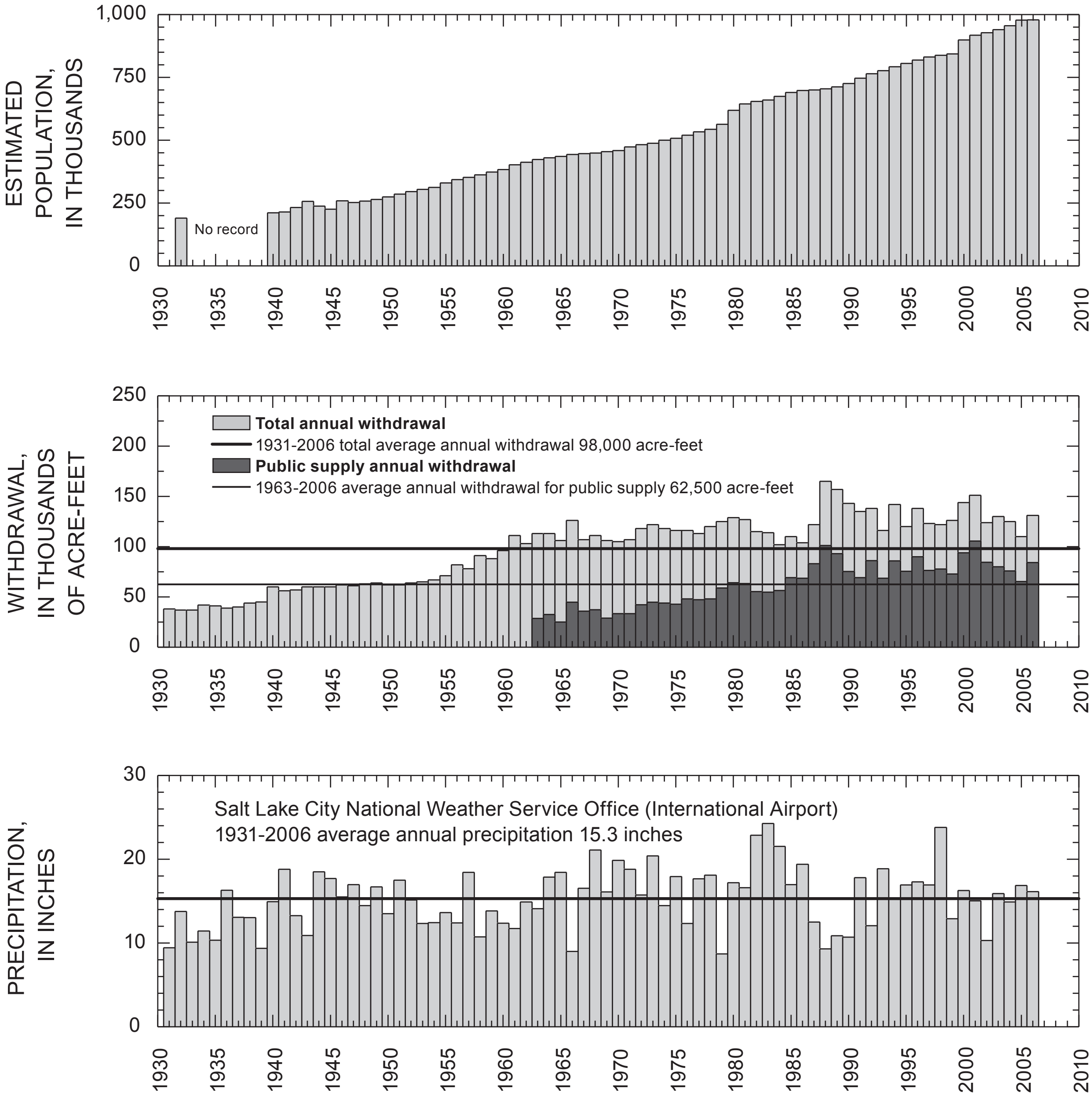


Figure 9. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

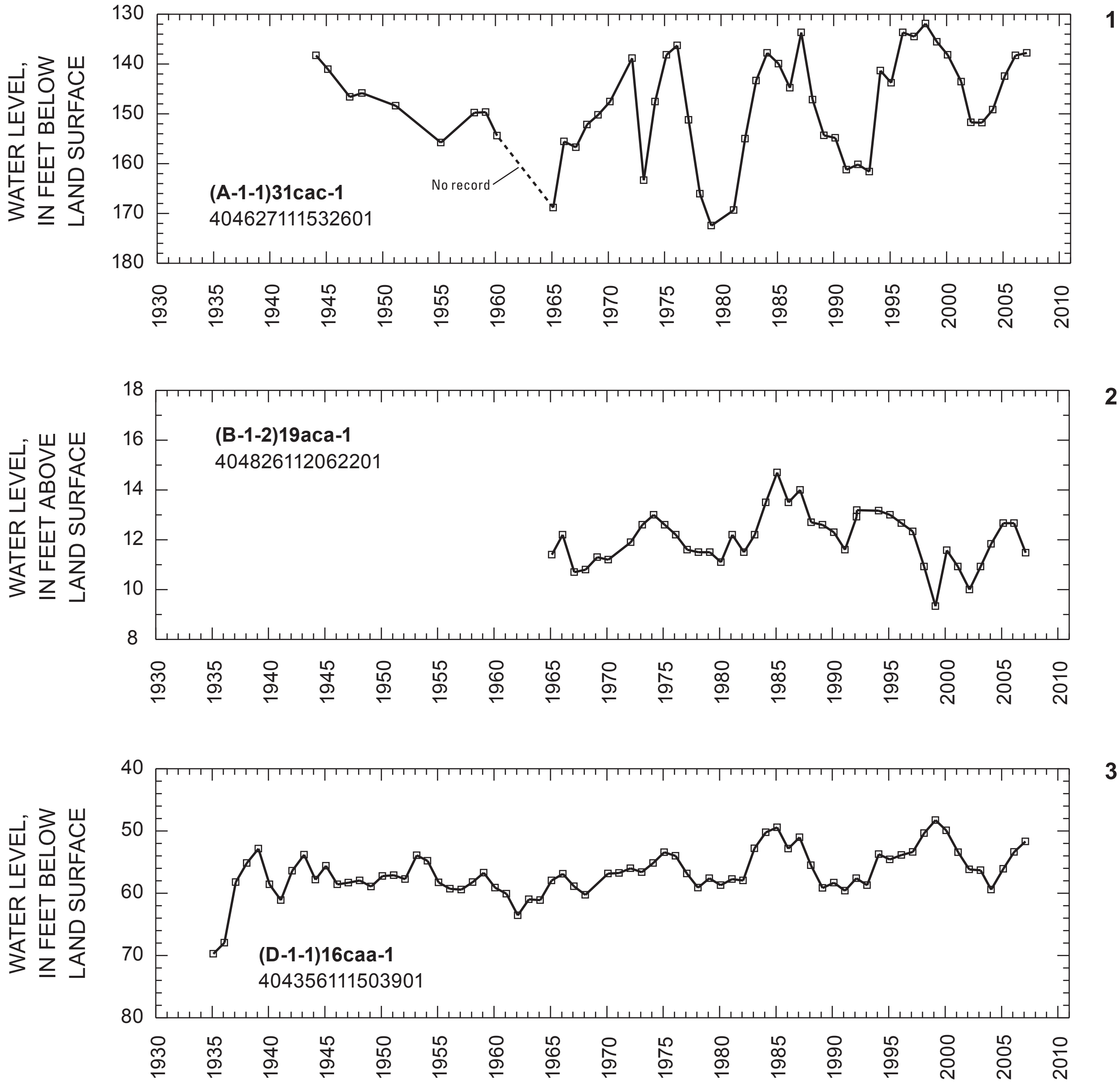


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.

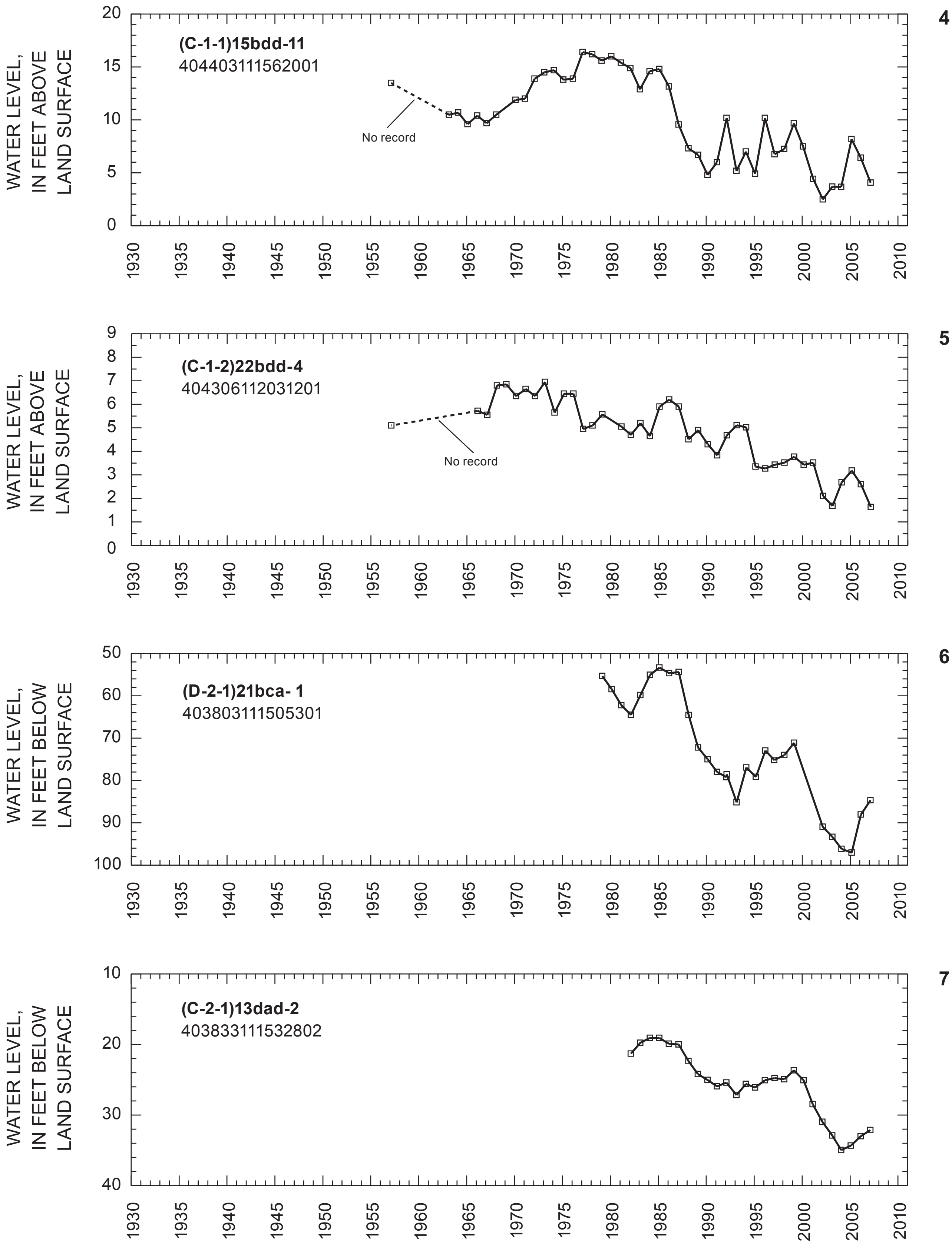
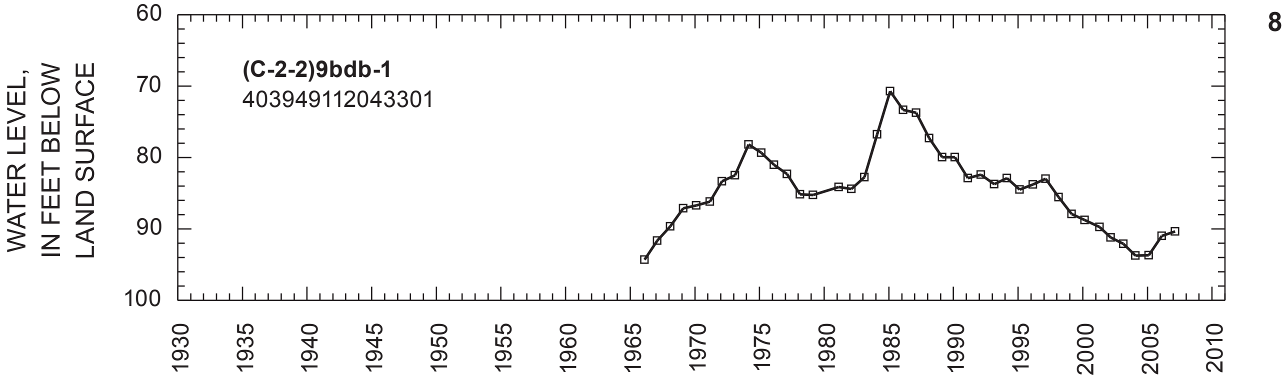
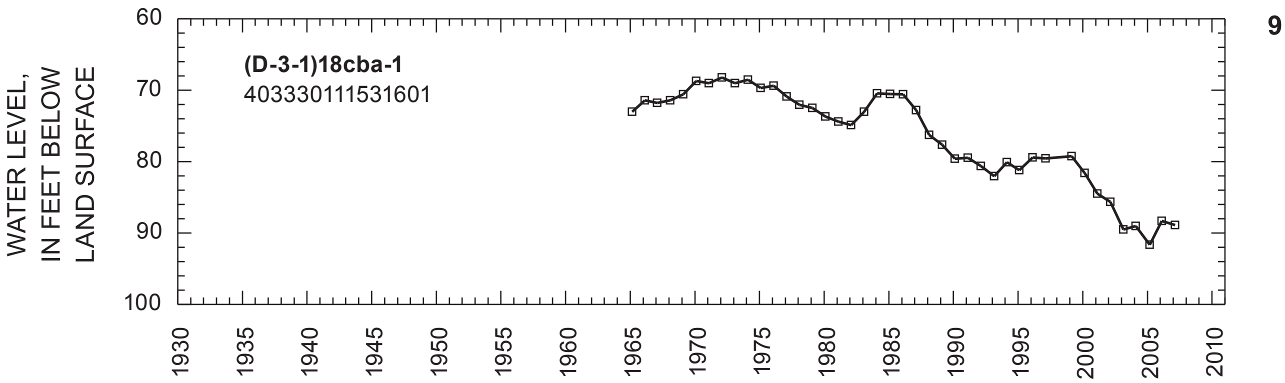


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.





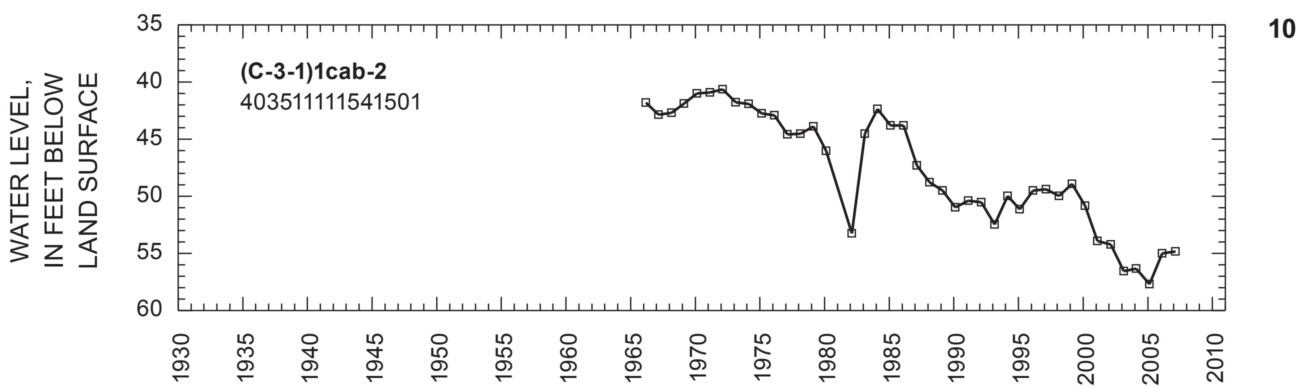
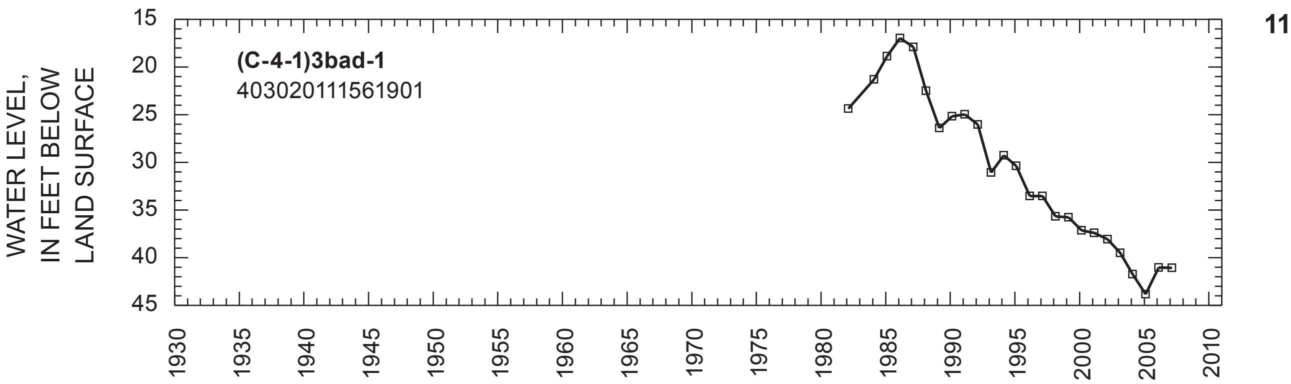


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.



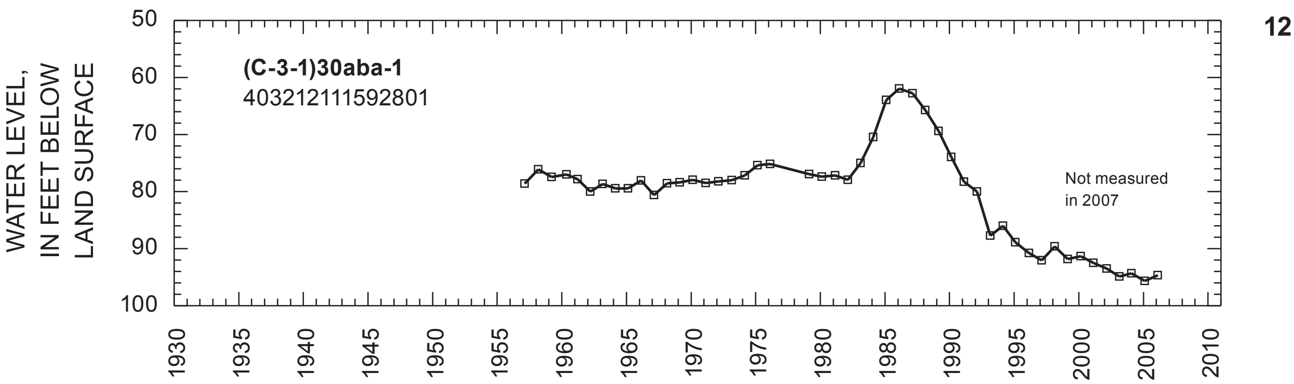


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.

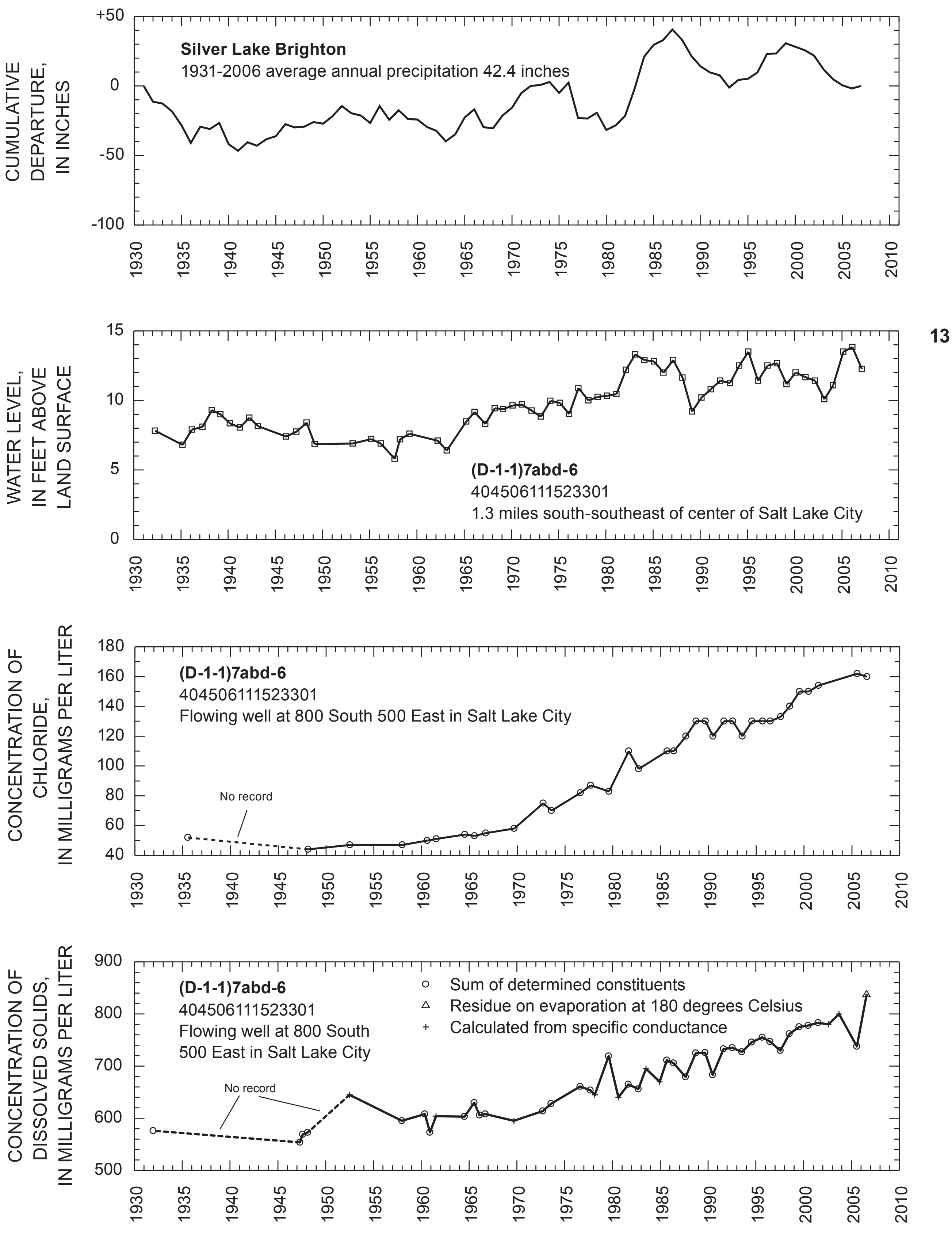


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.

TOOELE VALLEY

By J.L. Cillessen

Tooele Valley is between the Stansbury and Oquirrh Mountains and extends from Great Salt Lake south to South Mountain. The total area of the valley is about 250 square miles.

Ground water occurs in the bedrock and unconsolidated deposits in Tooele Valley under both water-table and artesian conditions, but most of the water withdrawn by wells is from artesian aquifers in the unconsolidated deposits.

Total estimated withdrawal of water from wells in Tooele Valley in 2006 was about 19,000 acre-feet, which is the same as the revised value for 2005 and 3,000 acre-feet less than the average annual withdrawal for 1996-2005 (tables 2 and 3). Withdrawal for irrigation was about 9,500 acre-feet, which is 500 acre-feet less than the revised value for 2005. Withdrawal for public supply was about 6,700 acre-feet, which is 200 acre-feet less than the withdrawal for 2005. Withdrawal for industry was about 1,500 acre-feet, which is 860 acre-feet more than in 2005.

One component of the total withdrawal of water from wells is an estimate of the amount of water that naturally discharges from flowing wells. That amount is determined on the basis of measured discharge at a select subset of flowing wells. The average difference in discharge from the previous year, for the subset, is used to scale a base amount of discharge. That scaled amount is reported as the current year's flowing well discharge for the valley. The base amount of 8,200 acre-feet per year was calculated from an extensive survey in 1962 by Gates (1962, table 1, p. 27) and re-evaluated by Razem and Steiger (1981, p. 15).

Flowing-well measurements and data analysis that supplemented the standard scaling techniques resulted in a flowing-well discharge estimate of 5,200 acre-feet for 2005 (Bert Stolp, U.S. Geological Survey, written commun., 2007). This is about 900 acre-feet more than was reported in this series for the same year (Burden and others, 2006). The value of 5,200 acre-feet is now considered the base amount for Tooele Valley. The difference in the base amount is due to a large number of flowing wells that no longer flow uncontrolled; they have either been capped or sealed so that the natural discharge can be enhanced by pumping.

The location of wells in Tooele Valley in which the water level was measured during March 2007 is shown in figure 11. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1 is shown in figure 12. Precipitation during 2006 at Tooele was about 21.0 inches, which is about 2.2 inches less than in 2005 and about 3.2 inches more than the average annual precipitation for 1936-2006.

Water levels in most of the wells measured in Tooele Valley changed only slightly from March 2006 to March 2007.

Physical properties and records of chemical analyses for water from one well in Tooele Valley are listed in tables 4 and 5, and the location of the well is plotted in figure 39. The dissolved-solids concentration of water from well (C-2-5)35cab-1, located about 5 miles west of Erda in Tooele Valley, was 2,520 milligrams per liter. Chloride concentration was 1,200 milligrams per liter. Both dissolved-solids and chloride concentrations exceeded the secondary drinking-water standards for the State of Utah. Hardness, as calcium carbonate, was 490 milligrams per liter.

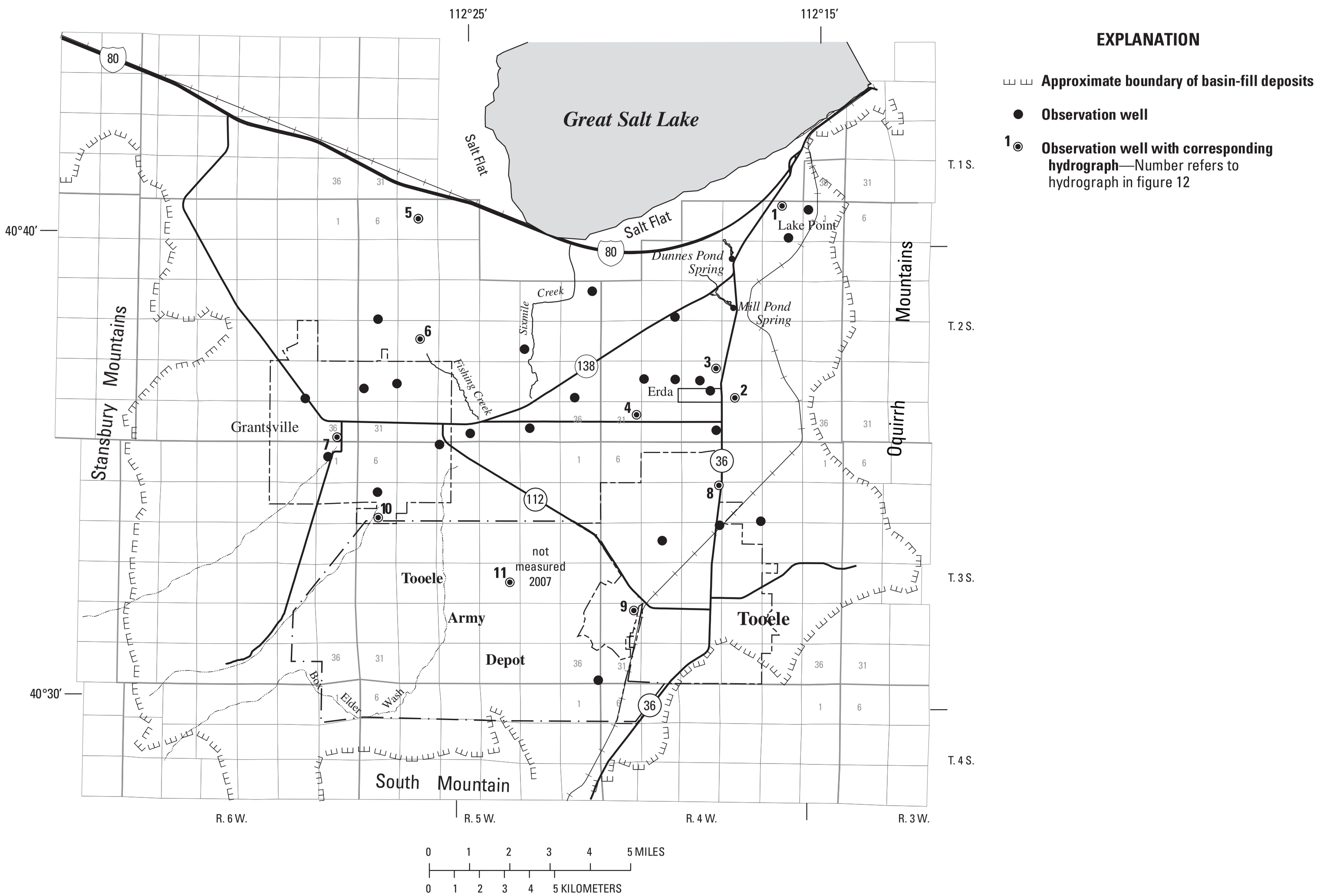


Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 2007.

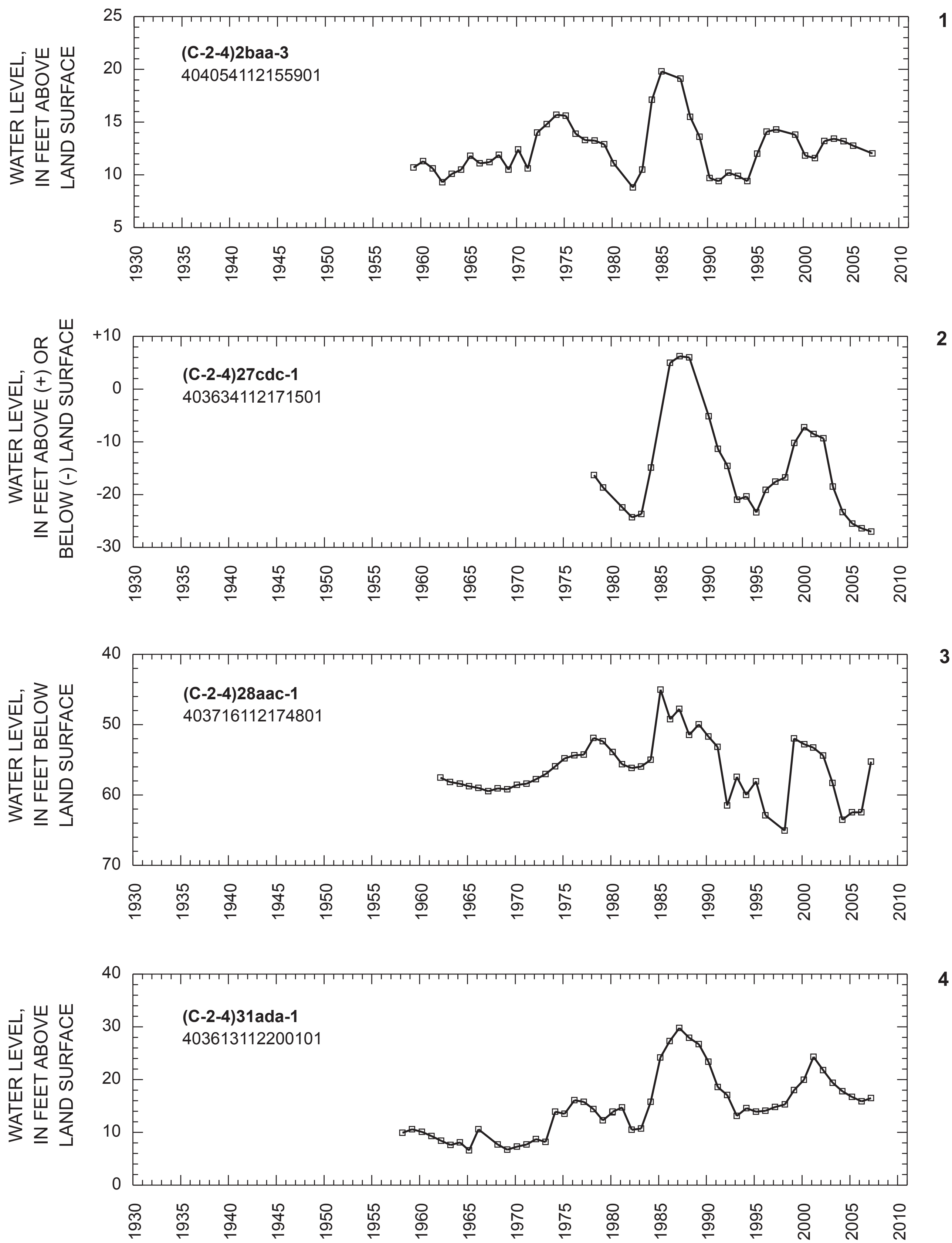


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.

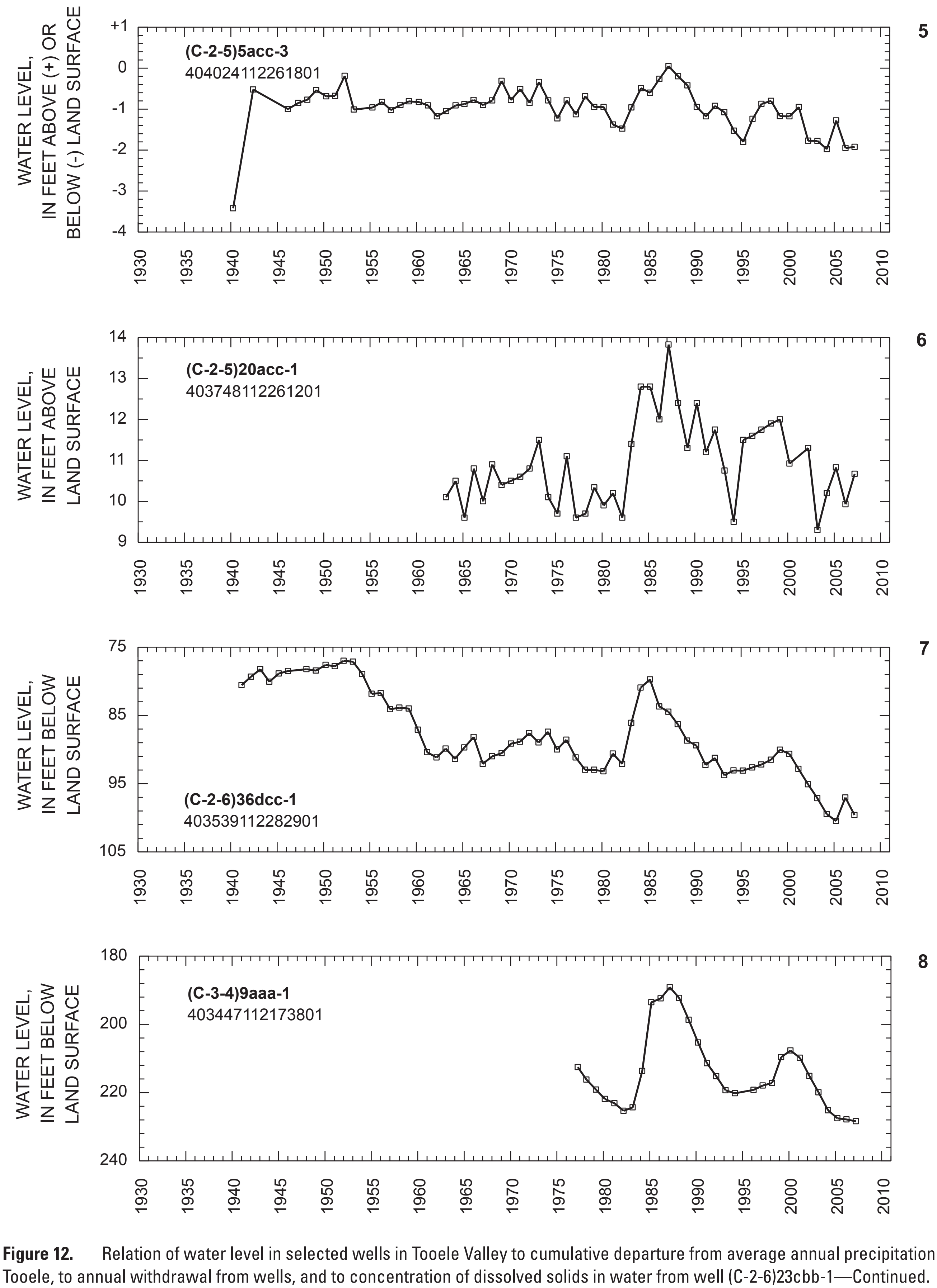
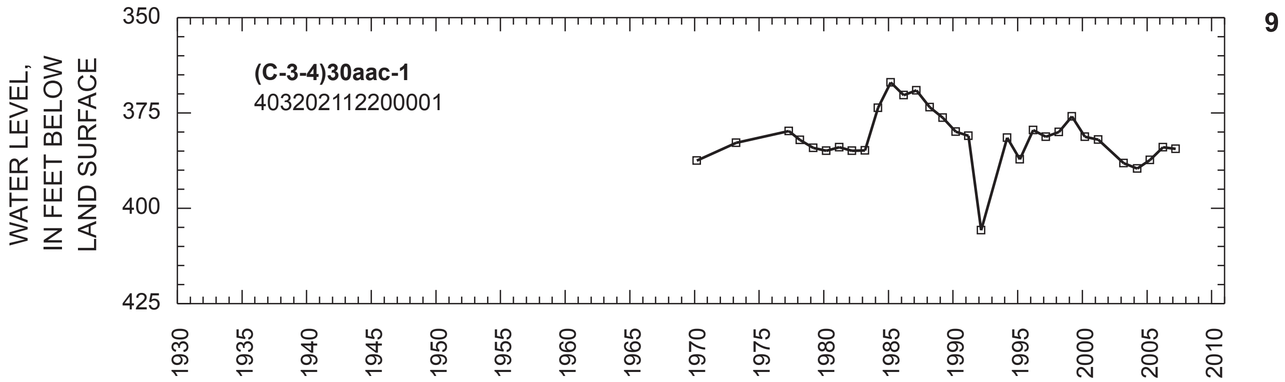
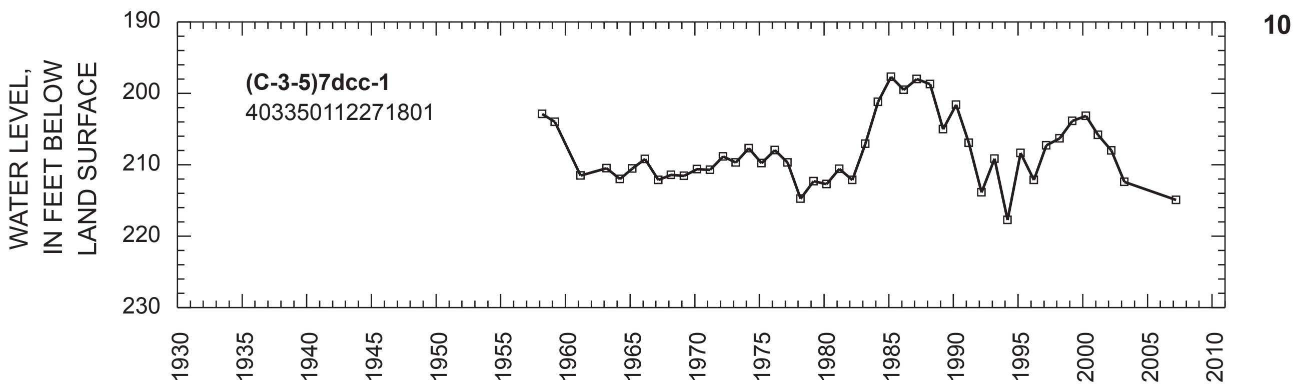


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1—Continued.





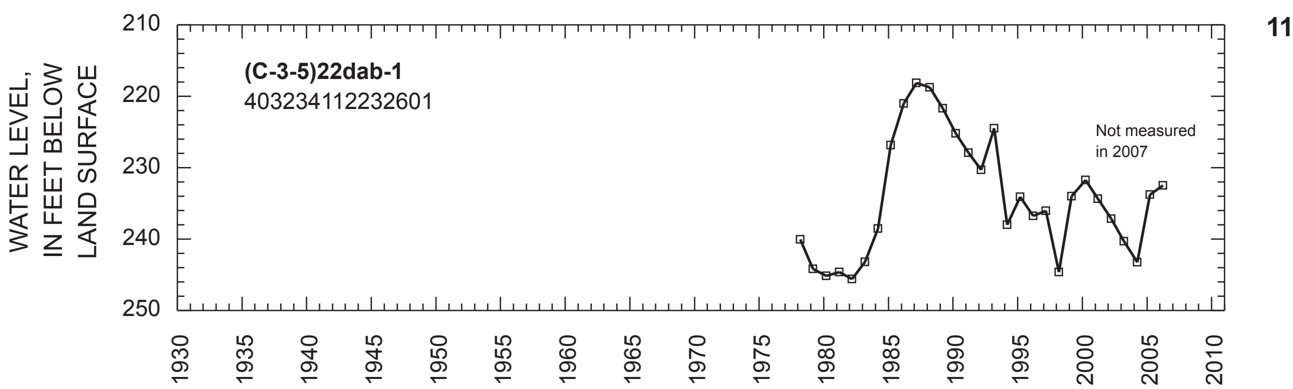


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1—Continued.

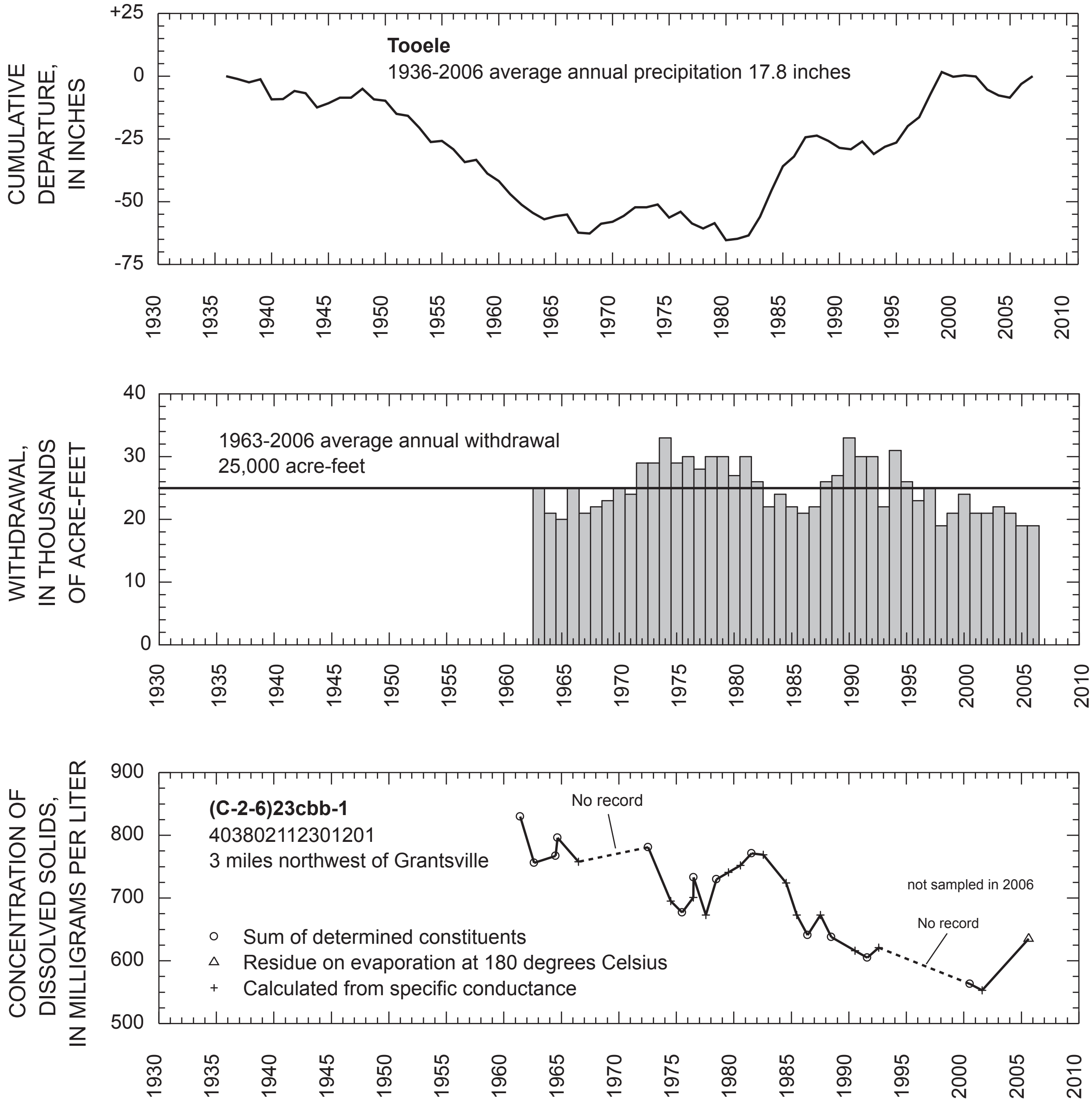


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1—Continued.

UTAH AND GOSHEN VALLEYS

By S.J. Gerner

Utah Valley is divided into two ground-water basins, northern and southern, which are separated by Provo Bay in northern Utah Valley. Ground water occurs in unconsolidated basin-fill deposits in the valley. The principal ground-water recharge area for the basin-fill deposits is in the eastern part of the valley, along the base of the Wasatch Range.

Southern Utah Valley is bounded by the Wasatch Range, West Mountain, and the northern extension of Long Ridge. Goshen Valley is south of Provo and is bounded by West Mountain, Long Ridge, the Lake Mountains, and the East Tintic Mountains. Ground water in Utah and Goshen Valleys occurs in the alluvium under both water-table and artesian conditions, but most wells discharge from artesian aquifers.

