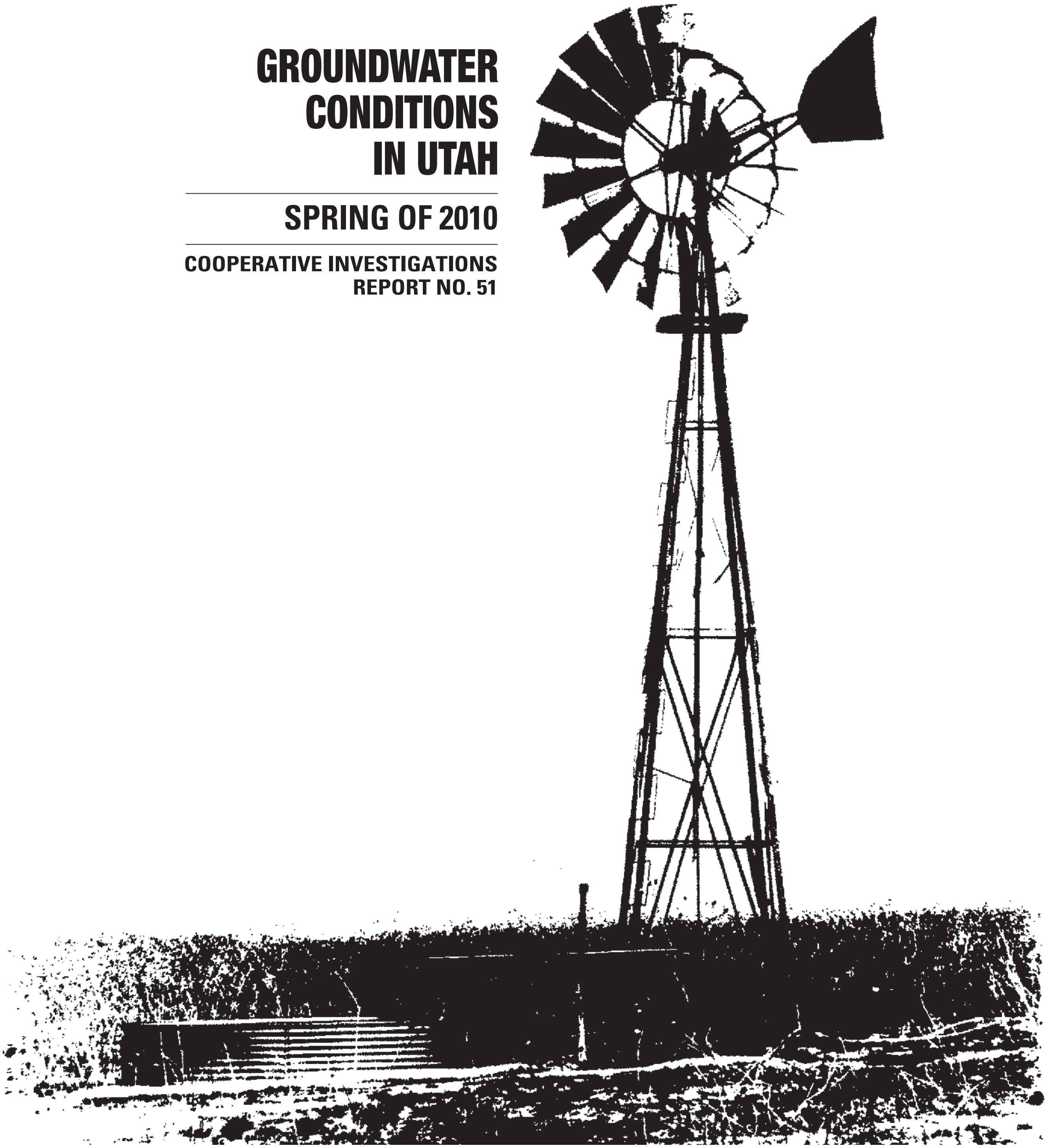
GROUNDWATER CONDITIONS IN UTAH

SPRING OF 2010

COOPERATIVE INVESTIGATIONS REPORT NO. 51



UTAH DEPARTMENT OF NATURAL RESOURCES and
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

U.S. GEOLOGICAL SURVEY

GROUNDWATER CONDITIONS IN UTAH, SPRING OF 2010

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

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

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Conversion Factors, Datums, and Water-Quality Units

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	2.59	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. Chemical concentration in water is reported in milligrams per liter (mg/L) or micrograms per liter (µg/L), which express the solute mass per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

Specific conductance is 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.

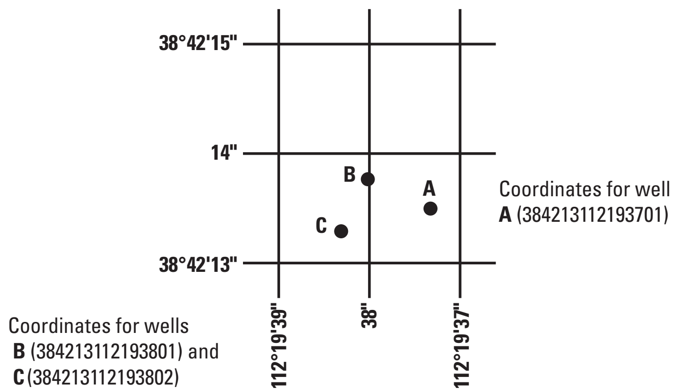
Definition of Terms

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 average 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 groundwater observation well.
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.
Maximum Contaminant Level (MCL)—The maximum concentration of a substance that is allowed in public drinking water systems, as established by the U.S. Environmental Protection Agency (EPA).

Numbering System for Wells and Surface-Water Sites

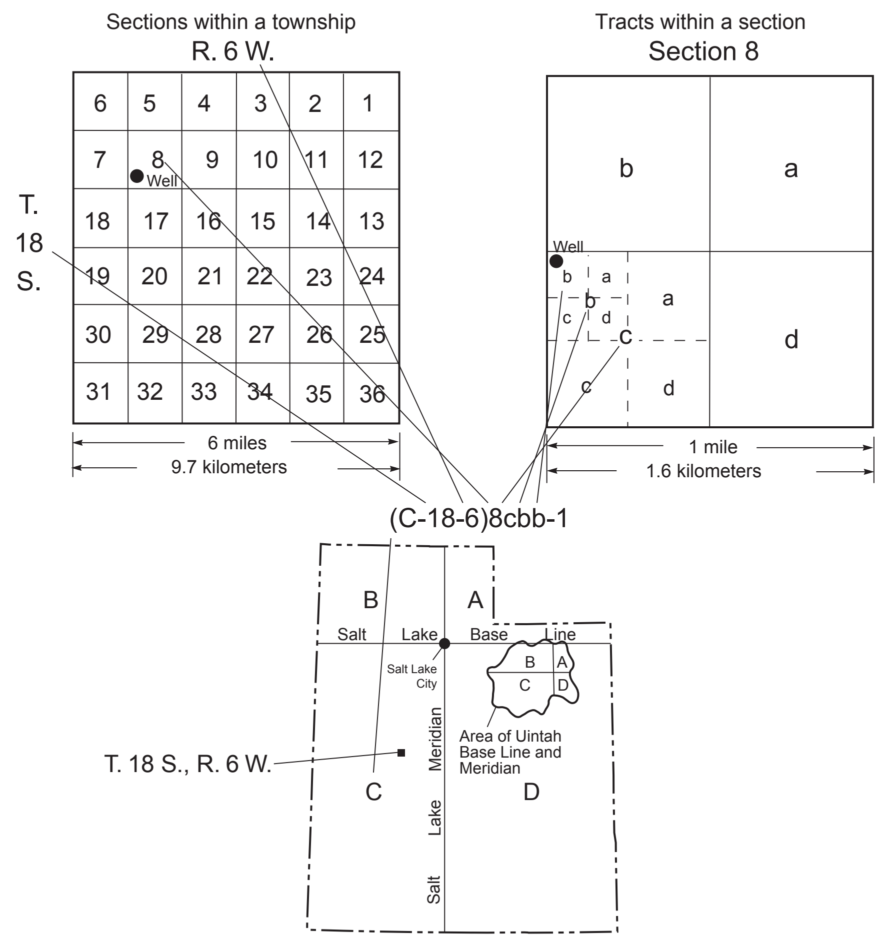
Wells by Latitude and Longitude

The U.S. Geological Survey well-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 six digits denote the degrees, minutes, and seconds of latitude, and the next seven digits denote degrees, minutes, and seconds of longitude; the last two 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. 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 for each well, another well number is assigned based on the U.S. Bureau of Land Management system of land subdivision.



Wells by the Cadastral System of Land Subdivision

The well-numbering system used in Utah is based on the Cadastral 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.



Surface-Water Sites— Downstream Order and Station Number

Since October 1, 1950, hydrologic-station records in U.S. Geological Survey 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.

As an added means of identification, each hydrologic station and partial-record station has been assigned a station number. These station numbers are in the same downstream order used in this report. In assigning a station number, no distinction is made between partial-record stations and other stations; therefore, the station number for a partial-record station indicates downstream-order position in a list composed of both types of stations. Gaps are consecutive. The complete 8-digit (or 10-digit) number for each station such as 09004100, which appears just to the left of the station name, includes a 2-digit part number “09” plus the 6-digit (or 8-digit) downstream order number “004100.” In areas of high station density, an additional two digits may be added to the station identification number to yield a 10-digit number. The stations are numbered in downstream order as described above between stations of consecutive 8-digit numbers.

Groundwater Conditions in Utah, Spring of 2010

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

Introduction

This is the forty-seventh in a series of annual reports that describe groundwater 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 groundwater conditions.

This report, like the others in the series, contains information on well construction, groundwater 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 groundwater. Supplementary data are included in reports of this series only for those years or areas which are important to a discussion of changing groundwater conditions and for which applicable data are available.

This report includes individual discussions of selected significant areas of groundwater development in the State for calendar year 2009. 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 also available online at *http://www.waterrights.utah.gov/techinfo/* and *http://ut.water.usgs.gov/publications/GW2010.pdf*. Groundwater conditions in Utah for calendar year 2008 are reported in Burden and others (2009) and available online at *http://ut.water.usgs.gov/publications/GW2009.pdf*.

Analytical results associated with water samples collected from each area of groundwater development were compared to State of Utah maximum contaminant levels (MCLs) and secondary drinking-water standards of routinely measureable substances present in water supplies. The MCLs and secondary drinking-water standards can be accessed online 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 accessed at *http://www.epa.gov/safewater/mcl.html#mcls*. Maximum contaminant levels and secondary drinking-water standards were developed for public water systems and do not apply to the majority of wells sampled during this study.

Every 5 years, this report series includes maps depicting comparisons of 30-year changes in water levels for each of the major areas of groundwater development. The water-level change maps in this report show the difference between water levels measured in 1980 and in 2010. Water-level rises or declines occurring on shorter time scales are shown in plots of annual water-level measurements for several wells in each of the major areas of groundwater development.

Utah's Groundwater Reservoir

Small amounts of groundwater 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 groundwater 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 groundwater 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 groundwater development.

Most wells in Utah yield water from unconsolidated basin-fill 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.

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.

Summary of Conditions

The total estimated withdrawal of water from wells in Utah during 2009 was about 969,000 acre-feet (table 2), which is about 33,000 acre-feet less than the revised total for 2008 and 76,000 acre-feet more than the 1999–2008 average annual withdrawal (table 3). The decrease in withdrawal resulted mostly from decreased public-supply use. The total estimated withdrawal for public supply was about 262,000 acre-feet, which is about 27,000 acre-feet less than the value for 2008. Withdrawal for irrigation was about 550,000 acre-feet, which is 5,000 acre-feet less than the value for 2008. Withdrawal for industrial use was about 95,000 acre-feet, the same as reported in 2008. Withdrawal for domestic and stock use was about 63,000 acre-feet, which is the same as in 2008.

From 2008 to 2009, groundwater withdrawal decreased in 9 of the 16 areas of groundwater development discussed in this report (table 2). Withdrawal in Utah and Goshen Valleys decreased about 15,000 acre-feet, the largest decrease of any of the groundwater development areas shown in figure 1. The 2009 withdrawal was more than the average annual withdrawal for 1999–2008 in 12 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 2009 at 17 of 28 weather stations included in this report (National Oceanic and Atmospheric Administration, 2009), was less than the long-term average. The greatest decrease in precipitation from average was 4.8 inches at St. George. The greatest increase in precipitation from average was 5.5 inches at Pine View Dam.

During February and March 2010, about 650 water-level measurements were made 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 which are not included in this report. All water-level data are available online at *http://nwis.waterdata.usgs.gov/ut/nwis/gwlevels*.

In 2009, 295 wells were constructed for new appropriations of groundwater, as determined by the Utah Division of Water Rights (table 2), which is 191 fewer wells than the total reported for 2008. In 2009, 11 large-diameter wells (12 inches or more) were constructed for new appropriations of groundwater (table 2), which is 8 less than the total reported for 2008. These are principally for withdrawal of water for public supply, irrigation, and industrial use.

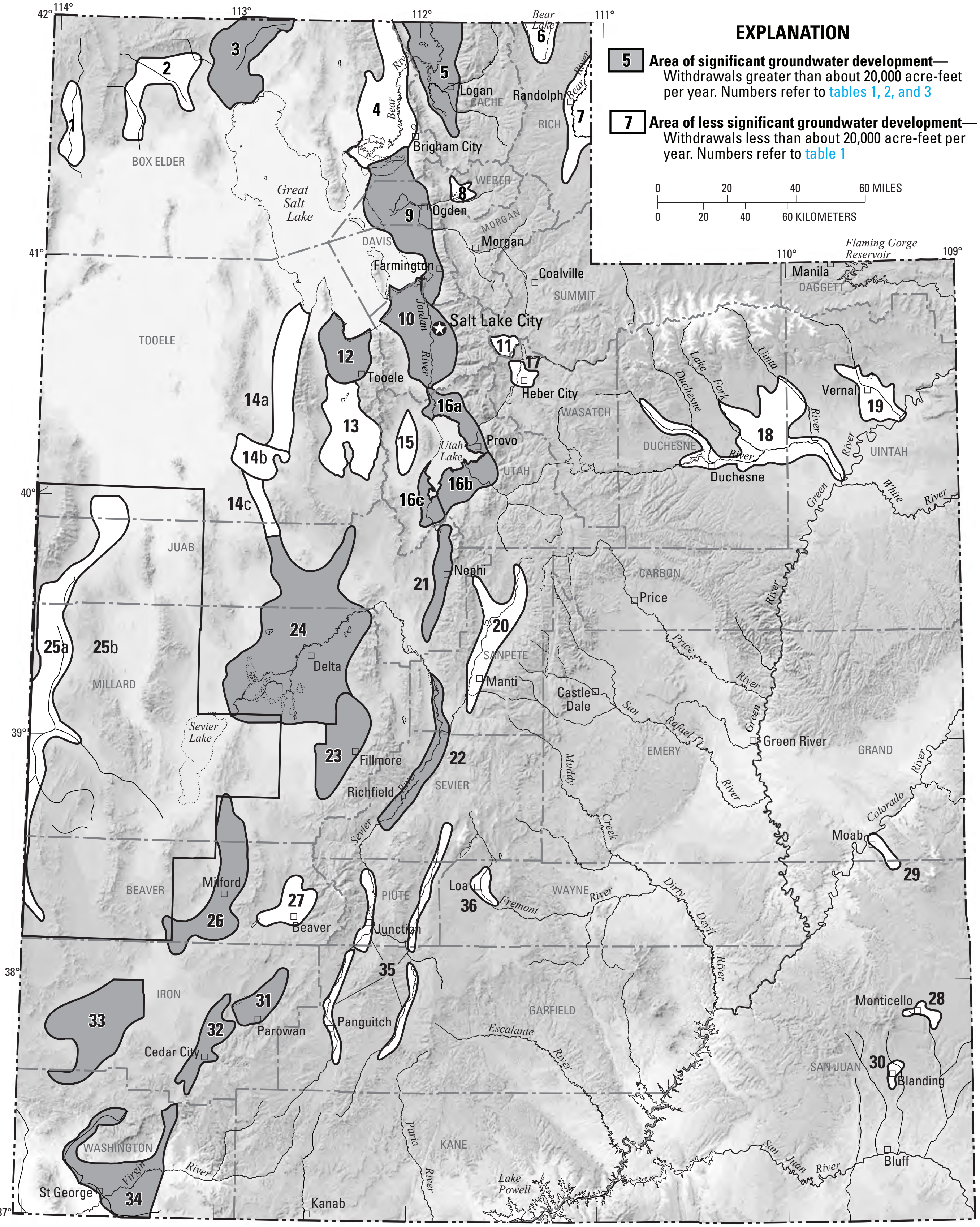


Figure 1. Areas of groundwater development in Utah specifically referred to in this report.

Table 1. Areas of groundwater 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 area	Unconsolidated
2	Park Valley	Do.
3	Curlew Valley	Unconsolidated and consolidated
4	Malad-lower Bear River area	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	Do.
13	Rush Valley	Do.
14a	Skull Valley	Unconsolidated
14b	Dugway area	Do.
14c	Old River Bed	Do.
15	Cedar Valley, Utah County	Do.
16a	Northern Utah Valley	Do.
16b	Southern Utah Valley	Do.
16c	Goshen Valley	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
25a	Snake Valley	Do.
25b	West Desert	Do.
26	Milford area (Escalante Valley)	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 (Escalante Valley)	Do.
34	Central Virgin River area	Unconsolidated and consolidated
35	Upper Sevier Valley	Unconsolidated
36	Upper Fremont River Valley	Unconsolidated and consolidated

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

Area	Number in figure 1	Number of wells[1] constructed in 2009		Estimated withdrawal from wells (acre-feet)							
				2009							
		Total	Diameter of 12 inches or more	Irrigation	Industrial[1]	Public supply[1]	Domestic and stock	Sub-total (rounded)	Total (rounded)	2008 total[2] (rounded)
Curlew Valley	3	0	0	33,700	0	200	100		34,000	44,000
Cache Valley	5	19	0	13,700	6,000	9,100	2,000		31,000	34,000
East Shore area	9	4	0	7,200	3,900	30,000	5,000		46,000	54,000
Salt Lake Valley	10	3	0	580	[3] 35,200	79,500	22,000		137,000	135,000
Tooele Valley	12	2	0	[4,5] 12,500	1,200	10,500	1,100		25,000	[6] 28,000
Utah and Goshen Valleys				27,200	9,200	55,700	16,700		109,000	124,000
Northern Utah Valley[7]	16a	2	0	(6,700)	(5,900)	(42,600)	(8,100)	(63,300)		
Southern Utah Valley[7]	16b	7	0	(5,300)	(3,300)	(13,000)	(8,500)	(30,100)		
Goshen Valley[7]	16c	1	1	(15,200)	(0)	(100)	(100)	(15,400)		
Juab Valley	21	2	0	20,000	110	[8]570	400		21,000	26,000
Sevier Desert	24	8	1	41,200	4,000	1,100	1,200		48,000	44,000
Central Sevier Valley	22	20	0	22,200	50	3,600	1,300		27,000	24,000
Pahvant Valley	23	4	1	103,100	0	1,000	320		104,000	94,000
Cedar Valley, Iron County	32	5	1	28,600	100	6,900	2,300		38,000	40,000
Parowan Valley	31	5	2	[9] 36,100	100	530	340		37,000	38,000
Escalante Valley										
Milford area	26	3	0	45,600	[10] 10,000	750	140		56,000	51,000
Beryl-Enterprise area	33	6	0	89,200	[11] 2,900	610	650		93,000	93,000
Central Virgin River area	34	3	0	7,100	690	23,000	2,400		33,000	29,000
Other areas[12,13]		201	5	62,200	21,300	39,100	7,400		130,000	144,000
Total (rounded)		295	11	550,000	95,000	262,000	63,000		969,000	[6] 1,002,000

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

[2] From Burden and others (2009, table 2).

[3] Includes some use for air conditioning, about 2,800 acre-feet. About 94 percent was injected back into the aquifer.

[4] Includes some domestic and stock use.

[5] Includes some flowing well discharge.

[6] Revised.

[7] Numbers for Northern Utah Valley, Southern Utah Valley, and Goshen Valley, presented within parentheses, are a subtotal of withdrawal.

[8] Previously included some springs.

[9] Includes some stock use.

[10] Includes 7,560 acre-feet for geothermal power generation. About 99 percent was injected back into the aquifer.

[11] Includes 2,390 acre-feet for heating greenhouses. About 95 percent was injected back into the aquifer.

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

[13] 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 groundwater development in Utah, 1999–2008.

Area	Number in figure 1	Thousands of acre-feet[1] (rounded)											
		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	1999–2008 average	2009
Curlew Valley	3	29	41	36	[2]38	42	38	29	31	38	44	37	34
Cache Valley	5	24	30	32	33	27	27	29	31	36	34	30	31
East Shore area	9	61	60	57	49	49	46	41	46	52	54	52	46
Salt Lake Valley	10	126	145	151	[2]140	130	125	110	131	151	135	134	137
Tooele Valley	12	21	24	21	21	22	21	[2]18	[2]21	[2]27	[2]28	22	25
Utah and Goshen Valleys	16	[2]103	[2]120	[2]111	[2]111	[2]108	[2]105	[2]87	100	126	124	110	109
Northern Utah Valley[3]	16a	([2]68)	([2]73)	([2]67)	([2]64)	([2]68)	([2]66)	([2]46)	(58)	(72)	(71)	(65)	(63)
Southern Utah Valley[3]	16b	(21)	(33)	(32)	(36)	(33)	(30)	(31)	(29)	(38)	(34)	(32)	(30)
Goshen Valley[3]	16c	(13)	(15)	(12)	(11)	(7)	(9)	(10)	(12)	(16)	(19)	(12)	(15)
Juab Valley	21	14	27	29	29	27	26	14	21	26	26	24	21
Sevier Desert	24	12	15	19	36	28	41	24	20	34	44	27	48
Central Sevier Valley	22	20	13	12	11	15	15	17	16	19	24	16	27
Pahvant Valley	23	76	80	80	89	86	85	80	86	89	94	84	104
Cedar Valley, Iron County	32	32	[2]35	32	42	39	40	30	35	40	40	36	38
Parowan Valley	31	[2]26	30	[2]33	39	31	37	27	33	34	38	33	37
Escalante Valley													
Milford area	26	41	49	42	52	50	44	40	45	49	51	46	56
Beryl-Enterprise area	33	79	84	81	99	92	98	68	79	92	93	86	93
Central Virgin River area	34	[2]18	[2]26	27	27	28	26	29	32	33	29	28	33
Other areas		106	[2]135	114	131	128	129	111	130	155	144	128	130
Total (rounded)		[2]788	[2]914	[2]877	[2]947	[2]902	[2]903	[2]754	[2]857	[2]1,001	[2]1,002	893	969

[1] From previous reports in this series.

[2] Revised.

[3] Numbers for Northern Utah Valley, Southern Utah Valley, and Goshen Valley, presented within parentheses, are a subtotal of withdrawal.

Major Areas of Groundwater Development

Curlew Valley

By David V. Allen

The Curlew Valley drainage basin extends across the Utah-Idaho State line and includes the communities of Cedar Creek and Snowville (fig. 2). The valley is bounded on the west and east by the Raft River and Hansel Mountains, which range in altitude from about 6,500 to nearly 10,000 feet. The valley is open to the south, where water draining from it enters Great Salt Lake.

The Utah part of Curlew Valley (Utah subbasin) covers about 550 square miles in Box Elder County. 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 is substantially more in the mountains.

The principal source of water in Curlew Valley is groundwater. The groundwater reservoir is primarily composed of confined aquifers in alluvial and lacustrine basin-fill 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 2009 was about 34,000 acre-feet, which is 10,000 acre-feet less than the value for 2008 and 3,000 acre-feet less than the average annual withdrawal for 1999–2008 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2010 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.

Precipitation at Grouse Creek in 2009 was about 12.0 inches, which is about 5.0 inches more than in 2008 and about 0.9 inch more than the average annual precipitation for 1959–2009.

Water levels in Curlew Valley generally declined from March 2009 to March 2010. The largest decline, about 1.4 feet, was observed in a well about 16 miles west of Snowville.

Water levels generally declined from March 1980 to March 2010 in most of Curlew Valley for which data are available (fig. 4). The largest decline, nearly 10 feet, was observed in a well about 3 miles west of Snowville. Declines are probably the result of continued large withdrawals for irrigation. Rises of about 2 feet or less were observed in a well east of Snowville and a well between the Raft River Mountains and the Wildcat Hills. Rises are probably due to decreased local withdrawals.

Physical properties and records of chemical analyses for water from two wells in Curlew Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. The concentration of dissolved solids and dissolved chloride in the water sample from well (B-12-11)8abb-1 exceeded the secondary drinking-water standards for these constituents (500 and 250 mg/L, respectively). The water sample from this well also exceeded the MCL for total dissolved solids (2,000 mg/L).

The concentration of dissolved solids in water samples collected from well (B-12-11)8abb-1, 3 miles north of Kelton, and well (B-14-9)5bbb-1, 10 miles west of Snowville, from 1972–2009 and 1971–2008, respectively, is shown in figure 3. The dissolved-solids concentration in water samples from both wells has generally increased since the early 1970s. Well (B-14-9)5bbb-1 was not sampled in 2009.

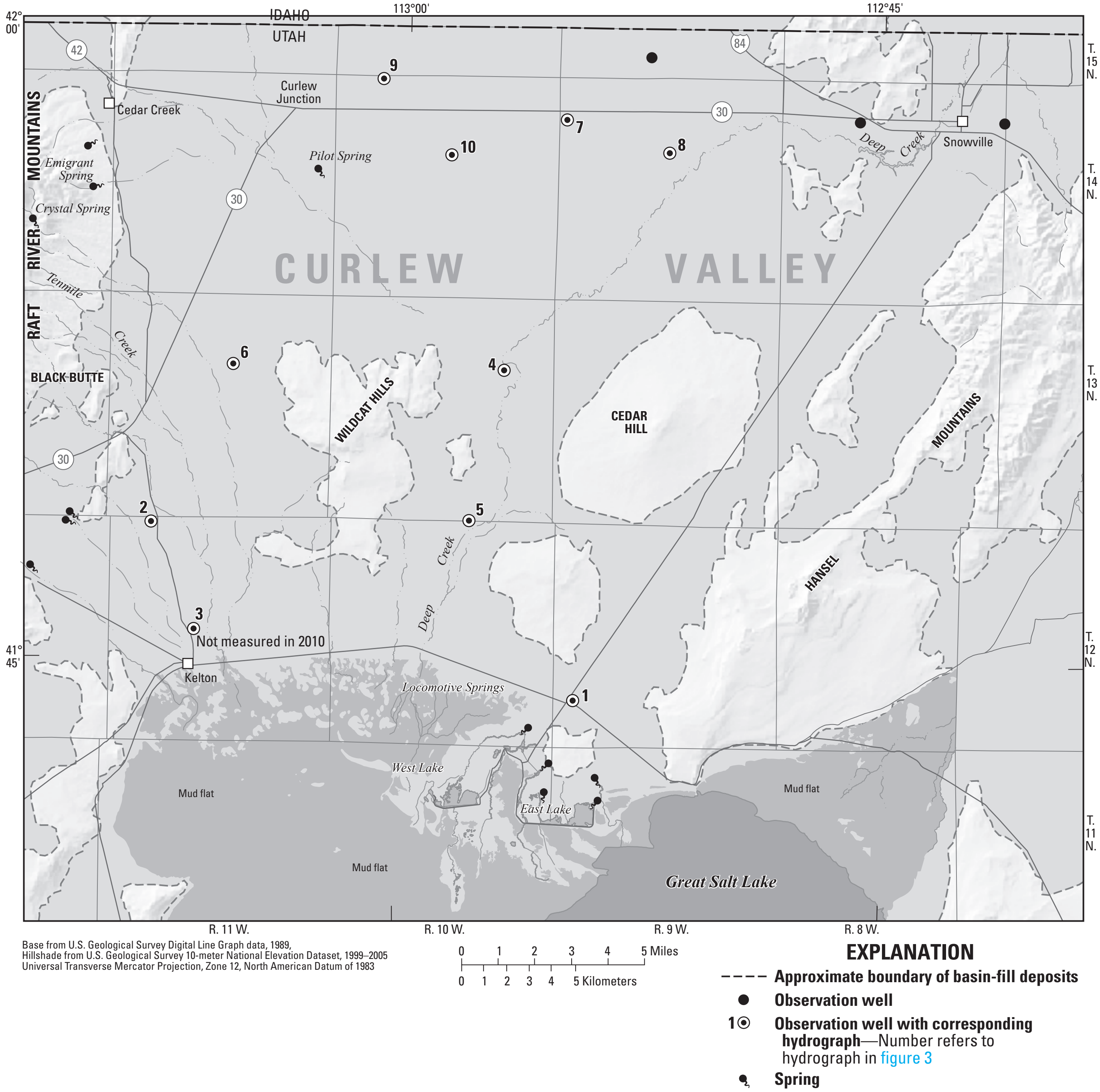


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2010.

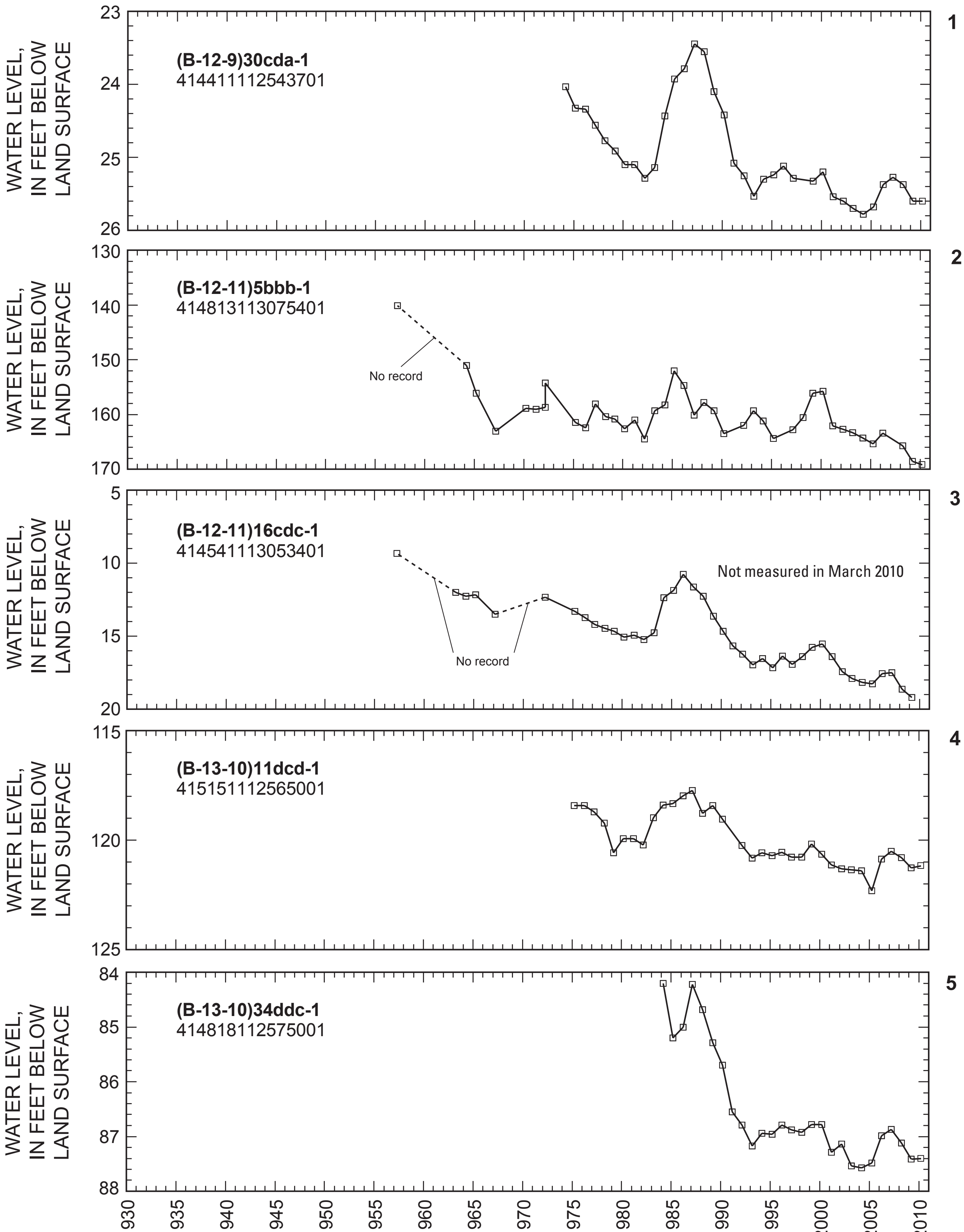
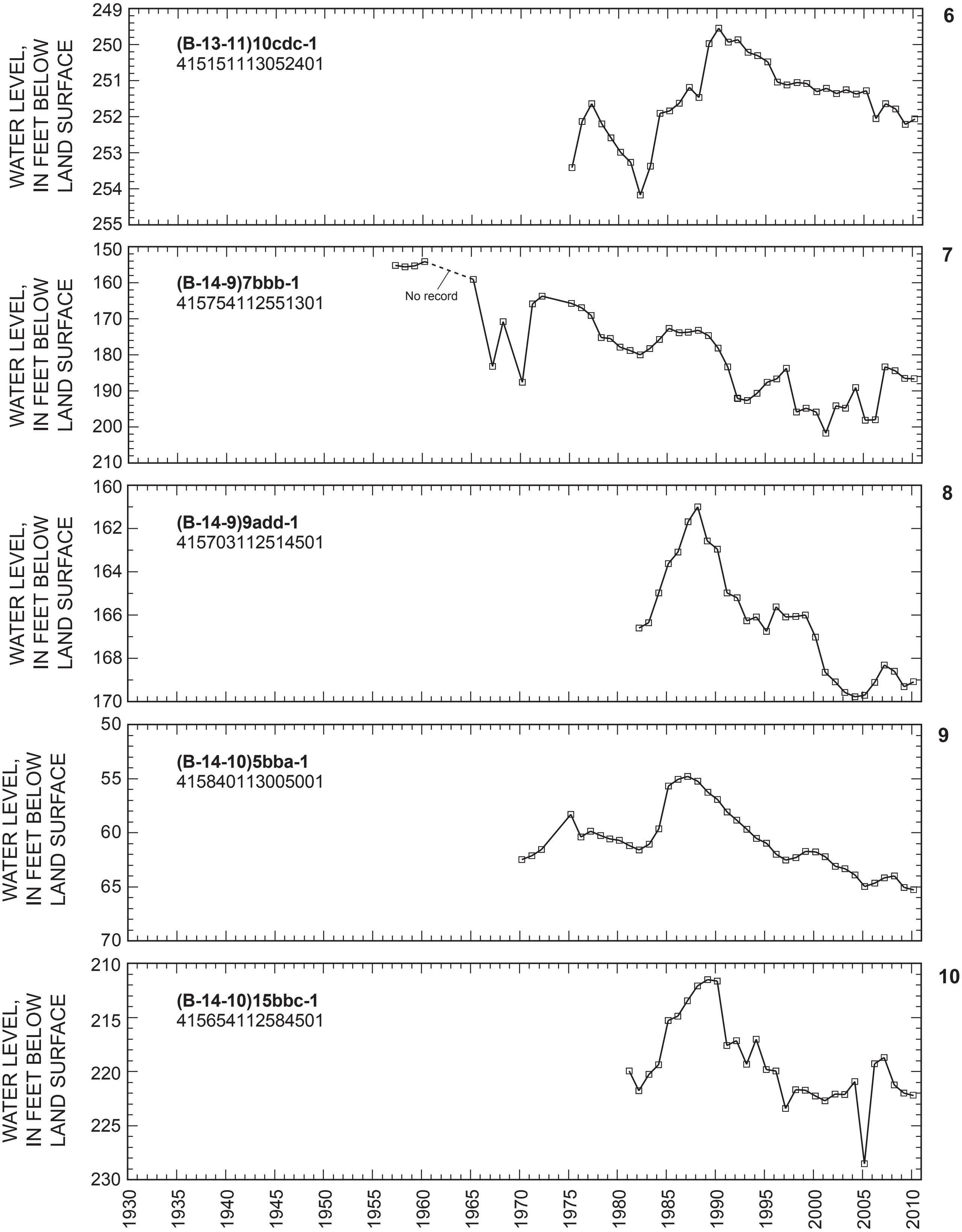


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.



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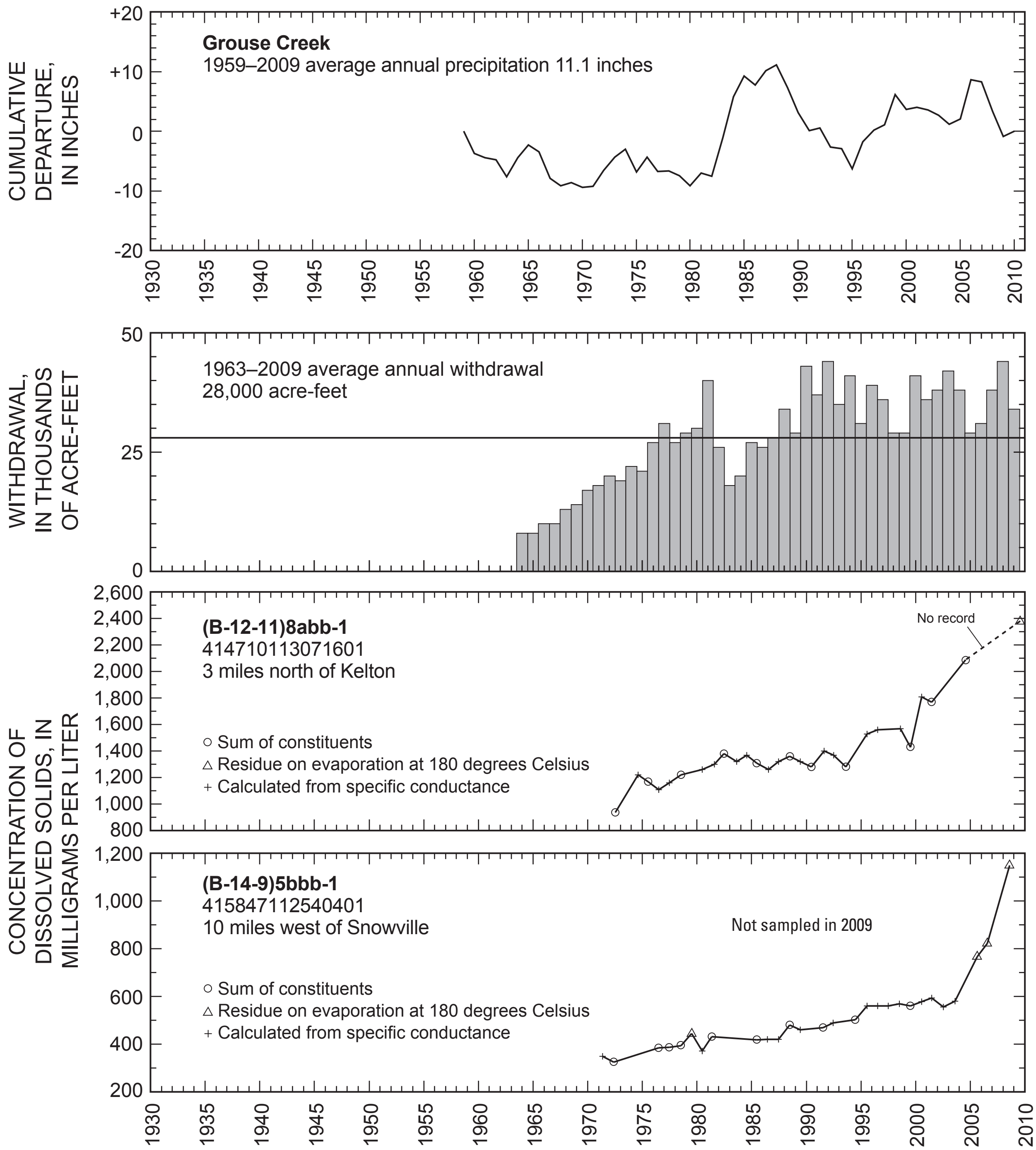

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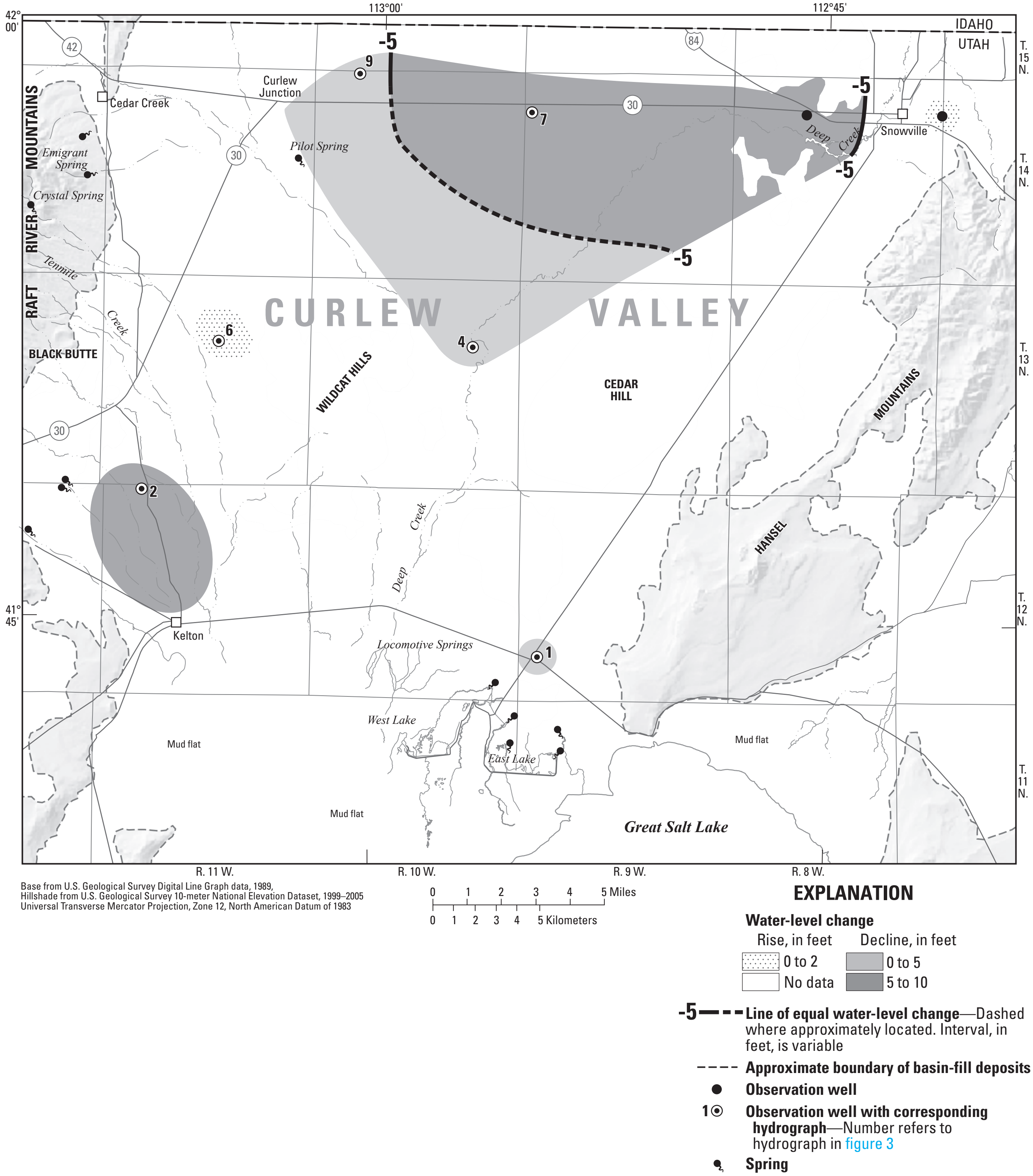


Figure 4. Water-level change in Curlew Valley from March 1980 to March 2010.

Cache Valley

By Jay R. Cederberg

Cache Valley covers about 450 square miles in Cache County where it is bounded on the east by the Bear River Range and on the southwest by the Wellsville Mountains (fig. 5). Groundwater occurs in unconsolidated basin-fill deposits in the valley, under both water-table and artesian conditions. Recharge to the groundwater system occurs principally along the margins of the valley, and groundwater moves toward the center of the valley and west toward Cache Junction.

Total estimated withdrawal of water from wells in Cache Valley in 2009 was about 31,000 acre-feet, which is 3,000 acre-feet less than in 2008 and 1,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3). Withdrawal for irrigation was 13,700 acre-feet (largely from flowing wells), which is about the same as in 2008. Withdrawal for public supply was 9,100 acre-feet, 3,800 acre-feet less than in 2008.

The location of wells in Cache Valley in which the water level was measured during March 2010 is shown in figure 5. 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 6.

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 2009 was about 190,700 acre-feet, which is 40,900 acre-feet more than the 2008 total of 149,800 acre-feet and 11,000 acre-feet more than the 1941–2009 average annual discharge. Precipitation at Logan, Utah State University, was about 21.4 inches in 2009. This is about 4.4 inches more than for 2008 and about 3.1 inches more than the average annual precipitation for 1930–2009.

Water levels throughout the valley generally rose from March 2009 to March 2010. This is consistent with increased precipitation in 2009 compared to 2008. Water levels fluctuated between 1935 and 1983; since 1985, water levels have fluctuated depending on the amount and timing of precipitation and recharge to the unconsolidated deposits from snowmelt runoff.

Water levels generally declined from March 1980 to March 2010 throughout Cache Valley where data are available, with the exception of a small increase near the Mendon area (fig. 7). The greatest decline, about 5.4 feet, was observed in a well south of Smithfield.

Physical properties and records of chemical analyses for water from five wells in Cache Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. The concentration of dissolved manganese in water samples from wells (A-13-1)29bcd-1, (B-11-1)9cdb-1, and (B-11-1)35cca-1 exceeded the secondary standard for this constituent (50 µg/L). Total dissolved solids in the water sample from well (B-11-1)9cdb-1 exceeded the secondary standard for this constituent (500 mg/L). The concentrations of arsenic and iron in water samples from wells (B-11-1)9cdb-1 and (B-11-1)35cca-1 exceeded the MCL for arsenic (10 µg/L) and the secondary standard for iron (300 µg/L).

The concentration of dissolved solids in water samples collected from well (A-13-1)29bcd-1, located 1.5 miles west of Smithfield, from 1970 to 2009, is shown in figure 6. The concentration has ranged from 223 to 278 mg/L, with a median value of 258 mg/L. The water sample collected in August 2009 had a dissolved-solids concentration of 263 mg/L, similar to the median value. There is little variability in the data and no apparent trends. This is consistent with the relatively small range (55 mg/L) and standard deviation (11.0 mg/L) associated with the data.

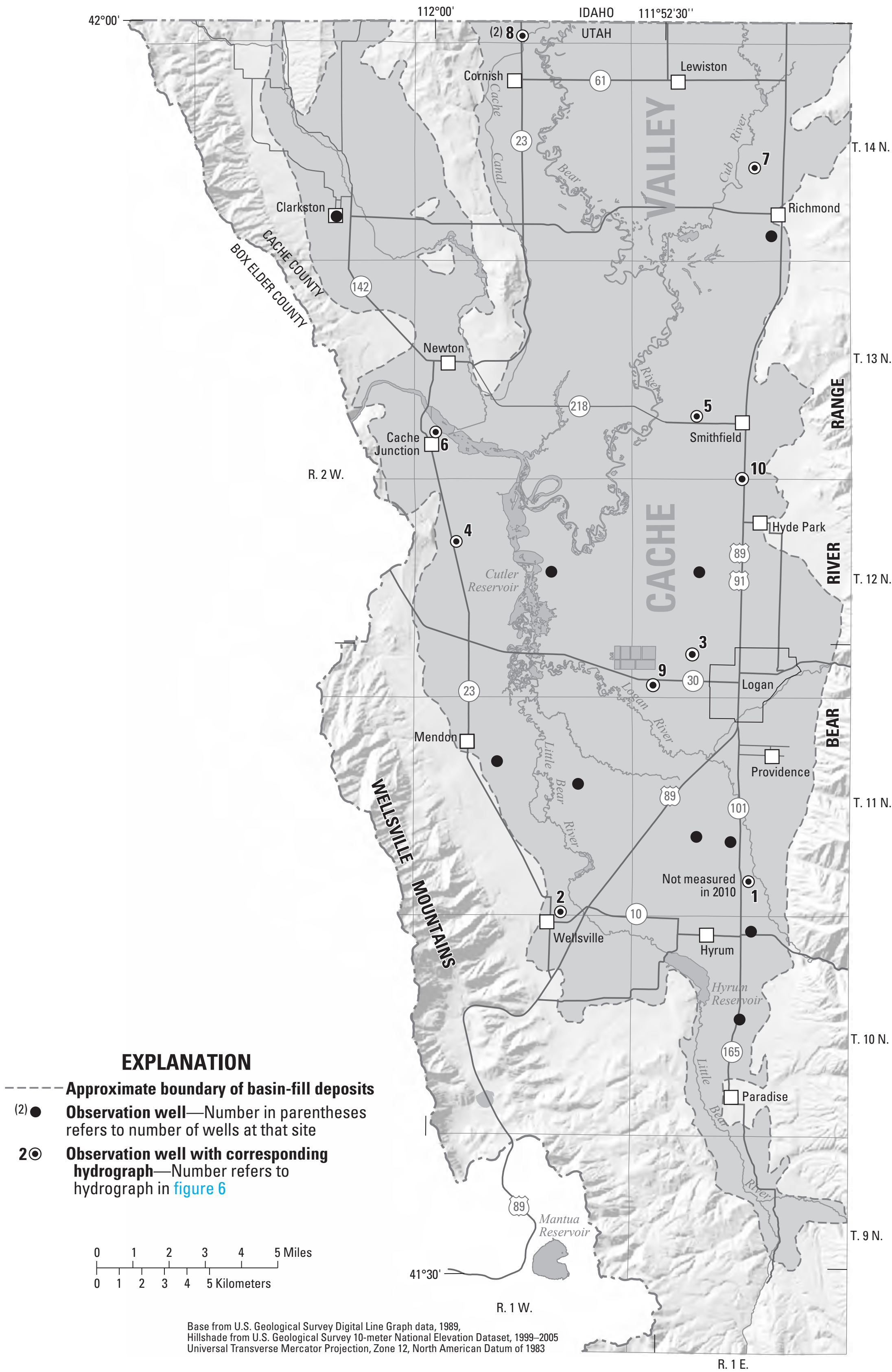


Figure 5. Location of wells in Cache Valley in which the water level was measured during March 2010.

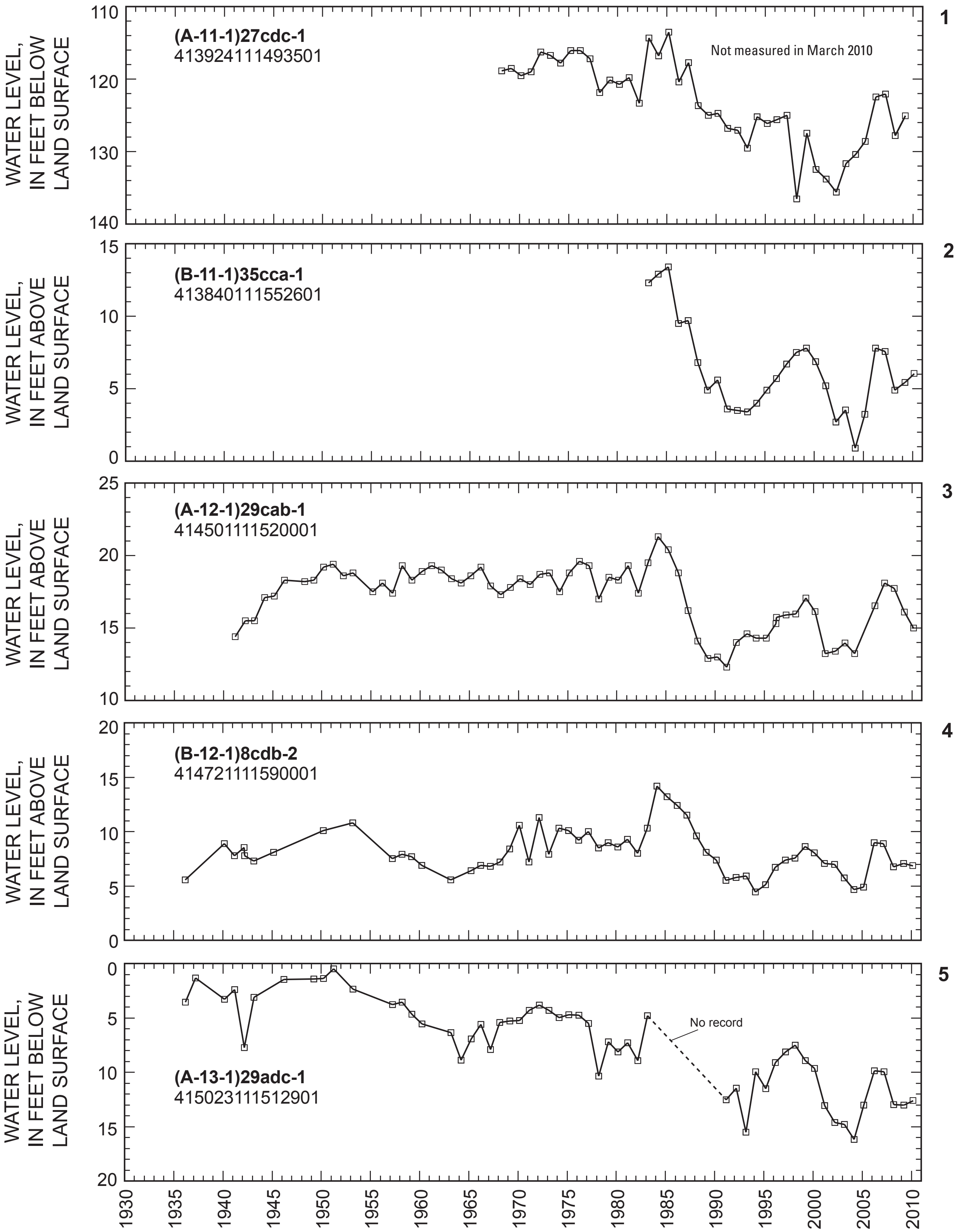


Figure 6. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.

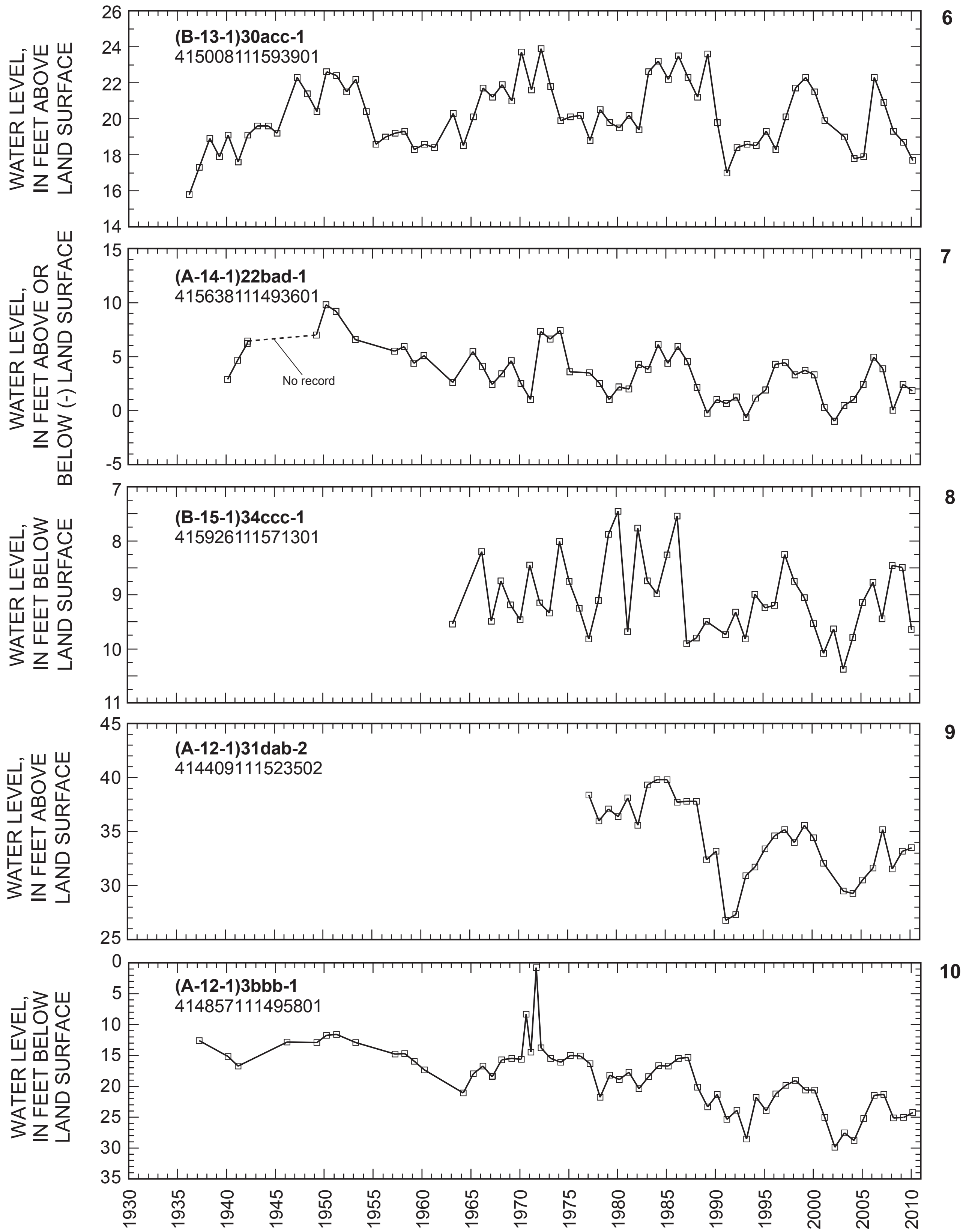


Figure 6. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.—Continued

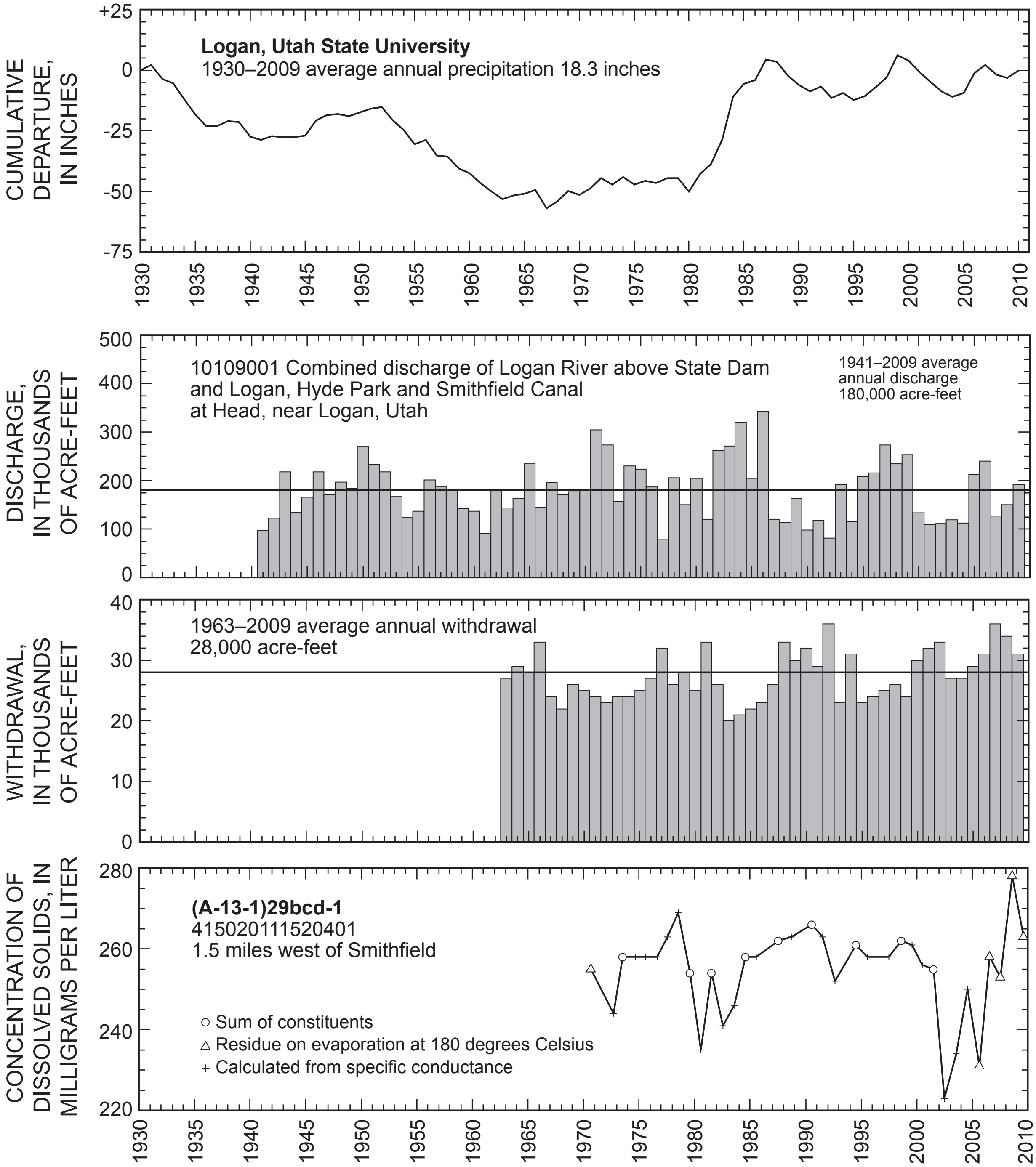


Figure 6. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.—Continued

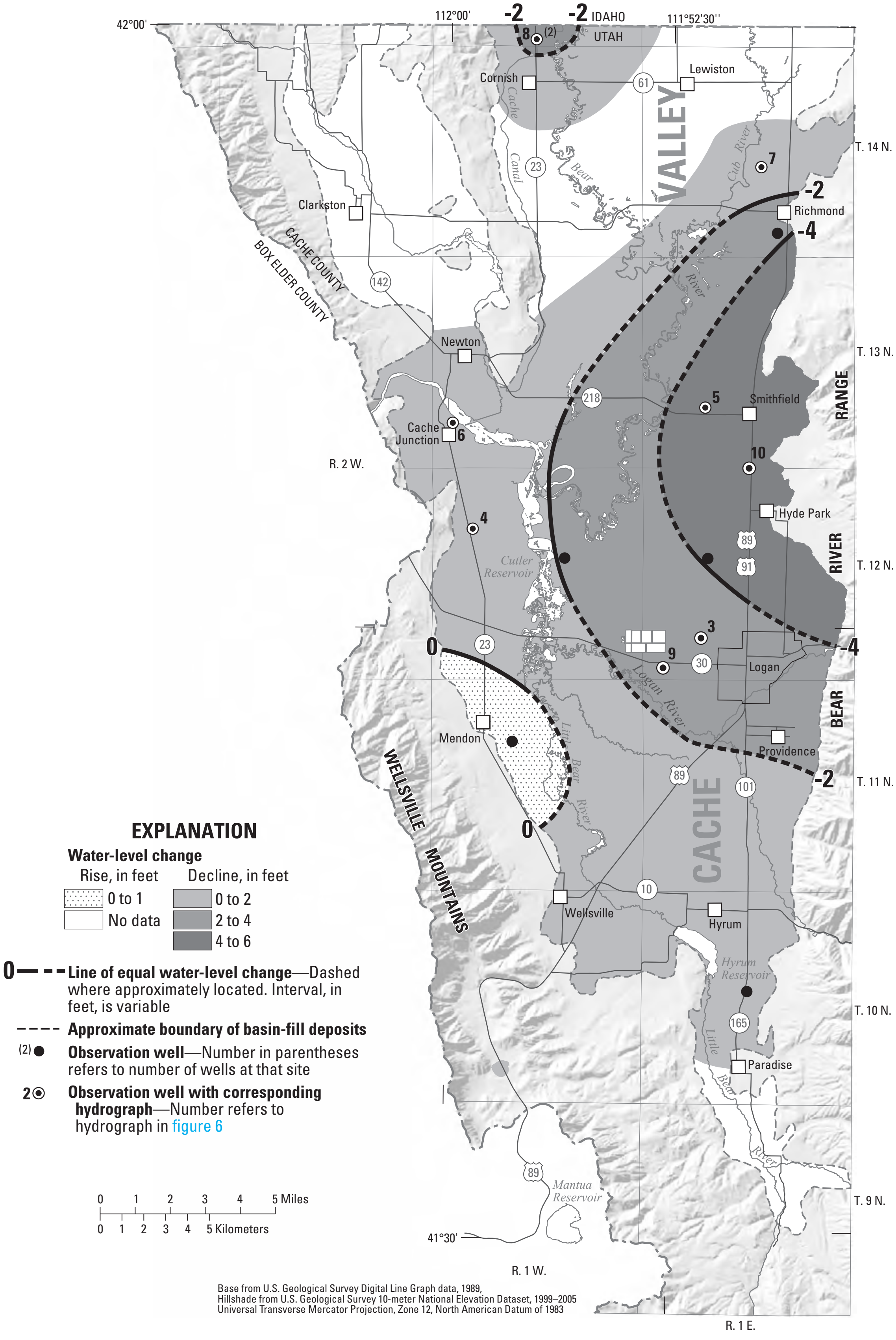


Figure 7. Water-level change in Cache Valley from March 1980 to March 2010.

