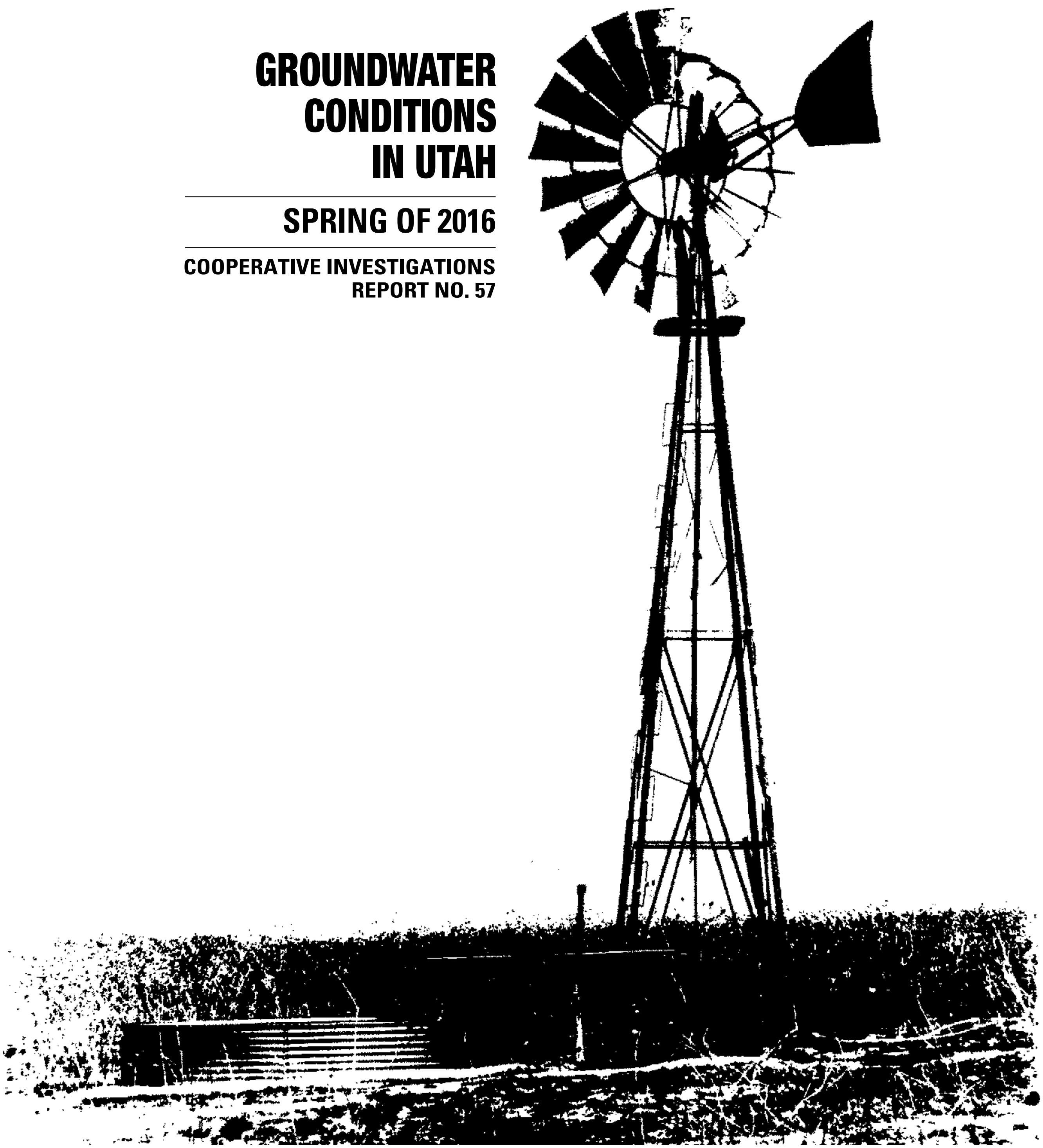
GROUNDWATER CONDITIONS IN UTAH

SPRING OF 2016

COOPERATIVE INVESTIGATIONS REPORT NO. 57



UTAH DEPARTMENT OF NATURAL RESOURCES and
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

U.S. GEOLOGICAL SURVEY

GROUNDWATER CONDITIONS IN UTAH, SPRING OF 2016

By
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U.S. Geological Survey

Prepared by the U.S. Geological Survey
in cooperation with the Utah Department of Natural Resources,
Division of Water Rights, and
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	0.06301	liter per second
inch	2.54	centimeter
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 1 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 in 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 groundwater 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–micron 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.

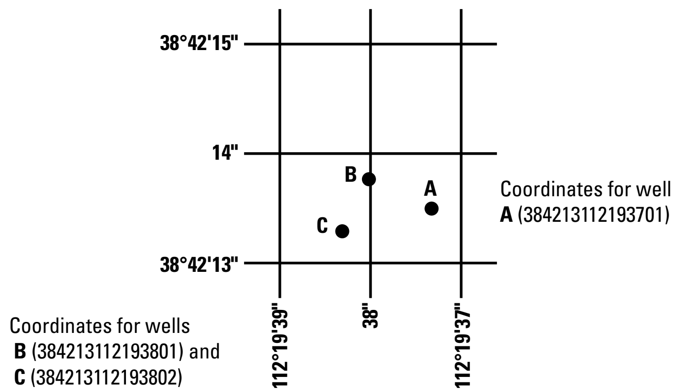
Land-surface datum (lsd)—A datum plane that is approximately at land surface at each groundwater observation well.

Precipitation—The total annual precipitation in inches, rounded to tenths of an inch. For selected locations, it is computed from monthly total precipitation (rain, sleet, hail, snow, etc.). Data are supplied by the National Oceanic and Atmospheric Administration (NOAA) and the Western Regional Climate Center (WRCC). Data may be provisional and/or estimated when used to compute annual total and long-term average precipitation values.

Numbering System for Wells and Surface-Water Sites

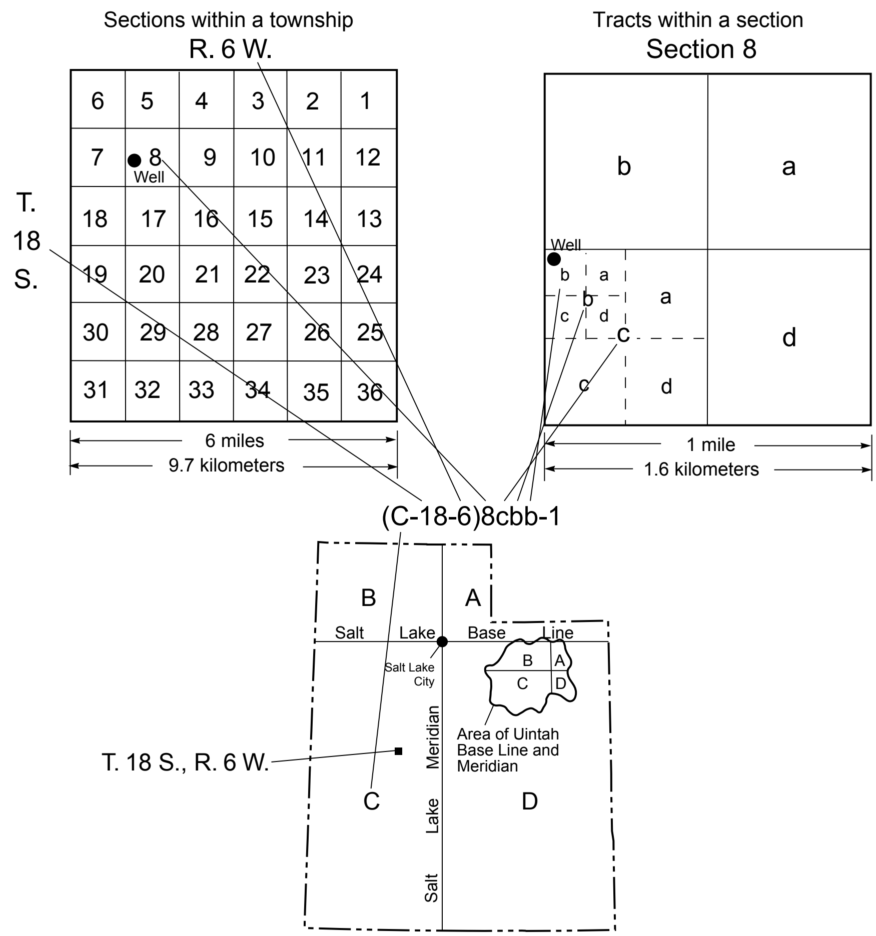
Wells by Latitude and Longitude

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 more than one 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 Cadastral 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 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 a "U" preceding the parentheses. Well numbers for wells located in half ranges will have an "R" 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 mainstem. All stations on a tributary entering upstream from a mainstem station are listed before that station. A station on a tributary entering between two mainstem 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 2016

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

Introduction

This is the fifty-third 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 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 withdrawals from wells, water-level changes, precipitation, streamflow, and chemical quality of water. Information on well construction included in this report refers only to new wells constructed for withdrawal of groundwater. Supplementary data are included in reports of this series only for those years or areas that 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 2015. 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 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/GW2016.pdf*. Groundwater conditions in Utah for calendar year 2014 are reported in Burden and others (2015) and are available online at *http://ut.water.usgs.gov/publications/GW2015.pdf*.

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 on figure 1 and 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 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-grained 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 materials eroded from adjacent mountains.

A small percentage of wells in Utah yield water from consolidated-rock (bedrock) aquifers. Consolidated rocks that have the highest yields are basalt, which contains interconnected vesicular openings, fractures, or permeable weathered zones at the tops of lava flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which may contain open fractures. Most wells that yield water from consolidated-rock aquifers 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 2015 was about 1,017,000 acre-feet (table 2), which is about 31,000 acre-feet less than the total for 2014 and 64,000 acre-feet more than the 2005–2014 average annual withdrawal (table 3). The decrease in withdrawal resulted mostly from decreased estimates for domestic and stock use[1]. The total estimated withdrawal for domestic and stock use was about 20,000 acre-feet, which is about 36,000 acre-feet less than the estimate for 2014 (Burden and others, 2015). Withdrawal for irrigation was about 591,000 acre-feet, which is 6,000 acre-feet less than in 2014. Withdrawal for industrial use was about 125,000 acre-feet, which is about 4,000 acre-feet less than the value for 2014. Withdrawal for public-supply use was about 285,000 acre-feet, which is 17,000 acre-feet more than in 2014.

From 2014 to 2015, groundwater withdrawals decreased in 10 of the 16 areas of groundwater development discussed in this report (table 2). Withdrawal in Other Areas decreased about 15,000 acre-feet, the largest decrease in any of the groundwater development areas shown on figure 1. Withdrawal in Pahvant Valley increased about 10,000 acre-feet, the largest increase in any of the areas. The 2015 total withdrawal was more than the average annual withdrawal for 2005–2014 in 10 of the 16 areas (table 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 2015 at 17 of 28 weather stations included in this report (Western Regional Climate Center, accessed July 1, 2016, at *http://www.wrcc.dri.edu*), was more than the long-term average. The greatest increase in precipitation from average was 8.1 inches at Hatch. The greatest decrease in precipitation from average was 5.4 inches at Deer Creek Dam.

During February and March 2016, about 620 water-level measurements were made in wells for areas included in this report. Most water-level data included in the hydrographs for these wells are from measurements made during February and March, but may include some water-level measurements made in April and May. Many of the wells 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 2015, 392 new wells were constructed, as determined by the Utah Division of Water Rights (table 2); this is 44 more wells than the total reported for 2014 (Burden and others, 2015). In 2015, 35 large-diameter wells (12 inches or more) were constructed (table 2), which is 3 more than the total reported for 2014. These new wells are used principally for withdrawal of water for public supply, irrigation, and industrial purposes.

[1] Estimates of withdrawals for domestic and stock use in 2015 for Cache Valley, East Shore area, Salt Lake Valley, Tooele Valley, and Utah and Goshen Valleys were determined from Maupin and others, 2014.