Previous reports in this series, those published since about 1986, have generally assumed that 28,000 acre-feet of water are withdrawn annually from flowing wells in northern Utah Valley. This value was calculated by Clark and Appel (1985) from an extensive survey in 1982 of flowing-well discharge. However, analysis of more-recent data has determined that the discharge from flowing wells in northern Utah Valley has probably been changing relative to annual precipitation and conversion of agricultural land to urban uses. Consequently, a method based on measured changes in water level and estimated changes in land use (Jay Cederberg, U.S. Geological Survey, written commun., 2007) was used for determining an estimate of annual withdrawal from flowing wells in northern Utah Valley during 2006. This method also was used to revise estimates of annual withdrawal from flowing wells in northern Utah Valley during 1996-2005. As a result, the estimated annual total withdrawal of water from wells in Utah and Goshen Valleys is 6,000 to 23,000 acre-feet less than previously reported for this period (table 3).

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 2006 was about 100,000 acre-feet, which is 13,000 acre-feet more than the revised value for 2005, and the same as the average annual withdrawal for 1996-2005 (tables 2 and 3). Withdrawal in southern Utah Valley was about 29,400 acre-feet, which is 1,400 acre-feet less than in 2005. Withdrawal in Goshen Valley was about 12,200 acre-feet, which is about 1,900 acre-feet more than in 2005. Ground-water withdrawal in northern Utah Valley was about 58,100 acre-feet, which is 12,400 acre-feet more than the revised value for 2005. The overall increase in withdrawals resulted from increased withdrawal for public supply and irrigation, particularly in northern Utah Valley.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2007 is shown in figure 13. Water levels in Goshen Valley and in the northern and southern parts of Utah Valley generally rose in the early 1980s. The rise corresponds to a period of greater-than-average precipitation and recharge from surface water. Water levels generally declined from 1985 to 1993 in Utah Valley and generally rose from 1993 to 1998. This rise is the result of greater-than-average precipitation during this period. Water levels generally declined throughout Utah Valley from March 1999 to March 2005. Water levels in some wells reached their lowest level for their period of record, many dating back to 1935. From March 2005 to March 2007, most water levels in Utah and Goshen Valleys rose as a result of average to greater-than-average precipitation in 2005 and 2006 following 6 years of less-than-average precipitation.

The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells, is shown in figure 14. Discharge of Spanish Fork at Castilla in 2006 was 224,300 acre-feet, which is 55,500 acre-feet more than the 1933-2006 annual average. Precipitation at Silver Lake near Brighton in 2006 was about 44.2 inches, which is about 1.8 inches more than the long-term average and about 4.0 inches more than in 2005. Precipitation at Spanish Fork Powerhouse in 2006 was about 22.4 inches, which is about 3.2 inches more than the long-term average and about 0.8 inch less than in 2005.

Physical properties and records of chemical analyses for water from three wells in Utah and Goshen Valleys are listed in tables 4 and 5, and the location of the wells is plotted in figure 39. Dissolved-solids concentration of water from well (D-5-1)20aba-2 in northern Utah Valley and well (D-9-1)36bbc-1 in southern Utah Valley was 305 and 310 milligrams per liter, respectively. Periodic sampling and subsequent analysis of water from well (D-9-1)36bbc-1, located about 1 mile north of Santaquin, shows a relatively stable dissolved-solids concentration for the last 35 years. Water from the Goshen Valley well (C-9-1)3ddb-1 had a dissolved-solids concentration of 811 milligrams per liter and a dissolved silica concentration of 61 milligrams per liter. The dissolved-solids concentration at well (C-9-1)3ddb-1 exceeded the secondary drinking-water standards for the State of Utah and the silica concentration was the highest of any of the samples collected.

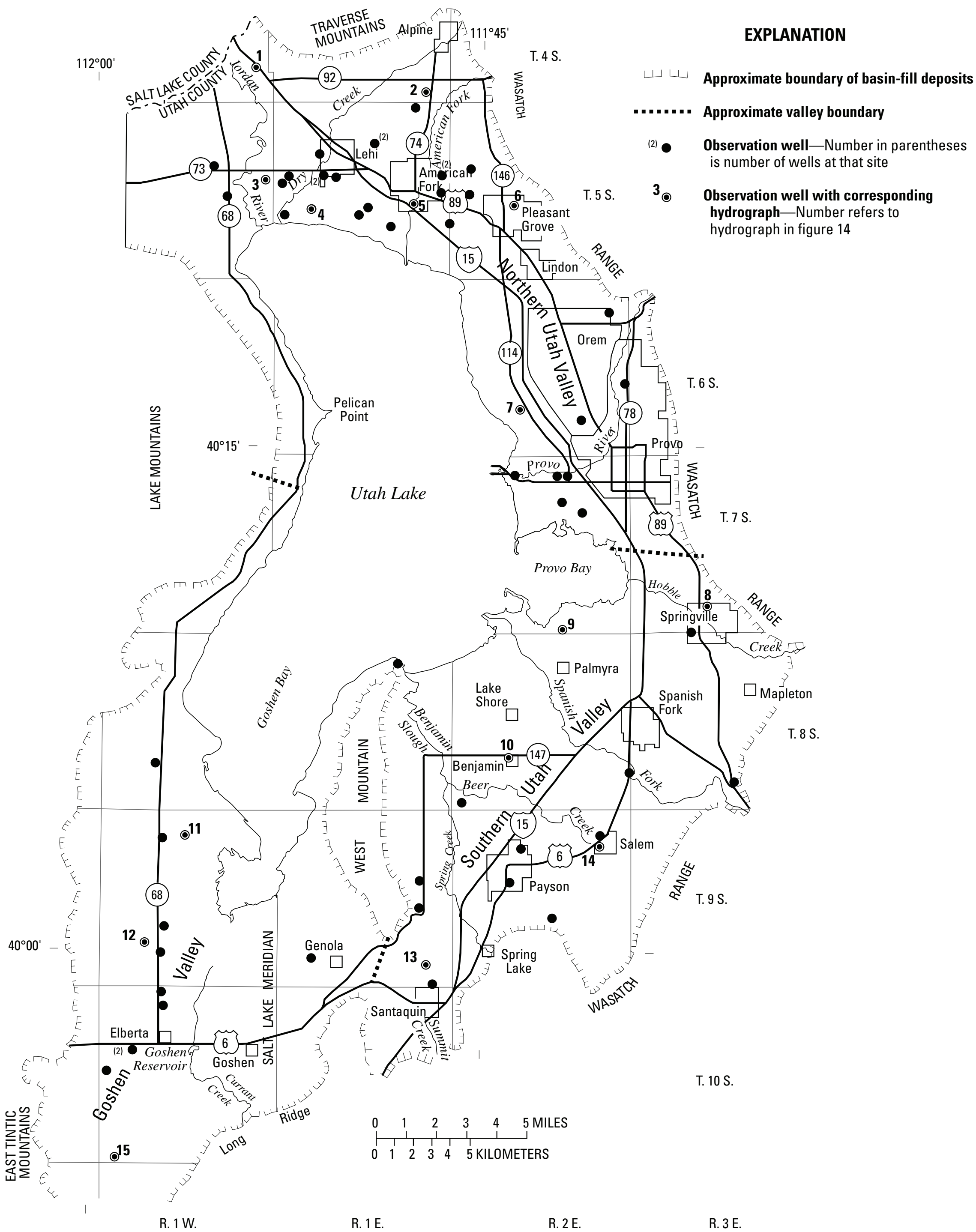


Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2007.

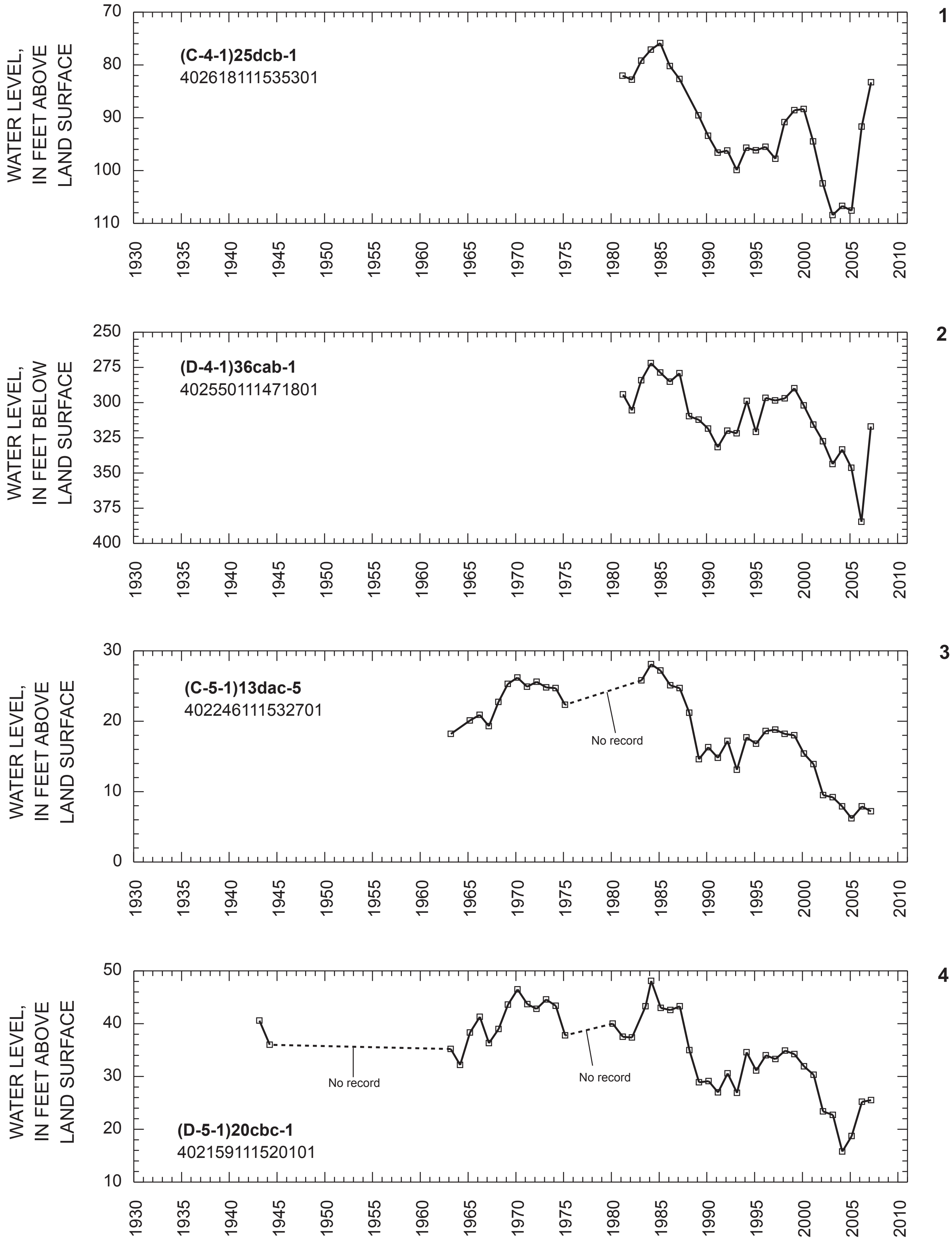


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.

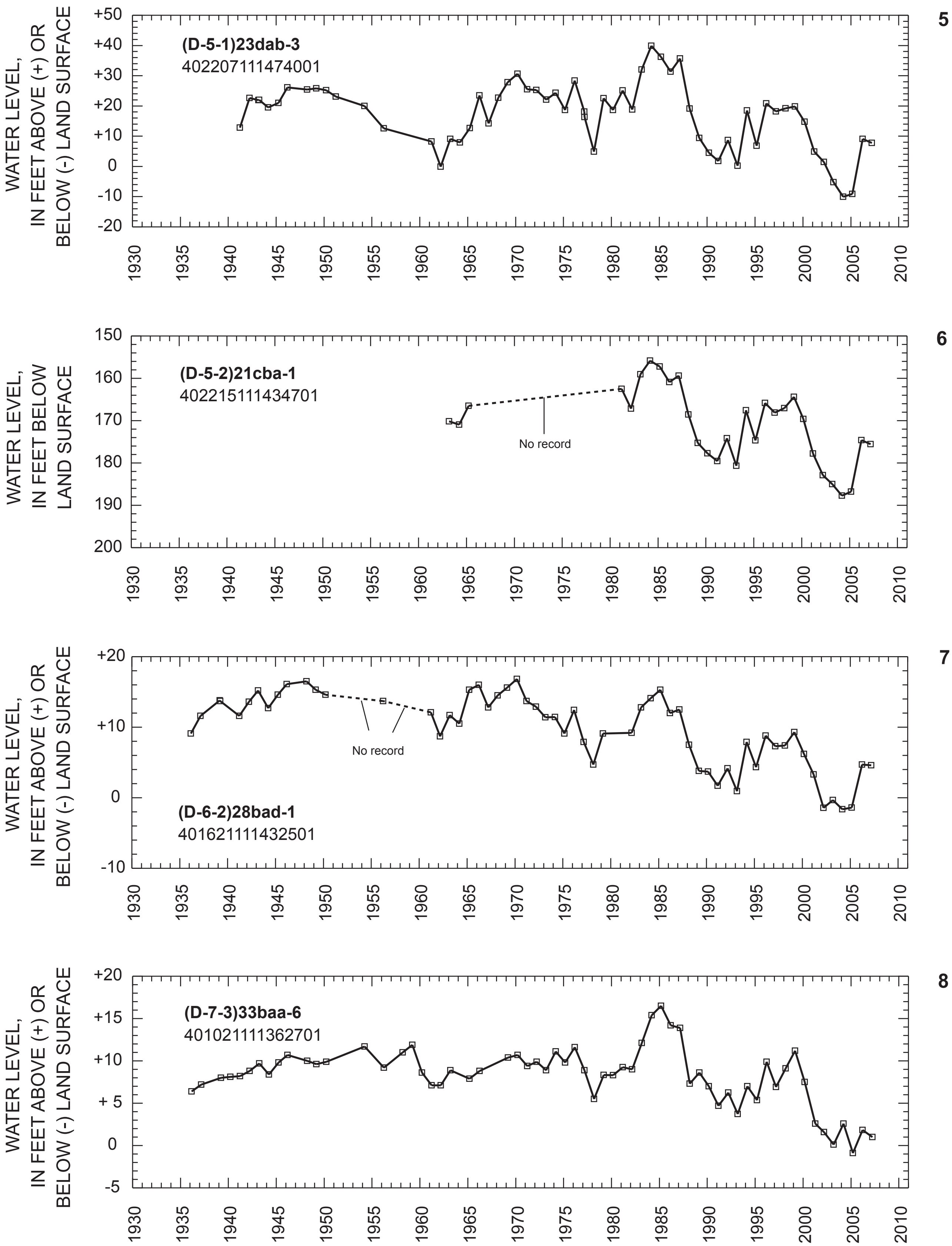


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells—Continued.

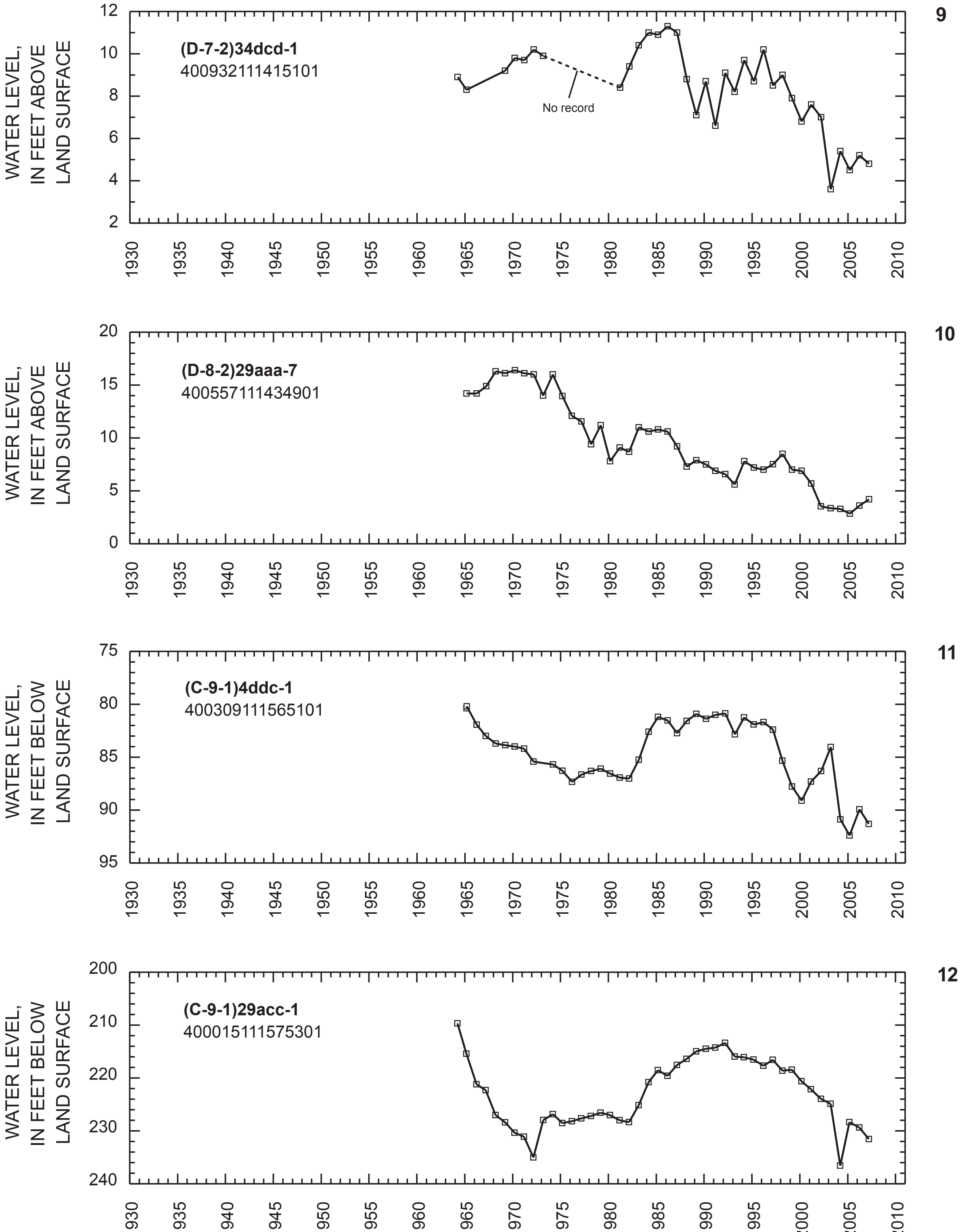
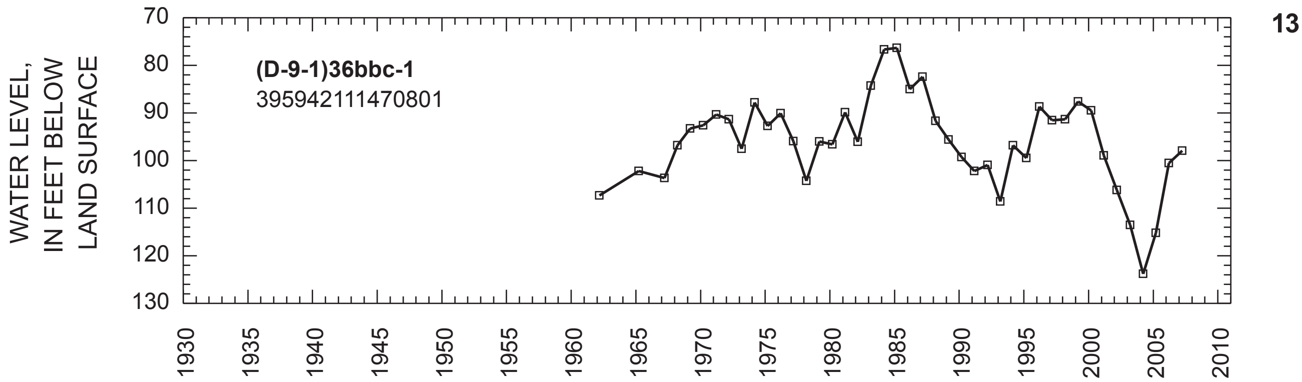
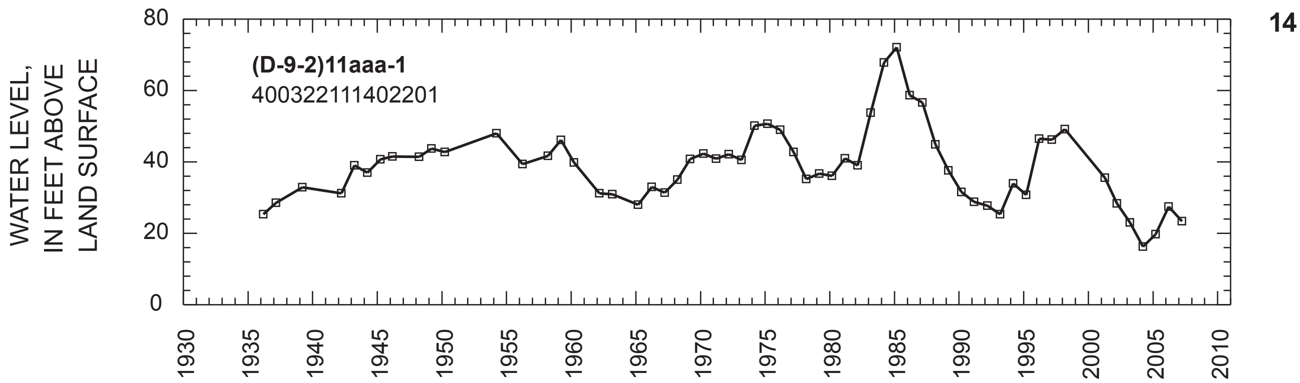


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells—Continued.





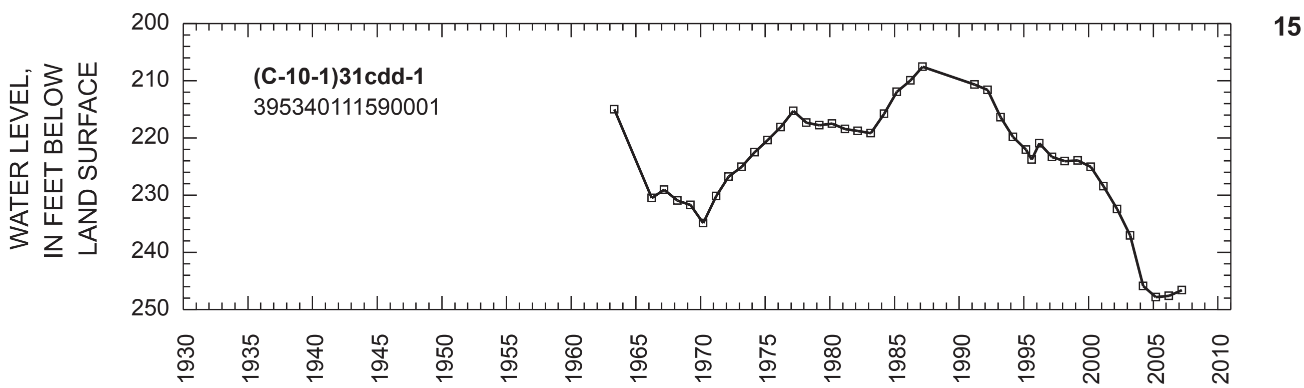


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells—Continued.

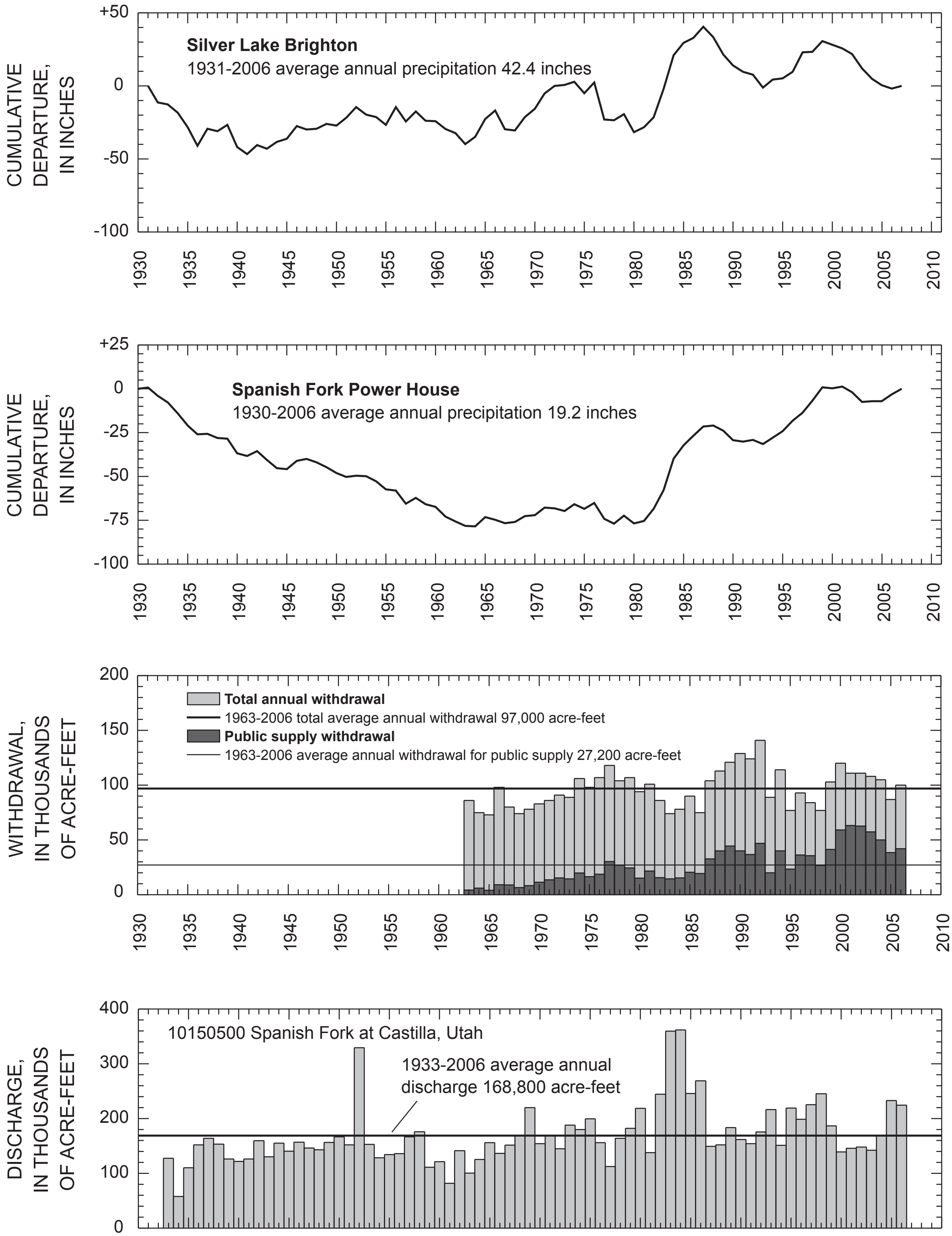


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells—Continued.

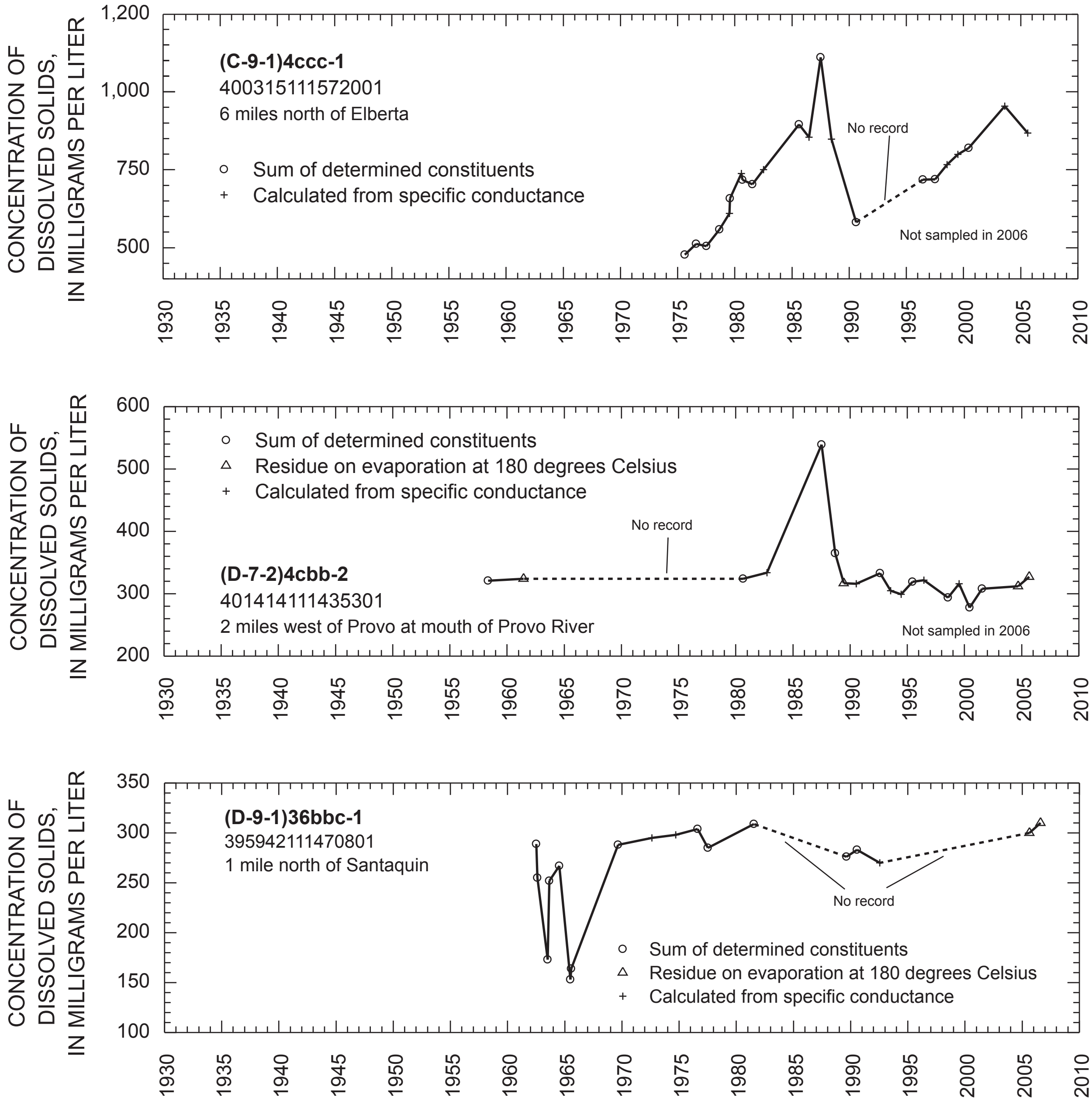


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells—Continued.

JUAB VALLEY

By R.J. Eacret

Juab Valley, which is about 30 miles long and averages about 4 miles wide, is in central Utah along the west side of the Wasatch Range and the San Pitch Mountains. Ground water in the valley drains near both its northern and southern ends—in northern Juab Valley via Currant Creek into Utah Lake, and in southern Juab Valley via Chicken Creek into the Sevier River. The northern and southern parts of Juab Valley are separated topographically by Levan Ridge, a gentle rise near the midpoint of the valley floor.

Ground water in Juab Valley occurs in the unconsolidated basin-fill deposits. Most of the recharge to the ground-water reservoir occurs on the eastern side of the valley along the Wasatch Range and the San Pitch Mountains. Ground water moves to the lower part of the valley and to eventual discharge points at the northern and southern ends of the valley. The ground-water divide between the northern and southern parts of Juab Valley is near Levan Ridge. Ground water occurs in the basin-fill deposits under both water-table and artesian conditions; artesian conditions are prevalent in the lower part of the valley.

Total estimated withdrawal of water from wells in Juab Valley in 2006 was about 21,000 acre-feet, which is 7,000 acre-feet more than the amount reported for 2005 and the same as the average annual withdrawal for 1996-2005 (tables 2 and 3).

The location of wells in Juab Valley in which the water level was measured during March 2007 is shown in figure 15. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1 is shown in figure 16.

Water levels in most of the wells measured in Juab Valley changed slightly from March 2006 to March 2007. Water levels generally rose from 1978 to their highest level in 1985. This rise corresponds to a period of greater-than-average precipitation during 1978-86. Water levels generally declined from 1986 to 2005, although there was a substantial rise from 1993 to 1999.

Precipitation at Nephi during 2006 was about 13.7 inches, which is about 0.7 inch less than the average annual precipitation for 1935-2006, and about 4.3 inches less than in 2005. The concentration of dissolved solids in water from well (C-12-1)24baa-1 fluctuated during 1964-2006, with no apparent trend.

Physical properties and records of chemical analyses for water from one well in Juab Valley are listed in tables 4 and 5, and the location of the well is plotted in figure 39. The dissolved-solids concentration of water from well (D-13-1)4cca-1, located in Nephi, was 1,030 milligrams per liter, with a corresponding specific-conductance value of 1,590 microsiemens per centimeter at 25 degrees Celsius. The concentration of chloride in water from this well was 288 milligrams per liter. Both dissolved-solids and chloride concentrations exceeded the secondary drinking-water standards for the State of Utah.

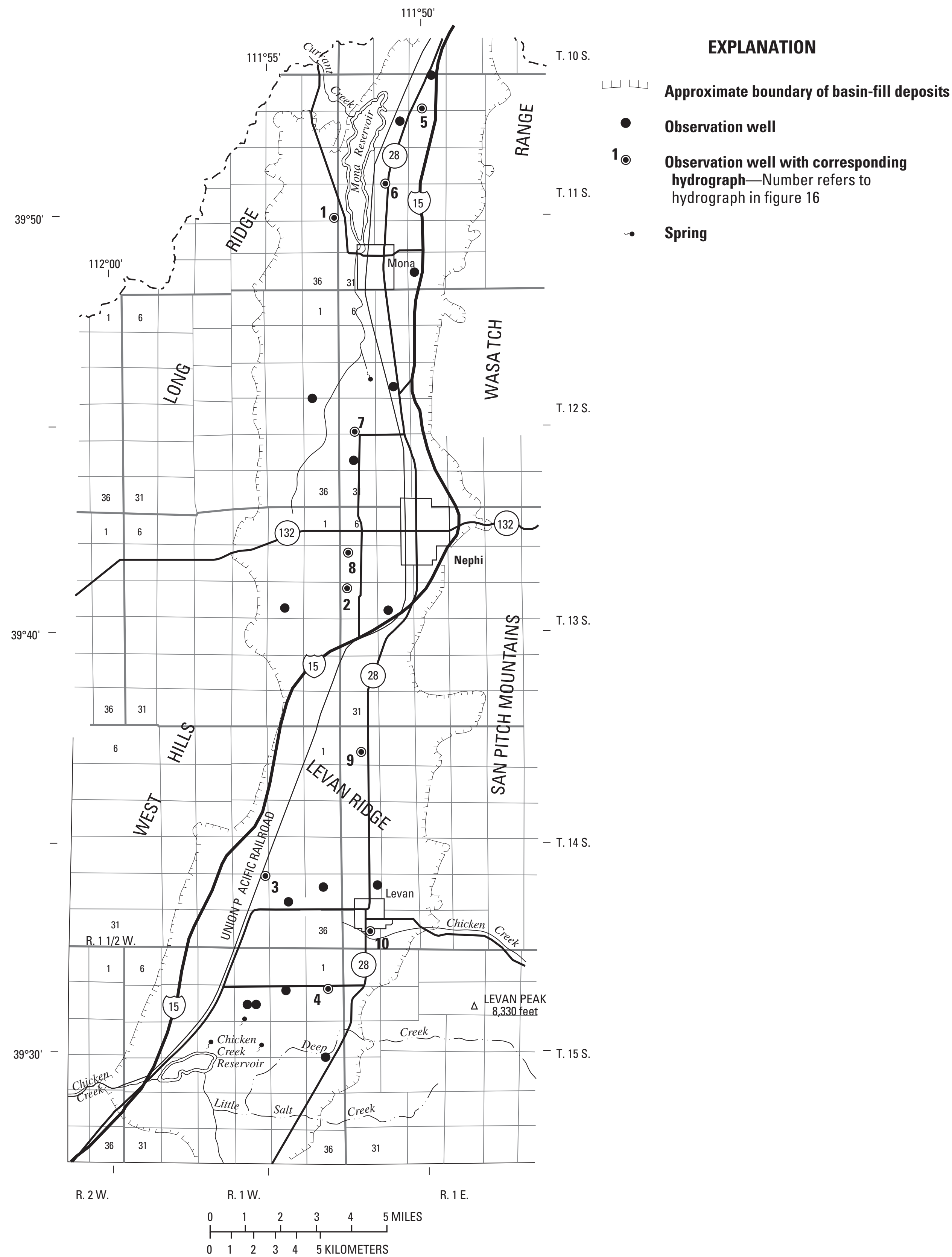


Figure 15. Location of wells in Juab Valley in which the water level was measured during March 2007.

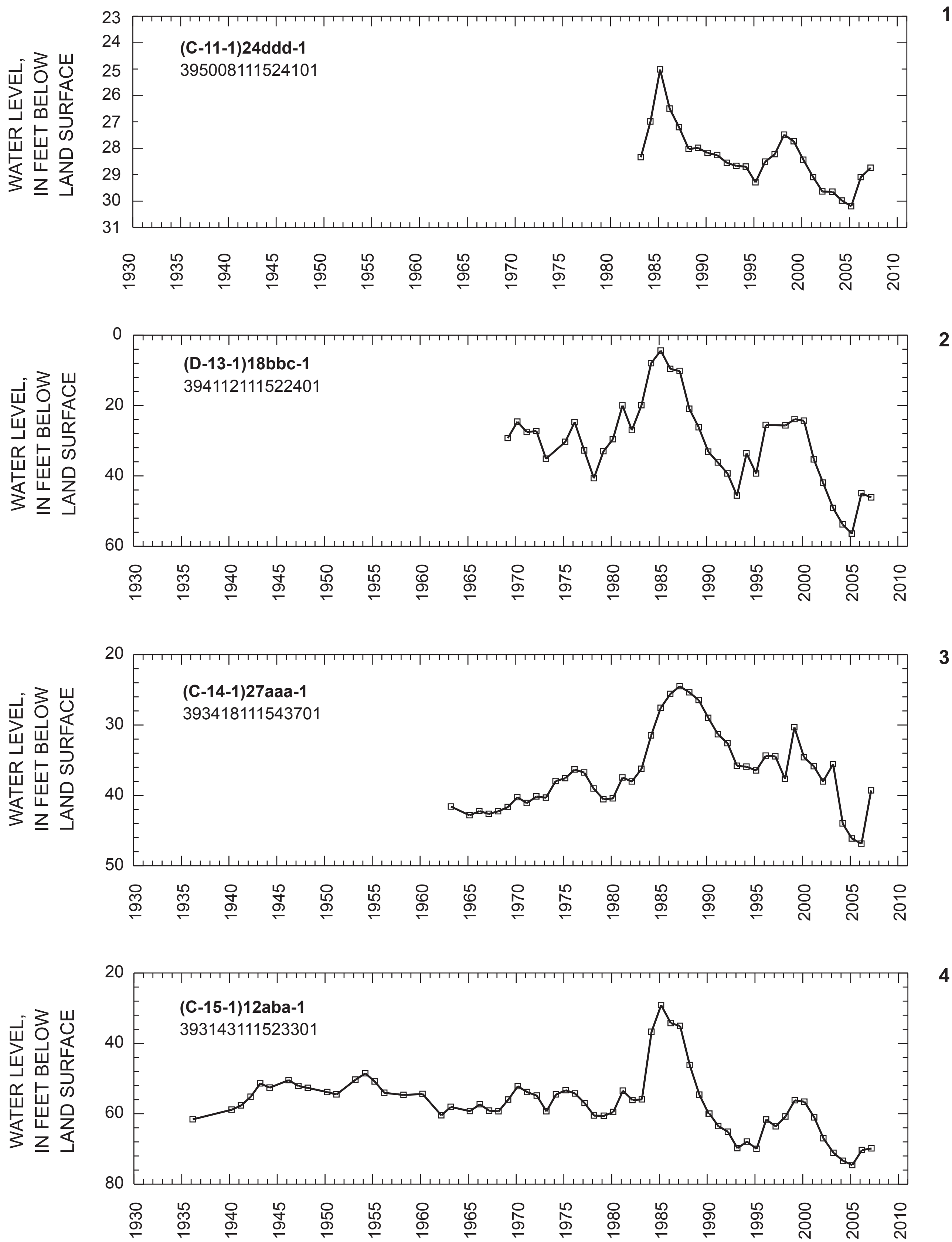


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1.

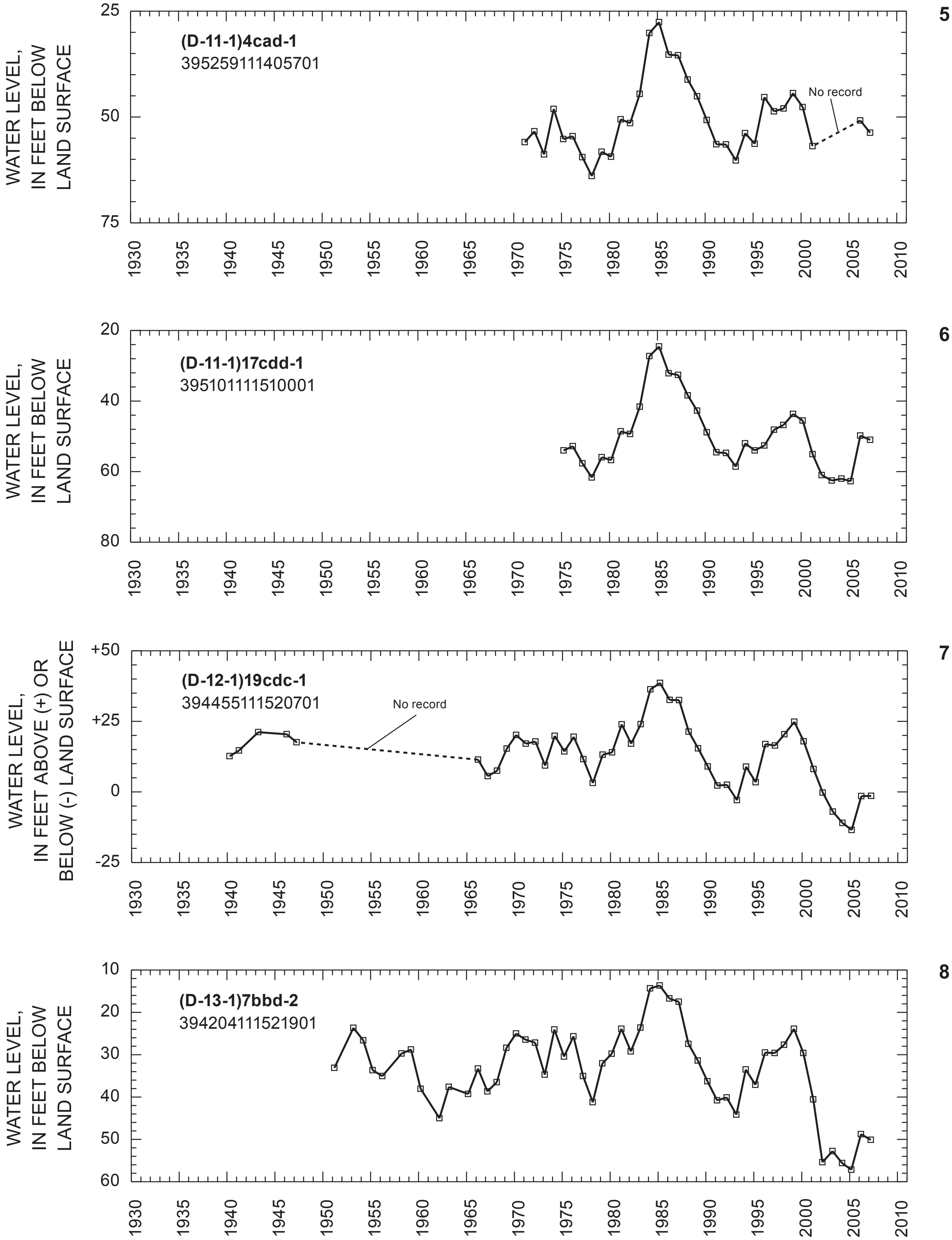
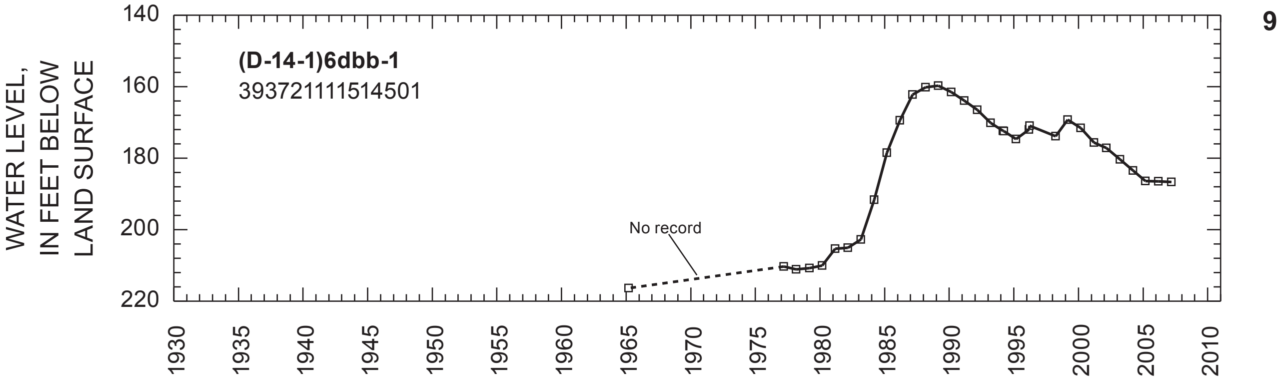


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1—Continued.