East Shore Area

By Martel J. Fisher

The East Shore area is in north-central Utah between the Wasatch Range and Great Salt Lake within Davis, Weber, and Box Elder Counties (fig. 8). Groundwater occurs in unconsolidated basin-fill 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 contact between the Wasatch Range and 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 2009 was about 46,000 acre-feet, which is 8,000 acre-feet less than was reported for 2008 and 6,000 acre-feet less than the average annual withdrawal for 1999–2008 (tables 2 and 3). Withdrawal for public supply was about 7,700 acre-feet less than in 2008. Withdrawal for irrigation was about 7,200 acre-feet, which is the same as in 2008. Withdrawal for industrial use was about 3,900 acre-feet, which is about 100 acre-feet less than in 2008.

The location of wells in the East Shore area in which the water level was measured during March 2010 is shown in figure 8. 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 9.

Precipitation at Ogden Pioneer Powerhouse in 2009 was about 18.3 inches, which is about 2.9 inches less than the average annual precipitation for 1930–2009 and about 3.5 inches more than in 2008.

Water levels declined from March 2009 to March 2010 in most of the wells measured in the East Shore area. Declines probably resulted from less recharge due to less-than-average precipitation and continued large withdrawals for public supply (table 2). Water levels have generally declined in most of the East Shore area from the mid-1950s to 2010.

Water levels generally declined from March 1980 to March 2010 in most of the East Shore area (fig. 10). The largest decline, about 34.3 feet, occurred in a well west of Clearfield. Rises of up to 3 feet occurred in small localized areas around Willard and along the Wasatch Front.

Physical properties and records of chemical analyses for water from five wells in the East Shore area are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. Water samples from wells (B-4-2)27aba-1, (B-5-2)6bdd-4 and (B-6-3)15cbc-1 exceeded the secondary standard for manganese (50 µg/L) and the MCL for arsenic (10 µg/L). The concentrations of dissolved chloride, manganese, and total dissolved solids in the water sample from well (B-7-2)32bbb-1 exceeded the secondary standards for these constituents (250 mg/L, 50 µg/L, and 500 mg/L, respectively). Water from well (B-4-2)27aba-1 also exceeded the secondary standard for iron (300 µg/L).

The concentration of dissolved solids in water samples collected from well (B-4-2)27aba-1, 2.3 miles south-southeast of Syracuse, from 1969 to 2008, is shown in figure 9. The concentration has ranged from 287 to 633 mg/L with a median value of 400 mg/L. From 1969 to 1993, dissolved-solids concentrations in water samples varied by as much as 346 mg/L; however, concentrations in water samples collected from 1995 to 2008 varied by less than 30 mg/L. The dissolved-solids concentration in the water sample collected in August 2008 (373 mg/L) compares well to the median value. The well was not sampled in 2009.

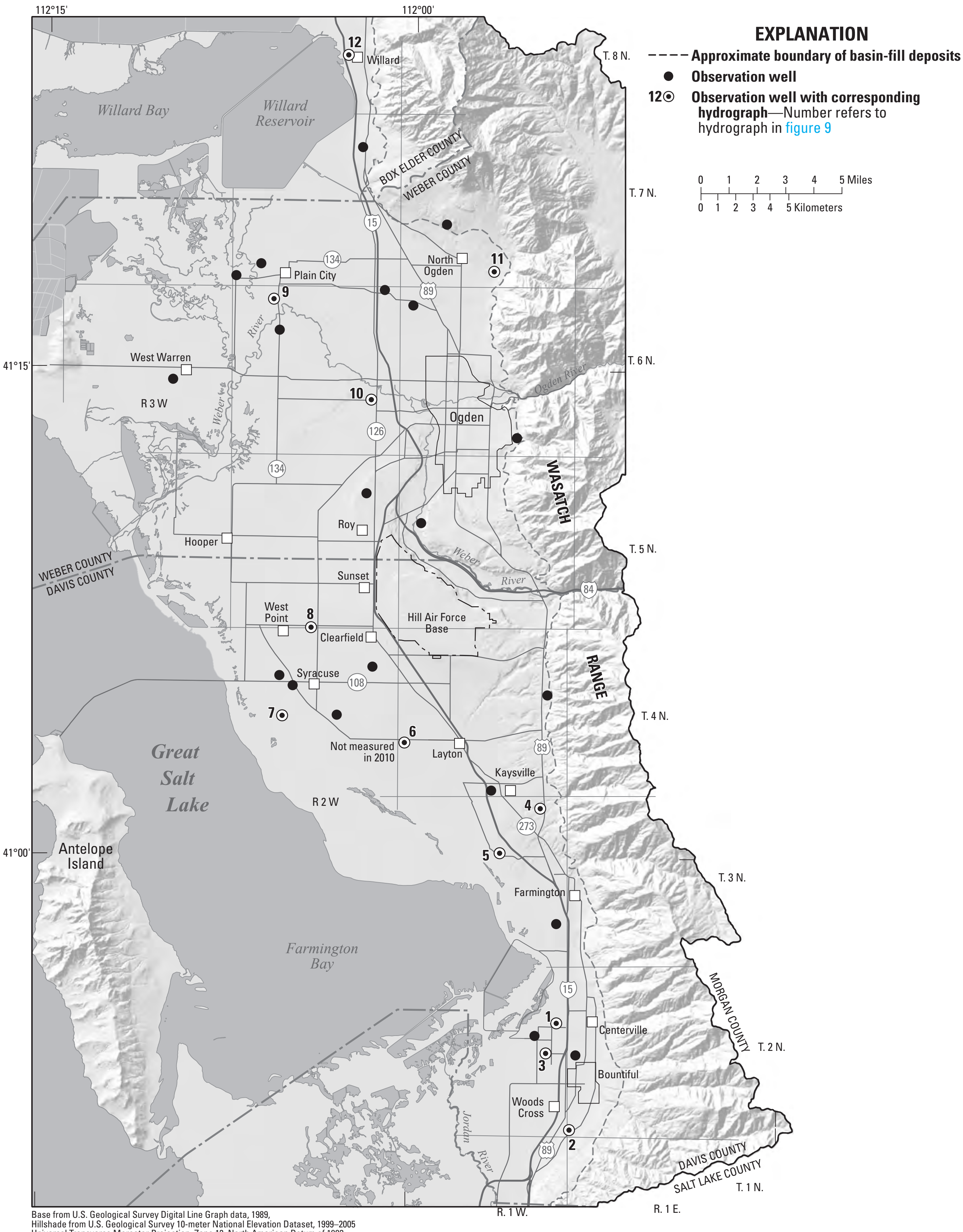


Figure 8. Location of wells in the East Shore area in which the water level was measured during March 2010.

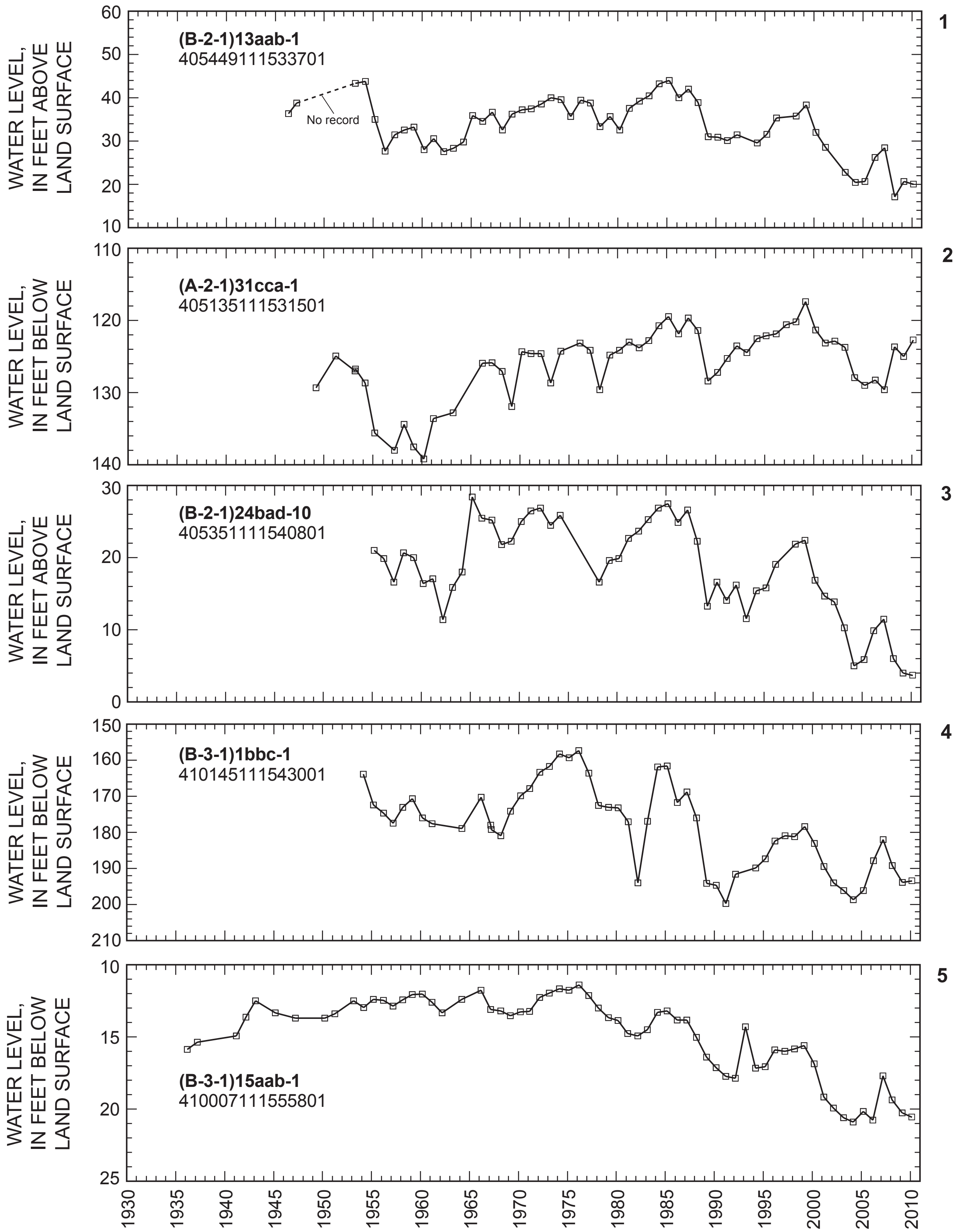


Figure 9. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

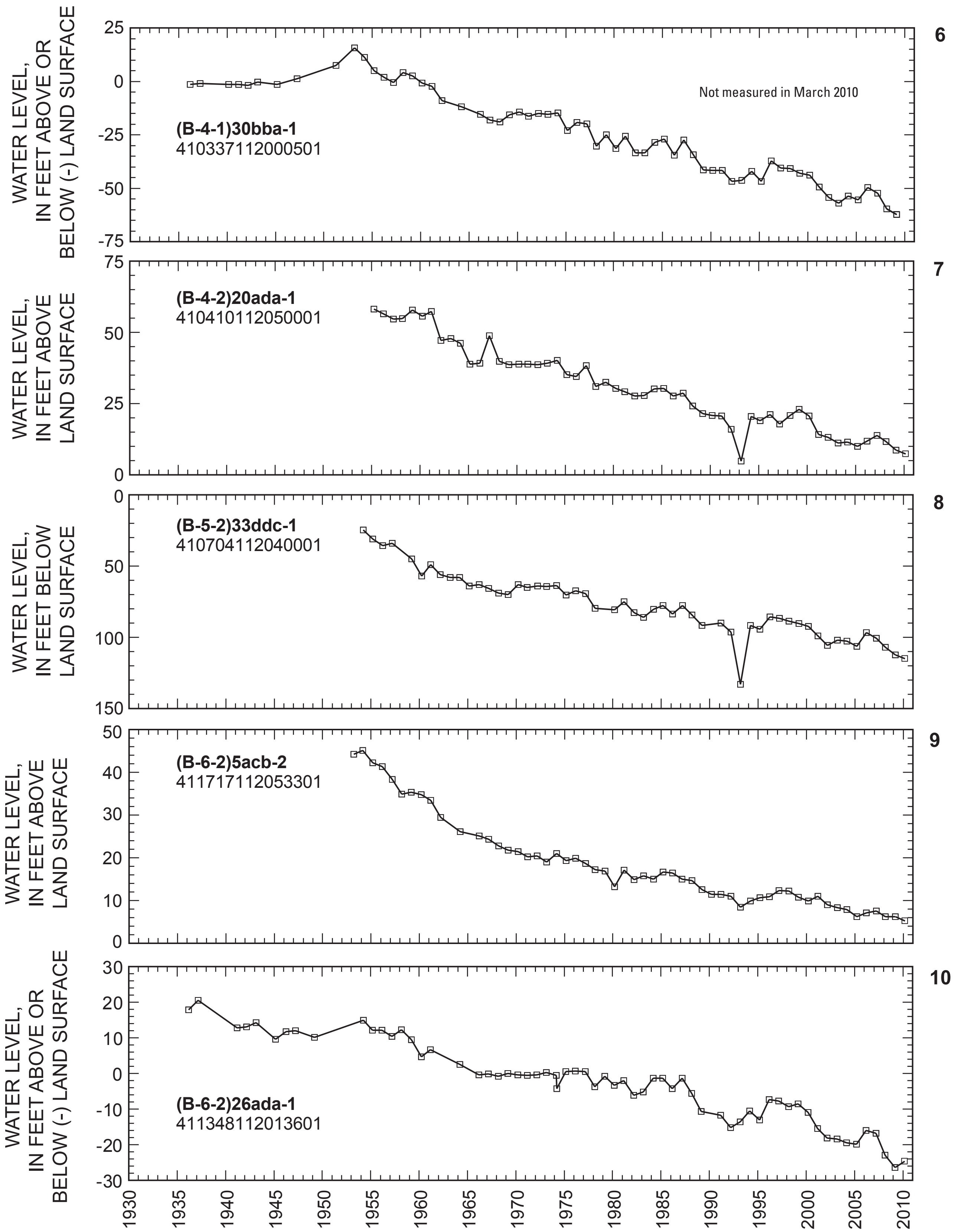


Figure 9. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

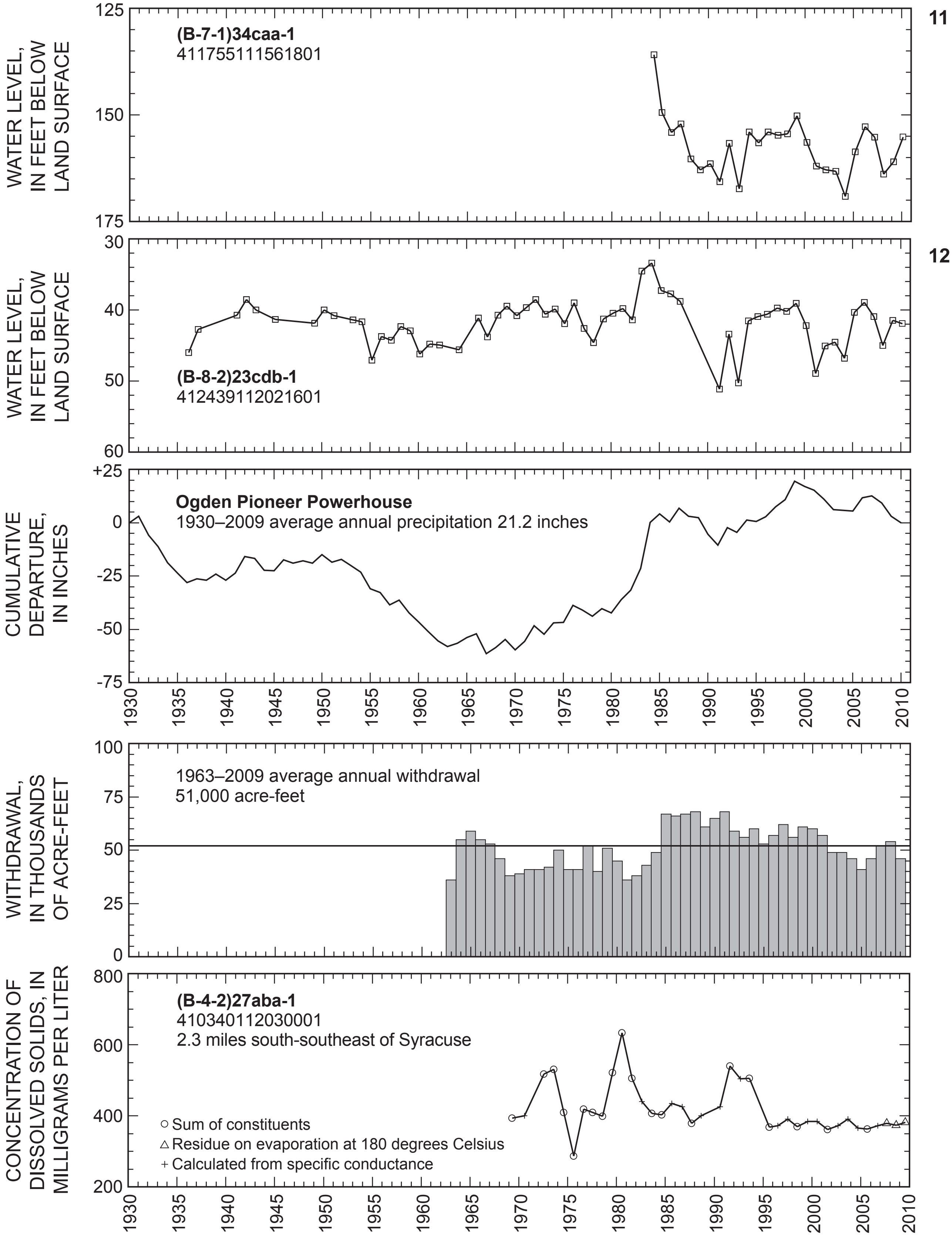
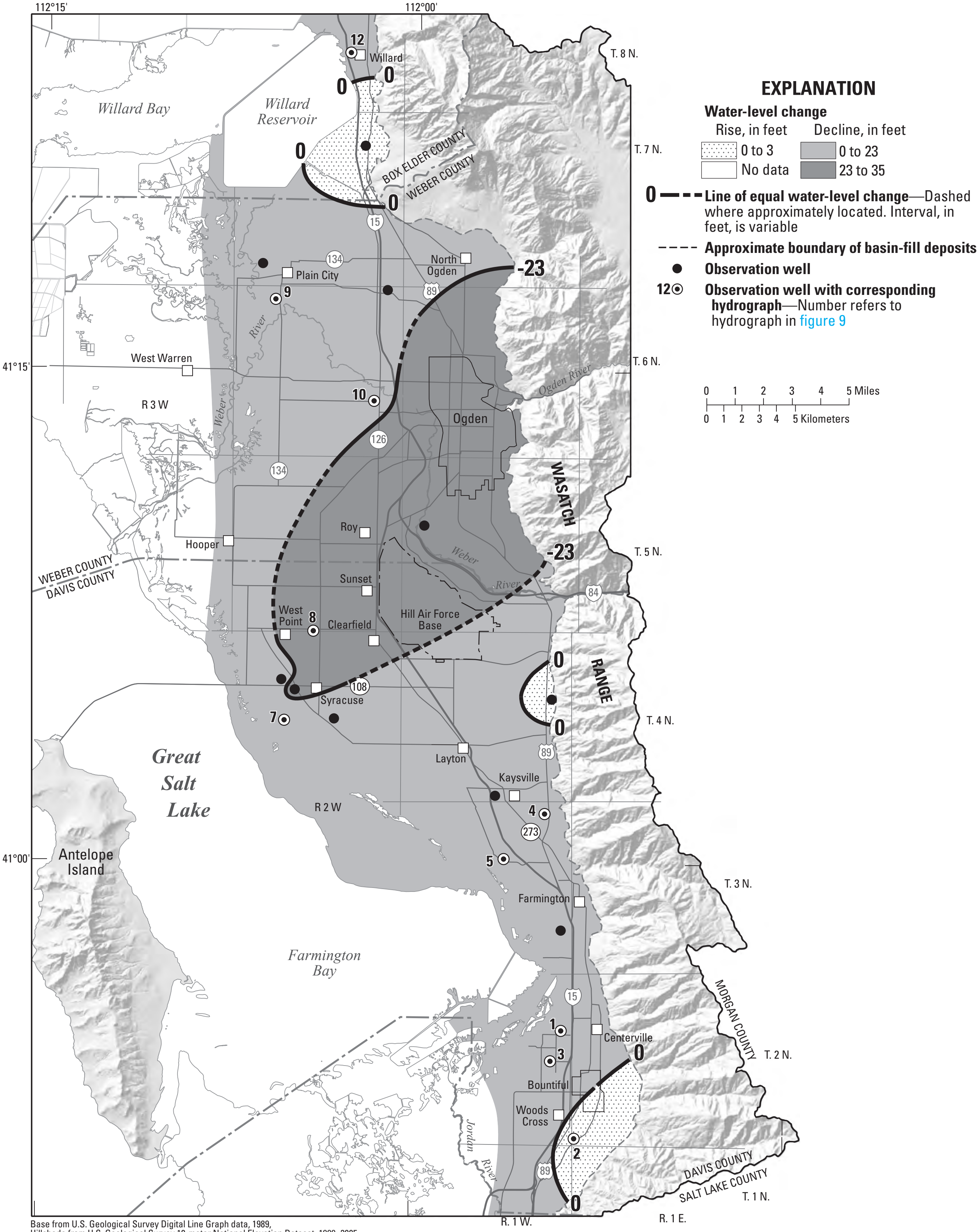


Figure 9. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued



Base from U.S. Geological Survey Digital Line Graph data, 1989,
Hillshade from U.S. Geological Survey 10-meter National Elevation Dataset, 1999–2005
Universal Transverse Mercator Projection, Zone 12, North American Datum of 1983

Figure 10. Water-level change in the East Shore area from March 1980 to March 2010.

Salt Lake Valley

By Michael L. Freeman

Salt Lake Valley covers about 400 square miles between the Wasatch Range and the Oquirrh and Traverse Mountains in Salt Lake County (fig. 11). Groundwater 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, groundwater 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, groundwater moves westward from the base of the Wasatch Range toward the Jordan River. The Jordan River drains both surface water and groundwater from the valley.

Total estimated withdrawal of water from wells in Salt Lake Valley in 2009 was about 137,000 acre-feet, which is 2,000 acre-feet more than in 2008 and 3,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3). Withdrawal for public supply was about 79,500 acre-feet, which is 500 acre-feet less than the total for 2008. Withdrawal for industrial use was about 35,200 acre-feet, which is 3,300 acre-feet more than the total for 2008.

The location of wells in Salt Lake Valley in which the water level was measured during February 2010 is shown in figure 11. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at the Salt Lake City Weather Service Office (WSO) (International Airport) are shown in figure 12. Precipitation at the Salt Lake City WSO during 2009 was about 15.8 inches, about 4.1 inches more than in 2008 and about 0.6 inch more than the average annual precipitation for 1931–2009.

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 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 13. Precipitation at Silver Lake Brighton was about 42.6 inches in 2009, which is about 1.8 inches more than in 2008 and about 0.3 inch more than the average annual precipitation for 1931–2009.

Water levels rose slightly from February 2009 to February 2010 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 part of the valley from 1994 to 1999.

Water levels in the principal aquifer mostly declined from February 1980 to February 2010 (fig. 14). The areas of greatest decline were near Holladay trending south-southwest through Draper and the southern part of the valley between Riverton and Herriman. The largest decline, about 36.8 feet, was observed in a well south of Holladay. The decline in water levels is probably due to continued large withdrawals for public supply and industrial use. Some rises in water levels were observed in the central and northeastern parts of the valley. The largest rise, about 18.7 feet, was observed in a well near the University of Utah.

Physical properties and records of chemical analyses for water from five wells in Salt Lake Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. The dissolved-solids concentration in water samples from all wells except (D-2-1)21dbc-1 exceeded the secondary standard for this constituent (500 mg/L). Water from well (B-1-2)29ccc-1 also exceeded the secondary standards for chloride (250 mg/L), manganese (50 µg/L), and iron (300 µg/L), and the MCLs for total dissolved solids (2,000 mg/L) and arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from well (D-1-1)7abd-6, a flowing well at 800 South 500 East in Salt Lake City, from 1931 to 2009, is shown in figure 13. The concentration has ranged from 554 to 879 mg/L with a median value of 683 mg/L. The concentration of dissolved solids increased from 576 mg/L in December 1931 to 879 mg/L in July 2009. The maximum dissolved-solids concentration was measured in the July 2009 water sample.

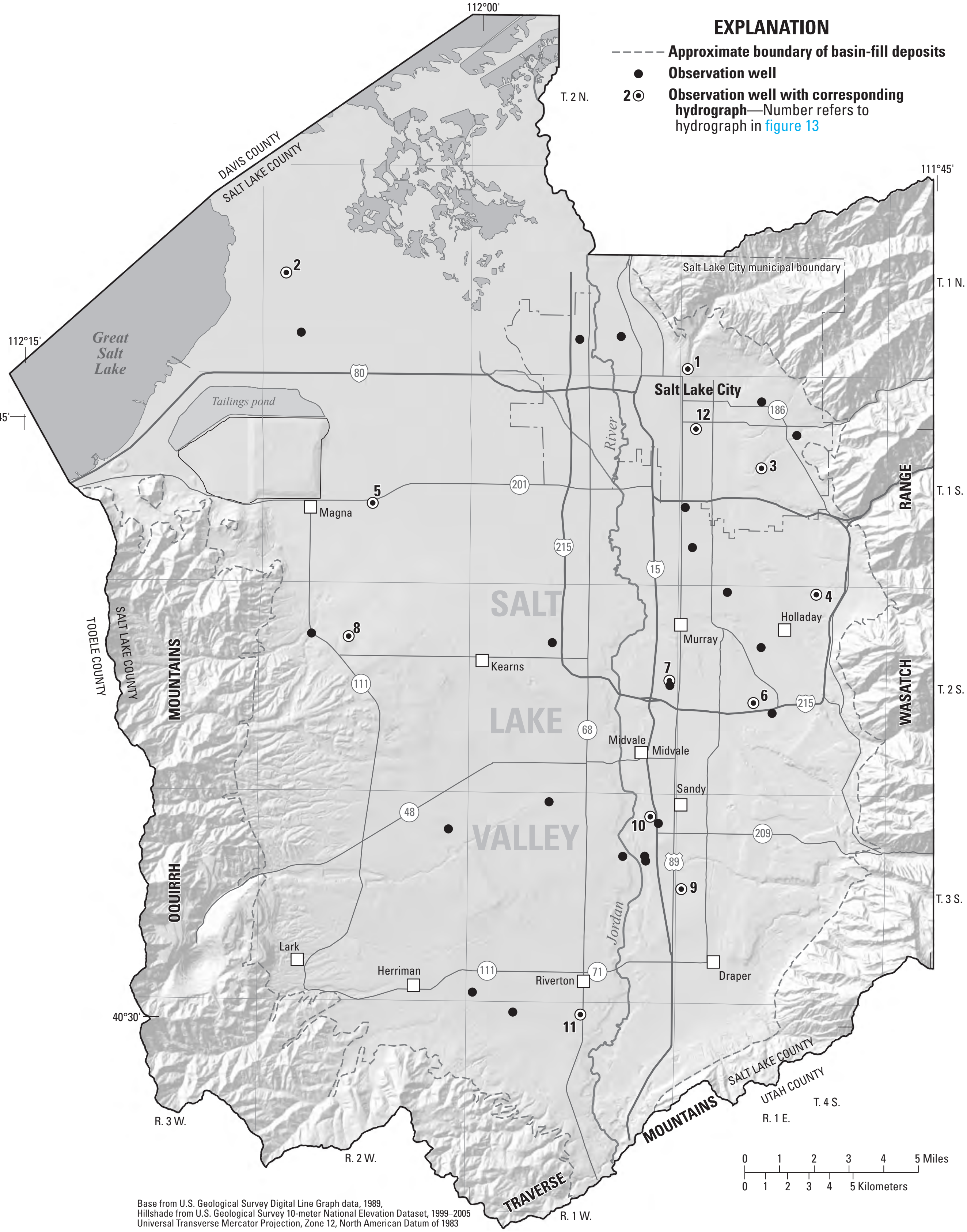


Figure 11. Location of wells in Salt Lake Valley in which the water level was measured during February 2010.

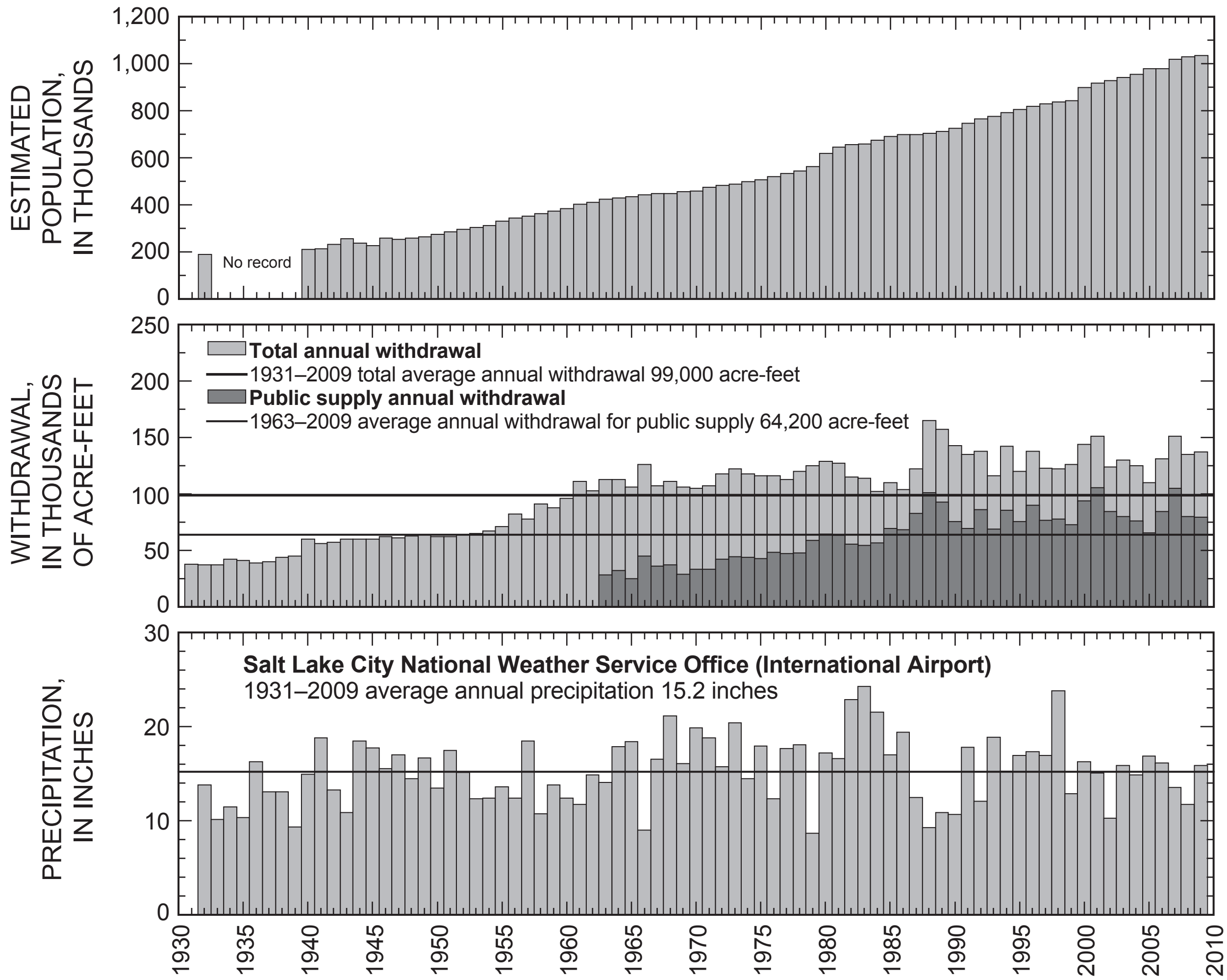


Figure 12. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

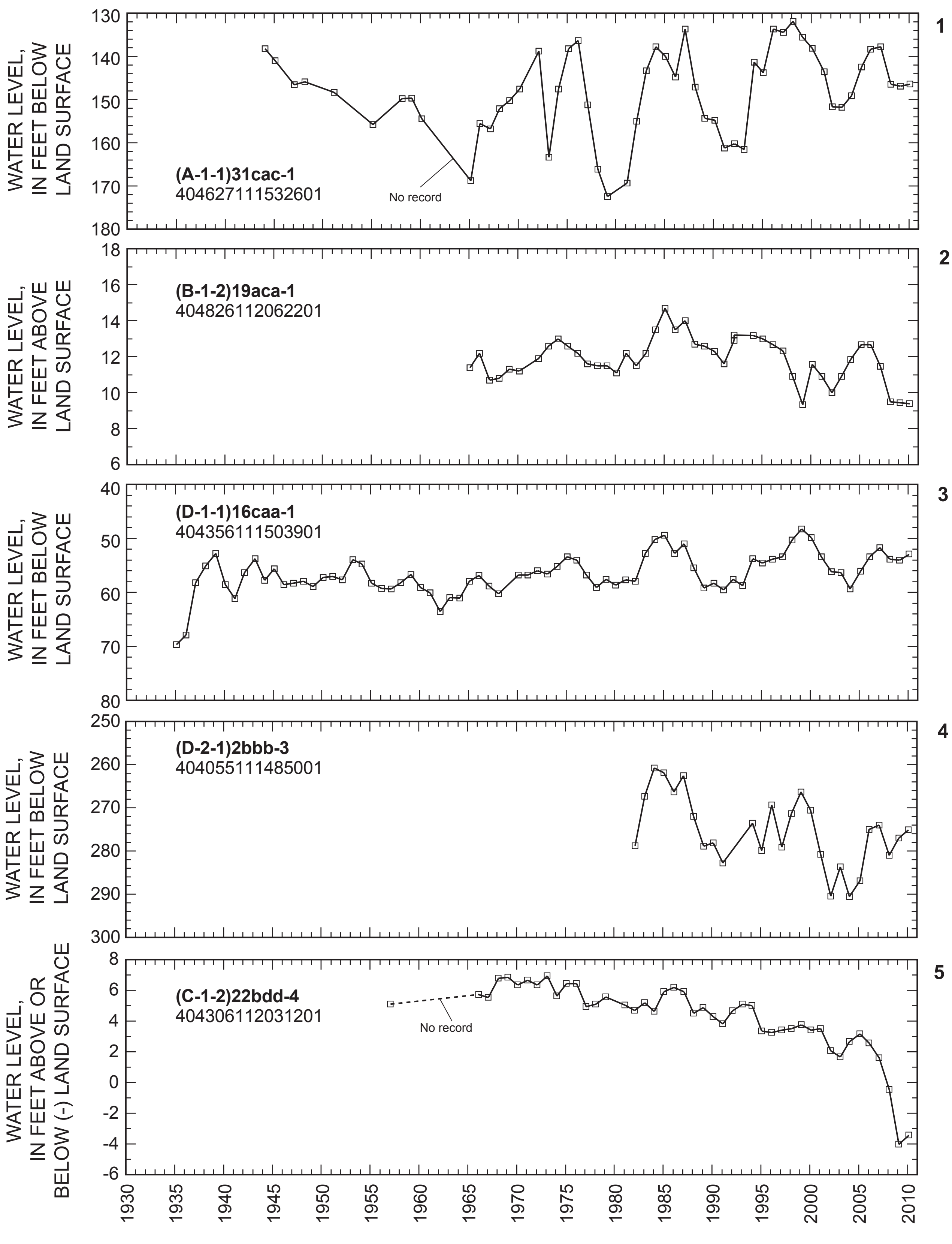


Figure 13. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.

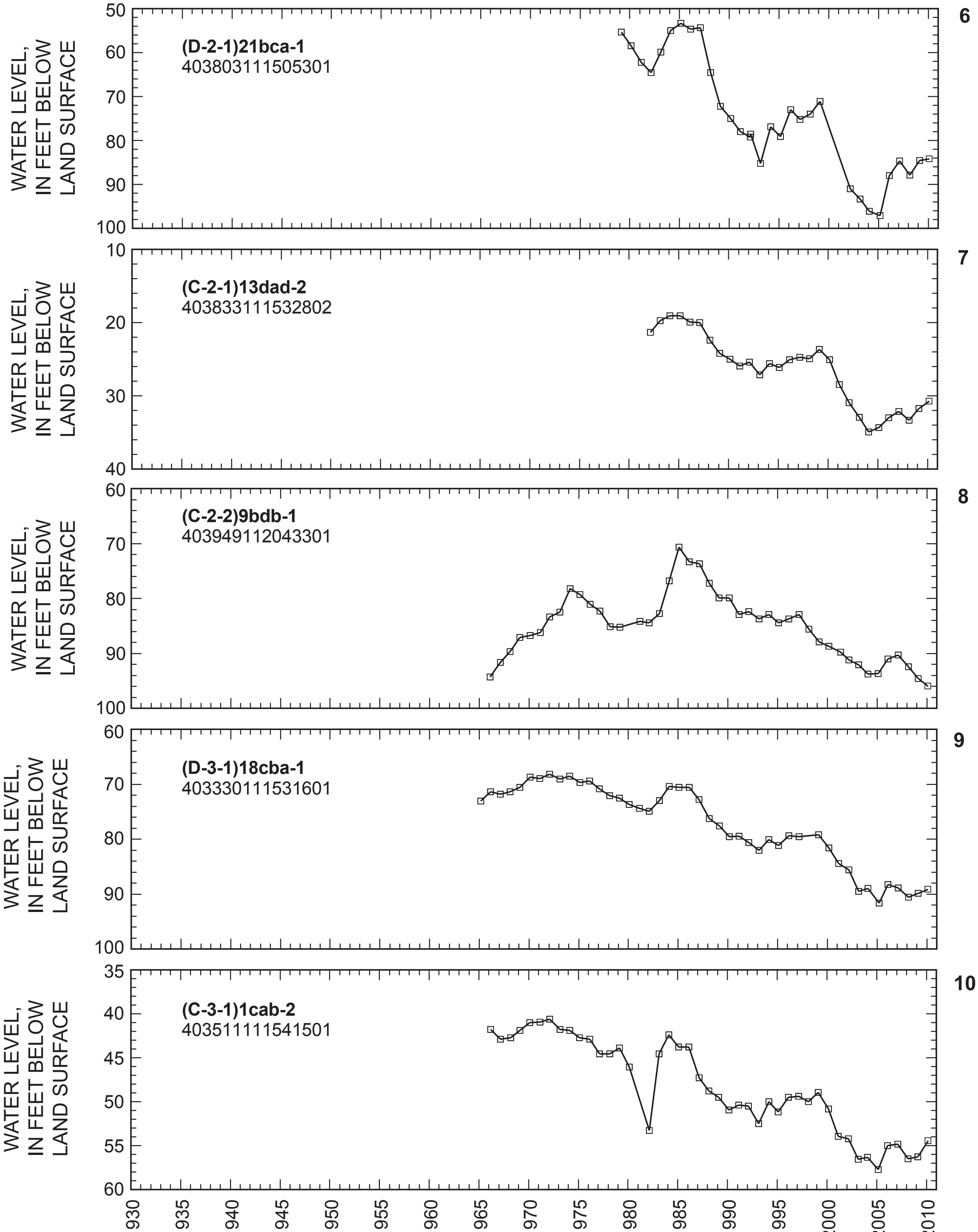


Figure 13. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.—Continued

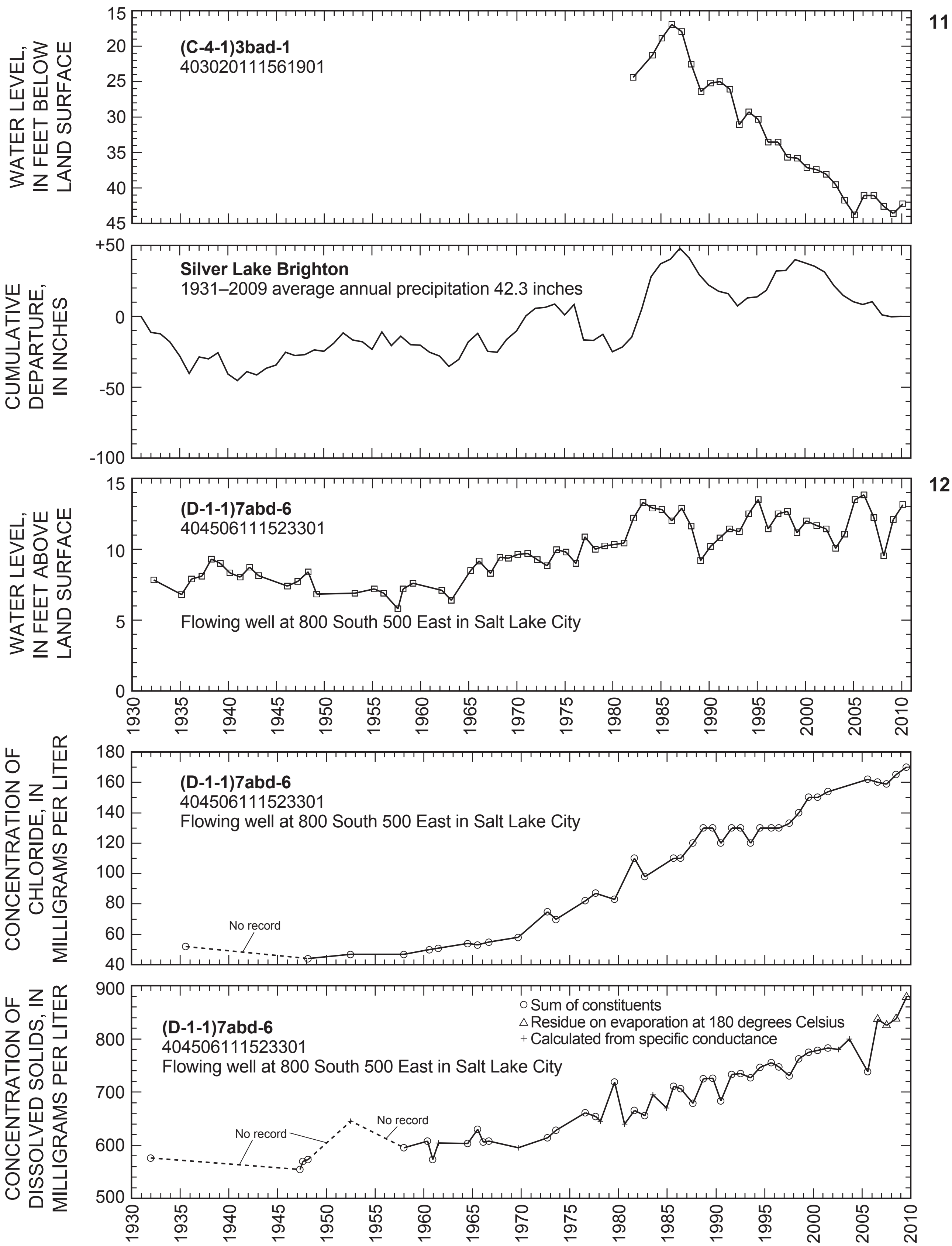


Figure 13. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.—Continued

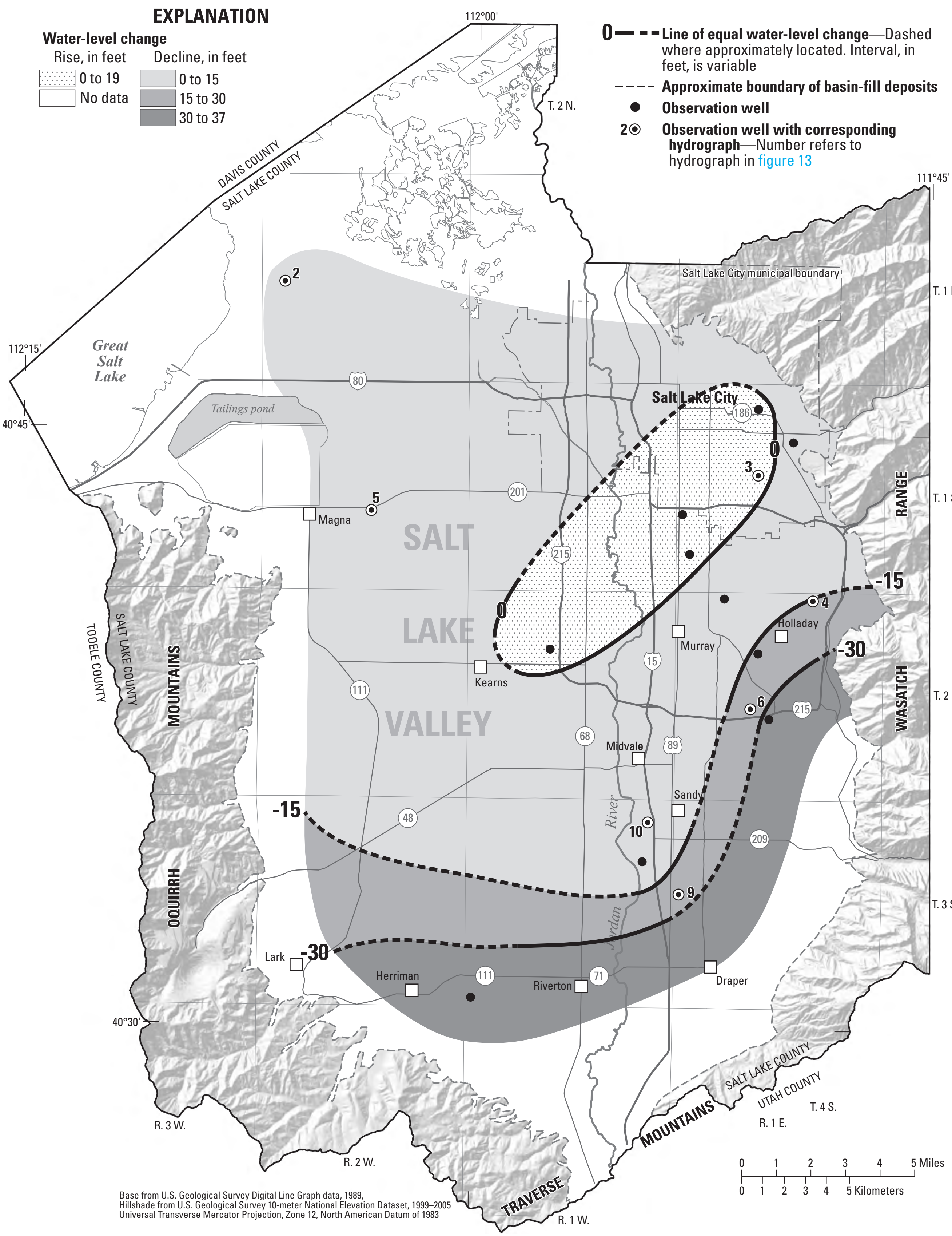


Figure 14. Water-level change in Salt Lake Valley from February 1980 to February 2010.

Tooele Valley

By Paul Downhour

Tooele Valley is between the Stansbury and Oquirrh Mountains and extends south from Great Salt Lake to South Mountain. The total area of the valley is about 250 square miles within Tooele County (fig. 15). Groundwater occurs in the bedrock and unconsolidated basin-fill 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 2009 was about 25,000 acre-feet, which is about 3,000 acre-feet less than the revised total for 2008 and 3,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3). Withdrawal for irrigation was about 12,500 acre-feet, which is 3,000 acre-feet less than the revised total for 2008. Withdrawal for public supply was about 10,500 acre-feet, which is 700 acre-feet more than in 2008. Withdrawal for industrial use was about 1,200 acre-feet, which is 300 acre-feet less than in 2008.

The location of wells in Tooele Valley in which the water level was measured during March 2010 is shown in figure 15. 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 16. Precipitation at Tooele during 2009 was about 16.9 inches, which is about 0.9 inch less than in 2008 and about 0.9 inch less than the average annual precipitation for 1936–2009.

Water levels declined in most of the wells measured in Tooele Valley from March 2009 to March 2010. Declines probably are the result of less-than-average precipitation and continued large local withdrawals for irrigation and public supply.

Water levels generally rose in the north-central part and declined along the east and west parts of Tooele Valley from March 1980 to March 2010 (fig. 17). The largest rise, about 1 foot, occurred in a well about 4 miles northwest of Erda. The largest decline, about 15.6 feet, occurred in a well about 1 mile east of Erda.

Physical properties and records of chemical analyses for water from five wells in Tooele Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. The dissolved-solids concentration in water samples from all five wells exceeded the secondary standard for this constituent (500 mg/L), and water from two of the wells ((C-2-5)34cbc-1 and (C-3-5)11bad-1) also exceeded the MCL (2,000 mg/L). The concentration of dissolved chloride in water samples from all wells except (C-2-4)33bdd-1 exceeded the secondary standard for this constituent (250 mg/L). Water from well (C-3-5)11bad-1 also exceeded the secondary standard for iron (300 µg/L).

The concentration of dissolved solids in water samples collected from well (C-2-6)23cbb-1, located 3 miles northwest of Grantsville, from 1961 to 2008, is shown in figure 16. The concentration has ranged from 553 to 848 mg/L with a median value of 701 mg/L. The maximum value was measured in the water sample collected in August 2008. The dissolved-solids concentration has increased since 2001. This well was not sampled in 2009.

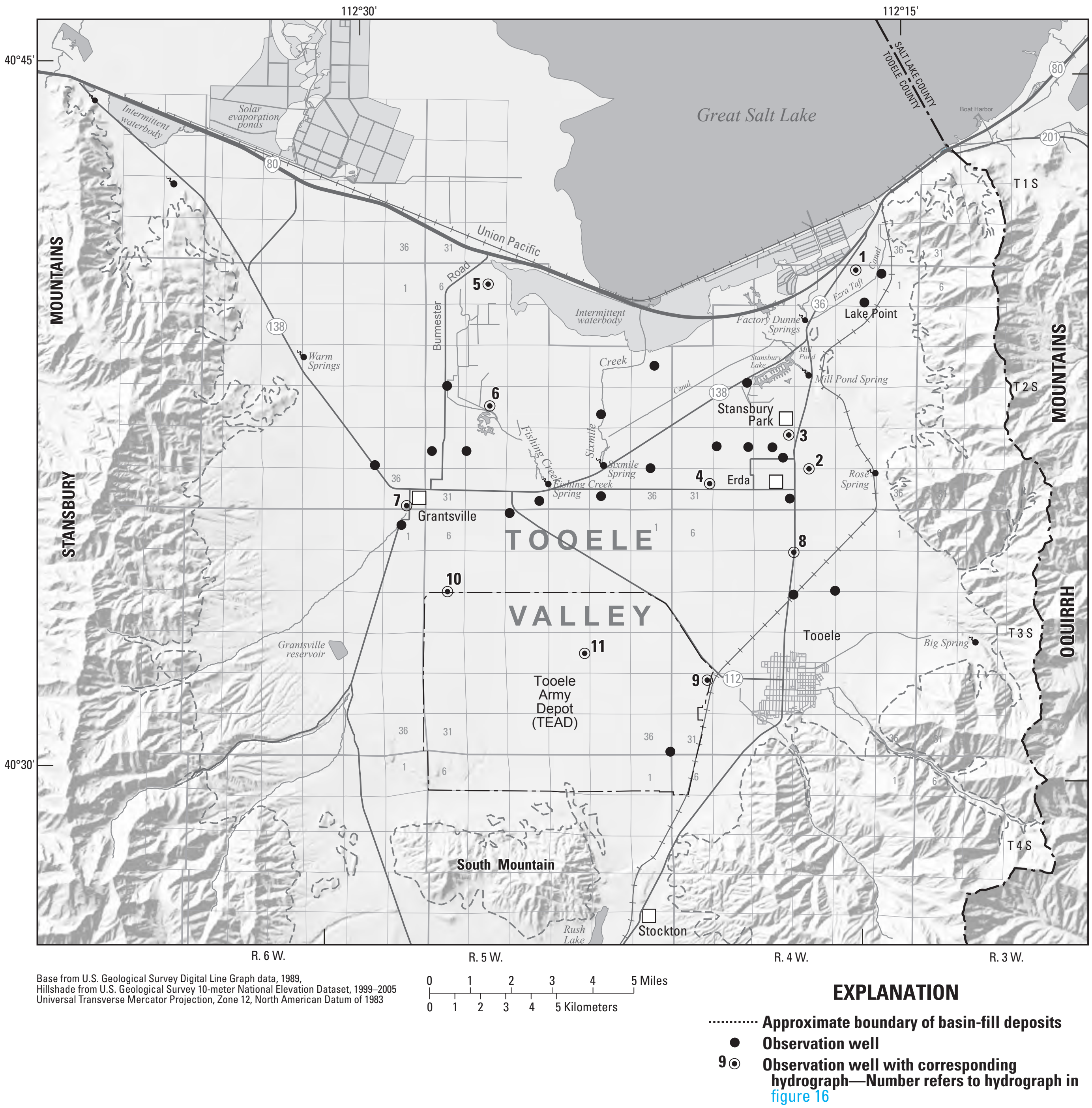


Figure 15. Location of wells in Tooele Valley in which the water level was measured during March 2010.

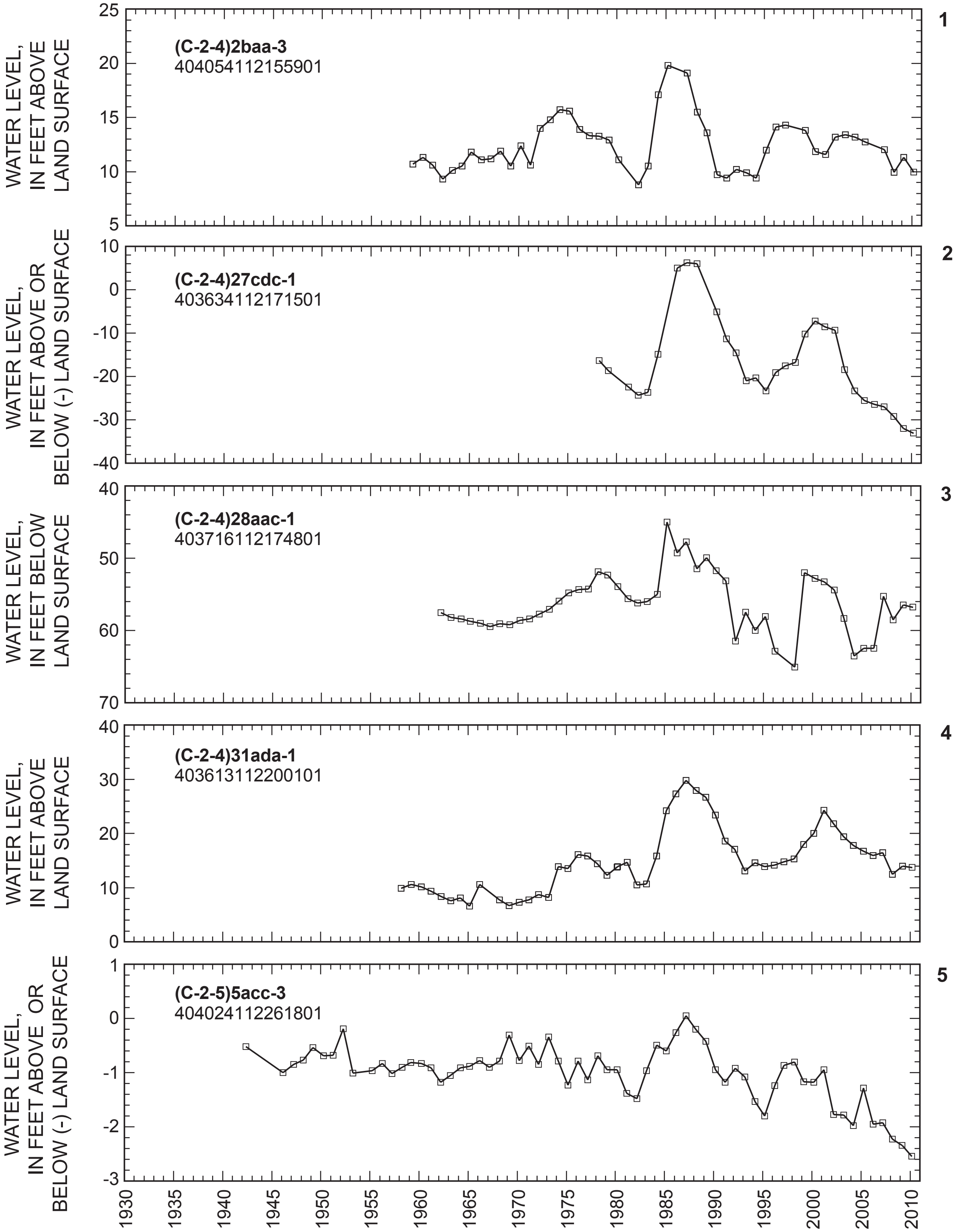


Figure 16. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.