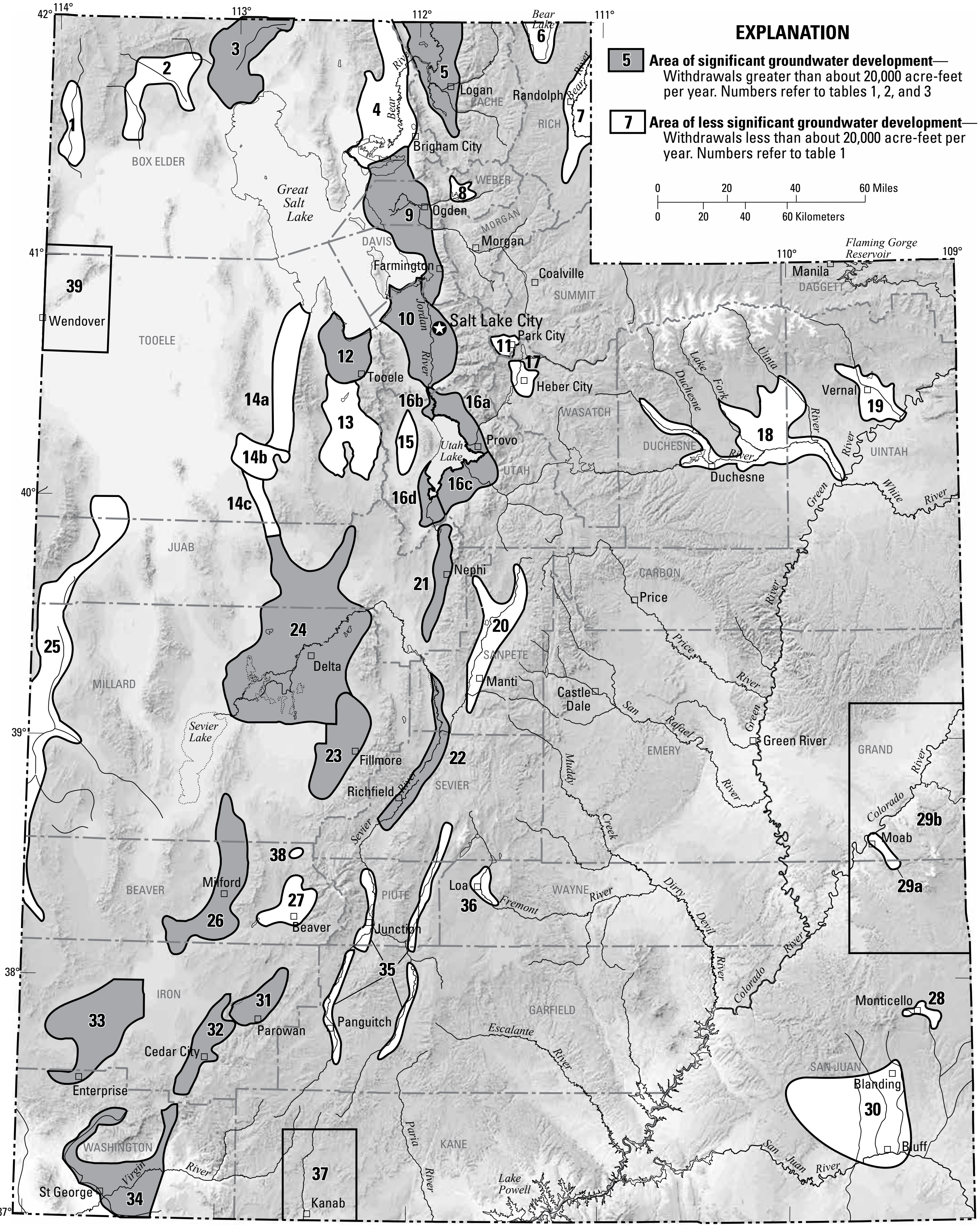


Figure 1. Areas of groundwater development in Utah specifically referred to in this report.

Table 1. Areas of groundwater development in Utah specifically referred to in this report and principal types of water-bearing lithologies.

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

Table 2. Number of wells constructed and estimated withdrawal of water from wells in Utah, 2015.

Area	Number in figure 1	Number of wells[1] constructed in 2015		Estimated withdrawal from wells, in acre-feet (rounded)					
				2015					
		Total	Diameter of 12 inches or more	Irrigation	Industrial[1]	Public supply[1]	Domestic and stock	Total	2014 total[2]
Curlew Valley	3	1	0	34,000	0	200	100	34,000	35,000
Cache Valley	5	33	0	14,000	4,600	11,200	[3] 1,500	31,000	27,000
East Shore area	9	2	1	3,600	3,300	27,600	[3] 1,100	36,000	40,000
Salt Lake Valley	10	6	0	600	[4] 45,200	86,200	[3] 490	132,000	145,000
Tooele Valley	12	14	0	[5, 6] 13,000	550	11,000	[3] 910	25,000	22,000
Utah and Goshen Valleys	16	39	2	32,500	11,600	56,400	[3] 1,800	102,000	107,000
Northern Utah Valley-east[7]	16a	(4)	(2)	(1,900)	(8,700)	(38,100)	(600)	(49,300)	(49,400)
Northern Utah Valley-west[7]	16b	(2)	(0)	(0)	(0)	(2,400)	(200)	(2,600)	(4,400)
Southern Utah Valley[7]	16c	(32)	(0)	(8,800)	(2,900)	(15,700)	(900)	(28,300)	(30,600)
Goshen Valley[7]	16d	(1)	(0)	(21,800)	(0)	(200)	(100)	(22,100)	(22,500)
Juab Valley	21	6	0	29,700	85	[8] 820	470	31,000	29,000
Sevier Desert	24	8	1	44,000	7,800	2,500	890	55,000	53,000
Central Sevier Valley	22	17	0	26,000	60	3,300	840	30,000	31,000
Pahvant Valley	23	9	4	127,000	0	800	320	128,000	118,000
Cedar Valley, Iron County	32	9	2	29,900	100	7,600	2,400	40,000	43,000
Parowan Valley	31	3	2	[9] 33,500	40	350	350	34,000	38,000
Escalante Valley									
Milford area	26	9	5	44,900	[10] 21,800	760	130	68,000	67,000
Beryl-Enterprise area	33	14	4	88,000	[11] 3,800	650	650	93,000	103,000
Central Virgin River area	34	6	2	4,400	510	27,000	2,400	34,000	31,000
Other areas[12, 13]		216	12	65,500	25,100	48,300	5,400	144,000	159,000
Total (rounded)		392	35	590,500	124,500	284,500	19,500	1,017,000	1,048,000

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

[2] From Burden and others (2015, table 2).

[3] From Maupin and others, 2014.

[4] Includes some use for air conditioning, about 2,700 acre-feet, of which about 92 percent was injected back into the aquifer.

[5] Includes some domestic and stock use.

[6] Includes some flowing well discharge.

[7] Numbers for Northern Utah Valley-east, Northern Utah Valley-west, 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 19,000 acre-feet for geothermal power generation, of which about 99 percent was injected back into the aquifer.

[11] Includes 3,840 acre-feet for heating greenhouses, of which 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 (table 4).

[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, 2005–2014.

Area	Number in figure 1	Thousands of acre-feet[1] (rounded) 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005–2014 average (rounded)	2015
Curlew Valley	3	29	31	38	44	34	39	32	42	40	35	36	34
Cache Valley	5	29	31	36	34	31	33	30	38	38	27	33	31
East Shore area	9	41	46	52	54	46	43	37	46	49	40	45	36
Salt Lake Valley	10	110	131	151	135	137	140	126	167	153	145	140	132
Tooele Valley	12	[2] 18	[2] 21	[2] 27	[2] 28	25	24	21	30	25	22	24	25
Utah and Goshen Valleys	16	[2] 87	[2] 99	126	[2] 120	[2] 105	[2] 106	[2] 90	[2] 113	[2] 115	107	107	102
Northern Utah Valley[3]	(16a, b)	[2] (46)	(58)	(72)	[2] (67)	[2] (60)	[2] (58)	[2] (45)	[2] (62)	(60)	(54)	(58)	(52)
Southern Utah Valley[3]	(16c)	(31)	(29)	(38)	(34)	(30)	(31)	(28)	[2] (35)	(35)	(31)	(32)	(28)
Goshen Valley[3]	(16d)	(10)	(12)	(16)	(19)	(15)	(17)	(17)	[2] (16)	[2] (20)	(22)	(16)	(22)
Juab Valley	21	14	21	26	26	21	22	15	28	27	29	23	31
Sevier Desert	24	24	20	34	44	48	46	20	24	[2] 46	53	36	55
Central Sevier Valley	22	17	16	19	24	27	26	31	28	28	31	25	30
Pahvant Valley	23	80	86	89	94	104	106	89	114	103	118	98	128
Cedar Valley, Iron County	32	30	35	40	40	38	38	34	40	39	43	38	40
Parowan Valley	31	27	33	34	38	37	34	32	38	32	38	34	34
Escalante Valley													
Milford area	26	40	45	49	51	56	62	53	67	68	67	56	68
Beryl-Enterprise area	33	68	79	92	93	93	90	84	91	93	103	89	93
Central Virgin River area	34	29	32	33	29	33	29	28	29	29	31	30	34
Other areas		111	130	155	144	130	134	123	156	145	159	139	144
Total (rounded)		[2] 754	[2] 856	[2] 1,001	[2] 998	[2] 965	[2] 972	[2] 845	[2] 1,051	[2] 1,030	1,048	953	1,017

[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 Adam S. Birken

The Curlew Valley drainage basin extends across the Utah-Idaho state line and includes the communities of Cedar Creek, Kelton, 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.

The principal source of water in Curlew Valley is groundwater. The groundwater reservoir consists primarily of confined artesian aquifers in alluvial and lacustrine basin-fill deposits and some water-table (unconfined) conditions in the 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 2015 was about 34,000 acre-feet, which is 1,000 acre-feet less than the value for 2014 and 2,000 acre-feet less than the average annual withdrawal for 2005–2014 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2016 is shown in figure 2. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Oakley, Idaho (62 miles northwest of Snowville), to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3.

Precipitation at Oakley, Idaho in 2015 was about 13.2 inches, which is 2.8 inches less than in 2014 and 2.2 inches more than the average annual precipitation for 1930–2015.

Water levels in Curlew Valley generally rose, or declined slightly, from March 2015 to March 2016. The largest rise, about 15 feet, occurred in a well about 11 miles west of Snowville. The largest decline, about 1.8 feet, occurred in a well about 15 miles west of Snowville. These rises and declines are most likely the result of changes in localized withdrawals for irrigation. The long-term declining water-level trend in most wells is likely due to continued large withdrawals for irrigation.

The concentration of dissolved solids in water samples collected from well (B-12-11)8abb-1, located 3 miles north of Kelton, and well (B-14-9)5bbb-1, located 10 miles west of Snowville, from 1972–2015 and 1971–2015, respectively, is shown in figure 3. Dissolved-solids concentrations in water from both wells have generally increased since the early 1970s, probably due to continued large withdrawals for irrigation.

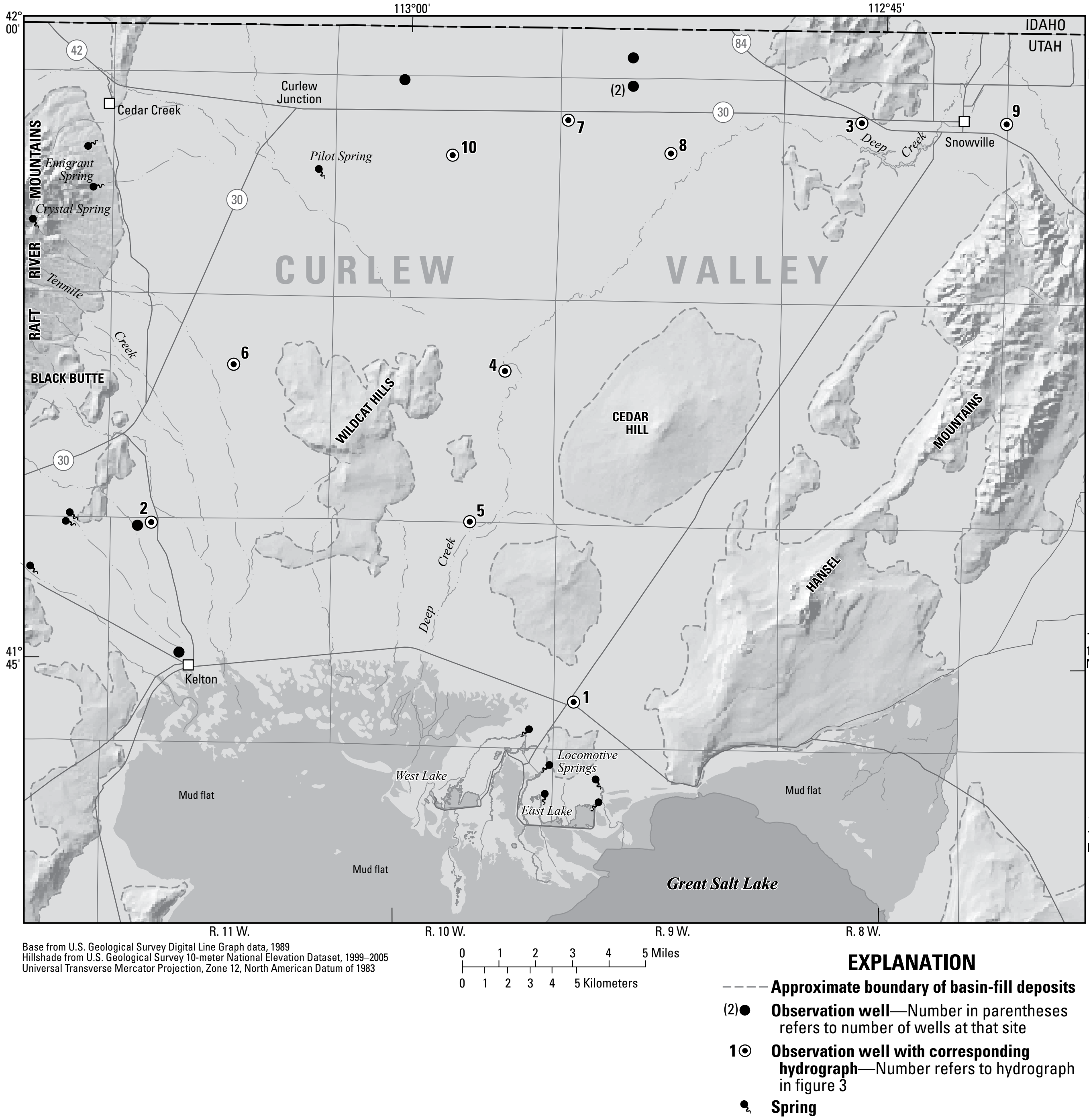


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2016.