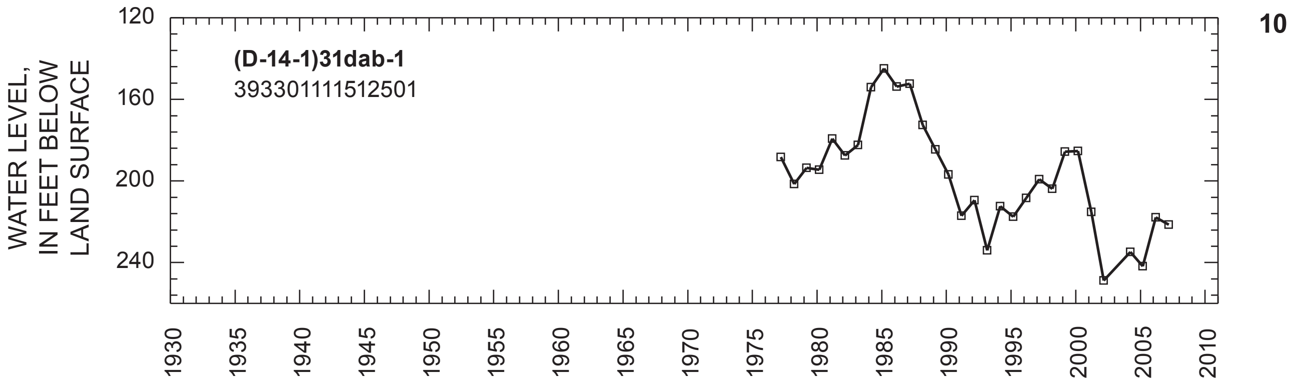


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1—Continued.

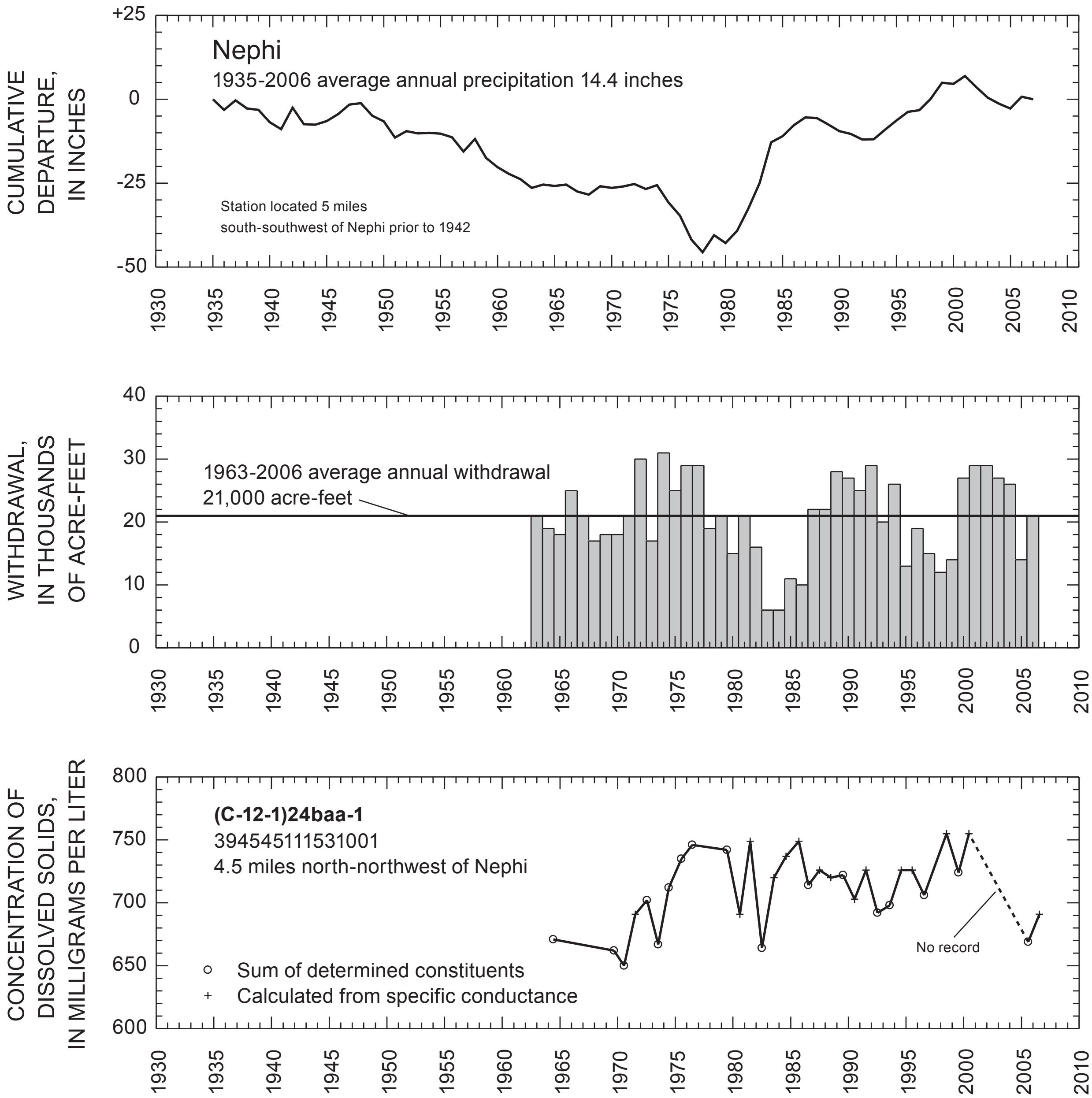


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1—Continued.

SEVIER DESERT

By Paul Downhour

The part of the Sevier Desert described here covers about 2,000 square miles and principally includes the broad, gently sloping areas that radiate from the mountain ranges located to the east, north, and west. The Sevier River enters the Sevier Desert from the east and is a source of recharge to the aquifers. Ground water occurs in the Sevier Desert in unconsolidated deposits under water-table and artesian conditions. Most of the ground water is discharged from wells completed in either of two artesian aquifers—the shallow or deep artesian aquifer.

Total estimated withdrawal of water from wells in the Sevier Desert in 2006 was about 20,000 acre-feet, which is 4,000 acre-feet less than in 2005 and about 2,000 acre-feet less than the 1996-2005 average annual withdrawal (tables 2 and 3). The decrease in withdrawals was mainly due to decreased withdrawal for irrigation, probably because of continued availability of surface water.

The location of wells in the Sevier Desert in which the water level was measured during March 2007 is shown in figures 17 and 18. The relation of the water level in selected observation wells to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1 is shown in figure 19. Water levels in both the shallow and deep aquifers in the Sevier Desert generally rose from 1980 to 1987, which corresponds to a period of greater-than-average precipitation and less-than-average withdrawal. Water levels in both aquifers began declining during 1987-90 and continued to decline until 1995. Levels generally rose or remained stable from about 1995 to 1999. Rises during this period probably resulted from decreased ground-water withdrawals because of greater-than-average precipitation, and greater availability of surface water for irrigation. Water levels generally declined from March 2001 to March 2005, probably as a result of 4 years of less-than-average surface-water supplies and increased withdrawals from wells. Most water levels measured in March 2007 in both the shallow and deep artesian aquifers were higher than in 2006, probably due to greater-than-average precipitation in the Sevier Desert, greater-than-average availability of surface water, and decreased ground-water withdrawals.

Discharge of the Sevier River near Juab in 2006 was 185,300 acre-feet, 44,700 acre-feet more than the revised total of 140,600 acre-feet in 2005 and 4,700 acre-feet more than the long-term average (1935-2006). Precipitation at Oak City was about 14.5 inches in 2006, about 1.6 inches more than the 1930-2006 average annual precipitation and about 7.2 inches less than in 2005.

Physical properties and records of chemical analyses for water from one well in the Sevier Desert are listed in tables 4 and 5, and the location of the well is plotted in figure 39. The concentration of dissolved solids in water from well (C-15-4)8cba-1, located about 2.5 miles east of Lynndyl, has increased from about 1,500 milligrams per liter in 1958 to about 2,250 milligrams per liter in 2006. Specific conductance of water from this well was 3,330 microsiemens per centimeter at 25 degrees Celsius. The dissolved-solids concentration exceeded the State of Utah maximum contaminant level. Additional constituents exceeded the secondary drinking-water standards for the State of Utah and included chloride, sulfate, and manganese. Hardness, as calcium carbonate, was 1,000 milligrams per liter.

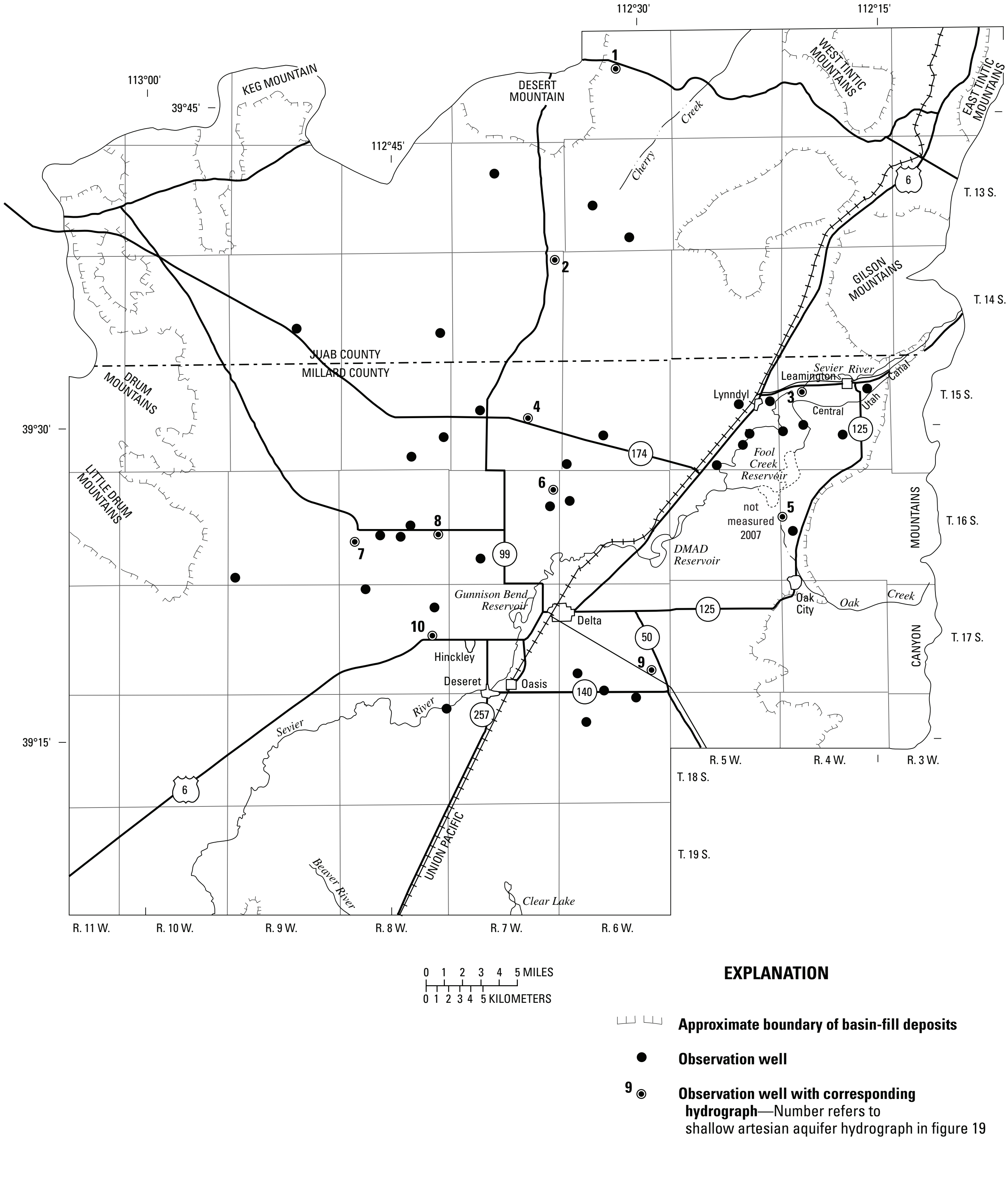


Figure 17. Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2007.

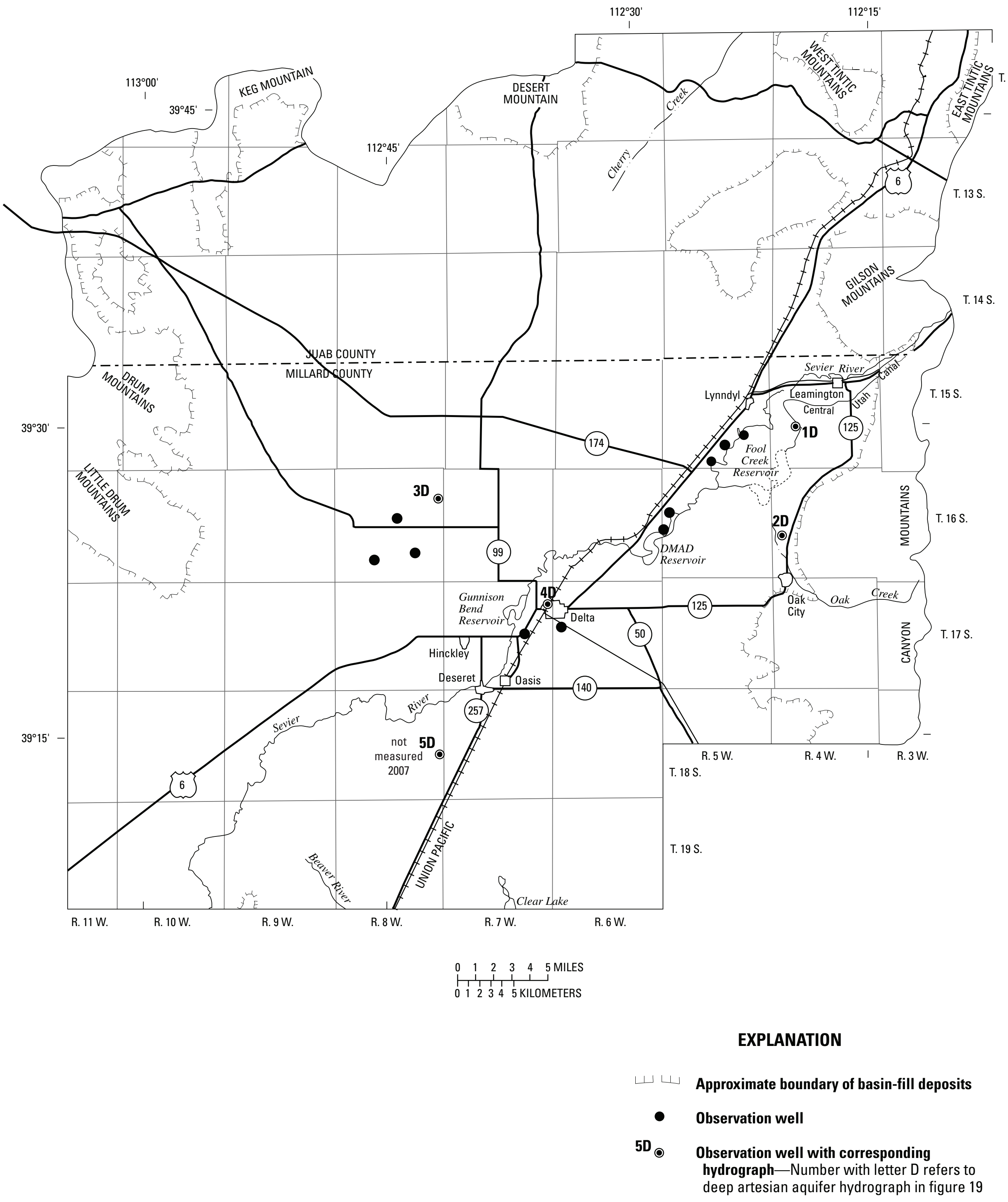


Figure 18. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2007.

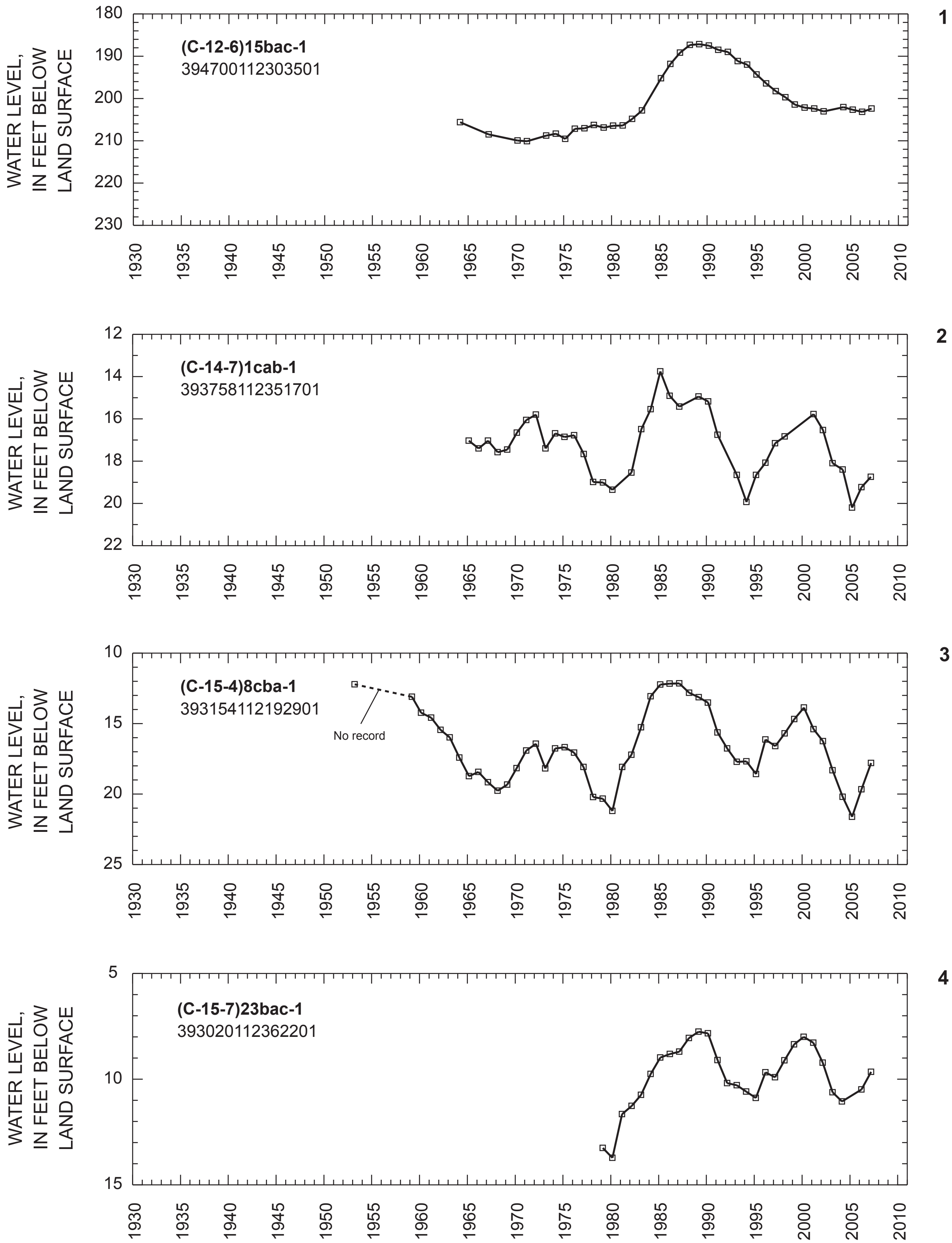


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.

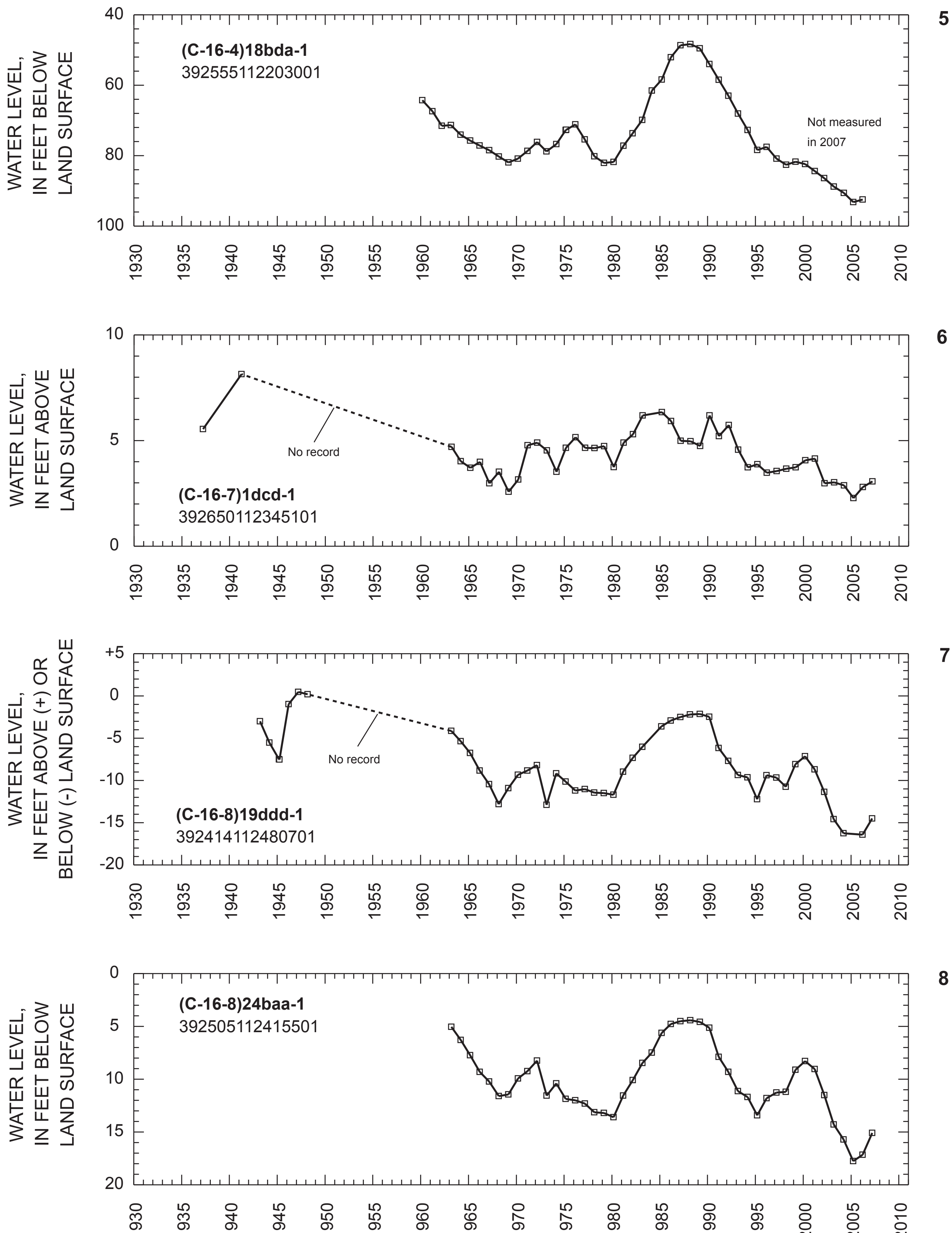


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1—Continued.

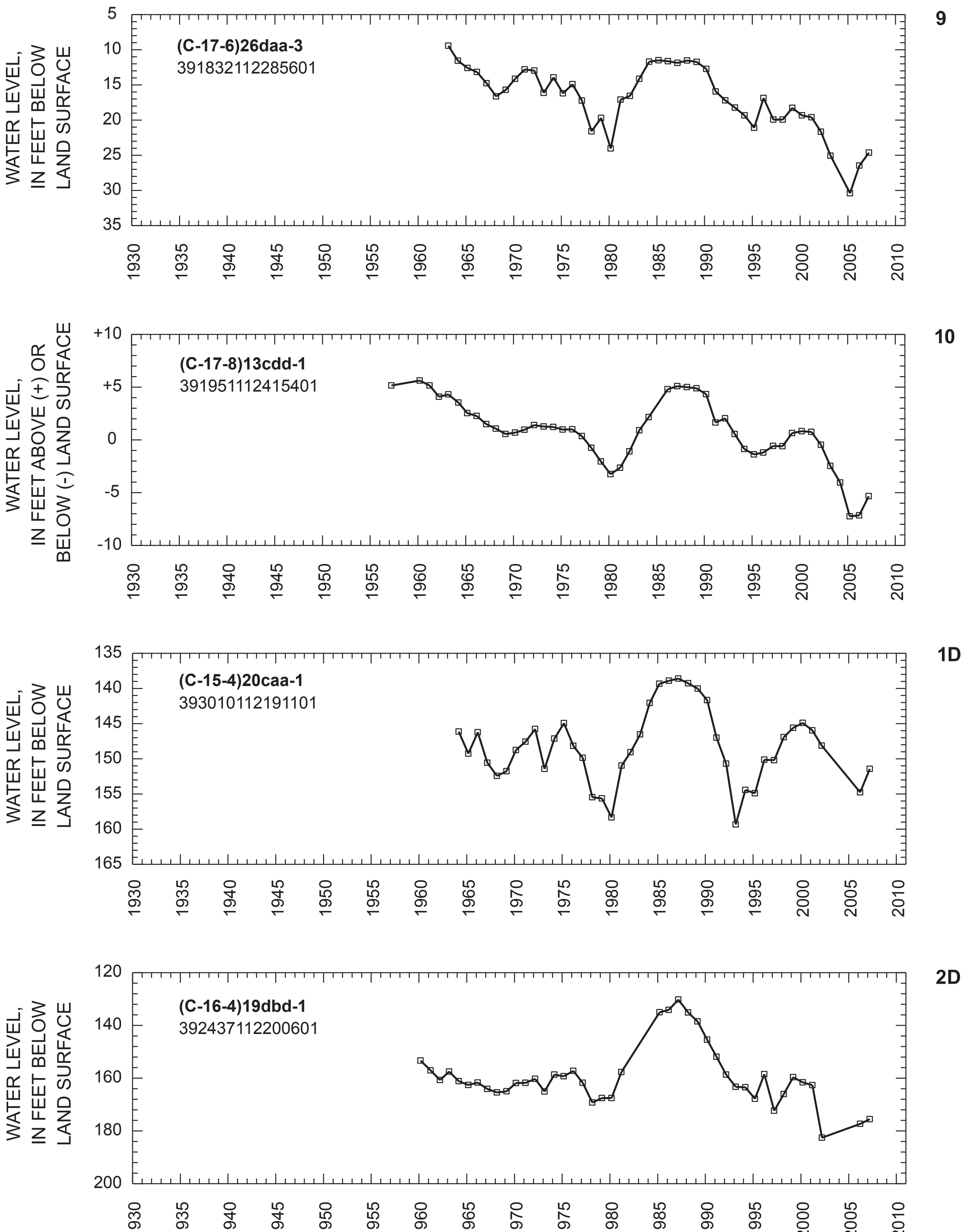


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1—Continued.

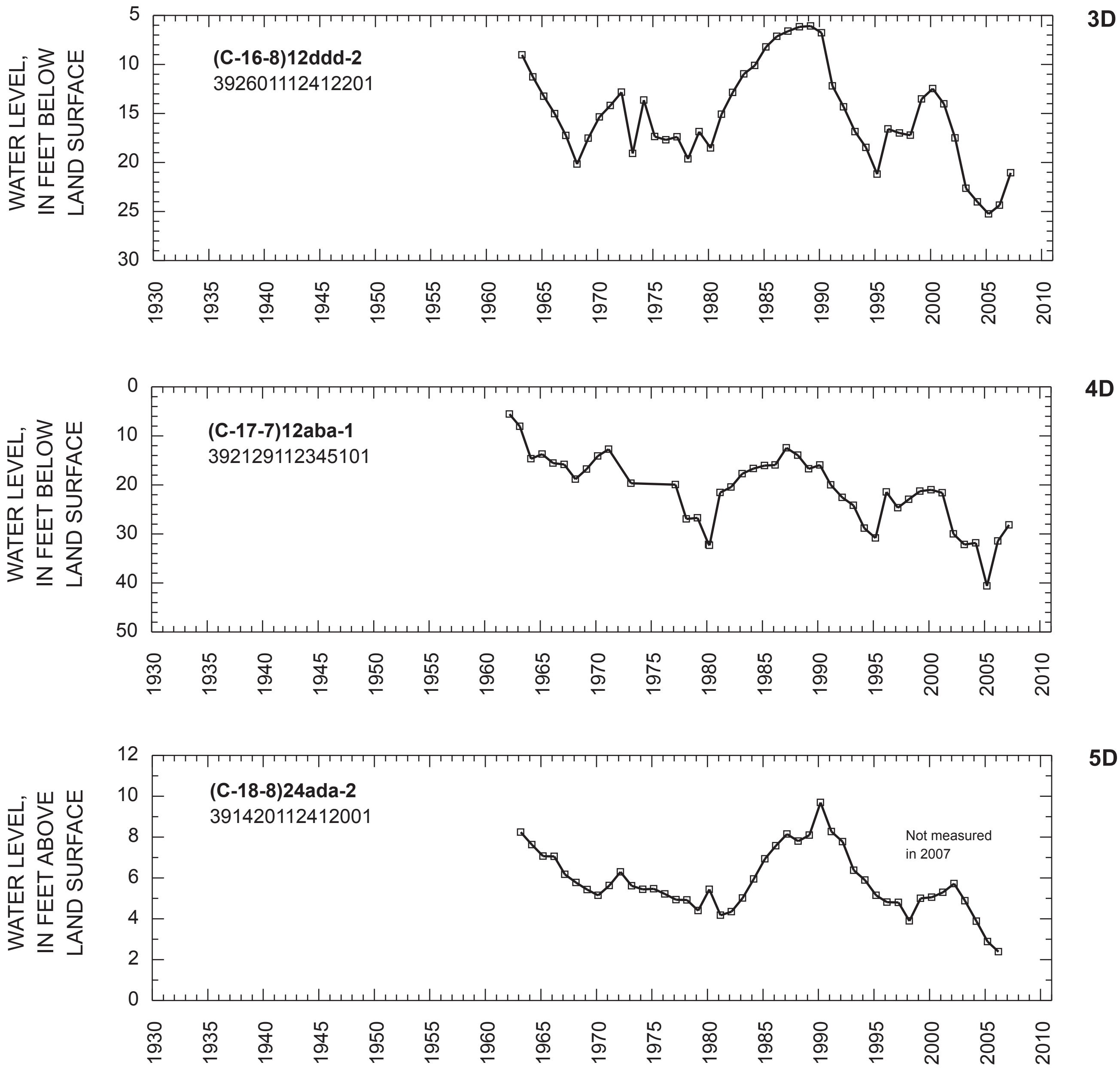


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1—Continued.

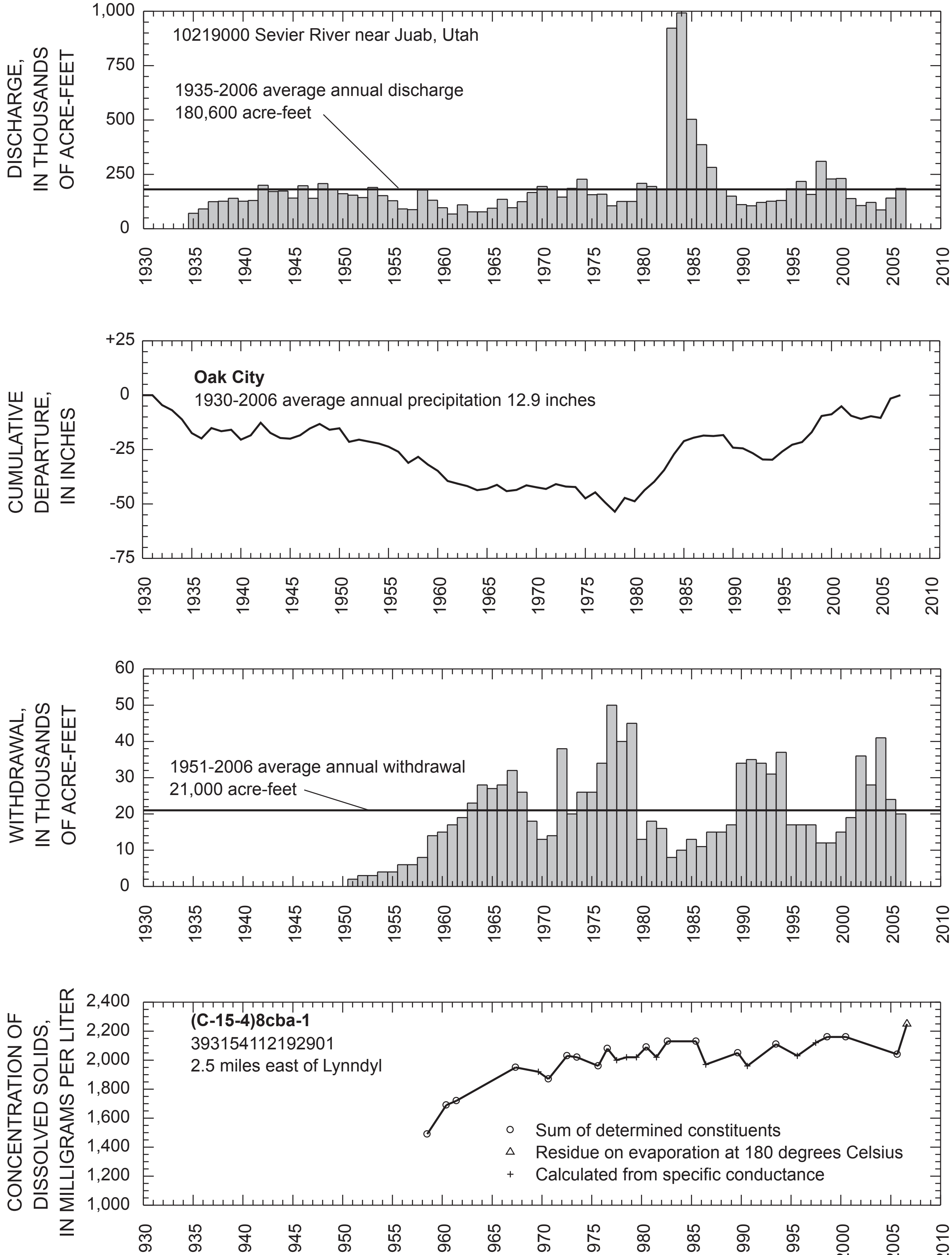


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1—Continued.

CENTRAL SEVIER VALLEY

By B.A. Slaugh

Central Sevier Valley, in south-central Utah, is surrounded by the Sevier and Wasatch Plateaus to the east and the Tushar Mountains, Valley Mountains, and Pahvant Range to the west. Altitude ranges from 5,100 feet on the valley floor at the north end of the valley near Gunnison to more than 12,000 feet in the Tushar Mountains.

Total estimated withdrawal of water from wells in the central Sevier Valley in 2006 was about 16,000 acre-feet, which is 1,000 acre-feet less than what was reported for 2005 and the same as the average annual withdrawal for 1996-2005 (tables 2 and 3).

The location of 26 wells in central Sevier Valley in which the water level was measured during March 2007 is shown in figure 20. The relation of the water level in selected observation wells to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 21.

Water levels generally declined from March 2001 to March 2005, rose in March 2006, and declined again in March 2007 in central Sevier Valley. Hydrographs for selected wells show that March water levels generally rose from about 1978 to 1985 and declined from 1985 to about 1993. Since 1993, water levels have fluctuated depending upon the amount and timing of precipitation and recharge from snowmelt runoff.

Discharge of the Sevier River at Hatch in 2006 was about 94,900 acre-feet. This is about 160,300 acre-feet less than the record high 255,200 acre-feet reported for 2005 (revised value) and about 14,900 acre-feet more than the 1940-2006 average annual discharge.

Precipitation at Richfield was about 8.7 inches in 2006, which is about 0.6 inch more than the 1950-2006 average annual precipitation and about 0.3 inch more than in 2005. Physical properties and records of chemical analyses for water from one well in the central Sevier Valley are listed in tables 4 and 5, and the location of the well is plotted in figure 39. The dissolved-solids concentration of water from well (C-23-2)15dcb-4, located near Venice, was 414 milligrams per liter with a corresponding specific conductance of 670 microsiemens per centimeter at 25 degrees Celsius. The concentration of dissolved solids in water from this well has varied from about 300 milligrams per liter in 1972 to about 650 milligrams per liter in 1982 with no apparent long-term trend in the data. Water-quality data for this well extend back to 1955.

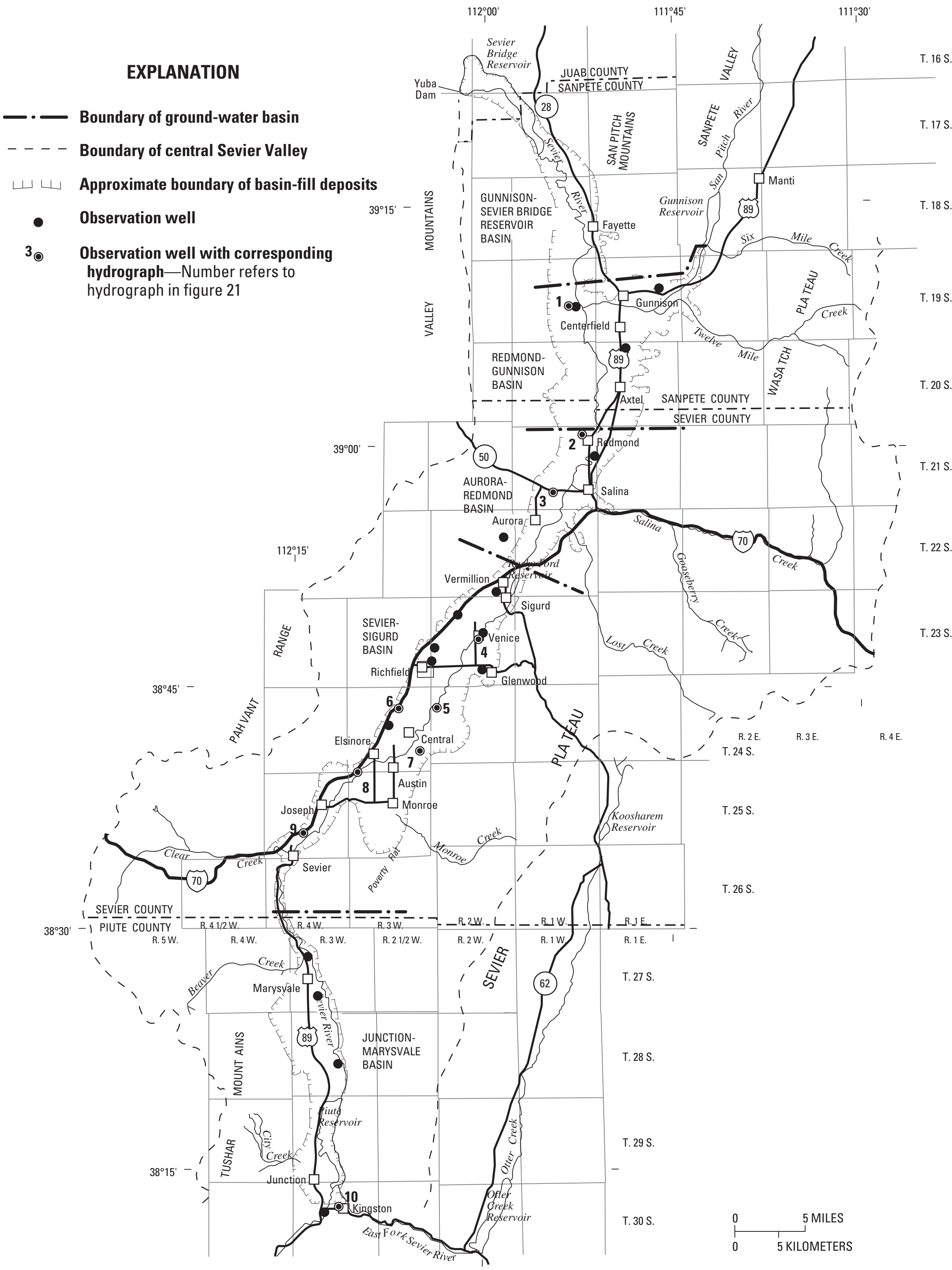


Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 2007.

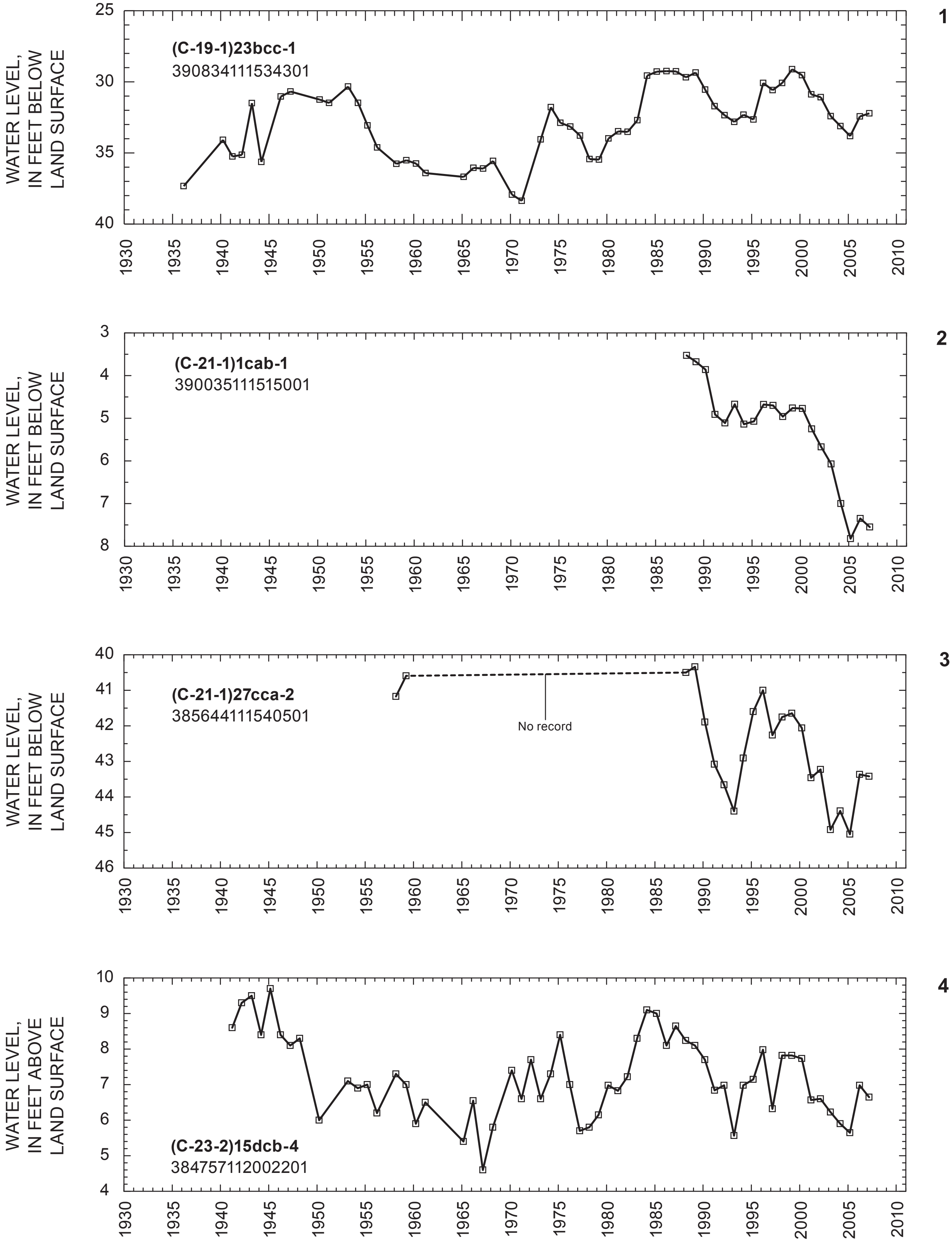


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

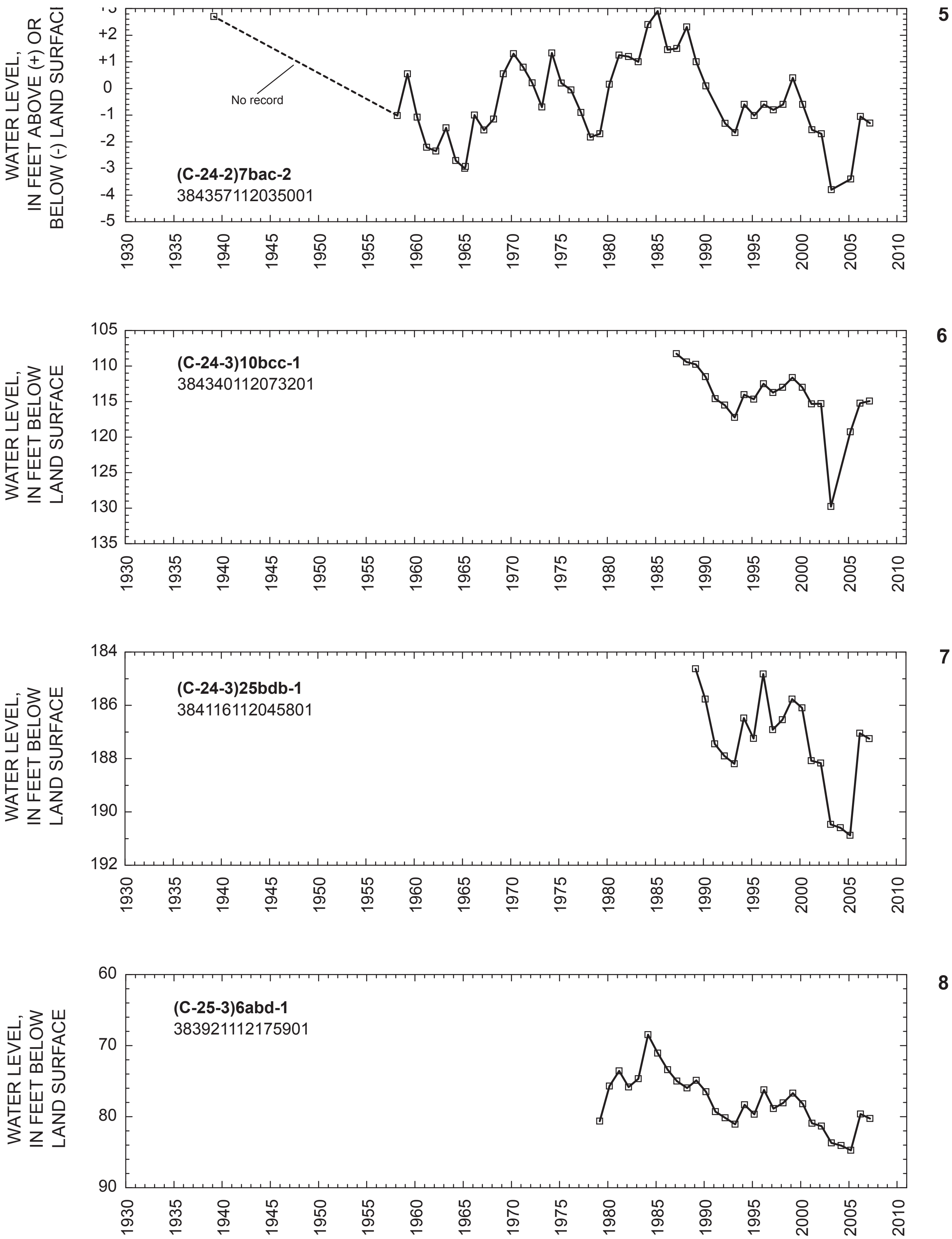
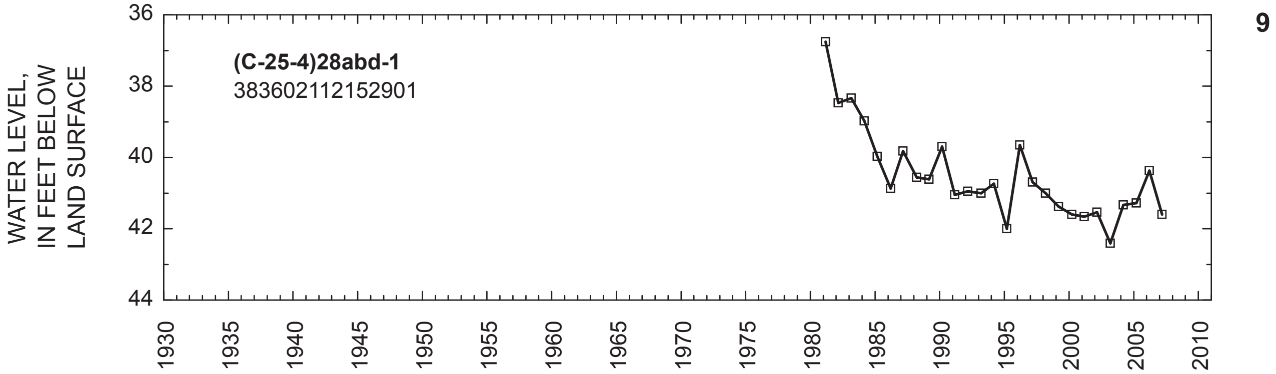


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.