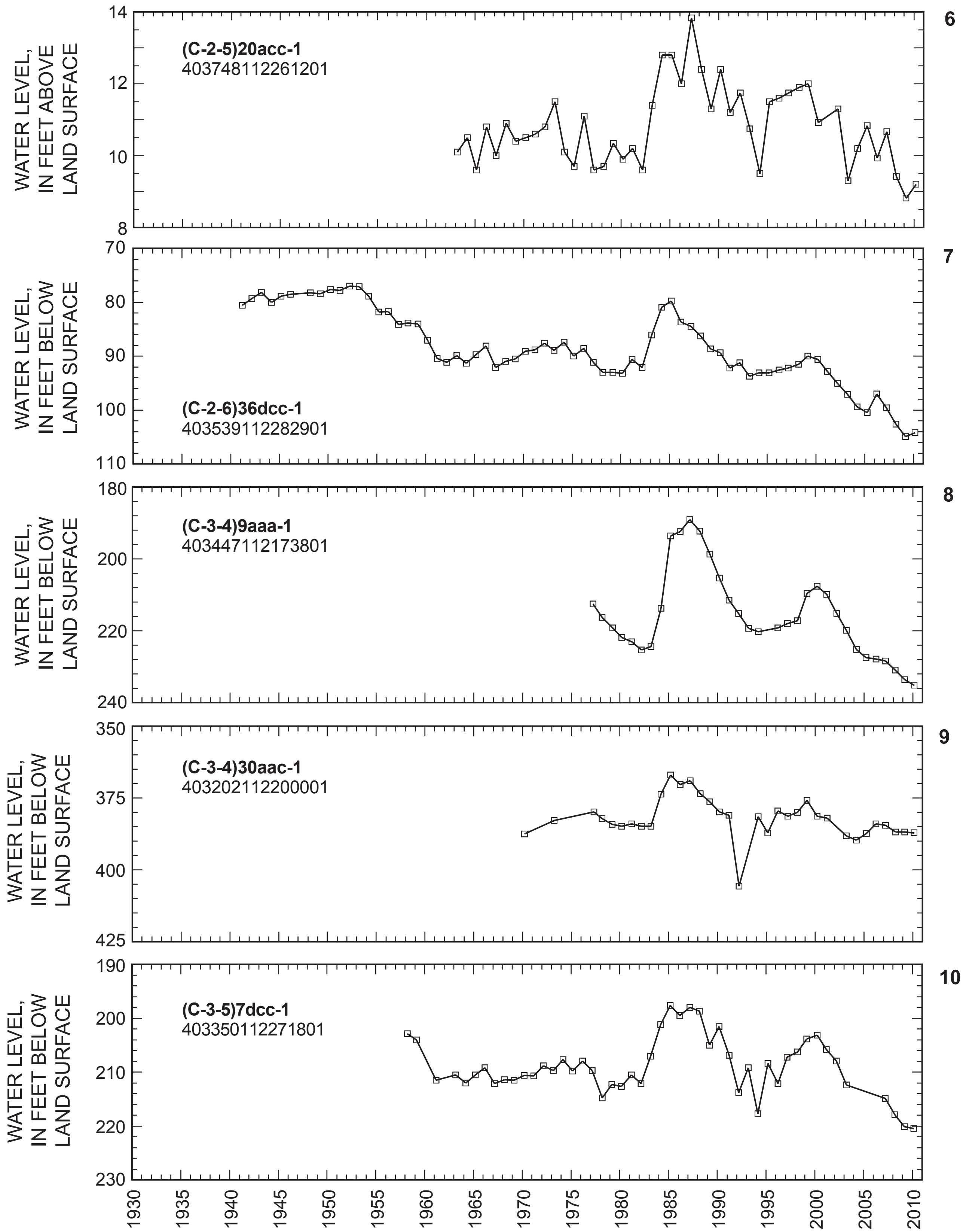


Figure 16. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.—Continued

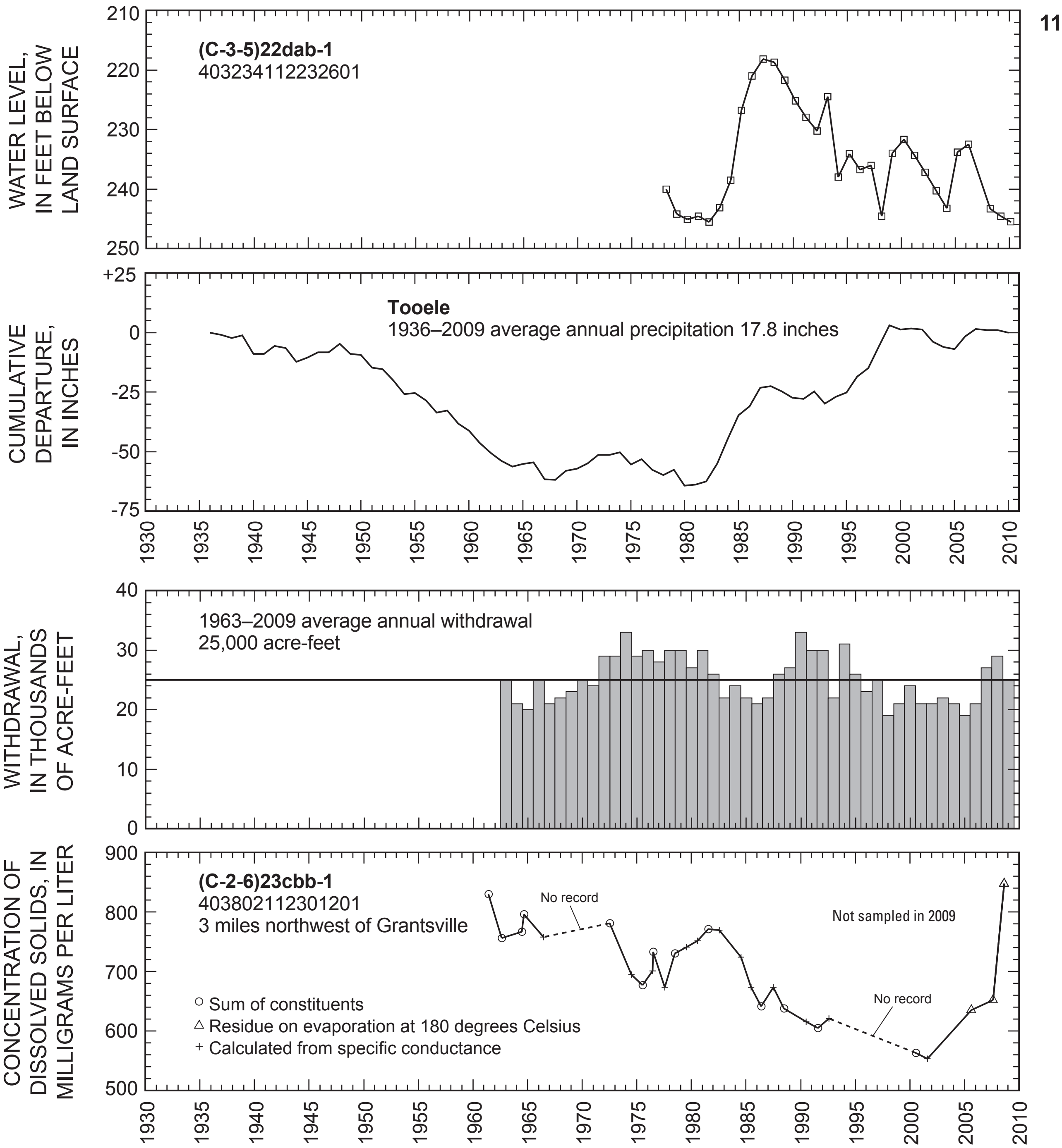


Figure 16. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.—Continued

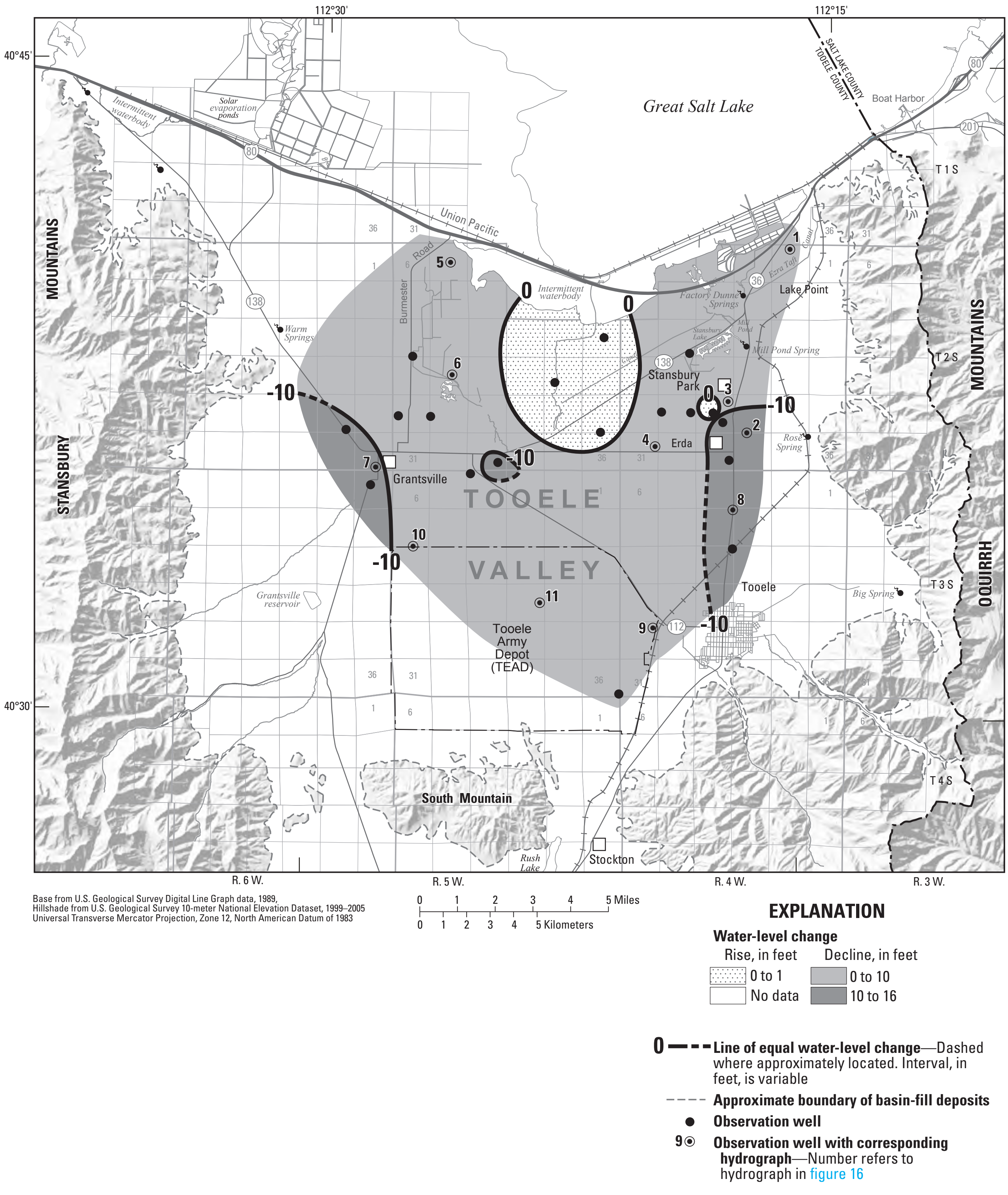


Figure 17. Water-level change in Tooele Valley from March 1980 to March 2010.

Utah and Goshen Valleys

By Michael Enright

Utah Valley, in Utah County, is divided into two groundwater basins, northern and southern, which are separated by Provo Bay in northern Utah Valley (fig. 18). Groundwater occurs in unconsolidated basin-fill deposits in the valley. The principal groundwater 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 bounded by West Mountain, Long Ridge, the Lake Mountains, and the East Tintic Mountains (fig. 18). Groundwater in Utah and Goshen Valleys occurs in the basin-fill deposits under both water-table and artesian conditions, but most wells discharge from artesian aquifers.

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 2009 was about 109,000 acre-feet, which is 15,000 acre-feet less than in 2008, and 1,000 acre-feet less than the average annual withdrawal for 1999–2008 (tables 2 and 3). Withdrawal in northern Utah Valley was about 63,300 acre-feet, which is 7,400 acre-feet less than in 2008. Withdrawal in southern Utah Valley was about 30,100 acre-feet, which is 3,800 acre-feet less than in 2008. Withdrawal in Goshen Valley was about 15,400 acre-feet, which is 4,000 acre-feet less than in 2008. The overall decrease in withdrawals was mainly due to decreased withdrawal for irrigation in Goshen Valley, and decreased withdrawal for public-supply use in both northern and southern Utah Valleys.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2010 is shown in figure 18. Water levels generally declined slightly in most of the wells measured in Utah and Goshen Valleys from March 2009 to March 2010. 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.

A comparison of the 30-year change in water levels, from March 1980 to March 2010, showed declines in all measured wells throughout Utah Valley (fig. 20). Declines ranged from less than 1 foot to almost 34 feet. Areas of larger declines were in agricultural areas such as Elberta, where irrigation from groundwater has increased, and developed areas such as Lehi, where pumpage for public-supply use has greatly increased since 1980.

The relation of the water level in selected observation wells to cumulative departure from average precipitation at Silver Lake 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 19. Discharge of Spanish Fork at Castilla in 2009 was about 191,400 acre-feet, which is 22,300 acre-feet more than the 1933–2009 annual average. Precipitation at Silver Lake Brighton in 2009 was about 42.6 inches, which is about 0.3 inch more than the long-term average (1931–2000) and about 1.8 inches more than in 2008. Precipitation at Spanish Fork Powerhouse in 2009 was about 24.3 inches, which is about 5.1 inches more than the long-term average (1930–2009) and about 7.4 inches more than in 2008.

Physical properties and records of chemical analyses for water from eight wells in Utah Valley (includes northern and southern Utah Valleys) and Goshen Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. For Goshen Valley, the dissolved-solids and dissolved-chloride concentrations in water samples from all three wells sampled exceeded the secondary standards for these constituents (500 and 250 mg/L, respectively). The concentration of dissolved nitrite plus nitrate in water from well (C-9-1)28ccb-1 exceeded the MCL for this constituent (10 mg/L), and water from well (C-9-1)4ddc-1 exceeded the MCL for arsenic (10 µg/L). For southern Utah Valley, the water sample from well (D-7-2)4cbb-2 exceeded the secondary standards for dissolved iron and manganese (300 and 50 µg/L, respectively). Results of analyses of water sampled from the two wells in northern Utah Valley ((D-5-1)20aba-1 and (D-6-2)17aca-1) did not exceed primary or secondary standards.

The concentration of dissolved solids in water samples collected from wells (C-9-1)28ccb-1, located 4 miles north of Elberta, (D-7-2)4cbb-2, located 2 miles west of Provo at mouth of Provo River, and (D-9-1)36bbc-1, located 1 mile north of Santaquin, is shown in figure 19. The concentration of dissolved solids in water from well (C-9-1)28ccb-1 has ranged from 498 to 1,420 mg/L with a median value of 696 mg/L. The maximum value for dissolved solids is associated with the sample collected in September 2008. Water collected in July 2009 had a dissolved-solids concentration of 1,370 mg/L. The dissolved-solids concentration in water from well (D-7-2)4cbb-2 has ranged from 278 to 539 mg/L with a median value of 320 mg/L. Water collected in 2009 had a dissolved-solids concentration of 328 mg/L, near the median value. The dissolved-solids concentration in water from well (D-9-1)36bbc-1 has ranged from 153 to 310 mg/L with a median value of 286 mg/L. This well was not sampled in 2009.

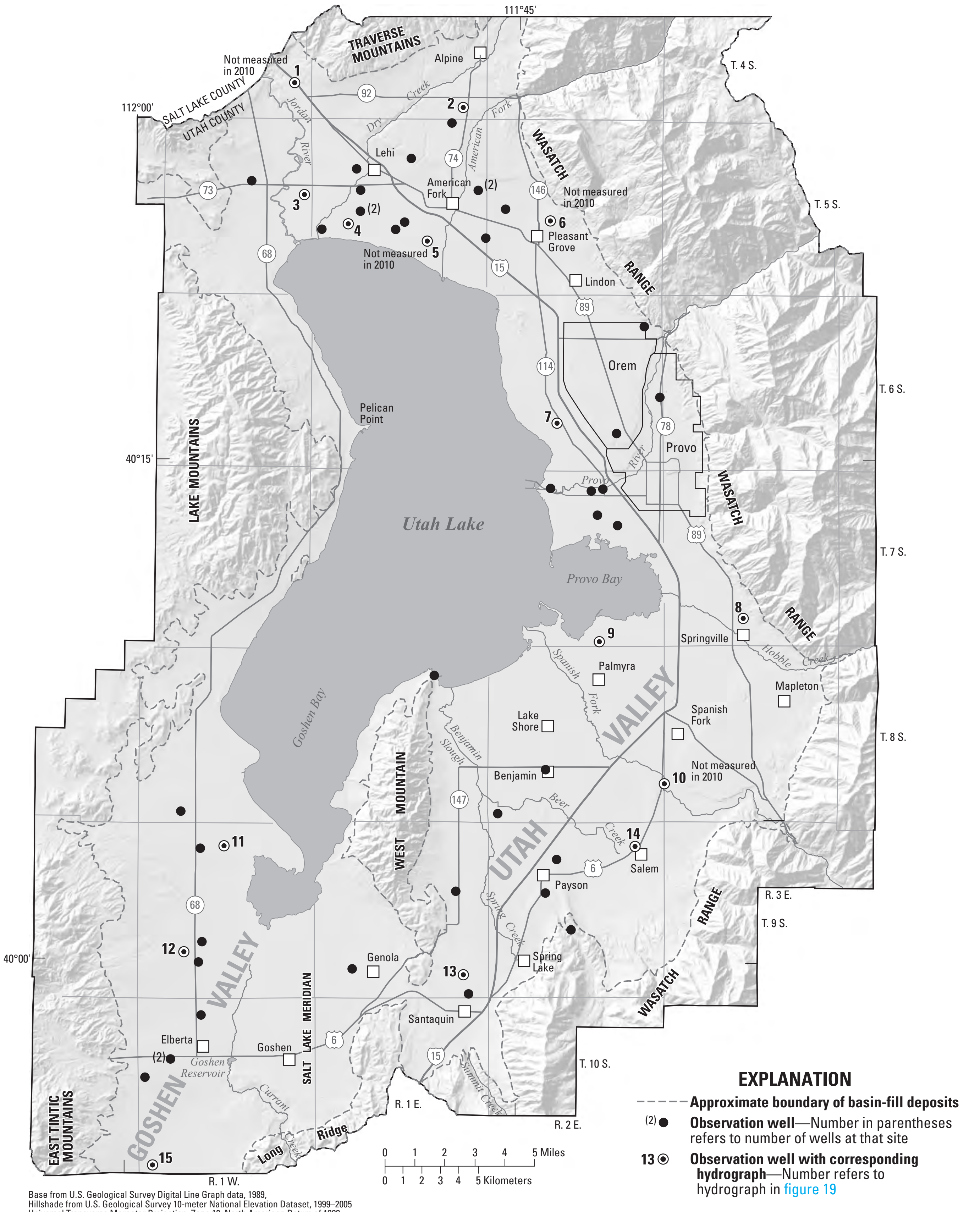


Figure 18. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2010.

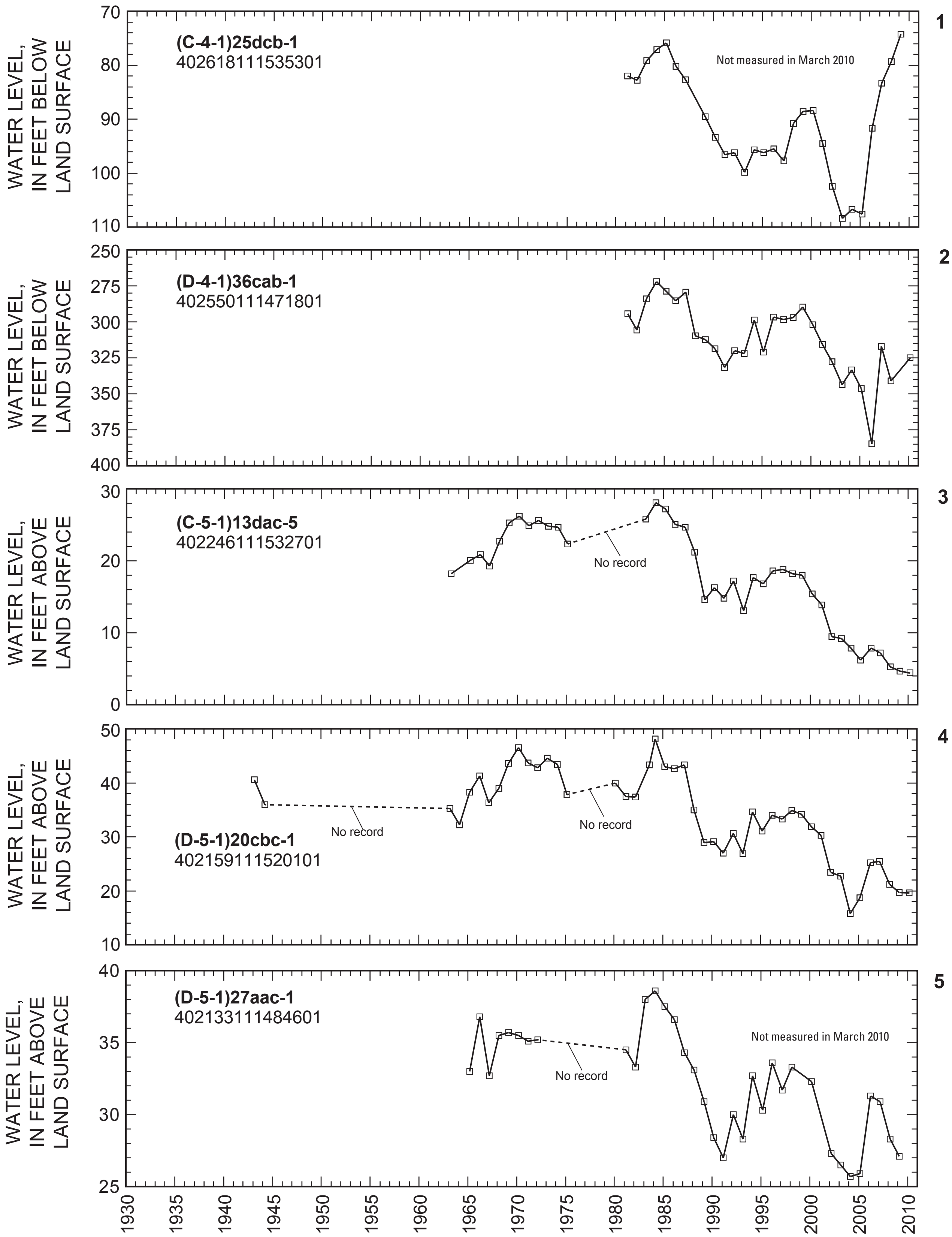


Figure 19. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.

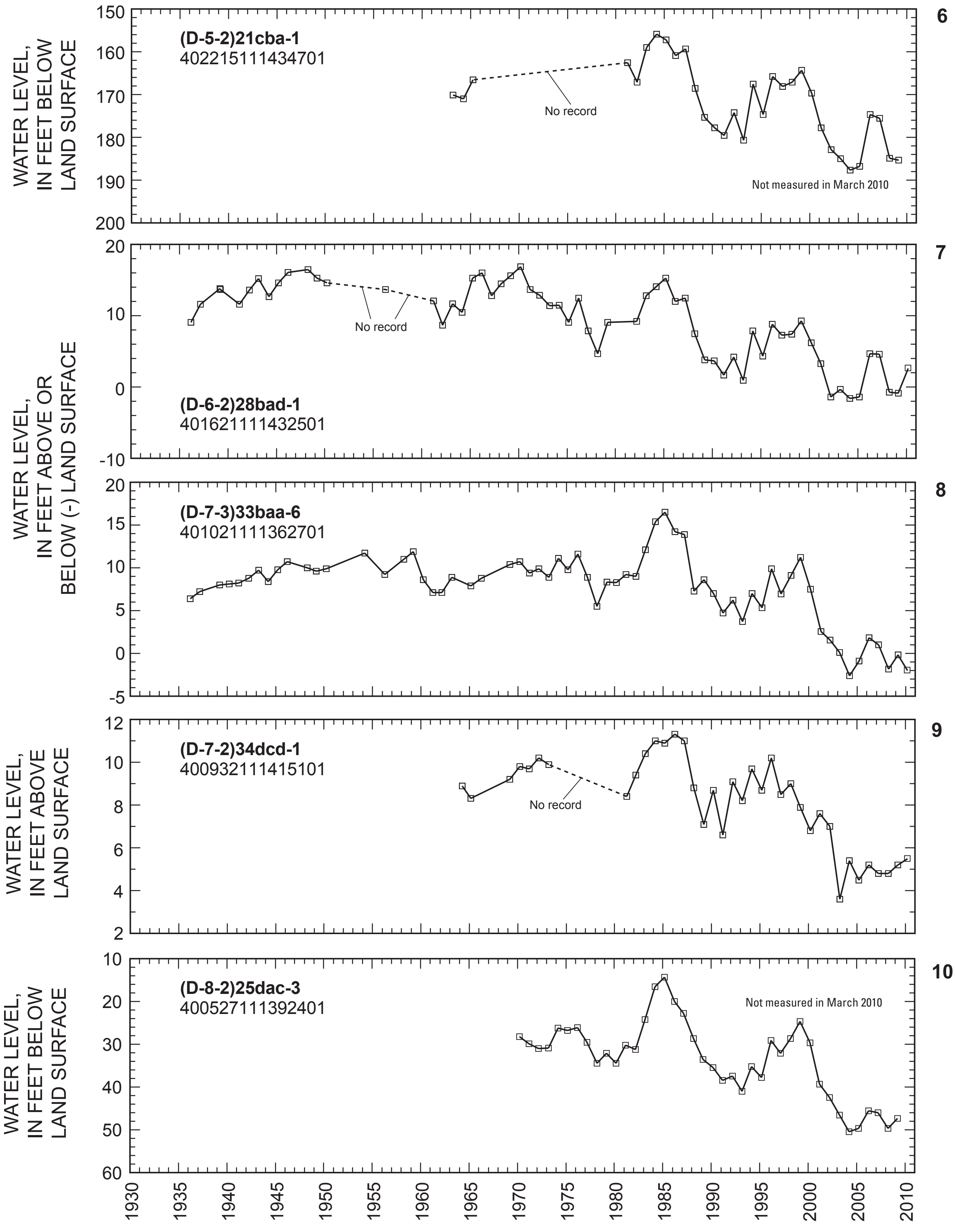


Figure 19. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.—Continued

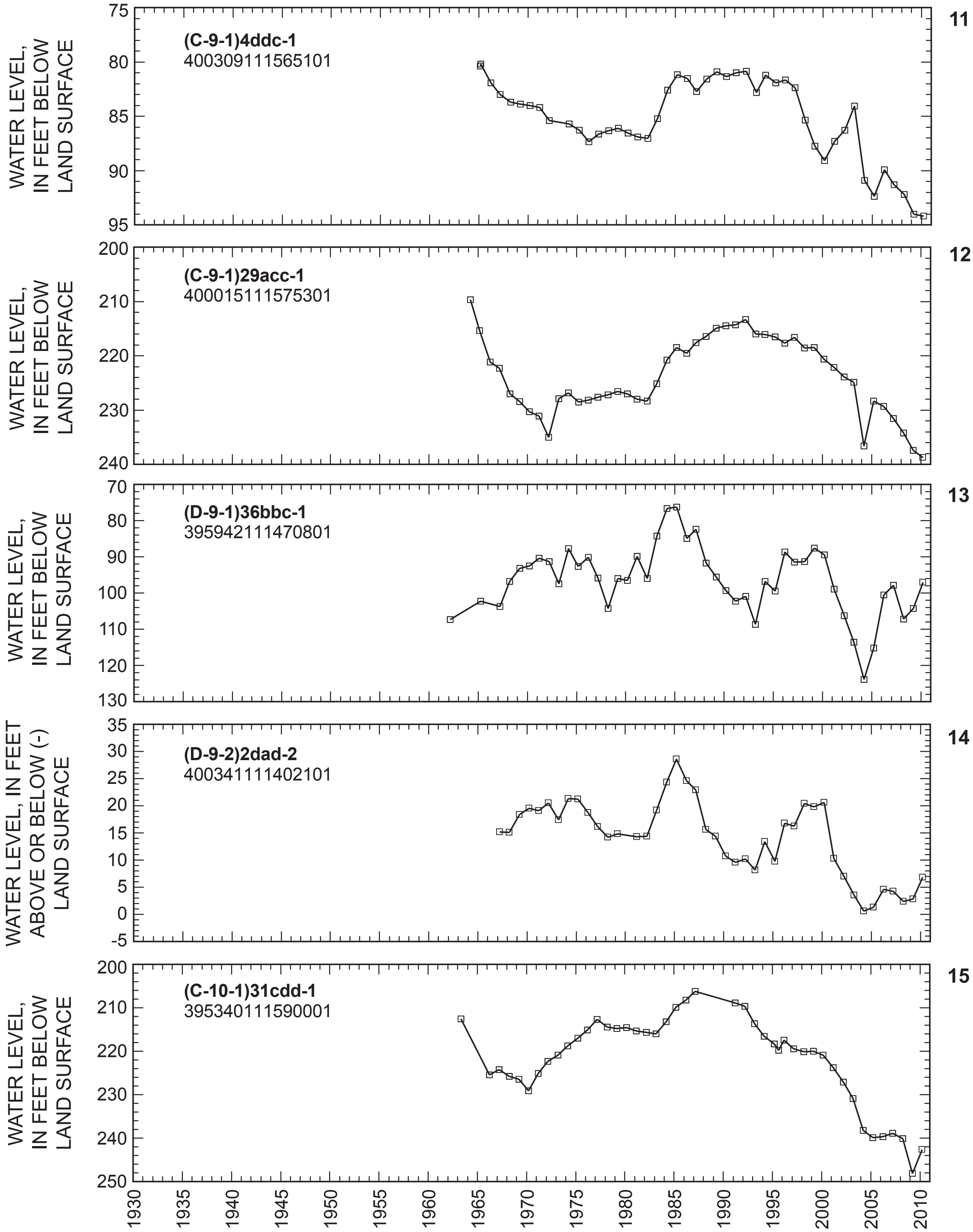


Figure 19. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.—Continued

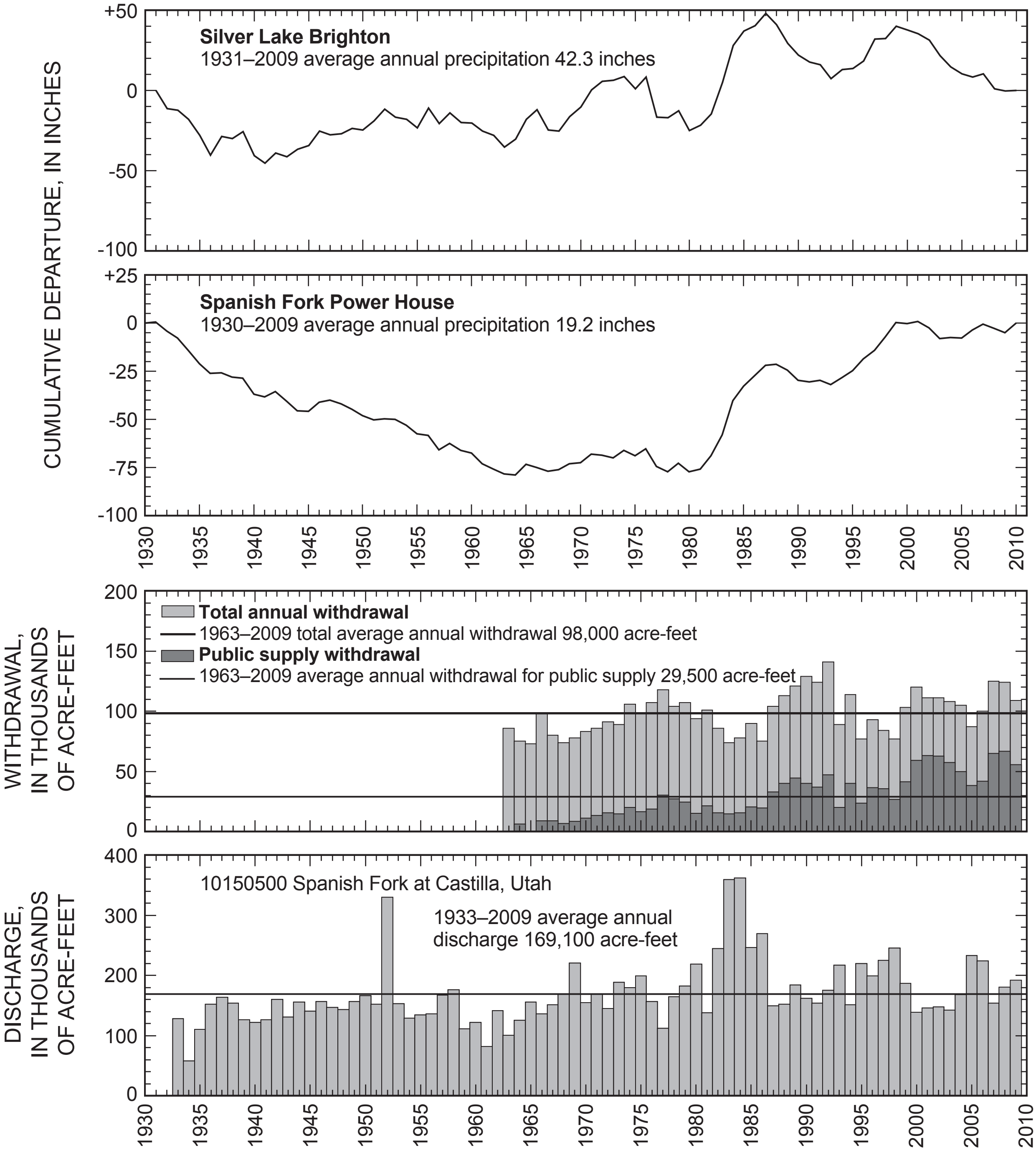


Figure 19. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.—Continued

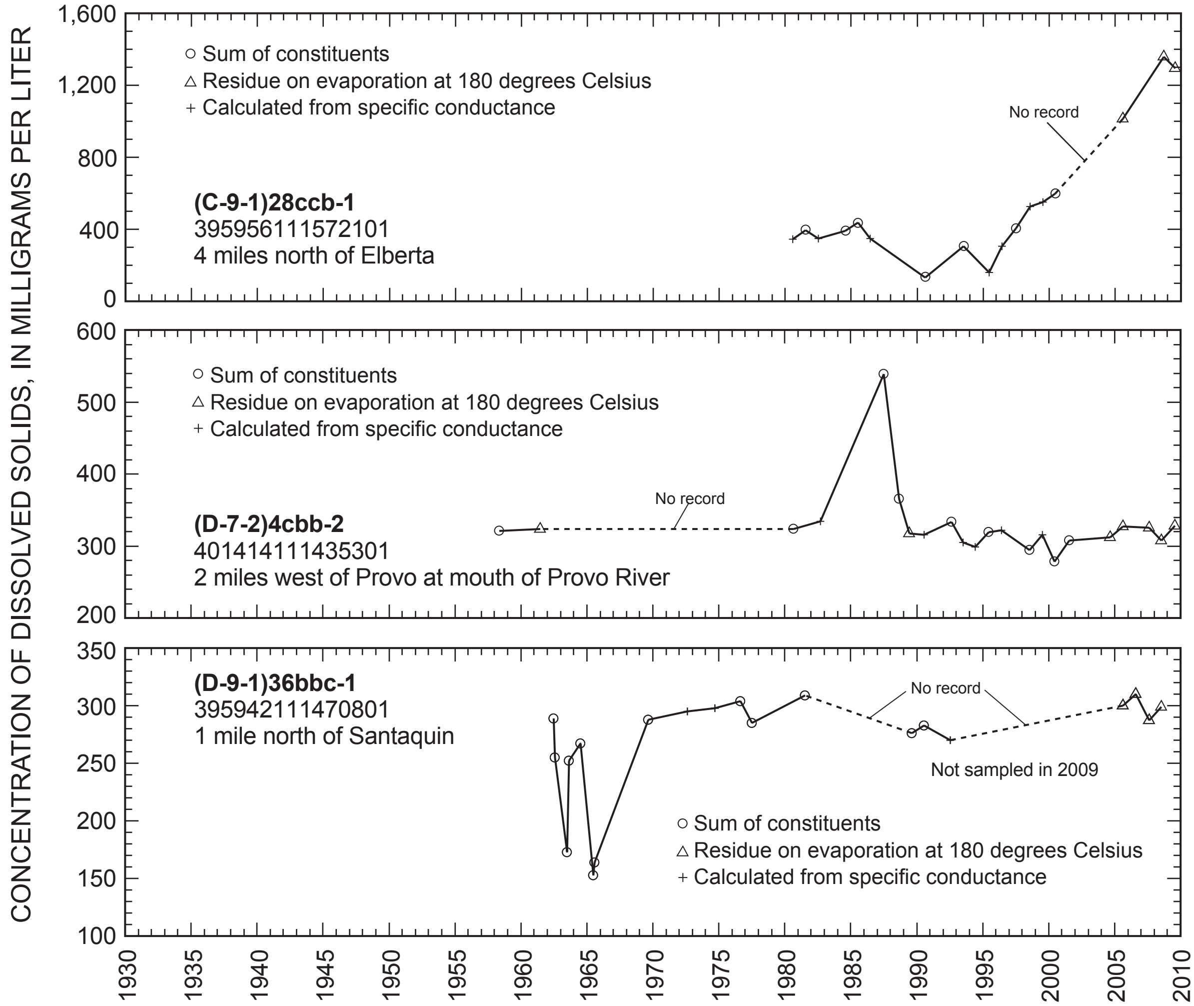


Figure 19. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.—Continued

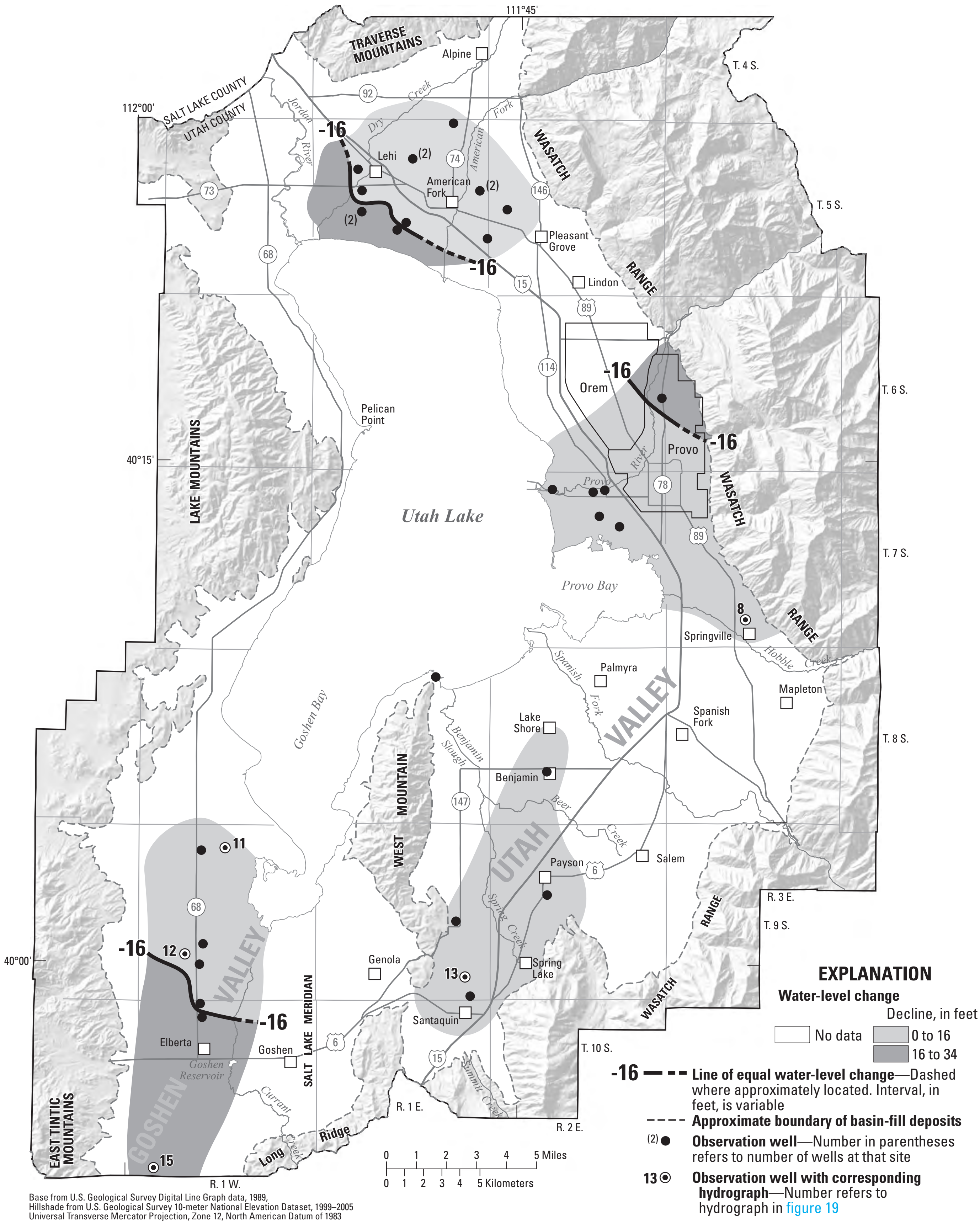


Figure 20. Water-level change in Utah and Goshen Valleys from March 1980 to March 2010.

Juab Valley

By Robert J. Eacret

Juab Valley, in central Utah in Juab County, is about 30 miles long and averages about 4 miles wide. It is bounded on the east side by the Wasatch Range and the San Pitch Mountains and on the west side by the West Hills and Long Ridge (fig. 21). Groundwater drains from the valley in two directions—in northern Juab Valley it drains north via Currant Creek into Utah Lake, and in southern Juab Valley it drains south via Chicken Creek into the Sevier River. The northern and southern parts of Juab Valley are separated topographically and hydrologically by Levan Ridge, a gentle rise near the midpoint of the valley floor.

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

Total estimated withdrawal of water from wells in Juab Valley in 2009 was about 21,000 acre-feet, which is 5,000 acre-feet less than the amount reported for 2008 and 3,000 acre-feet less than the average annual withdrawal for 1999–2008 (tables 2 and 3).

The location of wells in Juab Valley in which the water level was measured during March 2010 is shown in figure 21. 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 22. Precipitation at Nephi during 2009 was about 11.5 inches, which is about 2.8 inches less than the average annual precipitation for 1935–2009, and about 0.3 inch more than in 2008.

Water levels rose or declined only slightly in most of the wells measured in Juab Valley from March 2009 to March 2010 (fig. 22). 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 2010, although there was a substantial rise from 1993 to 1999.

Water levels from March 1980 to March 2010 generally declined throughout most of Juab Valley (fig. 23). The largest decline, about 47 feet, was observed in a well west of Levan. Rises were observed in wells in the northern and central parts of the valley. The largest rise, about 16 feet, was observed in a well north of Levan.

Physical properties and records of chemical analyses for water from three wells in Juab Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. Water samples from all three wells exceeded the secondary drinking-water standard for dissolved solids (500 mg/L). The water sample from well (D-13-1)4cca-1 exceeded the secondary drinking-water standard for chloride (250 mg/L) and water from well (D-14-1)31ada-1 exceeded the secondary drinking-water standard for sulfate (250 mg/L).

The concentration of dissolved solids in water samples collected from well (C-12-1)24baa-1, located 4.5 miles north-northwest of Nephi, from 1964 to 2007, is shown in figure 22. The concentration has ranged from 650 to 755 mg/L with a median value of 714 mg/L. Dissolved-solids concentrations have varied little during the period of record. The well was not sampled in 2008 or 2009.

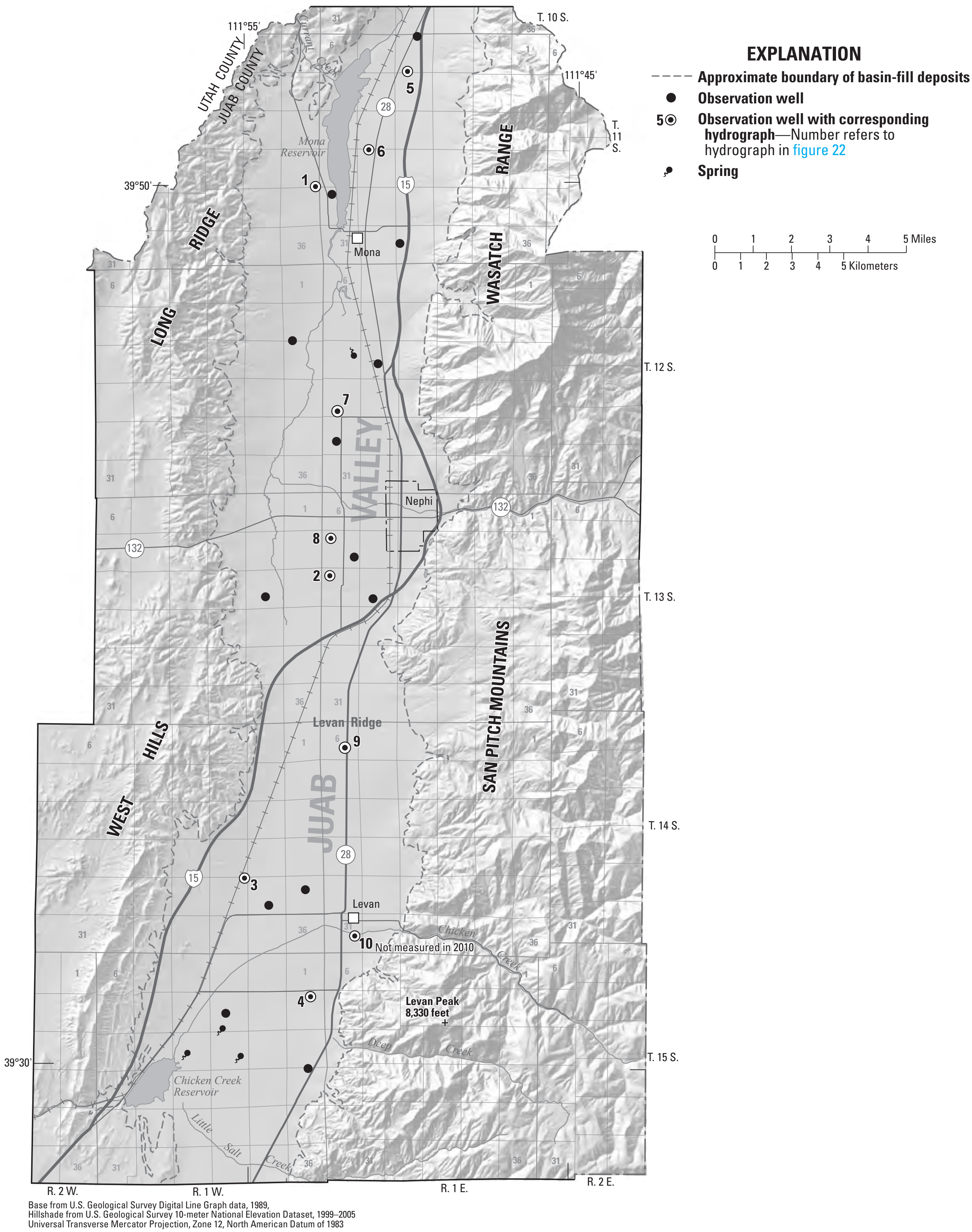


Figure 21. Location of wells in Juab Valley in which the water level was measured during March 2010.

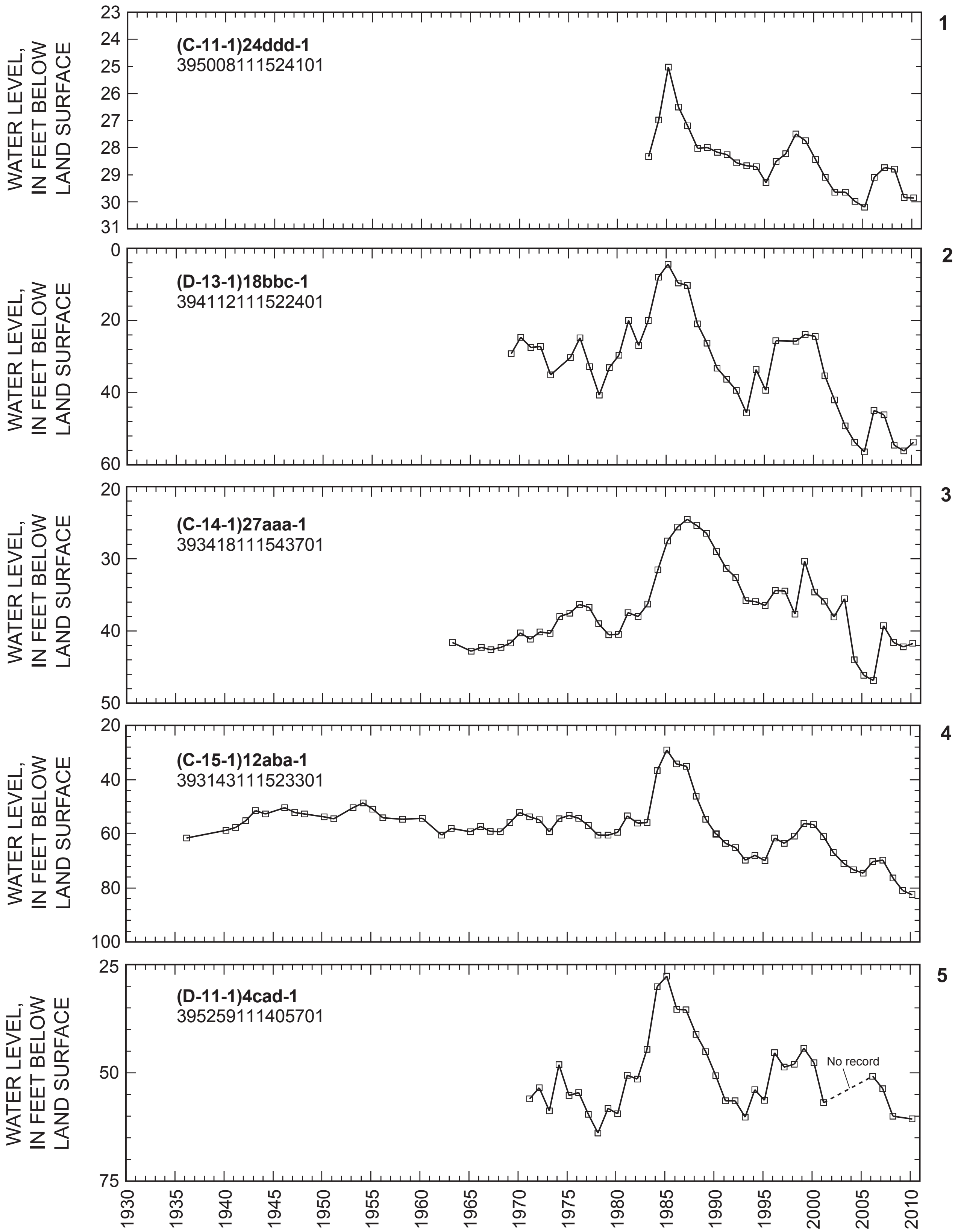


Figure 22. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1.

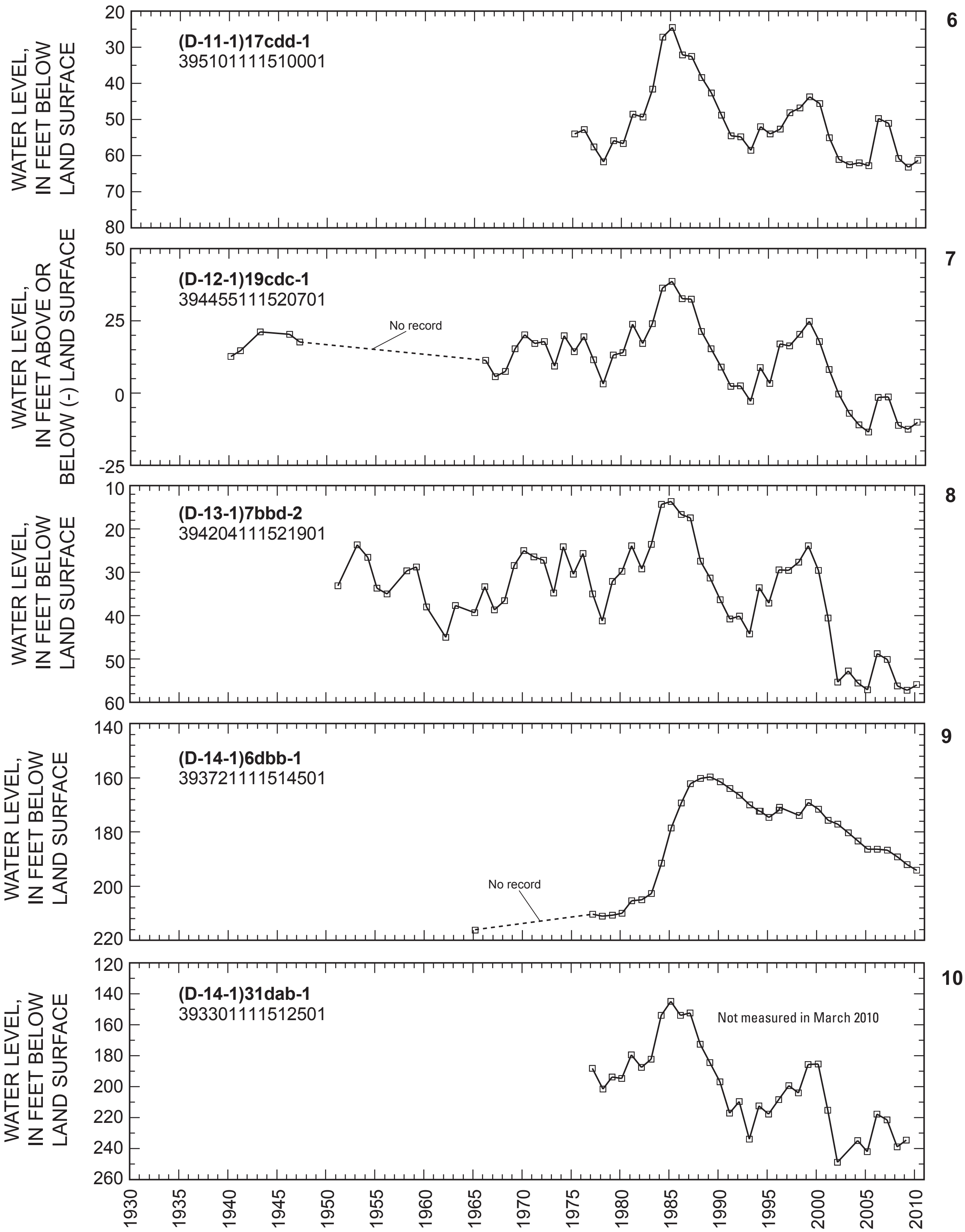


Figure 22. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1.—Continued

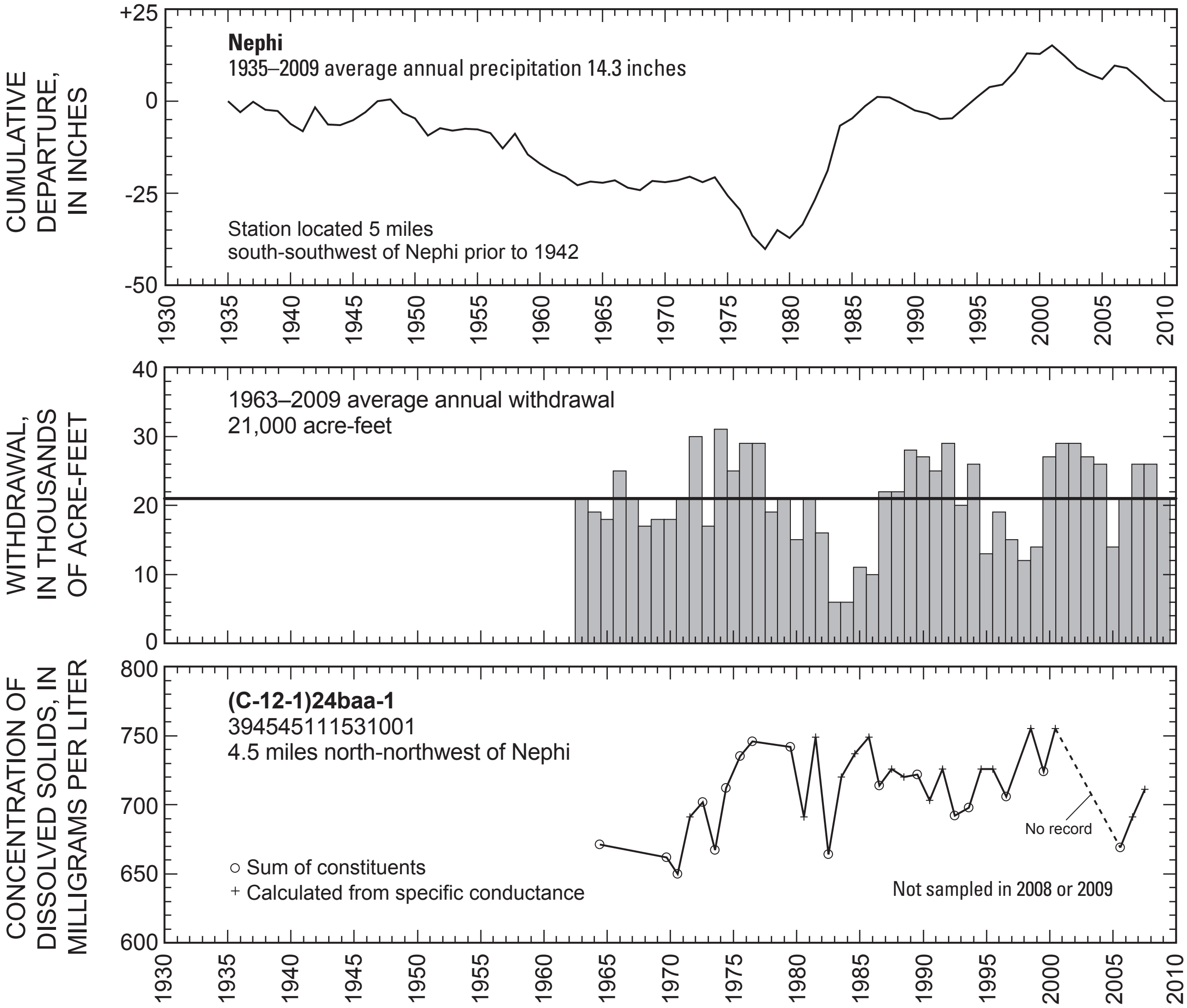
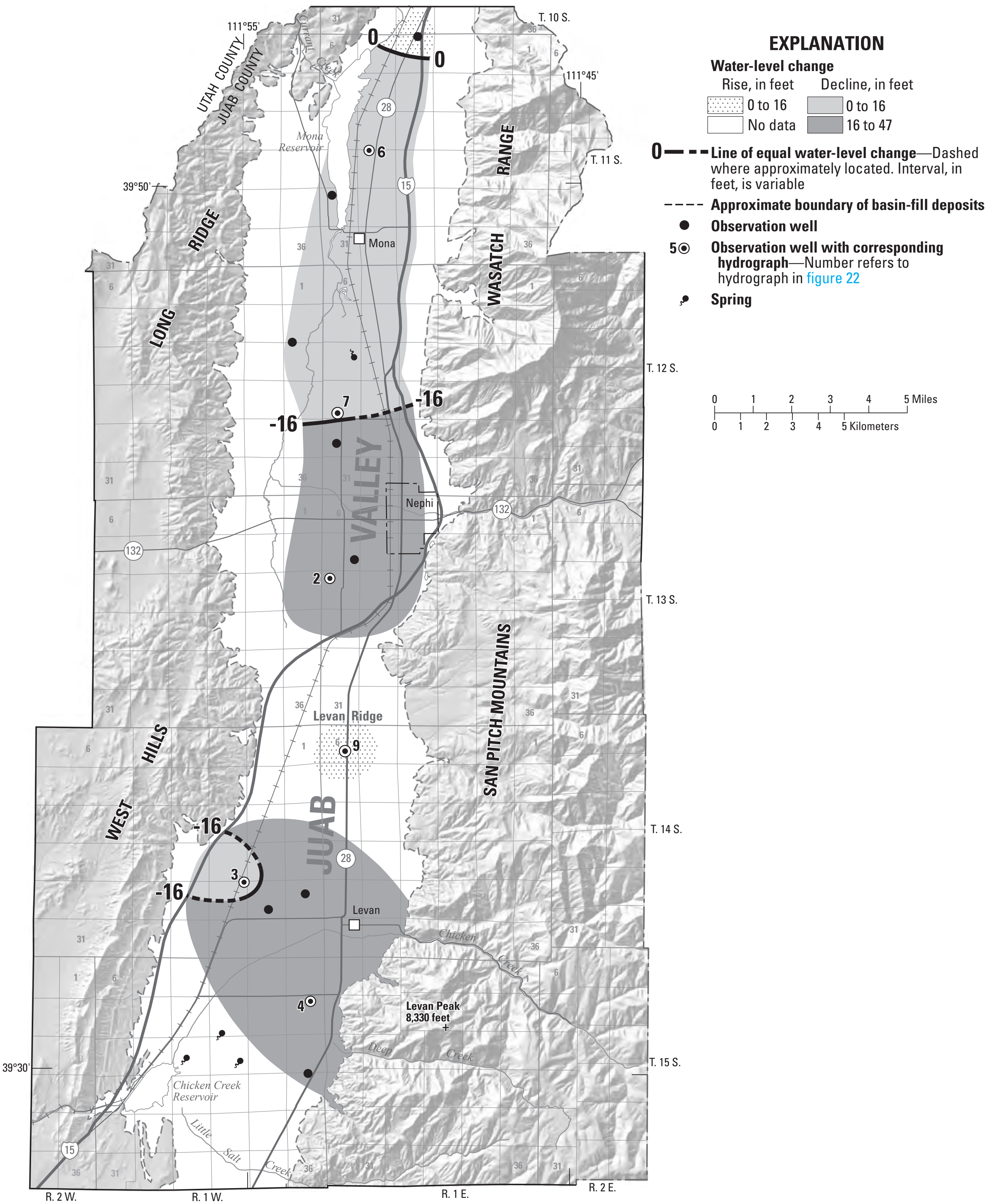


Figure 22. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1.—Continued



Base from U.S. Geological Survey Digital Line Graph data, 1989,
Hillshade from U.S. Geological Survey 10-meter National Elevation Dataset, 1999–2005
Universal Transverse Mercator Projection, Zone 12, North American Datum of 1983

Figure 23. Water-level change in Juab Valley from March 1980 to March 2010.