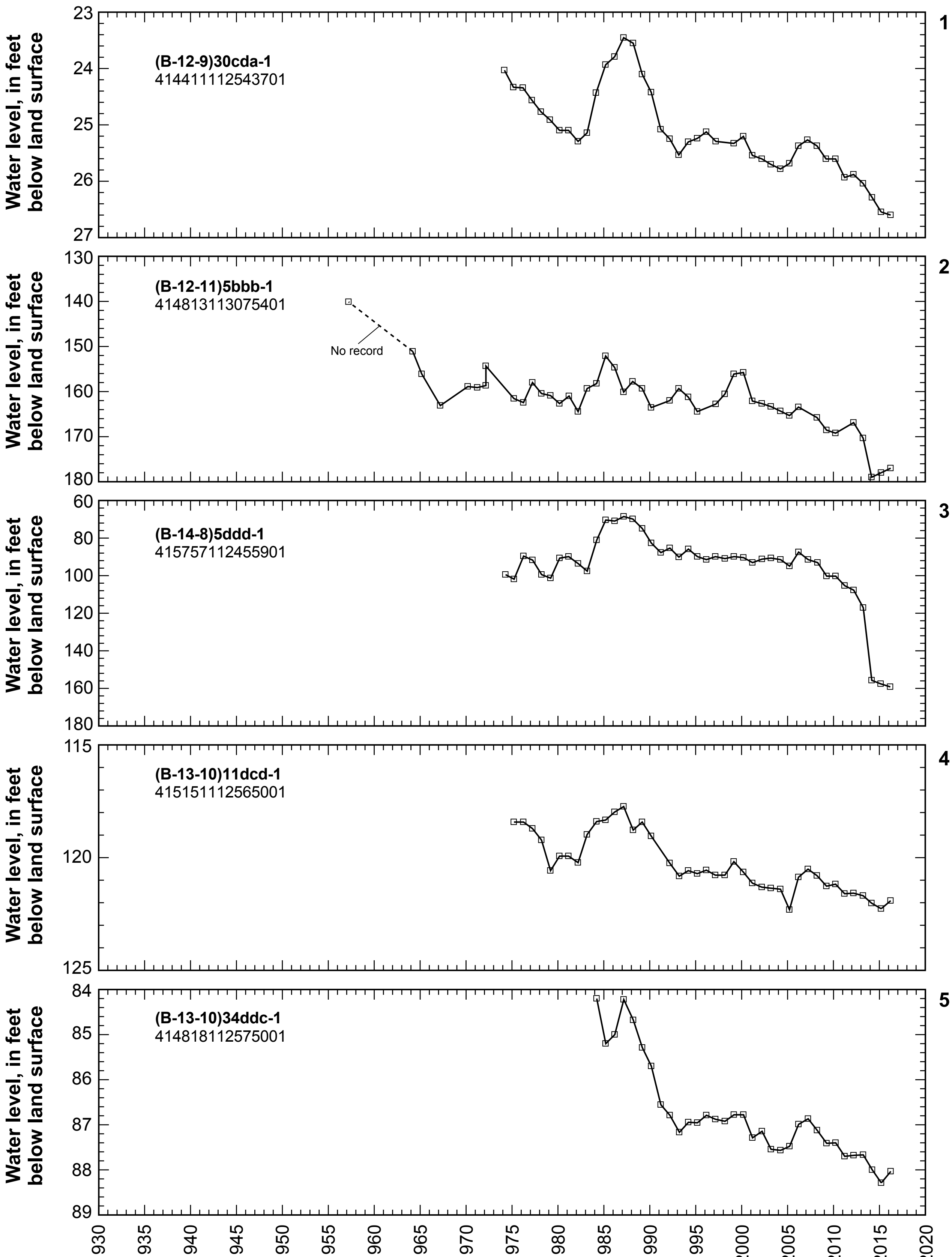


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

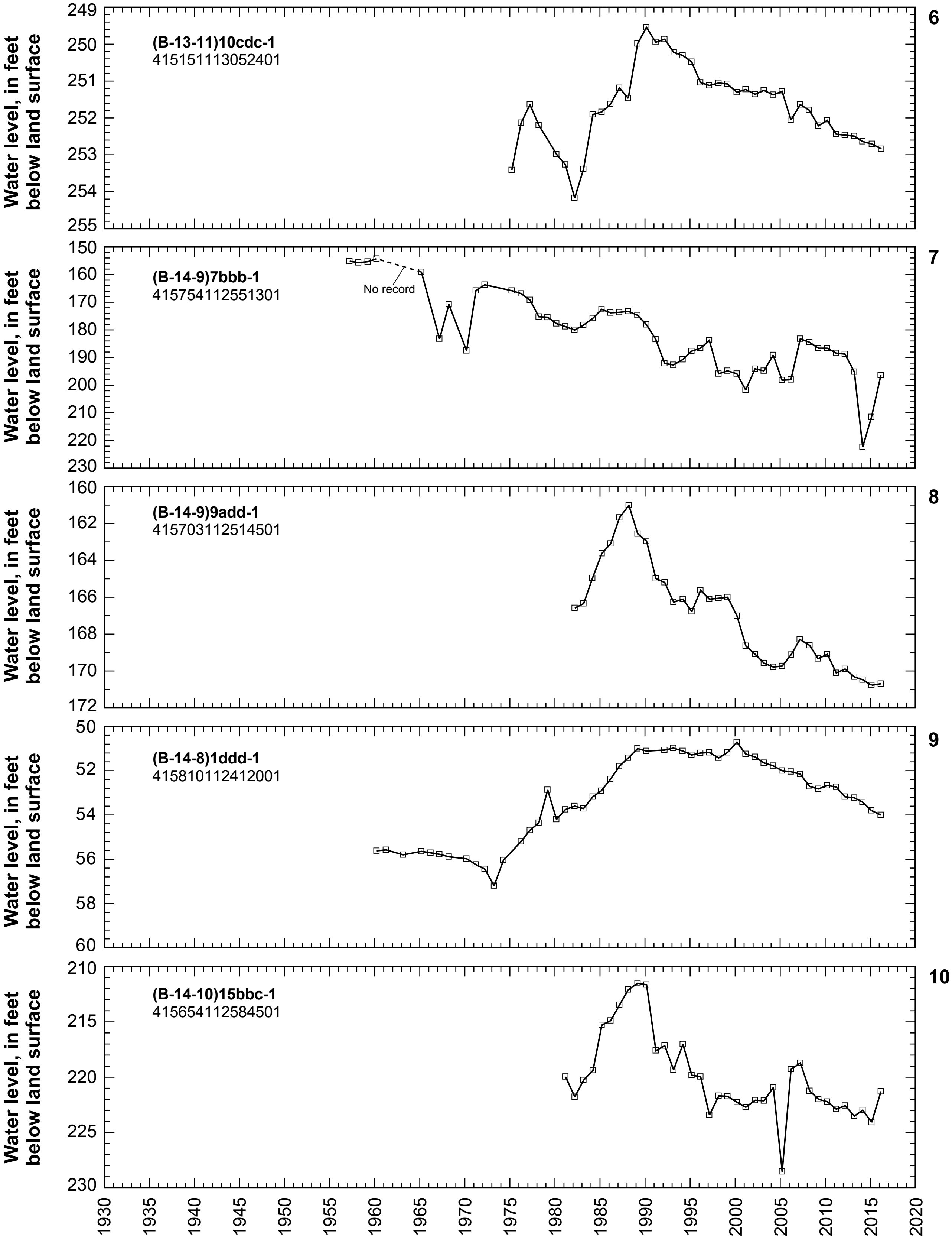


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

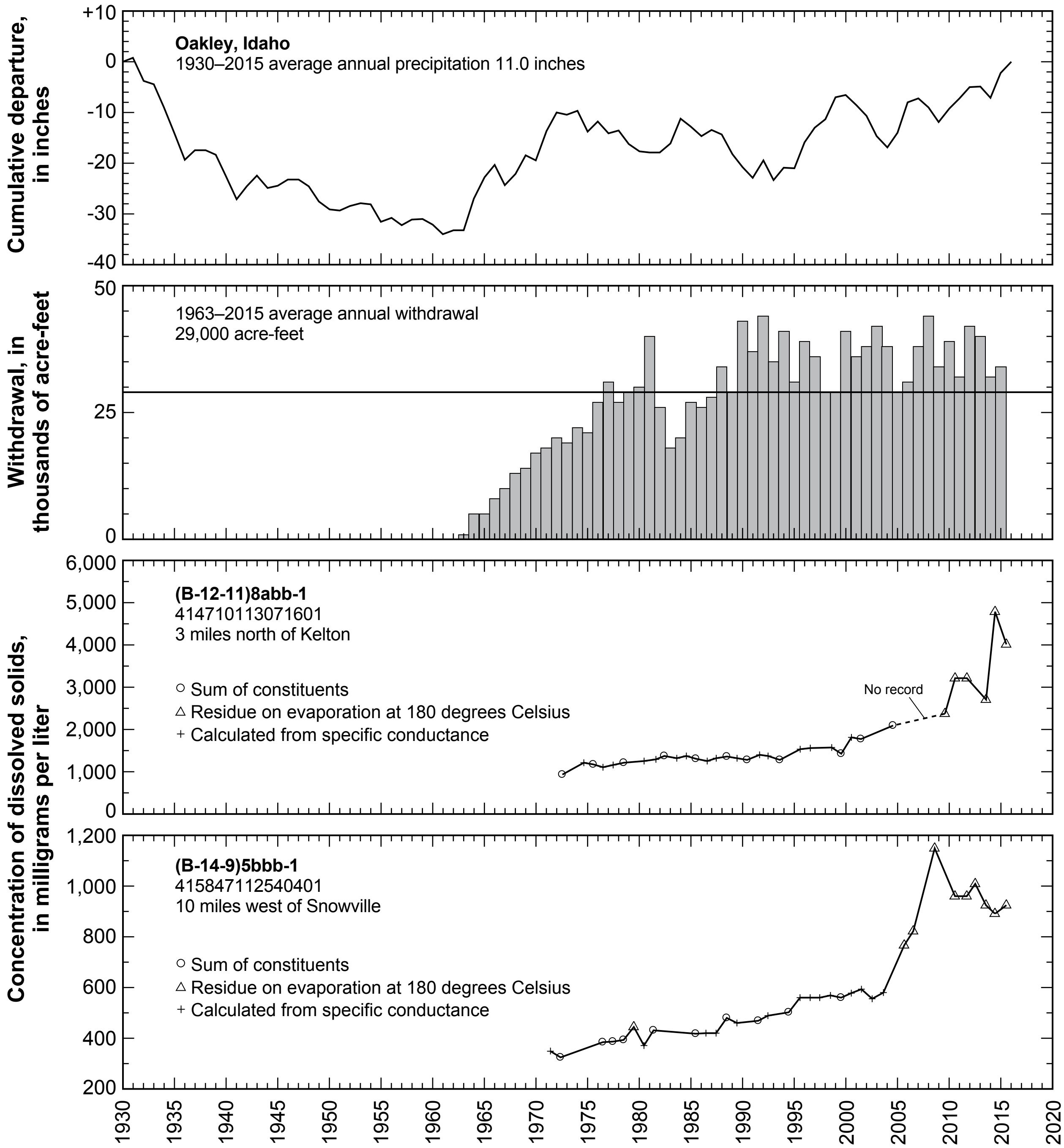


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cache Valley

By John P. Carricaburu

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. 4). 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 2015 was about 31,000 acre-feet, which is 4,000 acre-feet more than in 2014 and 2,000 acre-feet less than the average annual withdrawal for 2005–2014 (tables 2 and 3). Withdrawal for irrigation was 14,000 acre-feet, of which an estimated 10,000 acre-feet was from flowing wells. Irrigation withdrawals were 3,000 acre-feet more than in 2014. Withdrawal for public supply was 11,200 acre-feet, which is 2,300 acre-feet more than in 2014.