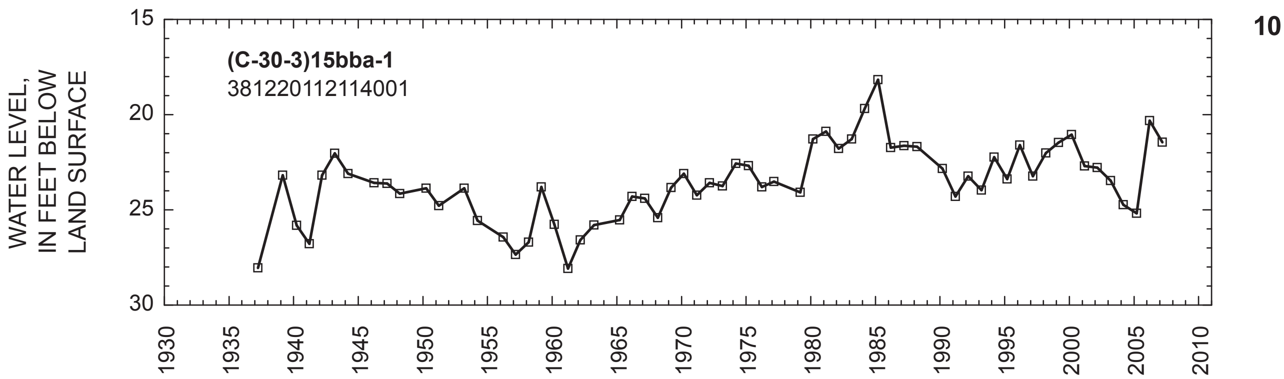


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

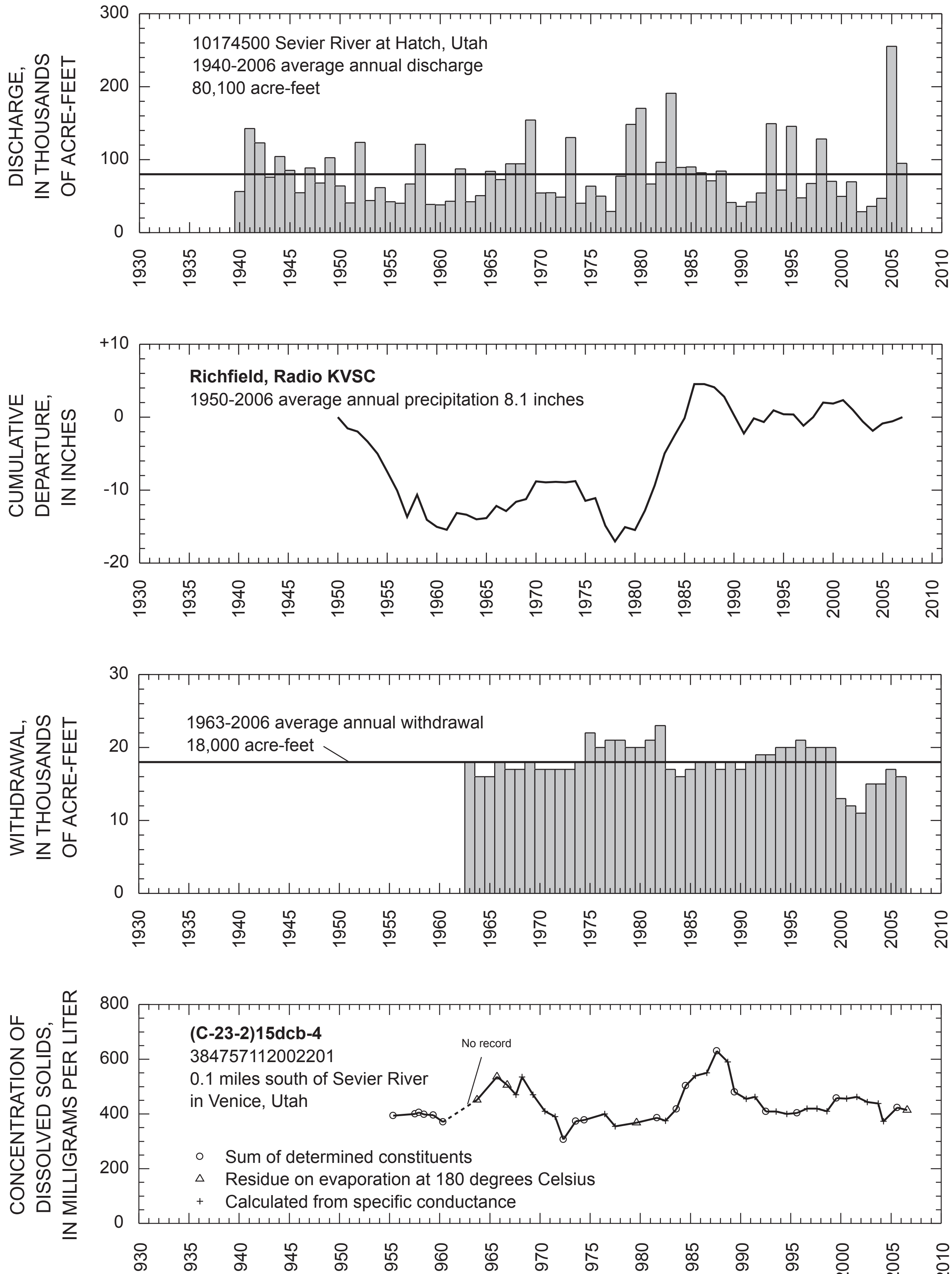


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

PAHVANT VALLEY

By R.L. Swenson

Pahvant Valley, in southeastern Millard County, extends from the vicinity of McCornick on the north to Kanosh on the south, from the Pahvant Range and Canyon Mountains on the east and northeast to a low basalt ridge known as The Cinders on the west. The area of the valley covers about 300 square miles, and water drains west to the valley from the mountainous terrain to the east.

Total estimated withdrawal of water from wells in Pahvant Valley in 2006 was about 86,000 acre-feet, which is about 6,000 acre-feet more than was reported in 2005 and 7,000 acre-feet more than the average annual withdrawal for 1996-2005 (tables 2 and 3). Withdrawal for irrigation in 2006 was about 84,300 acre-feet, which is 5,300 acre-feet more than was reported in 2005.

The location of wells in Pahvant Valley in which water levels were measured during March 2006 is shown in figure 22. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 23.

Water levels declined in most of the wells measured in Pahvant Valley from March 2006 to March 2007. The declines probably are a result of continued large withdrawals for irrigation. Water levels generally declined from the early 1950s until 1982 as a result of generally less-than-average precipitation and increased withdrawals. Water levels generally rose from 1982 to 1985, and were generally higher than in the early 1950s. The 1982-85 rises were the result of greater-than-average precipitation and decreased withdrawals for irrigation. Levels generally have declined since 1985.

Precipitation at Fillmore during 2006 was about 17.0 inches, which is about 1.8 inches more than the average annual precipitation for 1930-2006 and about 0.4 inch less than in 2005. The concentration of dissolved solids in water from wells near Flowell and west of Kanosh is shown in figure 23. The concentration of dissolved solids in water from well (C-21-5)7cdd-3, northwest of Flowell, has shown little change since 1983. The concentration of dissolved solids in water from well (C-23-6)8abd-1, west of Kanosh, generally has increased since the late 1950s.

Physical properties and records of chemical analyses for water from two wells in Pahvant Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 39. The concentration of dissolved solids in water from well (C-21-5)7cdd-3, located about 1.75 miles northwest of Flowell, was 1,000 milligrams per liter, exceeding the secondary drinking-water standards for the State of Utah. The dissolved-solids concentration for well (C-23-6)16bad-1, located about 6 miles west of Kanosh, was 3,540 milligrams per liter, exceeding the maximum contaminant level for the State of Utah. Water from this well had the highest dissolved-solids concentration of any of the samples collected. Additional constituents exceeded the secondary drinking-water standards for the State of Utah and included chloride (1,210 milligrams per liter) and sulfate (708 milligrams per liter).

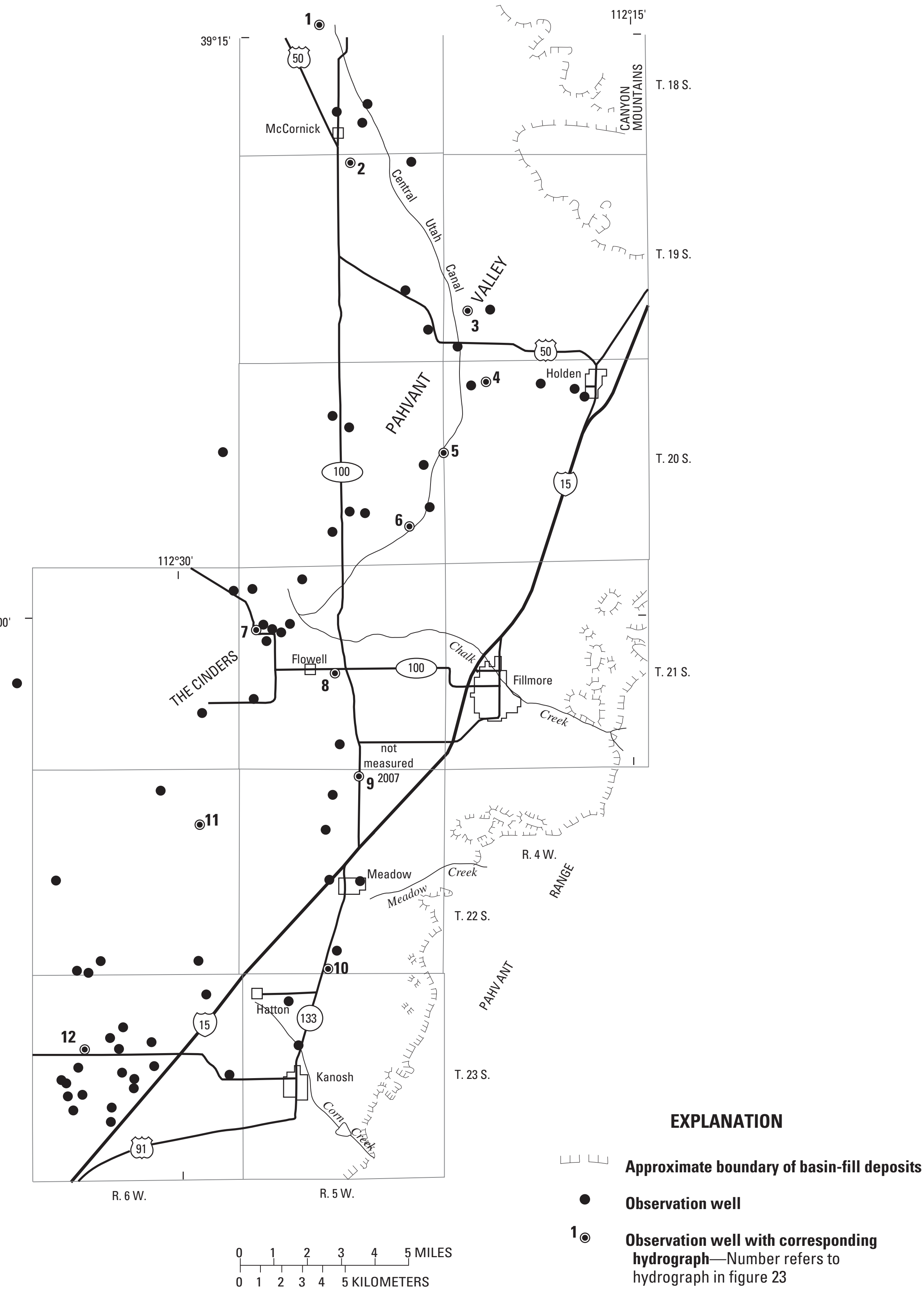


Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 2007.

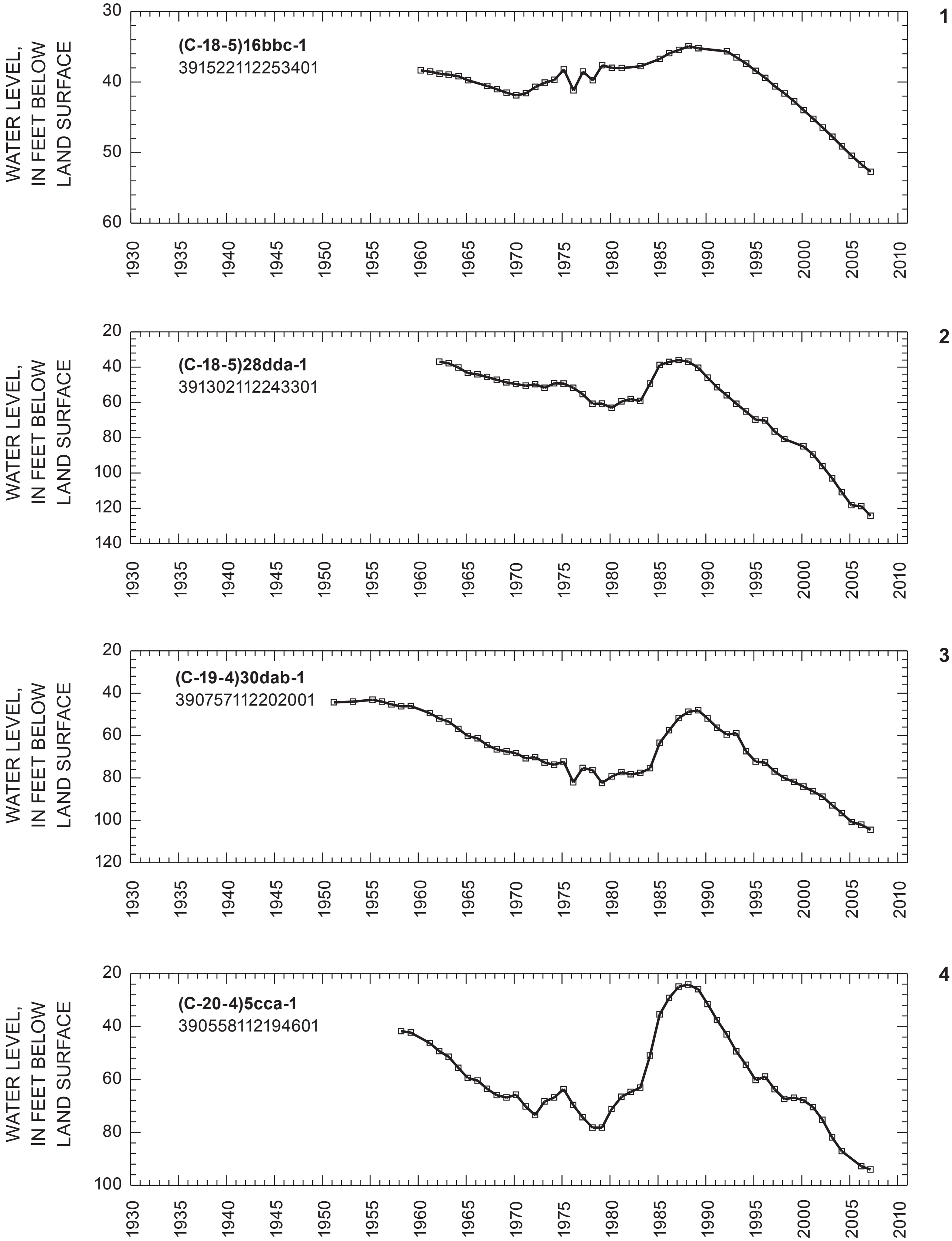
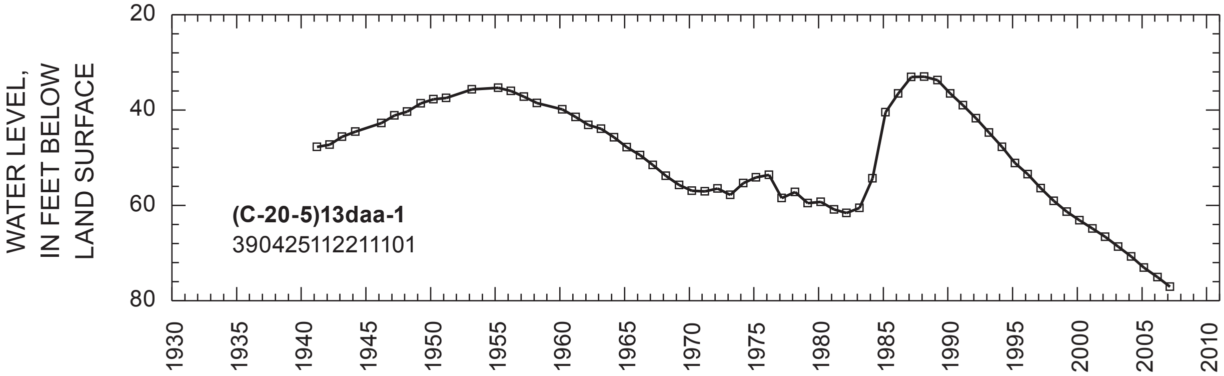


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.



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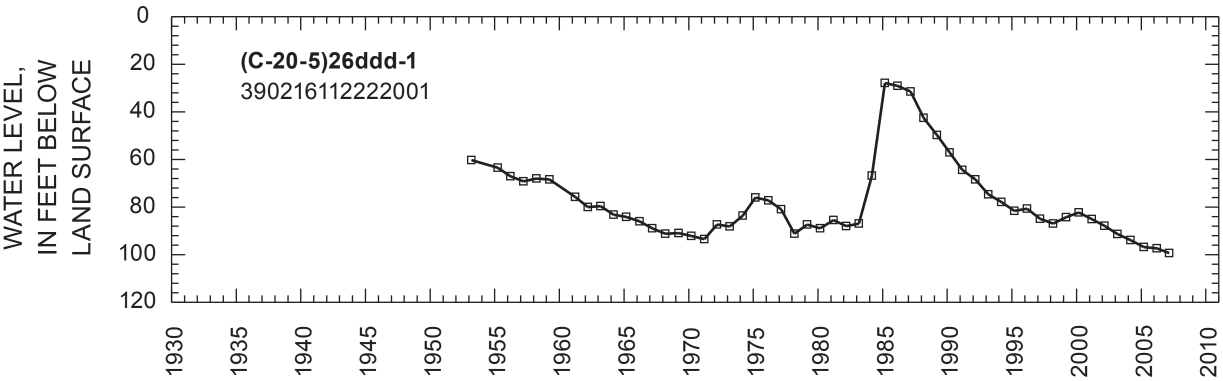

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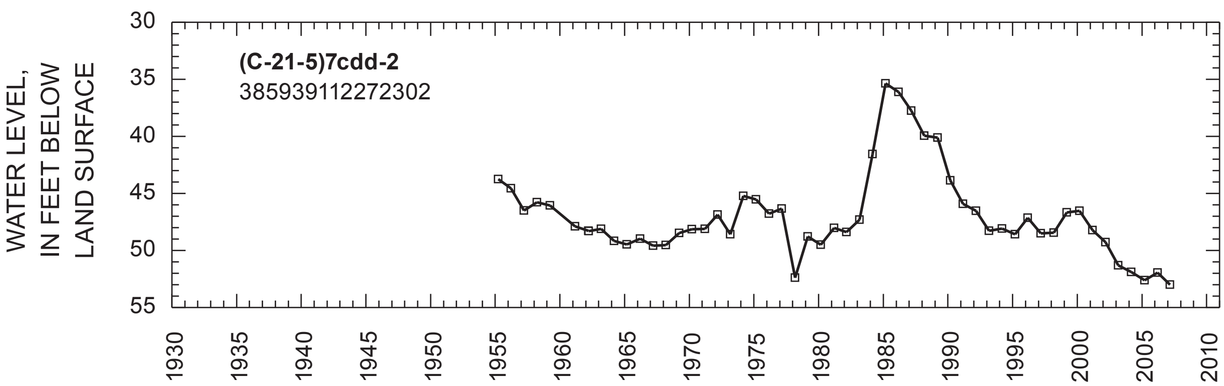

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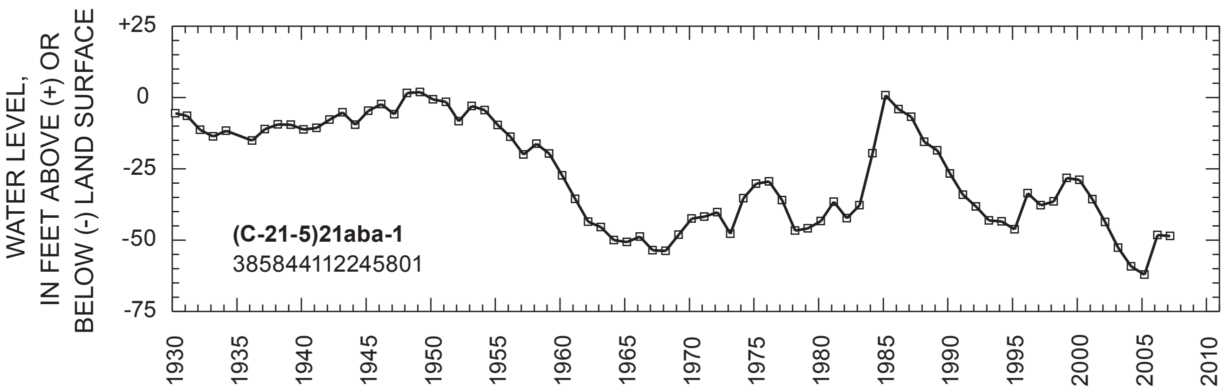

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Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells —Continued.

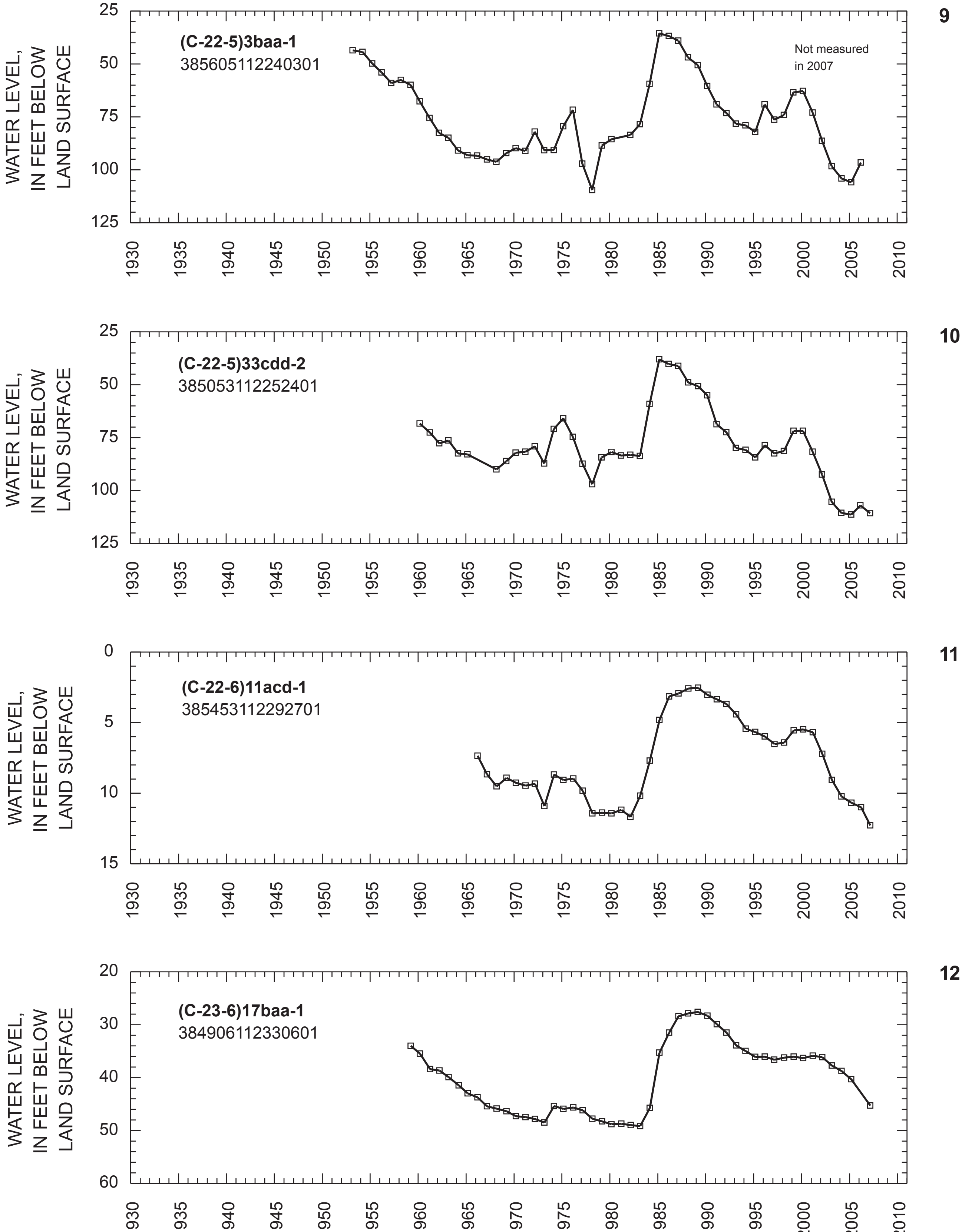


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

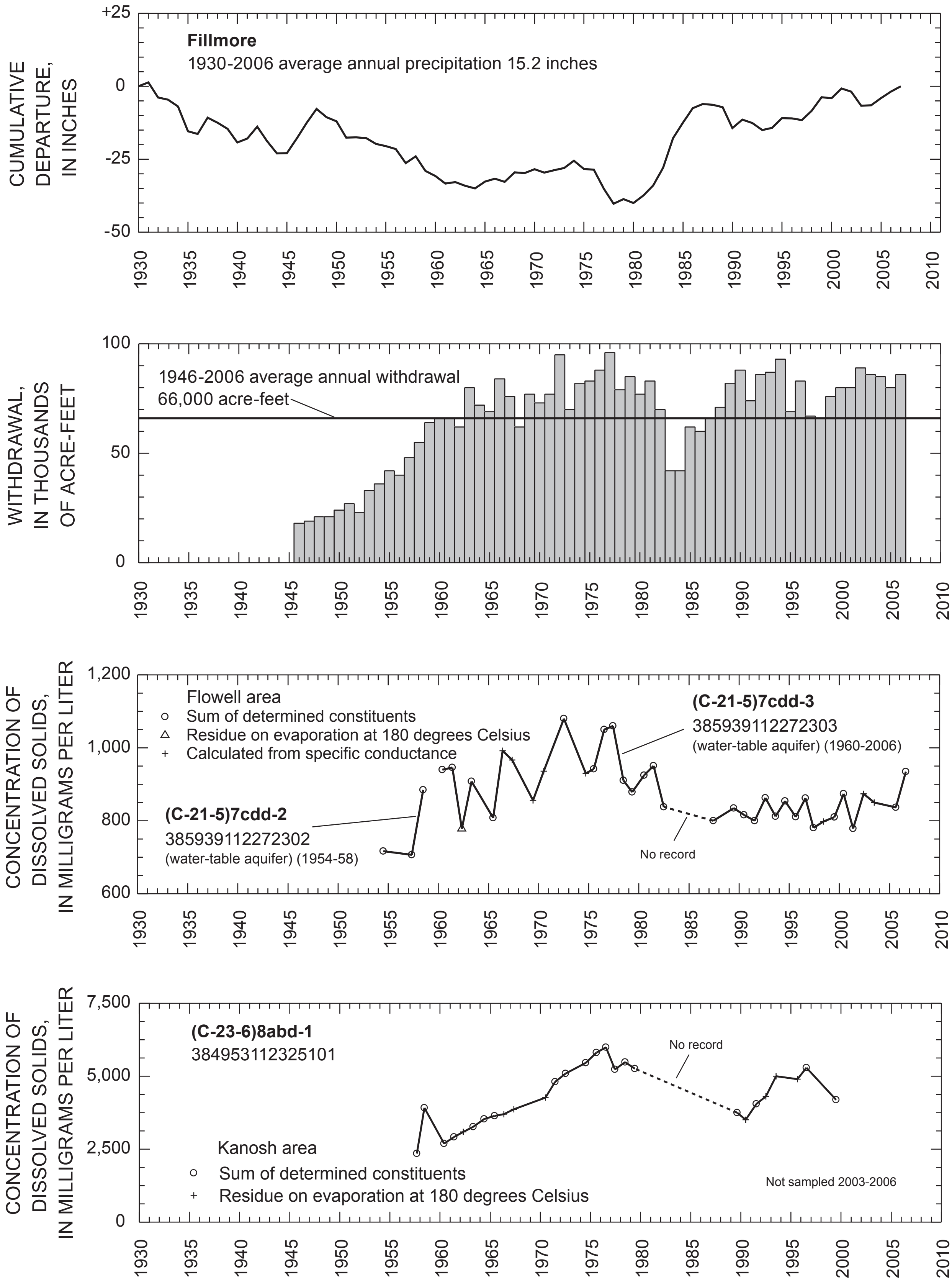


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

CEDAR VALLEY, IRON COUNTY

By J.H. Howells

Cedar Valley is in eastern Iron County, southwestern Utah. The valley covers about 170 square miles from about Townships 34 South to 37 South and Ranges 10 West to 12 West and includes Cedar City on its eastern edge. Ground water in Cedar Valley occurs in unconsolidated deposits, mostly under water-table conditions. The principal source of recharge to aquifers is water from Coal Creek, some of which seeps directly from the channel into the ground-water system after being diverted for irrigation.

Total estimated withdrawal of water from wells in Cedar Valley in 2006 was about 35,000 acre-feet, which is about 5,000 acre-feet more than 2005 and 1,000 acre-feet less than the average annual withdrawal for 1996-2005 (tables 2 and 3). The increase was mainly due to increased withdrawals for irrigation.

The location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2007 is shown in figure 24. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 25.

Ground-water levels generally declined from March 2006 to March 2007 in most parts of Cedar Valley. The largest declines, greater than 4 feet, were measured in three wells west of Quichapa Lake. Water-level rises were measured in three wells north and west of Enoch, in two wells west and south of Enoch, and in two wells east of Quichapa Lake. Water-level declines probably resulted from continued localized large withdrawals for irrigation and municipal use. Water-level rises probably result from locally decreased withdrawals.

Precipitation at Cedar City Federal Aviation Administration Airport in 2006 was about 10.4 inches, which is about 3.5 inches less than in 2005 and about 0.3 inch less than the average annual precipitation for 1949-2006. The discharge of Coal Creek was about 29,000 acre-feet in 2006, which is 52,000 acre-feet less than in 2005, and 4,400 acre-feet more than the average annual discharge for 1936 and 1939-2006.

Physical properties and records of chemical analyses for water from one well in Cedar Valley, Iron County, are listed in tables 4 and 5, and the location of the well is plotted in figure 39. The concentration of dissolved solids in water from well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, has shown an increase from about 360 milligrams per liter in 1987 to about 1,070 milligrams per liter in 2006. Both dissolved-solids and sulfate concentration (576 milligrams per liter) in water from this well exceed the secondary drinking-water standards for the State of Utah. Hardness, as calcium carbonate, was 750 milligrams per liter.

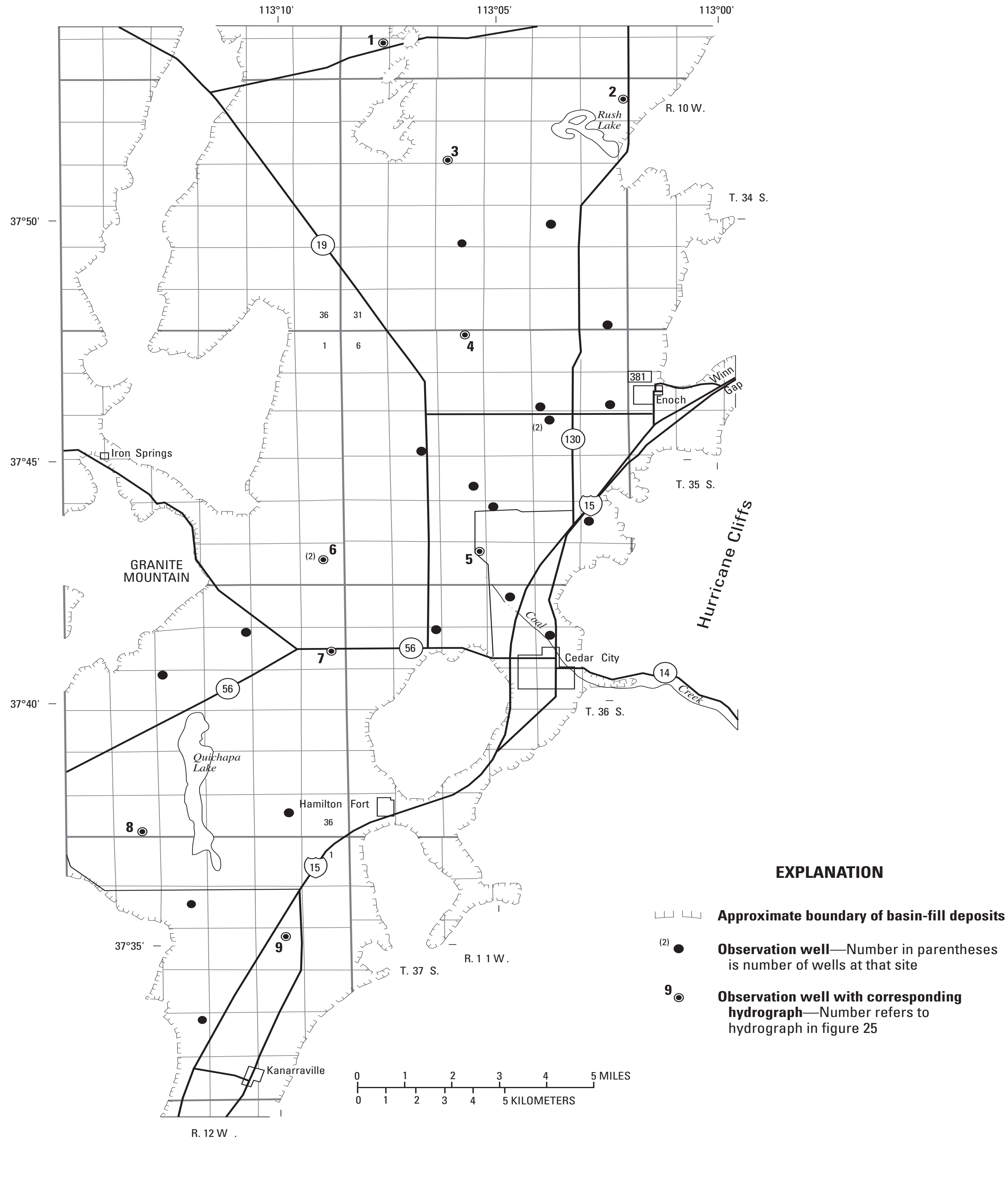


Figure 24. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2007.

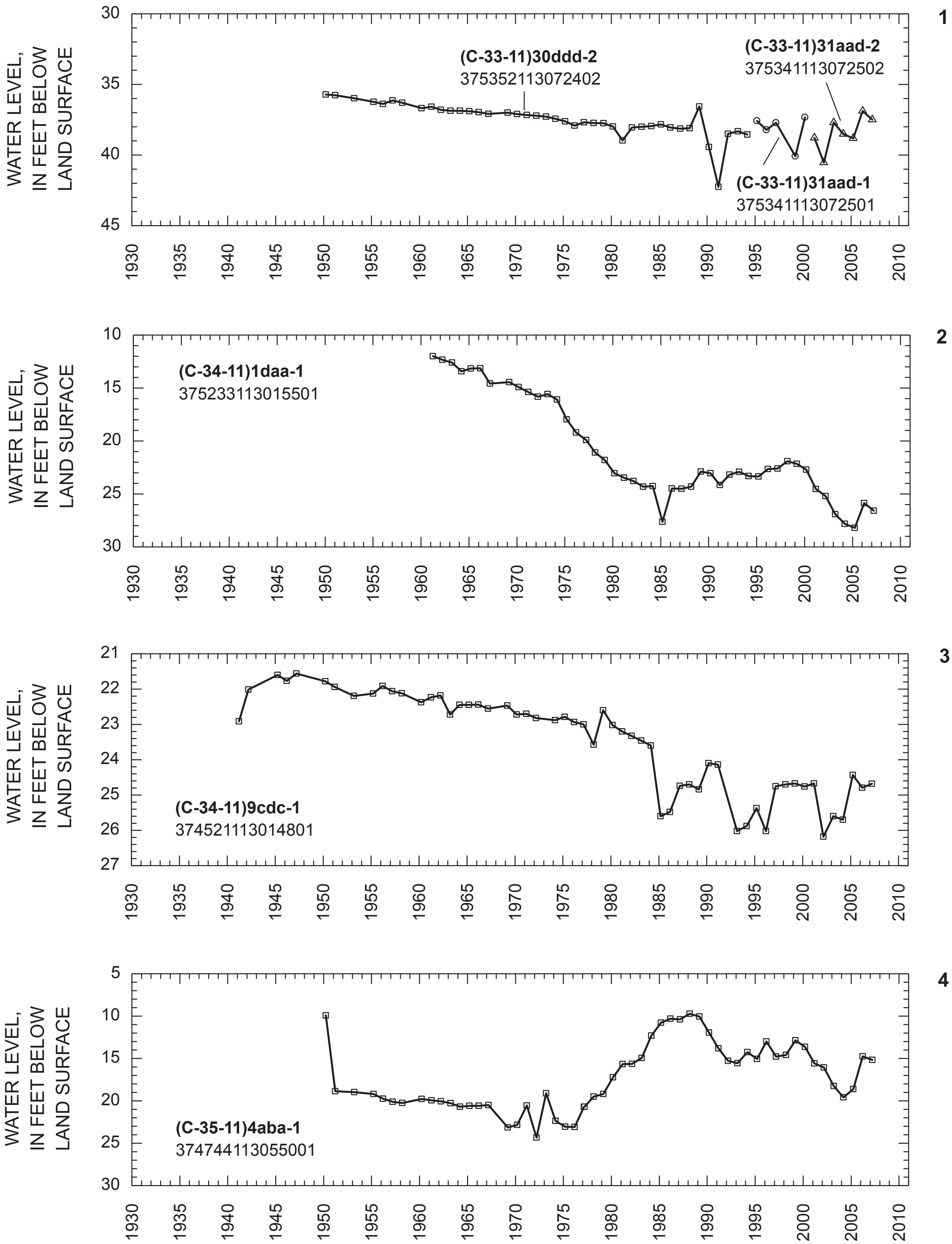


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

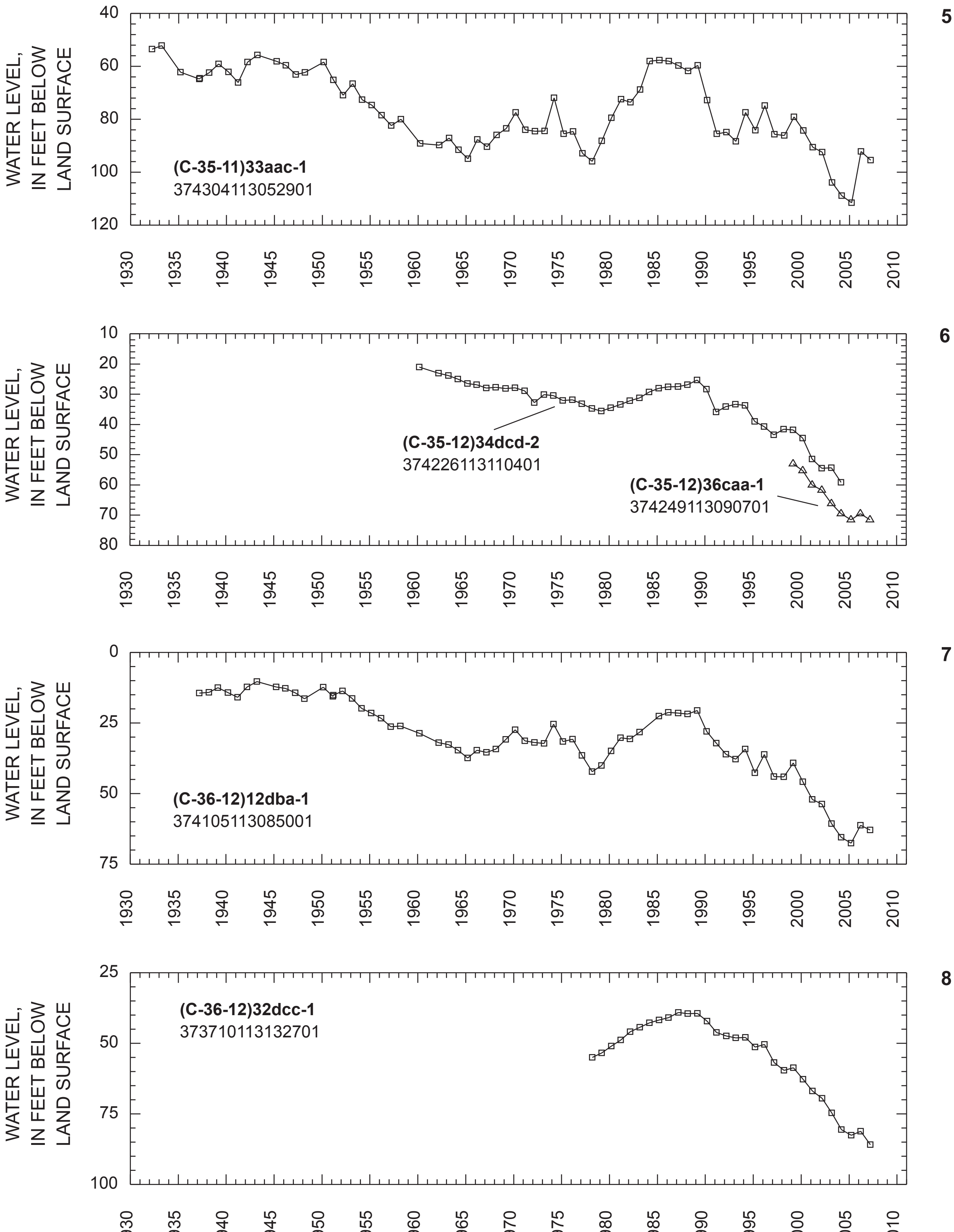


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

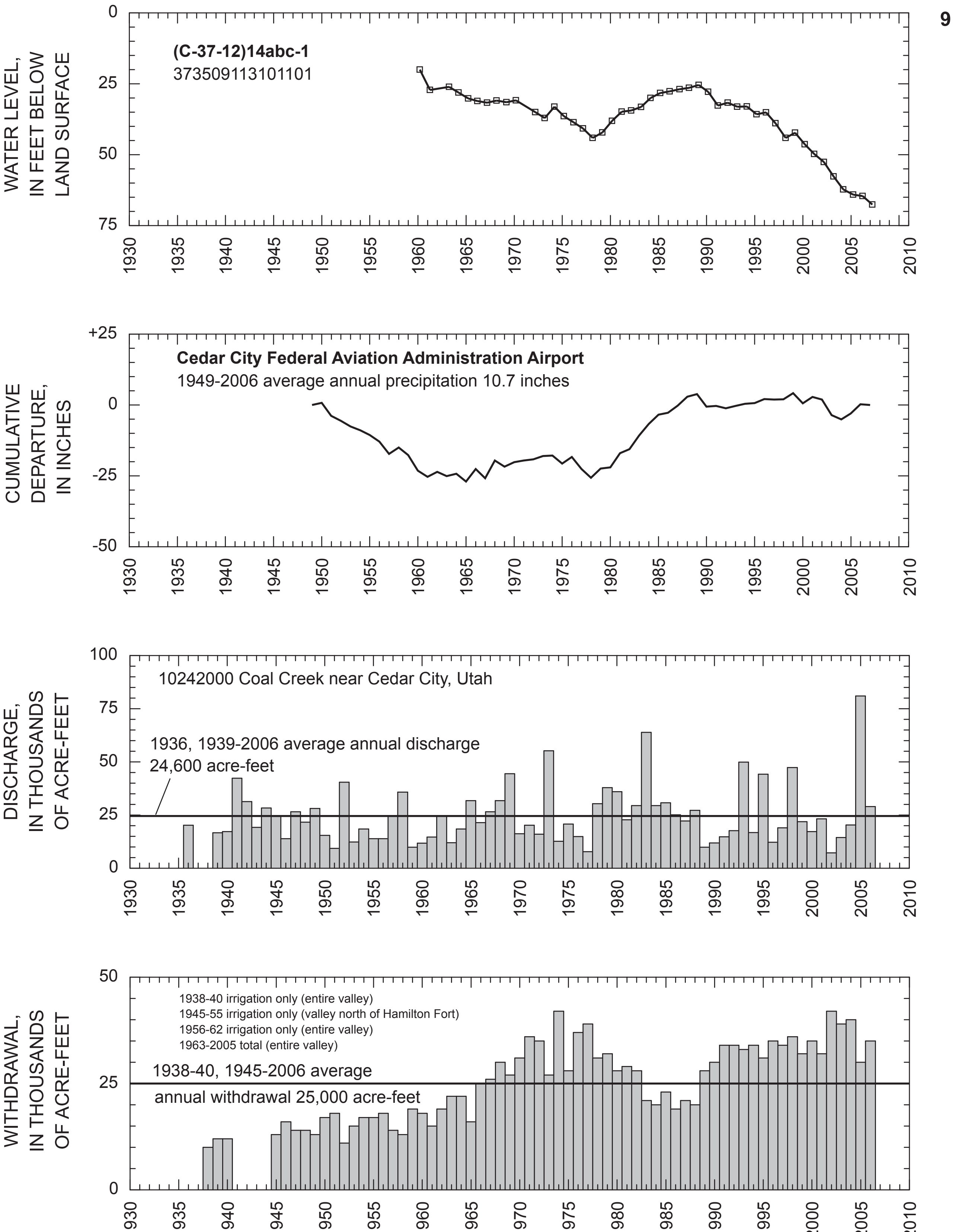


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

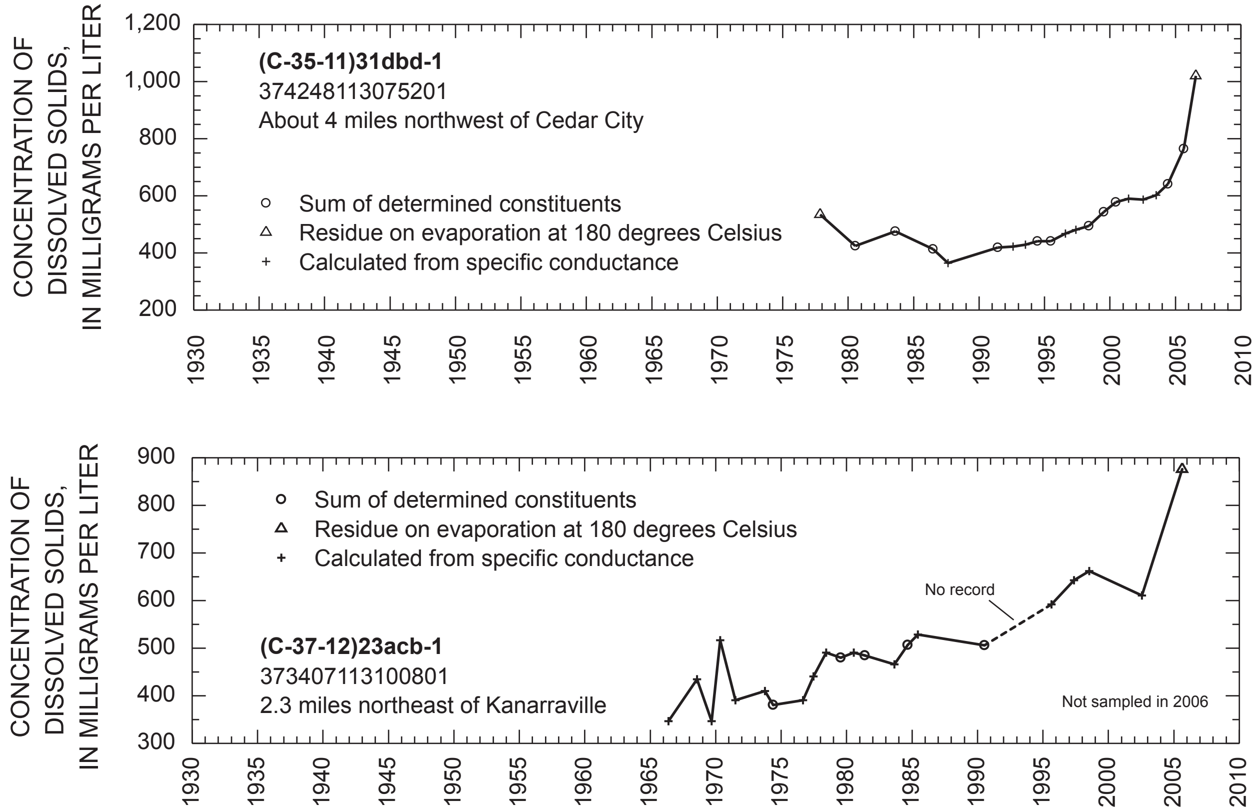


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

PAROWAN VALLEY

By J.H. Howells

Parowan Valley is in northern Iron County, southwestern Utah. The valley covers about 160 square miles between about Townships 32 South and 34 South and Ranges 7 West and 10 West and includes the towns of Paragonah and Parowan. Ground water occurs in unconsolidated deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Parowan Valley in 2006 was about 33,000 acre-feet, which is about 6,000 acre-feet more than was reported for 2005 and 3,000 acre-feet more than the average annual withdrawal for 1996-2005 (tables 2 and 3).