Sevier Desert

By Manuel Guzman

The part of the Sevier Desert described here covers about 2,000 square miles in northern Millard and southern Juab Counties (figs. 24 and 25). It principally includes the broad, gently sloping areas that radiate from the Canyon Mountains to the east, the Drum Mountains to the west, and several noncontinuous mountains to the north. Groundwater occurs in the Sevier Desert in unconsolidated deposits under water-table and artesian conditions. Most of the groundwater is discharged from wells completed in either of two artesian aquifers—the shallow or deep artesian aquifer. The Sevier River enters the Sevier Desert from the east and is a source of recharge to the aquifers.

Total estimated withdrawal of water from wells in the Sevier Desert in 2009 was about 48,000 acre-feet, which is 4,000 acre-feet more than in 2008 and about 21,000 acre-feet more than the 1999–2008 average annual withdrawal (tables 2 and 3). The increase in withdrawals was mainly due to increased withdrawal for irrigation.

The location of wells in the Sevier Desert in which the water level was measured during March 2010 is shown in figures 24 and 25. 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 26.

Discharge of the Sevier River near Juab in 2009 was 111,500 acre-feet, 23,000 acre-feet less than in 2008 and 66,800 acre-feet less than the long-term average (1935–2009). Precipitation at Oak City was about 12.6 inches in 2009, about 0.3 inch less than the 1930–2009 average annual precipitation and about 1.3 inches more than in 2008.

Most water levels from March 2009 to March 2010 declined in both the shallow and deep artesian aquifers in the Sevier Desert, probably due to less availability of surface water and increased groundwater withdrawals. Water levels in both the shallow and deep aquifers 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 groundwater withdrawals because of increased 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. Water levels measured in March 2006 and March 2007 generally rose in both aquifers, probably due to increased precipitation and availability of surface water. Water levels in the shallow and deep aquifers have generally declined since March 2008.

Water levels generally declined in the shallow and deep artesian aquifers from March 1980 to March 2010 (figs. 27 and 28). Declines of nearly 27 feet in the shallow and deep artesian aquifers occurred in a well north of Oak City. The decline in water levels is probably a result of continued large withdrawals for irrigation. Rises in water levels in the shallow artesian aquifer occurred in the northern part of the valley and in two isolated areas in the central and southern parts of the valley. The largest rise, more than 11 feet, occurred in a well in the northeastern part of the valley, between the East and West Tintic Mountains. Water levels in all wells in the deep artesian aquifer declined.

Physical properties and records of chemical analyses for water from four wells in the Sevier Desert are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. The water sample from well (C-15- 4)8cba-1 exceeded the secondary standards for chloride (250 mg/L), sulfate (250 mg/L), and manganese (50 µg/L). The water sample from this well also exceeded the secondary standard and MCL for dissolved solids (500 and 2,000 mg/L, respectively).

The concentration of dissolved solids in water samples collected from well (C-15-4)8cba-1, located 2.5 miles east of Lynndyl, from 1958 to 2009, is shown in figure 26. The concentration has ranged from 1,490 to 2,340 mg/L, with a median value of 2,030 mg/L. The concentration of dissolved solids has increased from 1,490 mg/L in 1958 to 2,340 mg/L in 2009.

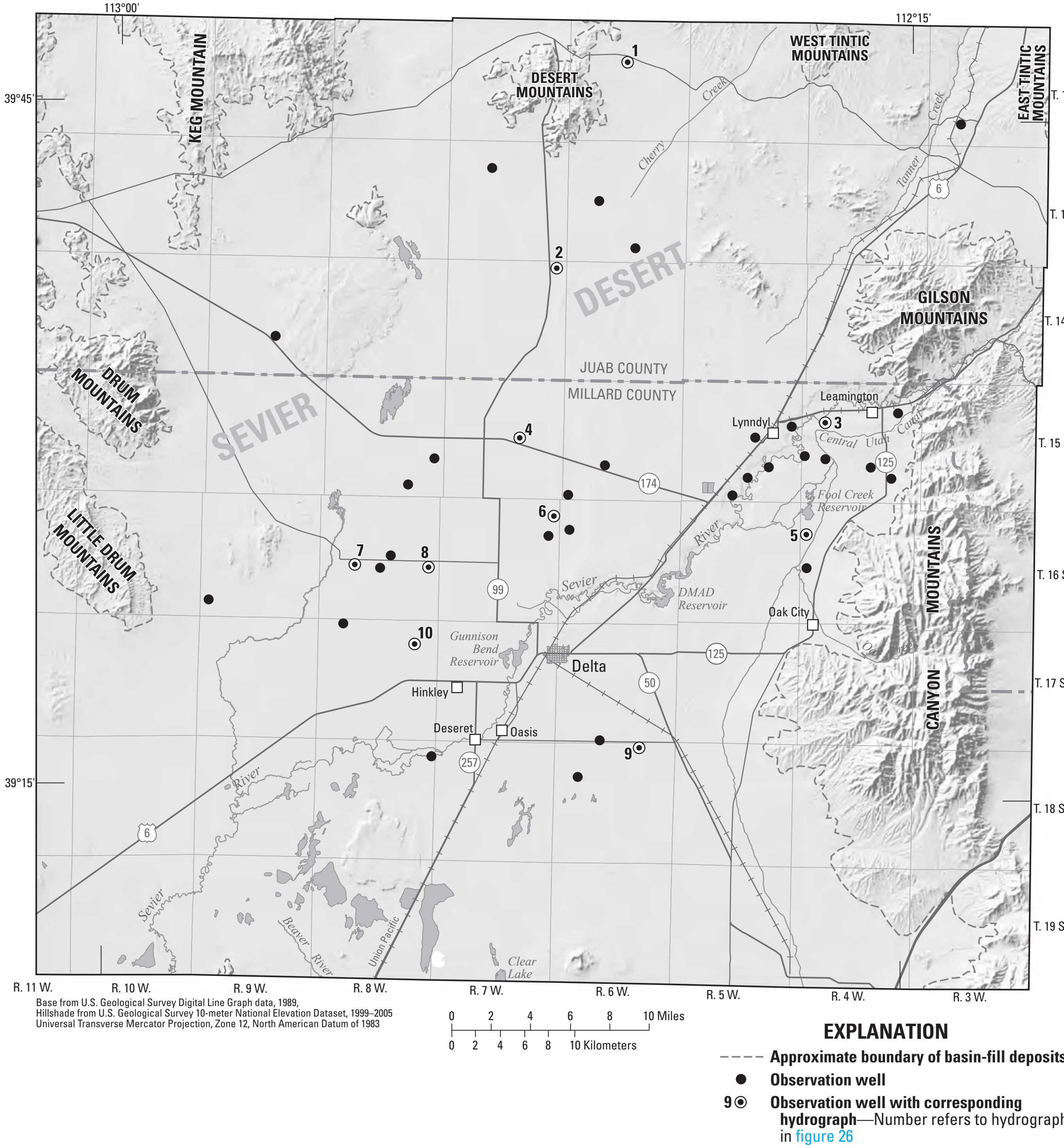


Figure 24. Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2010.

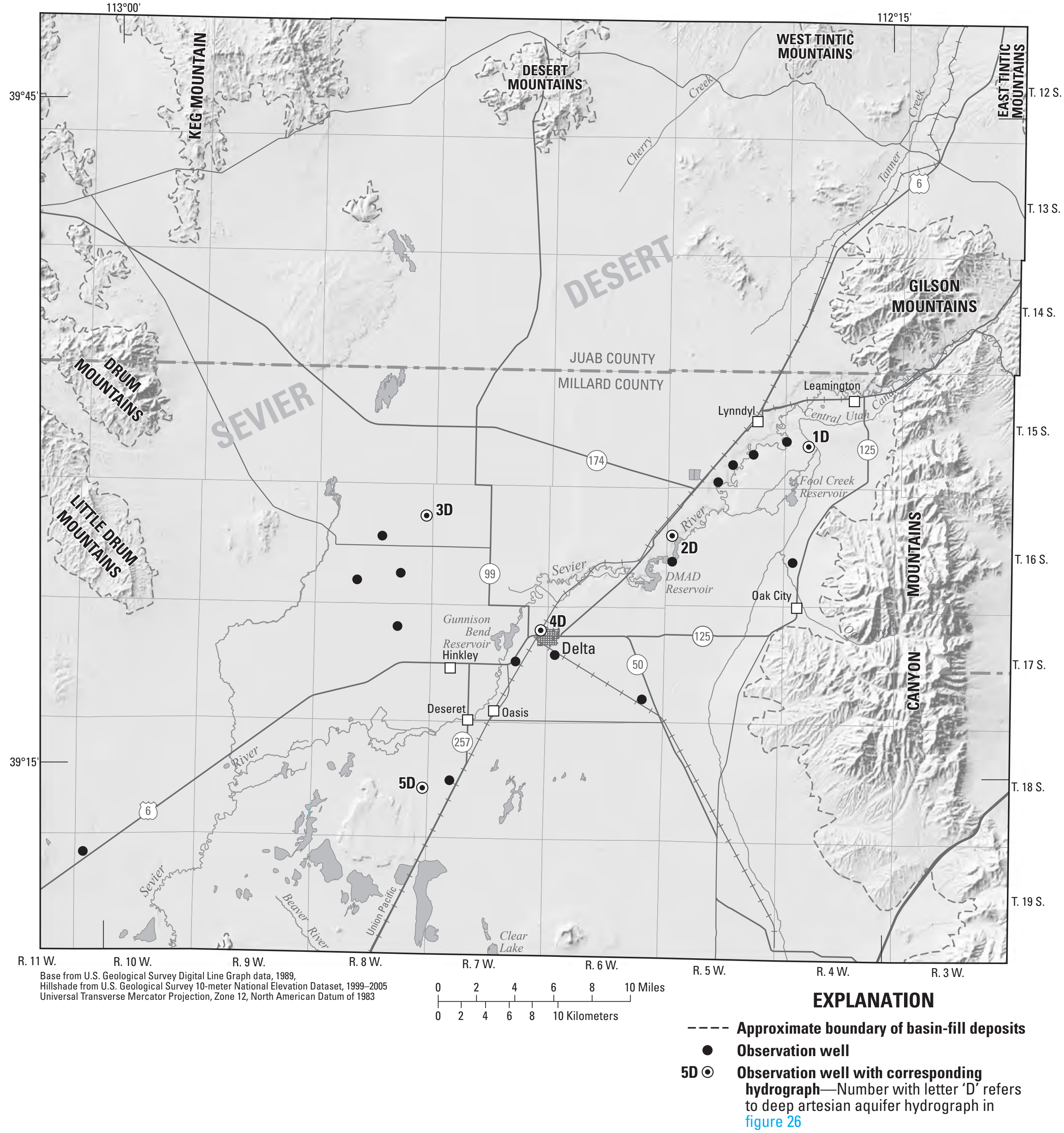


Figure 25. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2010.

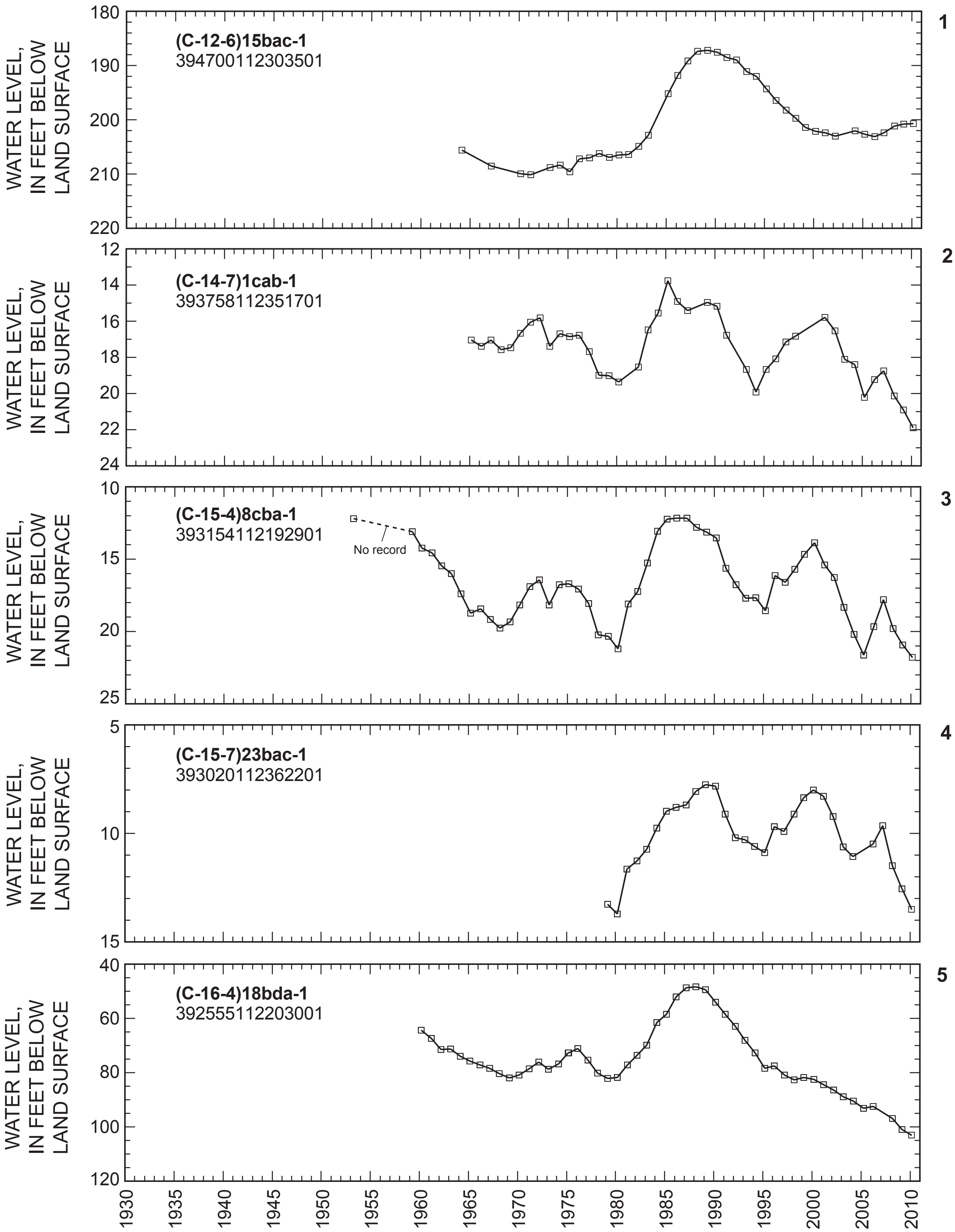


Figure 26. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.

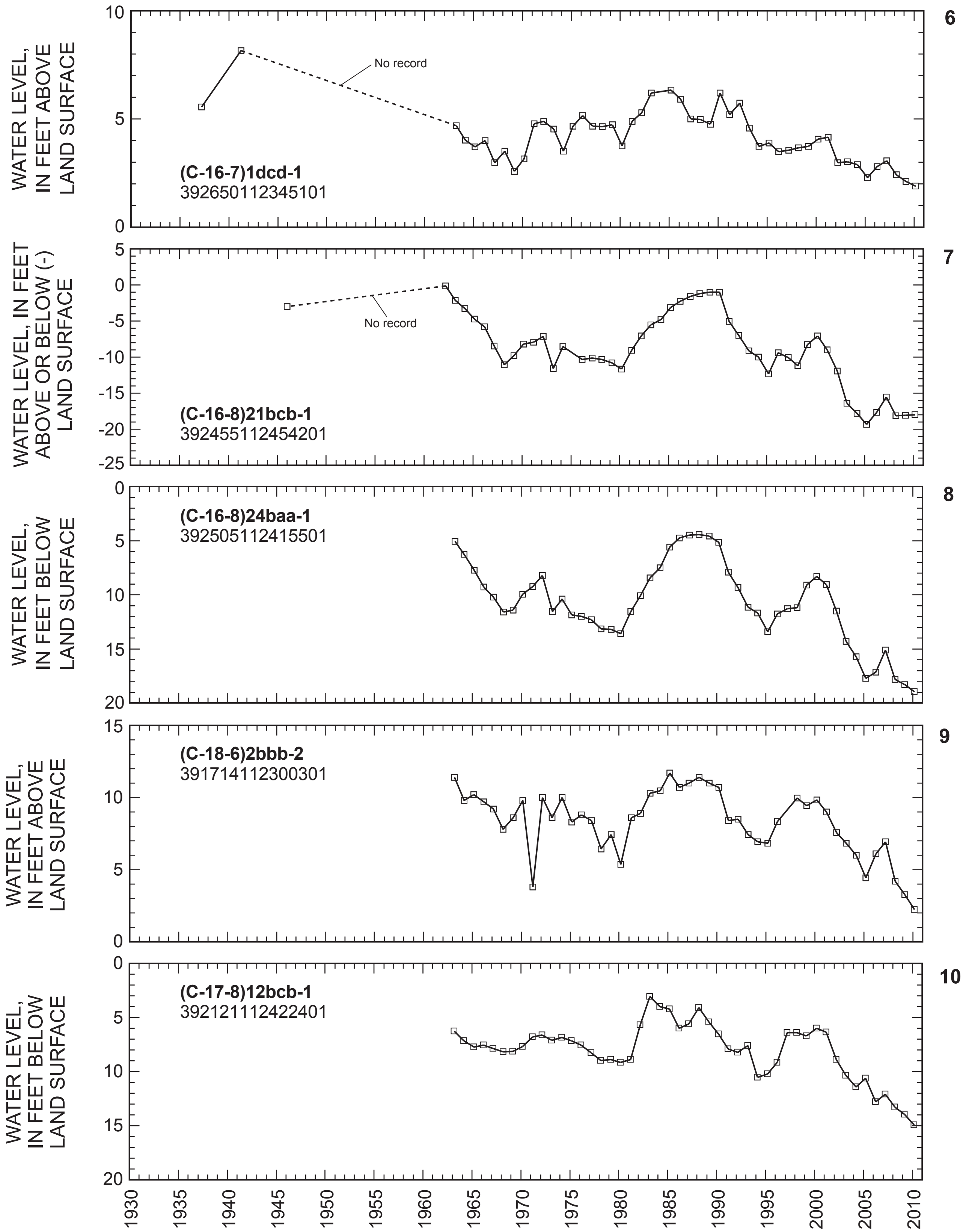


Figure 26. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

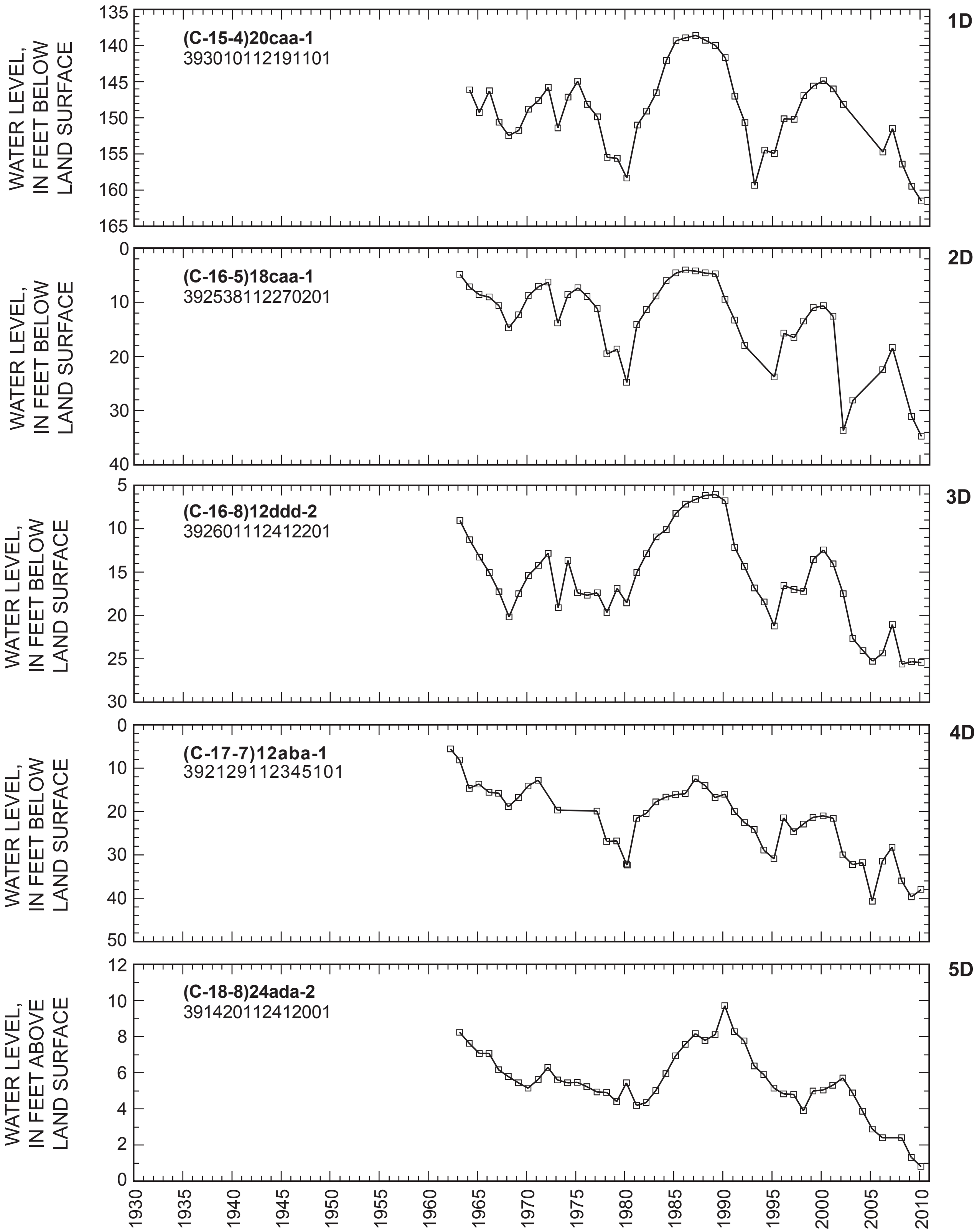


Figure 26. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

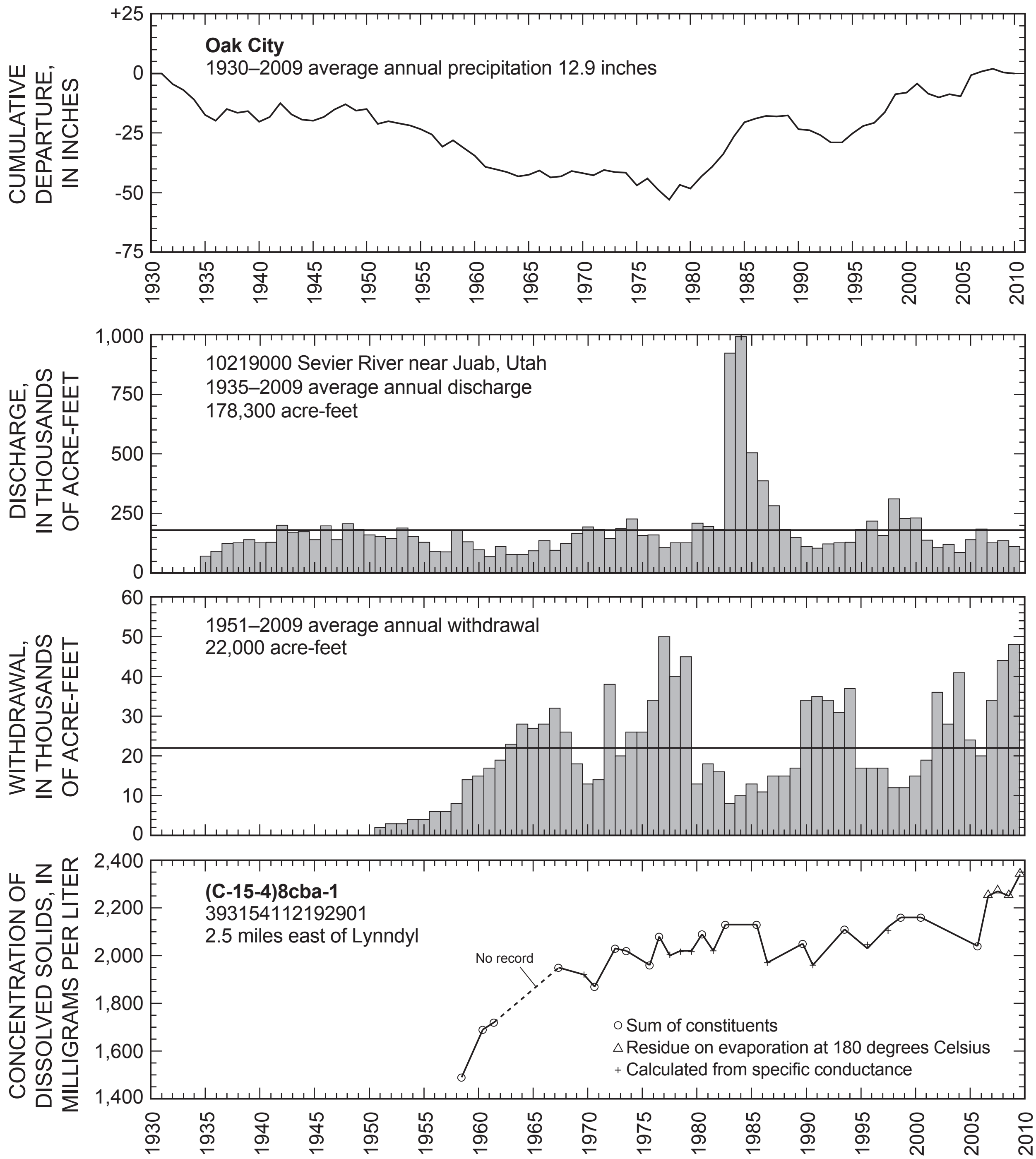


Figure 26. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

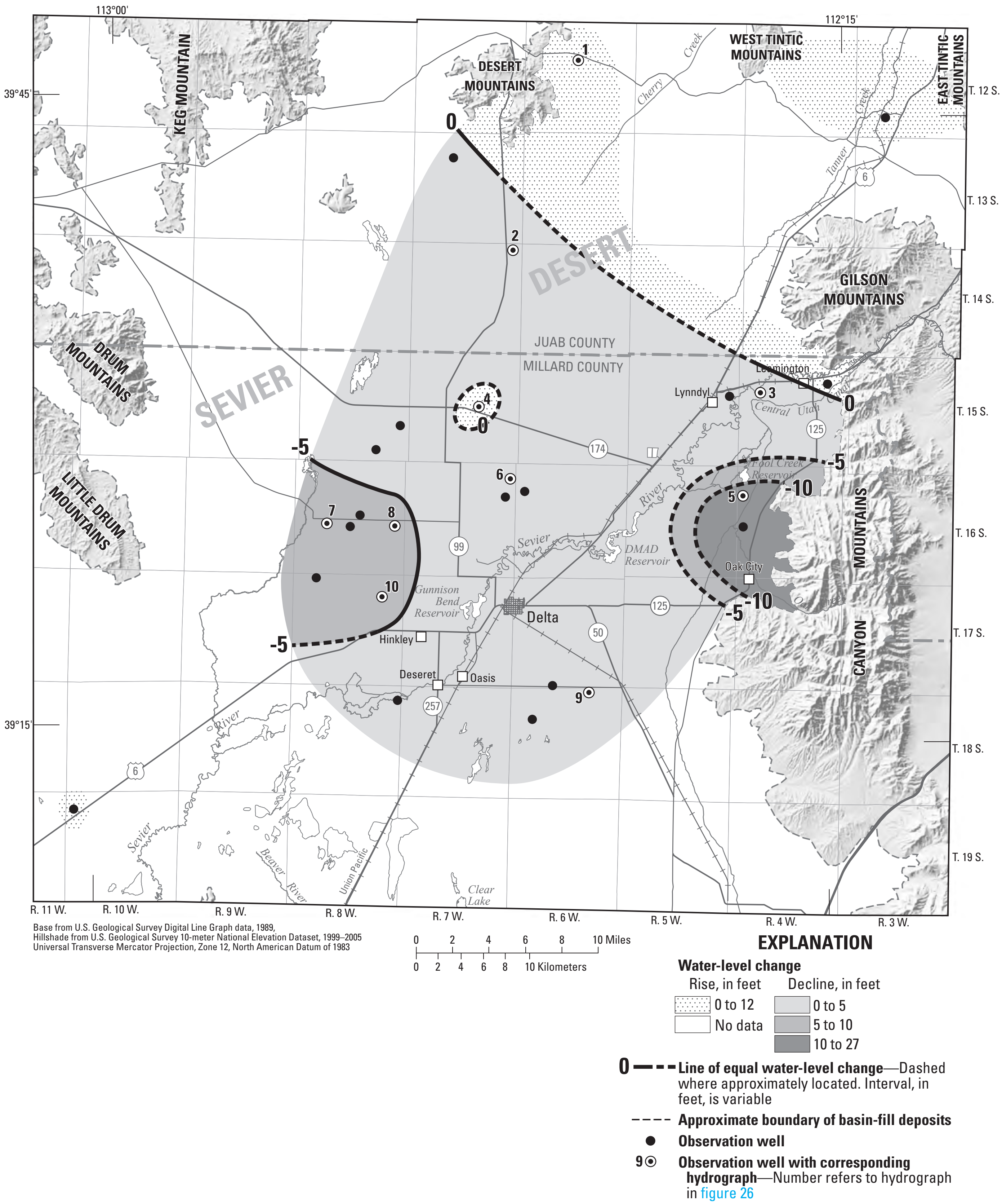


Figure 27. Water-level change in the shallow artesian aquifer in part of the Sevier Desert from March 1980 to March 2010.

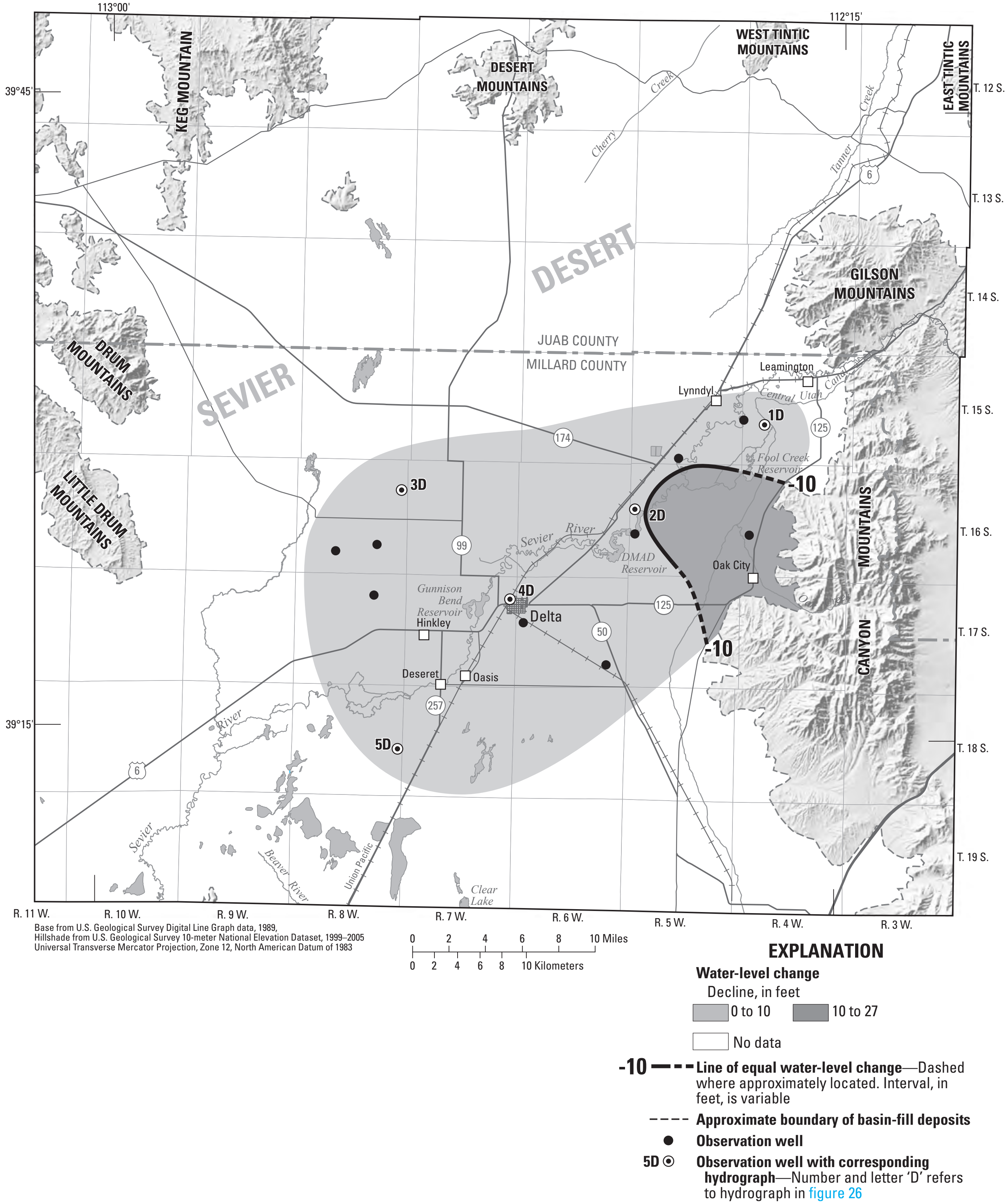


Figure 28. Water-level change in the deep artesian aquifer in part of the Sevier Desert from March 1980 to March 2010.

Central Sevier Valley

By Bradley A. Slaugh

Central Sevier Valley, located in northern Piute, Sevier, and southern Sanpete Counties, 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 (fig. 29). 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. Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in central Sevier Valley in 2009 was about 27,000 acre-feet, which is 3,000 acre-feet more than reported for 2008 and 11,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3).

The location of 24 wells in central Sevier Valley in which the water level was measured during March 2010 is shown in figure 29. 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 30.

Discharge of the Sevier River at Hatch in 2009 was about 67,600 acre-feet. This is about 187,600 acre-feet less than the record high 255,200 acre-feet reported for 2005 (revised value) and about 11,500 acre-feet less than the 1940–2009 average annual discharge. Precipitation at Richfield was about 4.2 inches in 2009, which is about 3.8 inches less than the 1950–2009 average annual precipitation and about 1.6 inches less than in 2008.

Water levels in north-central Sevier Valley generally rose only slightly from March 2009 to March 2010 and declined only slightly in south-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 to the basin-fill aquifer from snowmelt runoff.

Water levels declined from March 1980 to March 2010 in most of central Sevier Valley in areas where data are available (fig. 31). The greatest decline, about 12.9 feet, was observed in a well about 1 mile northeast of Richfield.

Physical properties and records of chemical analyses for water from four wells in central Sevier Valley are listed in tables 4 and 5, and the location of the wells is shown in figure 60. The concentration of dissolved solids in water from well (C-23-2)30baa-2 exceeded the secondary standard for this constituent (500 mg/L). Water from well (C-21-1)13abd-1 exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from well (C-23-2)15dcb-4, located 0.1 mile south of Sevier River in Venice, from 1955 to 2009, is shown in figure 30. The concentration has ranged from 307 to 630 mg/L, with a median value of 416 mg/L. Relative to the median value, there were modest (less than 225 mg/L) increases in dissolved-solids concentrations during the mid- to late 1960s and 1980s. Samples collected from 1990 through 2009 show little variation and are in close agreement with the median value.

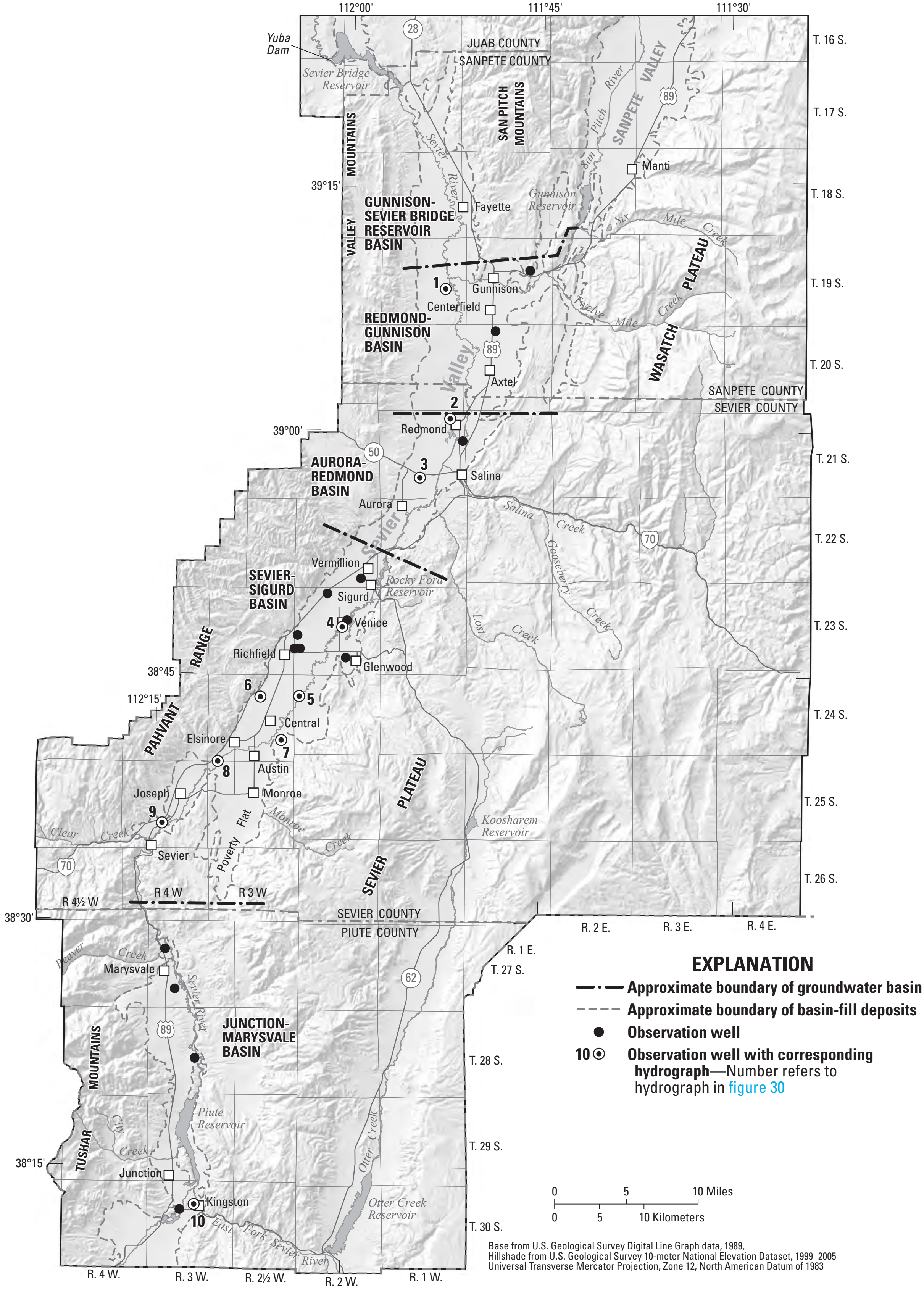


Figure 29. Location of wells in central Sevier Valley in which the water level was measured during March 2010.

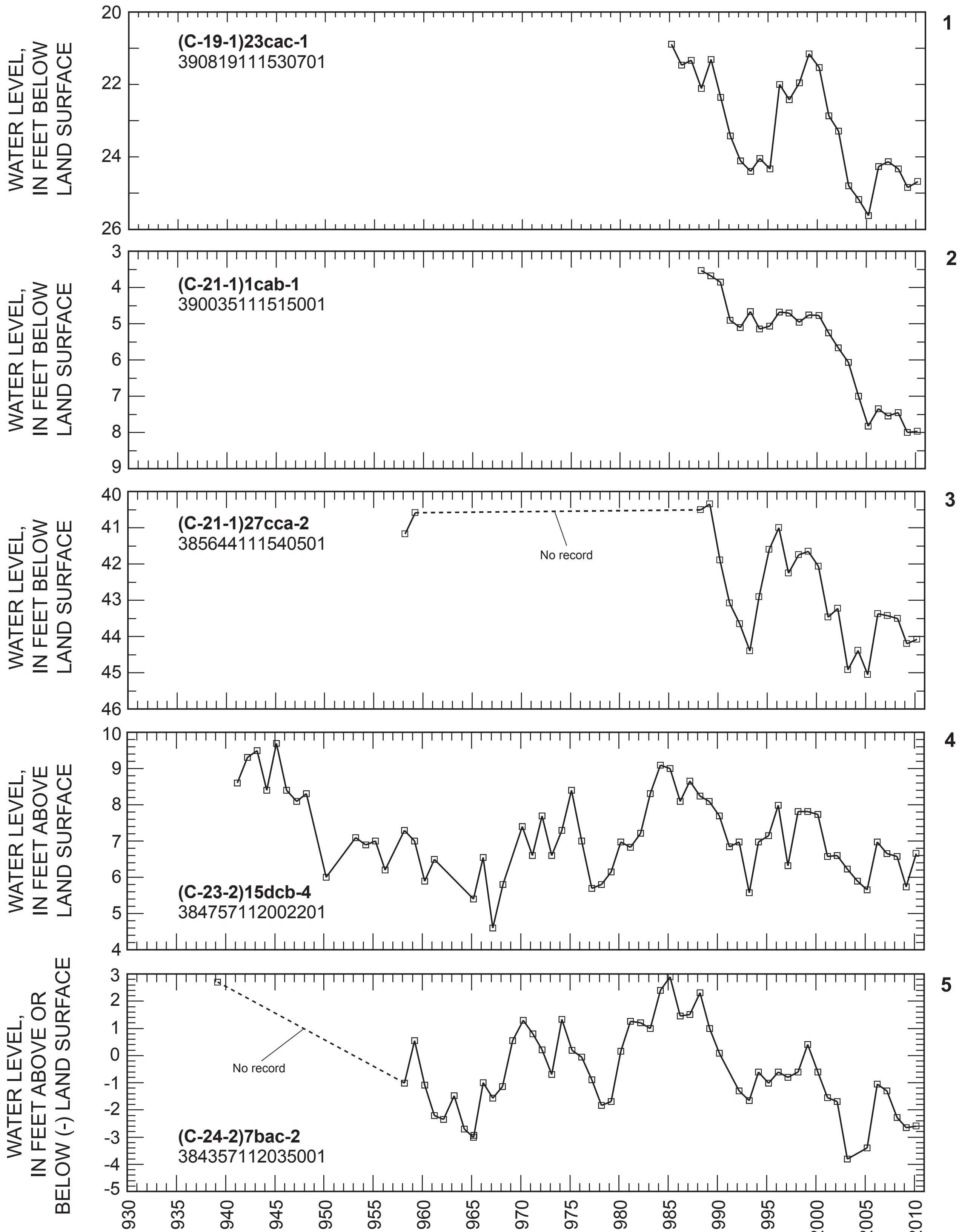


Figure 30. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

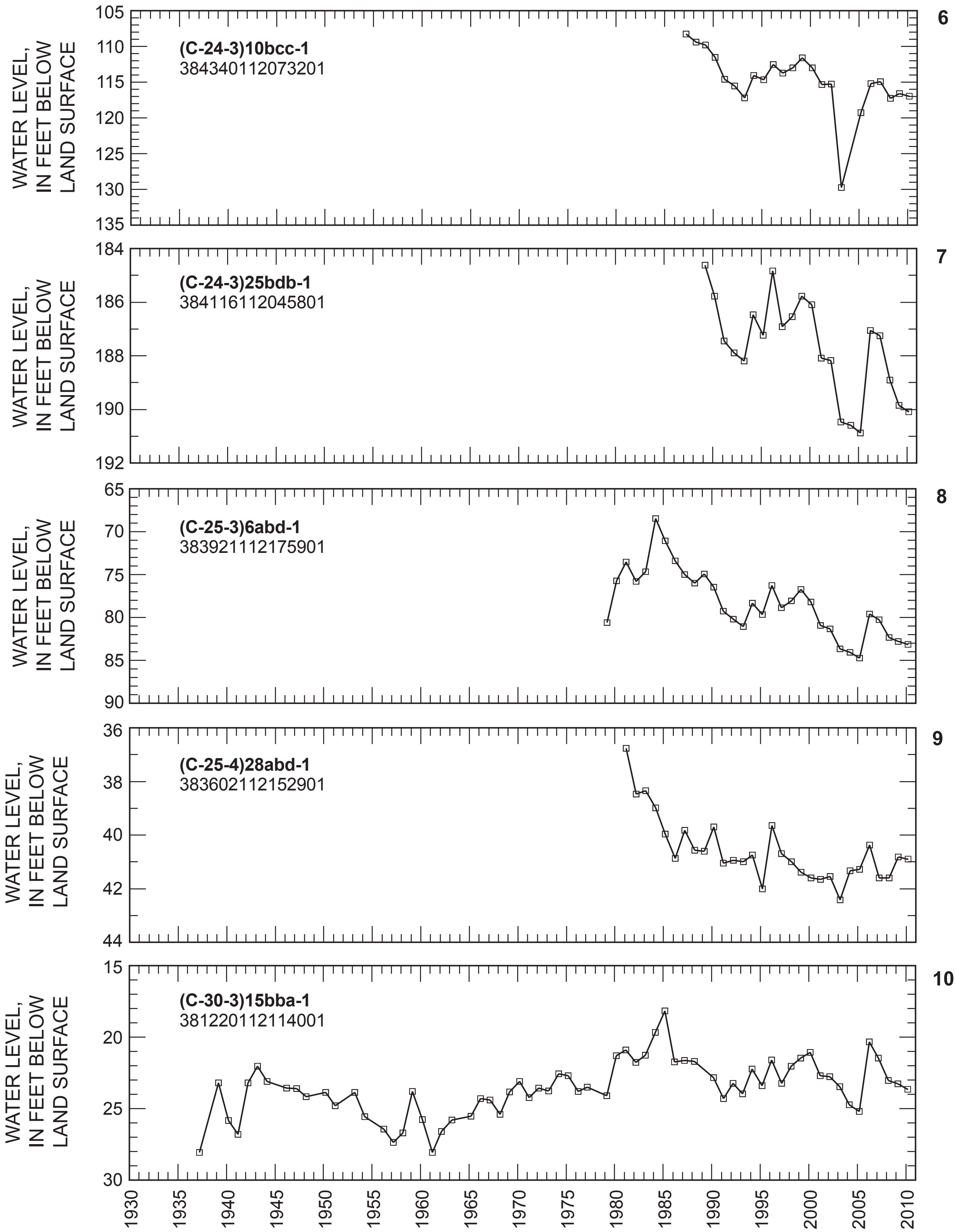


Figure 30. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.—Continued

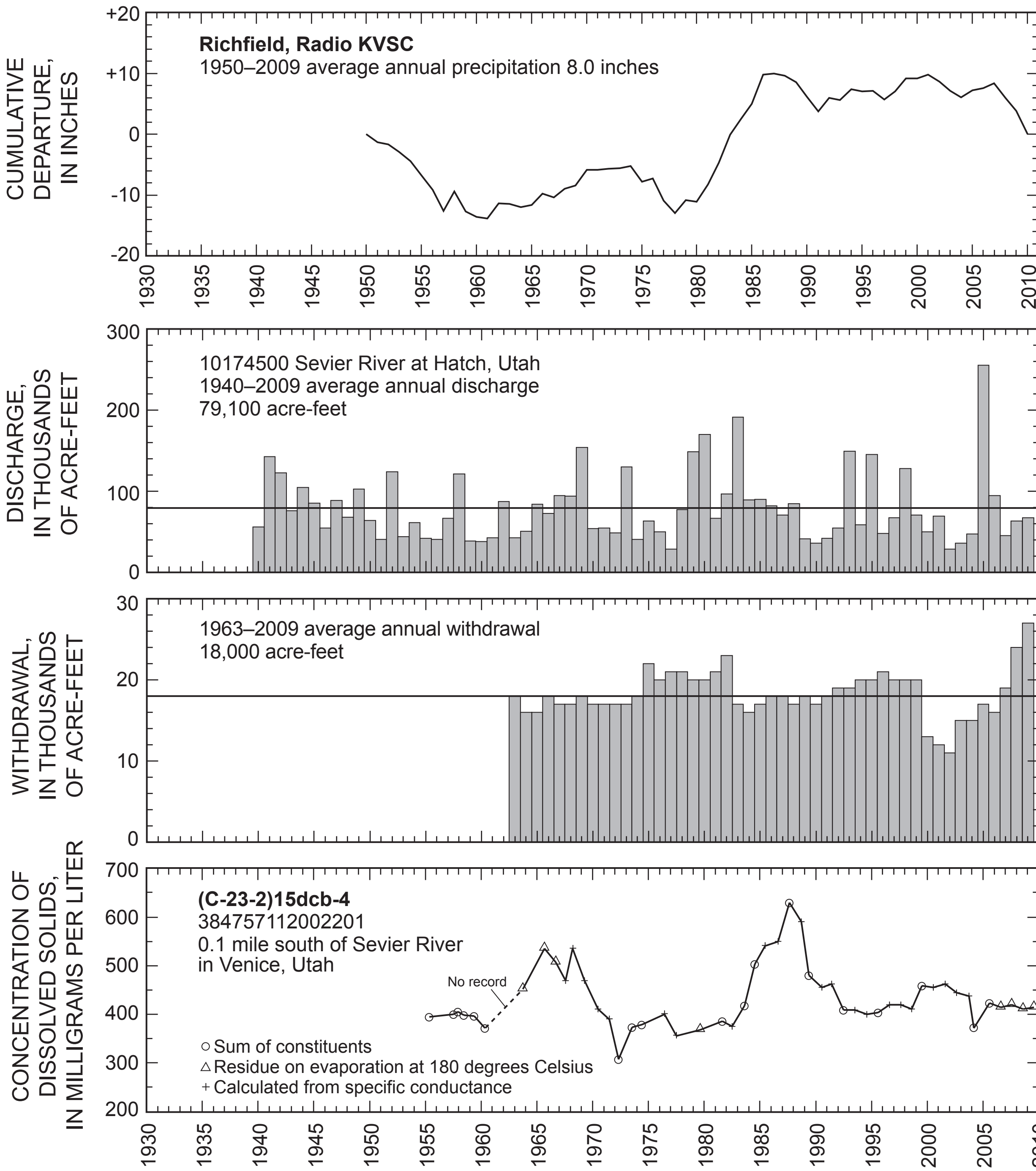


Figure 30. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.—Continued

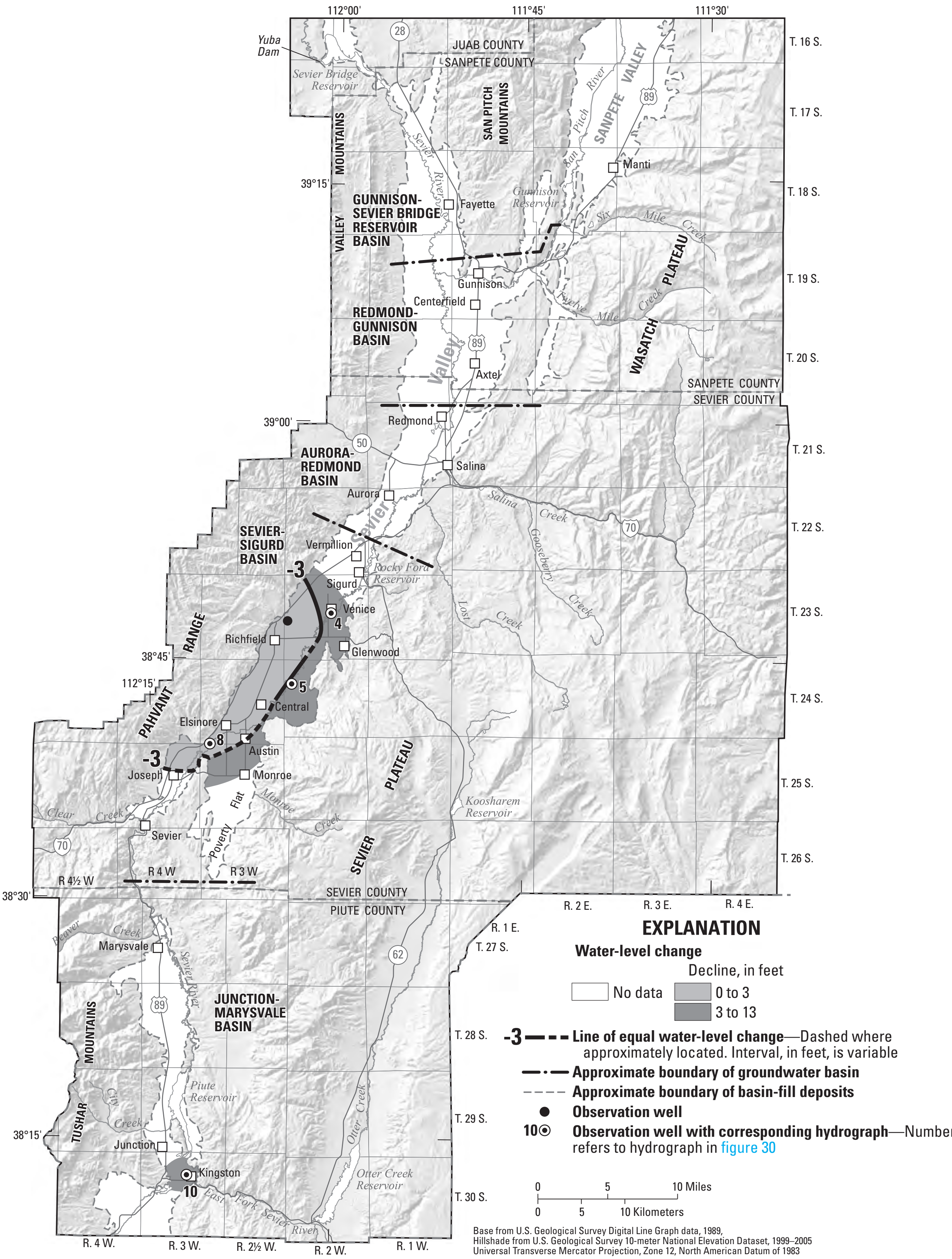


Figure 31. Water-level change in central Sevier Valley from March 1980 to March 2010.

Pahvant Valley

By Robert L. Swenson

Pahvant Valley, in southeastern Millard County, extends from the vicinity of McCornick in the north to Kanosh in the south, and from the Pahvant Range and Canyon Mountains on the east and northeast to a low basalt ridge known as The Cinders on the west (fig. 32). The area of the valley covers about 300 square miles. Groundwater drains west to the valley from the mountainous terrain to the east. Groundwater occurs in basin-fill deposits in the valley under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Pahvant Valley in 2009 was about 104,000 acre-feet, which is about 10,000 acre-feet more than was reported in 2008 and 20,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3). Withdrawal for irrigation in 2009 was about 103,100 acre-feet, which is 10,200 acre-feet more than was reported in 2008.

The location of wells in Pahvant Valley in which water levels were measured during March 2010 is shown in figure 32. 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 33.

Precipitation at Fillmore during 2009 was about 11.8 inches, which is about 3.3 inches less than the average annual precipitation for 1930–2009 and about 1.3 inches less than in 2008.

Water levels declined slightly in most of the wells measured in Pahvant Valley from March 2009 to March 2010. Declines in wells west of Flowell were generally less than 1.6 feet. Water levels rose slightly in two wells west of Hatton. 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. Water levels generally have declined throughout the valley since 1985.

Water levels from March 1980 to March 2010 generally declined throughout most of the valley with the exception of the extreme southwestern part, where water levels rose (fig. 34). The declines are probably the result of continued large withdrawals for irrigation. Declines of up to about 80 feet occurred in the area around McCornick. Rises of up to 6 feet were observed southwest of Kanosh. Rises are probably the result of decreased local withdrawals.