The location of wells in Cache Valley in which the water level was measured during March 2016 is shown in figure 4. The relation of the water level in selected observation wells to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1 is shown in figure 5.

Total discharge of the Logan River (combined flow from the Logan River above State Dam and Cache Highline Canal, near Logan) during 2015 was about 124,000 acre-feet, which is 20,200 acre-feet less than the 2014 total and 54,500 acre-feet less than the 1941–2015 average annual discharge. Precipitation at Logan, Utah State University, was about 20.1 inches in 2015. This is about 0.9 inch more than for 2014 and about 1.8 inches more than the average annual precipitation for 1930–2015.

Water levels throughout the valley generally declined from March 2015 to March 2016. Declines are probably the result of continued large withdrawals for irrigation and public-supply use. Water levels have fluctuated over the entire period of record, as far back as 1935 in many cases, depending on the amount and timing of precipitation, and recharge to the unconsolidated deposits from snowmelt runoff; however, long-term trends indicate declining water levels in most wells.

The concentration of dissolved solids in water samples collected during 1970 to 2015 from well (A-13-1)29bcd-1, located 1.5 miles west of Smithfield, is shown in figure 5. The concentration has ranged from 215 to 278 mg/L, with a median value of 258 mg/L. The dissolved-solids concentration from the September 2015 sample was 252 mg/L, close to the median value.

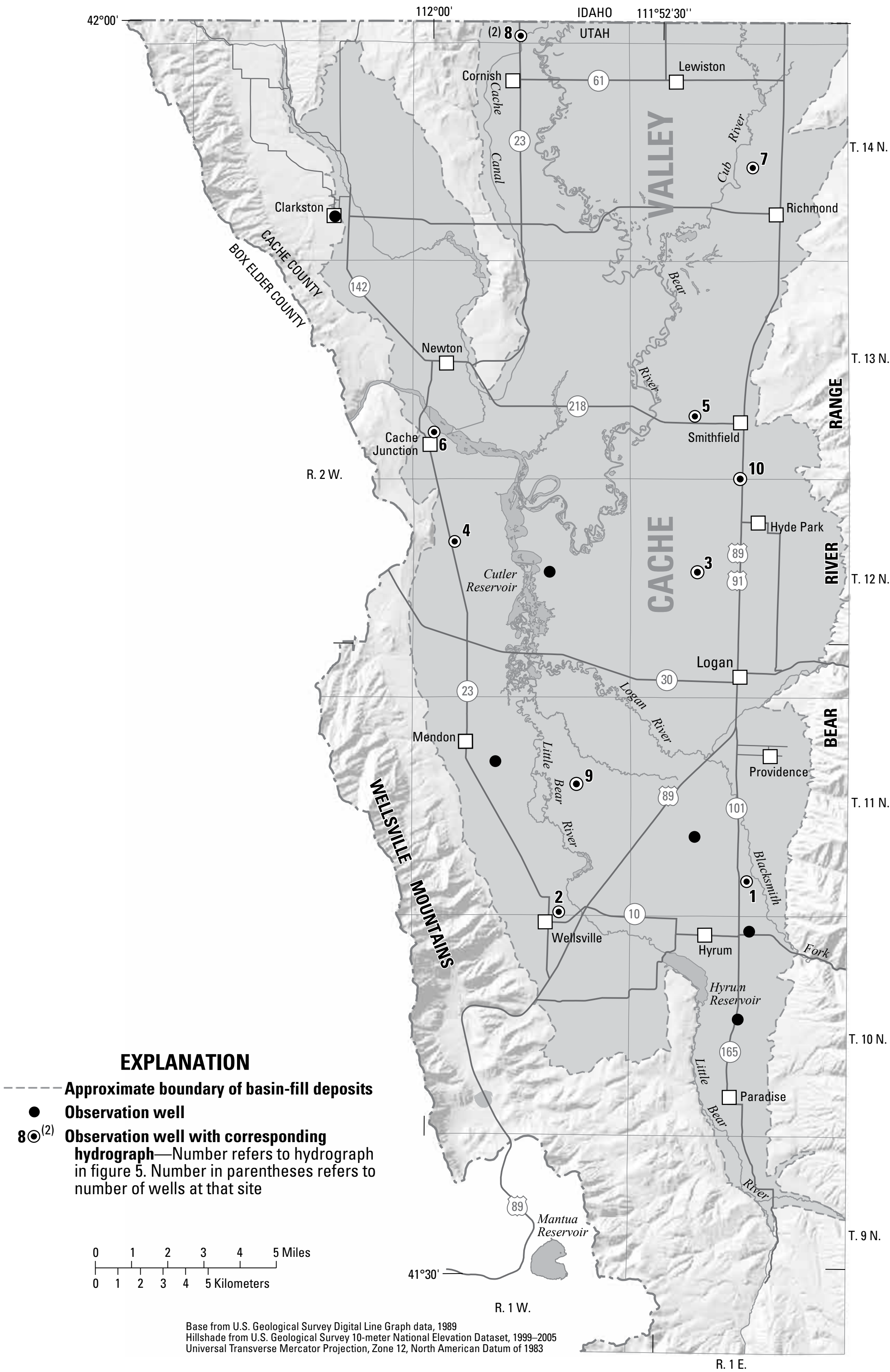


Figure 4. Location of wells in Cache Valley in which the water level was measured during March 2016.