The location of wells in Parowan Valley in which the water level was measured during March 2007 is shown in figure 26. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 27.

Water levels declined slightly from March 2006 to March 2007 in most parts of Parowan Valley. Water-level rises were measured in two wells near Paragonah. Water levels in Parowan Valley generally have declined since 1950. Rises occurred during 1973-74, 1983-85, and 1996-99. Declines were probably the result of continued large withdrawals for irrigation. Rises were probably the result of greater-than-average precipitation and less withdrawal for irrigation.

Precipitation at Cedar City Federal Aviation Administration Airport in 2006 was about 10.4 inches, which is about 3.5 inches less than the value for 2005 and 0.3 inch less than the average annual precipitation for 1949-2006. The concentration of dissolved solids in water from well (C-33-8)31ccc-1 has shown little change since 1976 (fig. 27).

Physical properties and records of chemical analyses for water from one well in Parowan Valley are listed in tables 4 and 5, and the location of the well is plotted in figure 39. The concentration of dissolved solids in water from well (C-33-9)36cad-1, located about 2.5 miles west of Paragonah, was 317 milligrams per liter with a specific conductance of 550 microsiemens per centimeter at 25 degrees Celsius. No constituents analyzed in water from this well exceeded drinking-water standards for the State of Utah.

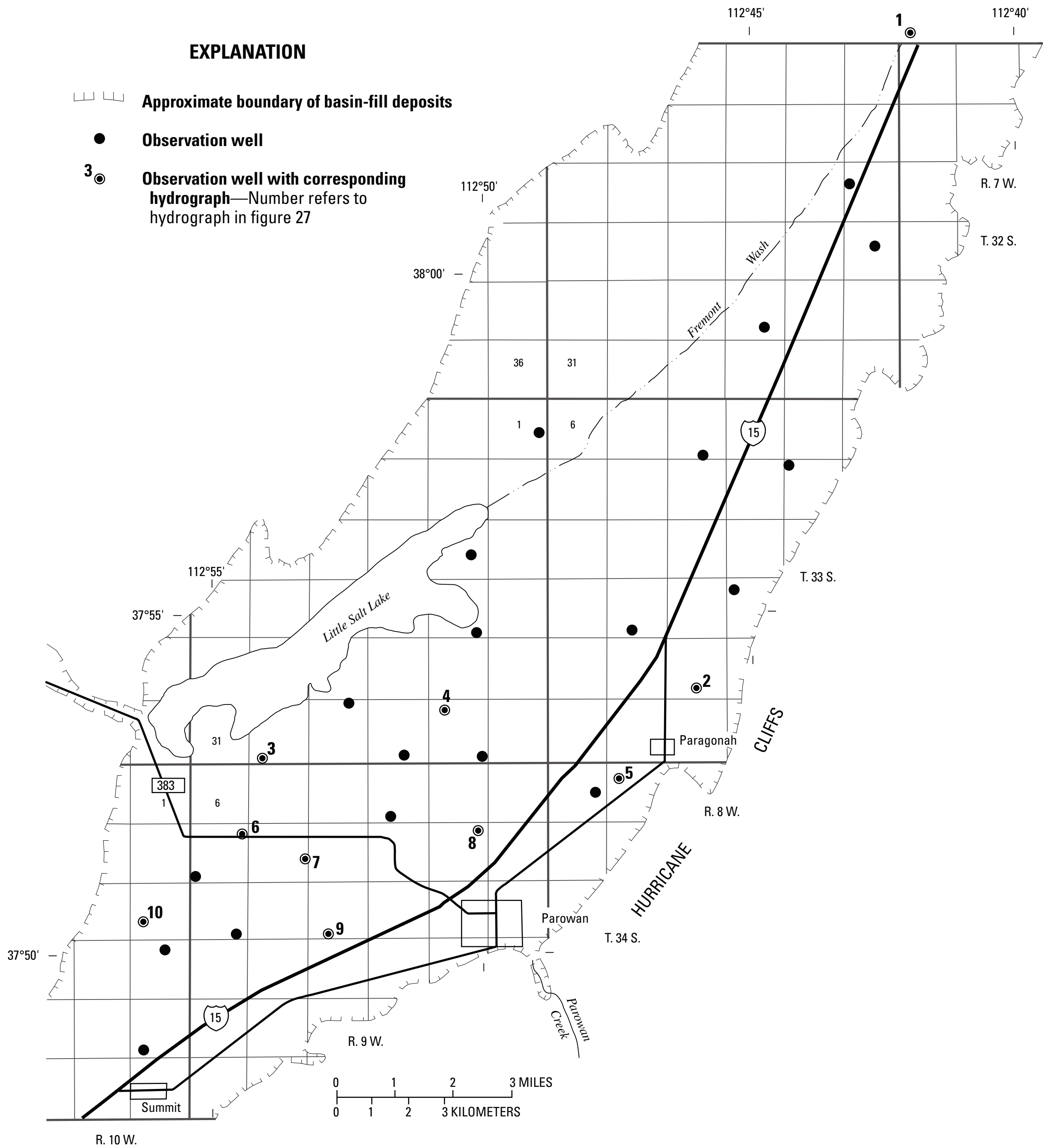


Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 2007.

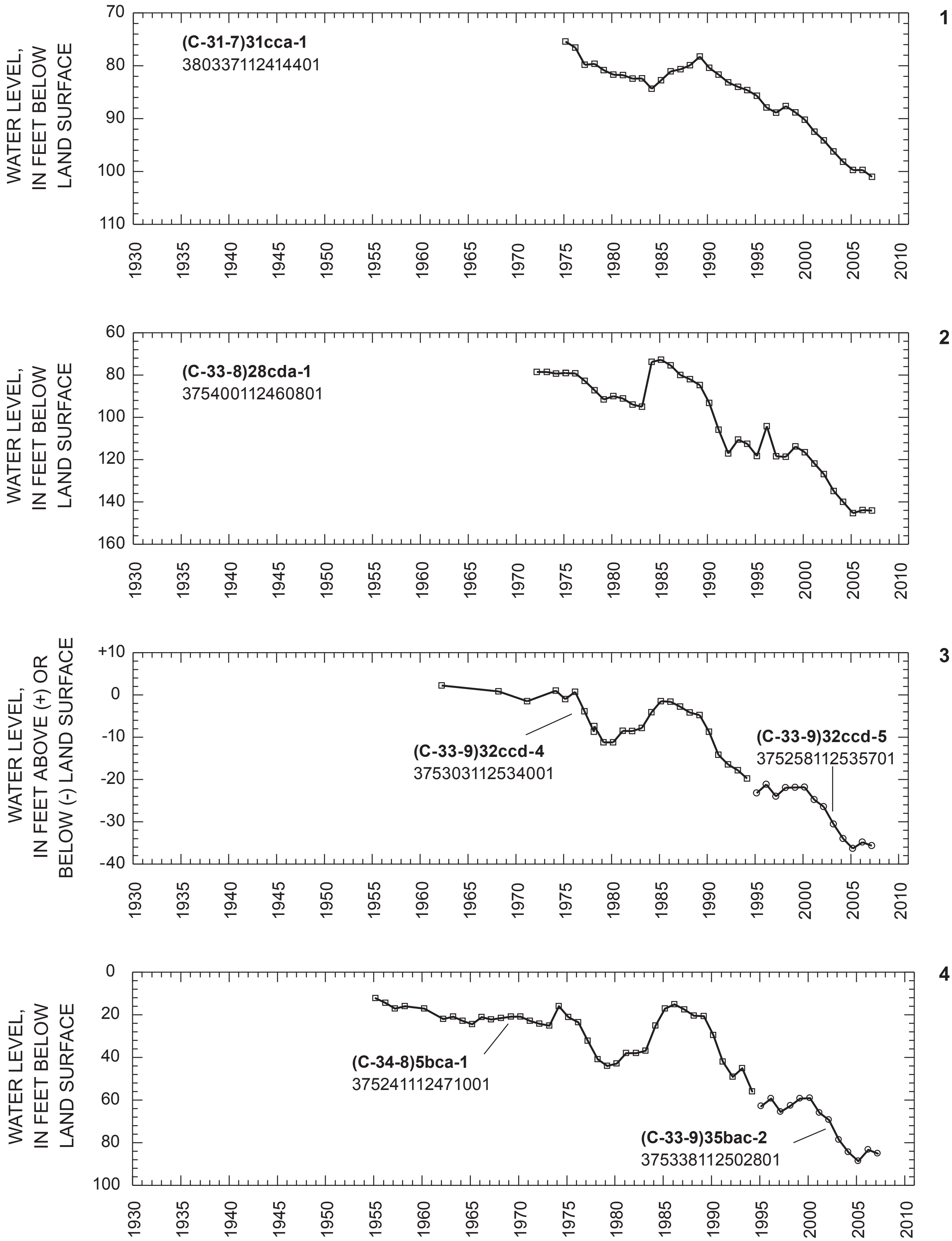


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

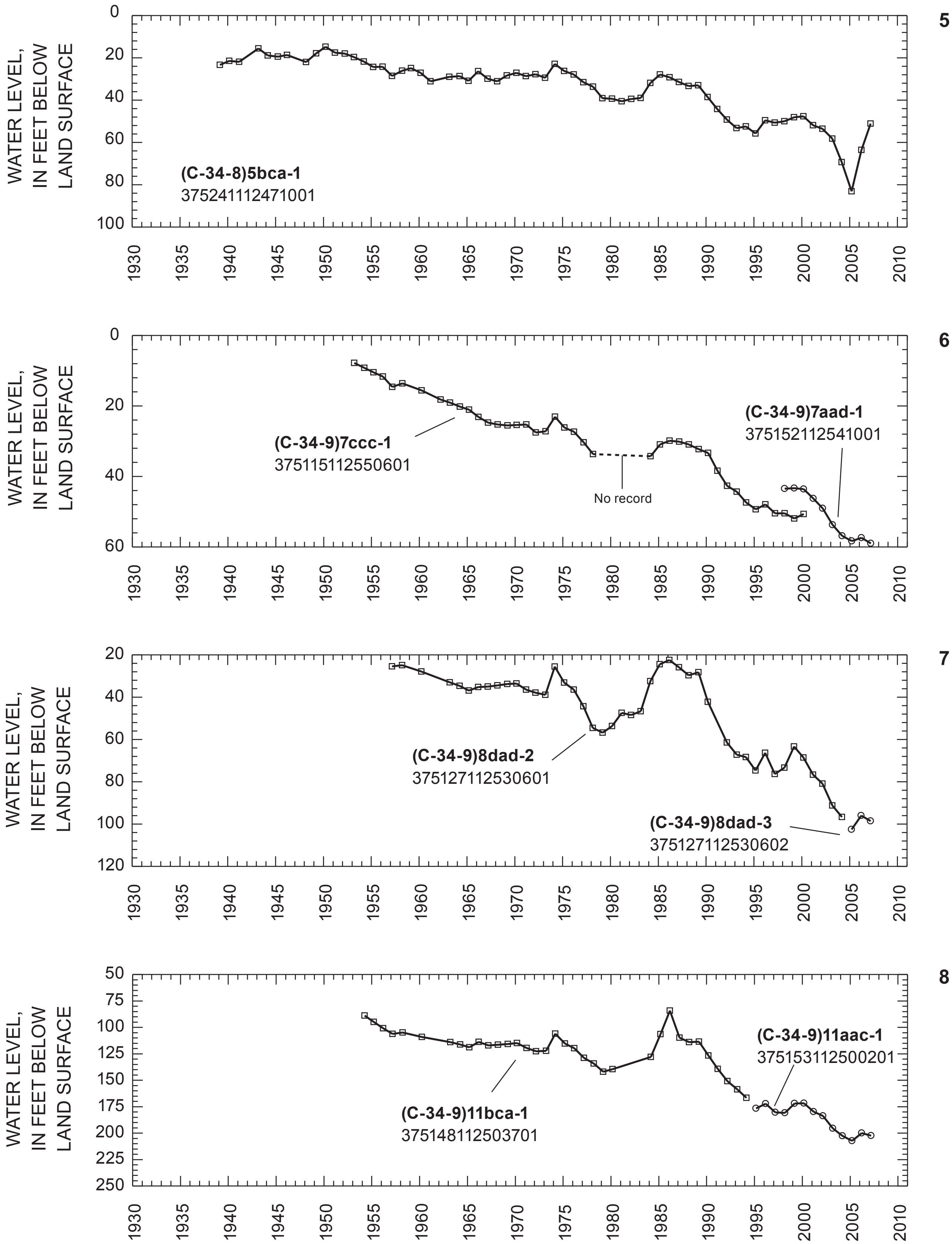


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

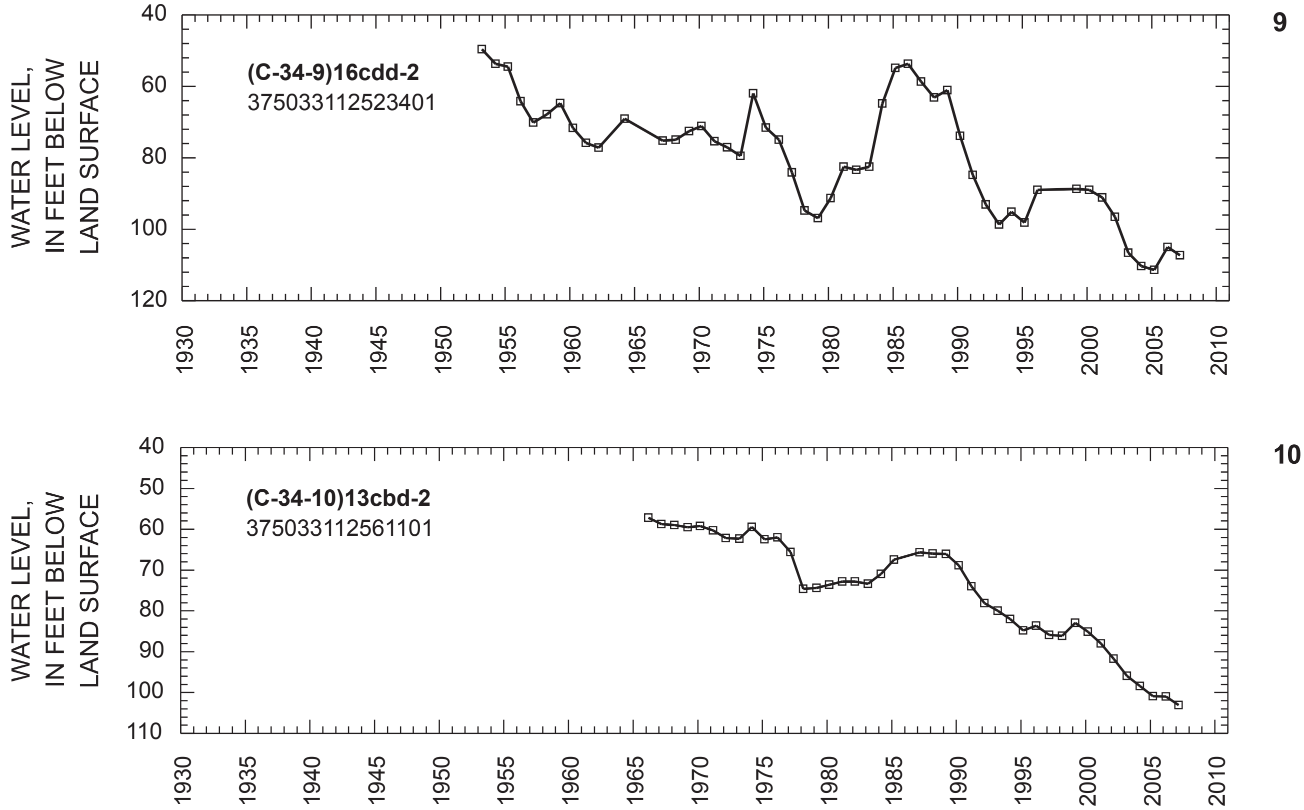


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

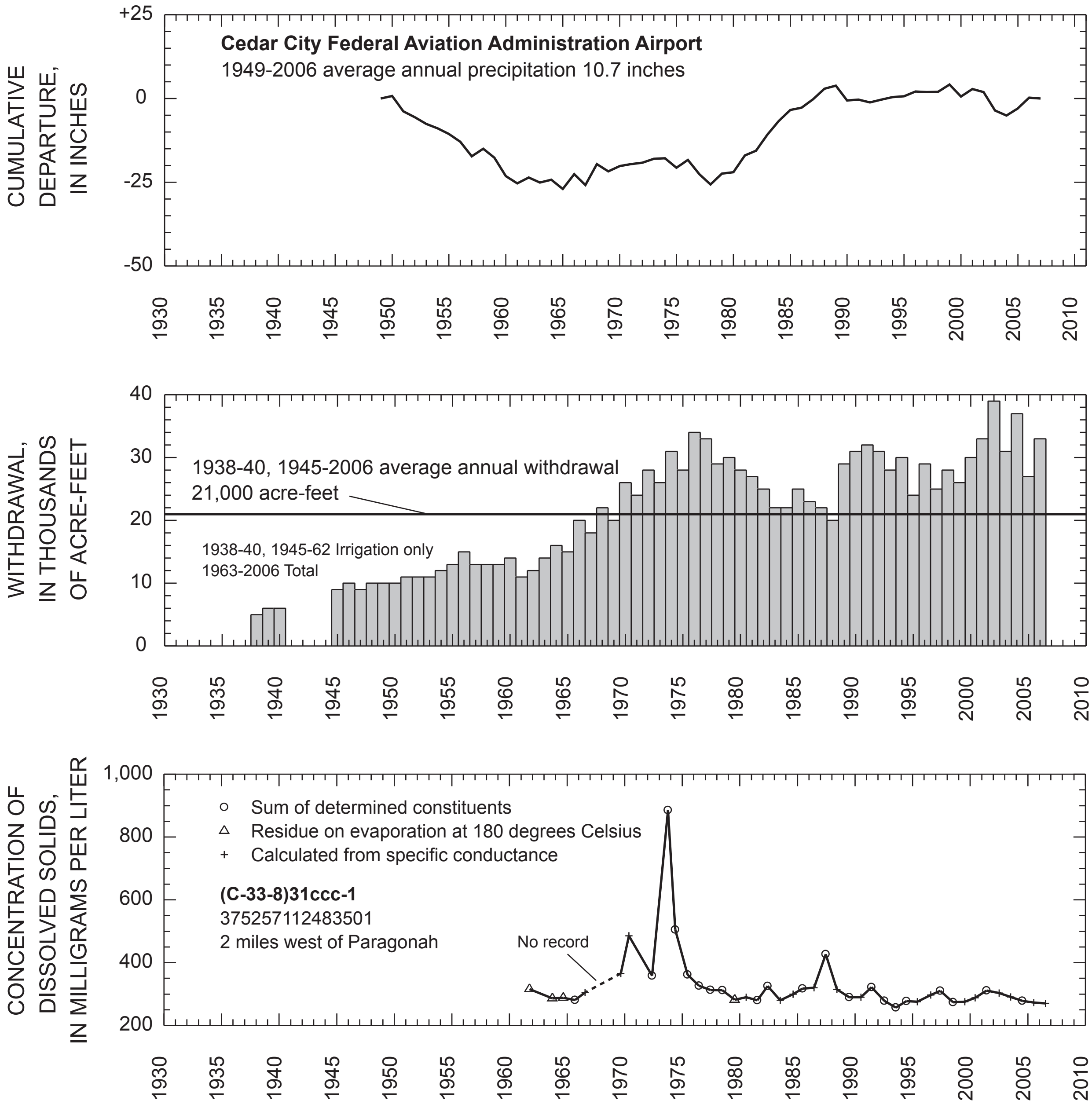


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

ESCALANTE VALLEY

Milford Area

By B.A. Slaugh

The Milford area is in southwestern Utah in parts of Millard, Beaver, and Iron Counties, between about Townships 24 South and 31 South and Ranges 9 West and 14 West.

Total estimated withdrawal of water from wells in the Milford area of the Escalante Valley in 2006 was about 45,000 acre-feet, which is 5,000 acre-feet more than was reported for 2005 and 1,000 acre-feet less than the average annual withdrawal for 1996-2005 (tables 2 and 3). The increase in withdrawals was mostly the result of increased irrigation and decreased availability of surface water.

The location of 34 wells measured in the Milford area during March 2007 is shown in figure 28. The relation of the water level in selected observation wells to cumulative departure from the average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)18daa-1 is shown in figure 29.

Water levels generally declined from March 2002 to March 2005, then rose slightly from March 2005 to March 2006 and declined again slightly from March 2006 to March 2007 in the Milford area. The amount of water-level rise or decline depends largely on ground-water withdrawals and the amount and timing of precipitation and discharge from the Beaver River. Water levels generally have declined since the early 1950s in the south-central Milford area in response to the long-term effects of ground-water withdrawals. Water-level rises during 1983-85 resulted from greater-than-average precipitation during 1982-85 and increased recharge from record flow in the Beaver River during 1983-84.

Precipitation at Black Rock in 2006 was about 10.8 inches, about 2.2 inches more than in 2005 and about 1.8 inches more than the 1952-2006 average annual precipitation. The gaging station on the Beaver River at Rocky Ford Dam was discontinued in 2003. The Natural Resources Conservation Service states in the "Utah Water Supply Outlook Report" that the total amount of water stored in Minersville Reservoir in 2006 was 8,300 acre-feet less than in 2005 (Natural Resources Conservation Service; written commun., 2007). Water from well (C-29-10)18daa-1 was not sampled in 2006.

Physical properties and records of chemical analyses for water from two wells in the Milford area are listed in tables 4 and 5, and the location of the wells is plotted in figure 39. Dissolved-solids concentration of water from well (C-28-10)28ccc-1, located about 3-miles south of Milford, and well (C-29-11)1add-1, located about 5 miles south-southwest of Milford, was 671 and 563 milligrams per liter, respectively. Each of these wells had a dissolved-solids concentration that exceeded the secondary drinking-water standard for the State of Utah.

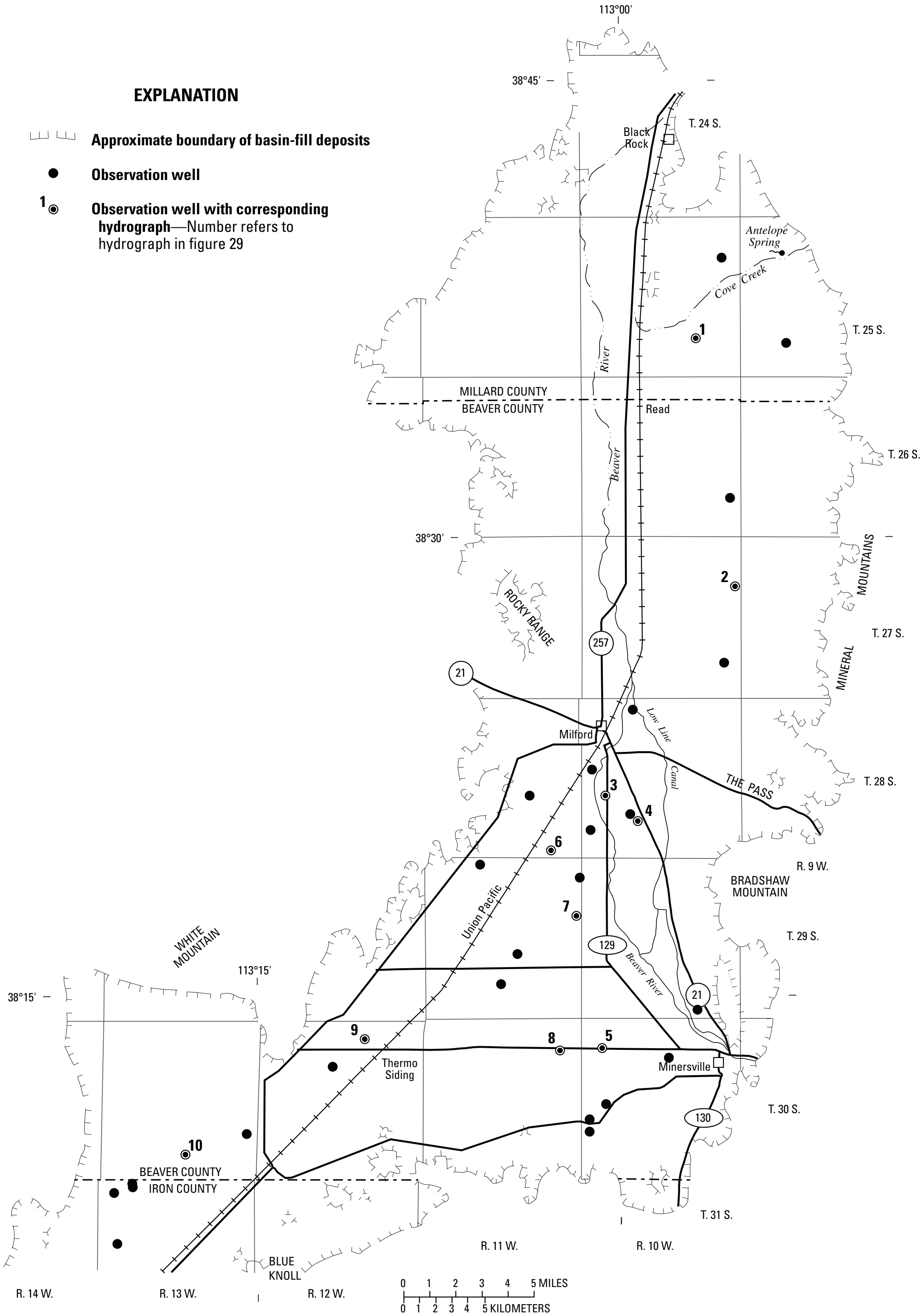


Figure 28. Location of wells in the Milford area in which the water level was measured during March 2007.

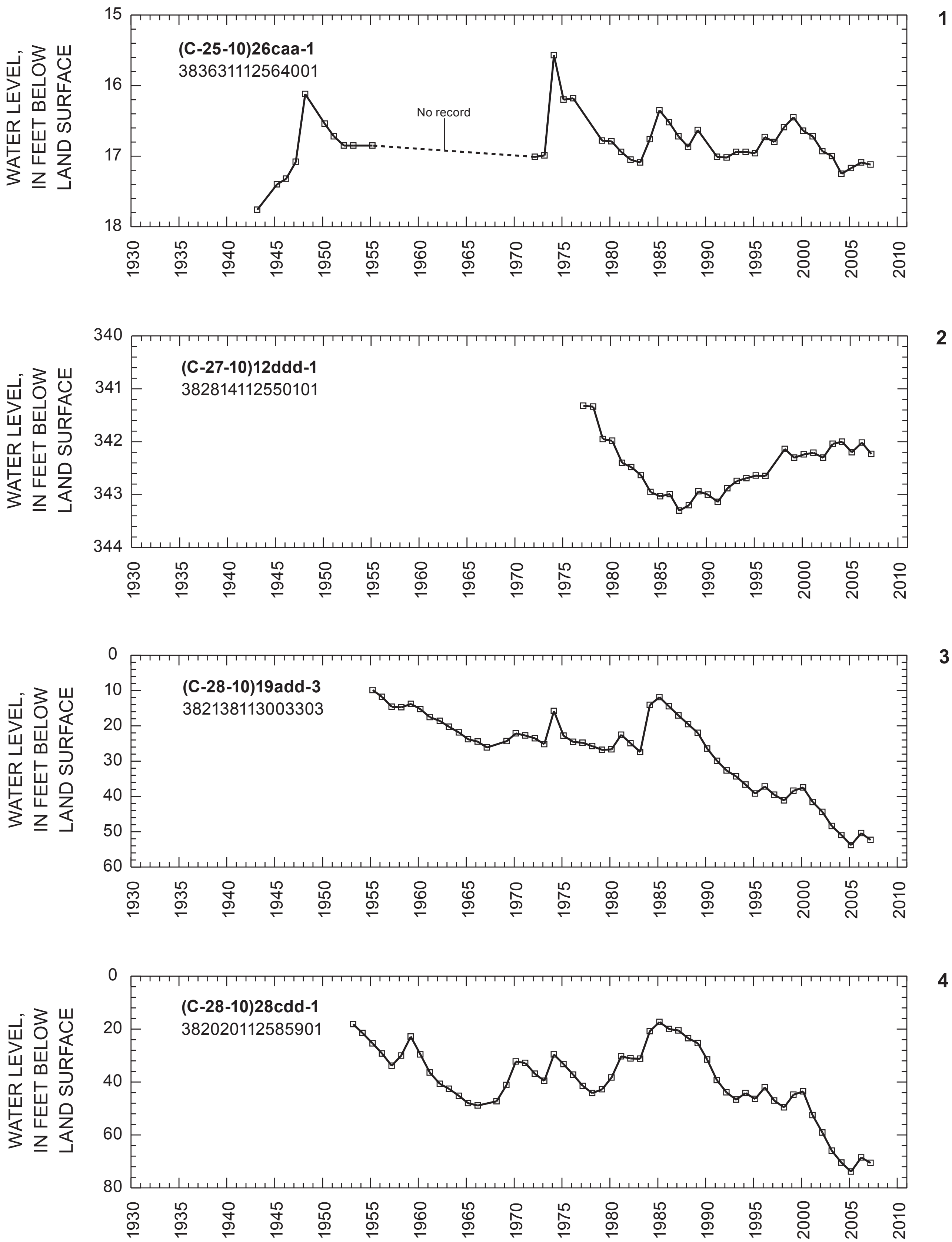


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)18daa-1.

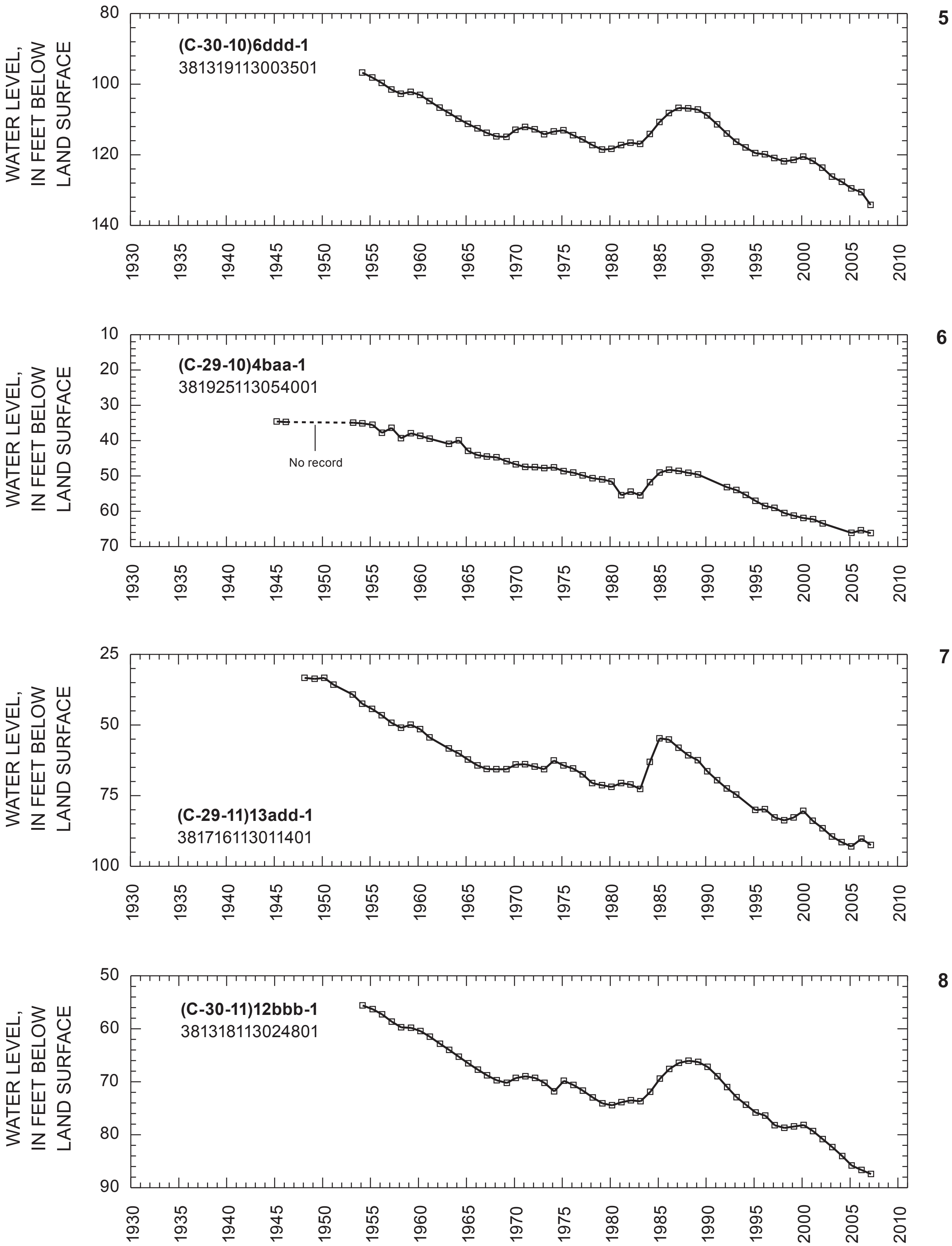
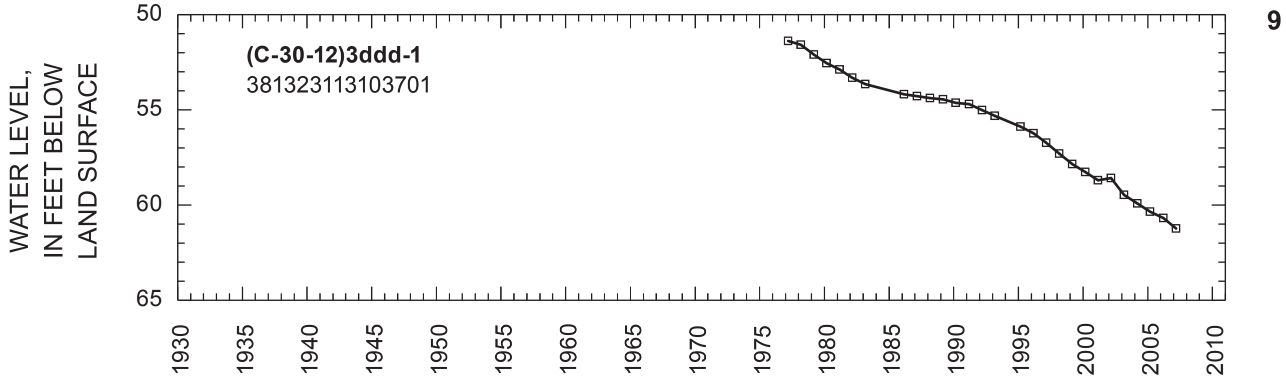


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)18daa-1—Continued.



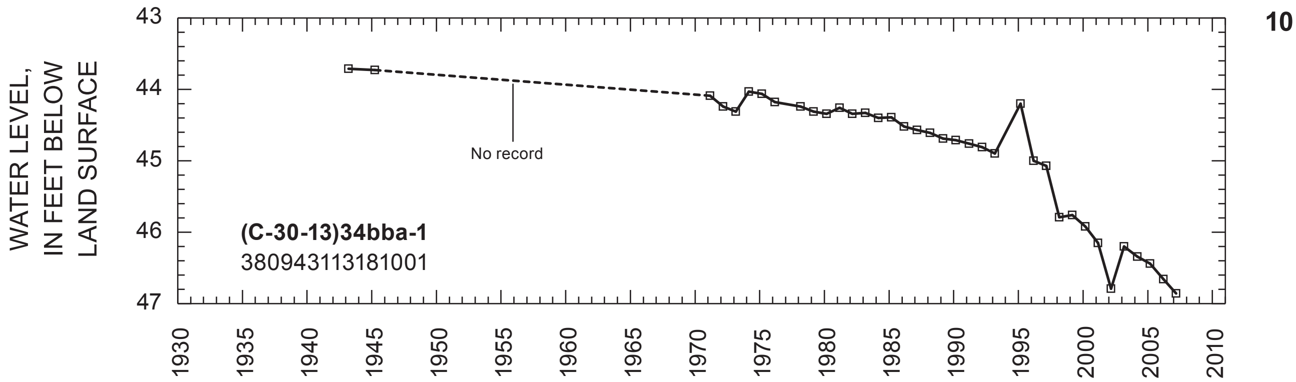


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)18daa-1—Continued.

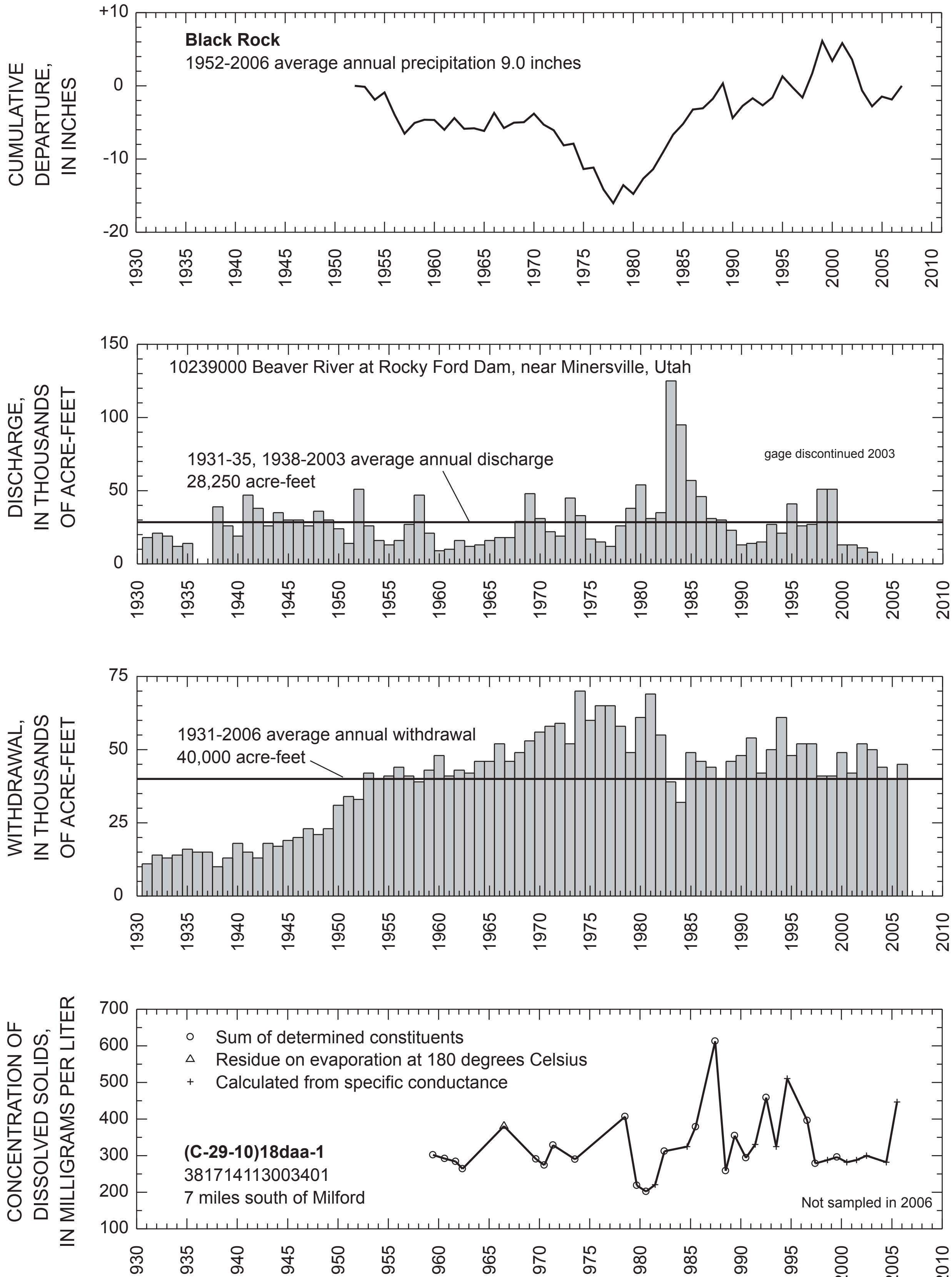


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)18daa-1—Continued.