Physical properties and records of chemical analyses for water from four wells in Pahvant Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. The dissolved-solids concentration in water samples from wells (C-21-5)7cdd-3 and (C-23-6)21add-1 exceeded the secondary standard (500 mg/L). The water sample from well (C-23-6)28bbb-2 exceeded secondary standards for chloride (250 mg/L), sulfate (250 mg/L), and dissolved solids (500 mg/L), and the MCLs for dissolved solids (2,000 mg/L) and nitrite plus nitrate (10 mg/L).

The concentration of dissolved solids in water samples collected from wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3, located in the Flowell area, from 1957 to 2009, and from well (C-23-6)8abd-1, located in the Kanosh area, from 1957 to 2008, is shown in figure 33. Wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3 are located near each other and are finished in the same aquifer. The dissolved-solids concentrations in water samples from these wells were combined to give an extended temporal record for this constituent. Dissolved-solids concentrations in water samples from wells in the Flowell area have ranged from 707 to 1,080 mg/L, with a median value of 874 mg/L. The water sample collected in August 2009 had a dissolved-solids concentration of 1,020 mg/L, similar to samples collected in August 2007 (1,040 mg/L) and 2008 (1,010 mg/L). The concentration of dissolved solids in water samples from well (C-23-6)8abd-1 has ranged from 2,350 to 5,990 mg/L, with a median value of 4,230 mg/L. This well was not sampled in 2009; however, the sample collected in August 2008 had a dissolved-solids concentration of 4,600 mg/L.

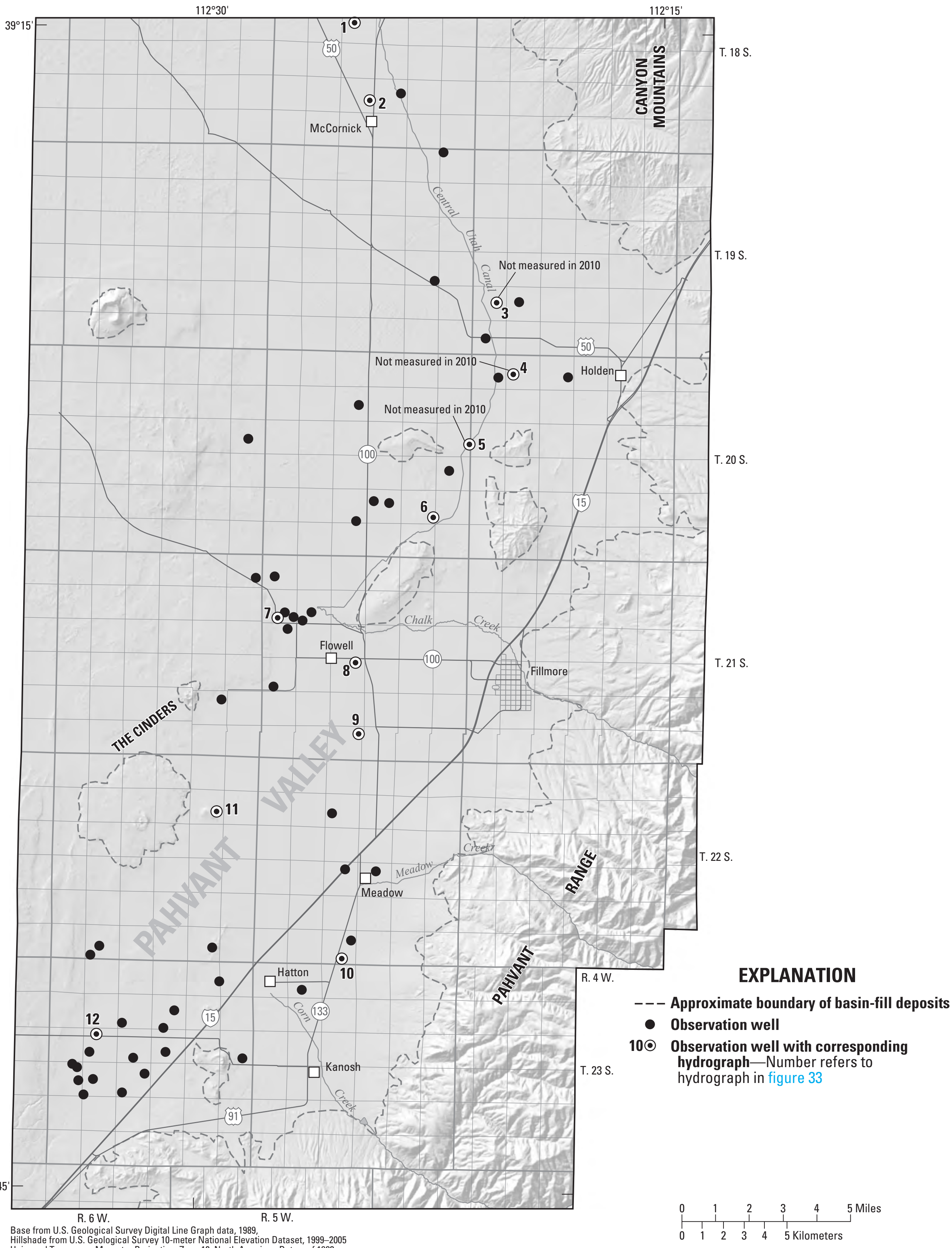


Figure 32. Location of wells in Pahvant Valley in which the water level was measured during March 2010.

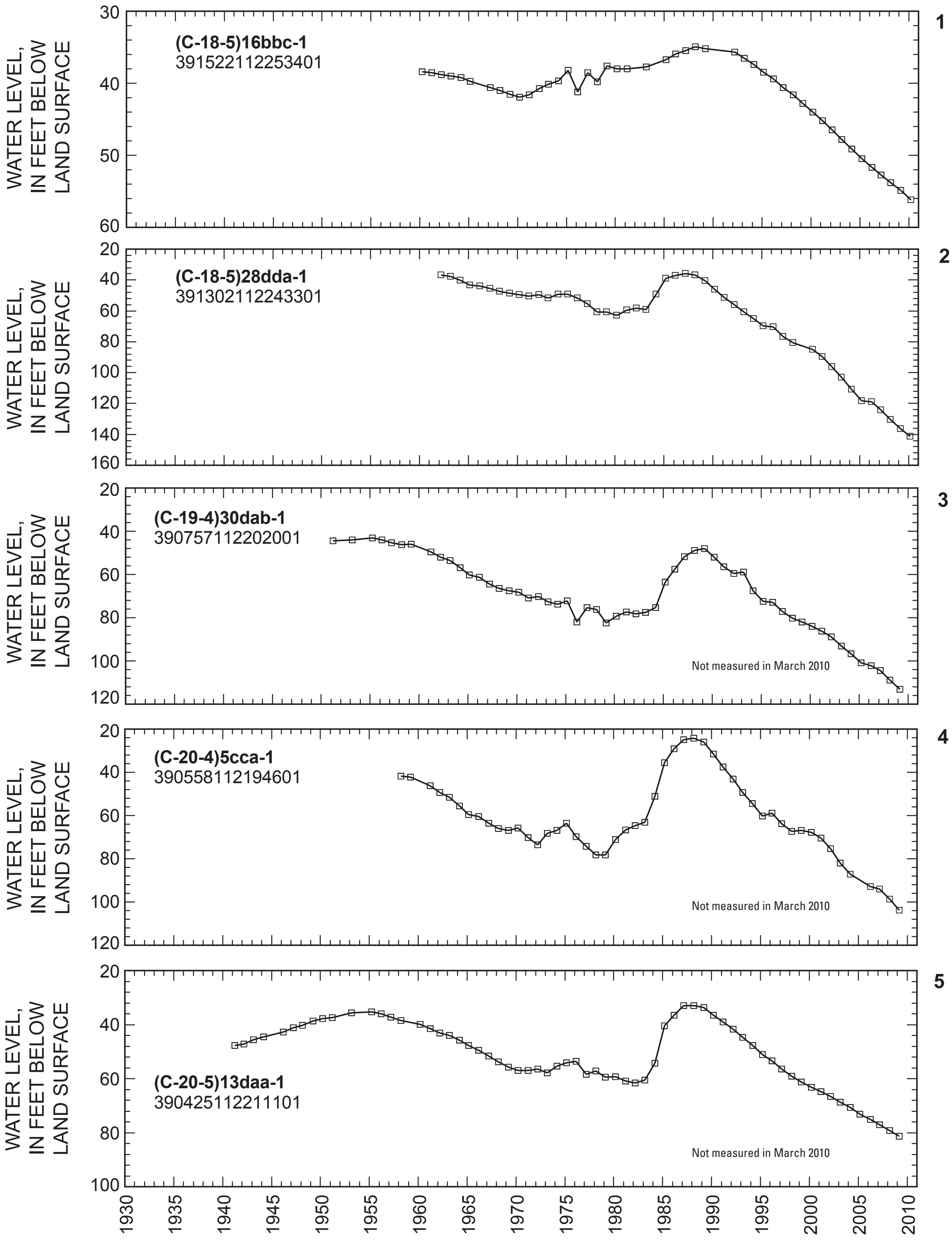


Figure 33. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

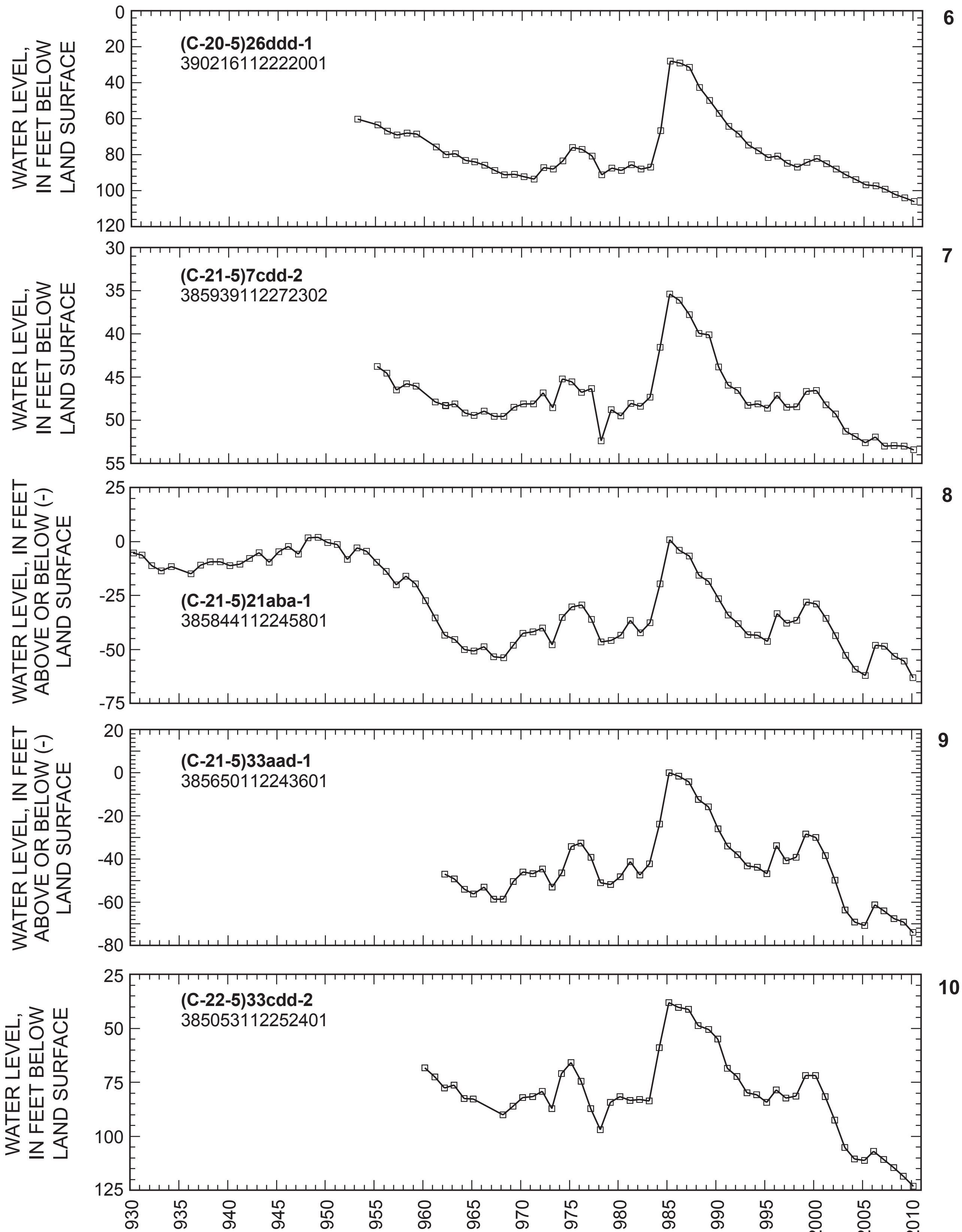


Figure 33. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

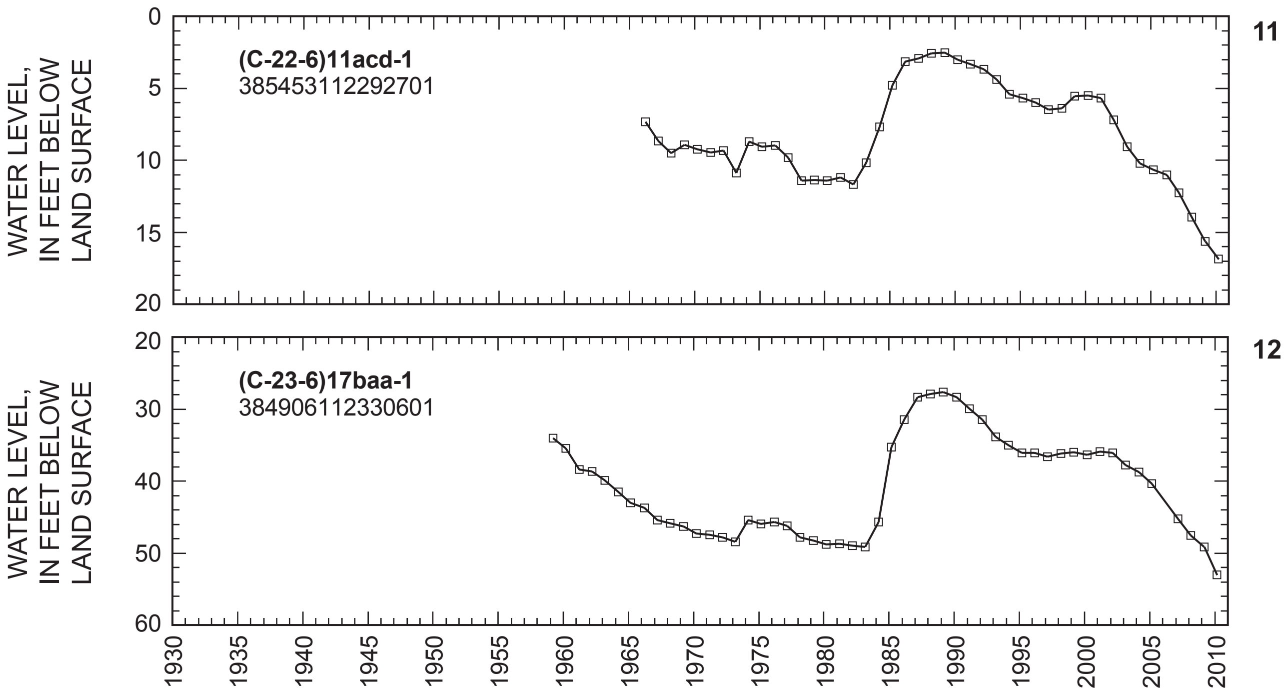


Figure 33. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

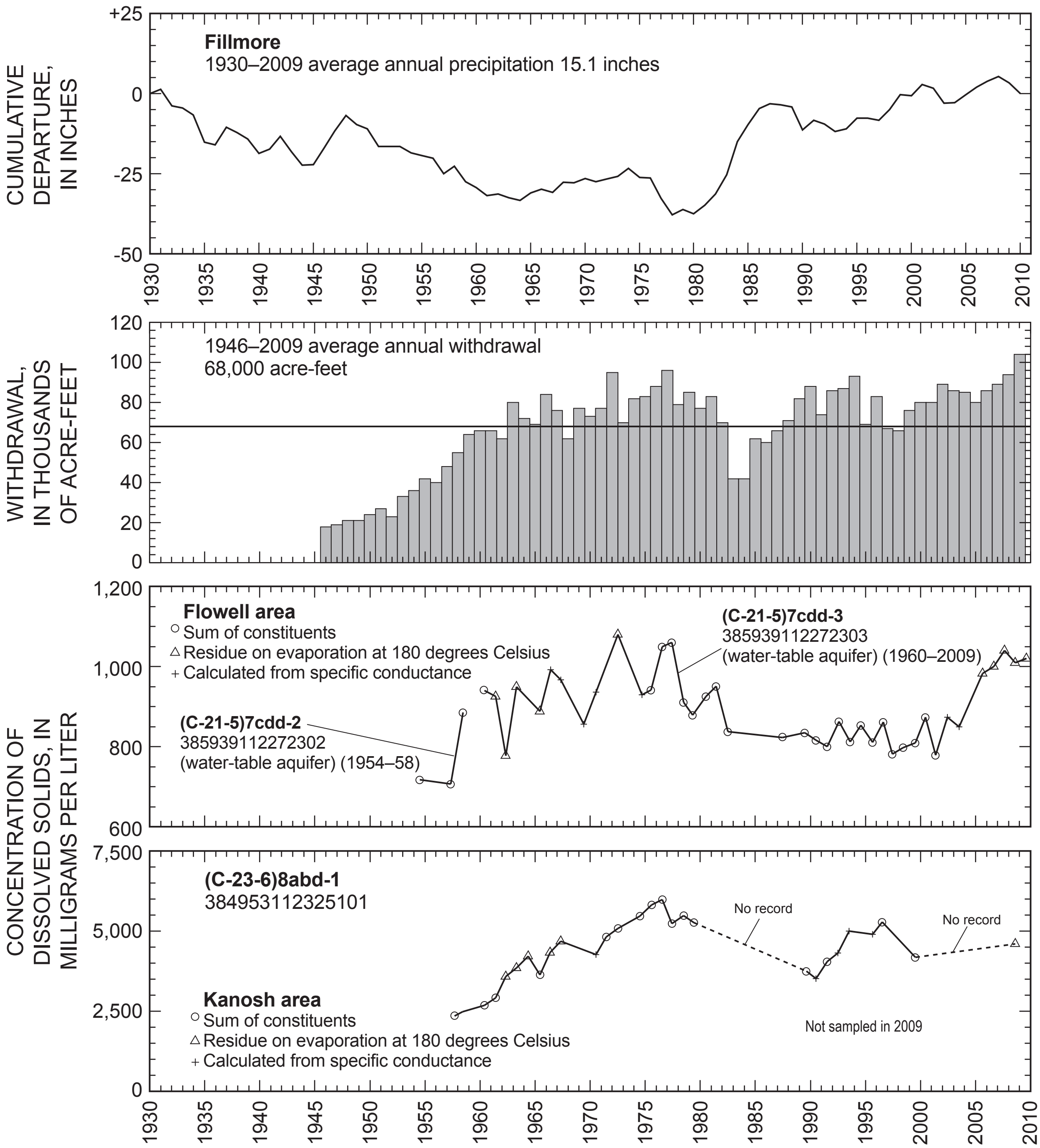


Figure 33. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

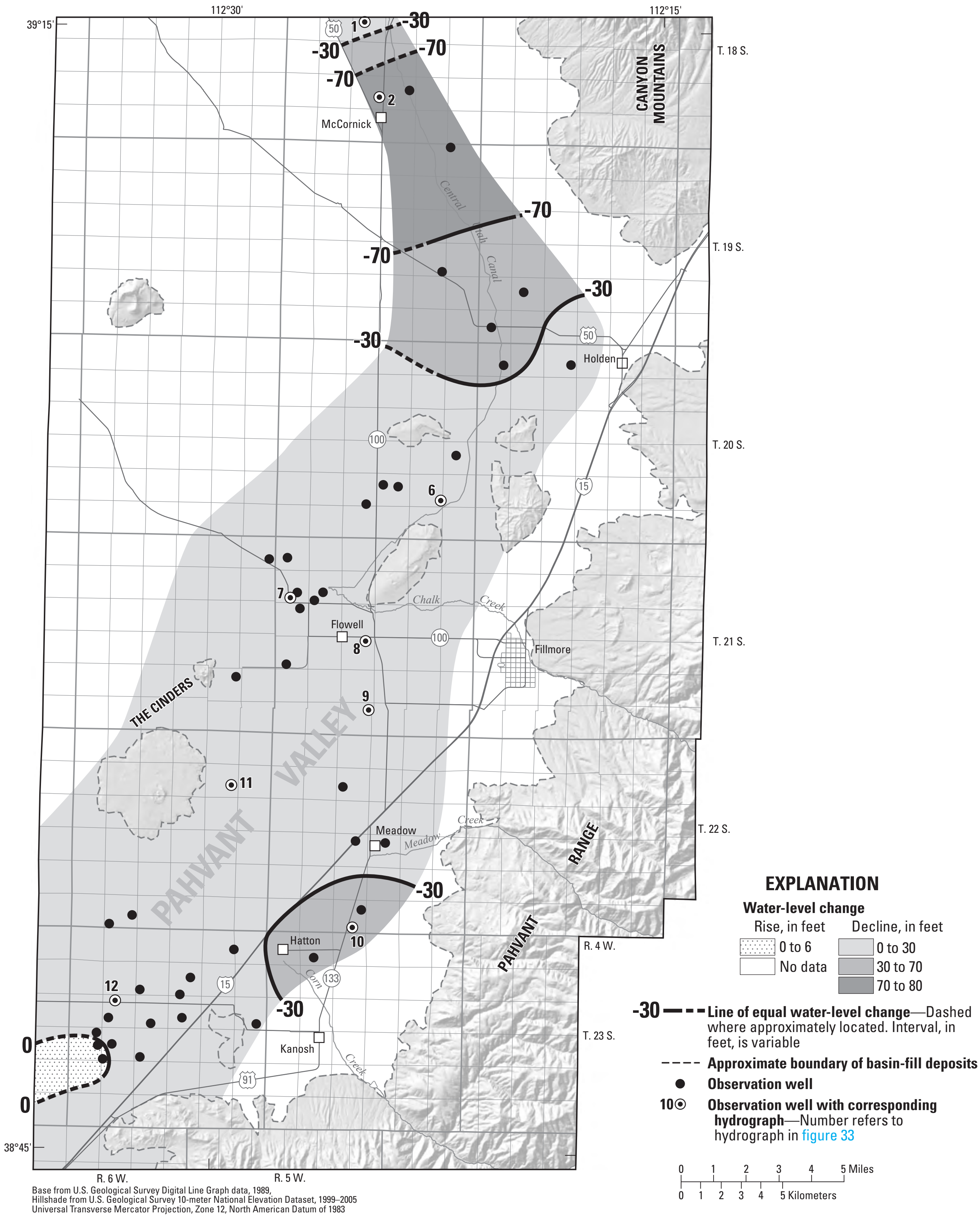


Figure 34. Water-level change in Pahvant Valley from March 1980 to March 2010.

Cedar Valley, Iron County

By James H. Howells

Cedar Valley is in eastern Iron County, southwestern Utah. The valley covers about 220 square miles from the vicinity of Rush Lake in the north to the community of Kanarraville in the south and includes Cedar City on its eastern edge (fig. 35). Groundwater in Cedar Valley occurs in unconsolidated basin-fill deposits, mostly under water-table conditions. The principal source of recharge to the basin-fill aquifer is water from Coal Creek, some of which seeps directly from the stream channel into the groundwater system.

Total estimated withdrawal of water from wells in Cedar Valley in 2009 was about 38,000 acre-feet, which is 2,000 acre-feet less than in 2008 and 2,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3).

The location of wells in Cedar Valley in which the water level was measured during March 2010 is shown in figure 35. 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 36.

Precipitation at Cedar City Federal Aviation Administration Airport in 2009 was about 8.9 inches, which is about 0.7 inch less than in 2008 and about 1.7 inches less than the average annual precipitation for 1949–2009. Discharge of Coal Creek was about 21,600 acre-feet in 2009, which is 4,000 acre-feet more than in 2008, and 2,700 acre-feet less than the average annual discharge for 1936 and 1939–2009.

Groundwater levels generally declined from March 2009 to March 2010 in most parts of Cedar Valley. The largest declines, about 4 feet, were measured in three wells west of Quichapa Lake. Water-level rises were measured in several wells in the northern part of the valley. Water-level declines probably resulted from continued localized large withdrawals for irrigation and municipal use. Water-level rises probably resulted from locally decreased withdrawals.

Groundwater levels declined from March 1980 to March 2010 in most of Cedar Valley in areas for which data are available (fig. 37). The largest decline, almost 49 feet, was observed in a well west of Hamilton Fort. The decline in water levels probably resulted from continued large withdrawals for irrigation and public supply. Small rises in water levels of up to 1 foot were observed in two wells in the northern part of the valley.

Physical properties and records of chemical analyses for water from five wells in Cedar Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. Water samples from wells (C-35-11)31dbd-1, (C-36-11)18bdd-1, and (C-37-12)23acb-1 exceeded the secondary standards for dissolved solids (500 mg/L) and sulfate (250 mg/L). The concentration of dissolved solids in water from well (C-37-12)34abb-1 also exceeded the secondary standard for this constituent.

The concentration of dissolved solids in water samples collected from well (C-37-12)23acb-1, located 2.3 miles northeast of Kanarraville, from 1966 to 2009, and well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, from 1977 to 2009, is shown in figure 36. Dissolved-solids concentration in water from well (C-37-12)23acb-1 has ranged from 347 to 961 mg/L, with a median value of 491 mg/L; the concentration of dissolved solids from 1966 to 2009 has generally increased. For well (C-35-11)31dbd-1, the concentration of dissolved solids in water samples has ranged from 364 to 1,020 mg/L, with a median value of 514 mg/L. From 1987 to 2009, the concentration has generally increased.

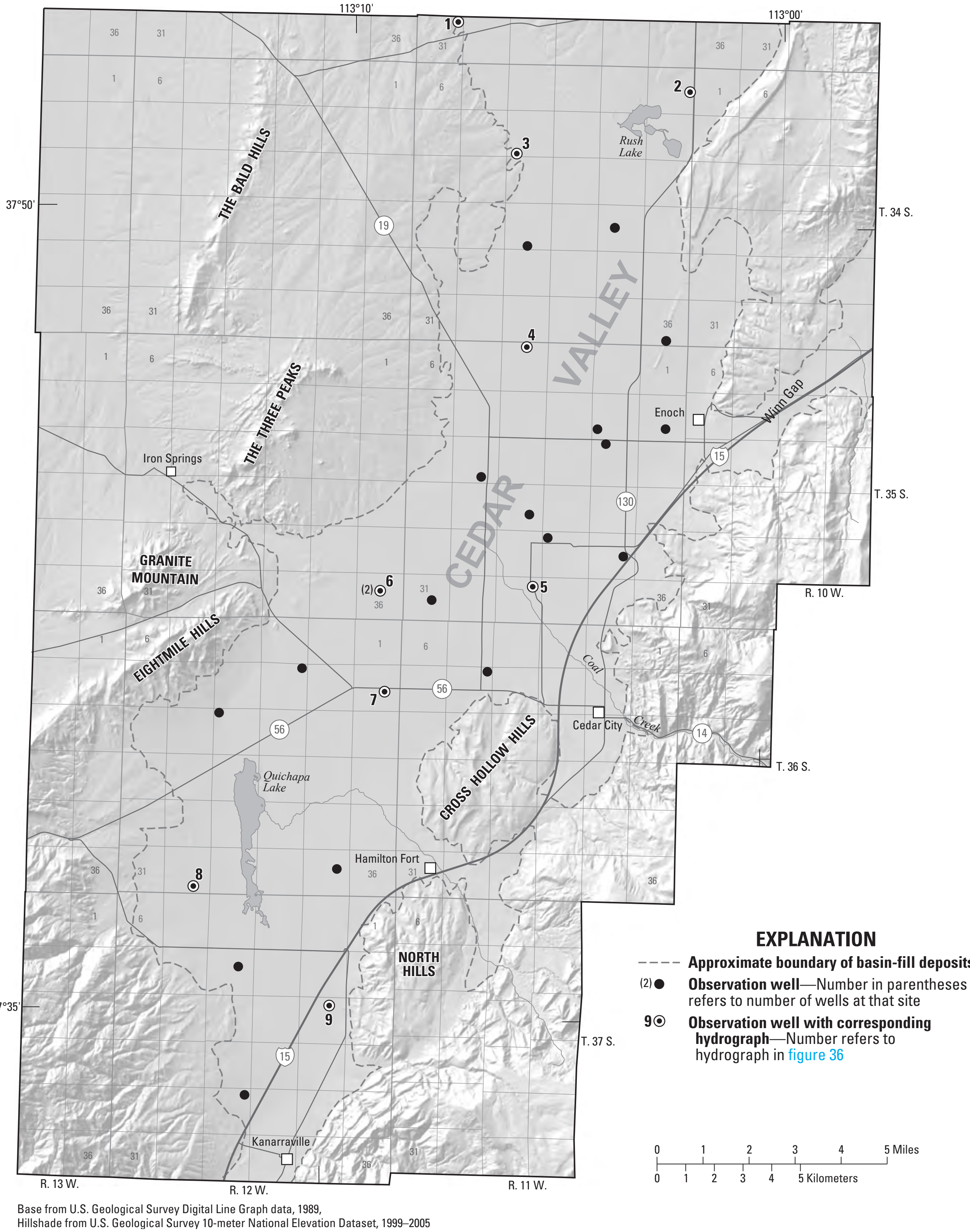


Figure 35. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2010.

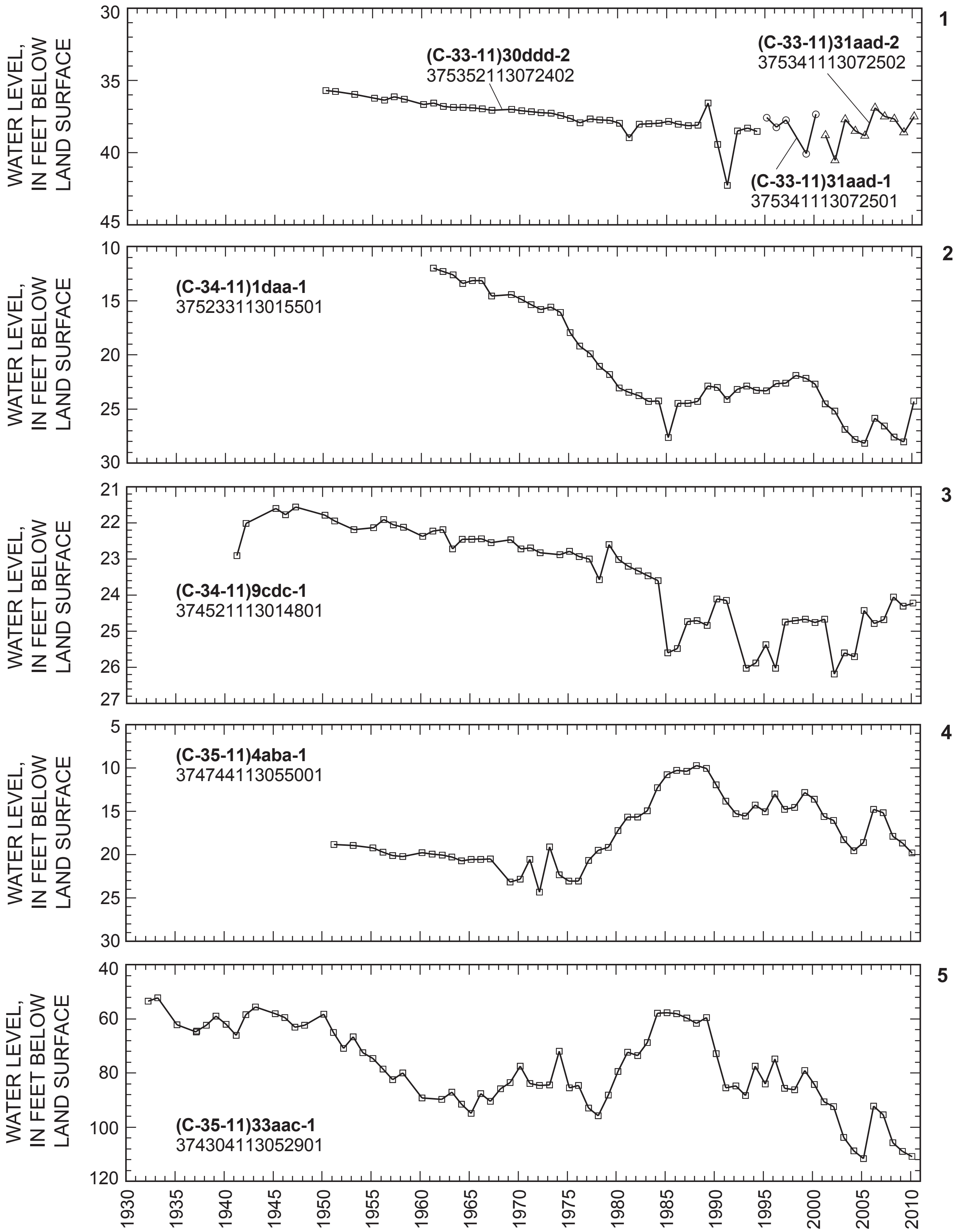


Figure 36. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

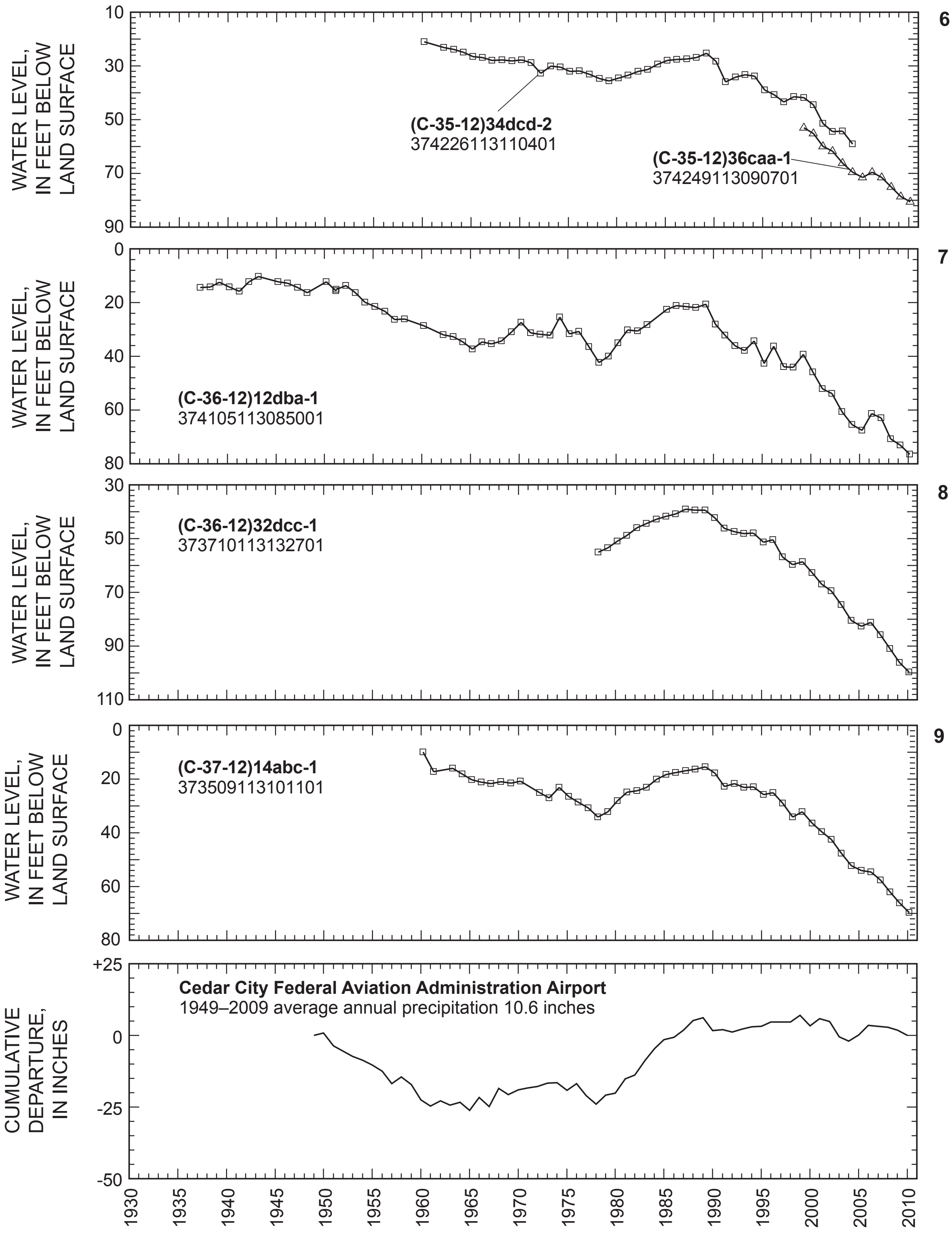


Figure 36. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

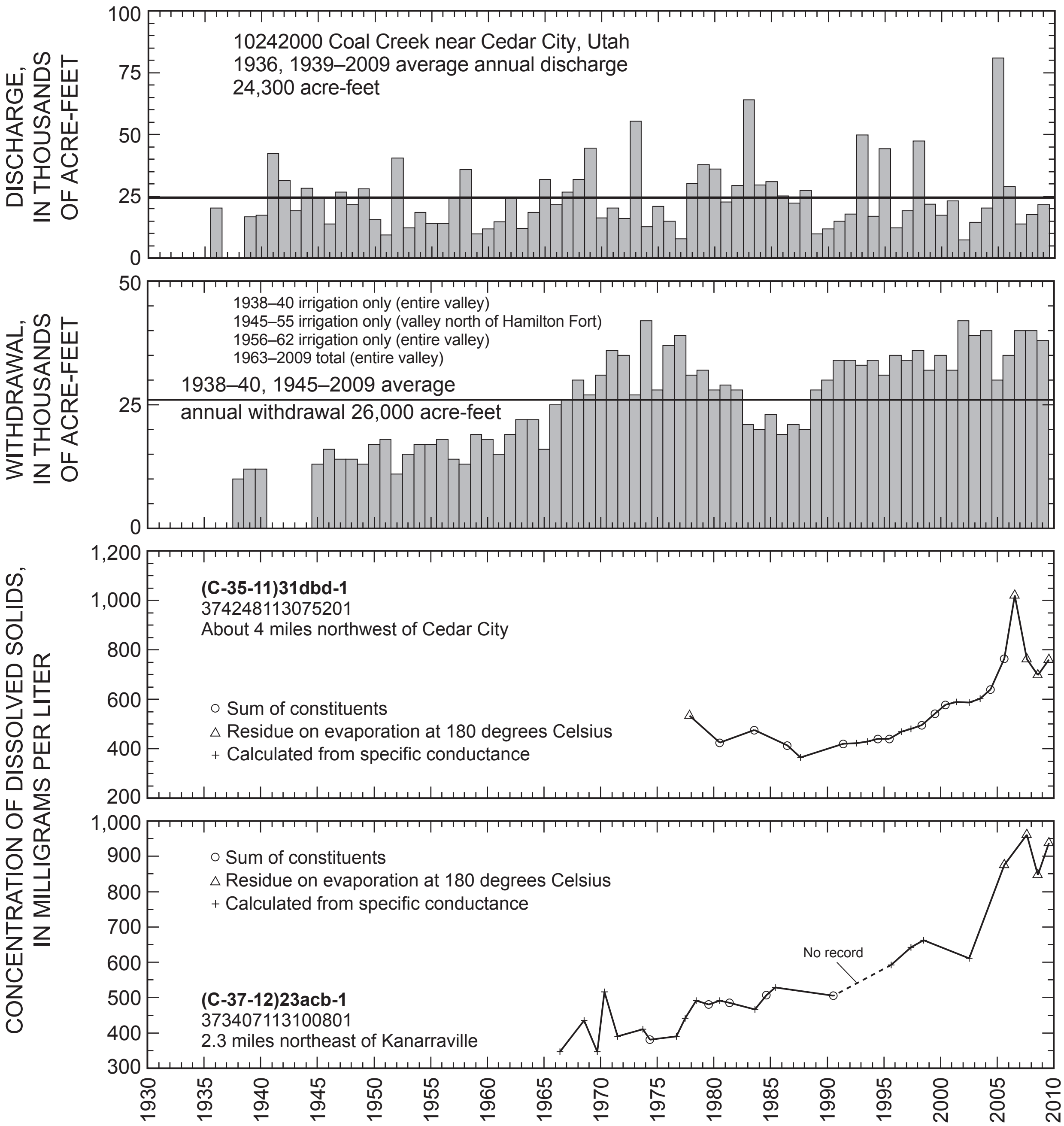


Figure 36. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

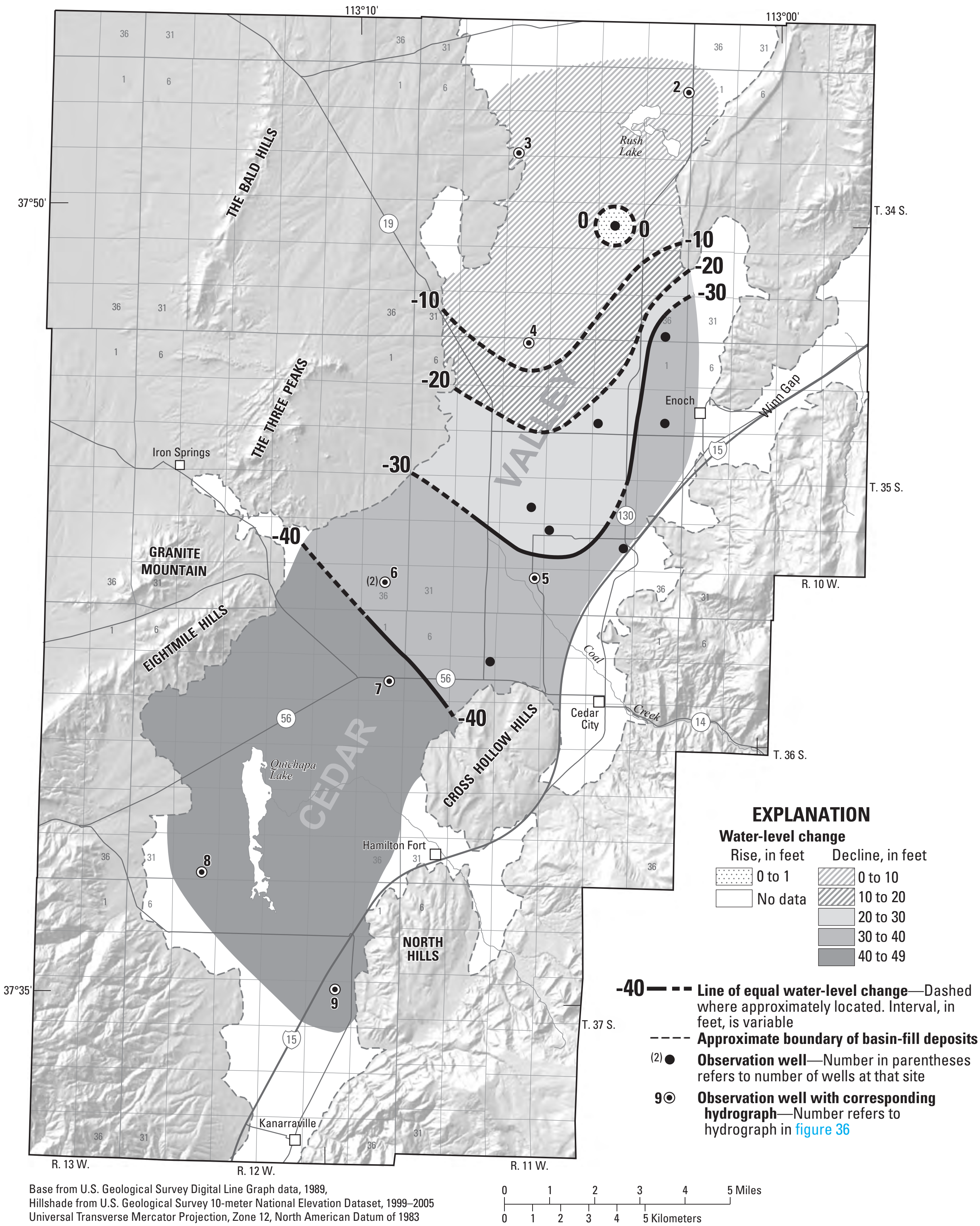


Figure 37. Water-level change in Cedar Valley, Iron County, from March 1980 to March 2010.

Parowan Valley

By James H. Howells

Parowan Valley is in northern Iron County, southwestern Utah. The valley covers about 160 square miles west of the Hurricane Cliffs and includes the towns of Paragonah and Parowan (fig. 38). Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Parowan Valley in 2009 was about 37,000 acre-feet, which is about 1,000 acre-feet less than was reported for 2008 and 4,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3). The decrease is mainly due to decreased withdrawals for irrigation.

The location of wells in Parowan Valley in which the water level was measured during March 2010 is shown in figure 38. 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 39.

Precipitation at Cedar City Federal Aviation Administration Airport in 2009 was about 8.9 inches, which is about 0.7 inch less than the value for 2008 and 1.7 inches less than the average annual precipitation for 1949–2009.

Water levels declined from March 2009 to March 2010 in parts of Parowan Valley for which data are available. The largest declines, greater than 3 feet, were measured in wells north and west of Parowan. Water levels in Parowan Valley generally have declined since 1950. Some rises occurred during 1973–74, 1983–85, 1996–99, and 2006. Declines are probably the result of continued large withdrawals for irrigation. Rises are probably the result of less withdrawal for irrigation and several years of greater-than-average precipitation.

Water levels declined from March 1980 to March 2010 in all parts of Parowan Valley for which data are available (fig. 40). The largest decline, more than 62 feet, occurred in a well northeast of Paragonah. The decline in water levels probably resulted from increased withdrawals for irrigation.

Physical properties and records of chemical analyses for water from three wells in Parowan Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. Water samples from wells (C-33-8)22bbc-2 and (C-33-9)14dbd-2 exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from well (C-33-8)31ccc-1, located 2 miles west of Paragonah, from 1961 to 2009, is shown in figure 39. The concentration has ranged from 257 to 885 mg/L, with a median value of 294 mg/L. The water sampled collected in July 2009 had a dissolved-solids concentration of 272 mg/L. With the exception of relatively high dissolved-solids concentrations in water samples collected in 1970, 1973, and 1974, concentrations have varied little.

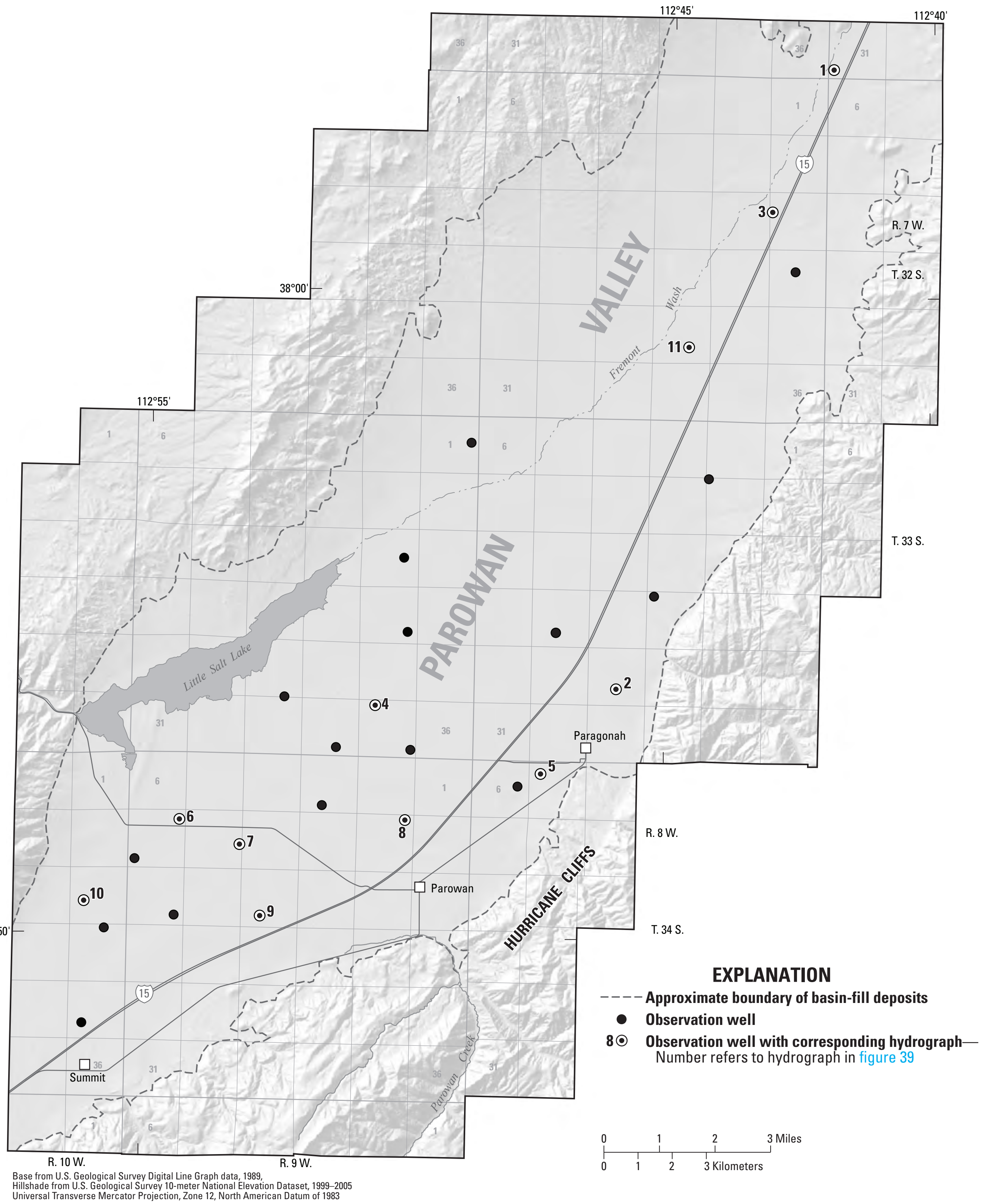


Figure 38. Location of wells in Parowan Valley in which the water level was measured during March 2010.

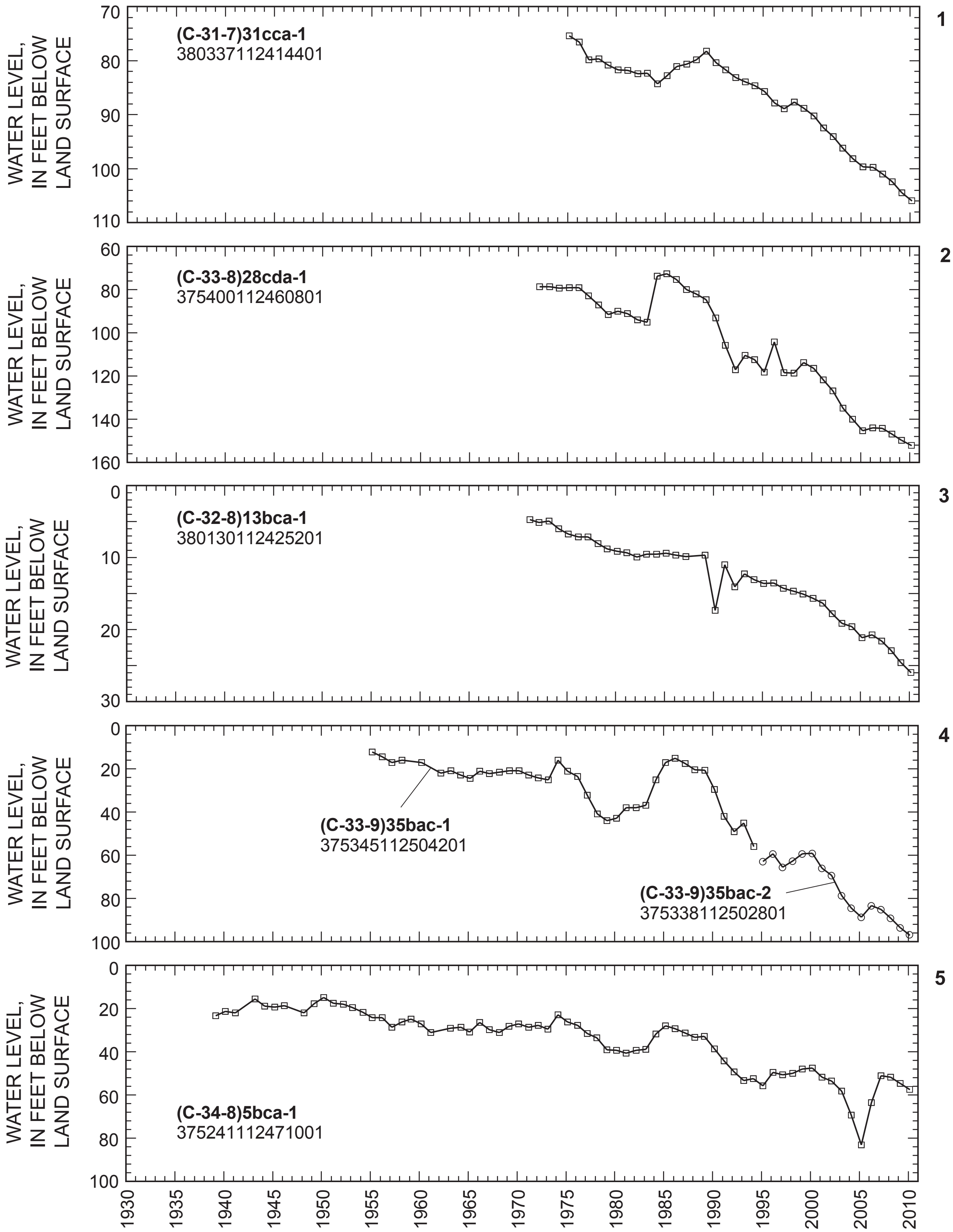


Figure 39. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

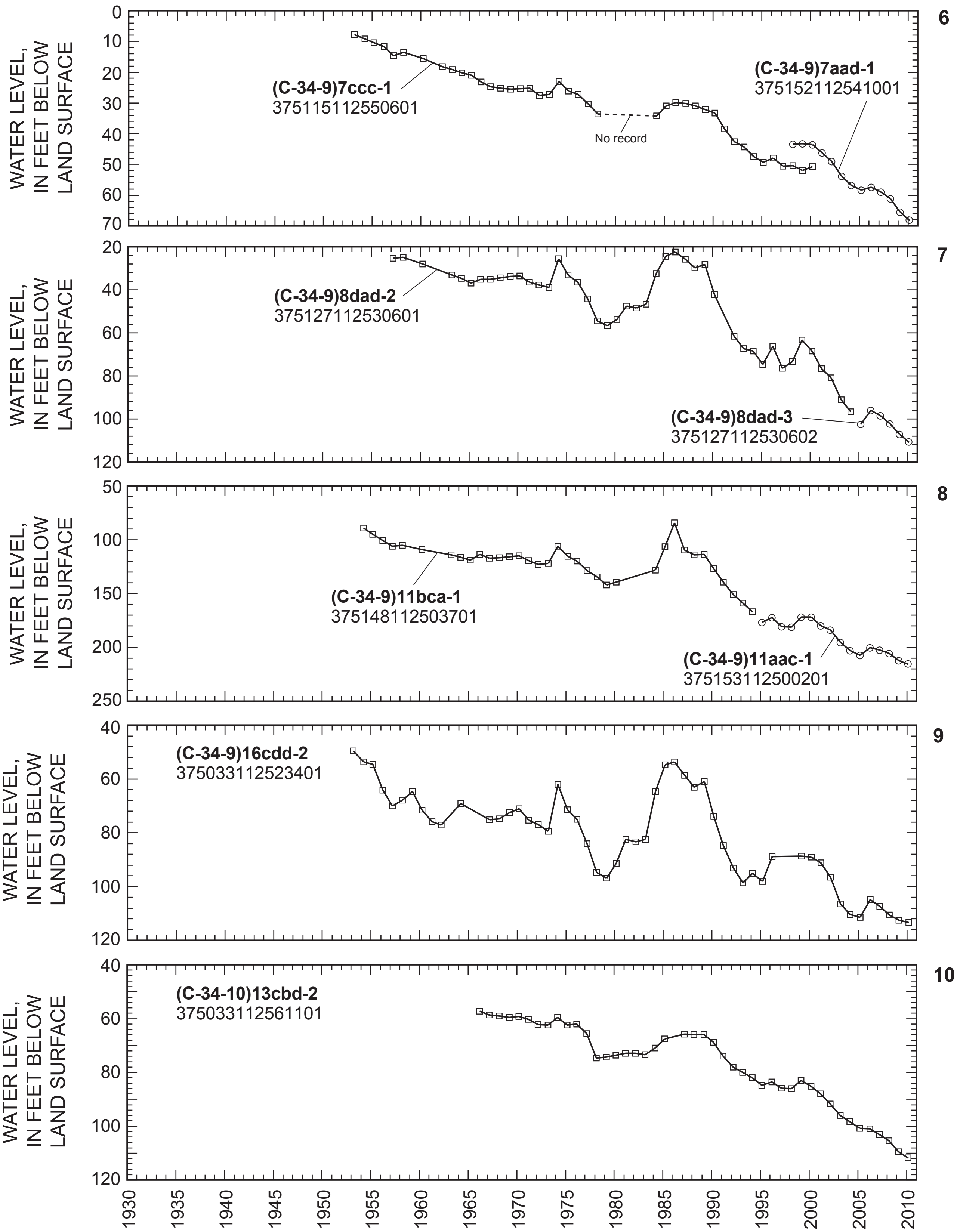


Figure 39. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

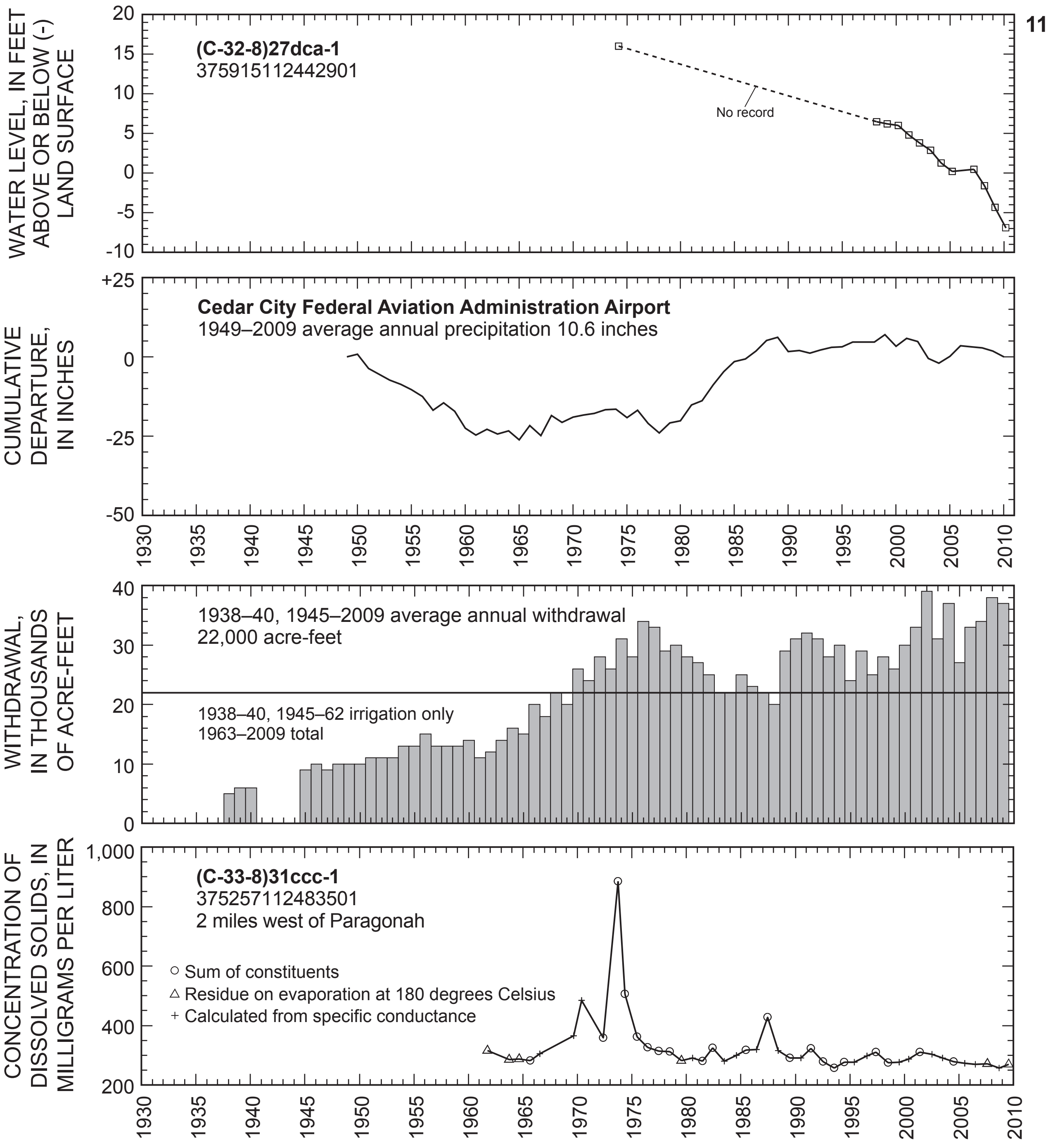


Figure 39. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

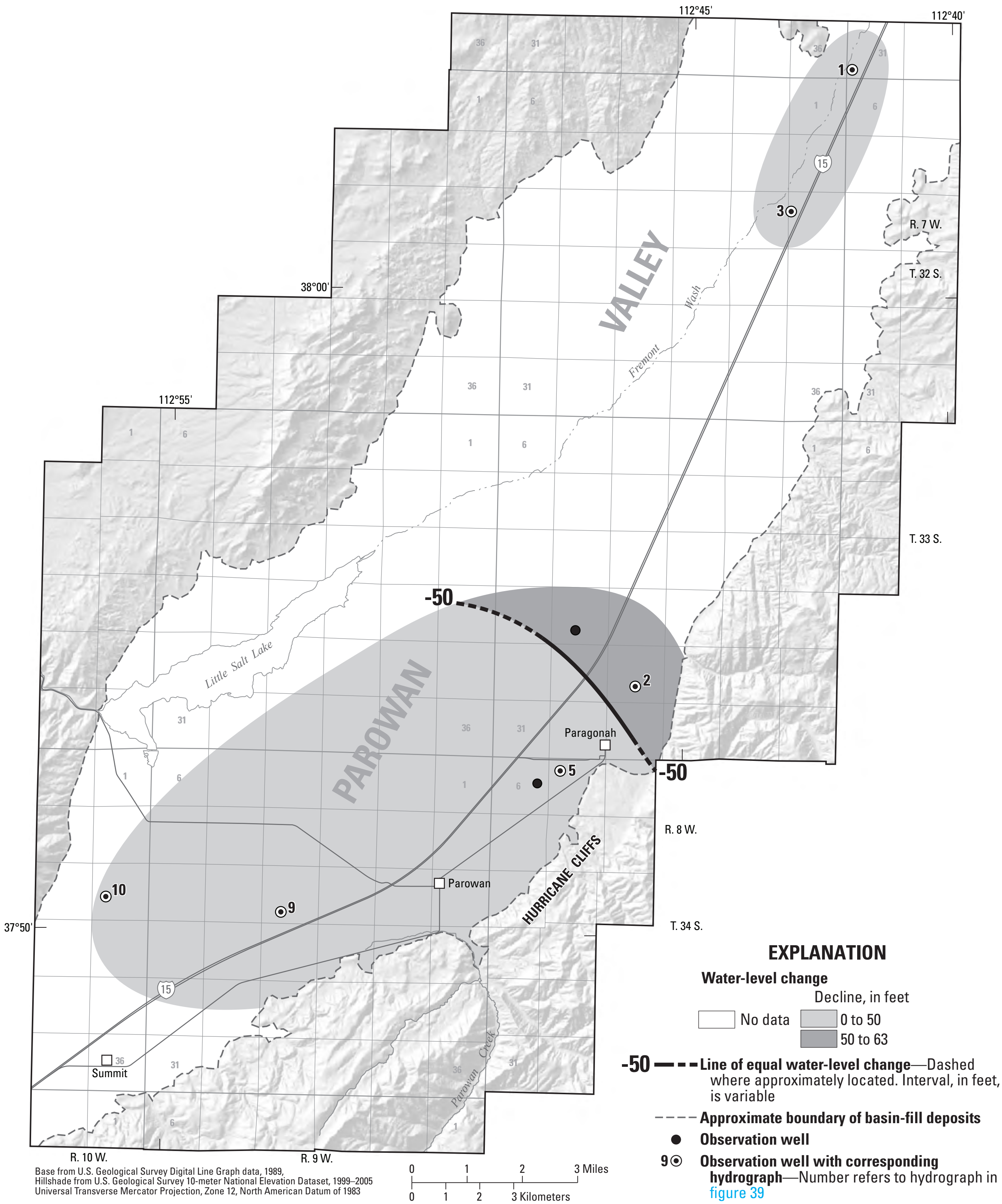


Figure 40. Water-level change in Parowan Valley from March 1980 to March 2010.