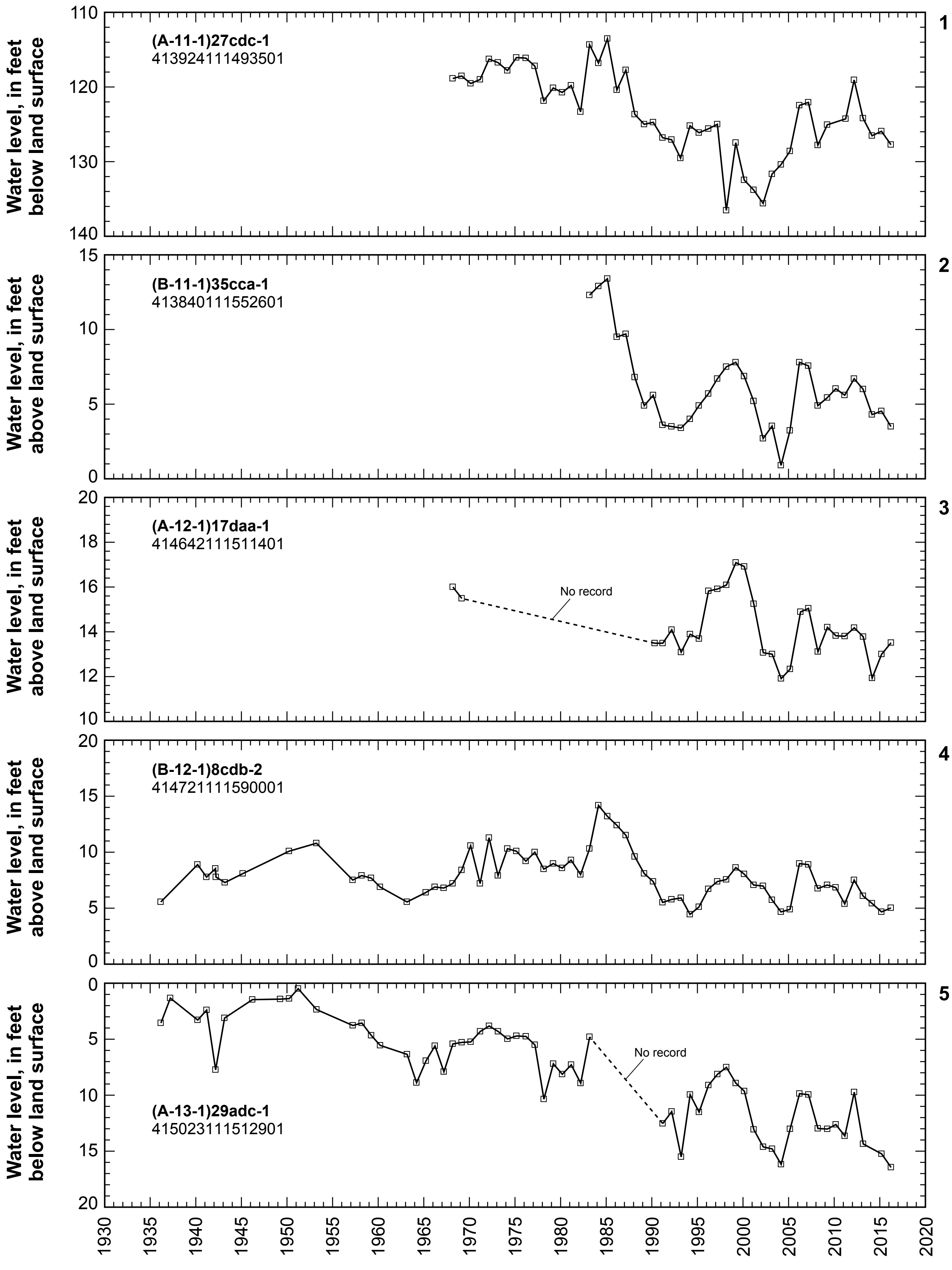


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

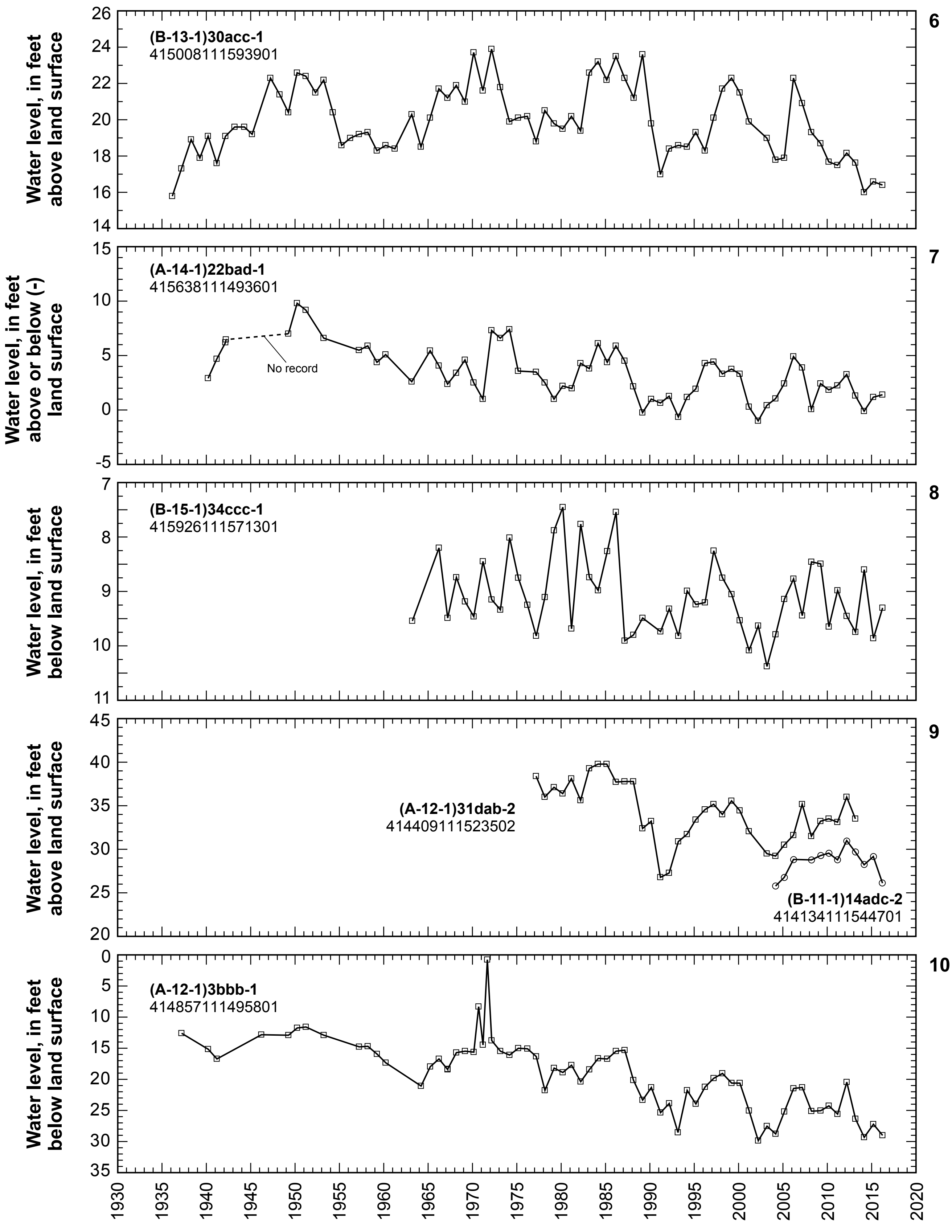


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

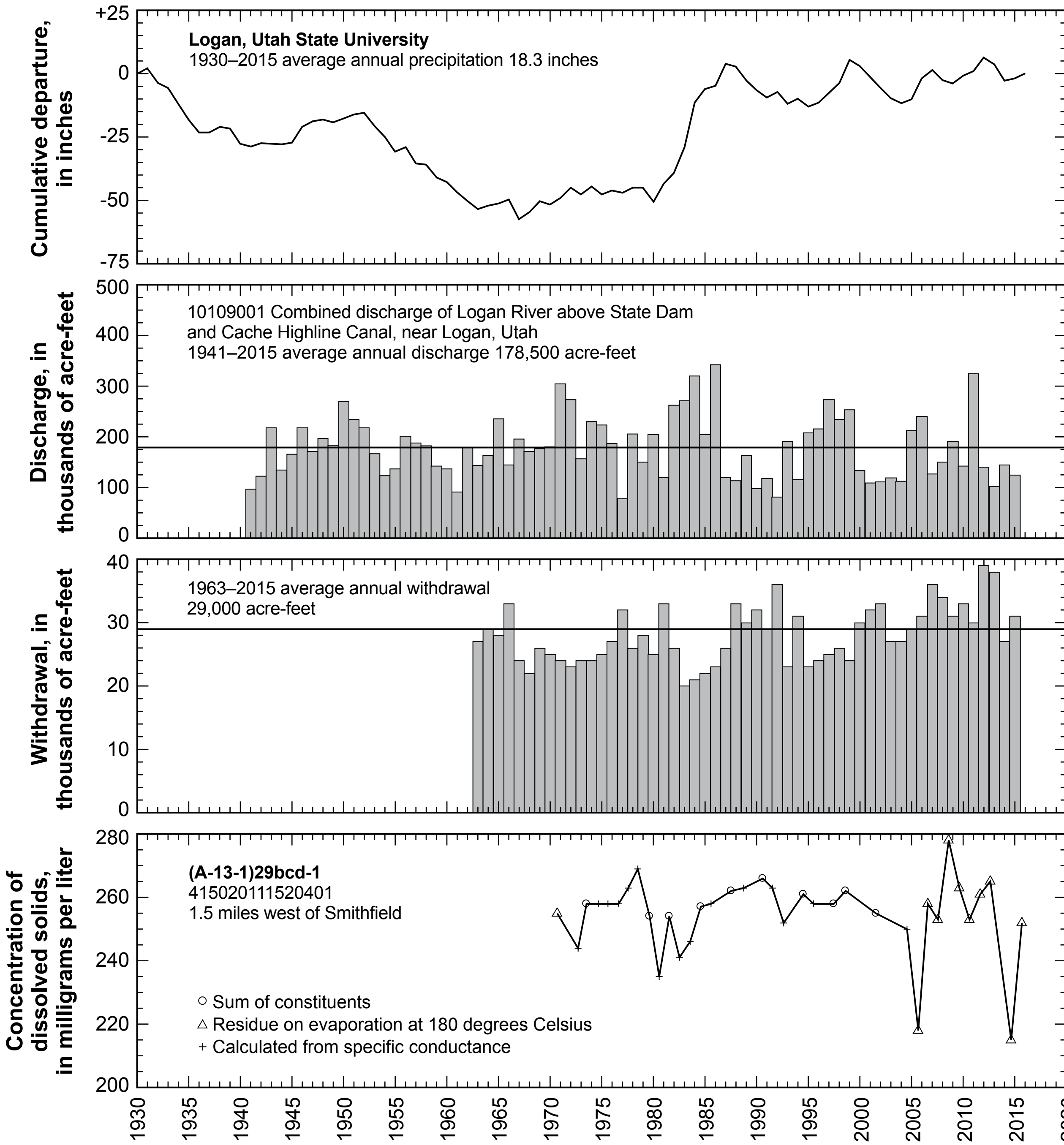


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

East Shore Area

By Katherine K. Jones

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. 6). 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.

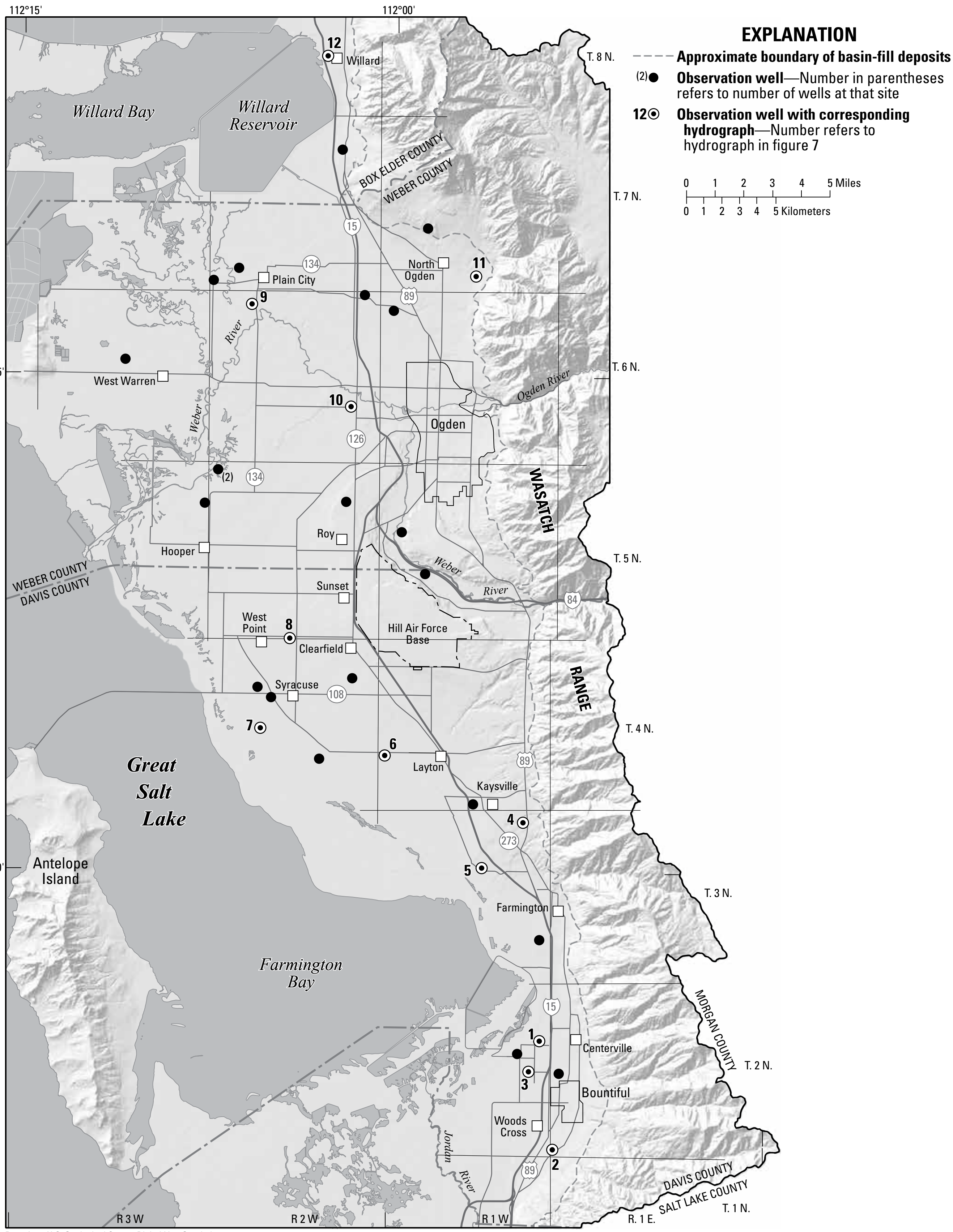
Total estimated withdrawal of water from wells in the East Shore area in 2015 was about 36,000 acre-feet, which is 4,000 acre-feet less than was reported for 2014 and 9,000 acre-feet less than the average annual withdrawal for 2005–2014 (tables 2 and 3). Withdrawal for public supply was 27,600 acre-feet in 2015, about 1,800 acre-feet less than in 2014. Withdrawal for irrigation was about 3,600 acre-feet, which is 400 acre-feet less than was reported for 2014. Withdrawal for industrial use was about 3,300 acre-feet, which is 700 acre-feet less than in 2014.

The location of wells in the East Shore area in which the water level was measured during March 2016 is shown in figure 6. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 7.

Precipitation at Pineview Dam in 2015 was about 29.9 inches, which is about 0.6 inch less than the average annual precipitation for 1949–2015 and about 1.3 inches less than in 2014.

Water levels declined from March 2015 to March 2016 in most of the wells measured in the East Shore area. Declines are probably due to less-than-average precipitation and continued large withdrawals for public-supply use. Water levels have generally declined since the mid-1980s in wells south of Kaysville and have generally declined since the mid-1950s in wells north of Kaysville.

The concentration of dissolved solids in water samples collected from well (B-4-2)27aba-1, located 2.3 miles south-southeast of Syracuse, from 1969 to 2015, is shown in figure 7. The median concentration during this period was 393 mg/L. From 1969 to 1993, dissolved-solids concentrations in water samples ranged from 287 to 633 mg/L. Dissolved-solid concentrations in water samples collected from 1995 to 2015 were much less variable, ranging from 362 to 399 mg/L. The dissolved-solids concentration in the water sample collected in June 2015 (381 mg/L) was similar to the median concentration.



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 6. Location of wells in the East Shore area in which the water level was measured during March 2016.