ESCALANTE VALLEY

Beryl-Enterprise Area

By H.K. Christiansen

The Beryl-Enterprise area covers about 800 square miles in the southern end of Escalante Valley between about Townships 31 South and 37 South and Ranges 12 West and 18 West (fig. 30).

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 2006 was about 79,000 acre-feet, which is 11,000 acre-feet more than in 2005 and 6,000 acre-feet less than the average annual withdrawal for 1996-2005 (tables 2 and 3). The increase was the result of increased withdrawals for irrigation.

The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2007 is shown in figure 30. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Enterprise Beryl Junction, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 31.

Water levels in the Beryl-Enterprise area declined from March 2006 to March 2007. Water levels have declined steadily since 1950 and show little or no recovery during periods of greater-than-average precipitation. The declines are a result of continued large withdrawals for irrigation since 1950. A decline of about 117 feet from March 1948 to March 2007 is shown in well (C-36-16)29daa-1 (fig. 31), about 5 miles northeast of Enterprise.

Precipitation at Enterprise Beryl Junction in 2006 was about 10.0 inches, which is the same as the average annual precipitation for 1960-2006 and about 4.4 inches less than in 2005. Concentration of dissolved solids in water from well (C-34-16)28dcc-2 has increased from about 460 milligrams per liter in 1967 to about 660 milligrams per liter in 2005 (fig. 31). The well was not sampled in 2006.

Physical properties and records of chemical analyses for water from one well in the Beryl-Enterprise area are listed in tables 4 and 5, and the location of the well is plotted in figure 39. Dissolved-solids concentration of water from well (C-35-16)9add-1 was 342 milligrams per liter. No constituents analyzed in water from this well exceeded drinking-water standards for the State of Utah.

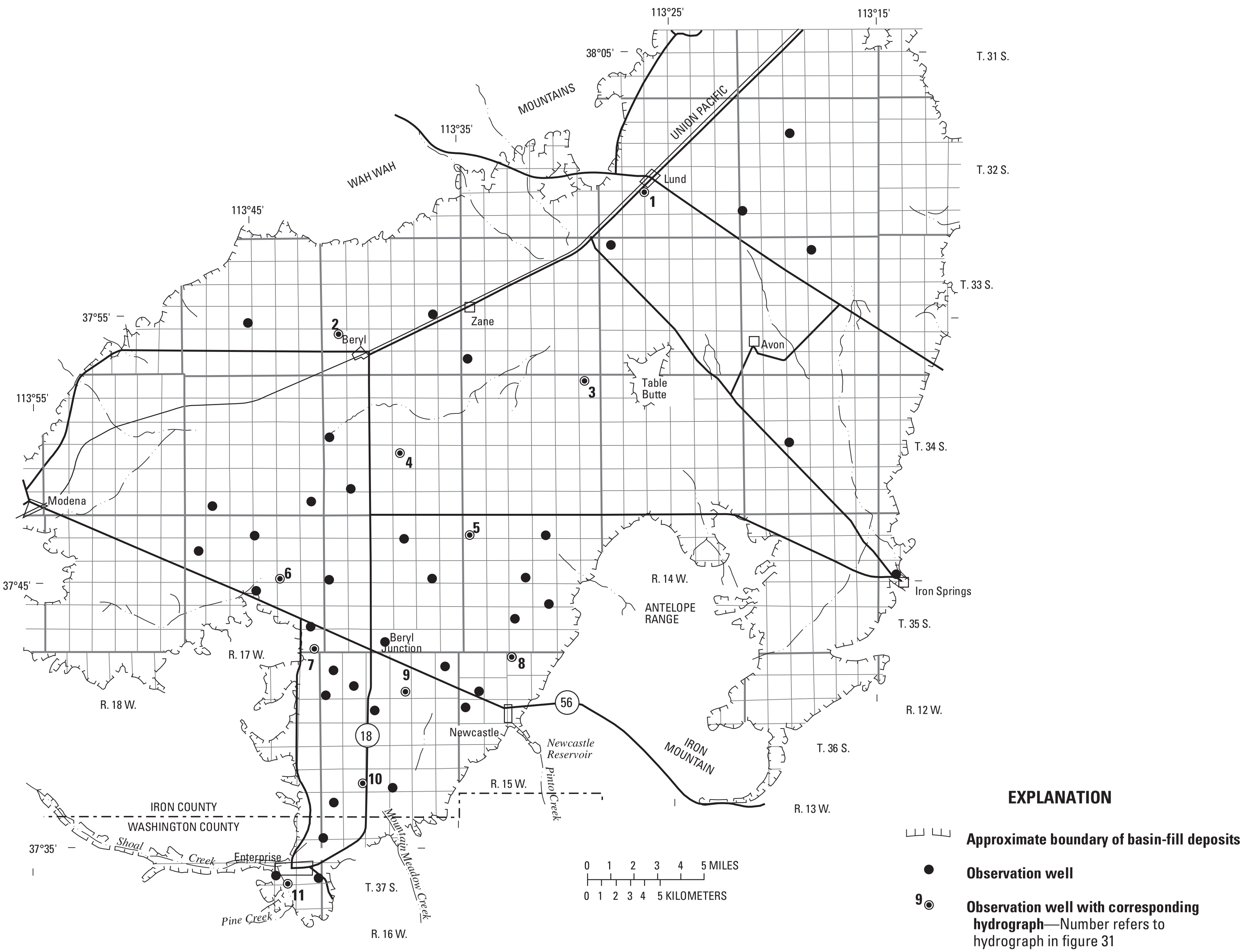


Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2007.

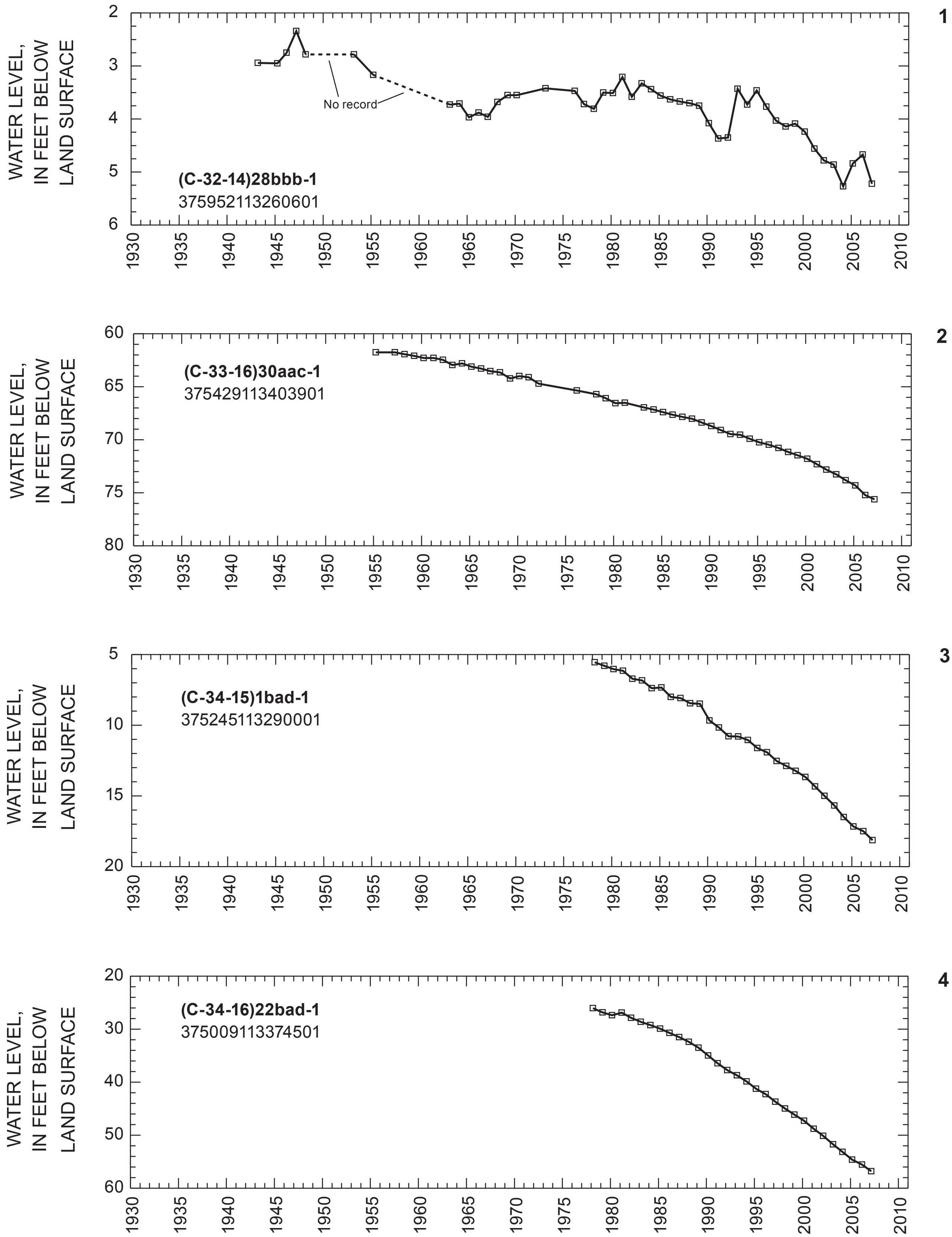


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise Beryl Junction, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

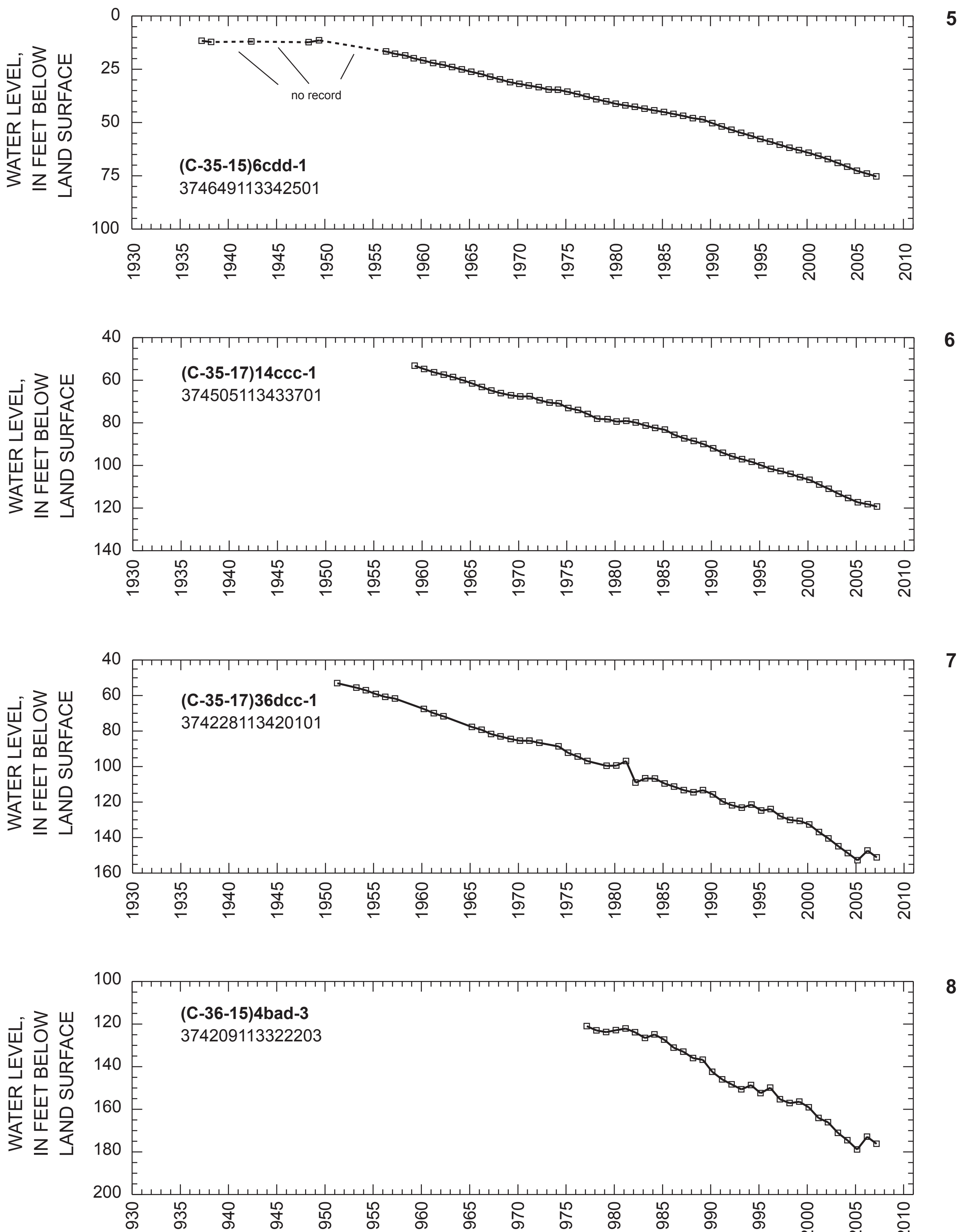


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise Beryl Junction, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2—Continued.

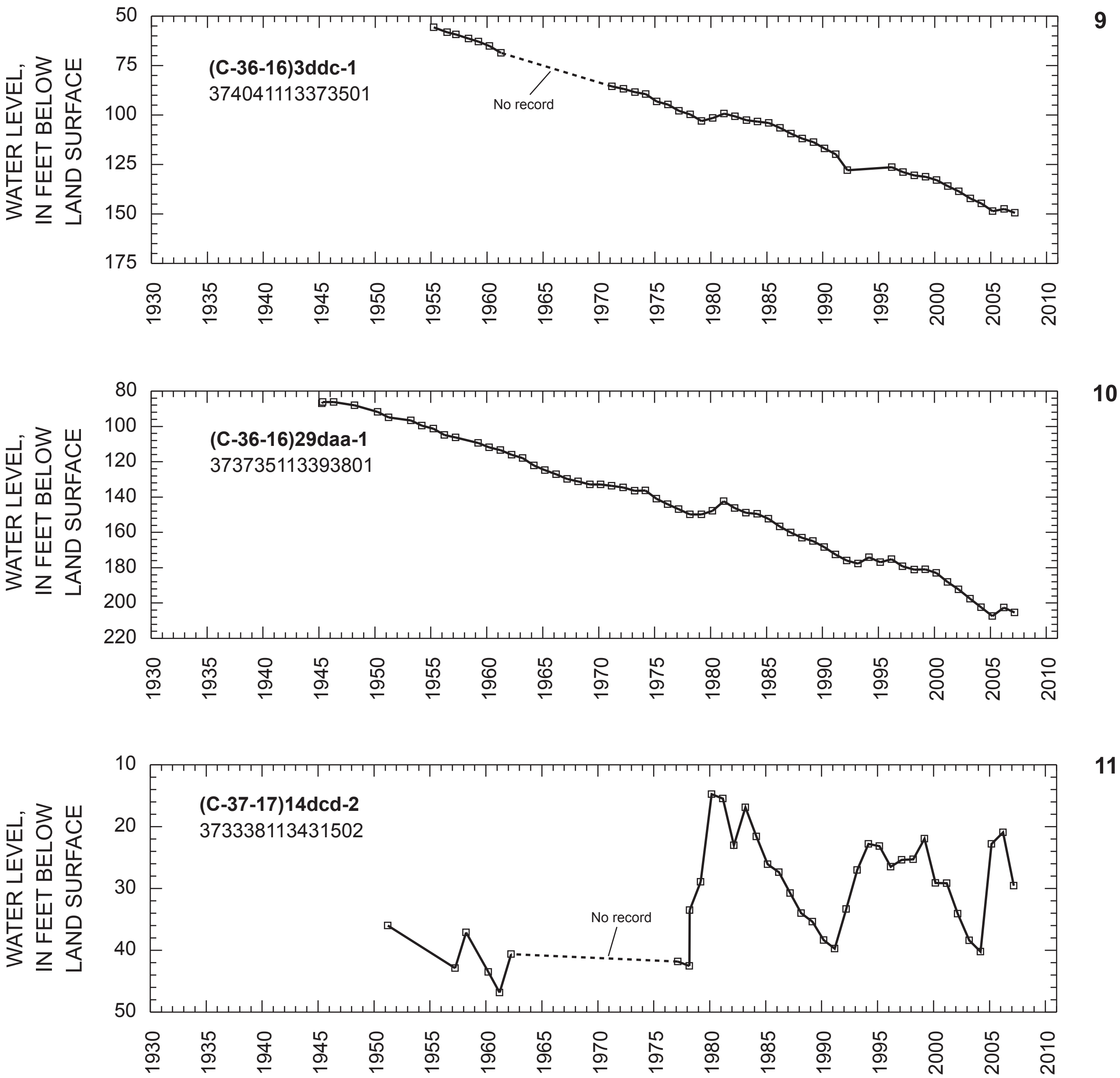


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise Beryl Junction, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 —Continued.

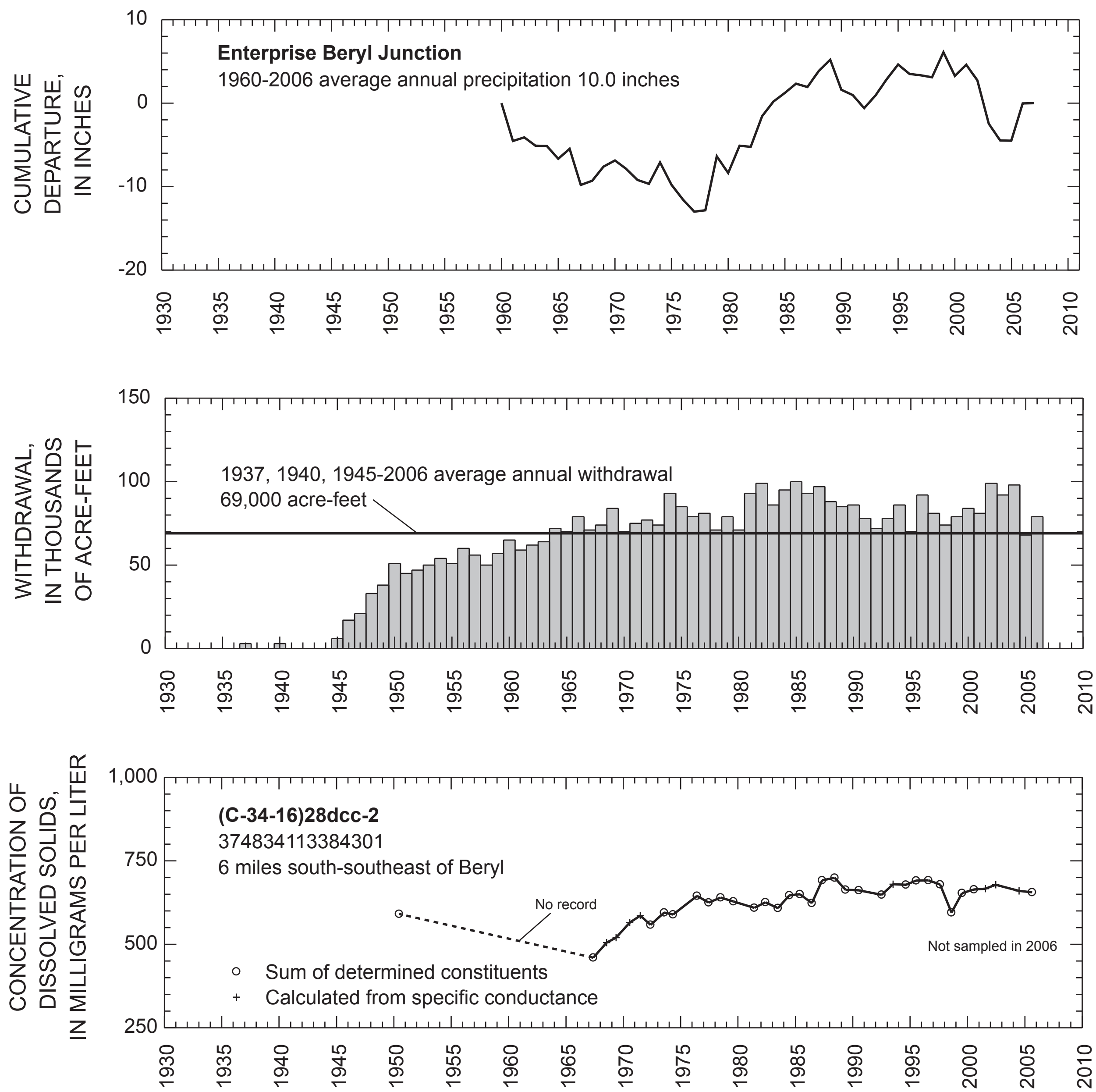


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise Beryl Junction, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2— Continued.

CENTRAL VIRGIN RIVER AREA

By H.K. Christiansen

The central Virgin River area is between the southern end of the Pine Valley Mountains and the Hurricane Cliffs to the east and the Beaver Dam Mountains to the southwest. Major ground-water development includes water from valley-fill aquifers that is used primarily for irrigation, and water from consolidated rock and valley fill that is used primarily for public supply. Most of the wells in which water levels are measured are near the Virgin and Santa Clara Rivers.

Total estimated withdrawal of water from wells in the central Virgin River area in 2006 was about 32,000 acre-feet, which is about 3,000 acre-feet more than in 2005 and 8,000 acre-feet more than the average annual withdrawal for 1996-2005 (tables 2 and 3). Withdrawal for irrigation decreased by about 200 acre-feet from 2005 to 2006. Withdrawal for industry in 2006 was the same as in 2005. Withdrawal for public supply was 3,300 acre-feet more than in 2005. Withdrawal for domestic and stock use was the same as in 2005.

The location of wells in the central Virgin River area in which the water level was measured during February 2007 is shown in figure 32. The relation of the water level in selected observation wells to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2 is shown in figure 33.

Water levels from February 2006 to February 2007 in the central Virgin River area show little change in the Santa Clara River drainage, the Fort Pearce Wash area, and most of the Virgin River drainage.

Discharge of the Virgin River at Virgin in 2006 was about 118,400 acre-feet, which is 240,900 acre-feet less than the revised value of 359,300 acre-feet for 2005 (a record high-water year) and about 16,300 acre-feet less than the long-term average for 1931-70, 1979-2006. Precipitation at St. George in 2006 was about 9.2 inches, which is about 1.0 inch more than the average annual precipitation for 1930-2006 and the same as in 2005.

Physical properties and records of chemical analyses for water from three wells in the central Virgin River area are listed in tables 4 and 5, and the location of the wells is plotted in figure 39. Water from well (C-41-17)8cbd-2, located about 4 miles north of Shivwits, had a dissolved-solids concentration of 298 milligrams per liter and had the second highest arsenic concentration. The arsenic level in water from this well exceeds the U.S. Environmental Protection Agency maximum contaminant level. Water from well (C-43-15)25cdd-1, located southeast of St. George, had a dissolved-solids concentration of 2,910 milligrams per liter and a sulfate concentration of 1,730 milligrams per liter. Both concentrations exceed the maximum contaminant level for the State of Utah. Hardness of water from well (C-43-15)25cdd-1 was 1,800 milligrams per liter (as $CaCO_3$).

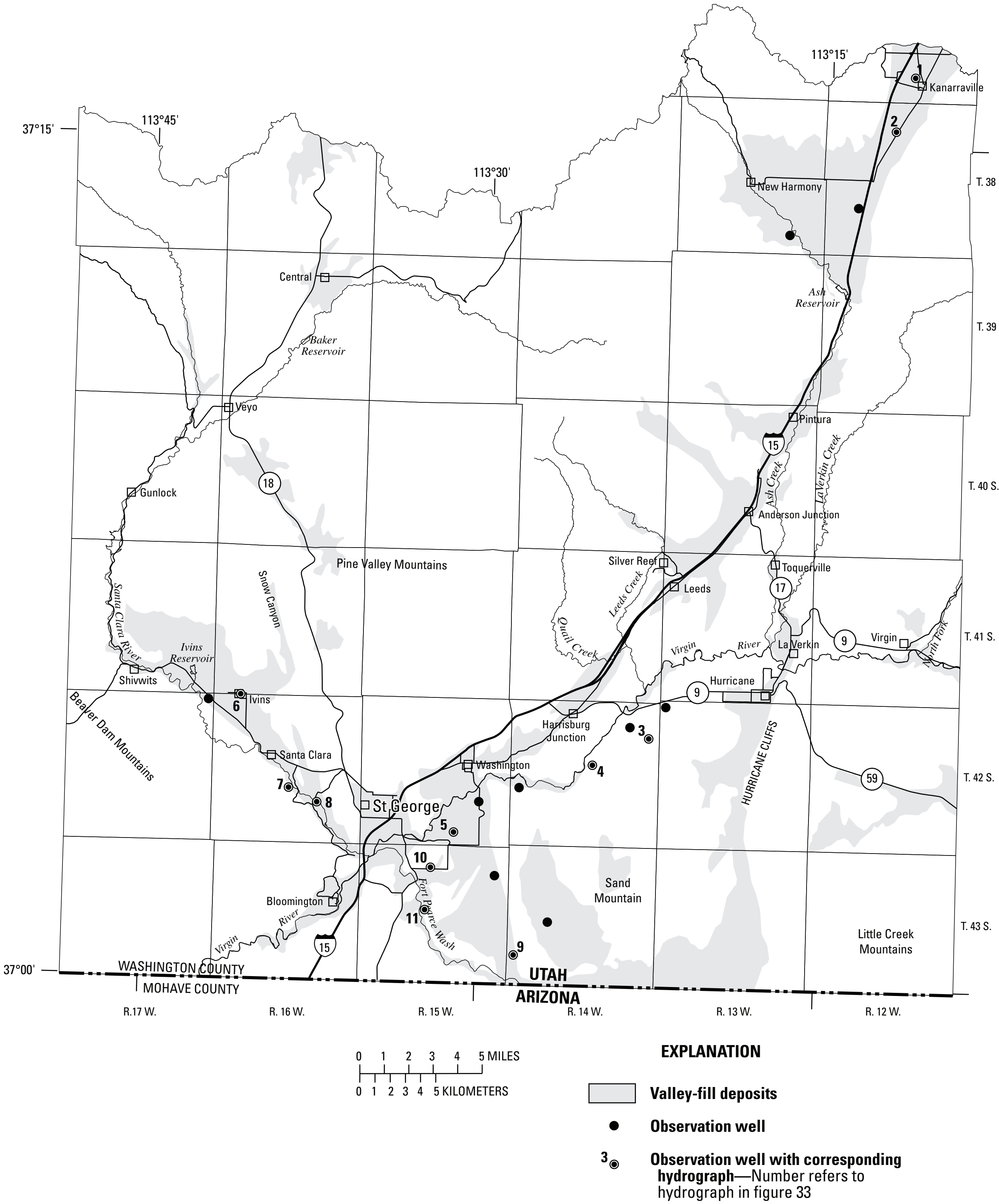


Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 2007.

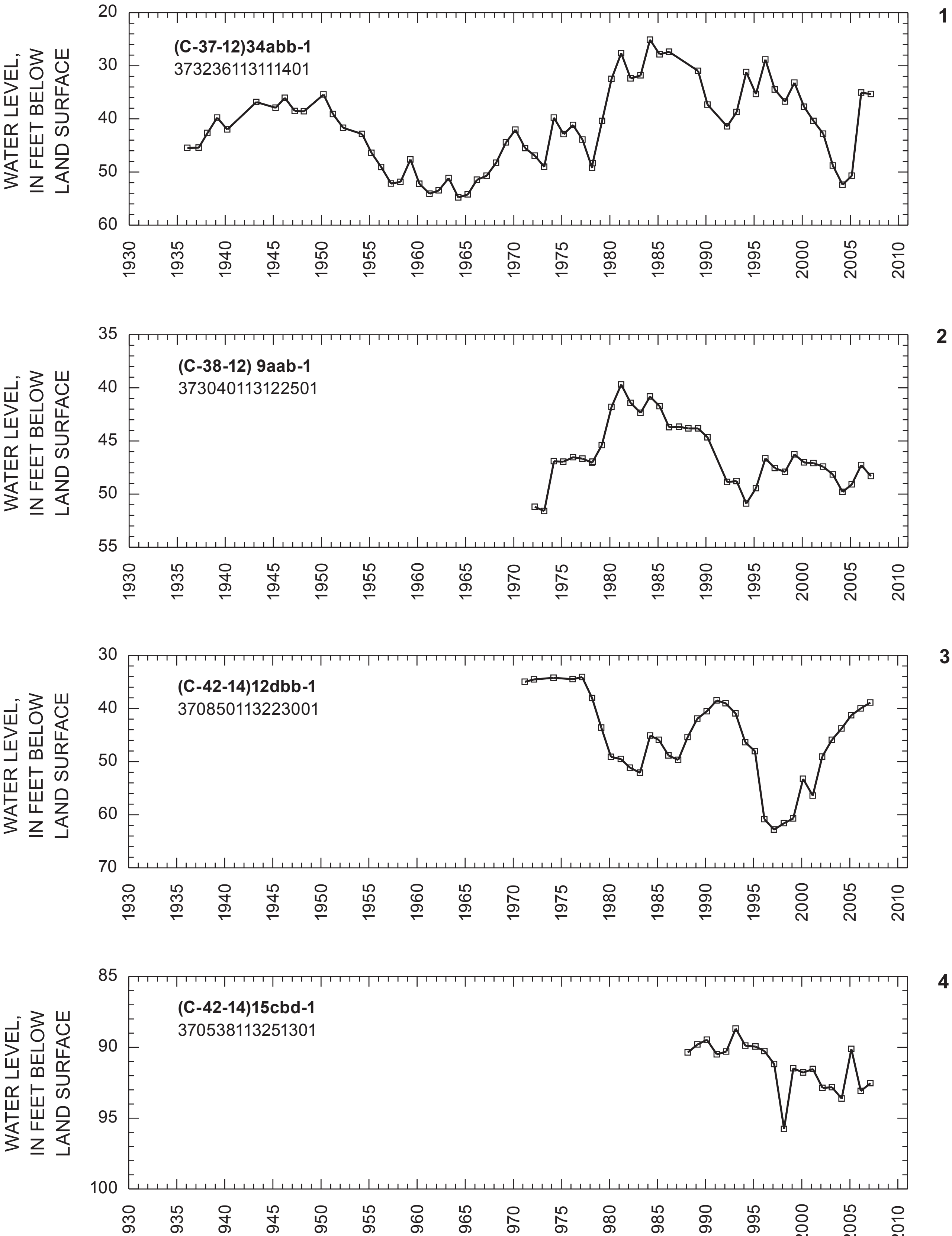
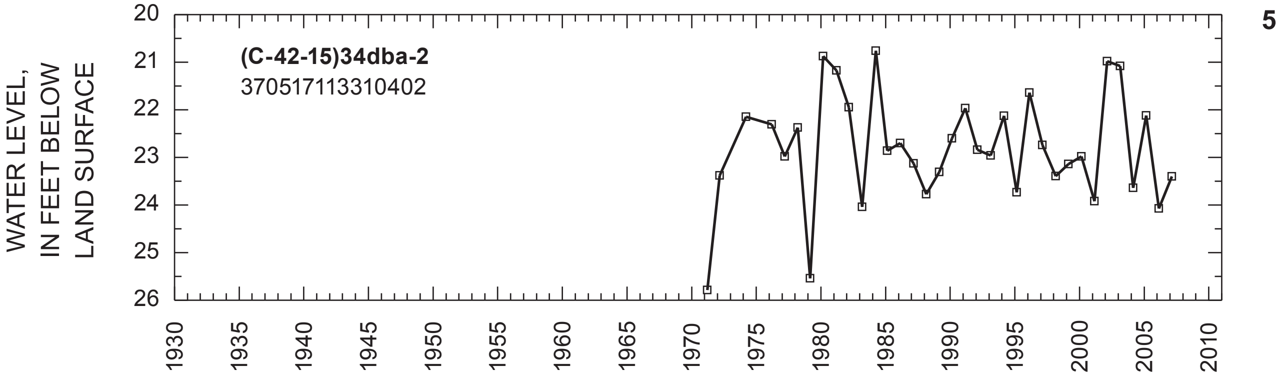
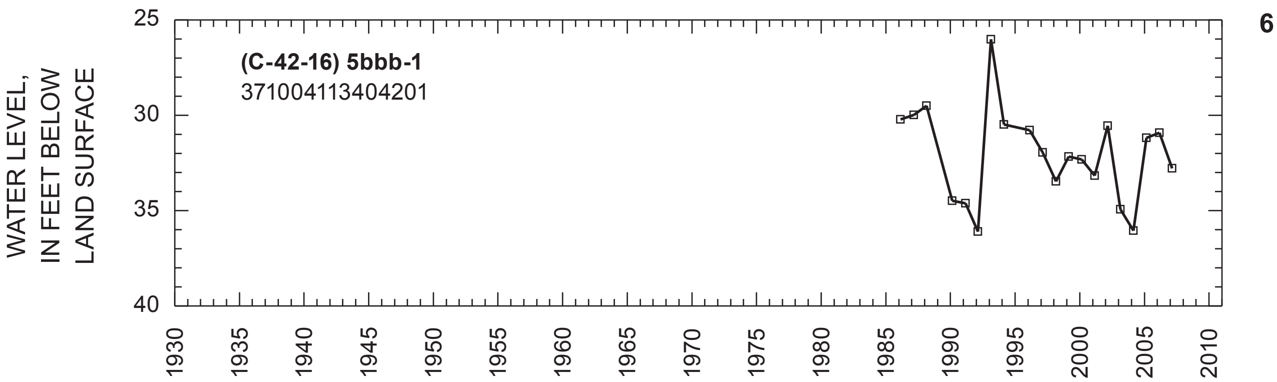
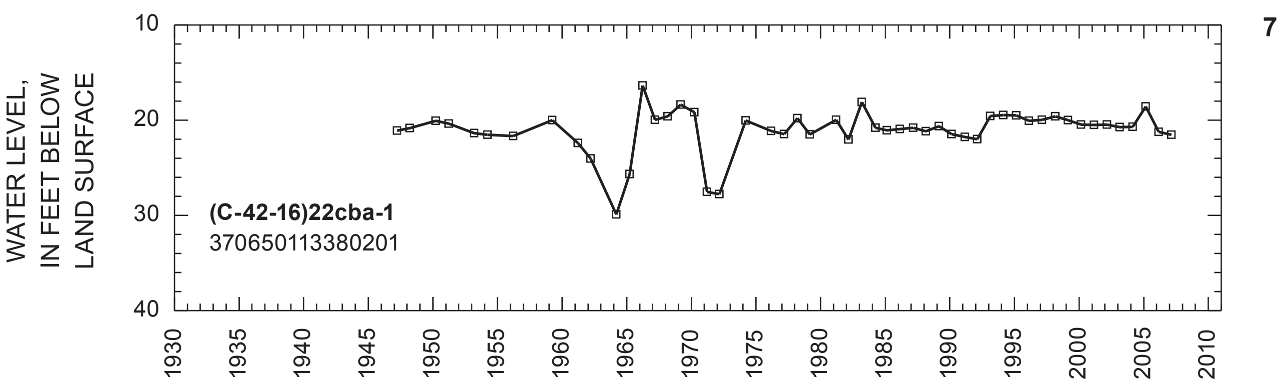


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2.







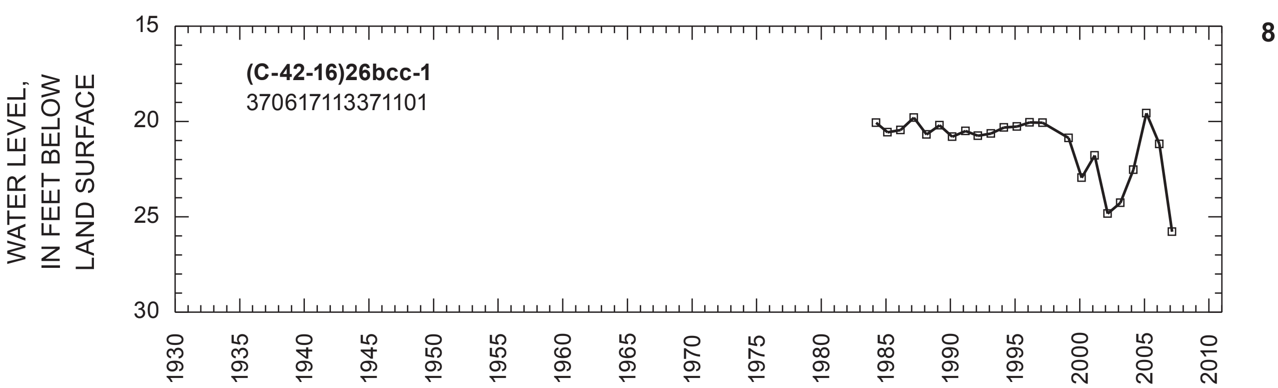


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2—Continued.

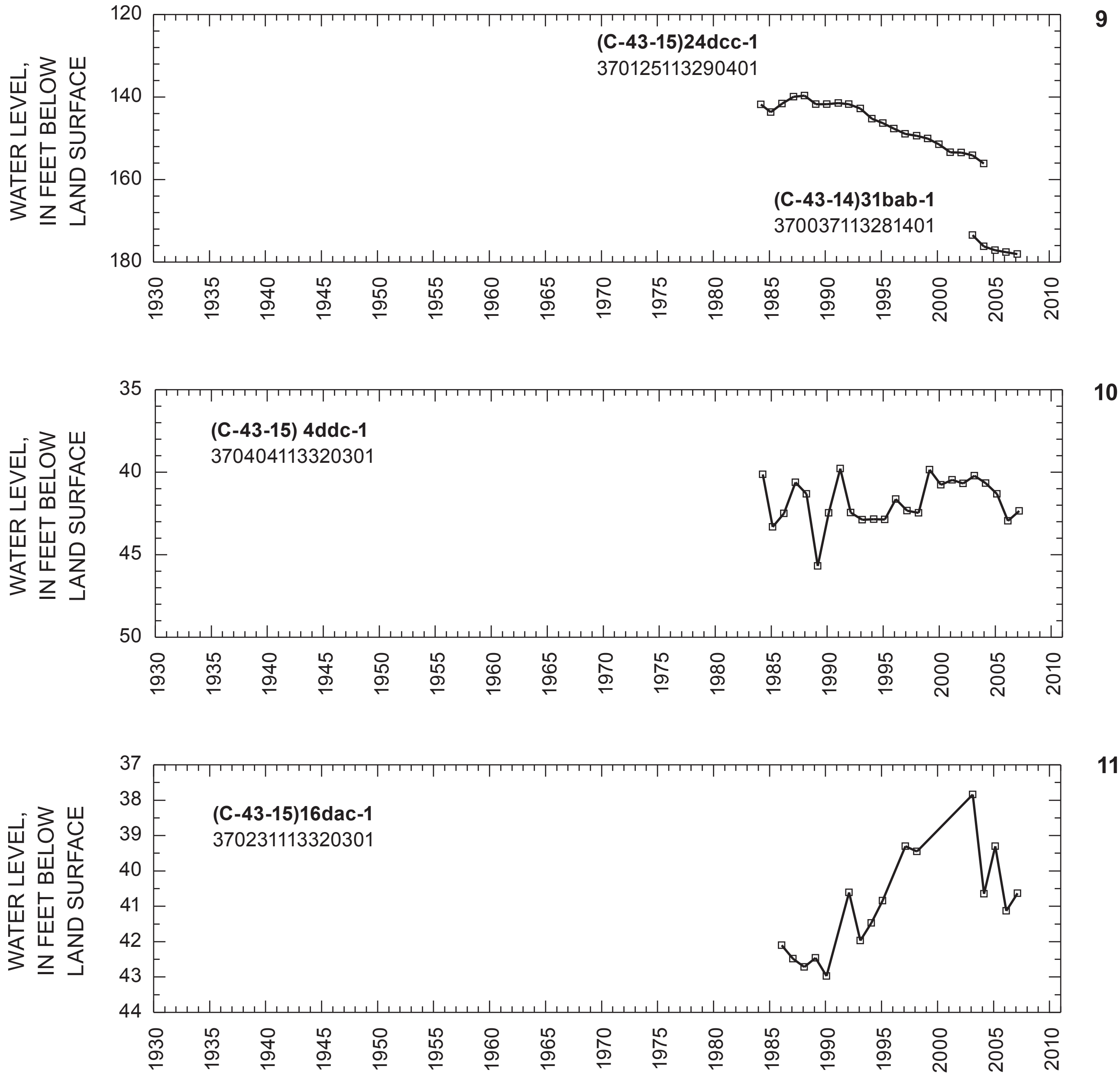


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2—Continued.

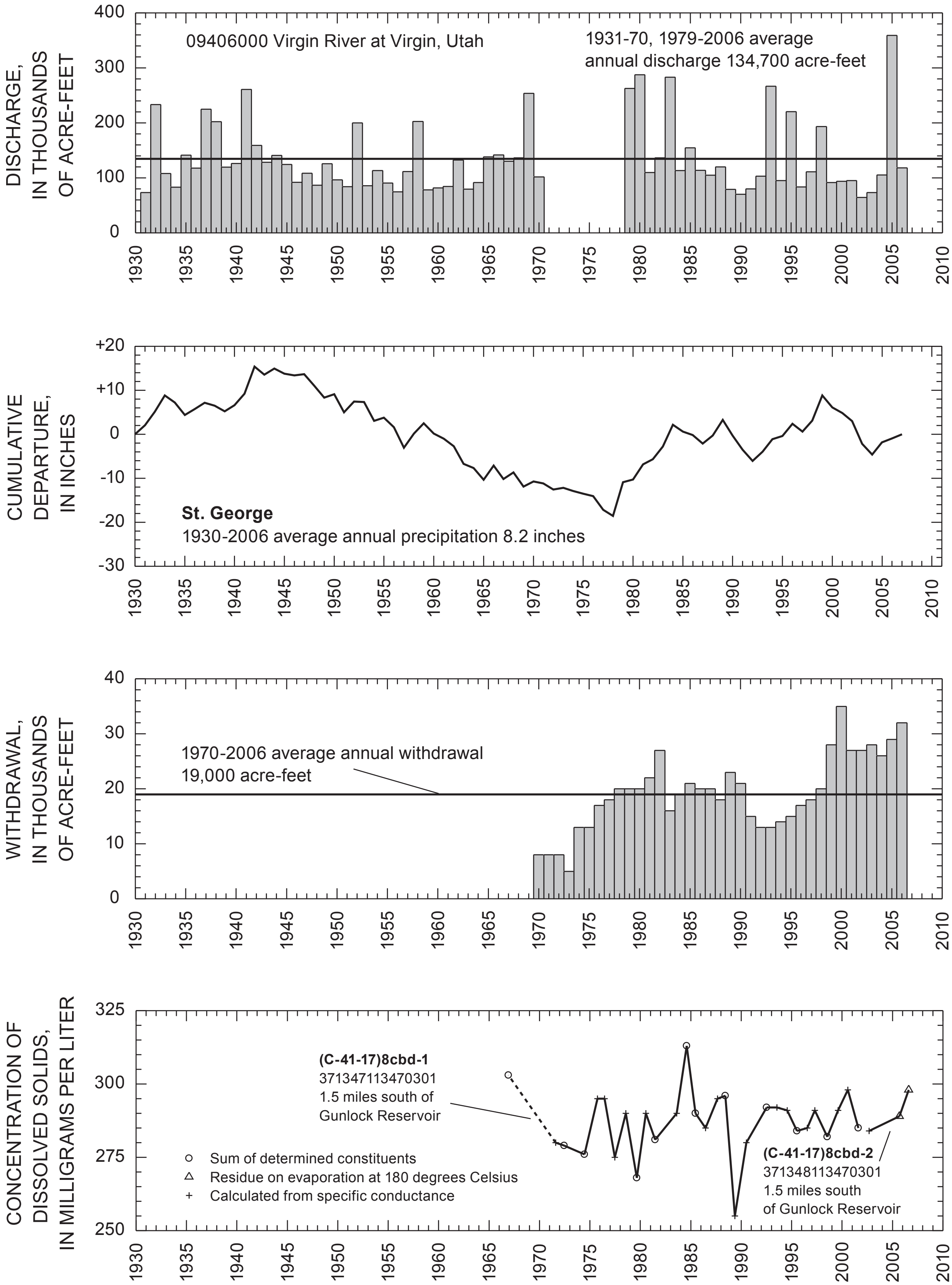


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2—Continued.

OTHER AREAS

By M.J. Fisher

Total estimated withdrawal of water from wells in the areas of Utah listed below in 2006 was about 130,000 acre-feet, which is 19,000 acre-feet more than the estimate for 2005 and 13,000 acre-feet more than the average annual withdrawal for 1996-2005 (tables 2 and 3). The largest increases were due to increased withdrawals for irrigation. In most of the areas listed below, withdrawals in 2006 were more than in 2005, except in Rush Valley, where withdrawals slightly decreased due to decreased irrigation and public-supply use.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2007 is shown in figure 34. The relation of the water level in observation wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield is shown in figure 35.

Water levels in selected wells in Cedar Valley generally rose during the 1970s. Water levels rose sharply from the early to mid-1980s as a result of greater-than-average precipitation, but generally have declined since the mid-1980s. Water levels rose slightly in most of the wells from March 2006 to March 2007.

The location of wells in Sanpete Valley in which the water level was measured during March 2007 is shown in figure 36. The relation of the water level in selected observation wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti is shown in figure 37.

Water levels in many of the selected wells in Sanpete County rose from the late 1970s to the mid-1980s as a result of greater-than-average precipitation and have varied since the mid-1980s, but overall have declined. Water levels rose slightly in most of the wells from March 2006 to March 2007.

The relation of the water level in wells in the remaining selected areas of Utah (see accompanying table) to cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 38. Water levels rose or decreased only slightly in most of the selected observation wells from March 2006 to March 2007.