Escalante Valley

Milford Area

By Bradley A. Slaugh

The Milford area is in southwestern Utah and includes that part of Escalante Valley lying entirely within Beaver County west of the Mineral Mountains, the southern part of Millard County, and a small area in the northern part of Iron County (fig. 41). Groundwater occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Milford area of Escalante Valley in 2009 was about 56,000 acre-feet, which is 5,000 acre-feet more than was reported for 2008 and 10,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3). This increase was mostly the result of increased withdrawal for irrigation.

The location of 32 wells in the Milford area in which the water level was measured during March 2010 is shown in figure 41. The relation of the water level in selected observation wells 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)5cdd-2 is shown in figure 42.

Precipitation at Black Rock in 2009 was about 6.2 inches, about 1.4 inches less than in 2008 and about 2.7 inches less than the 1952–2009 average annual precipitation.

Water levels generally declined slightly from March 2009 to March 2010 in the Milford area. The amount of water-level rise or decline depends largely on groundwater withdrawals, the amount and timing of precipitation, and recharge to the basin-fill aquifer from the Beaver River. Since the early1950s water levels generally have declined in the south-central Milford area in response to the long-term effects of groundwater withdrawals. Water-level rises during 1983–85 resulted from greater-than-average precipitation during 1982–85 and increased recharge to the basin-fill aquifer from record flow in the Beaver River during 1983–84.

Water levels generally declined from March 1980 to March 2010 throughout the Milford area in areas where data are available (fig. 43). The greatest decline, more than 38 feet, was observed approximately 4 miles southeast of Milford.

Physical properties and records of chemical analyses for water from five wells in the Milford area are listed in tables 4 and 5, and the location of the wells is plotted in figure 60. The concentration of dissolved solids in water samples from wells (C-29-10)5cdd-2 and (C-29-11)1add-1 exceeded the secondary standard (500 mg/L).

The concentration of dissolved solids in water samples collected from well (C-29-10)5cdd-2, located 5 miles south of Milford, from 1969 to 2009, is shown in figure 42. The concentration has ranged from 494 to 909 mg/L with a median value of 576 mg/L. The dissolved-solids concentration in the August 2009 sample (509 mg/L) compares well with the median value. With the exception of a relatively high dissolved-solids concentration in the water sample collected in 2001 (909 mg/L), concentrations have varied little.

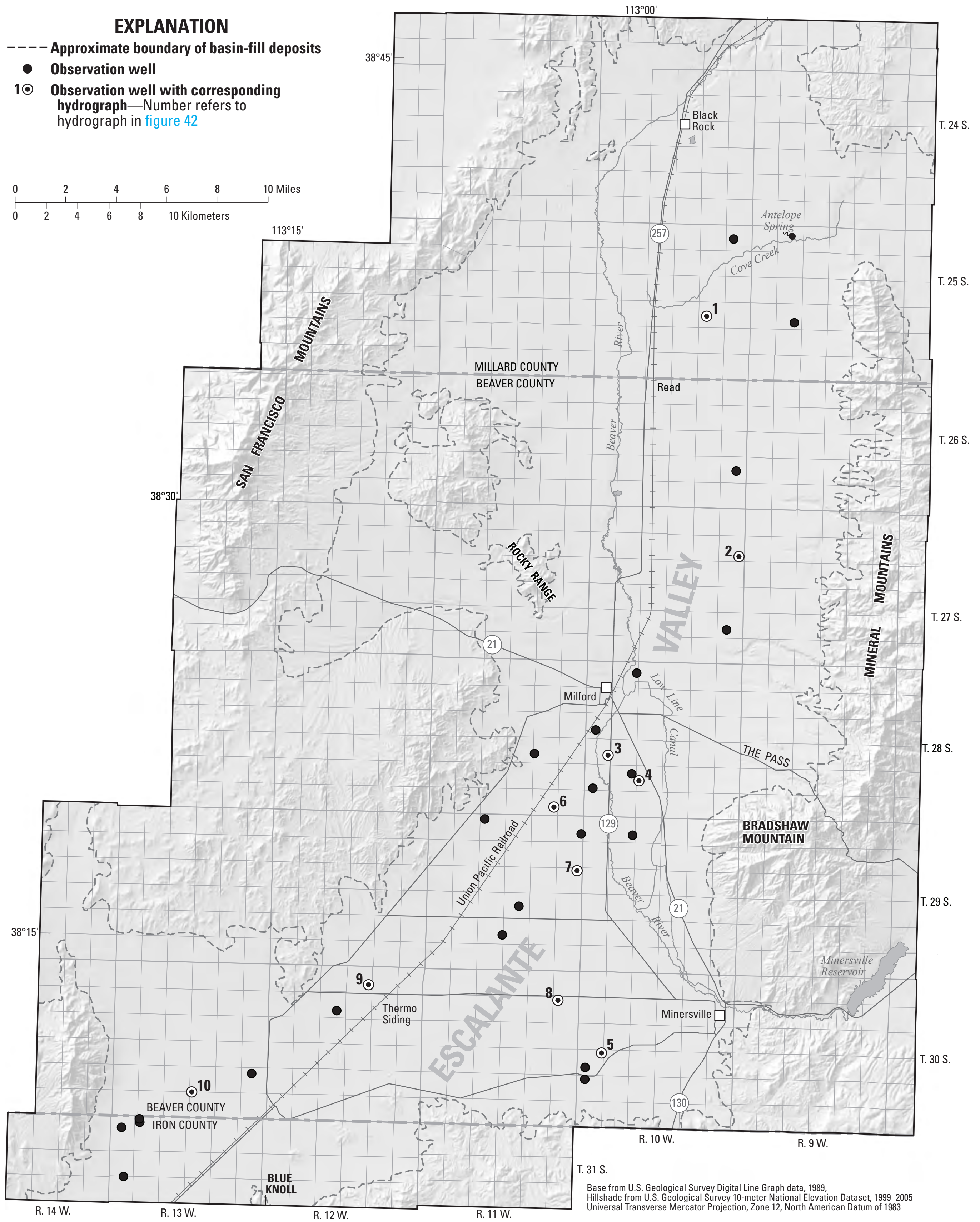


Figure 41. Location of wells in the Milford area in which the water level was measured during March 2010.

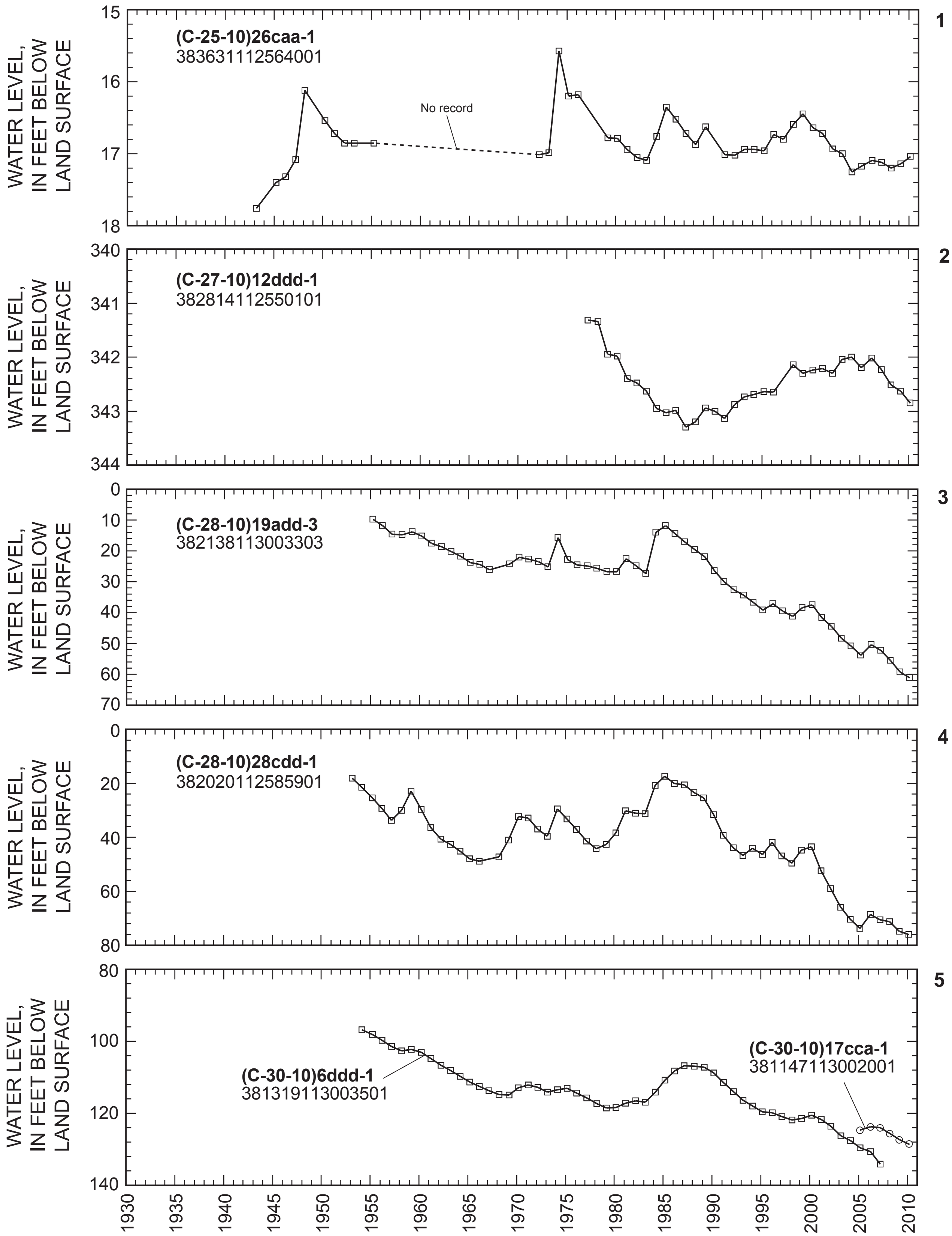


Figure 42. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.

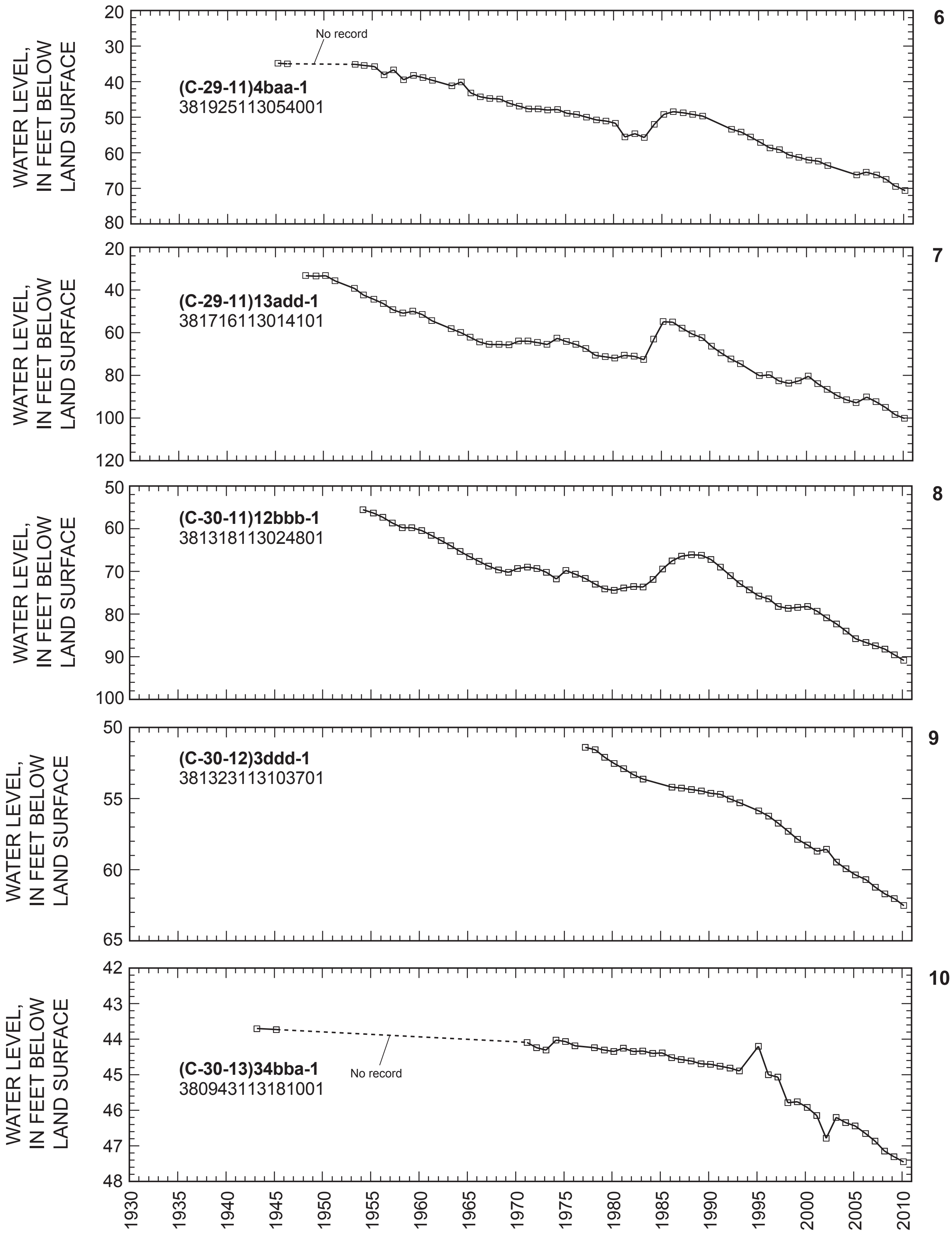


Figure 42. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

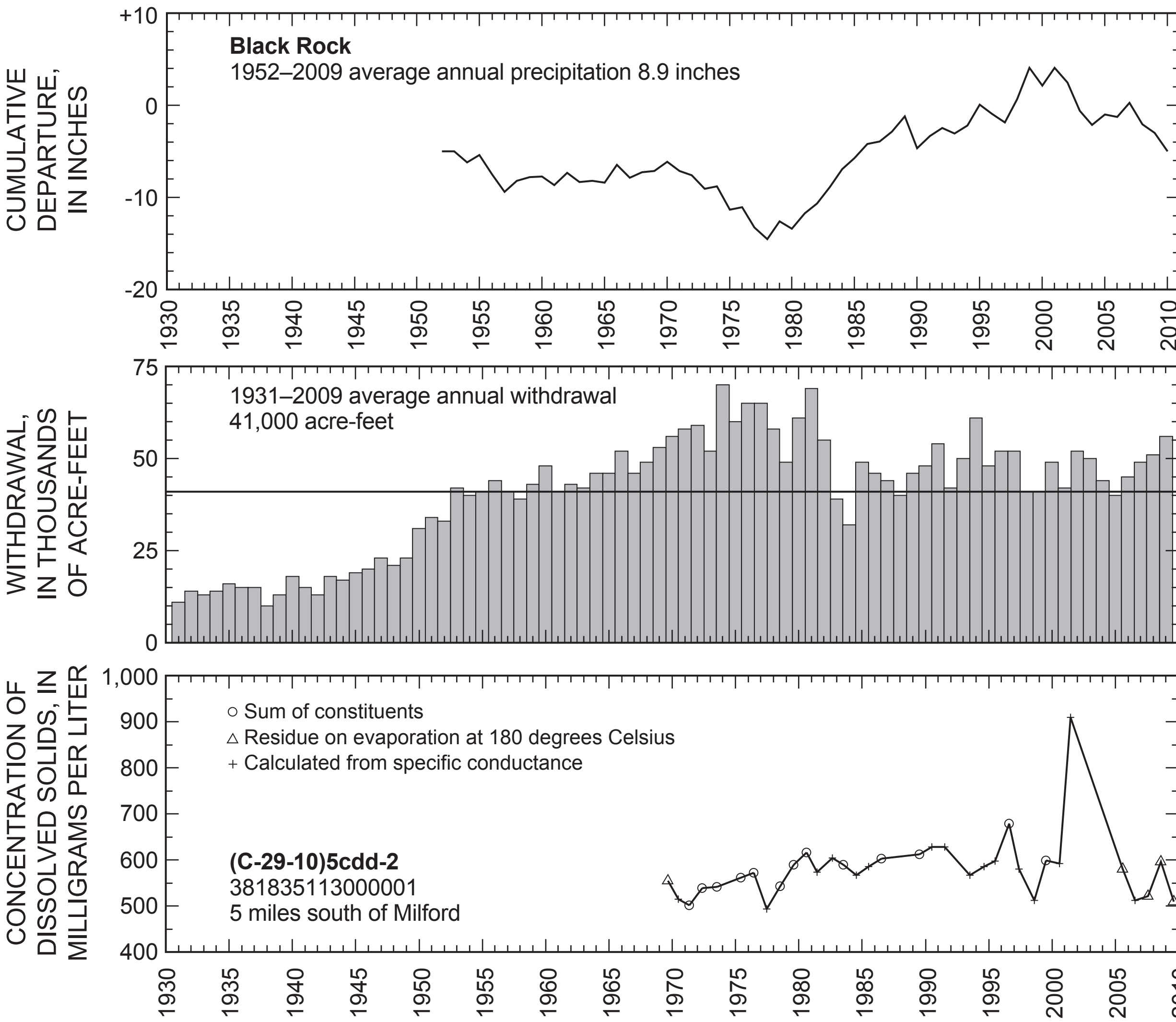


Figure 42. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

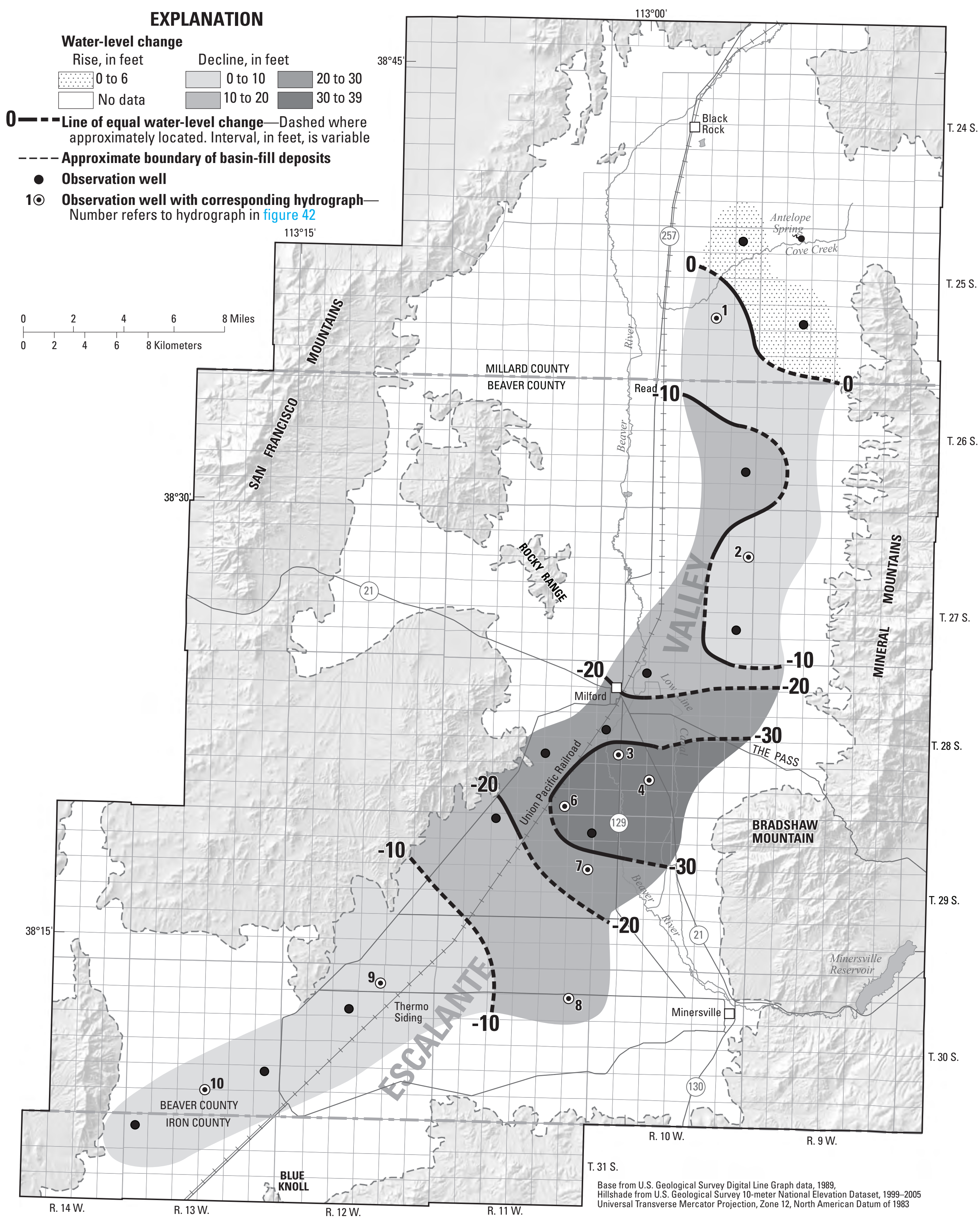


Figure 43. Water-level change in the Milford area from March 1980 to March 2010.

Escalante Valley

Beryl-Enterprise Area

By Howard K. Christiansen

The Beryl-Enterprise area covers about 800 square miles at the southern end of Escalante Valley, southeast of the Wah Wah Mountains in Iron County, and a small area in Washington County in the vicinity of the community of Enterprise (fig. 44). Groundwater occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 2009 was about 93,000 acre-feet, which is the same as in 2008 and 7,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3).

The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2010 is shown in figure 44. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 45.

Precipitation at Enterprise in 2009 was about 11.9 inches, which is about 2.1 inches less than the average annual precipitation for 1955–2009 and about 1.7 inches more than in 2008.

Water levels declined slightly from March 2009 to March 2010 in most of the wells measured in the Beryl-Enterprise area. 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 128 feet from March 1948 to March 2010 was observed in well (C-36-16)29daa-1, about 5 miles northeast of Enterprise (fig. 45).

Water levels from March 1980 to March 2010 declined in all of the Beryl-Enterprise area for which data are available (fig. 46). The greatest decline, more than 76 feet, was observed in a well about 6 miles south-southeast of Beryl Junction.

Physical properties and records of chemical analyses for water from five wells in the Beryl-Enterprise area are listed in tables 4 and 5, and the location of the wells is shown in figure 60. The water sample from well (C-35-15)3dcc-3 exceeded secondary standards for sulfate (250 mg/L) and dissolved solids (500 mg/L), and the MCL for arsenic (10 µg/L). The concentration of dissolved solids in water from well (C-34-16)28dcc-2 also exceeded the secondary standard for this constituent.

The concentration of dissolved solids in water samples collected from well (C-34-16)28dcc-2, located 6 miles south-southeast of Beryl, from 1950 to 2009, is shown in figure 45. The concentration has ranged from 460 to 788 mg/L with a median value of 648 mg/L. The concentration of dissolved solids in the water sample collected in August 2009 was 788 mg/L, the maximum value measured to date.

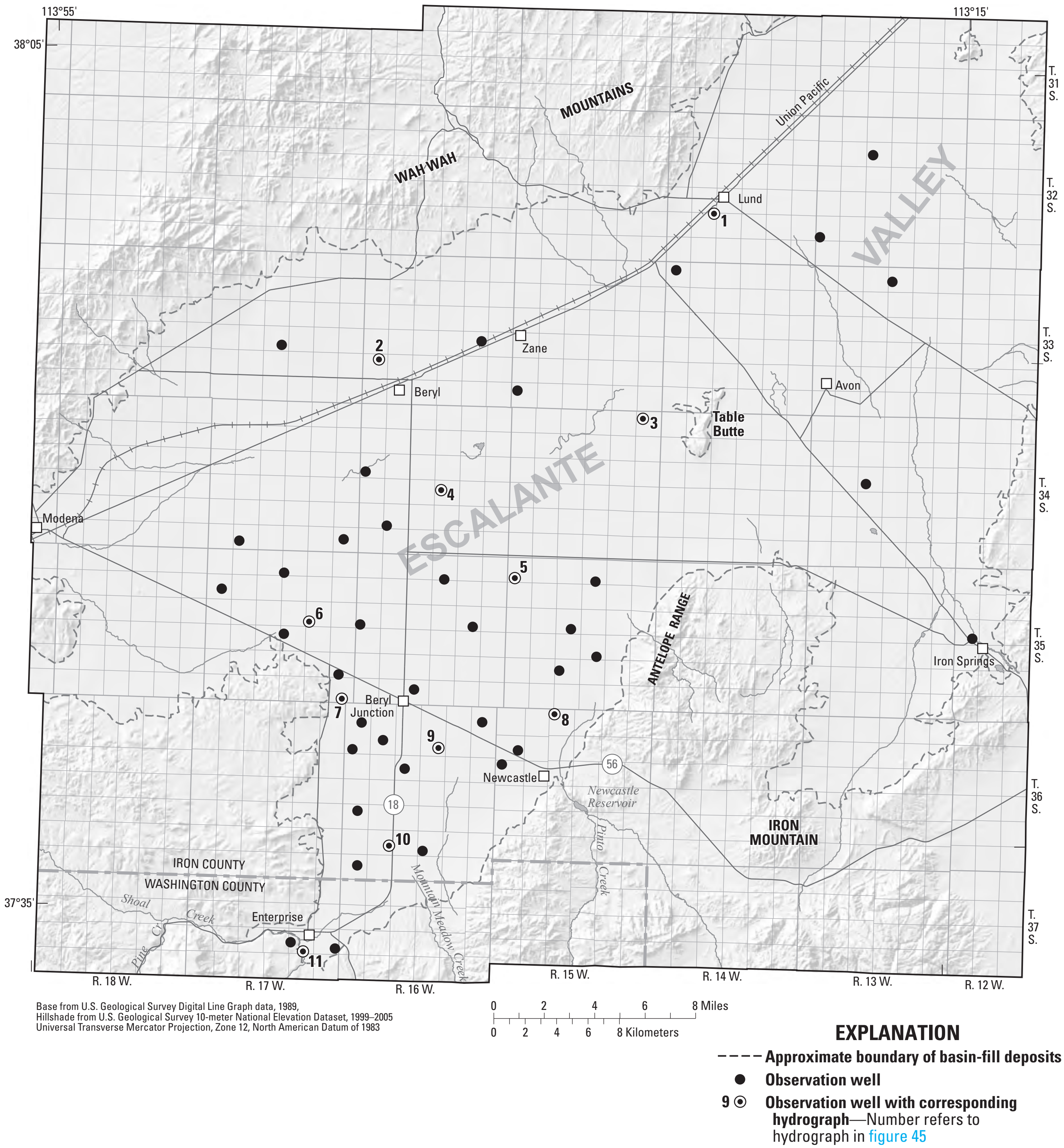


Figure 44. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2010.

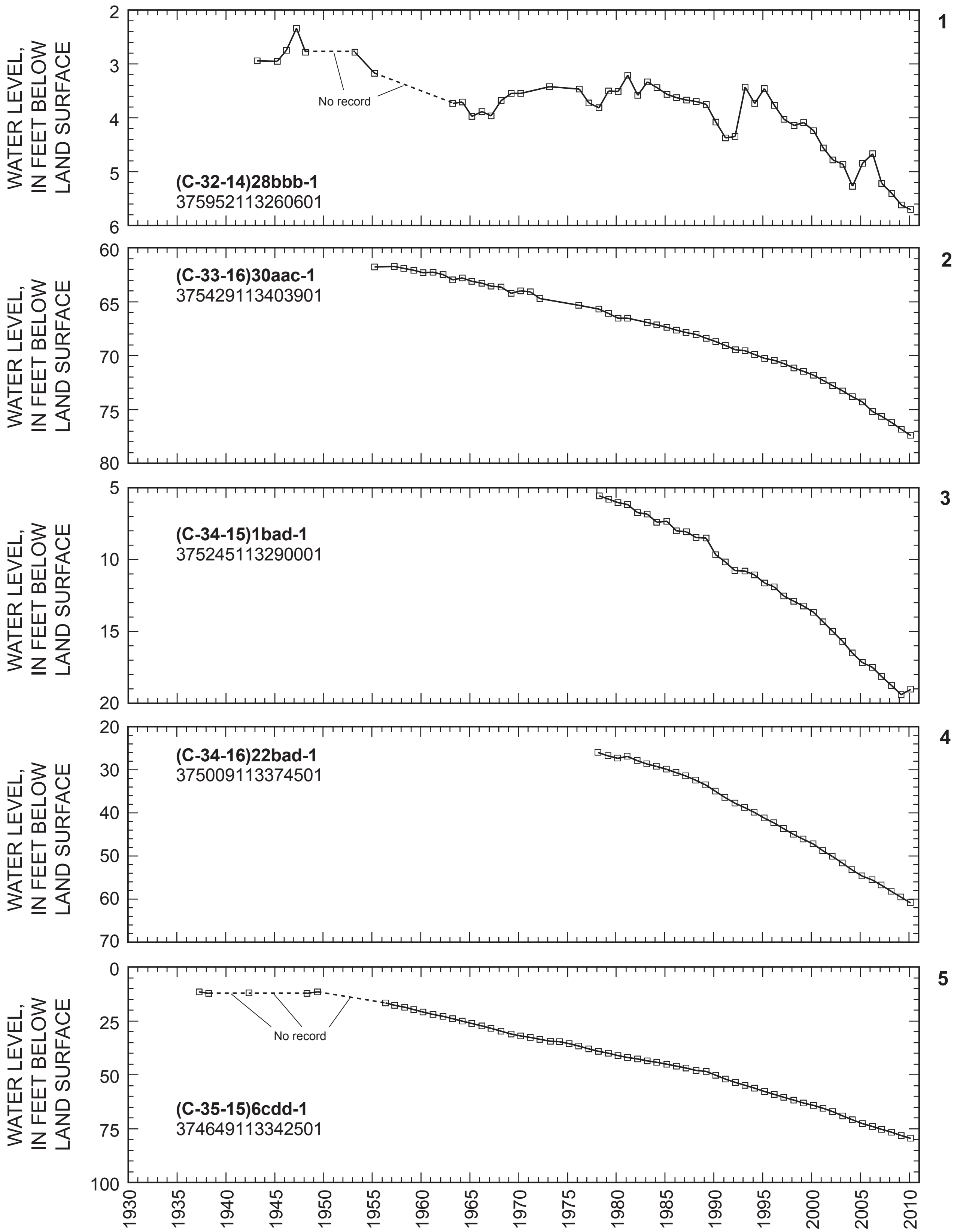


Figure 45. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

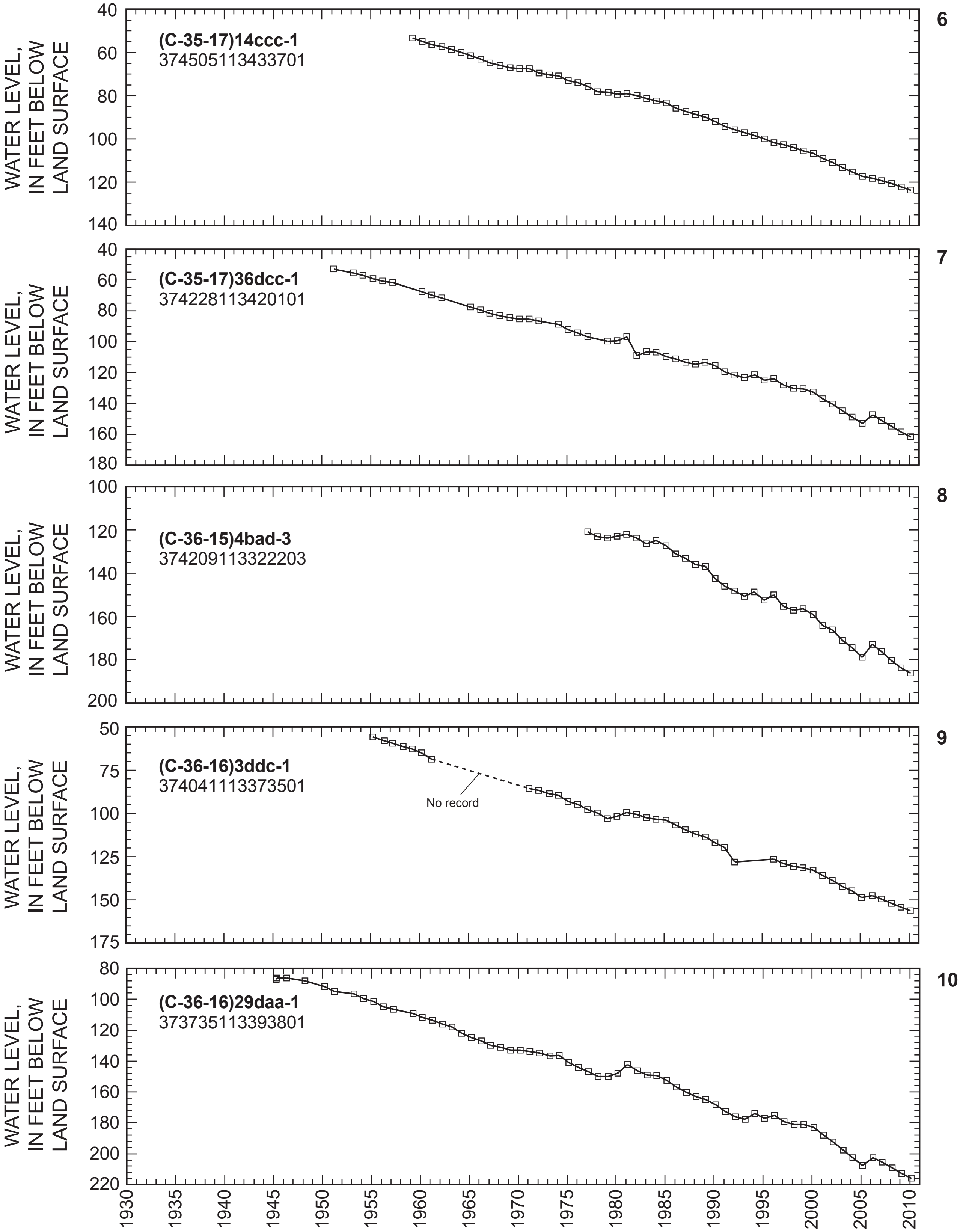


Figure 45. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.—Continued

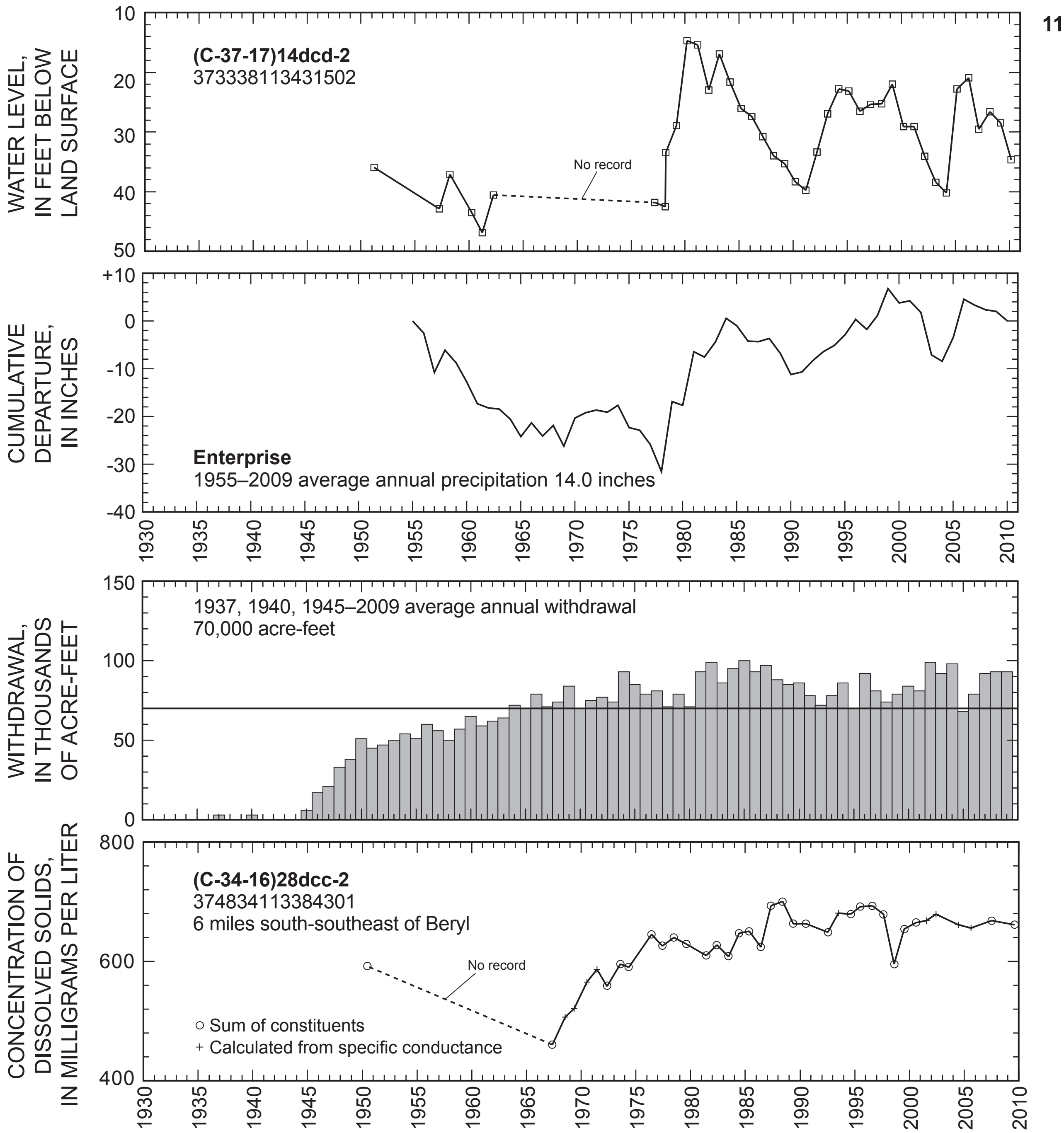


Figure 45. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.—Continued

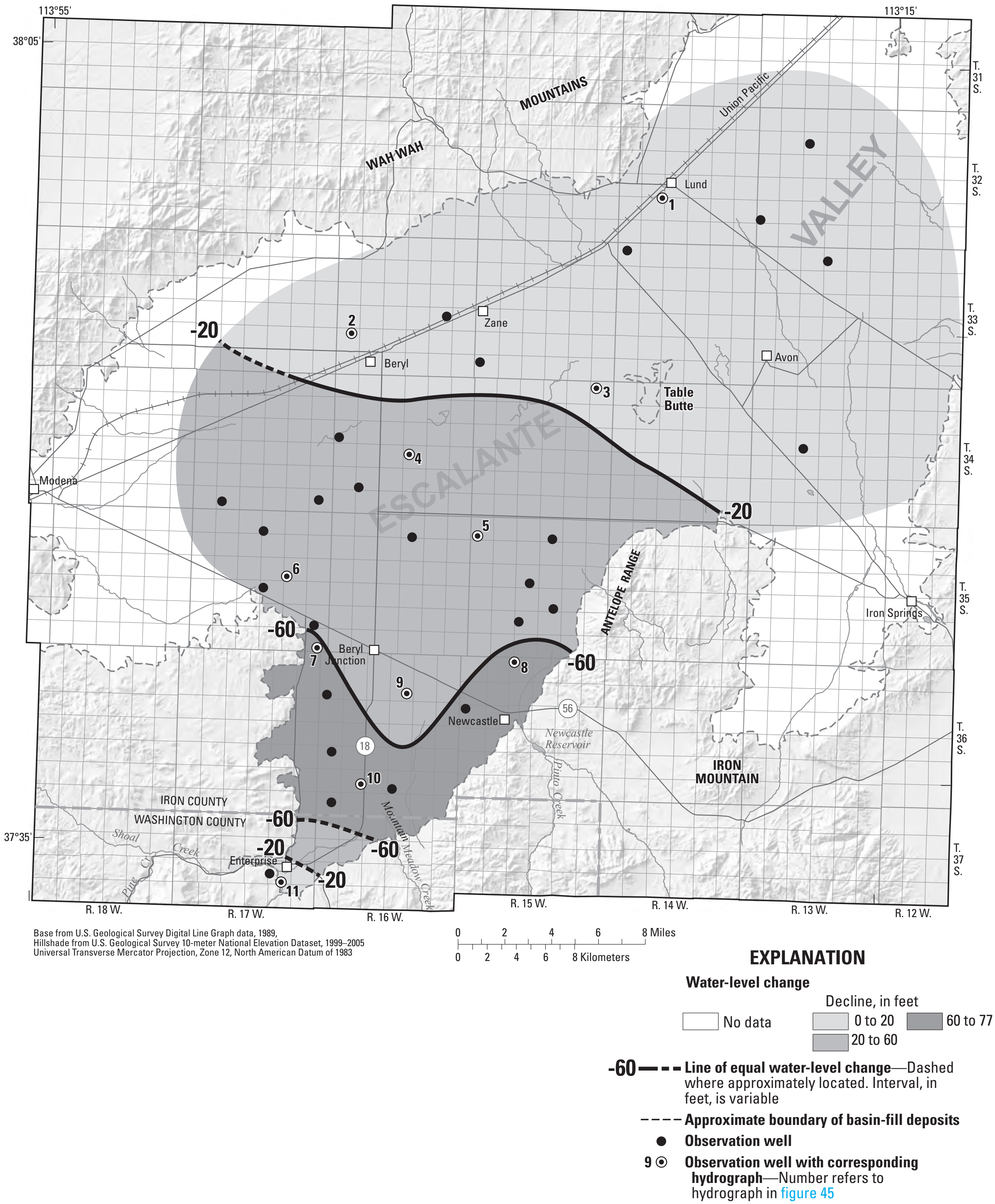


Figure 46. Water-level change in the Beryl-Enterprise area from March 1980 to March 2010.

Central Virgin River Area

By Howard K. Christiansen

The central Virgin River area is between the Pine Valley Mountains and the Hurricane Cliffs, and is bounded by the Beaver Dam Mountains to the southwest, in Washington County (fig. 47). Major groundwater 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 are located near the Virgin and Santa Clara Rivers.

Total estimated withdrawal of water from wells in the central Virgin River area in 2009 was about 33,000 acre-feet, which is about 4,000 acre-feet more than in 2008 and 5,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3). Withdrawal for irrigation increased by about 1,200 acre-feet from 2008 to 2009. Withdrawal for public supply increased by about 3,000 acre-feet. Withdrawals for domestic and stock use were about the same as in 2008.

The location of wells in the central Virgin River area in which the water level was measured during February 2010 is shown in figure 47. 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 48.

Discharge of the Virgin River at Virgin in 2009 was about 91,800 acre-feet, which is 2,100 acre-feet less than in 2008 and about 40,700 acre-feet less than the long-term average for 1931–70 and 1979–2009. Precipitation at St. George in 2009 was about 3.3 inches, which is about 4.8 inches less than the average annual precipitation for 1930–2009 and 0.9 inch less than in 2008.

Water levels from February 2009 to February 2010 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.

Water-level changes from February 1980 to February 2010 are shown in figure 49. Water levels generally declined in areas where data are available. The greatest decline, about 35 feet, occurred in a well in the Fort Pearce Wash area southeast of St. George. A rise of about 13 feet was observed in a well east-southeast of Harrisburg Junction.

Physical properties and records of chemical analyses for water from four wells in the central Virgin River area are listed in tables 4 and 5, and the location of the wells is shown in figure 60. The concentration of dissolved solids and sulfate in the water samples from wells (C-42-14)15cbd-1 and (C-42-16)26bcc-1 exceeded both secondary standards (500 and 250 mg/L, respectively) and MCLs (2,000 and 1,000 mg/L, respectively) for these constituents. The concentration of dissolved nitrite plus nitrate in the water samples from these wells also exceeded the MCL for this constituent (10 mg/L). Water from well (C-42-16)26bcc-1 also exceeded the secondary standards for chloride (250 mg/L) and manganese (50 µg/L). The water sample from well (C-41-17)8cbd-2 exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from wells (C-41-17)8cbd-1 and (C-41-17)8cbd-2, located 1.5 miles south of Gunlock Reservoir, from 1966 to 2009, is shown in figure 48. These wells are located near each other and are finished in the same aquifer. The dissolved-solids concentrations in water samples from both wells were combined to give an extended temporal record for this constituent. The concentration has ranged from 255 to 313 mg/L with a median value of 290 mg/L. The dissolved-solids concentration in the water sample collected in August 2009 (290 mg/L) was the median value.

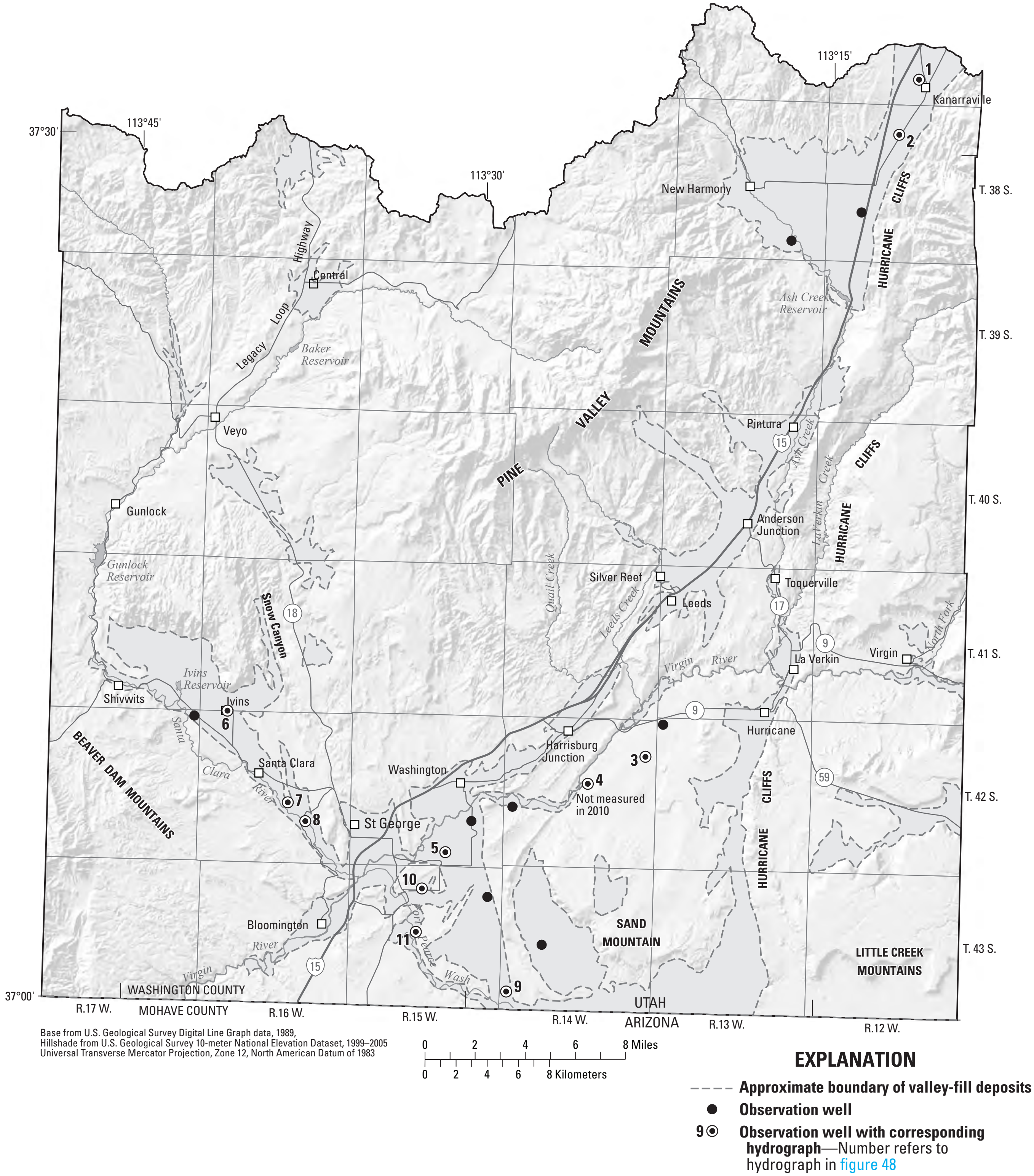


Figure 47. Location of wells in the central Virgin River area in which the water level was measured during February 2010.

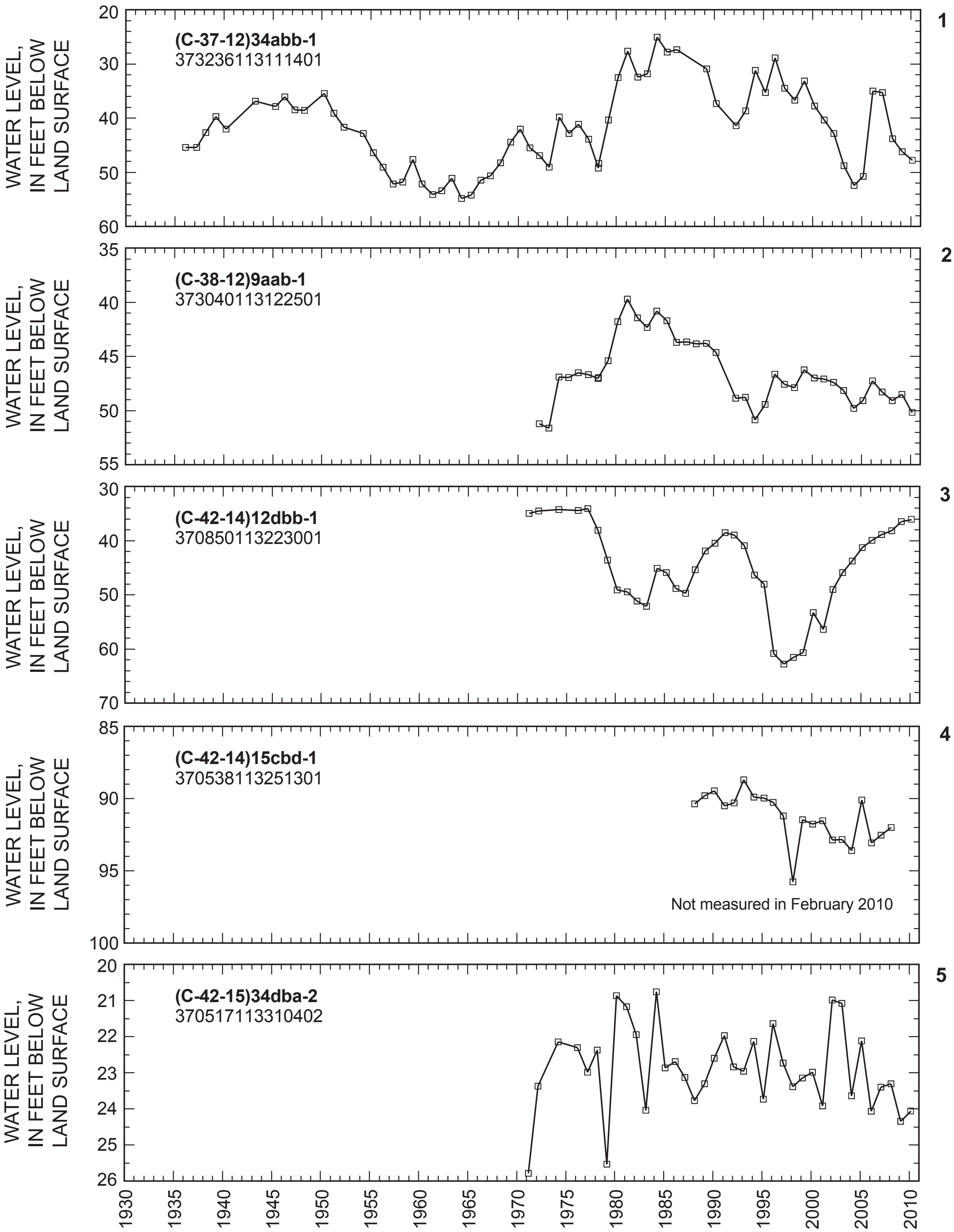


Figure 48. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2.