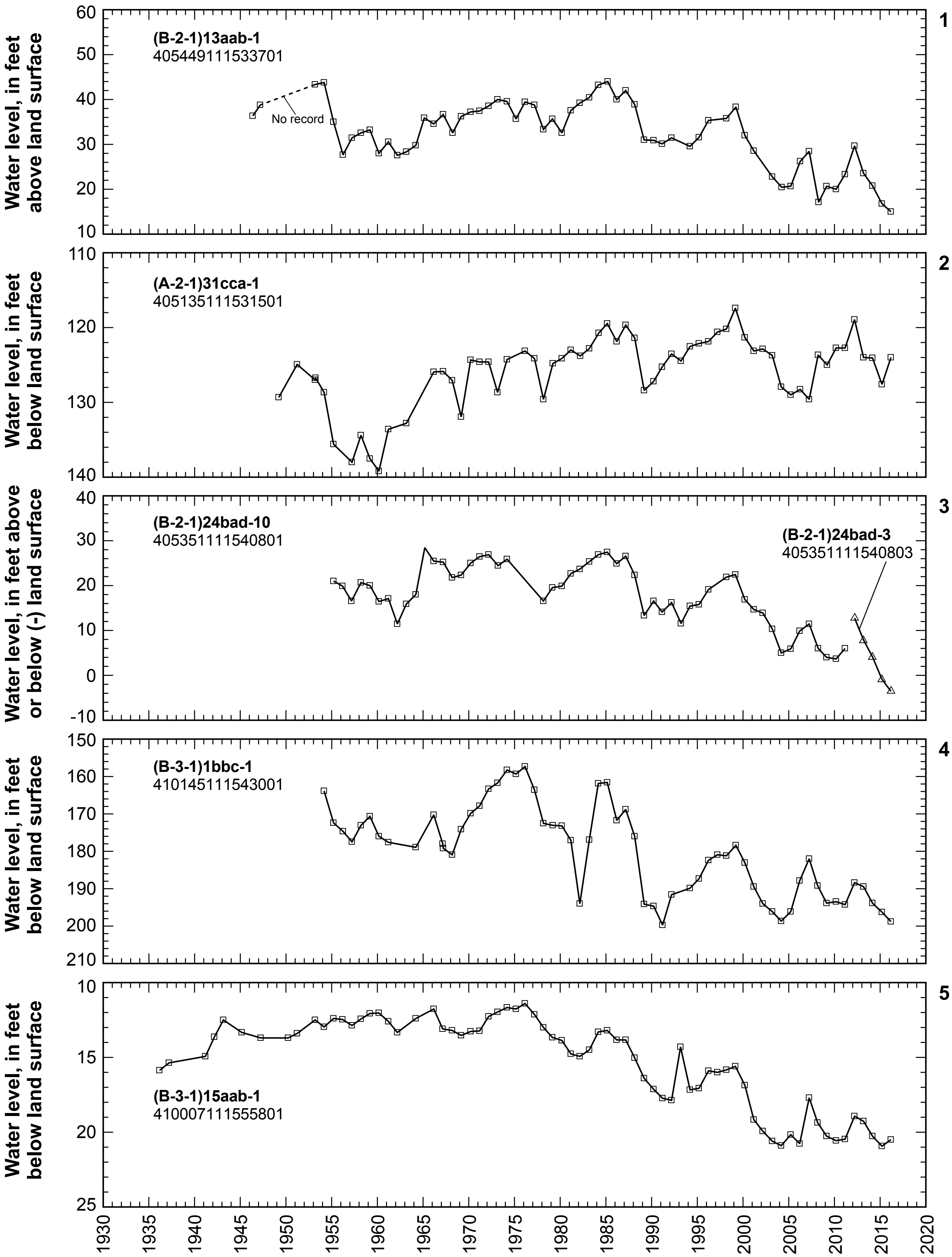


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

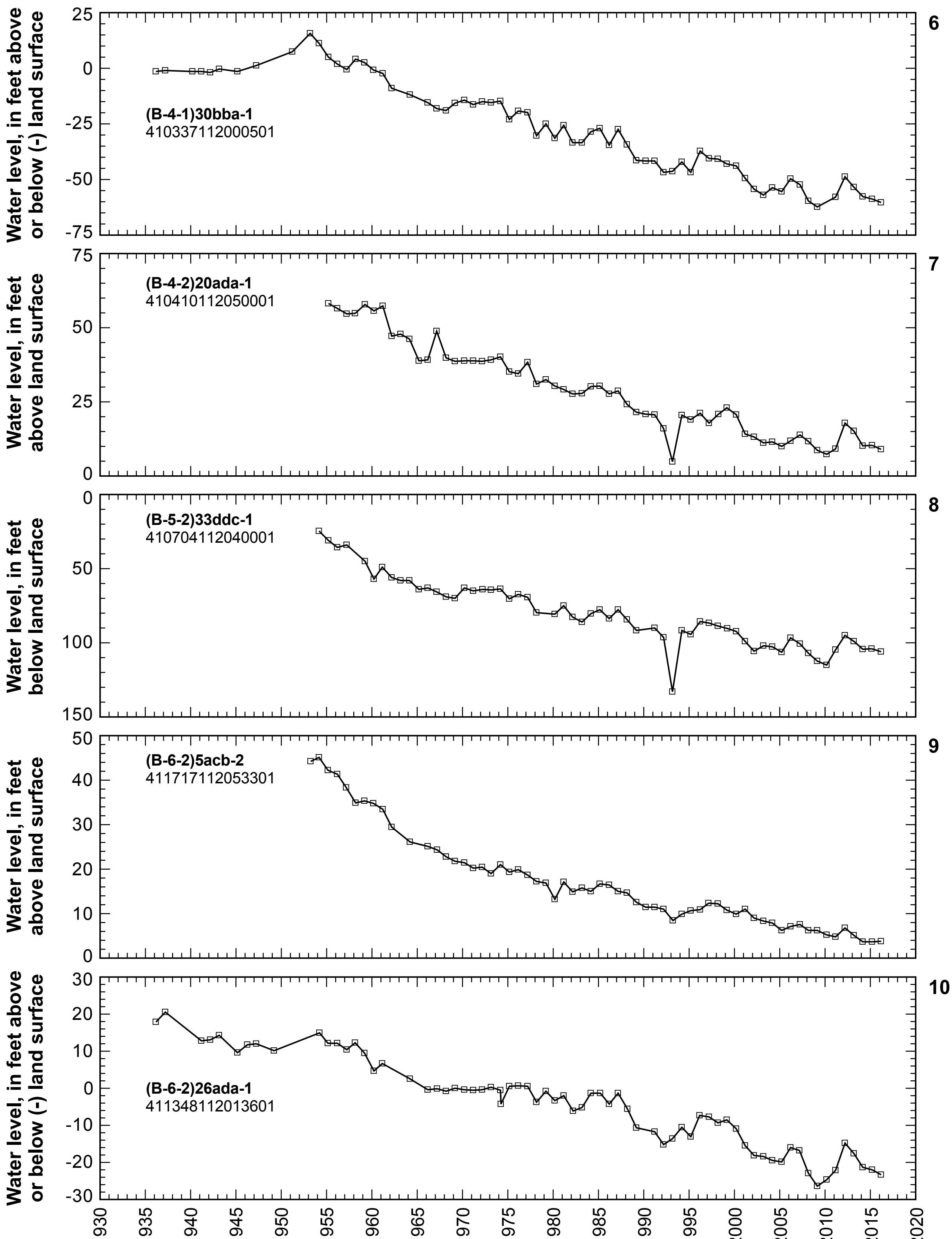


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

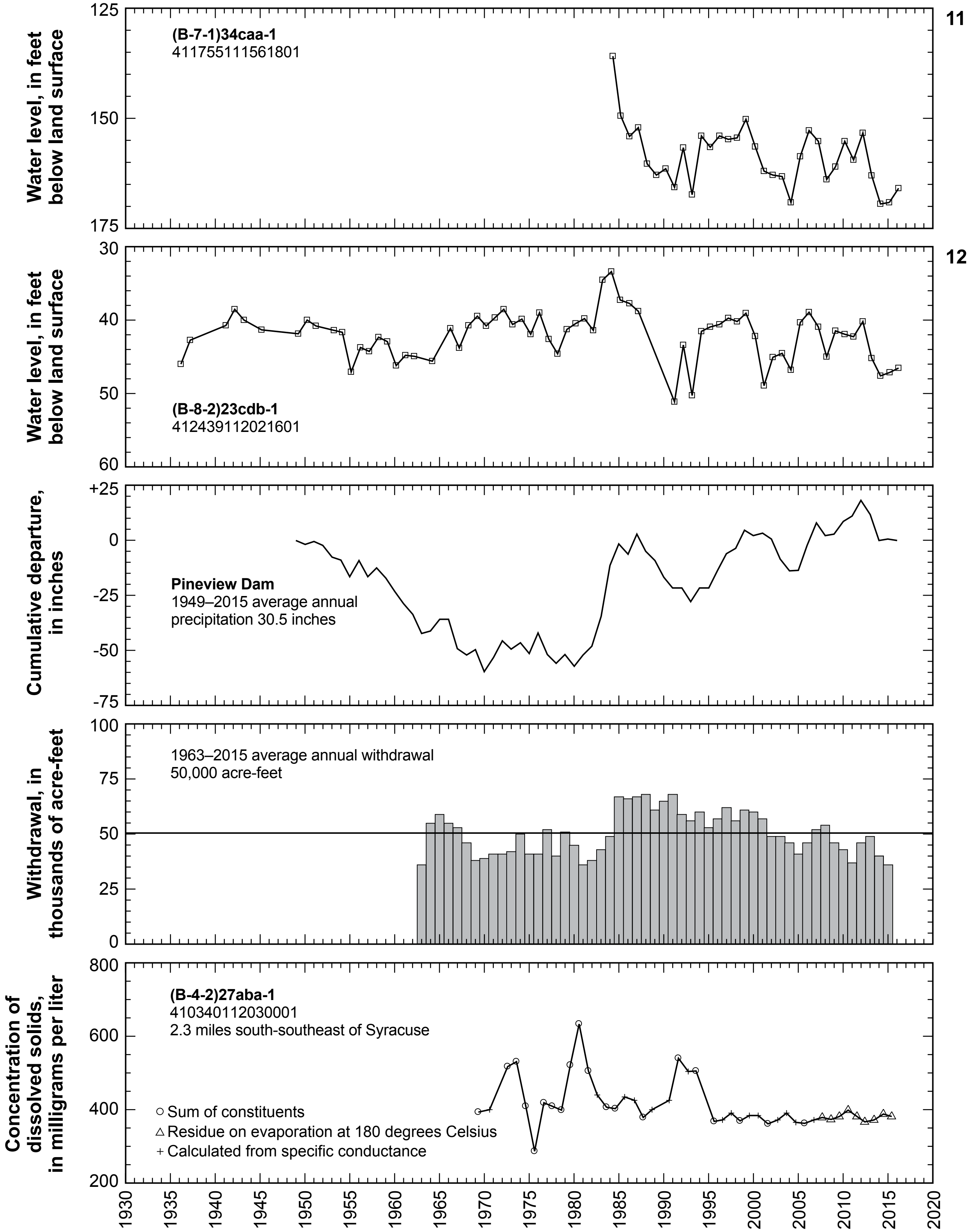


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

Salt Lake Valley

By V. Noah Derrick

Salt Lake Valley covers about 400 square miles between the Wasatch Range and the Oquirrh and Traverse Mountains in Salt Lake County (fig. 8). 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 2015 was about 132,000 acre-feet, which is 13,000 acre-feet less than in 2014 and 8,000 acre-feet less than the average annual withdrawal for 2005–2014 (tables 2 and 3). Withdrawal for public supply was about 86,200 acre-feet, which is 5,400 acre-feet more than the total for 2014. Withdrawal for industrial use was about 45,200 acre-feet, which is 4,000 acre-feet more than the total for 2014. The overall decrease in withdrawals was due to a change in the source of data for domestic and stock use[1].

The location of wells in Salt Lake Valley in which the water level was measured during February 2016 is shown in figure 8. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport) are shown in figure 9. Precipitation at Salt Lake City during 2015 was about 16.1 inches, about 1.6 inches more than in 2014 and about 0.9 inch more than the average annual precipitation for 1931–2015.

The relation of the water level in selected observation wells completed in the principal aquifer in Salt Lake Valley 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 10. Precipitation at Silver Lake Brighton was about 34.0 inches in 2015, which is about 10.0 inches less than in 2014 and about 8.2 inches less than the average annual precipitation for 1931–2015.

Water levels changes were mostly very small from February 2015 to February 2016 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.

The concentrations of dissolved solids and dissolved chloride (from 1931–2015 and 1935–2015, respectively) in water samples collected from well (D-1-1)7abd-6, a flowing well at 800 South 500 East in Salt Lake City, are shown in figure 10. The concentration of dissolved solids has ranged from 554 to 879 mg/L with a median value of 706 mg/L. The concentration of dissolved solids has generally increased since about 1947. The dissolved-solids concentration in June 2015, 814 mg/L, was similar to the value in June 2014 (809 mg/L). The dissolved chloride concentration generally increased from 44 mg/L in February 1948 to 172 mg/L in June 2015, with a median value of 120 mg/L.

[1] Maupin and others, 2014.

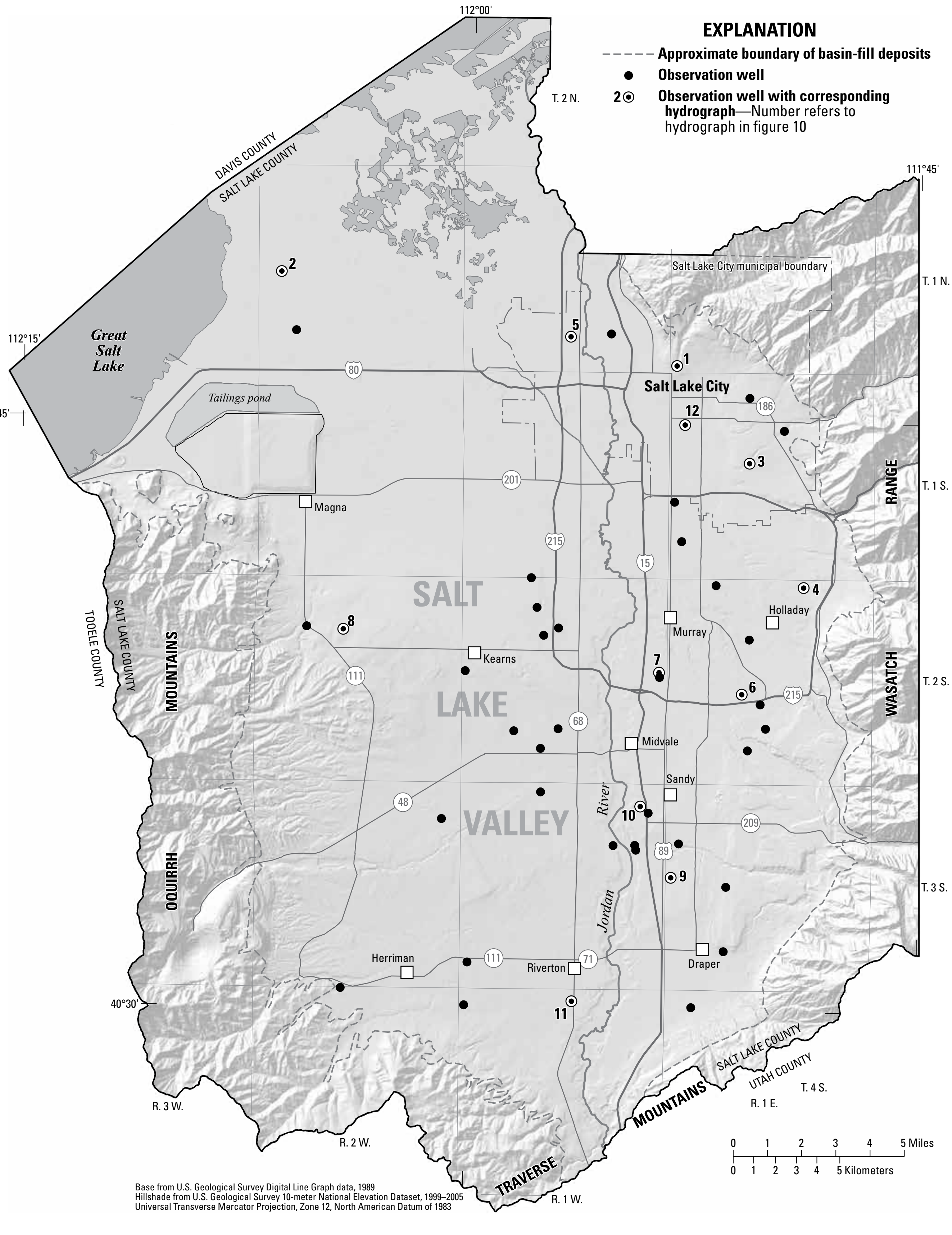


Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 2016.