Special emphasis areas are defined each year and targeted for more detailed sampling of water from wells throughout the selected area. Water from wells in Sanpete Valley was selected for detailed sampling during the 2006 sampling effort to supplement a Total Maximum Daily Loads (TMDL) study being conducted by the State of Utah.

Physical properties and records of chemical analyses for water from twelve wells in Sanpete Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 39. Dissolved-solids concentration of water from wells in Sanpete Valley sampled during 2006 ranged from 327 milligrams per liter to 735 milligrams per liter. Five of the twelve water samples had dissolved-solids concentrations exceeding the secondary drinking-water standard for the State of Utah. Water from well (D-14-3)20aca-1 exceeded the Utah maximum contaminant level for nitrite plus nitrate (15.8 milligrams per liter). Water from well (D-16-3)4aaa-1 exceeded the U.S. Environmental Protection Agency (EPA) maximum contaminant level for arsenic (13.4 micrograms per liter) and also exceeded the State of Utah secondary drinking-water standard for iron (4,270 micrograms per liter). The concentration of manganese (55.5 micrograms per liter) in water from well (D-16-2)13dda-1 exceeded the secondary drinking-water standard for the State of Utah. None of the remaining analyzed constituents in water from these wells exceeded recommended limits. No constituents analyzed in water from five of

Number in figure 1	Area	Estimated withdrawal (acre-feet)					
		2006					2005 total (rounded)
		Irrigation	Industrial	Public supply	Domestic and stock	2006 total (rounded)	
1	Grouse Creek Valley	1,200	0	0	20	1,200	1,000
2	Park Valley	2,900	0	0	10	2,900	2,700
4	Malad-lower Bear River Valley	4,200	460	4,300	200	9,200	7,200
8	Ogden Valley	0	0	11,200	20	11,200	10,700
13	Rush Valley	5,600	170	270	30	6,100	6,200
14	Dugway area, Skull Valley, and Old River Bed	2,300	3,600	1,600	10	7,500	7,000
15	Cedar Valley, Utah County	3,200	0	2,700	40	5,900	4,100
20	Sanpete Valley	3,800	550	420	4,000	8,800	7,800
25	Snake Valley	15,400	0	70	50	15,500	11,000
27	Beaver Valley	9,000	20	620	440	10,100	6,700
	Remainder of State	12,400	18,900	17,400	2,500	51,200	46,200
Total (rounded)		60,000	23,700	38,600	7,300	130,000	111,000

the twelve wells exceeded any drinking-water standards for the State of Utah or the EPA.

Physical properties and records of chemical analyses for water from an additional seventeen wells in other areas are listed in tables 4 and 5, and the location of the wells is plotted in figure 39. These wells are located in those areas of the State where withdrawals are less than in the major areas of groundwater development that are discussed individually in this report. Some noteworthy results are summarized below.

Water from well (B-12-4)34adb-1, located in the Lower Bear River area, had a dissolved-solids concentration of 1,520 milligrams per liter and a chloride concentration of 608 milligrams per liter. Both of these constituents exceeded the secondary drinking-water standard for the State of Utah. This water also had the highest concentration of selenium (26.7 micrograms per liter) of all the samples collected.

Water from well (C-29-7)19bcd-1, located in Beaver Valley, had a uranium concentration of 31.1 micrograms per liter, exceeding the EPA maximum contaminant level. This value was the highest concentration of uranium measured.

Water from well (D-40-22)30bbb-1, located in the Bluff area, had the highest measured arsenic value (66.1 micrograms per liter) of any of the samples collected. This value exceeds both the maximum contaminate level for the State of Utah and the EPA.

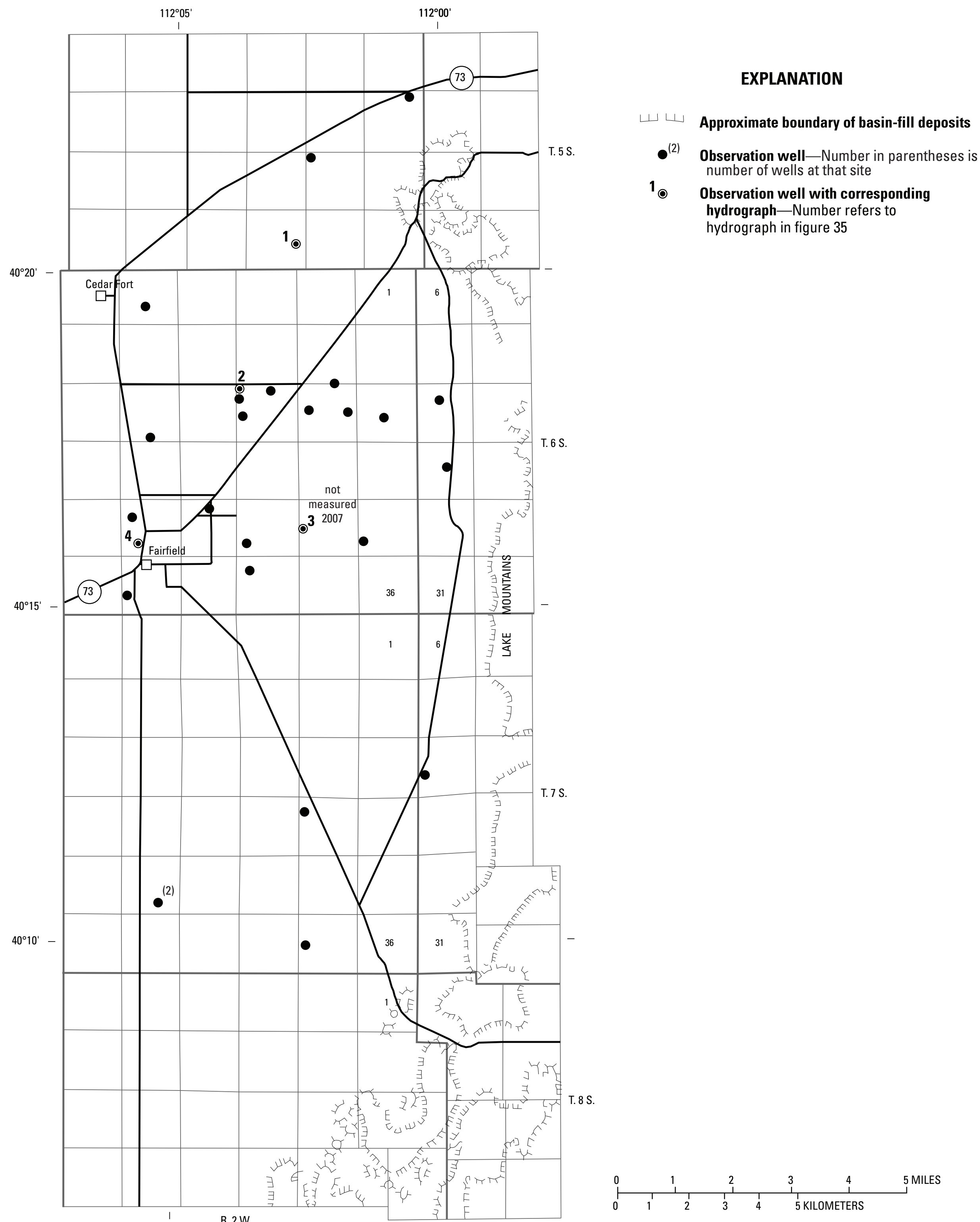


Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2007.

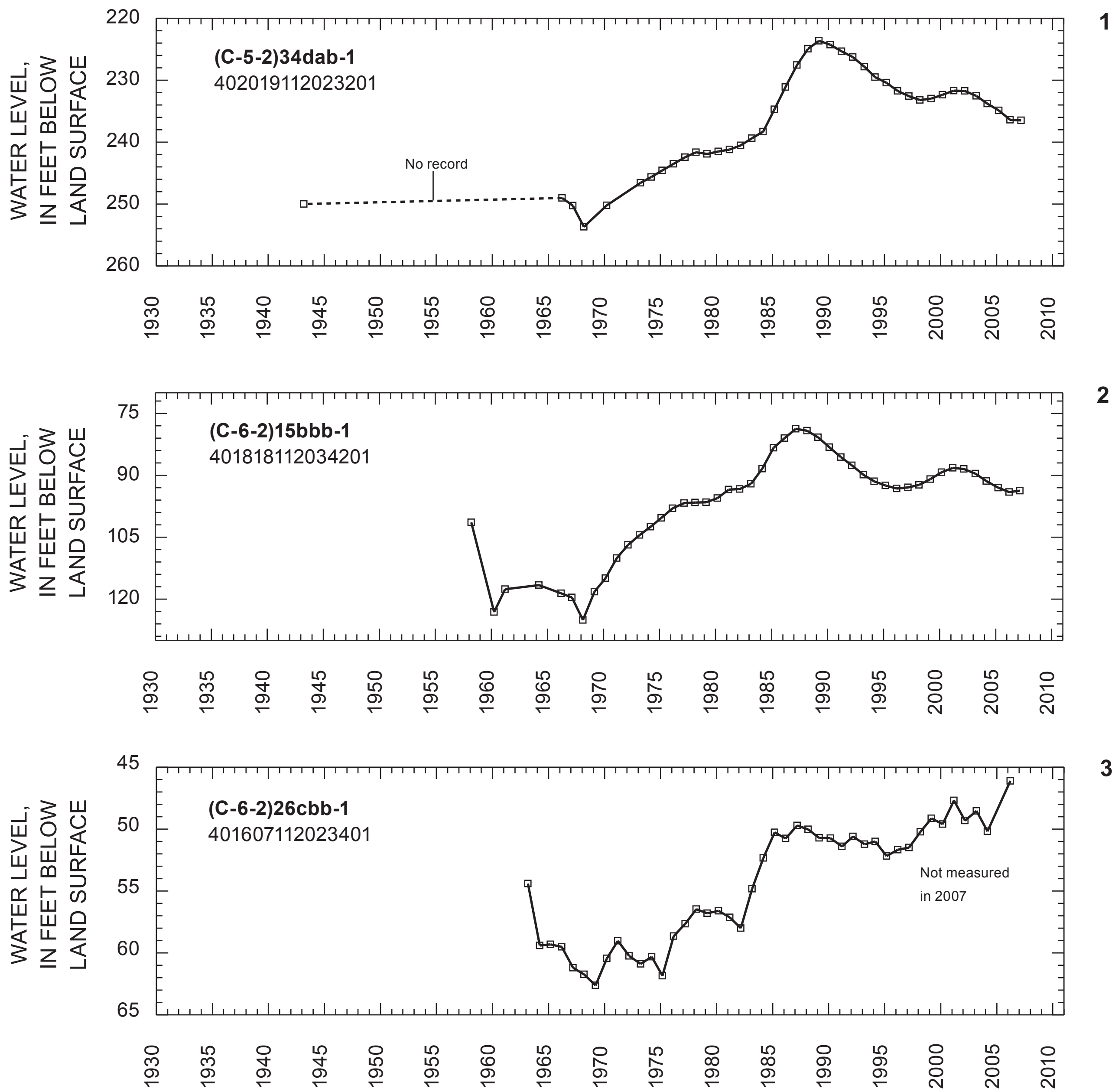


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield.

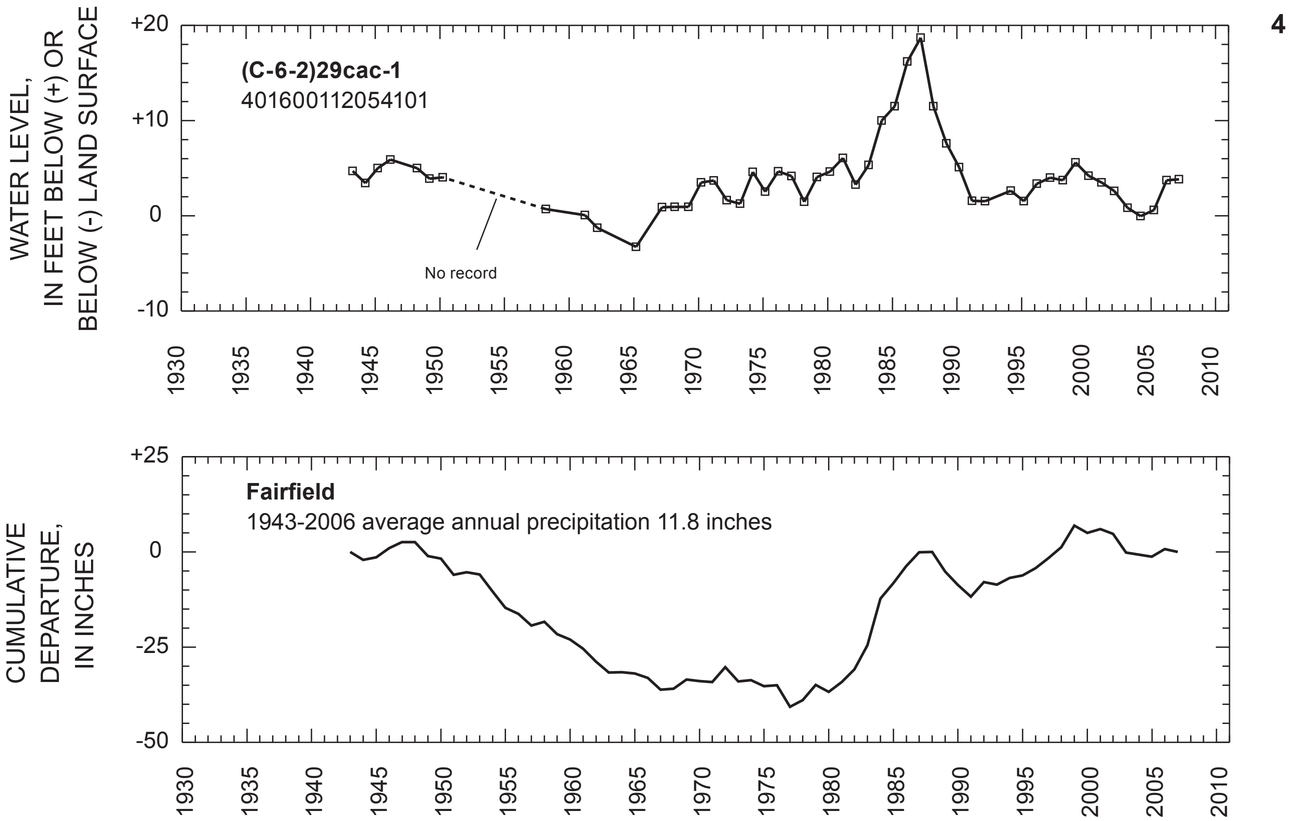


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield—Continued.

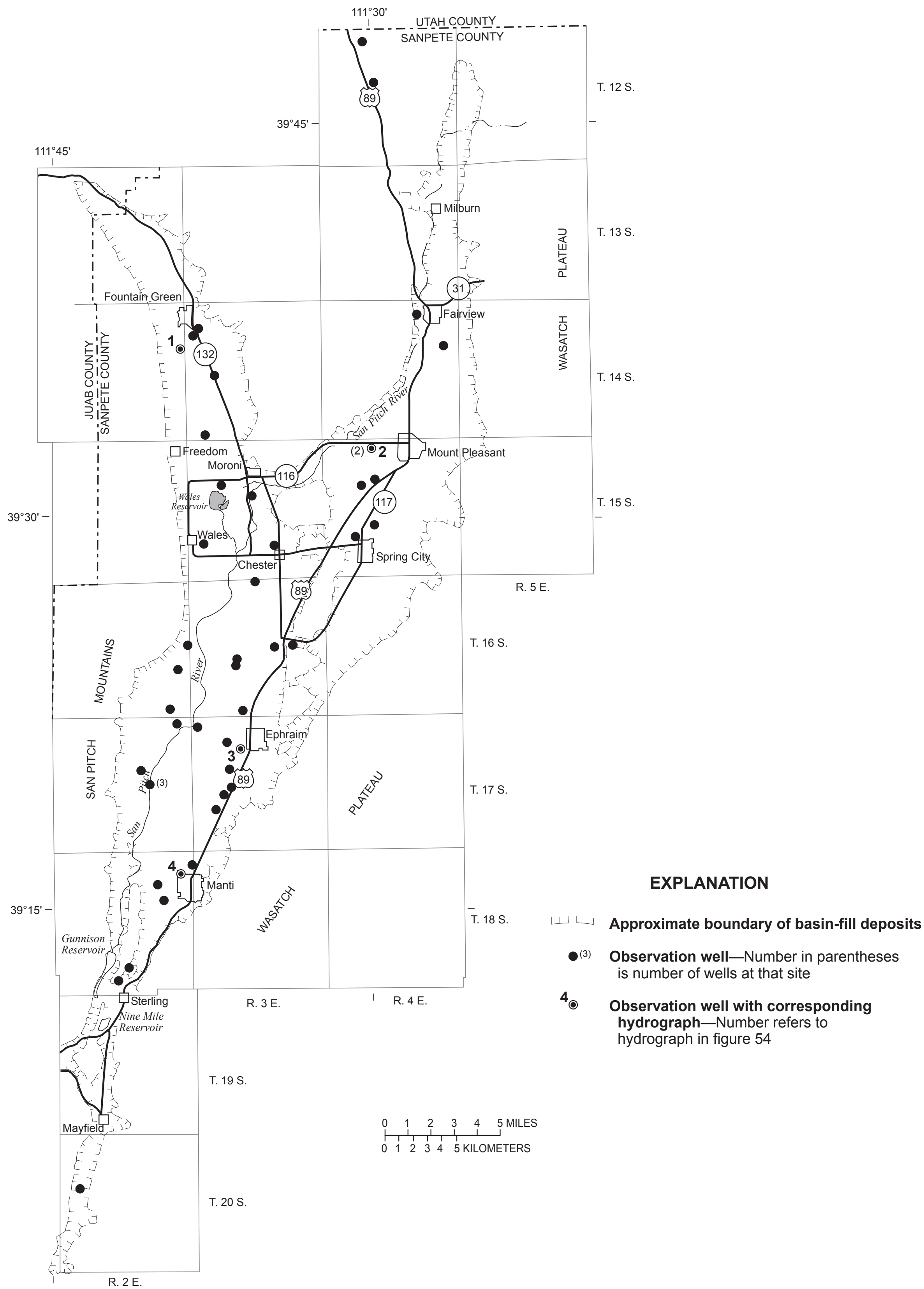


Figure 36. Location of wells in Sanpete Valley in which the water level was measured during March 2007.

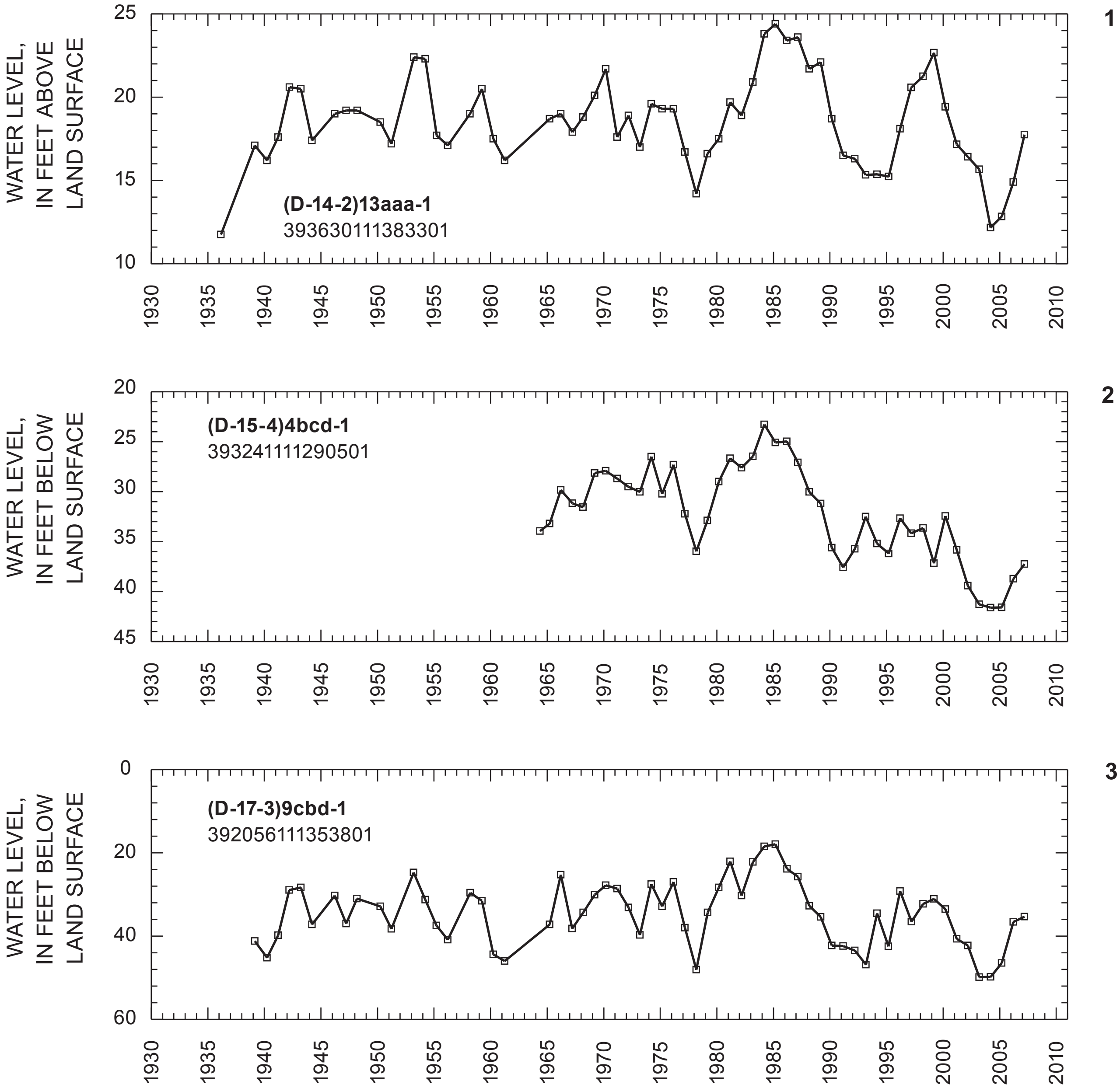


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

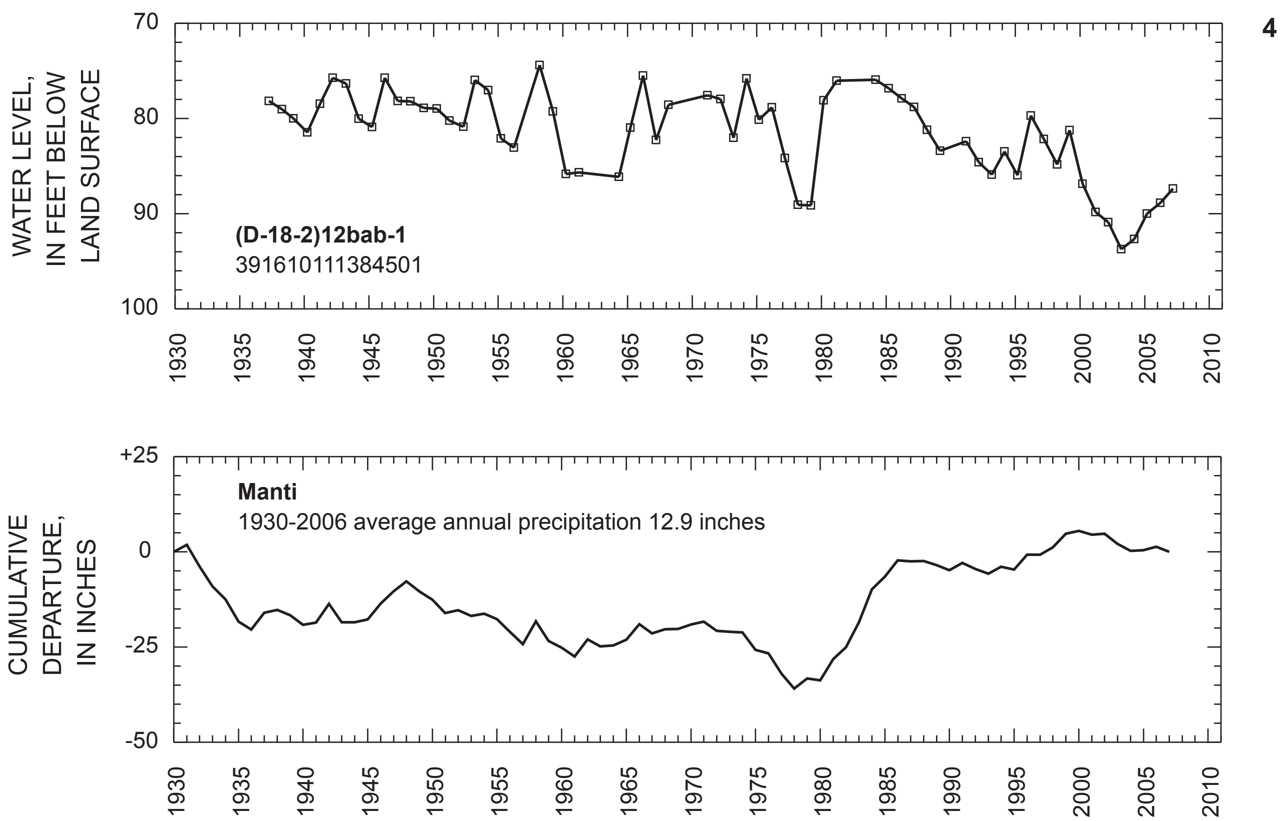


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti—Continued.