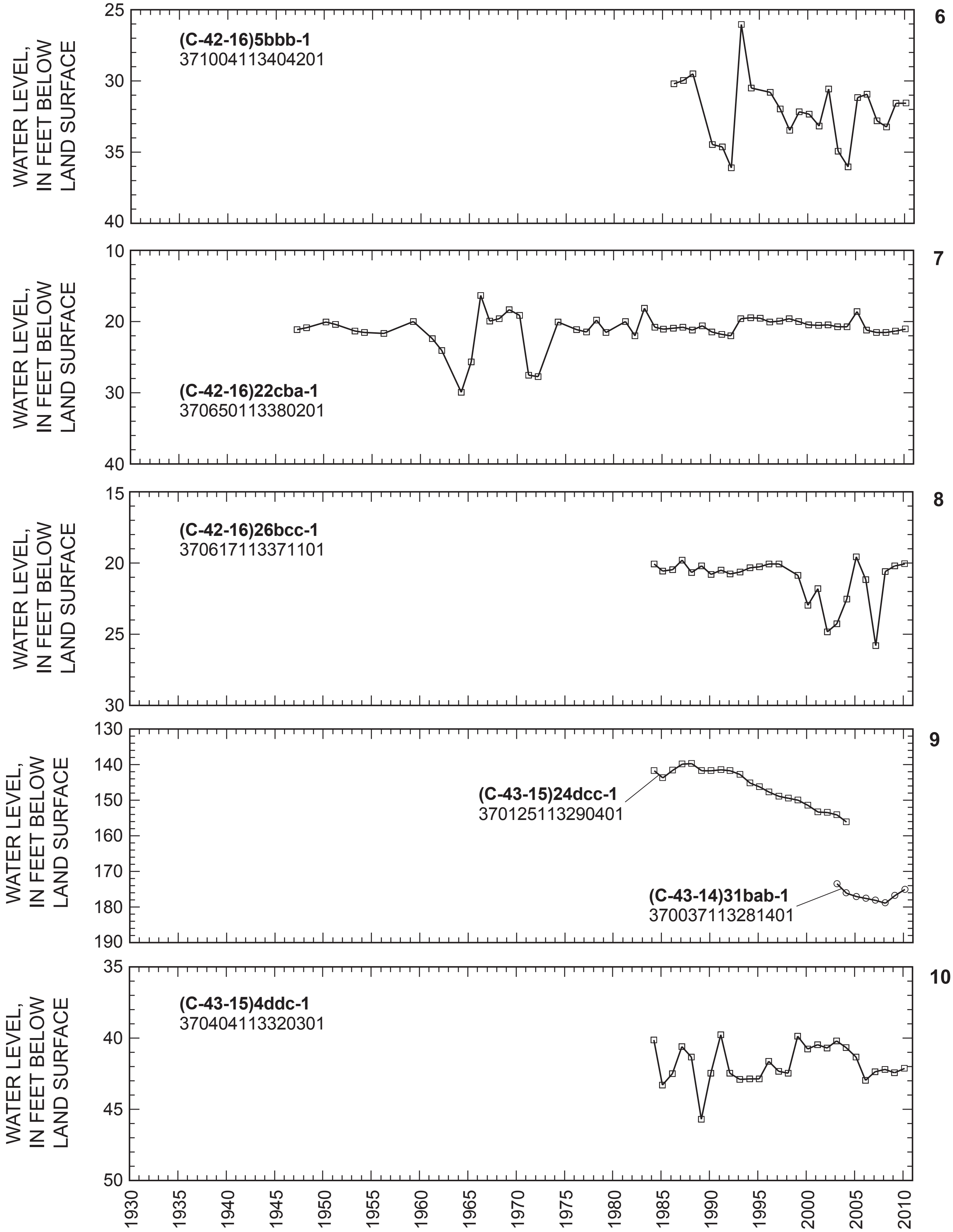


Figure 48. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2.—Continued

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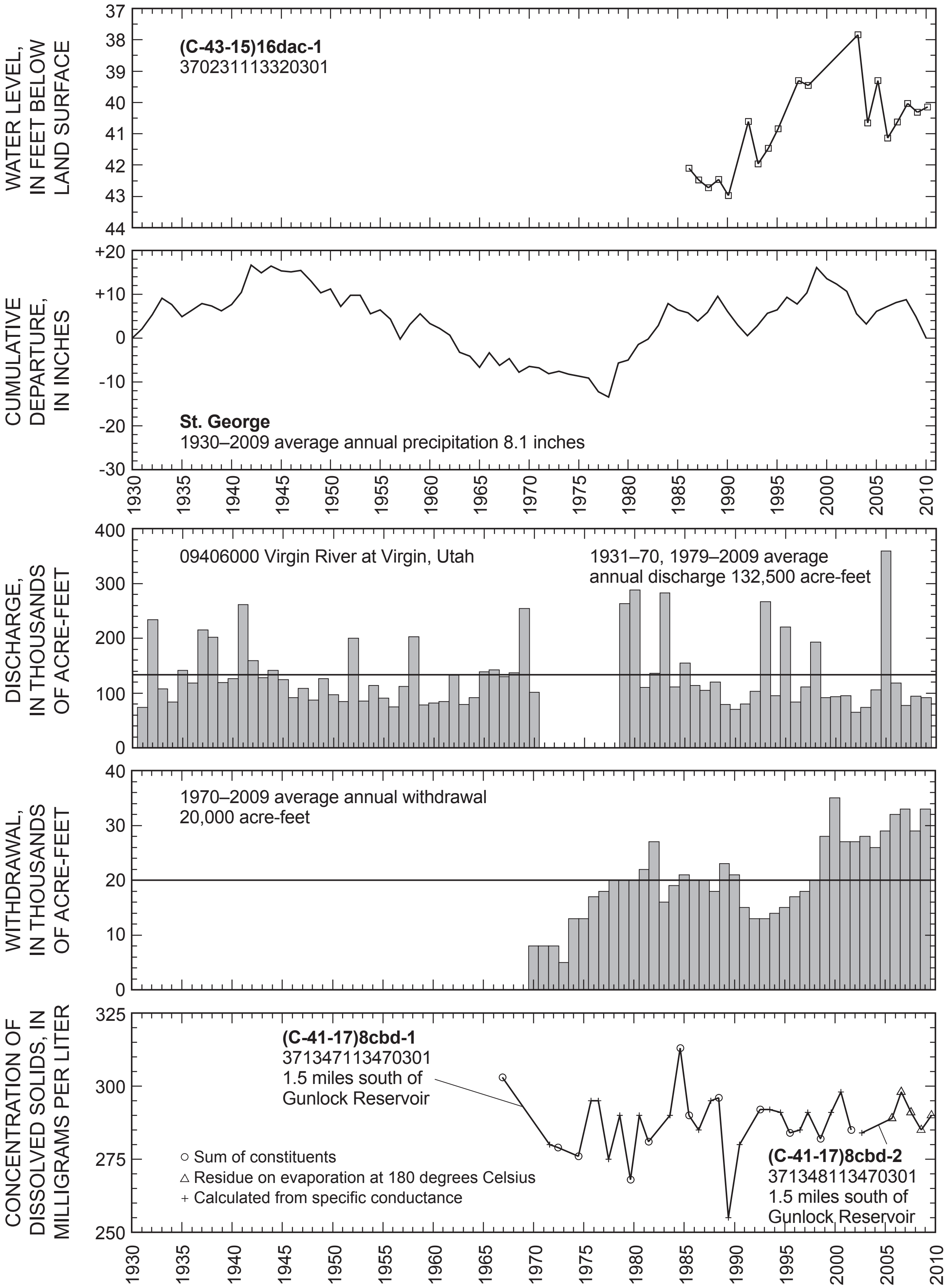

Figure 48. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2.—Continued

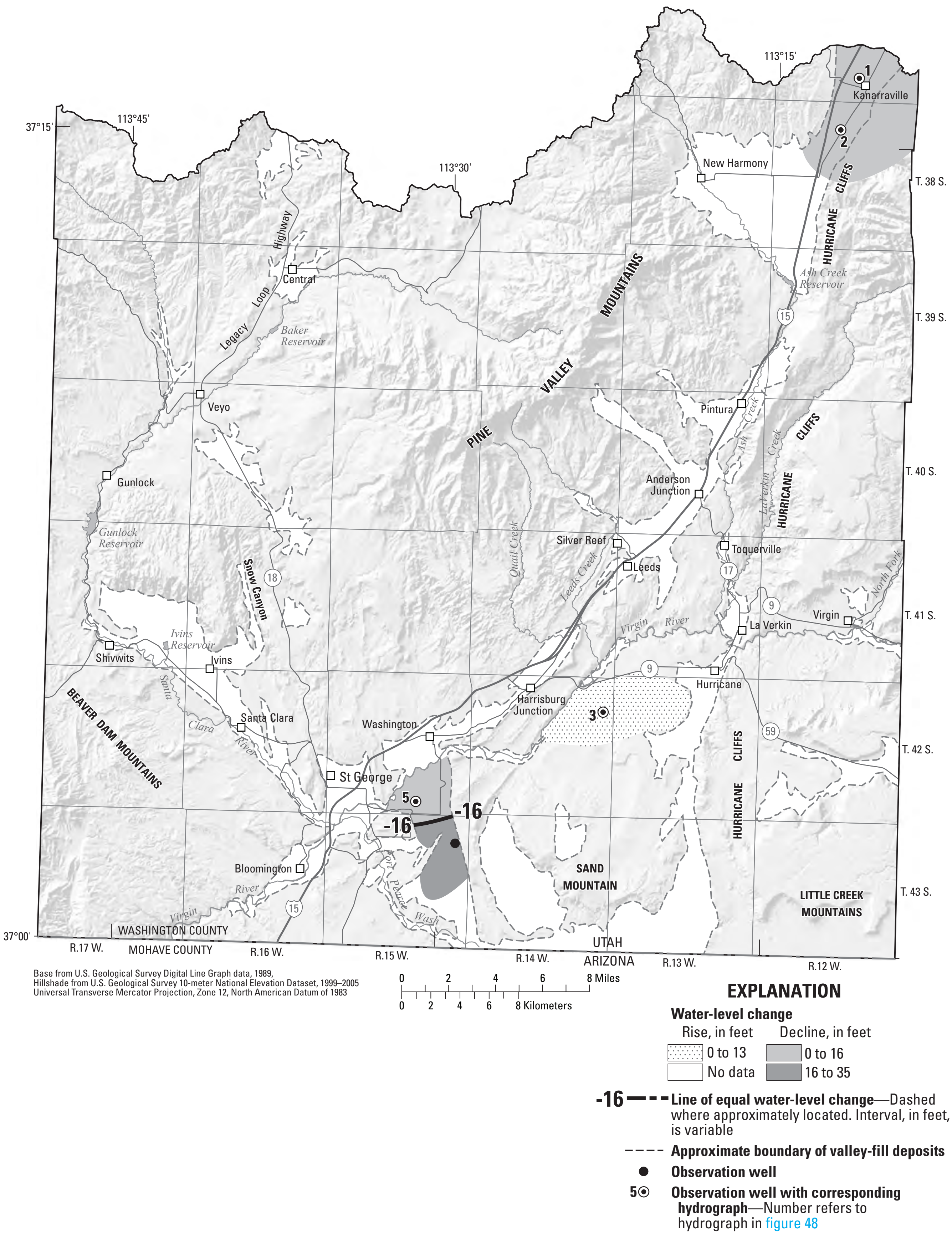

Figure 49. Water-level change in the central Virgin River area from February 1980 to February 2010.

Other Areas

By Martel J. Fisher

Total estimated withdrawal of water from wells in the areas of Utah listed below in 2009 was about 130,000 acre-feet, which is 14,000 acre-feet less than the estimate for 2008 and 2,000 acre-feet more than the average annual withdrawal for 1999–2008 (tables 2 and 3). The largest decreases were due to decreased withdrawals for industrial and public-supply use. In most of the areas listed below, withdrawals in 2009 were less than in 2008, except in Park Valley and Beaver Valley, where irrigation withdrawals increased slightly or stayed the same, and Ogden Valley, where public-supply use increased slightly.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2010 is shown in figure 50. The relation of the water level in observation wells in Cedar Valley to cumulative departure from average annual precipitation at Fairfield is shown in figure 51.

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 declined slightly in most of the wells from March 2009 to March 2010. Water levels in March 2010 were generally higher than those measured in March 1980 throughout Cedar Valley (fig. 52). The greatest rises, up to 25 feet, were observed in the eastern part of the valley. The rises probably resulted from decreased irrigation withdrawals and overall greater-than-average precipitation since 1976.

The location of wells in Sanpete Valley in which the water level was measured during March 2010 is shown in figure 53. 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 54.

Water levels in many of the selected wells in Sanpete Valley 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 or decreased only slightly in most of the selected observation wells from March 2009 to March 2010. Water levels generally declined from March 1980 to March 2010 throughout Sanpete Valley (fig. 55). The declines are probably the result of increased withdrawals for irrigation, industrial, and public-supply use. Small rises were observed in the areas northeast of Spring City and near Sterling.

The location of wells in Snake Valley and the West Desert in which the water level was measured during March 2010 is shown in figure 56. The relation of the water level in selected observation wells in the area to cumulative departure from average annual precipitation at Callao is shown in figure 57.

Water levels in many of the selected wells in Snake Valley and the West Desert declined from March 2009 to March 2010. Water levels rose sharply in the early to mid-1980s as a result of greater-than-average precipitation, but have generally declined since the mid-1980s. Water levels generally declined from March 1980 to March 2010 throughout most of Snake Valley (fig. 58). The declines are probably the result of continued large withdrawals for irrigation. The greatest declines were observed in the areas near Garrison and Border. Small rises were observed in areas near Trout Creek and north of Border.

Number in figure 1	Area	Estimated withdrawal (acre-feet)					
		2009					2008 total (rounded)
		Irrigation	Industrial	Public supply	Domestic and stock	2009 total (rounded)	
1	Grouse Creek Valley	1,700	0	0	20	1,700	2,200
2	Park Valley	2,000	0	0	10	2,000	2,000
4	Malad-lower Bear River Valley	2,500	340	4,900	200	7,900	10,900
8	Ogden Valley	0	0	11,200	20	11,200	11,100
13	Rush Valley	4,800	250	310	30	5,400	5,800
14	Skull Valley, Dugway area, and Old River Bed	2,900	3,400	1,100	10	7,400	8,400
15	Cedar Valley, Utah County	2,200	0	4,000	40	6,200	9,800
20	Sanpete Valley	4,800	800	660	4,000	10,300	10,500
25	Snake Valley	18,400	0	90	50	18,500	20,200
27	Beaver Valley	11,100	20	1,200	470	12,800	12,000
	Remainder of State	11,800	16,500	15,600	2,500	46,400	51,400
Total (rounded)		62,200	21,300	39,100	7,400	130,000	144,000

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 59. Water levels rose or decreased only slightly in most of the selected observation wells from March 2009 to March 2010.

Water Quality

Physical properties and records of chemical analyses for water from wells in the areas indicated below are listed in tables 4 and 5, and the location of the wells is shown in figure 60.

Beaver Valley

Concentrations of major ions, trace elements, and nutrients in water from well (C-29-8)31add-1, the only well sampled in Beaver Valley, did not exceed secondary standards or MCLs.

Malad-lower Bear River area

Water samples from four of the five wells sampled in the lower Bear River area, including wells (B-12-4)26bbb-1, (B-12-4)34adb-1, (B-12-4)35aab-1, and (B-12-4)35bbc-1 exceeded secondary standards for chloride (250 mg/L) and dissolved solids (500 mg/L). The concentration of dissolved sulfate in water from wells (B-12-4)26bbb-1 and (B-12-4)35aab-1 exceeded the secondary standard (250 mg/L). Water from well (B-12-4)26bbb-1 also exceeded the MCL for nitrite plus nitrate (10 mg/L). Water from well (B-12-4)35aab-1 exceeded the MCL for selenium (50 µg/L).

Duchesne River area

The water sample from well U(C-1-2)24aaa-1 exceeded the secondary standard for iron (300 µg/L). Water samples from wells U(C-1-4)31bbb-1 and U(C-3-5)31dcd-2 exceeded the secondary standard for dissolved solids (500 mg/L).

Kelton area

The water sample from well (B-12-11)6aba-1, one of two wells sampled in the Kelton area, exceeded the secondary standard for dissolved solids (500 mg/L).

Snake Valley

Three wells were sampled in Snake Valley. The water sample from well (C-23-19)30aac-1 exceeded the secondary standard for chloride (250 mg/L), sulfate (250 mg/L), and dissolved solids (500 mg/L). Water from well (C-23-19)20bac-2 exceeded the secondary standard for dissolved solids and the MCL for arsenic (10 µg/L).

Sanpete Valley

Concentrations of major ions, trace elements, and nutrients in water samples collected from three wells sampled in Sanpete Valley did not exceed secondary standards or MCLs.

Upper Sevier Valley

Concentrations of major ions, trace elements, and nutrients in water from well (C-30-2)28bdc-1, the only well sampled in the upper Sevier Valley, did not exceed secondary standards or MCLs.

Rush Valley

Concentrations of dissolved arsenic in water from the three wells sampled in Rush Valley exceeded the MCL for arsenic (10 µg/L).

Skull Valley

Concentrations of dissolved solids and chloride in the water sample from well (C-3-8)28cca-1, one of two wells that were sampled, exceeded the secondary standards for these constituents (500 and 250 mg/L, respectively).

Cedar Valley, Utah County

Concentrations of major ions, trace elements, and nutrients in water from the two wells sampled in this area did not exceed secondary standards or MCLs.

Heber Valley

Concentrations of major ions, trace elements, and nutrients in water from the four wells sampled in this area did not exceed secondary standards or MCLs.

Upper Fremont River Valley

Concentrations of dissolved solids and sulfate in the water sample from well (D-27-3)19aaa-1, the only well sampled in the upper Fremont River Valley, exceeded the secondary standards for these constituents (500 and 250 mg/L, respectively).

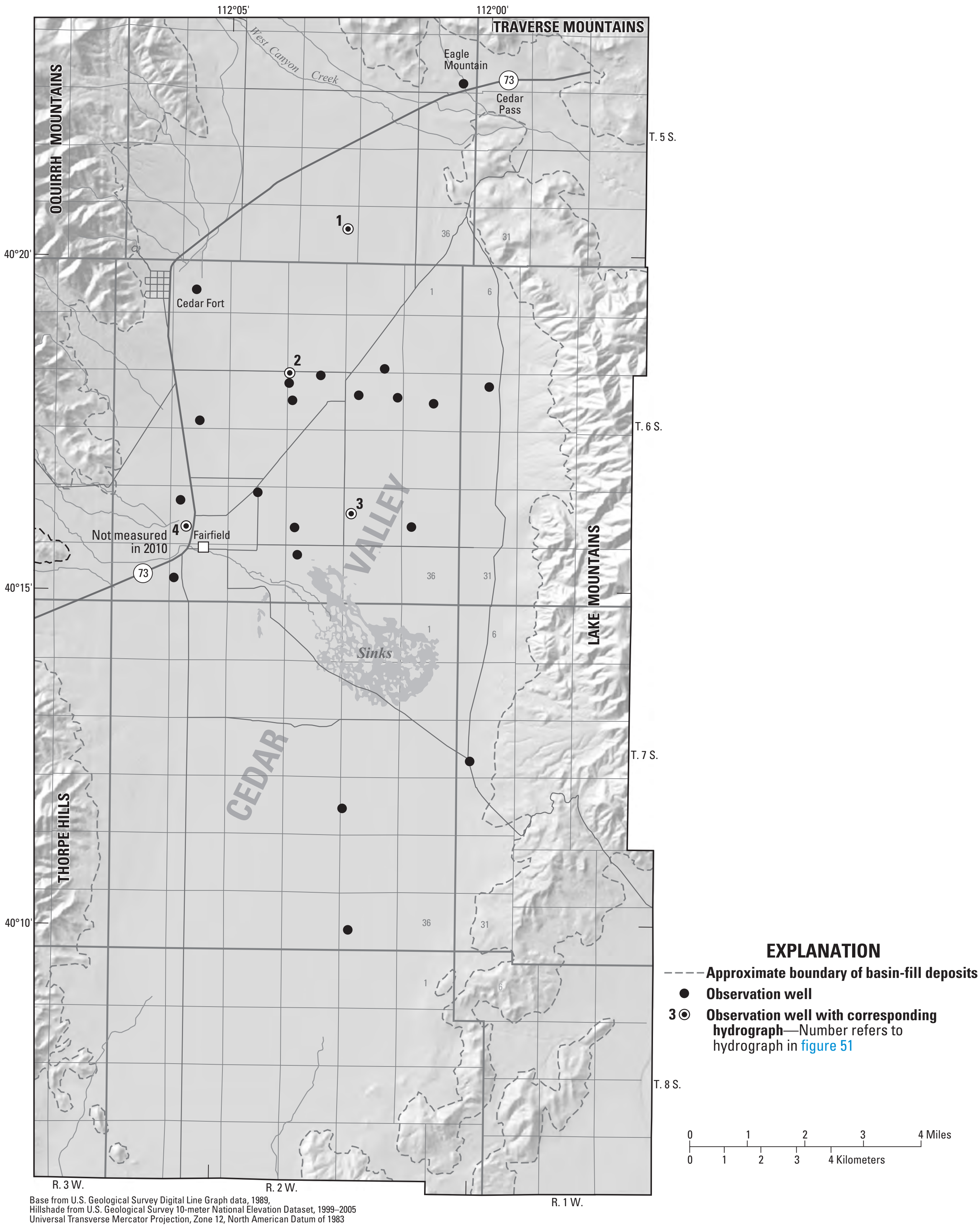

Figure 50. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2010.

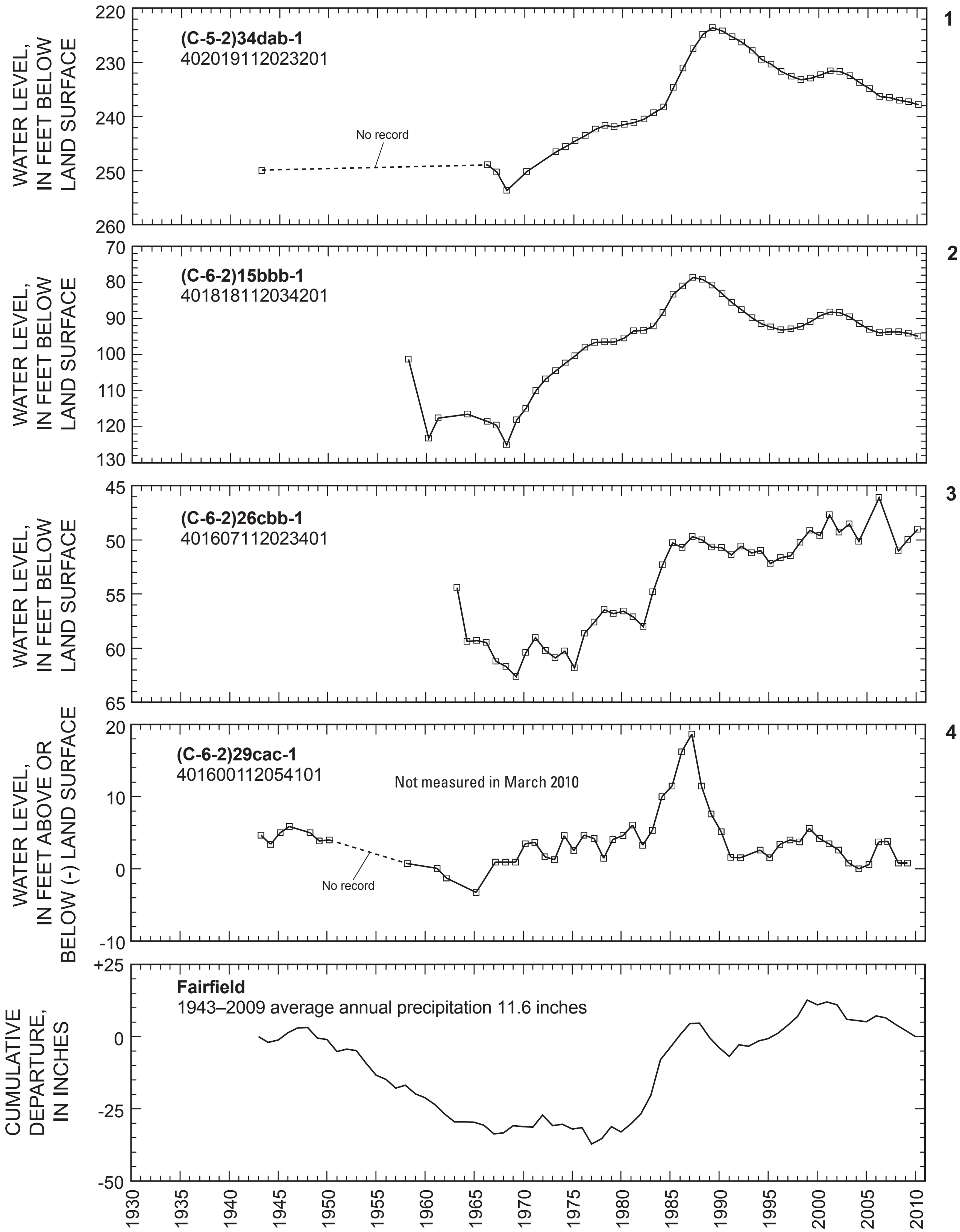

Figure 51. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield.

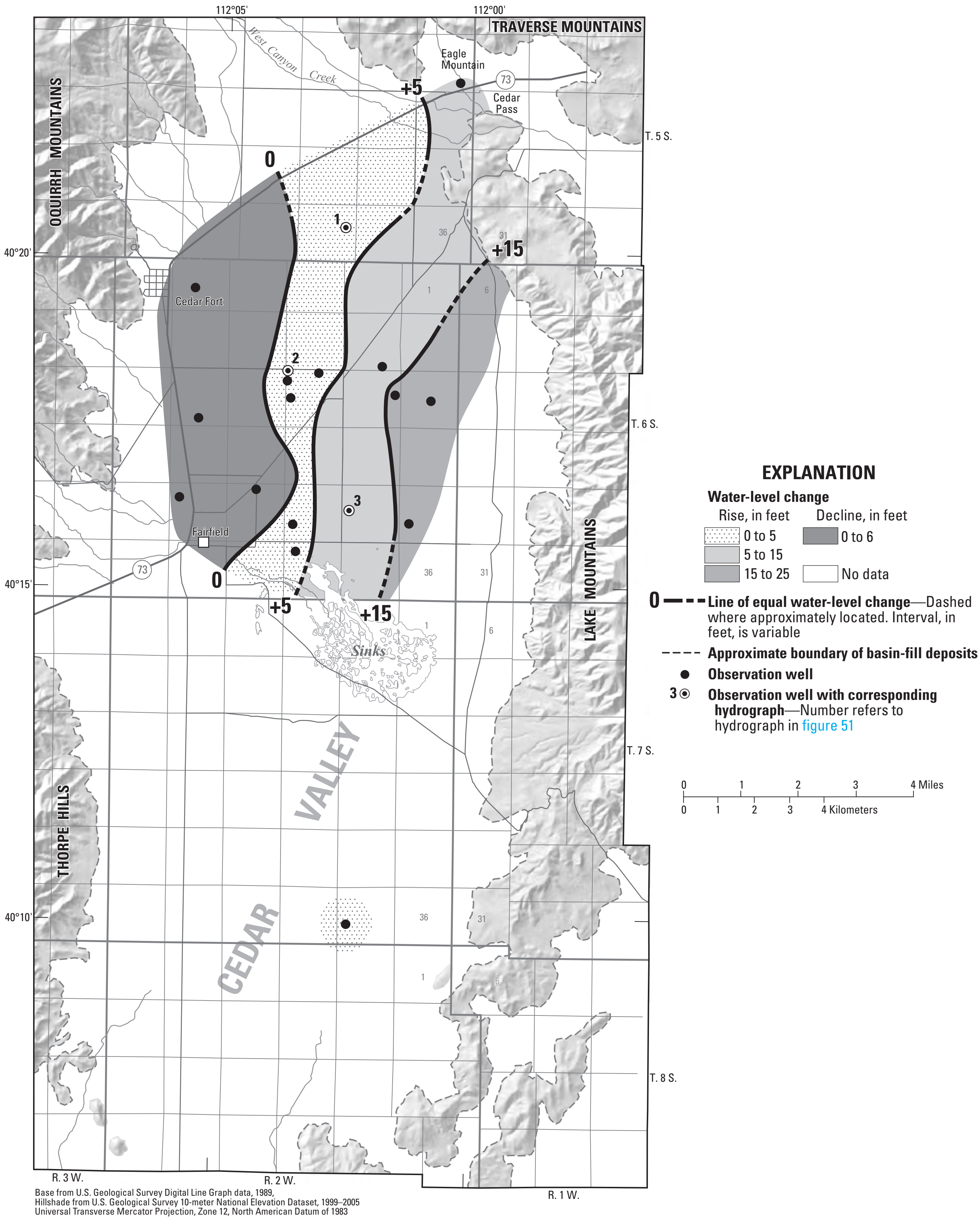

Figure 52. Water-level change in Cedar Valley, Utah County, from March 1980 to March 2010.

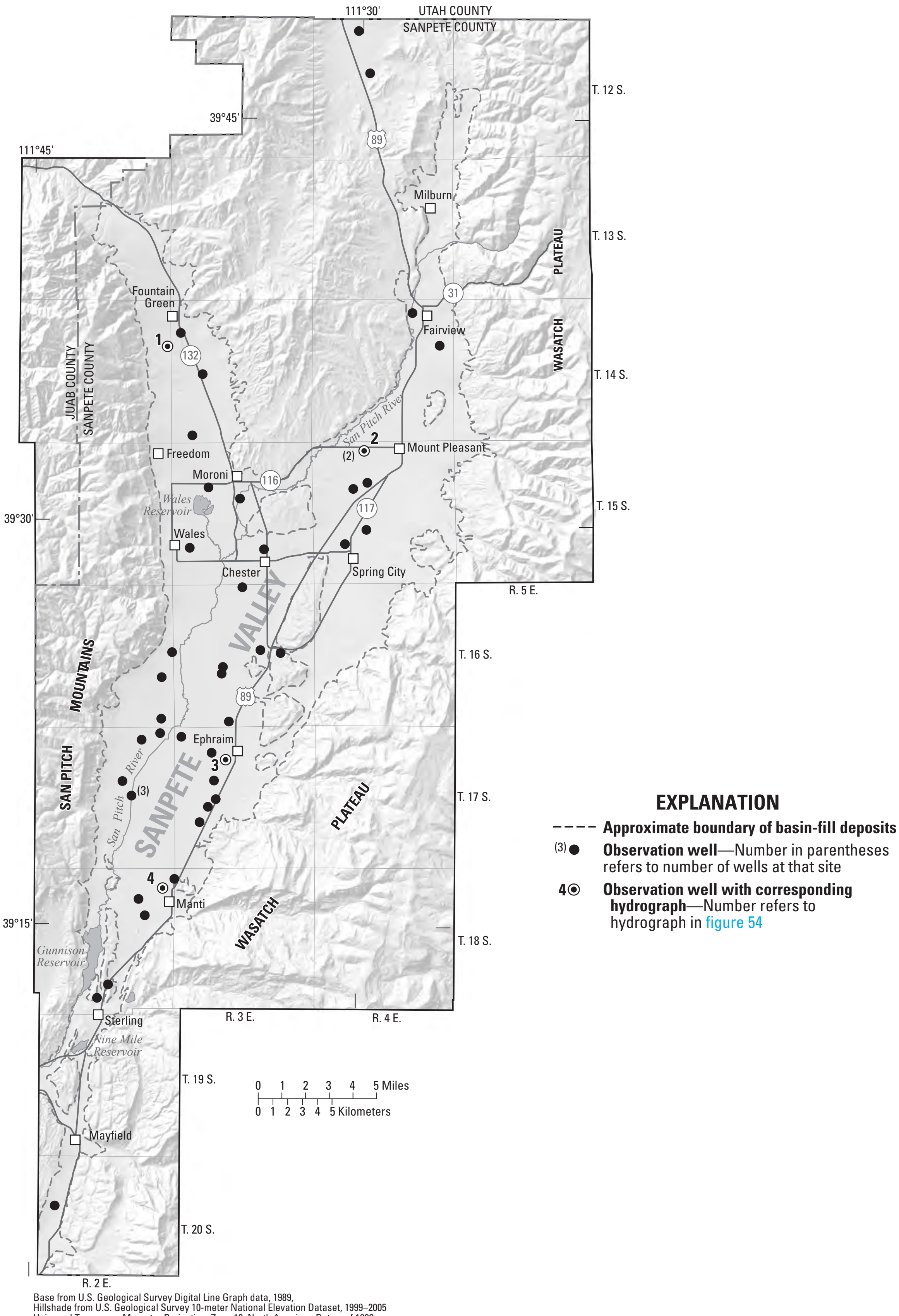

Figure 53. Location of wells in Sanpete Valley in which the water level was measured during March 2010.

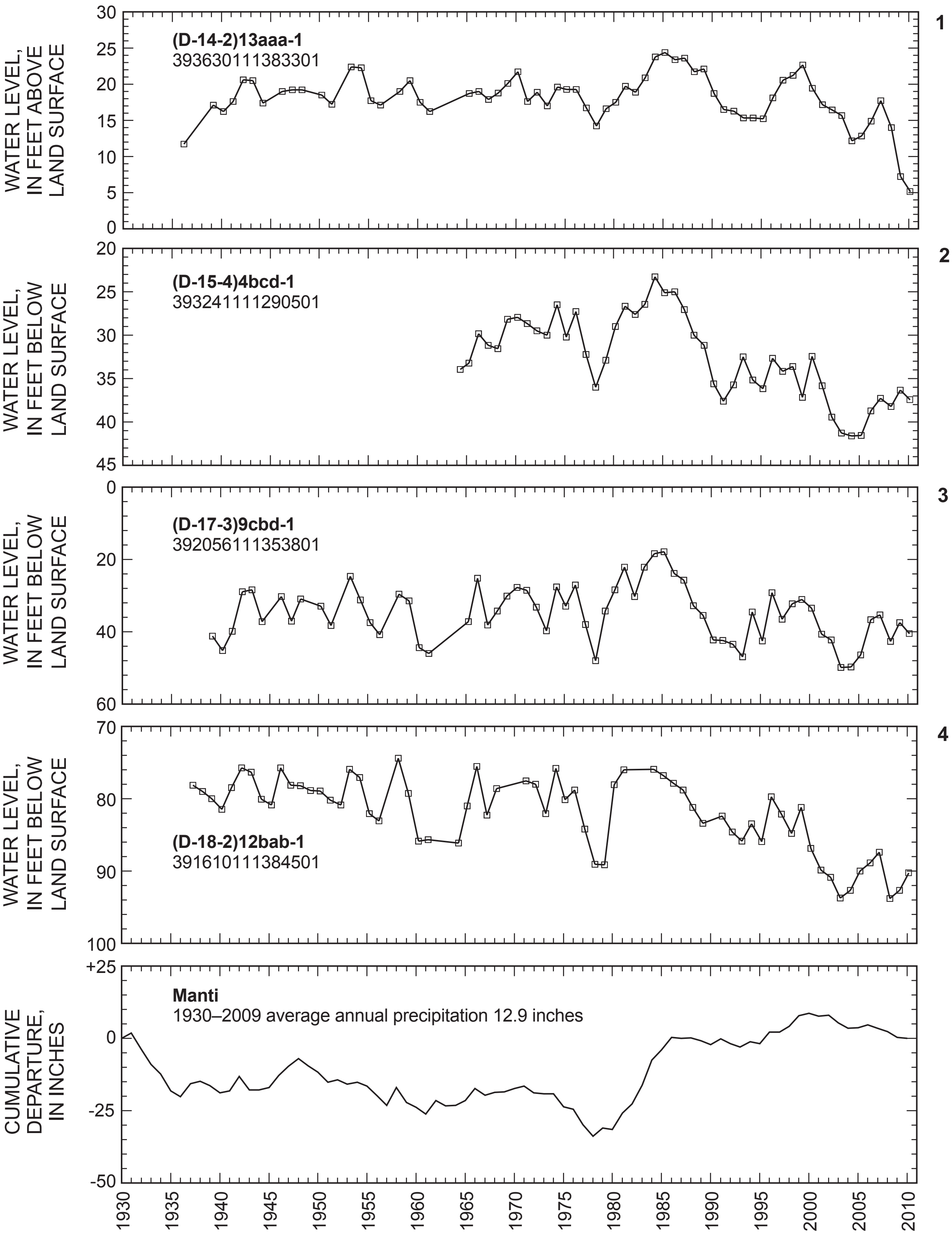

Figure 54. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

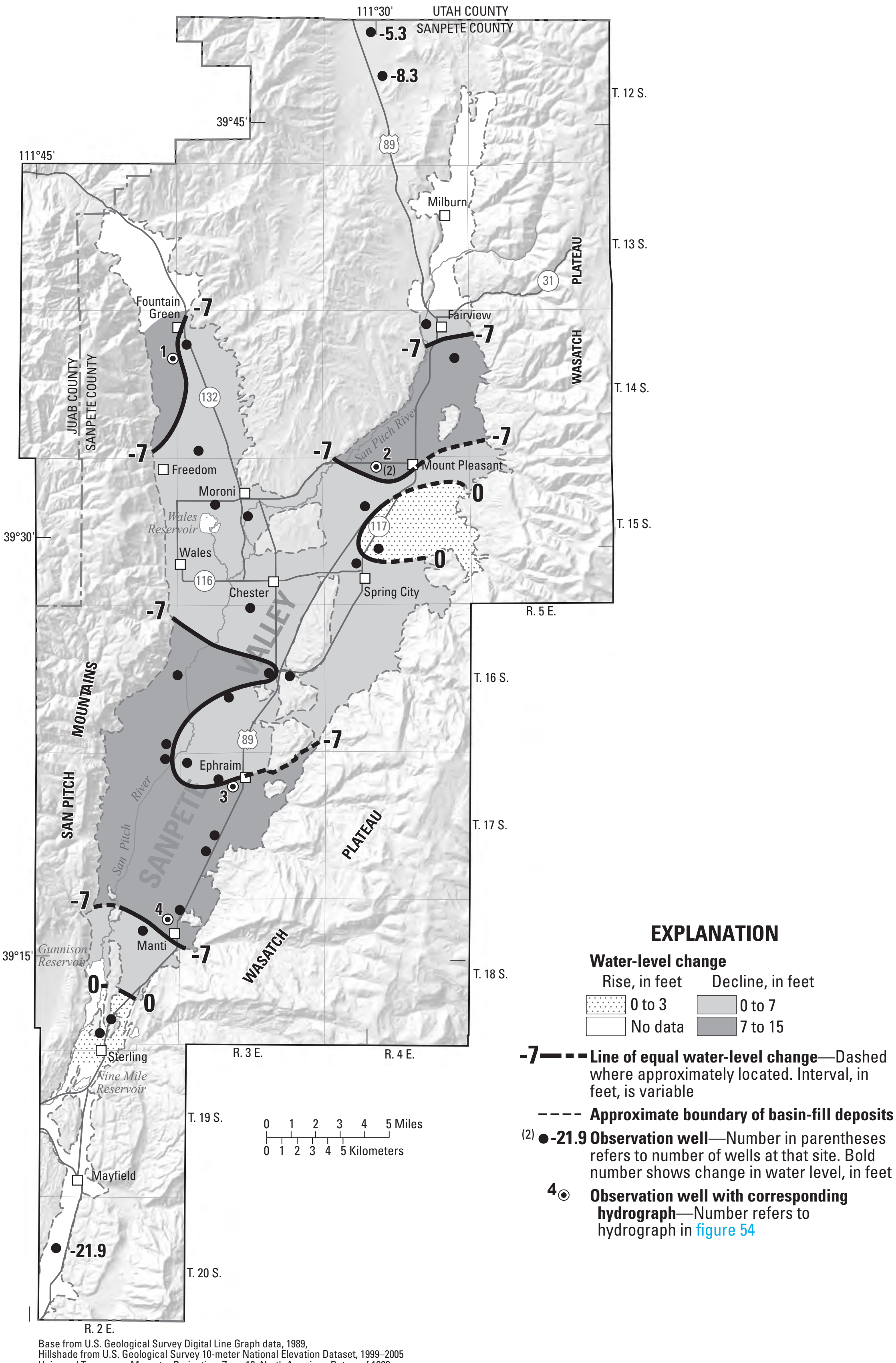

Figure 55. Water-level change in Sanpete Valley from March 1980 to March 2010.

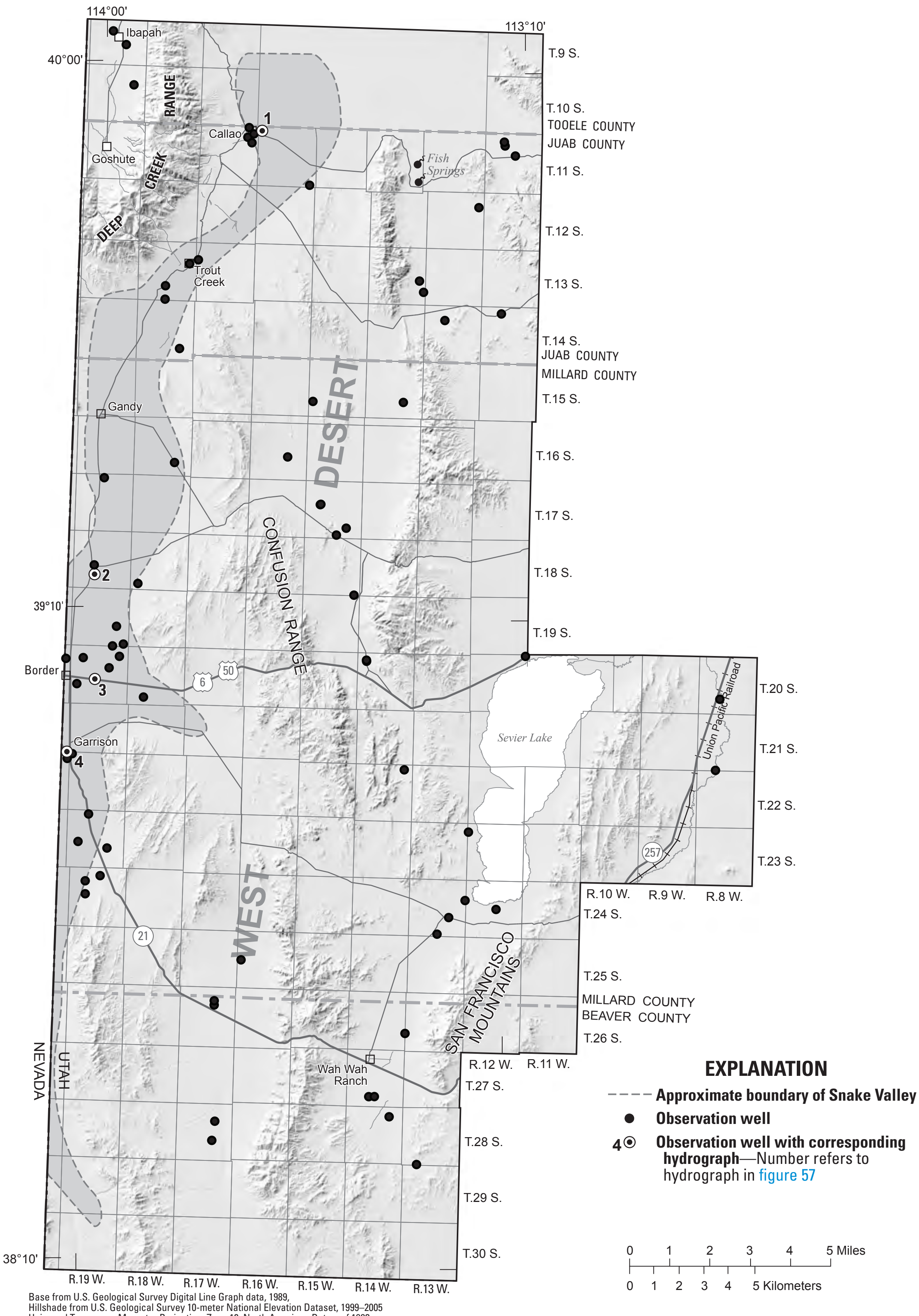

Figure 56. Location of wells in Snake Valley and the West Desert in which the water level was measured during March 2010.

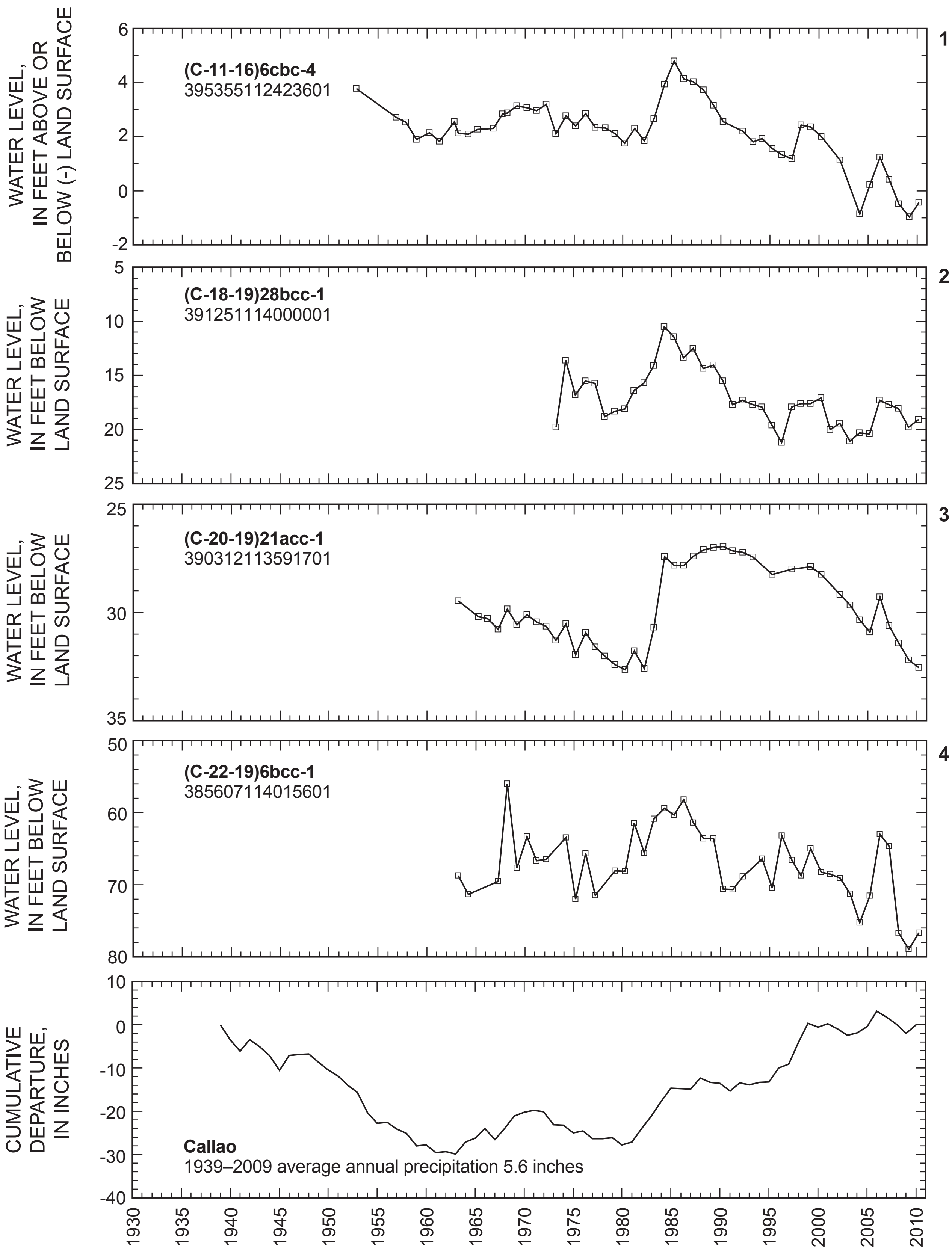

Figure 57. Relation of water level in selected wells in Snake Valley and the West Desert to cumulative departure from average annual precipitation at Callao.

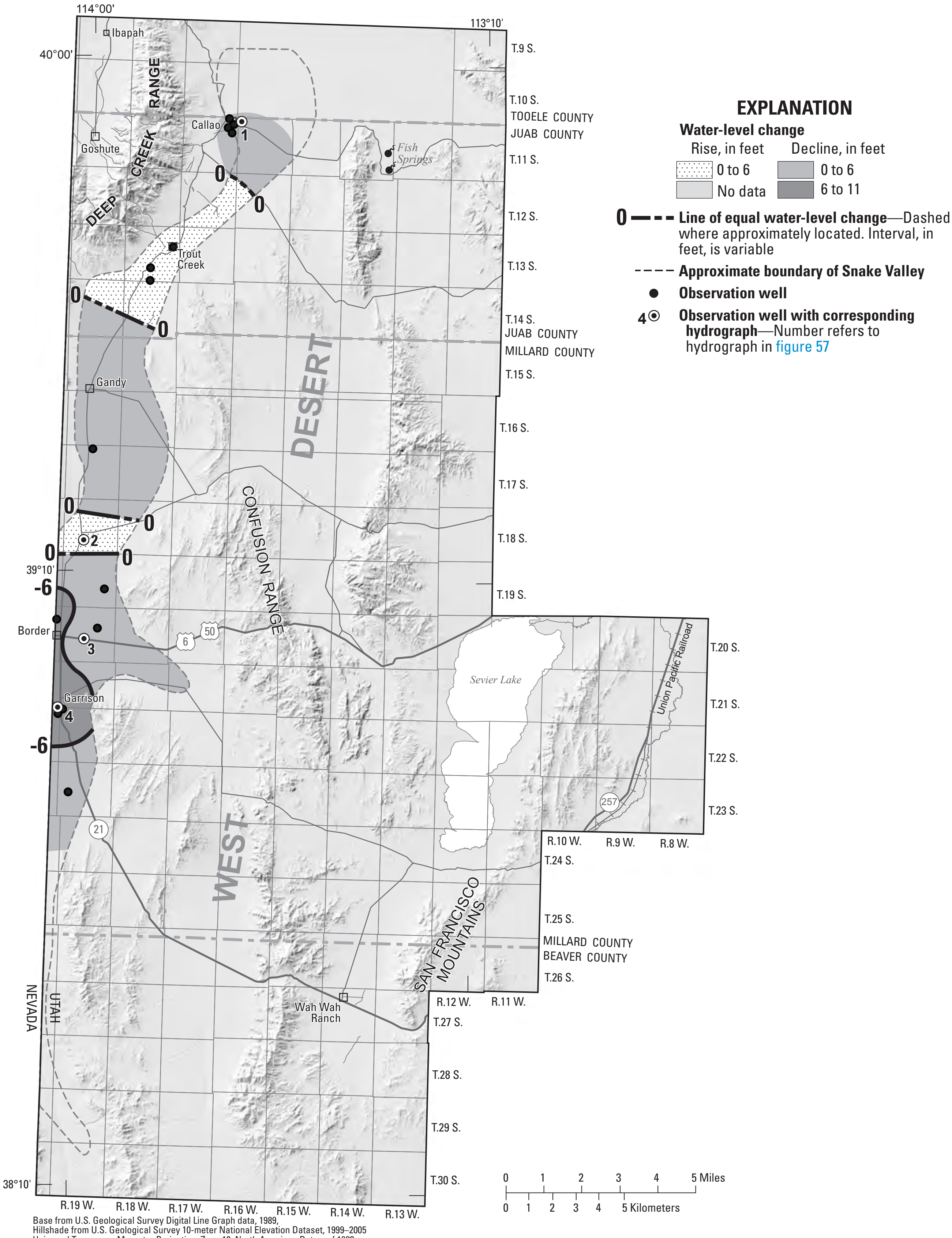

Figure 58. Water-level change in Snake Valley and the West Desert from March 1980 to March 2010.