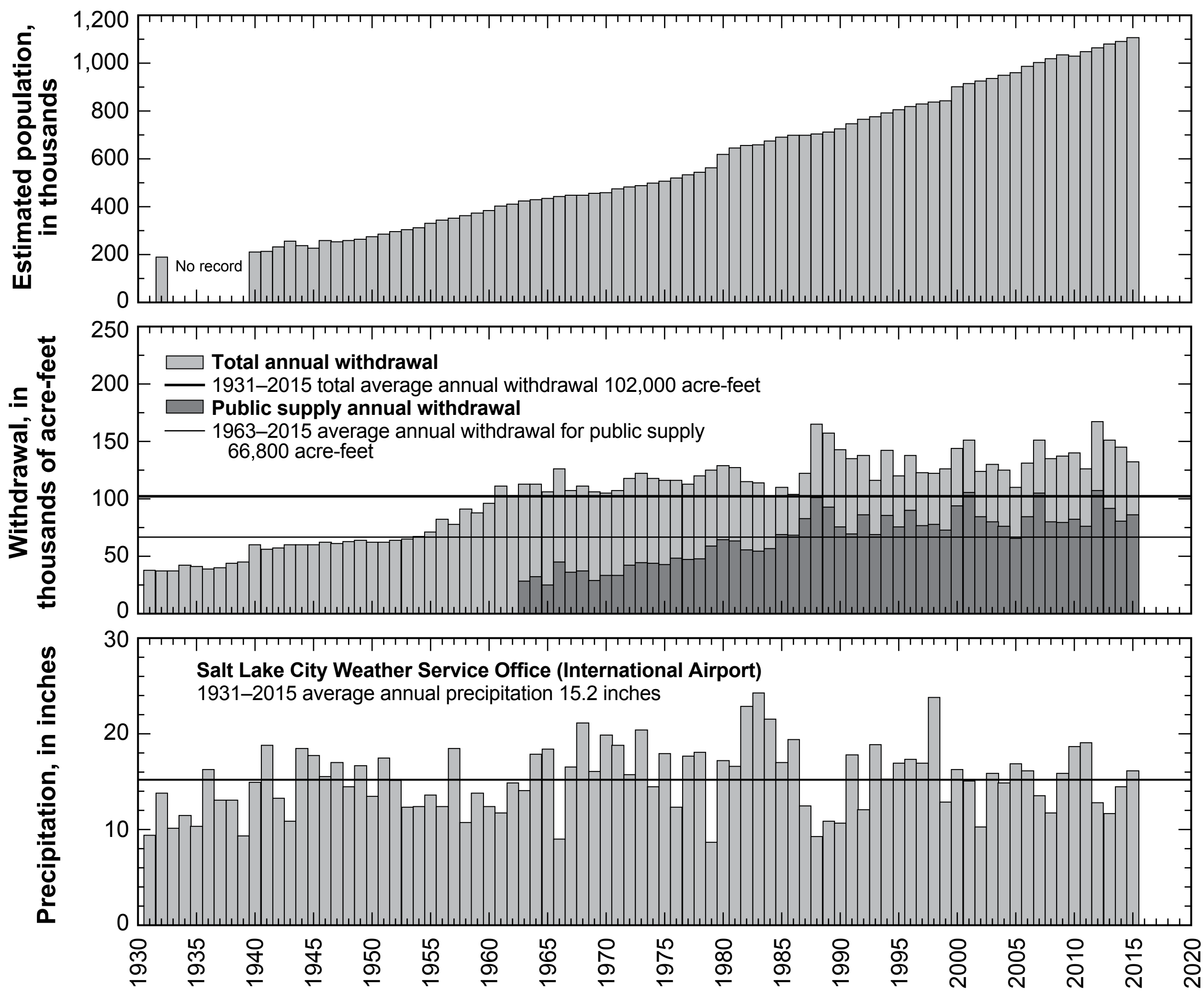


Figure 9. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

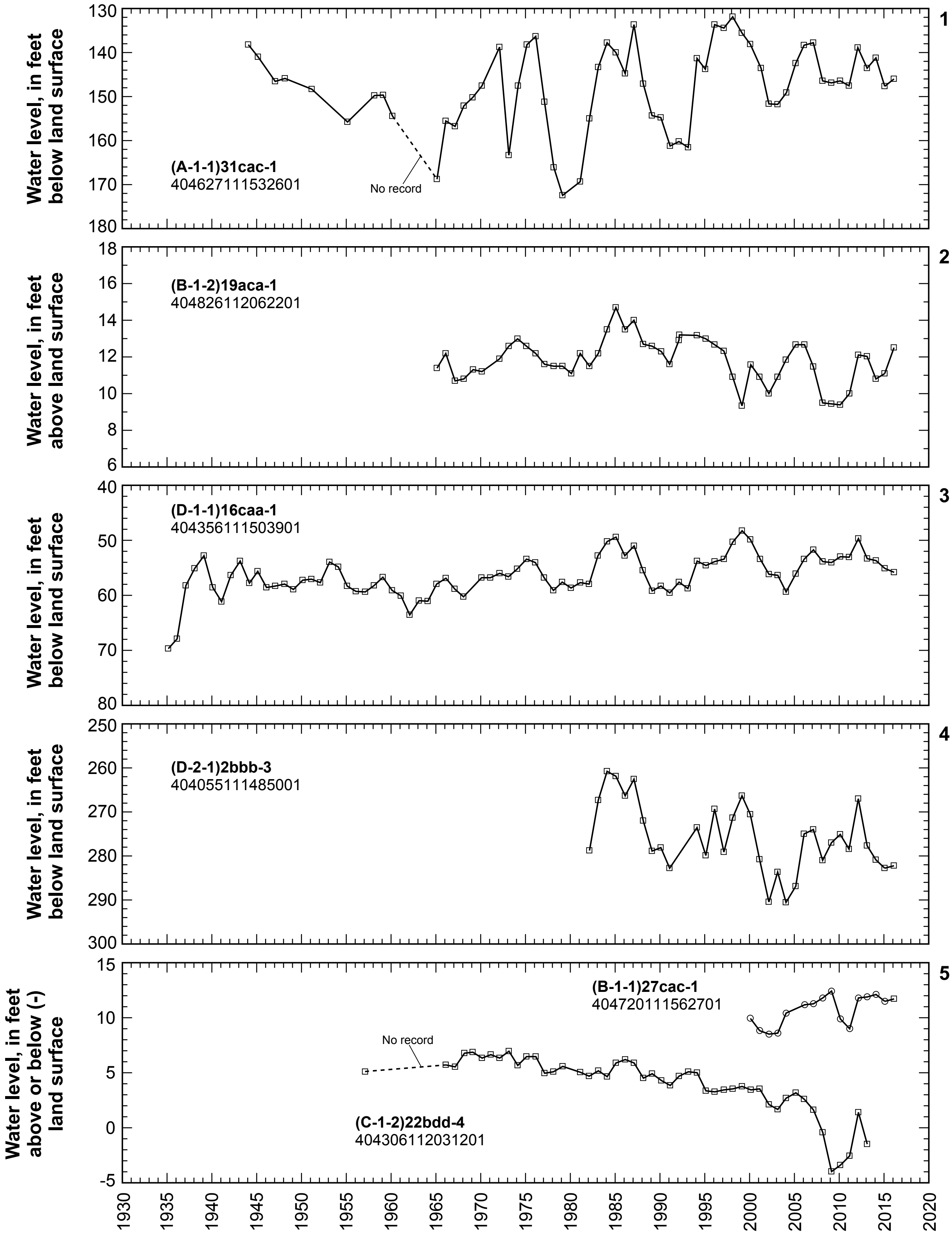


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

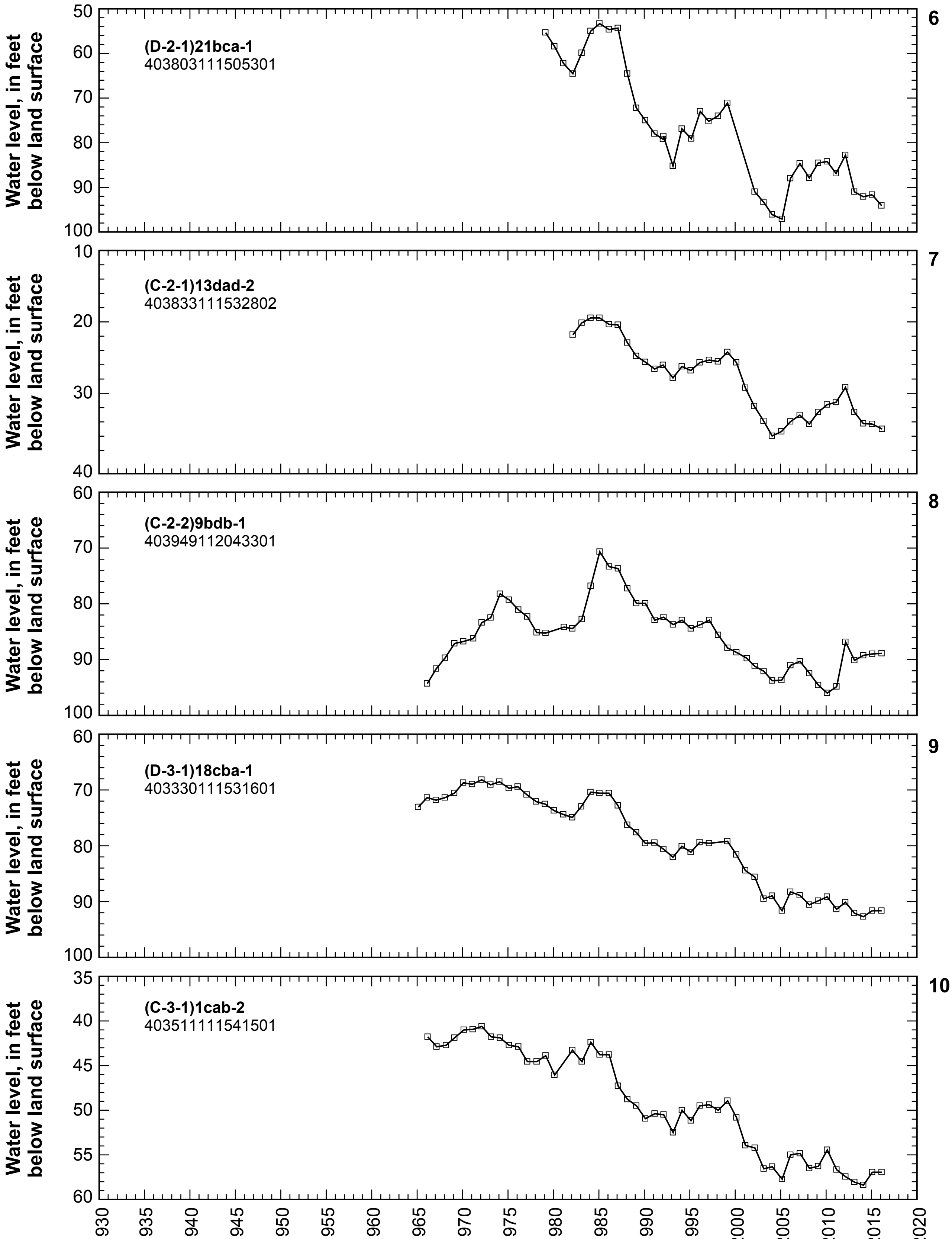


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

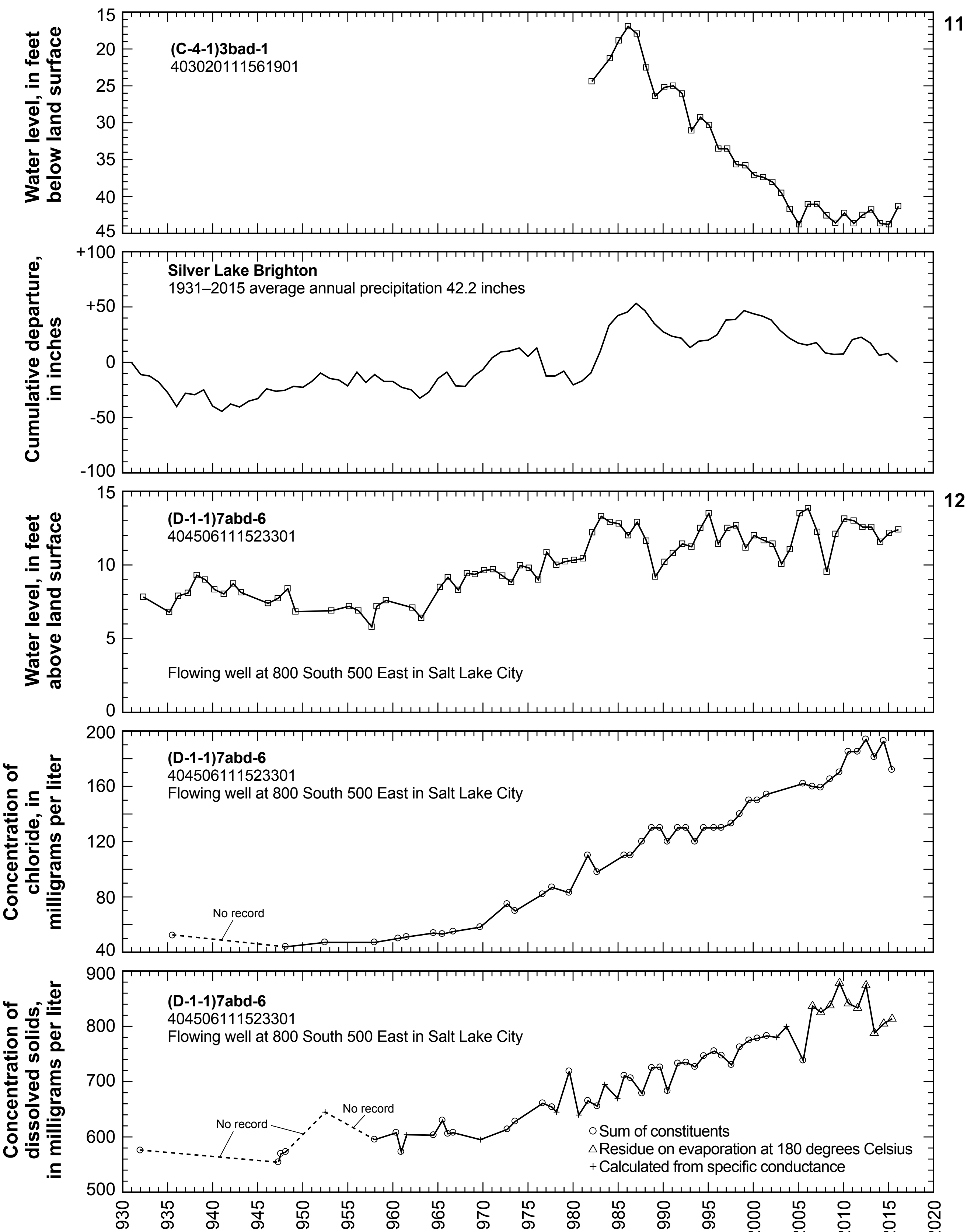


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

Tooele Valley

By Paul Downhour

Tooele Valley lies 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. 11). 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 2015 was about 25,000 acre-feet, which is about 3,000 acre-feet more than the total for 2014 and 1,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3). Withdrawal for irrigation was about 13,000 acre-feet, which is 3,000 acre-feet more than the total for 2014. Withdrawal for public supply was about 11,000 acre-feet, which is the same as in 2014. Withdrawal for industrial use was about 550 acre-feet, which is 150 acre-feet more than in 2014.