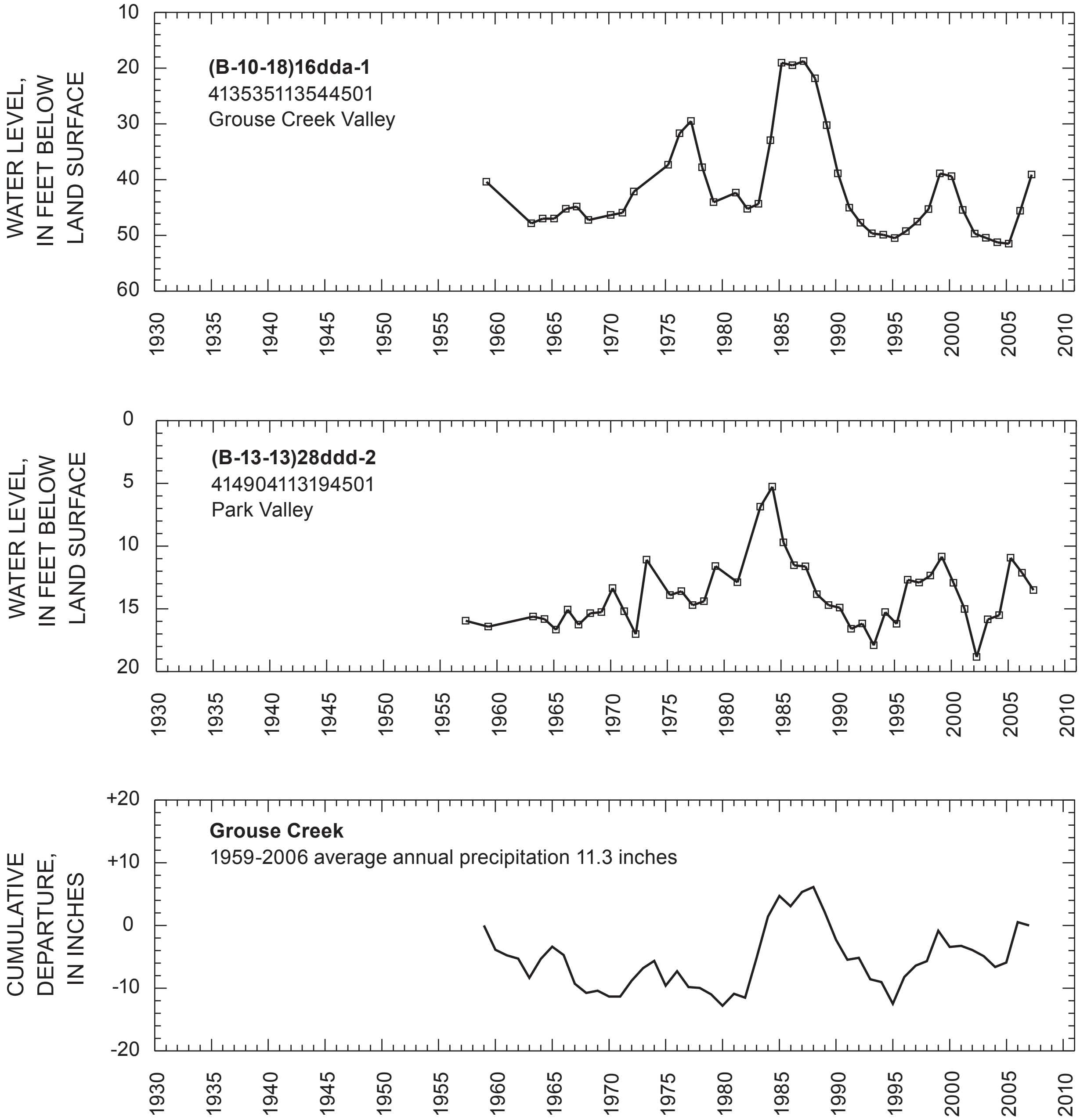


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

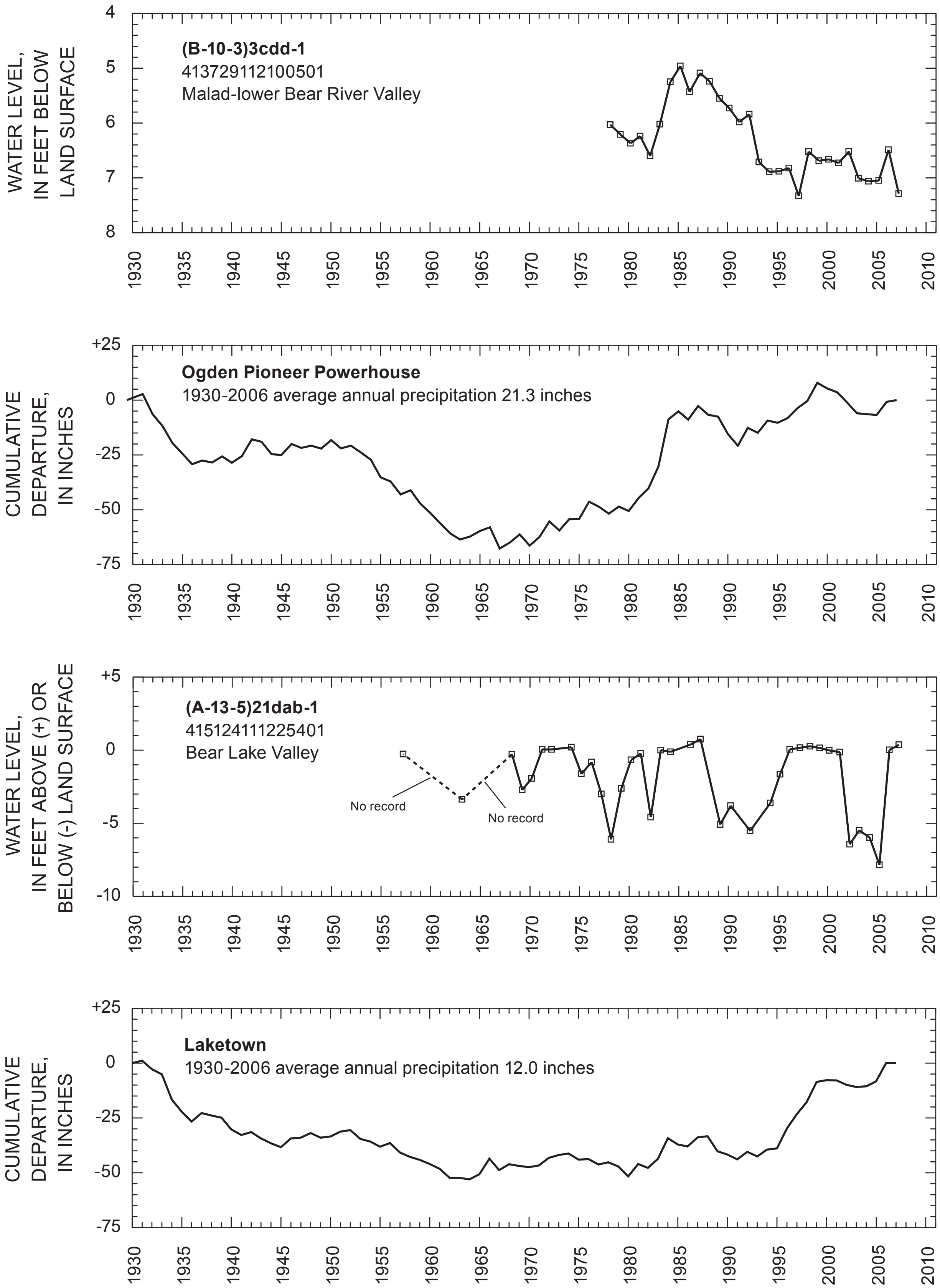


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

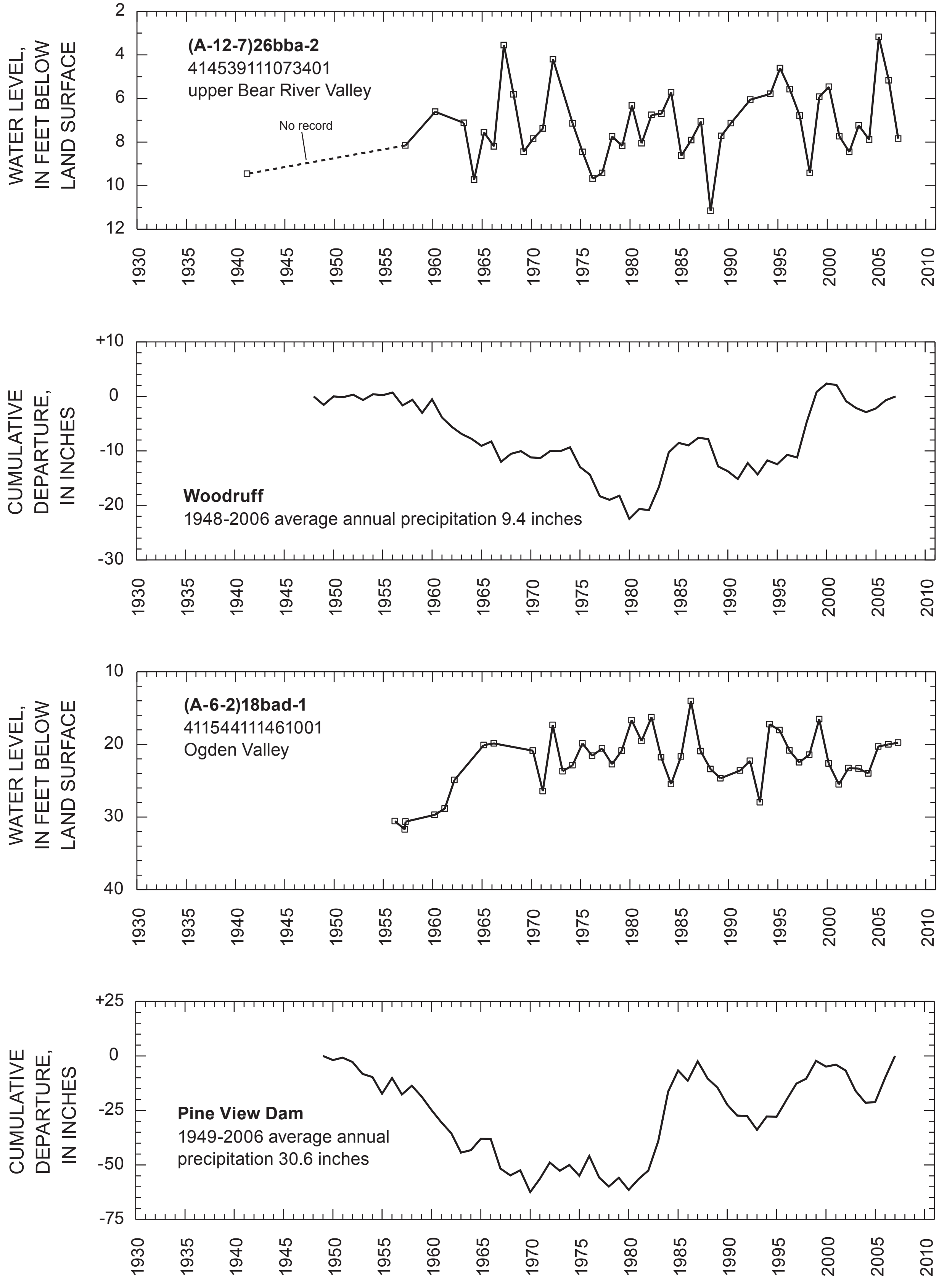


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

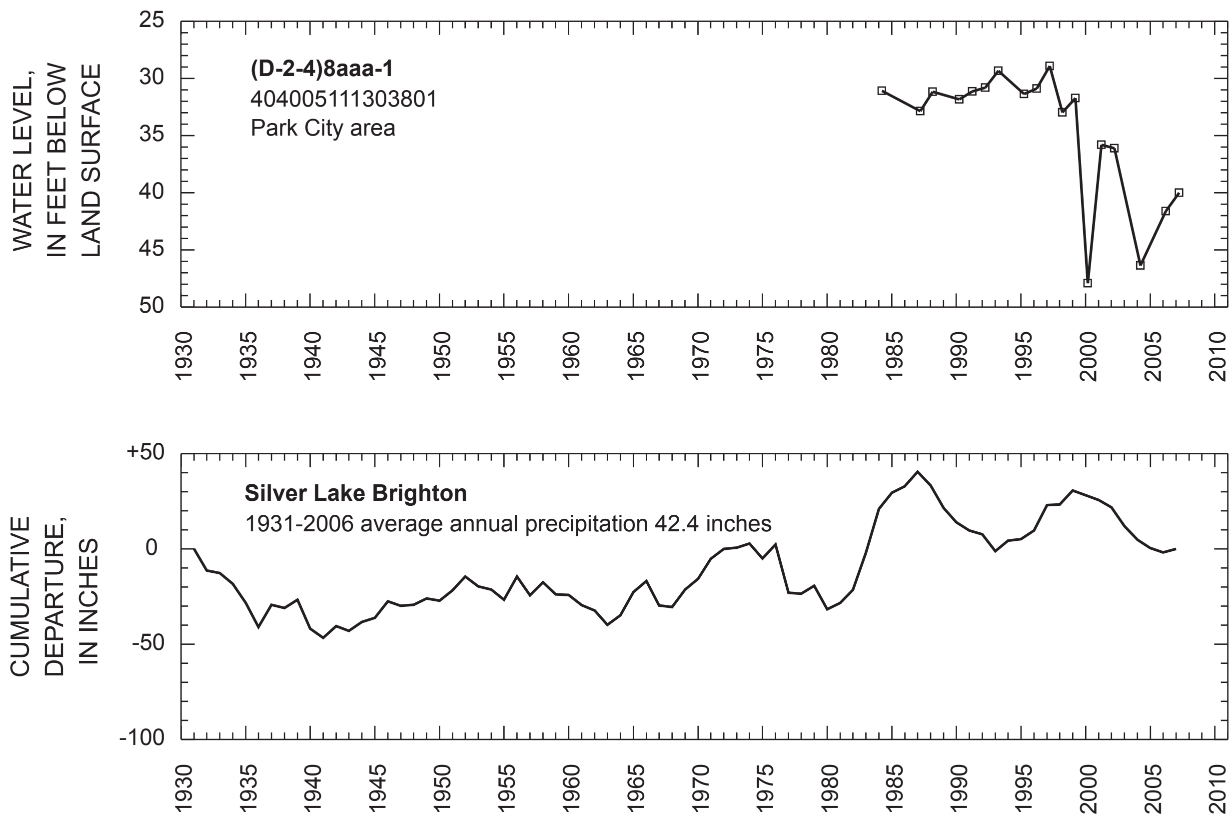


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

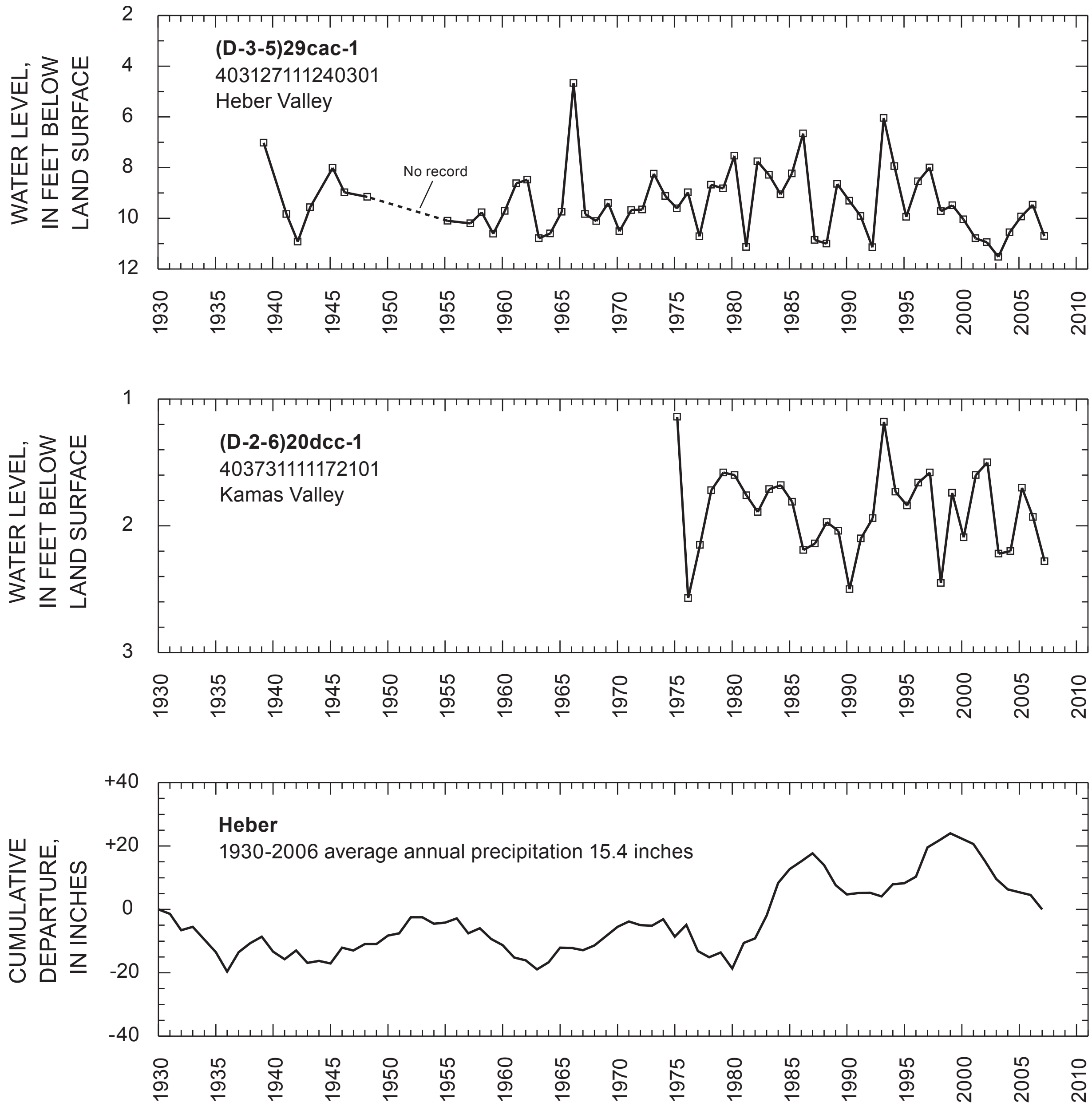


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

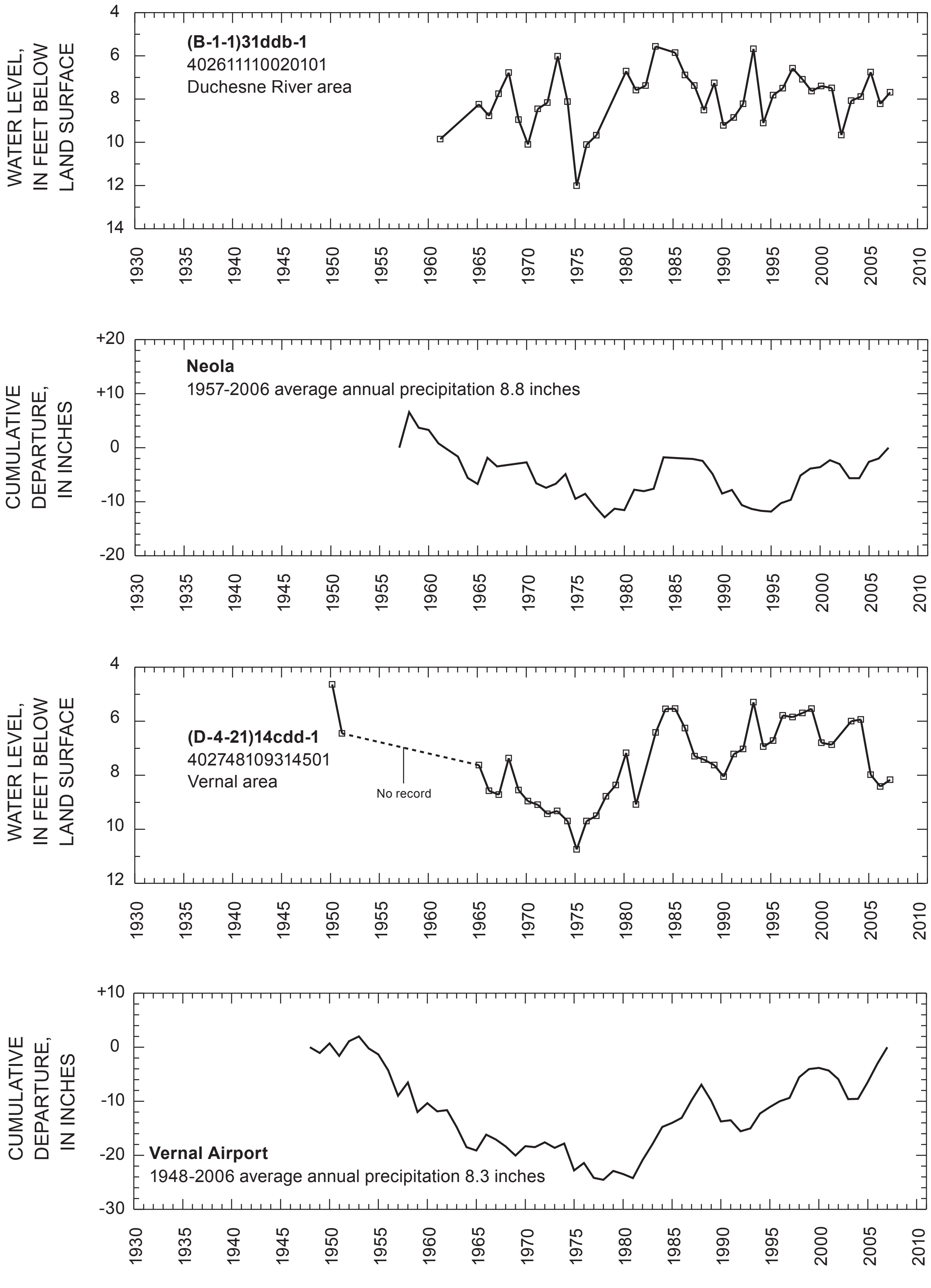


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

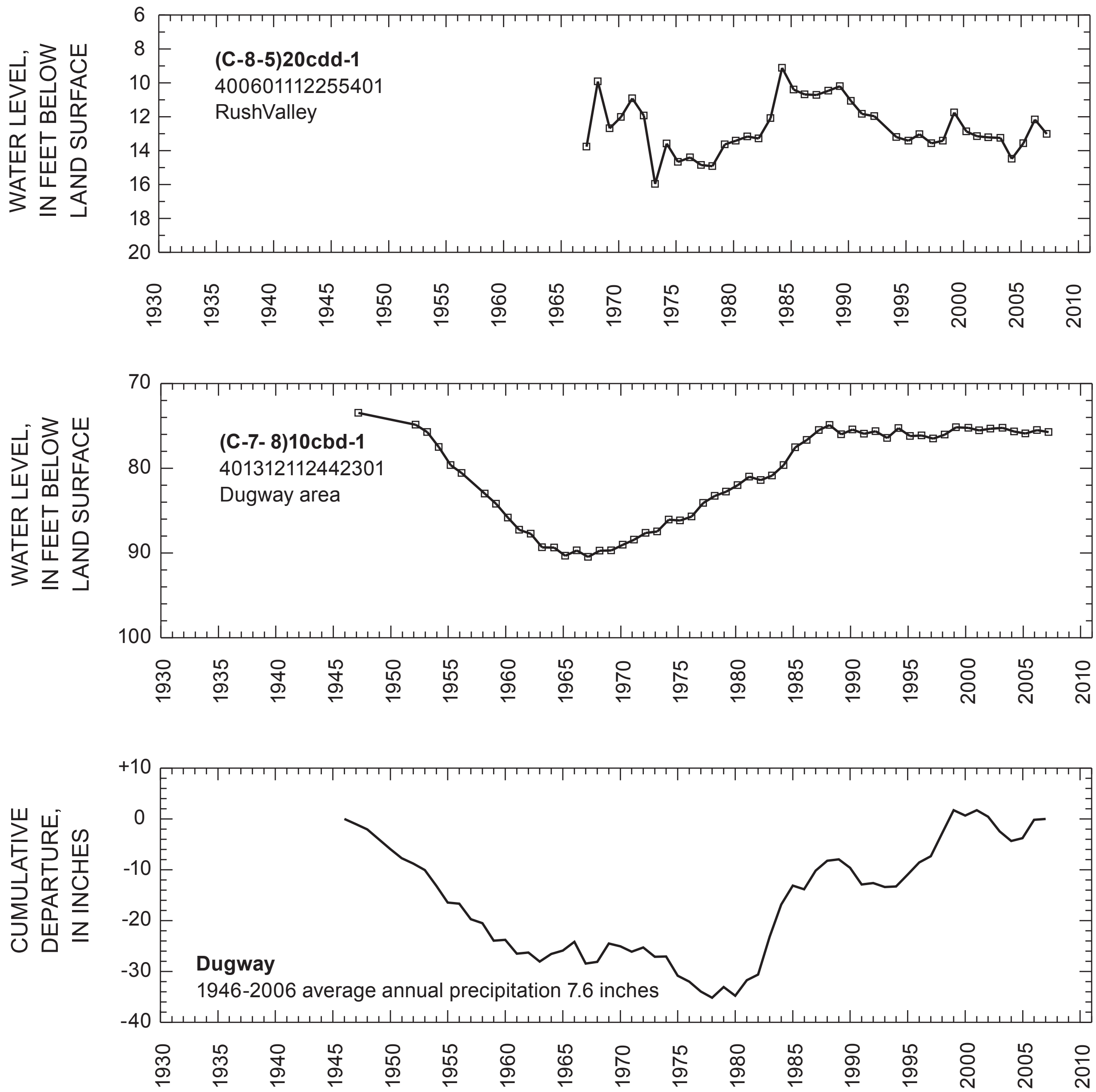


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

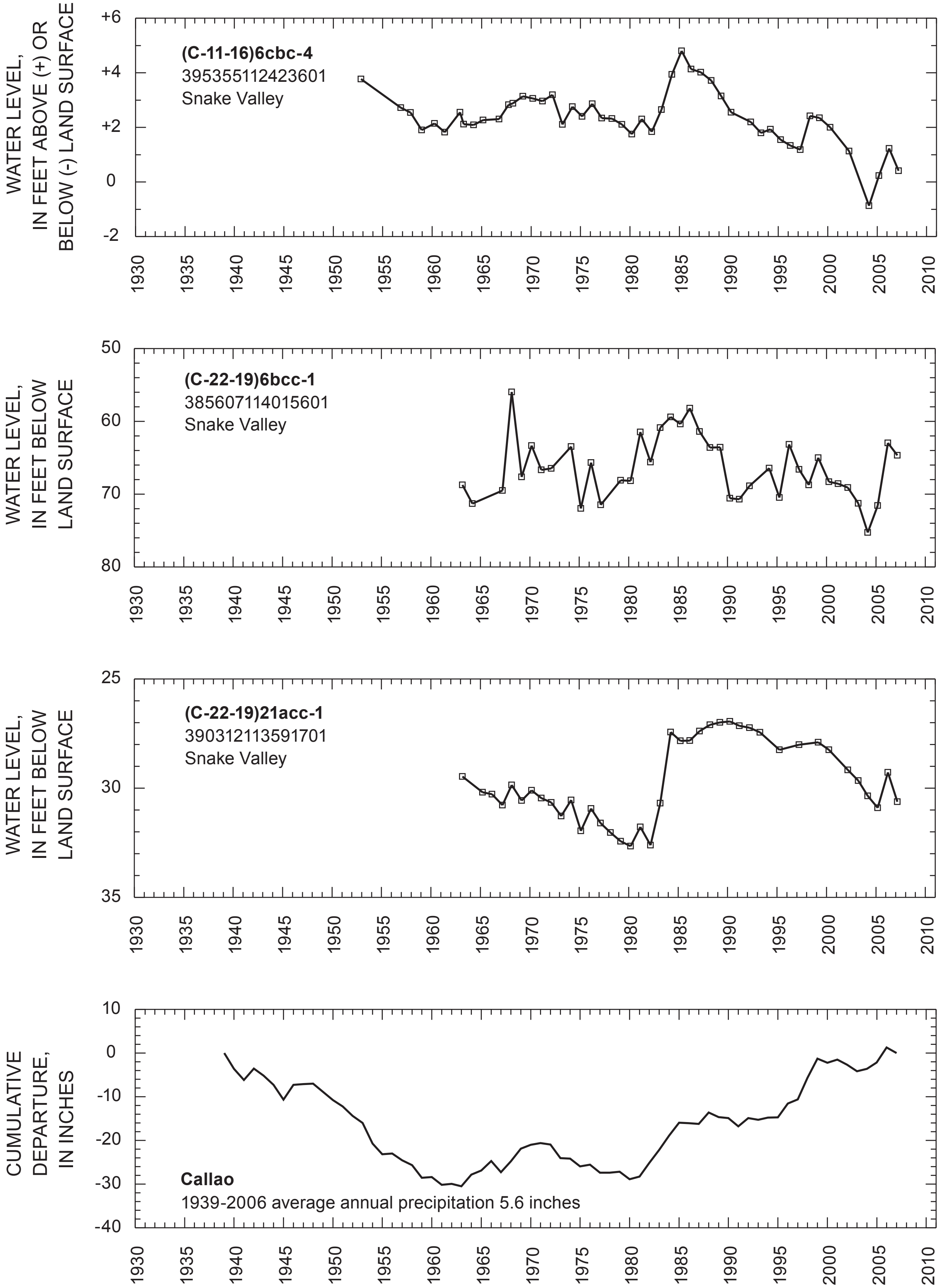


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

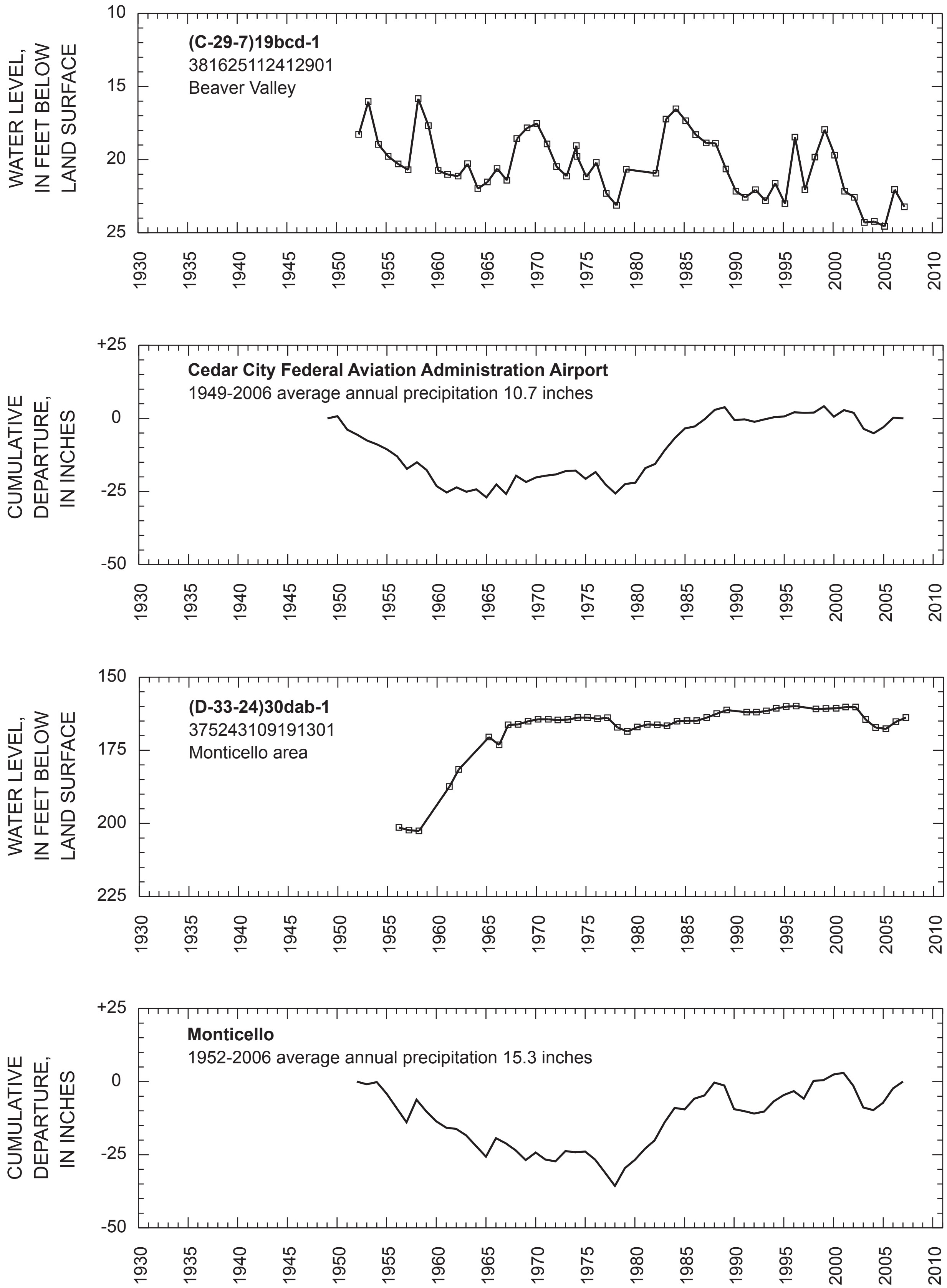


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

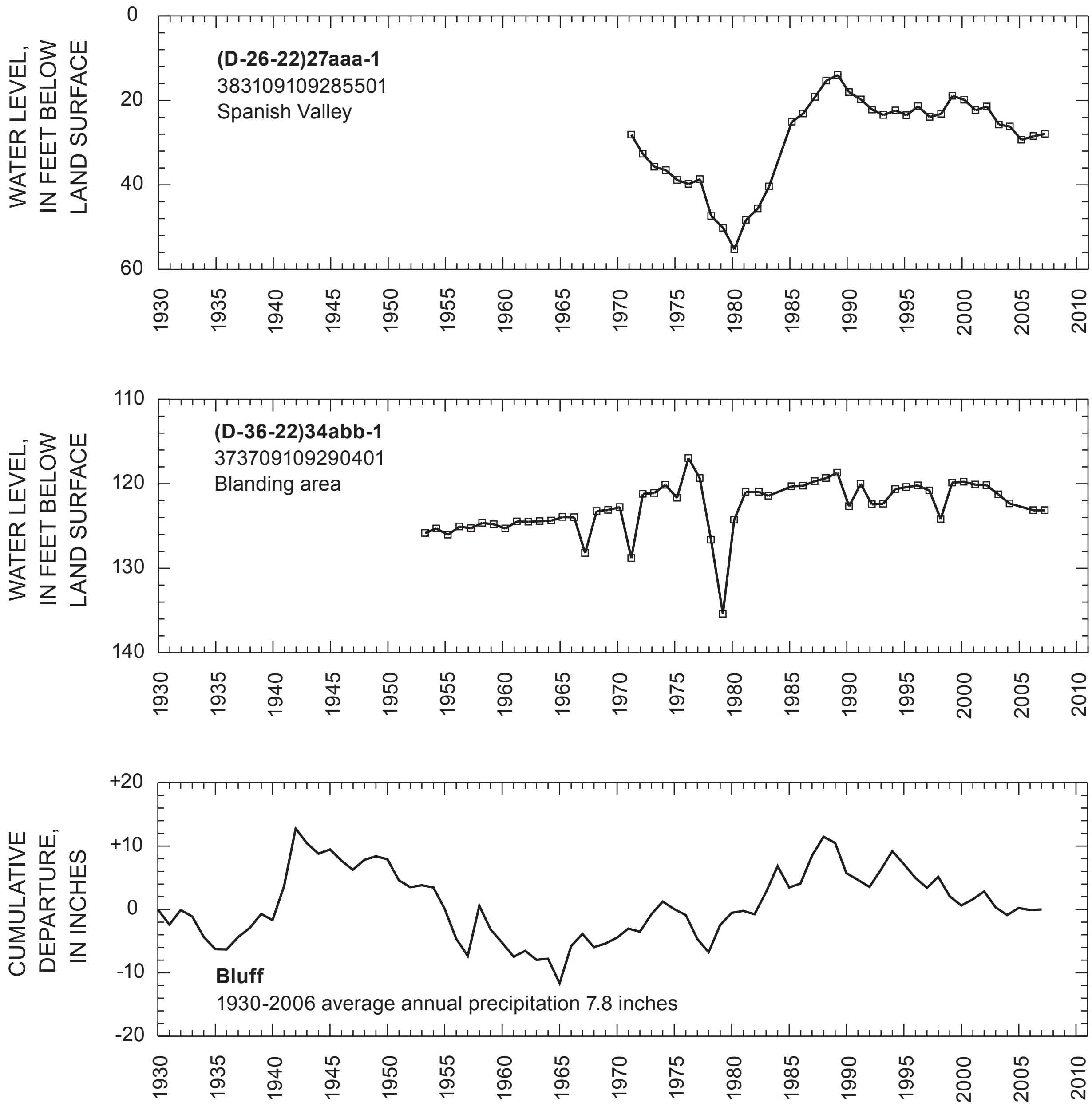


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

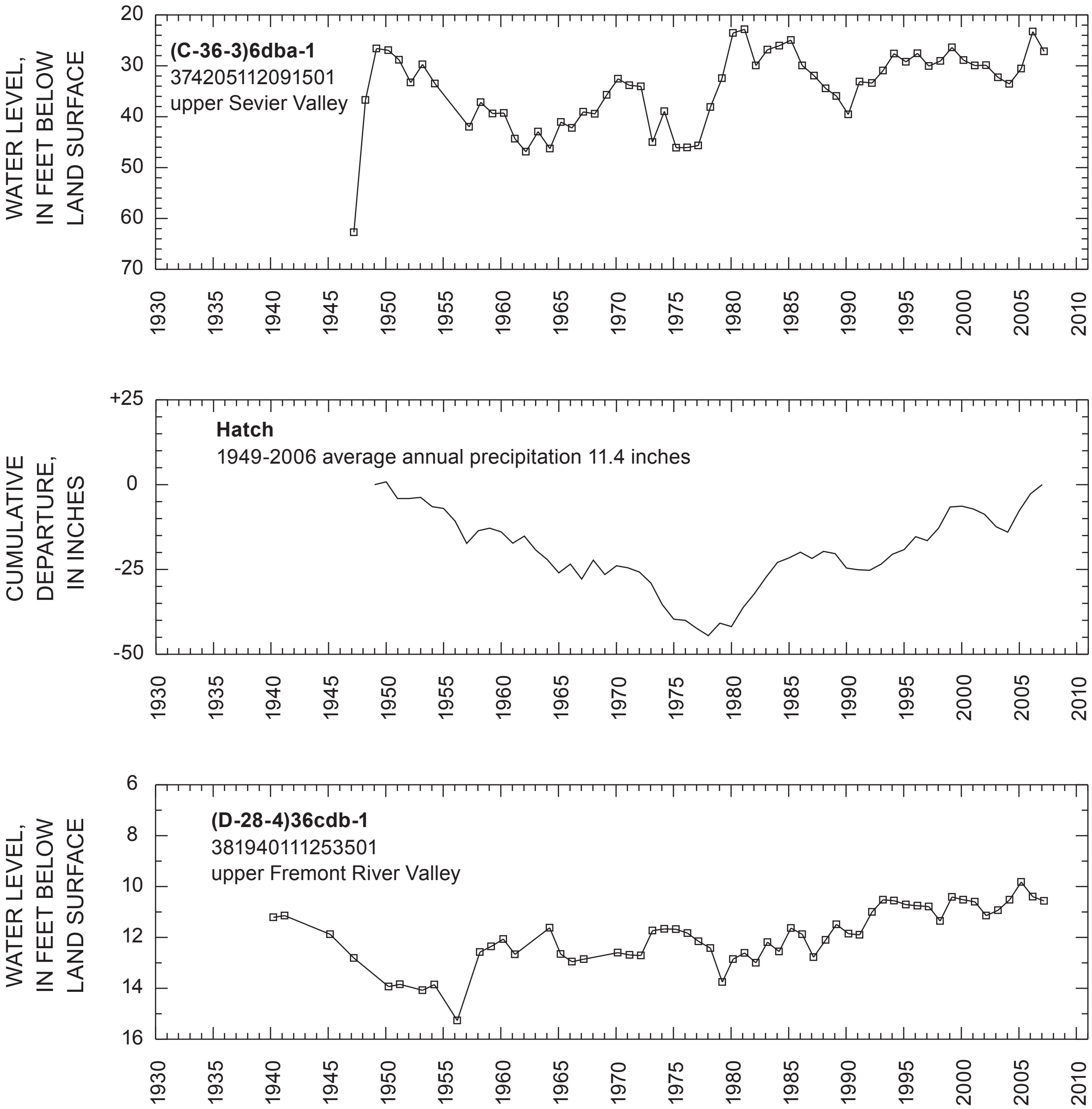


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

QUALITY OF WATER FROM SELECTED WELLS IN UTAH, SUMMER OF 2006

During July through September 2006, the U.S. Geological Survey (USGS), Utah Water Science Center, in cooperation with the Utah Department of Environmental Quality, Division of Water Quality, sampled water from 52 selected wells located in 17 counties (fig. 39). The USGS National Water Quality Laboratory analyzed the samples. Results of the chemical analyses are listed in tables 4 and 5 and include field values of pH, specific conductance, and temperature; and laboratory concentrations of common chemical constituents, dissolved solids, nutrients (nitrite plus nitrate, and orthophosphate), and selected trace elements. For reader convenience, the Utah State maximum contaminant levels (MCLs) and secondary drinking-water standards of routinely measurable substances present in water supplies can be obtained at *http://www.rules.utah.gov/publicat/code/r309/r309-200.htm#T5*, and the U.S. Environmental Protection Agency drinking-water standards can be obtained at *http://www.epa.gov/safewater/mcl.html#mcls*. MCLs were established for public drinking-water systems and may not apply to the majority of wells sampled during this study. The majority of the chemical analyses listed in tables 4 and 5 were obtained from water samples collected from irrigation wells. Results from the water-sample analyses presented in this report and additional data are available at *http://waterdata.usgs.gov/ut/nwis/qw*.

Six water-quality field blanks were collected to determine if samples were being contaminated during equipment decontamination or sample-collection procedures. A field blank is an inorganic blank water sample that is prepared by and obtained from the USGS National Water Quality Laboratory and carried in the field. The field blank is subjected to all aspects of sample collection, processing, preservation, transportation, shipment, and laboratory handling as an environmental sample. One field blank showed slightly elevated concentrations for a single constituent. An elevated level of uranium (0.05 micrograms per liter) above reporting limits was detected in one of the blanks. The remainder of the analyses did not show any elevated concentrations of other constituents, indicating that the environmental samples were not contaminated.

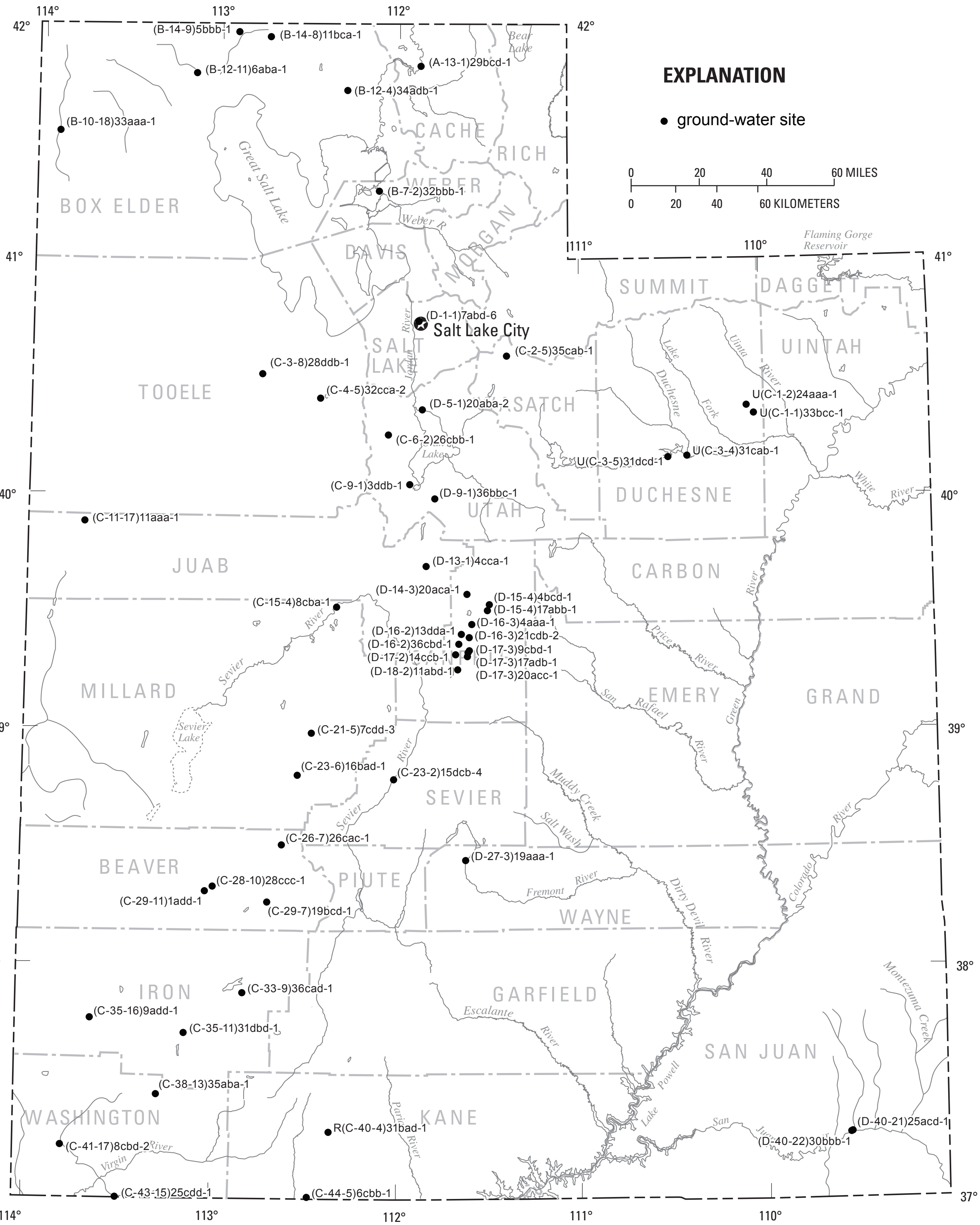


Figure 39. Location of ground-water sites sampled during the summer of 2006.

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2006.

[µS/cm, microsiemens per centimeter; ºC, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; <, less than; e, estimated]

Local identifier	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved in mg/L	Magnesium, dissolved, in mg/L
BEAVER COUNTY								
Beaver Valley								
(C-29-7)19bcd-1	381625112412901	07-19-06	7.5	500	12.7	200	59.4	11.8
Cove Fort area								
(C-26-7)26cac-1	383101112365301	07-19-06	7.7	608	14.7	240	73.1	14.2
Escalante Valley, Milford area								
(C-28-10)28ccc-1	382019112591701	08-08-06	7.9	1,020	15.8	410	87.4	46.8
(C-29-11)1add-1	381901113014101	08-08-06	7.8	840	15.4	340	98.1	22
BOX ELDER COUNTY								
Curlew Valley								
(B-12-11)6aba-1	414811113081701	07-20-06	7.9	1,080	17	280	78.2	20
(B-14-8)11bca-1	415737112431601	07-19-06	7.2	3,210	11.9	740	164	80.6
(B-14-9)5bbb-1	415847112540401	07-19-06	7.8	1,250	18	430	125	29
Grouse Creek Valley								
(B-10-18)33aaa-1	413300113543001	07-20-06	7.4	960	12.9	350	100	23.5
Lower Bear River area								
(B-12-4)34adb-1	414405112165701	07-25-06	7.8	1,910	16.4	730	161	80.2
CACHE COUNTY								
Cache Valley								
(A-13-1)29bcd-1	415020111520401	07-25-06	7.7	349	13.5	190	40	22.1
DUCHESNE COUNTY								
Altamont-Bluebell area								
U(C-1-1)33bcc-1	402114110003301	09-19-06	8.5	510	13.1	97	24.3	8.73
U(C-1-2)24aaa-1	402319110025601	09-18-06	7.8	355	20.3	170	49.6	11.2
Starvation Duchesne area								
U(C-3-4)31cab-1	401030110225701	09-19-06	7.5	580	15.4	300	84.3	21
Uinta Basin								
U(C-3-5)31dcd-1	401012110292101	09-19-06	9.2	1,860	14.8	20	2.4	3.37
IRON COUNTY								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	07-20-06	7.6	1,310	12.7	750	150	91.1
Parowan Valley								
(C-33-9)36cad-1	375309112491401	08-02-06	7.6	550	16	230	47.2	27.8
Escalante Valley, Beryl-Enterprise area								
(C-35-16)9add-1	374623113381301	08-08-06	7.6	490	12.9	200	60.5	11.4
JUAB COUNTY								
Juab Valley								
(D-13-1)4cca-1	394225111495701	07-26-06	7.6	1,590	11.7	470	127	36.5
Snake Valley								
(C-11-17)11aaa-1	395319113431201	08-02-06	8.0	405	15	130	39.5	8.15
KANE COUNTY								
Kanab area								
(C-44-5)6cbb-1	370050112274501	08-15-06	7.2	1,920	16.5	660	164	60.8
R(C-40-4)31bad-1	371740112210601	08-15-06	7.1	1,700	16.8	910	122	147
MILLARD COUNTY								
Pahvant Valley								
(C-21-5)7cdd-3	385939112272303	08-23-06	7.2	1,160	12.5	510	110	56.6
(C-23-6)16bad-1	384856112315701	08-23-06	7.0	4,330	16	1,200	322	93.4
Sevier Desert								
(C-15-4)8cba-1	393154112192901	08-21-06	7.1	3,330	14.1	1,000	227	113

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2006—Continued.

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrite plus nitrate, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
BEAVER COUNTY										
Beaver Valley										
5.2	22.6	186	0.07	22.9	0.7	35.8	30.5	314	2.52	0.035
Cove Fort area										
2.66	20.9	152	.17	82.9	.2	42.2	24.3	391	1.35	.03
Escalante Valley, Milford area										
3.92	41	104	.44	135	.5	31.8	209	671	2.43	.017
5.08	26.8	181	.23	108	.3	37.2	72.3	563	3.53	.036
BOX ELDER COUNTY										
Curlew Valley										
5.07	95.2	169	.2	207	.2	19.8	47.1	599	.48	.014
17.4	324	270	.63	684	.8	47.3	333	1,950	1.31	.045
11.8	44	128	.28	284	.2	56	23.5	822	1.89	.028
Grouse Creek Valley										
7.73	47.2	227	.22	121	.3	50.6	90.2	592	.6	.04
Lower Bear River area										
4.24	183	185	1.1	608	.2	20.3	143	1,520	4.45	.015
CACHE COUNTY										
Cache Valley										
1.49	23.6	234	<.02	8.08	.1	10.3	10.8	258	.14	.016
DUCHESNE COUNTY										
Altamont-Bluebell area										
1.67	100	154	<.02	.76	1.7	7.25	169	400	<.06	e.005
3.72	4.49	137	<.02	.88	.7	7.67	44.9	200	<.06	e.004
Starvation Duchesne area										
1.31	15	267	e.02	6.75	.2	9.03	50.8	354	.26	.007
Uinta Basin										
1.14	394	530	.06	170	1.4	15.6	170	1,130	.48	.057
IRON COUNTY										
Cedar Valley										
2.63	12.2	140	.08	18.5	<.5	20.7	576	1,070	3.41	.012
Parowan Valley										
3.04	23.7	211	.04	30.5	.2	28.3	33	317	.43	.025
Escalante Valley, Beryl-Enterprise area										
4.81	15.1	146	.21	50.2	.2	49.6	20.2	342	1.85	.035
JUAB COUNTY										
Juab Valley										
3.53	154	312	.06	288	.2	21.3	123	1,030	3.37	.024
Snake Valley										
1.75	31	136	.04	34.6	.3	19.1	10.3	233	.47	.033
KANE COUNTY										
Kanab area										
9.22	228	314	.26	52.7	.5	13.8	830	1,690	.09	.008
9.51	96.4	368	.09	22.7	.7	12.6	724	1,470	e.03	.008
MILLARD COUNTY										
Pahvant Valley										
4.57	118	320	.26	166	.2	24.9	238	1,000	5.43	.027
75.5	612	329	1.5	1,210	1.2	38	708	3,540	2.09	.047
Sevier Desert										
8.42	347	395	.58	619	.2	28.4	537	2,250	.68	.025

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2006—Continued.

Local identifier	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved in mg/L	Magnesium, dissolved, in mg/L
SALT LAKE COUNTY								
Salt Lake Valley								
(D-1-1)7abd-6	404506111523301	08-02-06	7.3	1,340	15.5	580	140	56.8
SAN JUAN COUNTY								
Bluff area								
(D-40-21)25acd-1	371657109331901	08-29-06	8.7	435	17.0	11	3.09	.823
(D-40-22)30bbb-1	371716109325501	08-29-06	9	810	20.0	5	1.19	.401
SANPETE COUNTY								
Sanpete Valley								
(D-14-3)20aca-1	393521111362501	08-15-06	7.1	792	10.7	350	91.6	29.1
(D-15-4)4bcd-1	393241111290501	08-15-06	7.8	574	12.2	300	67.1	32.9
(D-15-4)17abb-1	393113111294501	07-27-06	7.9	561	10.0	300	63.7	33.5
(D-16-2)13dda-1	392511111382001	08-14-06	7.6	1,070	14.3	350	60.5	48.5
(D-16-2)36cbd-1	392238111390501	08-14-06	7.6	728	14.2	290	43.1	43.8
(D-16-3)4aaa-1	392740111345301	07-27-06	7.4	1,050	11.5	330	70	38.2
(D-16-3)21cdb-2	392421111353601	08-14-06	7.5	1,090	11.0	480	78	68.2
(D-17-2)14ccb-1	391955111401301	08-14-06	7.7	872	11.0	370	56.3	56.6
(D-17-3)9cbd-1	392056111353801	07-27-06	7.7	676	12.4	310	52.6	43.6
(D-17-3)17adb-1	392023111360501	07-27-06	7.7	726	11.0	320	58	43
(D-17-3)20acc-1	391920111361901	08-14-06	7.4	704	13.3	360	61.2	49.1
(D-18-2)11abd-1	391601111392801	08-14-06	7.6	800	14.7	290	46.9	43.2
SEVIER COUNTY								
Central Sevier Valley								
(C-23-2)15dcb-4	384757112002201	08-07-06	7.4	670	12.9	310	63.4	36.9
TOOELE COUNTY								
Rush Valley								
(C-4-5)32cca-2	402525112251502	07-27-06	7.3	1,040	12.5	340	92.6	25.9
Skull Valley								
(C-3-8)28ddb-1	403126112444501	07-18-06	7.9	630	14.0	180	51.5	13.4
Tooele Valley								
(C-2-5)35cab-1	403602112230101	07-27-06	7.4	4,370	20.0	490	122	45.8
UTAH COUNTY								
Cedar Valley								
(C-6-2)26cbb-1	401607112023401	07-11-06	7.7	705	13.2	280	47.8	38.1
Goshen Valley								
(C-9-1)3ddb-1	400325111552501	08-10-06	7.7	1,380	14.2	250	63.7	22.4
Northern Utah Valley								
(D-5-1)20aba-2	402234111511501	08-10-06	7.7	511	11.3	240	57	24.9
Southern Utah Valley								
(D-9-1)36bbc-1	395942111470801	08-10-06	7.5	541	10.7	270	70.9	23.7
WASHINGTON COUNTY								
Central Virgin River area								
(C-38-13)35aba-1	372702113163401	08-14-06	7.5	440	14.5	190	57.3	12.6
(C-41-17)8cbd-2	371348113470301	08-14-06	7.4	480	18.5	220	62.5	15.3
(C-43-15)25cdd-1	370034113290801	08-14-06	7.2	2,570	21.8	1,800	570	92.7
WAYNE COUNTY								
Upper Fremont Valley								
(D-27-3)19aaa-1	382717111365601	08-07-06	7.5	1,260	11.5	710	213	44.2
WEBER COUNTY								
East Shore area								
(B-7-2)32bbb-1	411824112060601	08-07-06	7.5	2,440	18.8	350	73.2	40.5

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2006—Continued.

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrite plus nitrate, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
SALT LAKE COUNTY										
Salt Lake Valley										
3.1	53.1	293	.12	160	.2	18.7	171	837	5.64	.045
SAN JUAN COUNTY										
Bluff area										
1.22	93	173	e.01	2.05	e.1	11.2	45.4	269	<.06	.006
1.02	184	353	.04	14.5	.5	10.6	50.2	490	<.06	.009
SANPETE COUNTY										
Sanpete Valley										
4.05	28.2	277	.13	46.6	e.1	36.1	31.9	511	15.8	.045
2.25	11	301	.02	8.44	.1	10.4	16.1	348	2.52	.008
1.06	7.97	302	e.01	6.56	.1	8.15	14.3	327	2.07	.006
3.29	91.3	234	.12	138	.5	24.6	138	670	<.06	.017
1.13	48	265	.14	67.7	.3	18.4	42.9	445	.64	.014
7.68	92.3	342	.1	93.7	.2	42.1	90.7	649	<.06	.056
2.49	61.9	324	.22	73.9	.3	20.7	188	735	3.74	.023
1.23	45.1	304	.1	55.3	.3	17	103	538	1	.018
1.38	29.3	334	.02	9.46	.2	11.9	38.5	401	2.29	.008
1.33	32.5	325	.06	19.3	.3	15.1	58.3	441	2.63	.01
1.44	20.9	316	.05	14.7	.3	15.3	71	451	2.56	.01
1.71	66.8	322	.08	26	.3	11.2	84.3	499	2.65	.01
SEVIER COUNTY										
Central Sevier Valley										
3	19	274	.07	32	.4	33.4	48.4	414	.86	.043
TOOELE COUNTY										
Rush Valley										
1.36	69	216	.14	163	.1	14.6	50.1	583	1.8	.013
Skull Valley										
1.91	47.8	125	.08	102	.2	19	19.2	348	1.36	.026
Tooele Valley										
10.6	667	200	.95	1,200	.5	22.5	126	2,520	3.77	.017
UTAH COUNTY										
Cedar Valley										
3.1	21.1	191	.11	84.9	.4	53	23.8	406	.22	.029
Goshen Valley										
11.5	157	165	.25	271	.5	61	83.8	811	.98	.034
Northern Utah Valley										
1.55	14.2	205	e.01	10.8	.2	12.1	45.9	305	2.34	.01
Southern Utah Valley										
1.48	7.44	241	.03	17.8	.2	16.4	19.4	310	2.25	.013
WASHINGTON COUNTY										
Central Virgin River area										
1.76	13	190	.08	15.3	.2	36.7	14.4	274	1.14	.066
2.1	13.2	197	.07	13.1	.3	17.6	37.6	298	.43	.018
10.1	60.9	102	.29	46.6	.2	17.8	1,730	2,910	4	.011
WAYNE COUNTY										
Upper Fremont Valley										
3.71	32.7	205	.06	11.8	e.1	28.4	568	1,140	2.8	.039
WEBER COUNTY										
East Shore area										
2.2	316	150	.48	674	.3	28.1	<.9	1,370	<.06	.054

Table 5. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2006.

[µg/L, micrograms per liter; <, less than; e, estimated]

Local identifier	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
BEAVER COUNTY								
Beaver Valley								
(C-29-7)19bcd-1	381625112412901	07-19-06	2.2	<6	0.8	0.9	0.64	31.1
Cove Fort area								
(C-26-7)26cac-1	383101112365301	07-19-06	2.4	<6	e.3	e.3	1.2	3.62
Escalante Valley, Milford area								
(C-28-10)28ccc-1	382019112591701	08-08-06	3.7	6	<.6	2.1	3.1	6.42
(C-29-11)1add-1	381901113014101	08-08-06	3.4	8	1.2	1.1	.55	21.2
BOX ELDER COUNTY								
Curlew Valley								
(B-12-11)6aba-1	414811113081701	07-20-06	1.5	e4	<.6	1.4	1.1	2.06
(B-14-8)11bca-1	415737112431601	07-19-06	8.7	<18	2.1	3	6	5.86
(B-14-9)5bbb-1	415847112540401	07-19-06	1.9	<6	<.6	.8	1.6	1.37
Grouse Creek Valley								
(B-10-18)33aaa-1	413300113543001	07-20-06	6.5	91	1	4.7	2.9	8.13
Lower Bear River area								
(B-12-4)34adb-1	414405112165701	07-25-06	.68	10	<.6	1	26.7	2.02
CACHE COUNTY								
Cache Valley								
(A-13-1)29bcd-1	415020111520401	07-25-06	6	191	59.5	.8	e.06	.35
DUCHESNE COUNTY								
Altamont-Bluebell area								
U(C-1-1)33bcc-1	402114110003301	09-19-06	1.7	112	5.5	2.1	<.08	1.07
U(C-1-2)24aaa-1	402319110025601	09-18-06	<.12	465	19.4	e.3	<.08	.04
Starvation Duchesne area								
U(C-3-4)31cab-1	401030110225701	09-19-06	.46	11	e.6	.6	.32	1.08
Uinta Basin								
U(C-3-5)31dcd-1	401012110292101	09-19-06	<.12	12	3.4	<.4	.17	.04
IRON COUNTY								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	07-20-06	.77	e4	.7	e.3	2	3.49
Parowan Valley								
(C-33-9)36cad-1	375309112491401	08-02-06	2.7	<6	<.6	e.2	.42	2.01
Escalante Valley, Beryl-Enterprise area								
(C-35-16)9add-1	374623113381301	08-08-06	2.9	<6	<.6	e.3	.92	2.49
JUAB COUNTY								
Juab Valley								
(D-13-1)4cca-1	394225111495701	07-26-06	.56	<6	<.6	.5	1.2	1.78
Snake Valley								
(C-11-17)11aaa-1	395319113431201	08-02-06	.54	<6	<.6	.5	.14	9.34
KANE COUNTY								
Kanab area								
(C-44-5)6cbb-1	370050112274501	08-15-06	.65	57	139	6	.12	1.25
R(C-40-4)31bad-1	371740112210601	08-15-06	.15	13	154	1.2	.08	8.75
MILLARD COUNTY								
Pahvant Valley								
(C-21-5)7cdd-3	385939112272303	08-23-06	2	<6	<.6	1.4	2.3	3.59
(C-23-6)16bad-1	384856112315701	08-23-06	9.4	6	<.6	e.7	1.5	1.89
Sevier Desert								
(C-15-4)8cba-1	393154112192901	08-21-06	3.2	181	439	2.5	.18	5.62

Table 5. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2006—Continued.

Local identifier	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
SALT LAKE COUNTY								
Salt Lake Valley								
(D-1-1)7abd-6	404506111523301	08-02-06	1	<6	.9	1.2	1.5	1.9
SAN JUAN COUNTY								
Bluff area								
(D-40-21)25acd-1	371657109331901	08-29-06	10.2	<6	7.9	.6	<.08	.04
(D-40-22)30bbb-1	371716109325501	08-29-06	66.1	e3	1.5	1.6	<.08	.37
SANPETE COUNTY								
Sanpete Valley								
(D-14-3)20aca-1	393521111362501	08-15-06	1.2	<6	<.6	e.3	1.9	1.92
(D-15-4)4bcd-1	393241111290501	08-15-06	.23	<6	<.6	e.2	.56	.81
(D-15-4)17abb-1	393113111294501	07-27-06	.16	<6	<.6	e.2	.37	1.08
(D-16-2)13dda-1	392511111382001	08-14-06	.6	39	55.5	9.5	<.08	2.38
(D-16-2)36cbd-1	392238111390501	08-14-06	6.1	160	24.3	1.4	.44	.7
(D-16-3)4aaa-1	392740111345301	07-27-06	13.4	4,270	26.5	.6	<.08	4.29
(D-16-3)21cdb-2	392421111353601	08-14-06	2.6	<6	<.6	2.5	5	3.76
(D-17-2)14ccb-1	391955111401301	08-14-06	1.1	<6	<.6	.7	5.5	2.14
(D-17-3)9cbd-1	392056111353801	07-27-06	.37	<6	<.6	1	1	2.17
(D-17-3)17adb-1	392023111360501	07-27-06	.38	<6	<.6	1.7	2.1	2.31
(D-17-3)20acc-1	391920111361901	08-14-06	.51	e5	<.6	1.1	1.7	1.88
(D-18-2)11abd-1	391601111392801	08-14-06	.3	<6	<.6	1.2	.88	1.44
SEVIER COUNTY								
Central Sevier Valley								
(C-23-2)15dcb-4	384757112002201	08-07-06	3.7	e4	<.6	3.4	1.1	5.47
TOOELE COUNTY								
Rush Valley								
(C-4-5)32cca-2	402525112251502	07-27-06	.52	e6	<.6	.4	1.9	2.21
Skull Valley								
(C-3-8)28ddb-1	403126112444501	07-18-06	.95	<6	<.6	.6	.37	.42
Tooele Valley								
(C-2-5)35cab-1	403615111230301	07-27-06	3.9	e15	<1.8	6.2	4.3	2.34
UTAH COUNTY								
Cedar Valley								
(C-6-2)26cbb-1	401607112023401	07-11-06	6.3	6	11.6	2.1	.53	3.22
Goshen Valley								
(C-9-1)3ddb-1	400325111552501	08-10-06	8.4	e6	<.6	3.5	1.3	5.56
Northern Utah Valley								
(D-5-1)20aba-2	402234111511501	08-10-06	.5	<6	<.6	1.1	1.4	7.28
Southern Utah Valley								
(D-9-1)36bbc-1	395942111470801	08-10-06	.4	<6	<.6	.5	1.3	1.57
WASHINGTON COUNTY								
Central Virgin River area								
(C-38-13)35aba-1	372702113163401	08-14-06	2.7	<6	<.6	1	.51	5.79
(C-41-17)8cbd-2	371348113470301	08-14-06	30.1	<6	<.6	5.3	.35	1.5
(C-43-15)25cdd-1	370034113290801	08-14-06	.41	<18	e1.4	3.2	6.1	6.11
WAYNE COUNTY								
Upper Fremont Valley								
(D-27-3)19aaa-1	382717111365601	08-07-06	1.1	<6	<.6	e.2	.66	18.3
WEBER COUNTY								
East Shore area								
(B-7-2)32bbb-1	411824112060601	08-07-06	3.1	158	286	.5	<.08	<.04

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