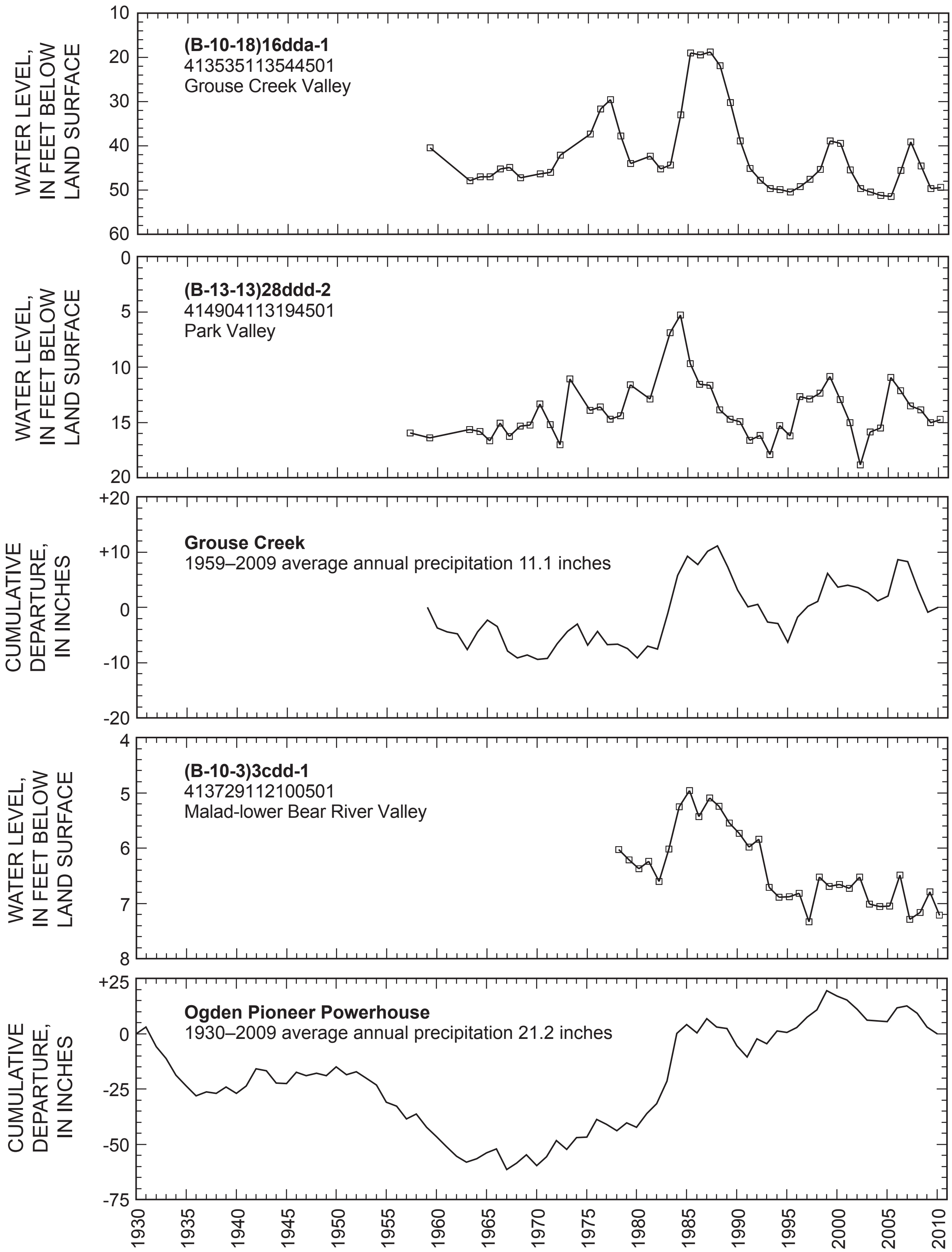

Figure 59. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

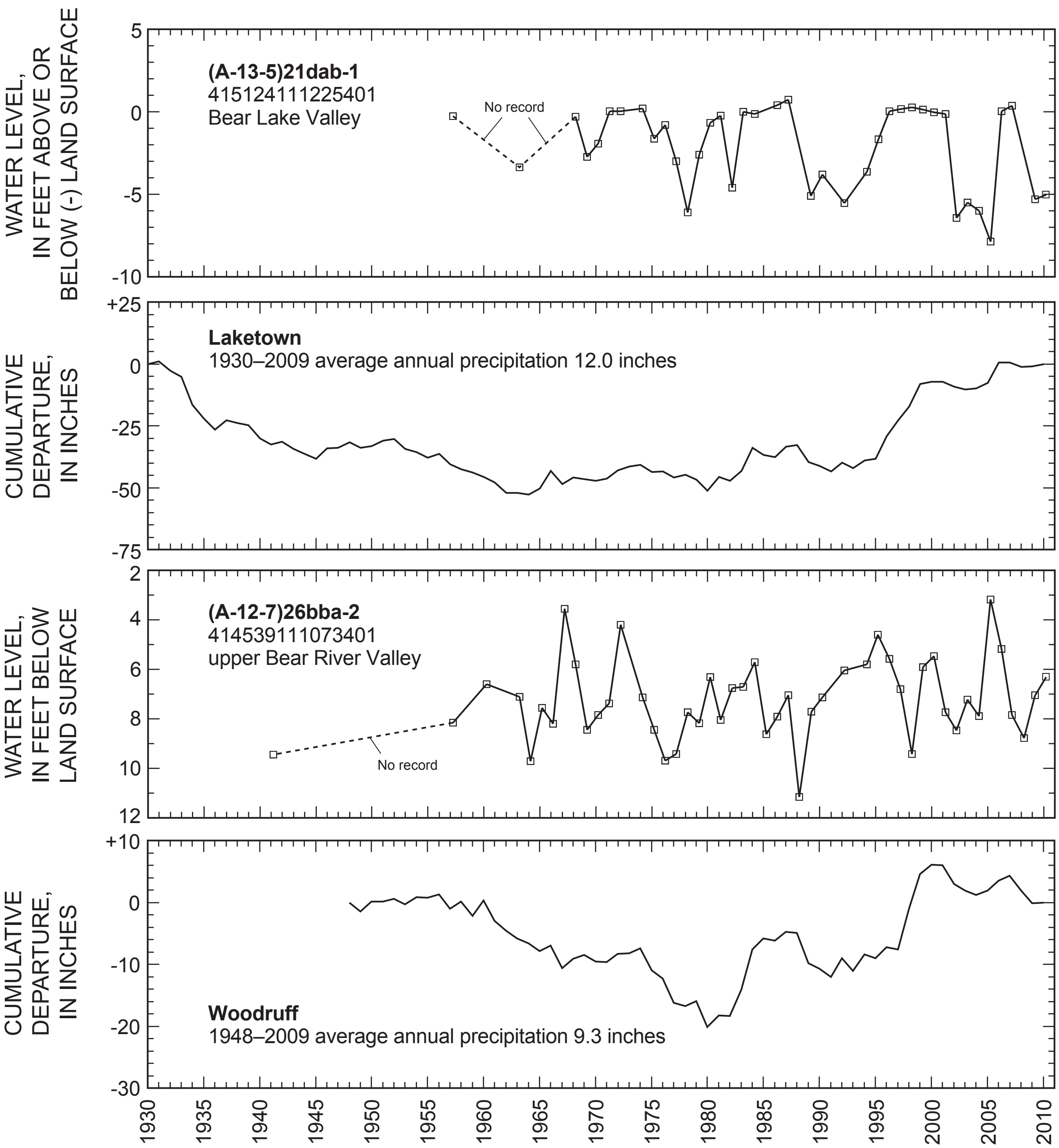

Figure 59. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

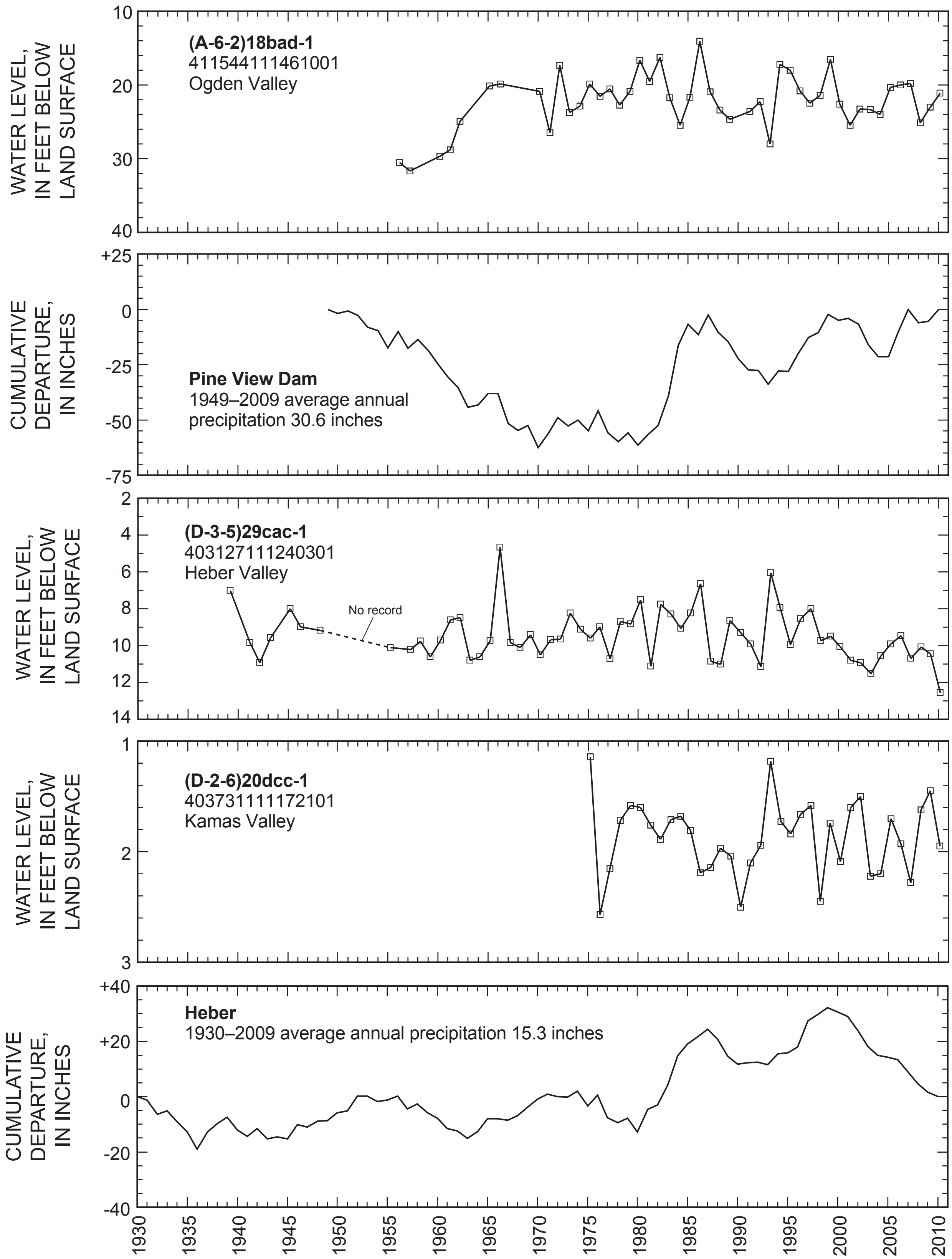

Figure 59. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

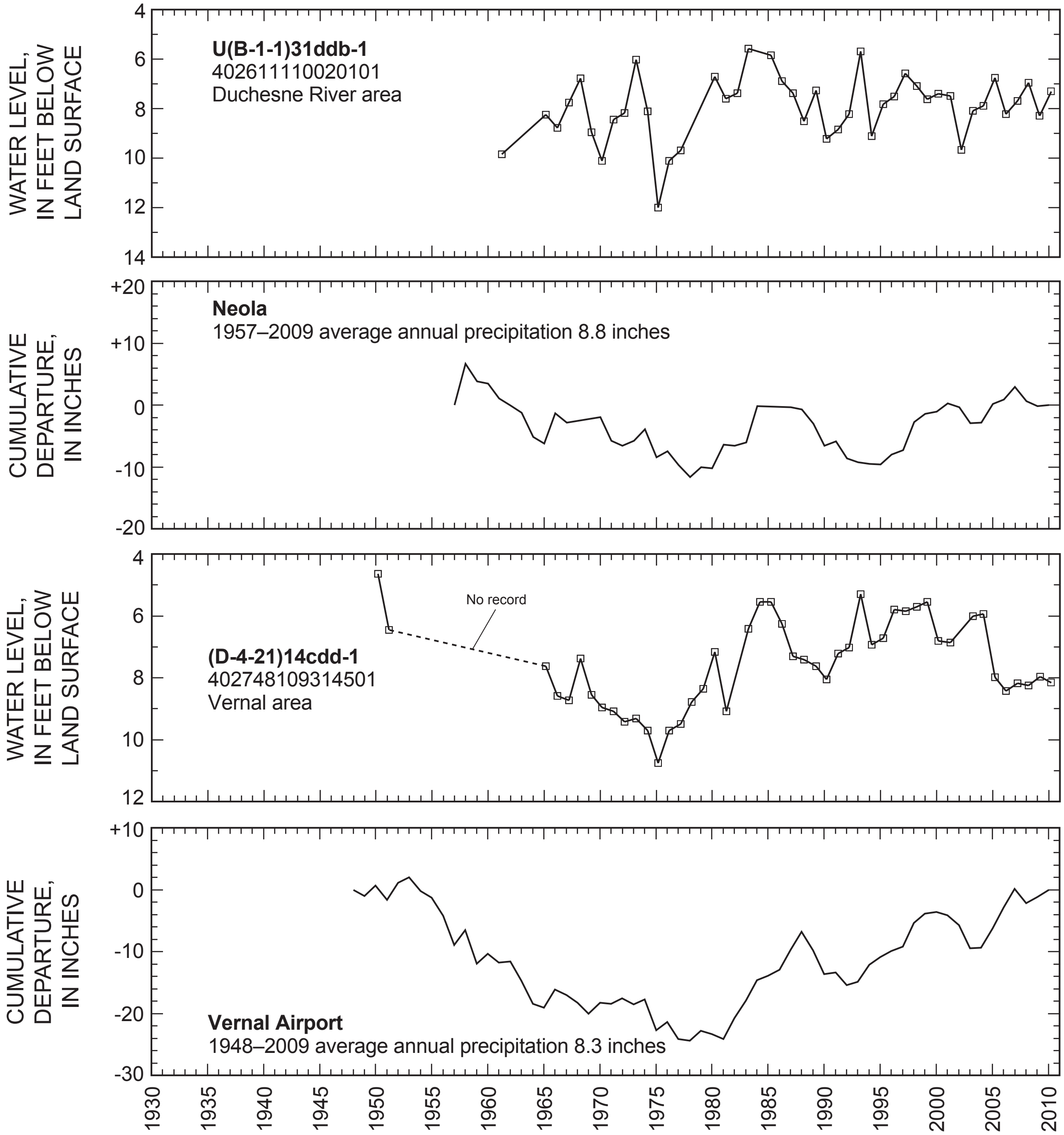

Figure 59. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

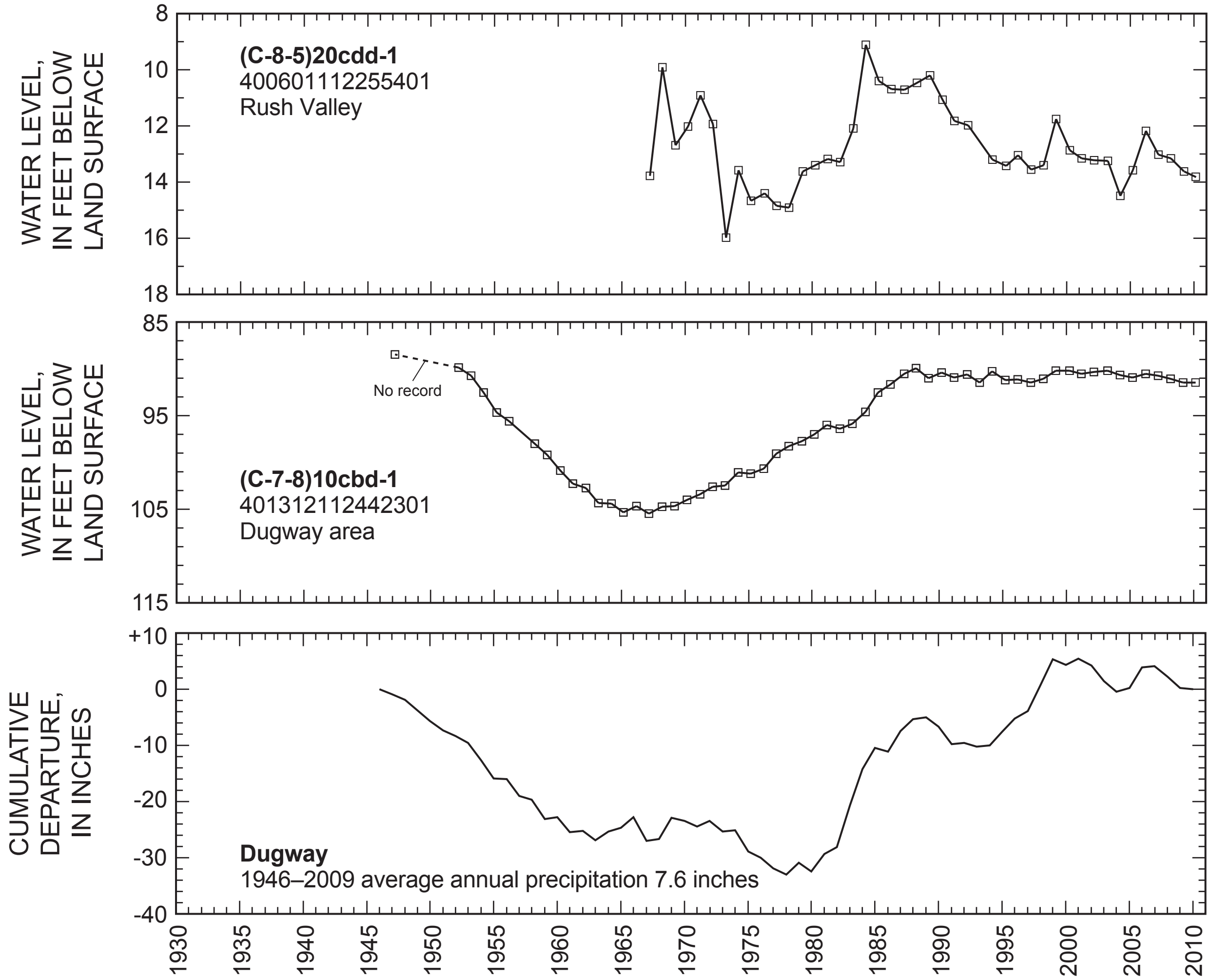

Figure 59. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

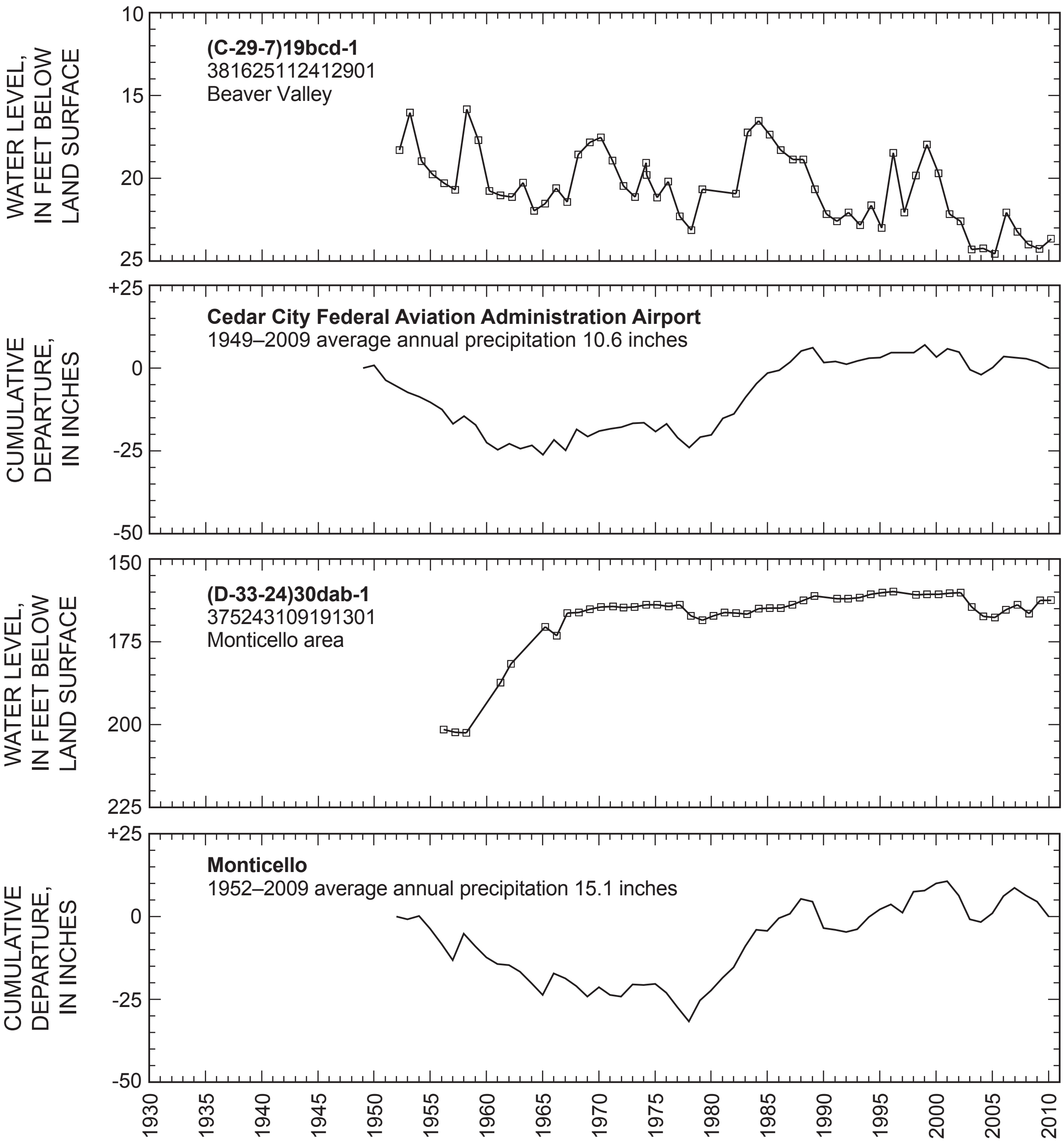

Figure 59. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

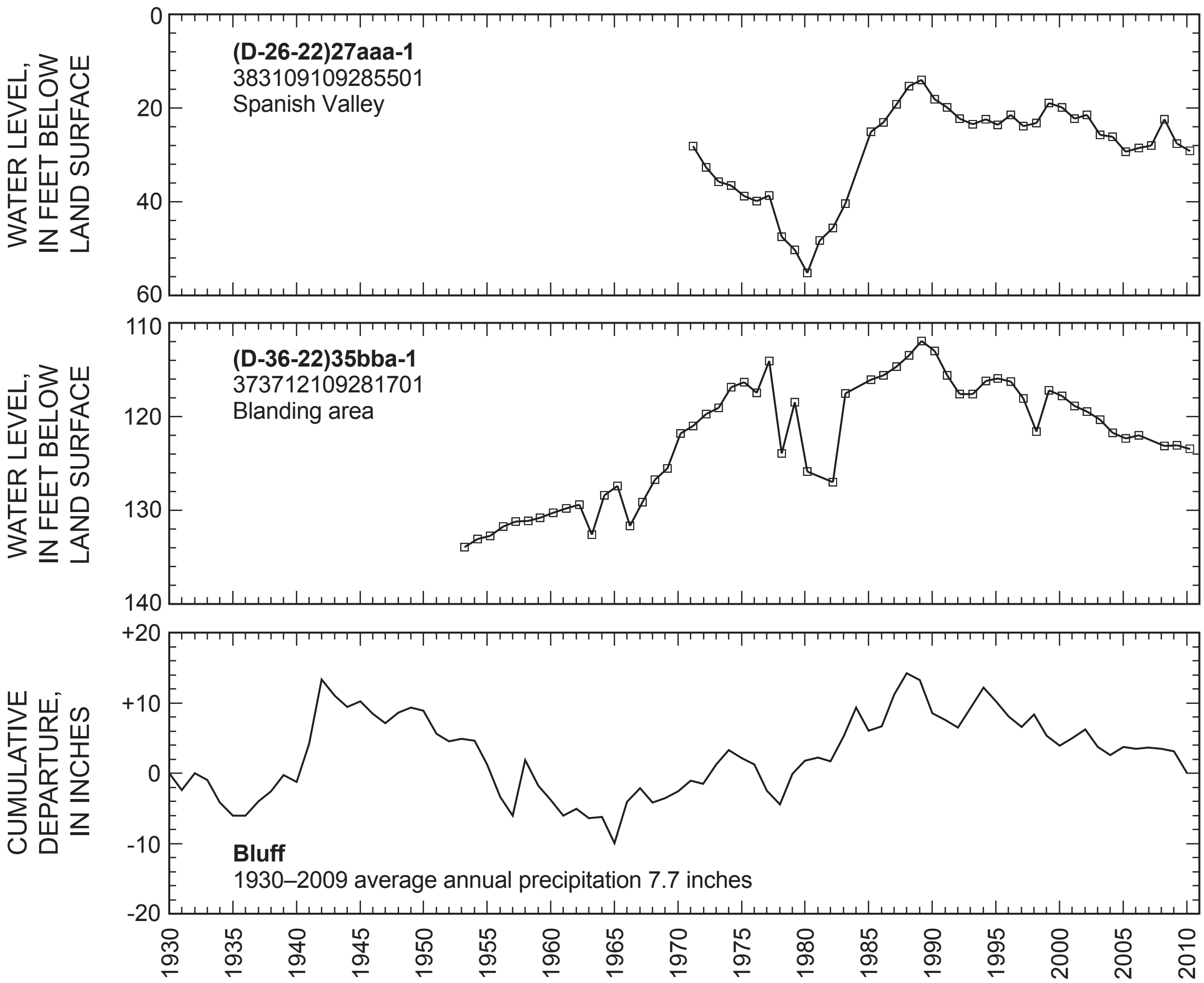

Figure 59. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

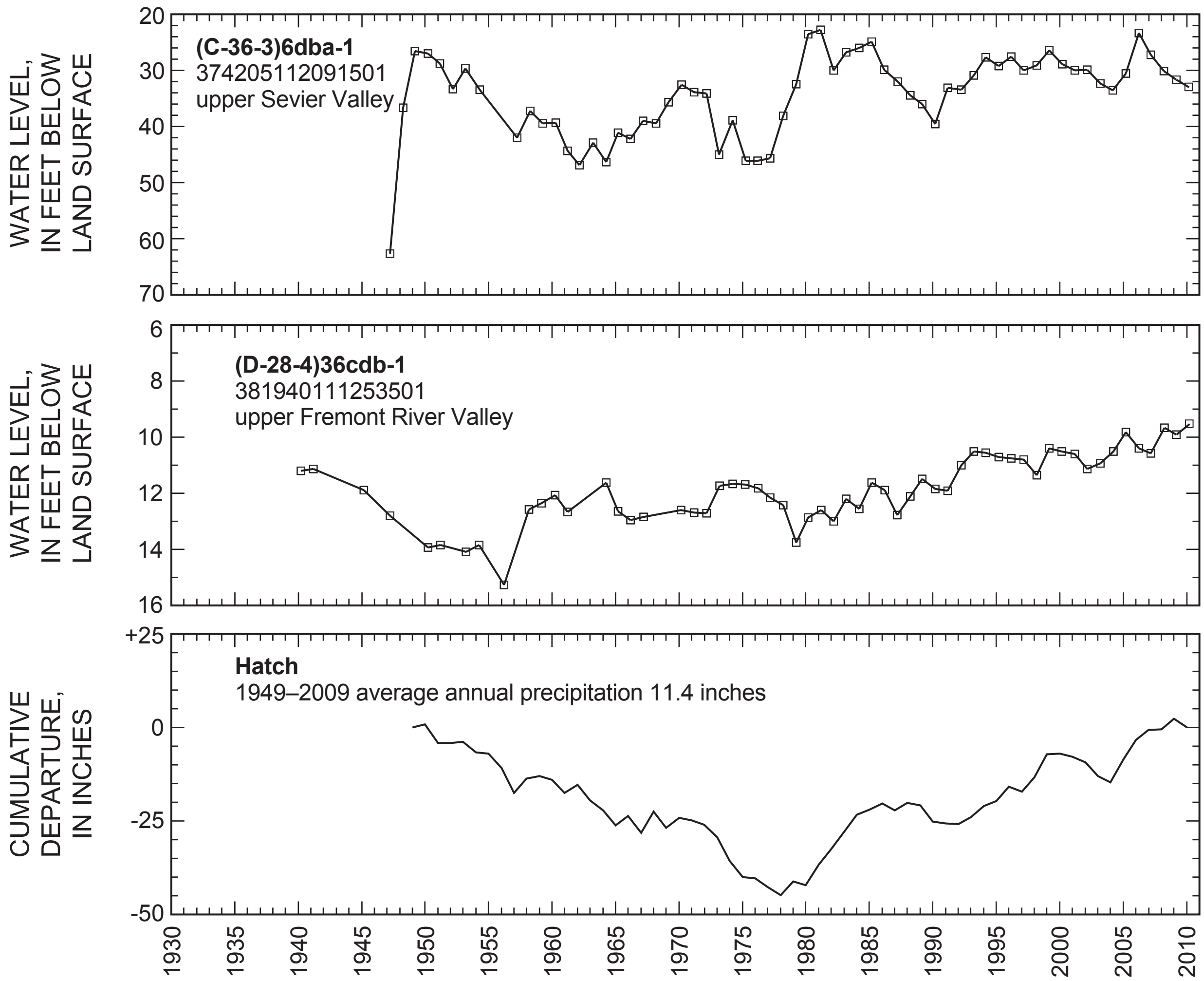

Figure 59. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

Quality of Water from Selected Wells in Utah, Summer of 2009

From July through August 2009, 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 104 wells located in 19 counties (fig. 60). Samples were collected during this time period to limit seasonal variability in the data. The majority of water samples were collected from irrigation wells. Field parameters that were measured at the time the water samples were collected included pH, specific conductance, and water temperature. Chemical constituents that were analyzed in the water samples included major ions, dissolved solids, nutrients (nitrite plus nitrate and orthophosphate), and selected trace elements. The USGS National Water Quality Laboratory in Denver, Colorado, analyzed the water samples. Field parameter values and analytical results for major ions, dissolved solids, and nutrients are listed in table 4. Analytical results for trace elements are listed in table 5.

The water samples were collected using protocols in the USGS National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated). Analytical methods used by the laboratory are described in Fishman and Friedman (1989). Water-quality data in this report are stored in the USGS National Water Information System (NWIS) database and are available online at *http://waterdata.usgs.gov/ut/nwis/qw*.

Water-quality field blanks were collected to determine if samples were being contaminated during equipment decontamination and/or sample collection and processing procedures. A field blank is an inorganic blank water sample that is prepared by the USGS National Water Quality Laboratory, carried in the field, and processed using the same methods and equipment as the environmental water samples. The field blank is subject to processing in the field, preservation, shipment, laboratory handling procedures, and analytical protocols. Ten field blank water samples were processed during the 2009 sampling period. Analytical results associated with the samples were less than the detection limit for all constituents.

Replicate water samples also were collected at two wells. A replicate sample is collected concurrent with an environmental sample and is used to assess the repeatability of the laboratory analytical results. Analytical results for the replicate water samples were in good agreement with the environmental samples, confirming the repeatability of the laboratory analytical results.

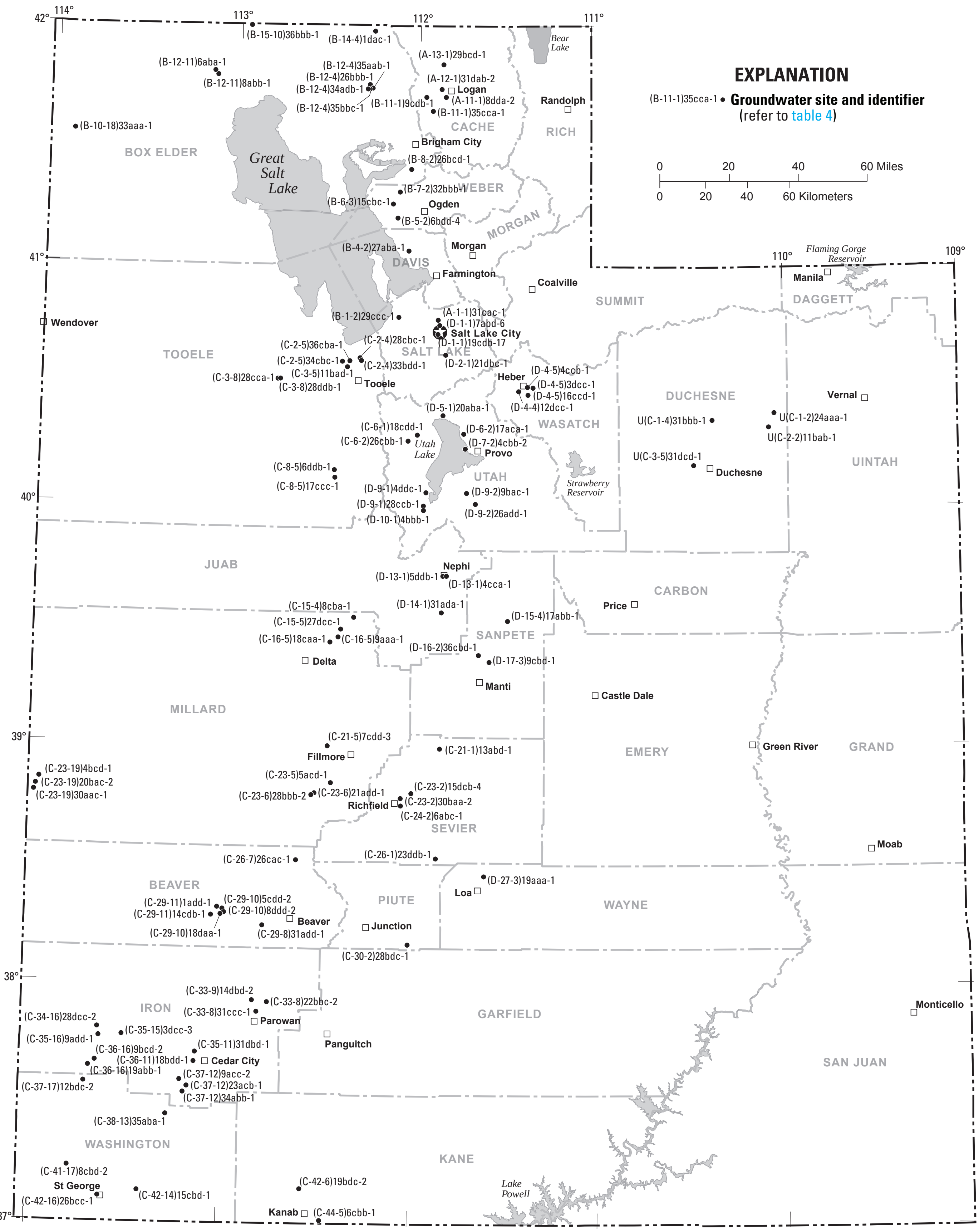

Figure 60. Location of groundwater sites sampled during the summer of 2009.

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2009.

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

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-29-8)31add-1	381435112471401	7/28/2009	7.3	1,020	12.6	360	100	27.1
Cove Fort								
(C-26-7)26cac-1	383101112365301	7/28/2009	7.9	600	14.8	250	74.5	14.7
Escalante Valley, Milford area								
(C-29-10)5cdd-2	381835113000001	8/11/2009	7.7	800	16	360	107	22.3
(C-29-10)8ddd-2	381741112592702	8/11/2009	7.7	784	18.4	310	81.9	26.4
(C-29-10)18daa-1	381714113003401	8/18/2009	7.5	557	15.4	230	68.4	14.2
(C-29-11)1add-1	381901113014101	8/11/2009	8.4	797	20.7	330	95.5	21.8
(C-29-11)14cdb-1	381700113033401	8/11/2009	7.8	715	18.9	260	75.3	17.3
Box Elder County								
Curlew Valley								
(B-12-11)8abb-1	414710113071601	7/31/2009	7.2	3,190	24.9	1,200	336	85.2
(B-15-10)36bbb-1	415939112562201	8/5/2009	7.6	L 492	16.1	190	56.2	11.8
East Shore area								
(B-8-2)26bcd-1	412405112022501	7/31/2009	7.4	168	14.9	33	6.44	4.15
Grouse Creek area								
(B-10-18)33aaa-1	413300113543001	7/31/2009	7.3	1,160	11.6	440	127	30.7
Kelton area								
(B-12-11)6aba-1	414811113081701	7/31/2009	7.6	1,020	16	280	78.5	20.4
(B-12-11)6abb-1	414813113082901	7/31/2009	7.7	731	14.4	290	84.3	18.6
Malad-lower Bear River area								
(B-12-4)26bbb-1	414510112163501	7/15/2009	7.3	L 2,460	13.6	1,100	253	119
(B-12-4)34adb-1	414405112165701	7/15/2009	7.5	1,900	16.4	540	120	59.1
(B-12-4)35aab-1	414418112154801	7/15/2009	7.6	2,560	15.1	970	229	96.9
(B-12-4)35bbc-1	414406112163601	7/15/2009	7.5	L 1,550	16.7	330	75	35.6
(B-14-4)1dac-1	415833112150701	8/5/2009	7.5	L 734	12.1	270	69.2	23.8
Cache County								
Cache Valley								
(A-11-1)8dda-2	414211111510902	8/19/2009	7.5	524	10.4	270	67.2	26.0
(A-12-1)31dab-2	414409111523502	8/19/2009	7.7	415	16.0	210	48.6	20.4
(A-13-1)29bcd-1	415020111520401	8/19/2009	7.8	454	13.3	190	41.3	22.2
(B-11-1)9cdb-1	414209111574001	8/19/2009	7.2	950	10.8	330	88.5	26.2
(B-11-1)35cca-1	413840111552601	8/19/2009	7.1	720	12.4	220	55.6	20.0
Davis County								
East Shore area								
(B-8-2)26bcd-1	412405112022501	7/31/2009	7.4	168	14.9	33	6.44	4.15
Duchesne County								
Duchesne River area								
U(C-1-2)24aaa-1	402319110025601	8/11/2009	6.9	350	14.0	170	49.2	11.4
U(C-1-4)31bbb-1	402130110231301	8/11/2009	7.3	833	11.7	420	86.1	48.8
U(C-2-2)11bab-1	401946110044601	8/11/2009	7.2	366	16.3	160	40.1	14.1
U(C-3-5)31dcd-2	401012110291901	8/11/2009	—	1,820	13.6	17	1.83	2.98
Iron County								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	7/29/2009	7.6	1,070	—	540	104	68.0
(C-36-11)18bdd-1	374017113080401	7/29/2009	7.7	1,270	15.4	620	123	75.8
(C-37-12)9acc-2	373542113122402	7/29/2009	8.0	359	17.6	130	42.4	6.01
(C-37-12)23acb-1	373407113100801	7/29/2009	7.5	1,300	15.0	600	131	67.2
(C-37-12)34abb-1	373236113111401	7/29/2009	7.2	810	11.6	430	110	38.0
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-2	374834113384301	8/5/2009	7.4	1,090	12.3	440	133	24.8
(C-35-15)3dcc-3	374649113305801	8/5/2009	7.6	1,380	13.7	570	134	56.0
(C-35-16)9add-1	374623113381301	8/5/2009	7.5	459	12.5	190	58.7	10.7
(C-36-16)9bcd-2	374014113391101	8/5/2009	7.3	539	14.1	230	72.0	11.7
(C-36-16)19abb-1	373854113411501	8/5/2009	7.4	485	11.4	210	64.0	11.3
Parowan Valley								
(C-33-8)22bbc-2	375523112451902	7/28/2009	8.4	486	16.7	61	14.8	5.74
(C-33-8)31ccc-1	375257112483501	7/28/2009	7.9	458	14.9	200	40.1	23.9
(C-33-9)14dbd-2	375548112500401	7/29/2009	8.1	878	15.1	240	40.4	34.1

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2009.—Continued

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

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										
6.34	79.9	330	0.23	71.7	0.55	48.6	105	661	3.02	0.072
Cove Fort										
2.75	20.8	151	.17	80.1	.18	43.3	24.9	415	1.18	.035
Escalante Valley, Milford area										
4.67	26.5	256	.19	52.3	.24	35.2	70.2	509	2.44	.046
3.86	35.3	188	.22	64.9	.32	27.9	98.4	494	3.98	.017
4	19.3	137	.17	48.5	.29	35.3	55.5	343	2.24	.037
5.19	27	163	.25	104	.32	38.1	69.9	517	3.34	.025
5.68	30.6	97	.24	107	.39	43.3	75.7	478	2.29	.021
Box Elder County										
Curlew Valley										
11	128	125	.76	1,040	e.10	22.4	39	2,380	1.8	.011
8.25	17.1	143	.05	53	.2	61.8	20.5	321	.68	.029
East Shore area										
3.6	25.3	77	e.02	6.97	e.09	13.9	10	123	.65	.134
Grouse Creek area										
8.83	63.2	246	.36	194	.27	49.5	108	804	.86	.044
Kelton area										
5.35	103	170	.21	224	.2	19.8	49	630	.48	.016
2.93	40.7	164	.15	140	.15	17.1	29.8	498	.54	.014
Malad-lower Bear River area										
6.95	167	145	.84	650	.16	31.3	414	1,880	15.5	.031
4.09	176	190	.58	497	.21	21.7	74	1,130	2.61	.016
5.82	176	183	1.04	514	.13	25.1	473	1,690	9.38	.027
4.82	164	204	.29	344	.23	19.9	42.8	849	1.68	.02
2.15	41.2	210	.11	86	.15	16.9	31.4	413	1.88	.02
Cache County										
Cache Valley										
1.44	7.45	245	e.02	11.6	e.10	9.73	25.6	302	.91	.014
1.47	7.72	202	e.02	7.38	e.10	11.5	11.5	241	.49	.018
1.56	23.7	216	e.02	8.84	e.08	10.9	11.5	263	.14	.011
7.93	44.6	384	.12	76.8	.58	50.4	<.18	538	<.04	.076
10.5	49.1	298	.07	49.2	.35	45.6	<.18	417	<.04	.387
Davis County										
East Shore area										
5.37	116	269	.06	41.0	.37	30.2	e.17	381	<.04	.612
Duchesne County										
Duchesne River area										
3.95	4.56	137	<.02	.94	.67	7.98	45.6	217	<.04	<.008
.84	23.8	417	.15	22.7	1.05	36.6	25.4	507	1.47	.052
3.29	12.7	142	<.02	1.44	.58	9.85	49.0	215	<.04	e.005
1.08	382	552	.07	169	1.27	15.5	149	1,110	<.04	.063
Iron County										
Cedar Valley										
2.58	11.1	146	.06	14.3	.25	21.3	370	760	2.07	.013
3.47	46.5	173	.16	46.4	.24	34.2	453	981	3.58	.021
6.81	17.8	128	.17	26.0	.27	68.8	10.9	274	.98	.034
1.85	47.4	145	.65	112	e.04	18.3	391	938	2.02	.026
1.99	14.3	310	.03	8.83	.22	18.0	135	532	1.15	.015
Escalante Valley, Beryl-Enterprise area										
8.69	35.5	123	.89	219	.56	61.2	95.2	788	1.62	.039
5.68	69.6	127	.66	181	.40	58.4	322	962	1.29	.031
4.71	14.3	145	.19	43.0	.22	51.2	20.3	302	1.60	.036
4.17	16.6	154	.28	62.4	.26	38.6	20.5	358	2.47	.042
4.50	18.0	173	.18	35.9	.32	35.6	21.2	314	2.52	.047
Parowan Valley										
1.42	75.3	120	.08	67.7	.46	23.6	19.2	291	.29	.026
2.66	20.3	192	.07	20.0	.18	28.9	20.6	269	1.46	.031
3.07	59.0	110	.25	163	.40	22.3	35.2	448	.10	.018

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2009.—Continued

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

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
				Juab County				
Juab Valley								
(D-13-1)4cca-1	394225111495701	7/28/2009	7.0	1,740	11.8	510	137	41.8
(D-13-1)5ddb-1	394225111502201	7/28/2009	7.1	1,540	11.5	510	139	40.8
(D-14-1)31ada-1	393315111511601	7/28/2009	7.0	1,340	12.9	710	185	59.5
				Kane County				
Kanab area								
(C-42-6)19bdc-2	370843112340602	8/3/2009	8.1	249	—	120	21.9	15.5
(C-44-5)6cbb-1	370050112274501	8/3/2009	7.1	2,120	18.8	700	177	62.9
				Millard County				
Pahvant Valley								
(C-21-5)7cdd-3	385939112272303	8/12/2009	7.2	1,520	12.0	530	116	58.2
(C-23-5)5acd-1	385026112261001	8/12/2009	7.6	662	14.0	290	75.6	24.6
(C-23-6)21add-1	384751112312201	8/12/2009	7.5	1,140	16.0	320	58.1	42.1
(C-23-6)28bbb-2	384722112322101	8/12/2009	7.0	6,540	15.5	2,200	390	305
Sevier Desert								
(C-15-4)8cba-1	393154112192901	7/22/2009	7.0	—	13.5	1,000	223	114
(C-15-5)27dcc-1	392854112233801	7/22/2009	7.7	469	21.6	150	30.1	17.9
(C-16-5)9aaa-1	392656112242601	7/22/2009	7.5	405	24.0	140	27.6	16.9
(C-16-5)18caa-1	392538112270201	7/22/2009	8.0	334	21.5	130	23.2	18.1
Snake Valley								
(C-23-19)4bcd-1	385048113592901	7/23/2009	7.9	441	12.1	210	38.9	27.4
(C-23-19)20bac-2	384900114003001	7/23/2009	7.4	L 1,020	13.0	320	45.6	48.8
(C-23-19)30aac-1	384729114010301	7/23/2009	7.2	L 2,440	12.9	920	177	116
				Piute County				
Upper Sevier Valley								
(C-30-2)28bdc-1	381003112010301	7/21/2009	8.0	432	14.9	180	44.1	17.1
				Salt Lake County				
Salt Lake Valley								
(A-1-1)31cac-1	404627111532601	7/28/2009	7.4	1,160	—	420	99.9	42.1
(B-1-2)29ccc-1	404704112060401	7/28/2009	7.9	L 9,200	15.2	240	34.7	36.7
(D-1-1)7abd-6	404506111523301	7/28/2009	7.1	1,300	14.5	580	135	59.0
(D-1-1)19cdb-17	404253111530901	7/28/2009	7.4	1,120	14.4	490	122	44.4
(D-2-1)21dbc-1	403742111503201	7/28/2009	7.7	416	13.0	170	45.6	14.2
				Sanpete County				
Sanpete Valley								
(D-15-4)17abb-1	393113111294501	8/31/2009	7.7	622	9.9	330	71.9	37.2
(D-16-2)36cbd-1	392238111390501	8/31/2009	7.5	787	14.4	320	49.5	47.7
(D-17-3)9cbd-1	392056111353801	8/31/2009	7.8	666	12.7	330	56.1	46.0
				Sevier County				
Central Sevier Valley								
(C-21-1)13abd-1	385910111512101	7/22/2009	9.0	751	18.4	140	29.8	16.9
(C-23-2)15dcb-4	384757112002201	7/21/2009	7.3	673	17.7	320	63.1	38.3
(C-23-2)30baa-2	384641112034601	7/21/2009	7.5	872	17.0	410	82.7	50.3
(C-24-2)6abc-1	384450112034001	7/22/2009	7.3	1,520	12.2	750	176	74.7
Upper Sevier Valley								
(C-26-1)23ddb-1	383140111522001	7/21/2009	7.7	216	14.4	82	26.8	3.67
				Tooele County				
Rush Valley								
(C-8-5)6ddb-1	400849112263901	7/8/2009	7.6	638	16.5	230	44.0	29.1
(C-8-5)6ddb-2	400849112263902	7/8/2009	7.5	582	16.1	240	45.8	30.3
(C-8-5)17ccc-1	400652112261801	7/8/2009	7.7	545	16.1	220	42.1	26.7
Skull Valley								
(C-3-8)28cca-1	403128112453501	7/10/2009	7.7	L 1,210	13.7	380	106	27.1
(C-3-8)28ddb-1	403126112444501	7/10/2009	8.0	558	13.8	190	52.3	13.8
Tooele Valley								
(C-2-4)28cbc-1	403702112040101	7/8/2009	—	2,190	14.9	340	84.9	30.5
(C-2-4)33bdd-1	403629112174801	7/13/2009	7.4	971	14.0	300	76.6	27.3
(C-2-5)34cbc-1	403612112241001	7/13/2009	7.5	L 5,010	17.8	940	226	91.2
(C-2-5)36cba-1	403603112215801	7/6/2009	—	2,030	19.5	400	101	36.1
(C-3-5)11bad-1	403419112222001	7/10/2009	7.1	7,950	25.6	740	183	68.9

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2009.—Continued

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

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
Juab County										
Juab Valley										
3.88	172	311	0.07	294	0.18	22.8	133	1,050	3.60	0.027
3.75	138	378	.09	214	.15	25.2	104	932	5.21	.031
2.05	40.6	243	.05	53.7	.24	13.7	431	1,030	1.55	.010
Kane County										
Kanab area										
2.04	3.42	117	.05	3.87	.11	14.4	4.61	147	2.19	.017
9.80	240	316	.25	57.1	.48	14.3	862	1,710	.08	.009
Millard County										
Pahvant Valley										
5.02	126	317	.28	170	.14	27.0	245	1,020	5.21	.023
1.85	25.9	259	.07	37.6	e.07	21.0	33.3	410	2.79	.028
4.74	108	186	.31	164	.36	27.7	131	700	5.58	.014
12.0	558	177	3.05	1,720	.30	33.0	807	4,600	34.3	.020
Sevier Desert										
8.41	364	420	.59	612	.17	30.2	545	2,340	.54	.025
2.15	34.4	126	.06	43.1	.17	26.8	40.0	283	.76	.015
1.96	26.7	137	.05	30.7	.17	25.8	21.9	245	.64	.018
2.00	19.9	128	.04	21.2	.16	26.2	12.1	208	.54	.016
Snake Valley										
2.56	13.3	153	.05	11.8	1.50	20.2	61.1	285	.31	.011
4.30	97.1	324	.18	74.4	1.01	52.6	92.2	637	2.51	.057
6.95	161	245	1.08	398	.60	45.8	402	1,600	6.04	.035
Piute County										
Upper Sevier Valley										
4.58	15.9	194	.07	11.2	.24	32.1	21.4	270	.38	.034
Salt Lake County										
Salt Lake Valley										
3.37	61.9	268	.07	167	.21	20.2	71.1	664	4.50	.017
20.1	1,730	291	1.94	2,810	1.49	21.2	240	5,210	<.04	.139
2.93	54.3	290	.12	170	.16	19.7	174	879	5.24	.042
3.79	44.9	258	.08	92.4	.23	16.8	211	753	3.11	.019
1.92	13.7	138	.03	21.9	.15	11.2	33.9	246	1.93	.011
Sanpete County										
Sanpete Valley										
1.20	8.95	302	e.02	6.22	.11	8.83	14.5	342	2.27	e.006
1.24	49.6	262	.15	69.2	.30	19.2	49.1	455	.75	.013
1.47	27.8	320	.02	8.07	.21	12.6	37.3	376	2.03	.009
Sevier County										
Central Sevier Valley										
4.22	88.7	115	.09	105	.52	41.9	88.0	460	.29	.022
3.27	18.8	272	.07	27.8	.37	34.4	48.6	414	.95	.042
1.85	31.7	436	.07	14.5	.18	15.7	32.2	524	3.19	.022
4.67	56.0	372	.11	20.4	.16	33.0	493	1,160	2.35	.035
Upper Sevier Valley										
2.86	9.06	83	.06	13.0	.20	41.5	5.06	163	.44	.023
Tooele County										
Rush Valley										
2.65	38.5	153	.08	83.7	.53	14.1	28.9	350	.38	.009
2.70	42.5	155	.09	94.3	.53	14.3	30.6	379	.45	.009
2.15	29.9	150	.07	66.4	.39	16.4	24.8	322	.10	.010
Skull Valley										
4.29	80.4	89	.26	285	e.07	19.6	27.0	748	3.59	.026
1.92	46.4	114	.08	99.8	.14	18.9	19.9	337	1.13	.028
Tooele Valley										
3.15	306	205	.36	540	e.10	13.5	47.2	1,220	1.98	.019
2.20	94.4	203	.12	122	.13	12.8	112	594	1.95	.025
12.7	605	162	1.11	1,440	.38	24.0	185	2,910	4.36	.018
4.02	262	195	.34	524	.16	19.8	35.6	1,220	2.56	.019
19.6	1,380	190	1.59	2,570	.38	27.2	108	4,810	.64	.020

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2009.—Continued

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

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
Utah County								
Cedar Valley								
(C-6-1)18cdd-1	401730111594501	7/22/2009	7.2	747	29.8	270	65.3	25.8
(C-6-2)26cbb-1	401607112023401	7/22/2009	7.3	809	11.4	350	57.5	50.1
Goshen Valley								
(C-9-1)4ddc-1	400309111565101	7/22/2009	7.5	1,380	16.9	320	84.3	27.6
(C-9-1)28ccb-1	395956111572101	7/22/2009	7.2	2,080	18.0	620	161	53.7
(C-10-1)4bbb-1	395848111571801	7/22/2009	7.5	2,300	—	670	167	60.4
Northern Utah Valley								
(D-5-1)20aba-1	402236111511501	7/30/2009	7.7	273	11.8	130	29.6	13.8
(D-6-2)17aca-1	401801111442501	7/30/2009	7.3	L 568	14.6	260	63.0	25.1
Southern Utah Valley								
(D-7-2)4cbb-2	401414111435301	7/28/2009	7.5	538	13.0	260	64.4	25.1
(D-9-2)9bac-1	400311111432001	7/28/2009	7.3	659	14.7	300	71.6	29.1
(D-9-2)26add-1	400023111402200	7/28/2009	7.1	591	11.4	320	76.6	30.1
Wasatch County								
Heber Valley								
(D-4-4)12dcc-1	402842111263101	8/17/2009	7.0	605	11.0	290	79.8	21.0
(D-4-5)3dcc-1	402937111214901	8/17/2009	6.8	585	10.6	270	91.0	11.2
(D-4-5)4ccb-1	402946111233901	8/14/2009	6.8	395	11.0	190	60.7	8.86
(D-4-5)16ccd-1	402750111232701	8/14/2009	7.7	445	11.7	220	52.0	21.7
Washington County								
Central Virgin River area								
(C-38-13)35aba-1	372702113163401	8/4/2009	7.6	434	13.8	210	60.7	13.0
(C-41-17)8cbd-2	371348113470301	8/4/2009	7.4	472	18.3	220	63.7	15.7
(C-42-14)15cbd-1	370538113251301	8/4/2009	7.4	2,500	24.3	1,200	266	138
(C-42-16)26bcc-1	370617113371101	8/4/2009	7.1	5,640	17.7	2,500	586	253
Escalante Valley, Beryl Enterprise area								
(C-37-17)12bdc-2	373456113423501	8/5/2009	7.1	535	11.4	220	67.8	11.5
Wayne County								
Upper Fremont River Valley								
(D-27-3)19aaa-1	382717111365601	7/21/2009	7.1	1,380	14.1	710	210	44.9
Weber County								
East Shore area								
(B-5-2)6bdd-4	411153112064601	7/30/2009	8.0	450	16.0	140	34.3	13.6
(B-6-3)15cbc-1	411523112082101	7/30/2009	8.3	412	15.9	32	7.60	3.07
(B-7-2)32bbb-1	411824112060601	7/30/2009	7.9	2,420	18.2	330	69.7	38.5

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2009.—Continued

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

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
Utah County										
Cedar Valley										
3.37	32.9	201	0.09	69.8	0.53	20.4	65.0	439	0.97	0.012
3.55	20.9	188	.14	137	.32	56.5	26.1	485	.20	.034
Goshen Valley										
14.6	138	143	.33	277	.33	68.9	113	843	2.25	.034
17.3	128	111	.73	483	.18	67.2	121	1,370	17.9	.033
16.8	153	91	.60	627	.21	37.2	100	1,460	3.54	.016
Northern Utah Valley										
1.19	8.06	113	e.01	7.12	.19	11.2	21.4	172	—	.011
4.54	14.9	214	.04	19.1	.19	21.2	56.6	341	1.26	.034
Southern Utah Valley										
2.62	15.3	230	.03	12.4	.22	19.6	46.2	328	<.04	.028
7.72	26.1	267	.05	29.0	.23	53.7	39.6	441	4.05	.038
1.77	11.1	268	.04	23.0	.18	20.1	29.4	370	2.65	.015
Wasatch County										
Heber Valley										
1.32	15.3	240	—	32.2	e.06	22.2	28.5	360	2.87	—
3.50	8.13	200	—	36.6	e.06	38.2	8.26	374	9.92	—
2.29	5.19	168	—	10.6	e.06	42.2	16.7	263	3.97	—
1.02	7.61	201	—	10.7	.12	12.5	28.3	270	1.09	—
Washington County										
Central Virgin River area										
1.74	13.4	199	.08	16.5	.17	38.5	17.3	287	1.20	.057
2.17	13.1	197	.07	13.7	.35	17.5	40.9	290	.45	.018
9.38	127	158	.61	225	.35	22.3	1,010	2,060	13.5	.014
14.2	690	315	1.40	329	.59	23.6	2,960	5,610	20.4	.023
Escalante Valley, Beryl Enterprise area										
4.66	26.1	228	.13	23.6	.23	44.7	18.7	346	3.30	.082
Wayne County										
Upper Fremont River Valley										
3.91	32.6	205	.07	12.6	e.07	30.4	583	1,120	2.74	.040
Weber County										
East Shore area										
7.66	33.6	221	.03	16.6	.25	30.8	e.14	269	<.04	.137
9.32	72.8	197	.04	15.9	.32	20.4	.20	258	<.04	.250
20.3	310	154	.47	690	.32	30.6	<.90	1,380	<.04	.054

Table 5. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2009.

[µg/L, micrograms per liter; <, less than; e, estimated; —, no data; M, presence verified but not quantified]

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-29-8)31add-1	381435112471401	7/28/2009	4.6	<4	<0.2	2.4	1.1	23.7
Cove Fort								
(C-26-7)26cac-1	383101112365301	7/28/2009	2.7	<4	<.2	.3	1.4	3.63
Escalante Valley, Milford area								
(C-29-10)5cdd-2	381835113000001	8/11/2009	2.5	<4	e.1	.5	.61	32.7
(C-29-10)8ddd-2	381741112592702	8/11/2009	4.9	e3	<.2	1.9	1.1	10.1
(C-29-10)18daa-1	381714113003401	8/18/2009	3.1	9	.6	.9	.40	7.26
(C-29-11)1add-1	381901113014101	8/11/2009	4.3	7	.2	1.1	.54	16.7
(C-29-11)14cdb-1	381700113033401	8/11/2009	3.9	4	<.2	1.4	.65	7.84
Box Elder County								
Curlew Valley								
(B-12-11)8abb-1	414710113071601	7/31/2009	.85	20	1.6	.5	1.2	3.34
(B-15-10)36bbb-1	415939112562201	8/5/2009	2.5	<4	<.2	.8	1.1	1.67
East Shore area								
(B-8-2)26bcd-1	412405112022501	7/31/2009	.79	<4	.8	.7	.37	.15
Grouse Creek area								
(B-14-4)1dac-1	415833112150701	8/5/2009	1.6	13	.8	.4	1.5	.81
Kelton area								
(B-12-11)6aba-1	414811113081701	7/31/2009	1.7	e3	<.2	1.4	1.2	2.15
(B-12-11)6abb-1	414813113082901	7/31/2009	1.3	<4	<.2	.9	1.0	1.80
Malad-lower Bear River area								
(B-12-4)26bbb-1	414510112163501	7/15/2009	2.2	13	e.3	.5	33.6	3.02
(B-12-4)34adb-1	414405112165701	7/15/2009	.78	8	<.4	.8	13.0	1.31
(B-12-4)35aab-1	414418112154801	7/15/2009	1.4	e7	e.2	.6	70.2	2.68
(B-12-4)35bbc-1	414406112163601	7/15/2009	.96	39	.5	1.2	4.0	1.24
(B-14-4)1dac-1	415833112150701	8/5/2009	1.6	13	.8	.4	1.5	.81
Cache County								
Cache Valley								
(A-11-1)8dda-2	414211111510902	8/19/2009	.21	<4	<.2	.4	.62	.88
(A-12-1)31dab-2	414409111523502	8/19/2009	.94	<4	<.2	.5	.31	.67
(A-13-1)29bcd-1	415020111520401	8/19/2009	6.6	194	65.8	.7	.06	.29
(B-11-1)9cdb-1	414209111574001	8/19/2009	12.7	1,720	293	.1	.08	<.01
(B-11-1)35cca-1	413840111552601	8/19/2009	23.0	1,880	171	.6	e.04	<.01
Davis County								
East Shore area								
(B-4-2)27aba-1	410340112030001	7/30/2009	24.6	372	51.2	.4	<.06	.01
Duchesne County								
Duchesne River area								
U(C-1-2)24aaa-1	402319110025601	8/11/2009	<.06	597	19.5	.2	<.06	.04
U(C-1-4)31bbb-1	402130110231301	8/11/2009	3.8	<4	<.2	1.8	.91	5.66
U(C-2-2)11bab-1	401946110044601	8/11/2009	.18	260	8.9	.4	<.06	.12
U(C-3-5)31dcd-2	401012110291901	8/11/2009	2.0	<4	.2	.3	<.06	.08
Iron County								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	7/29/2009	1.0	5	.3	.6	1.4	2.67
(C-36-11)18bdd-1	374017113080401	7/29/2009	3.2	4	<.2	1.7	3.5	4.28
(C-37-12)9acc-2	373542113122402	7/29/2009	6.4	<4	e.2	1.8	.98	.98
(C-37-12)23acb-1	373407113100801	7/29/2009	.73	8	.8	.4	12.1	1.92
(C-37-12)34abb-1	373236113111401	7/29/2009	.33	<4	<.2	.5	.98	1.72
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-2	374834113384301	8/5/2009	8.8	<4	<.2	.5	3.0	3.40
(C-35-15)3dcc-3	374649113305801	8/5/2009	15.1	14	3.5	1.3	2.0	3.68
(C-35-16)9add-1	374623113381301	8/5/2009	3.1	<4	<.2	.3	.96	2.34
(C-36-16) 9bcd-2	374014113391101	8/5/2009	2.6	<4	<.2	.4	1.5	3.62
(C-36-16)19abb-1	373854113411501	8/5/2009	1.8	<4	<.2	.7	.92	7.24
Parowan Valley								
(C-33-8)22bbc-2	375523112451902	7/28/2009	11.2	<4	3.3	1.4	.11	.55
(C-33-8)31ccc-1	375257112483501	7/28/2009	4.7	e2	<.2	.5	.80	1.95
(C-33-9)14dbd-2	375548112500401	7/29/2009	10.5	6	1.2	1.9	.28	1.51
Juab County								

Table 5. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2009.—Continued

[µg/L, micrograms per liter; <, less than; e, estimated; —, no data; M, presence verified but not quantified]

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
Juab Valley								
(D-13-1)4cca-1	394225111495701	7/28/2009	0.48	<4	<0.2	0.5	1.6	1.39
(D-13-1)5ddb-1	394225111502201	7/28/2009	.68	e3	<.2	.5	2.7	2.02
(D-14-1)31ada-1	393315111511601	7/28/2009	.31	4	e.2	.2	.99	.55
Kane County								
Kanab area								
(C-42-6)19bdc-2	370843112340602	8/3/2009	1.0	<4	<.2	M	.39	.43
(C-44-5)6cbb-1	370050112274501	8/3/2009	1.1	39	125	5.2	.15	1.11
Millard County								
Pahvant Valley								
(C-21-5)7cdd-3	385939112272303	8/12/2009	2.4	<4	<.2	1.5	2.7	3.51
(C-23-5)5acd-1	385026112261001	8/12/2009	3.5	e2	<.2	.2	.47	1.15
(C-23-6)21add-1	384751112312201	8/12/2009	6.7	5	<.2	1.4	2.5	2.75
(C-23-6)28bbb-2	384722112322101	8/12/2009	4.7	29	<.8	.6	17.2	12.5
Sevier Desert								
(C-15-4)8cba-1	393154112192901	7/22/2009	3.9	169	441	2.6	e.25	6.14
(C-15-5)27dcc-1	392854112233801	7/22/2009	7.1	<4	<.2	.5	.56	2.33
(C-16-5)9aaa-1	392656112242601	7/22/2009	2.9	<4	<.2	.5	.37	1.09
(C-16-5)18caa-1	392538112270201	7/22/2009	3.4	<4	e.1	.5	.34	1.19
Snake Valley								
(C-23-19)4bcd-1	385048113592901	7/23/2009	4.0	<4	<.2	8.5	3.7	3.15
(C-23-19)20bac-2	384900114003001	7/23/2009	22.6	e3	<.2	18.6	15.9	9.87
(C-23-19)30aac-1	384729114010301	7/23/2009	6.5	9	e.3	2.6	27.1	18.5
Piute County								
Upper Sevier Valley								
(C-30-2)28bdc-1	381003112010301	7/21/2009	7.3	<4	<.2	1.3	.59	3.46
Salt Lake County								
Salt Lake Valley								
(A-1-1)31cac-1	404627111532601	7/28/2009	1.4	7	.3	1.4	1.7	1.95
(B-1-2)29ccc-1	404704112060401	7/28/2009	181	679	101	17.0	e.23	.16
(D-1-1)7abd-6	404506111523301	7/28/2009	1.1	5	5.2	1.1	1.7	1.73
(D-1-1)19cdb-17	404253111530901	7/28/2009	.73	<4	<.2	.5	2.2	1.21
(D-2-1)21dbc-1	403742111503201	7/28/2009	.77	<4	.8	1.8	.57	7.49
Sanpete County								
Sanpete Valley								
(D-15-4)17abb-1	393113111294501	8/31/2009	.29	<4	<.2	.2	.45	1.17
(D-16-2)36cbd-1	392238111390501	8/31/2009	6.1	139	24.8	1.6	.74	.95
(D-17-3)9cbd-1	392056111353801	8/31/2009	.38	<4	<.2	1.0	1.1	2.18
Sevier County								
Central Sevier Valley								
(C-21-1)13abd-1	385910111512101	7/22/2009	10.8	<4	<.2	3.4	.47	4.32
(C-23-2)15dcb-4	384757112002201	7/21/2009	4.0	e2	e.1	3.4	1.3	5.35
(C-23-2)30baa-2	384641112034601	7/21/2009	2.1	<4	.5	.3	.40	2.48
(C-24-2)6abc-1	384450112034001	7/22/2009	2.0	<4	24.3	.4	.90	17.9
Upper Sevier Valley								
(C-26-1)23ddb-1	383140111522001	7/21/2009	3.7	<4	<.2	.5	.31	2.59
Tooele County								
Rush Valley								
(C-8-5)6ddb-1	400849112263901	7/8/2009	15.2	<4	<.2	2.4	.76	1.40
(C-8-5)6ddb-2	400849112263902	7/8/2009	14.2	<4	<.2	2.3	.86	1.44
(C-8-5)17ccc-1	400652112261801	7/8/2009	10.7	12	.4	2.2	.29	2.18
Skull Valley								
(C-3-8)28cca-1	403128112453501	7/10/2009	.79	e2	<.2	.3	1.5	.39
(C-3-8)28ddb-1	403126112444501	7/10/2009	1.1	<4	<.2	.6	.50	.39
Tooele Valley								
(C-2-4)28cbc-1	403702112040101	7/8/2009	1.2	10	.5	.4	1.3	1.83
(C-2-4)33bdd-1	403629112174801	7/13/2009	1.4	<4	<.2	.5	2.4	2.02
(C-2-5)34cbc-1	403612112241001	7/13/2009	4.3	18	<.8	2.0	8.5	2.37
(C-2-5)36cba-1	403603112215801	7/6/2009	1.7	e6	e.3	.6	1.1	1.62
(C-3-5)11bad-1	403419112222001	7/10/2009	3.7	1,280	10.1	1.7	1.4	2.24
Utah County								

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[µg/L, micrograms per liter; <, less than; e, estimated; —, no data; M, presence verified but not quantified]

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Cedar Valley								
(C-6-1)18cdd-1	401730111594501	7/22/2009	5.3	<4	<.2	2.2	1.2	1.92
(C-6-2)26cbb-1	401607112023401	7/22/2009	6.9	6	25.3	2.2	.62	3.21
Goshen Valley								
(C-9-1)4ddc-1	400309111565101	7/22/2009	11.2	e3	<.2	1.7	2.4	4.24
(C-9-1)28ccb-1	395956111572101	7/22/2009	3.9	12	<.4	1.5	6.8	4.93
(C-10-1)4bbb-1	395848111571801	7/22/2009	.93	9	102	9.3	3.1	2.36
Northern Utah Valley								
(D-5-1)20aba-1	402236111511501	7/30/2009	1.3	<4	<.2	2.0	1.0	2.84
(D-6-2)17aca-1	401801111442501	7/30/2009	1.8	e2	2.1	1.6	1.3	1.88
Southern Utah Valley								
(D-7-2)4cbb-2	401414111435301	7/28/2009	2.2	906	74.0	.9	<.06	.02
(D-9-2)9bac-1	400311111432001	7/28/2009	2.8	<4	<.2	1.0	1.3	2.19
(D-9-2)26add-1	400023111402200	7/28/2009	.57	<4	<.2	.4	1.8	1.92
Wasatch County								
Heber Valley								
(D-4-4)12dcc-1	402842111263101	8/17/2009	—	<4	<.2	—	—	—
(D-4-5) 3dcc-1	402937111214901	8/17/2009	—	<4	.5	—	—	—
(D-4-5) 4ccb-1	402946111233901	8/14/2009	—	e2	.4	—	—	—
(D-4-5)16ccd-1	402750111232701	8/14/2009	—	5	1.0	—	—	—
Washington County								
Central Virgin River area								
(C-38-13)35aba-1	372702113163401	8/4/2009	2.8	<4	<.2	.8	.65	5.82
(C-41-17)8cbd-2	371348113470301	8/4/2009	29.6	e2	.2	6.0	.47	1.59
(C-42-14)15cbd-1	370538113251301	8/4/2009	6.7	<8	<.4	2.2	16.9	8.75
(C-42-16)26bcc-1	370617113371101	8/4/2009	1.9	171	1,690	6.1	18.9	86.2
Escalante Valley, Beryl Enterprise area								
(C-37-17)12bdc-2	373456113423501	8/5/2009	3.6	<4	<.2	.4	.57	3.59
Wayne County								
Upper Fremont River Valley								
(D-27-3)19aaa-1	382717111365601	7/21/2009	1.2	<4	<.2	.2	.81	17.4
Weber County								
East Shore area								
(B-5-2)6bdd-4	411153112064601	7/30/2009	12.8	223	124	.2	<.06	<.01
(B-6-3)15cbc-1	411523112082101	7/30/2009	22.8	94	56.6	2.9	<.06	<.01
(B-7-2)32bbb-1	411824112060601	7/30/2009	3.7	247	276	.5	e.05	<.01

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UTAH DEPARTMENT OF NATURAL RESOURCES

Utah Department of Environmental Quality