The location of wells in Tooele Valley in which the water level was measured during March 2016 is shown in figure 11. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1 is shown in figure 12. Precipitation at Tooele during 2015 was about 17.7 inches, which is about 2.3 inches more than in 2014 and about 0.2 inch less than the average annual precipitation for 1936–2015.

Water levels declined from March 2015 to March 2016 in most of the wells measured in Tooele Valley. The largest decline, about 2.8 feet, occurred in a well about 3 miles northeast of Tooele.

The concentration of dissolved solids in water samples collected from well (C-2-4)33bdd-1, located at Erda, from 1977 to 2015, is shown in figure 12. The concentration has ranged from 456 to 653 mg/L, with a median value of 586 mg/L. The concentration of dissolved solids in the water sample collected during June 2015 was 653 mg/L.

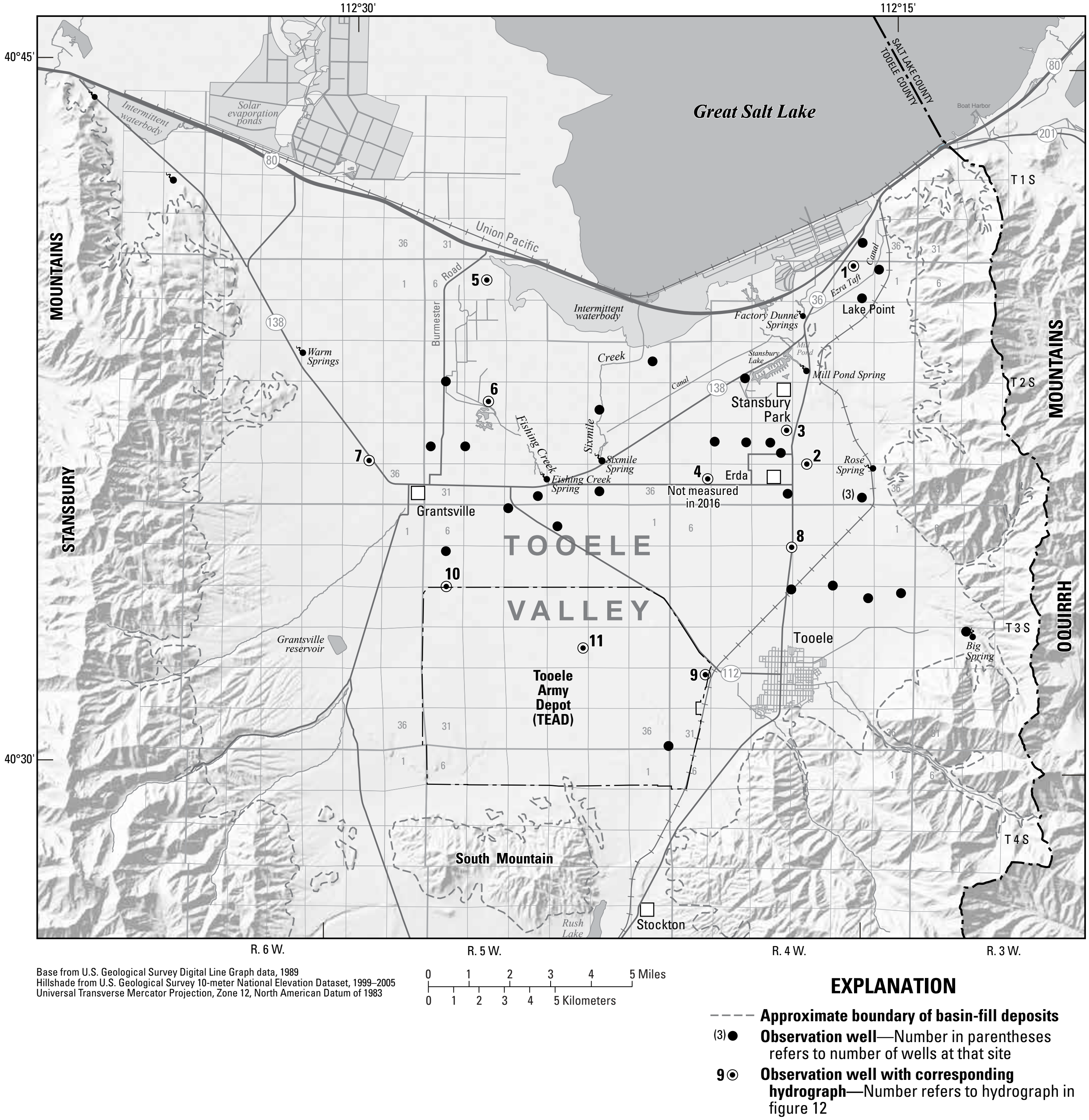


Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 2016.

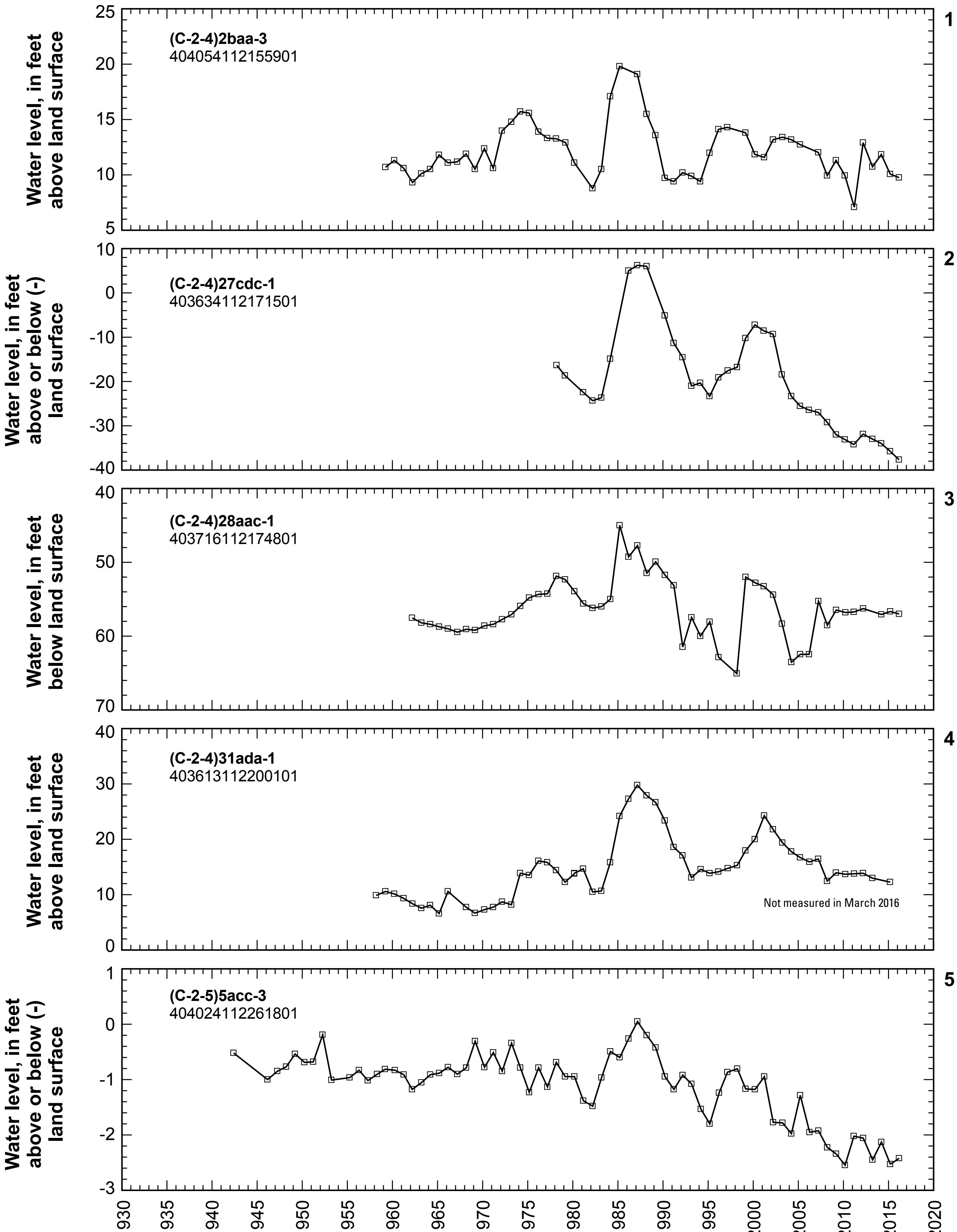


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.

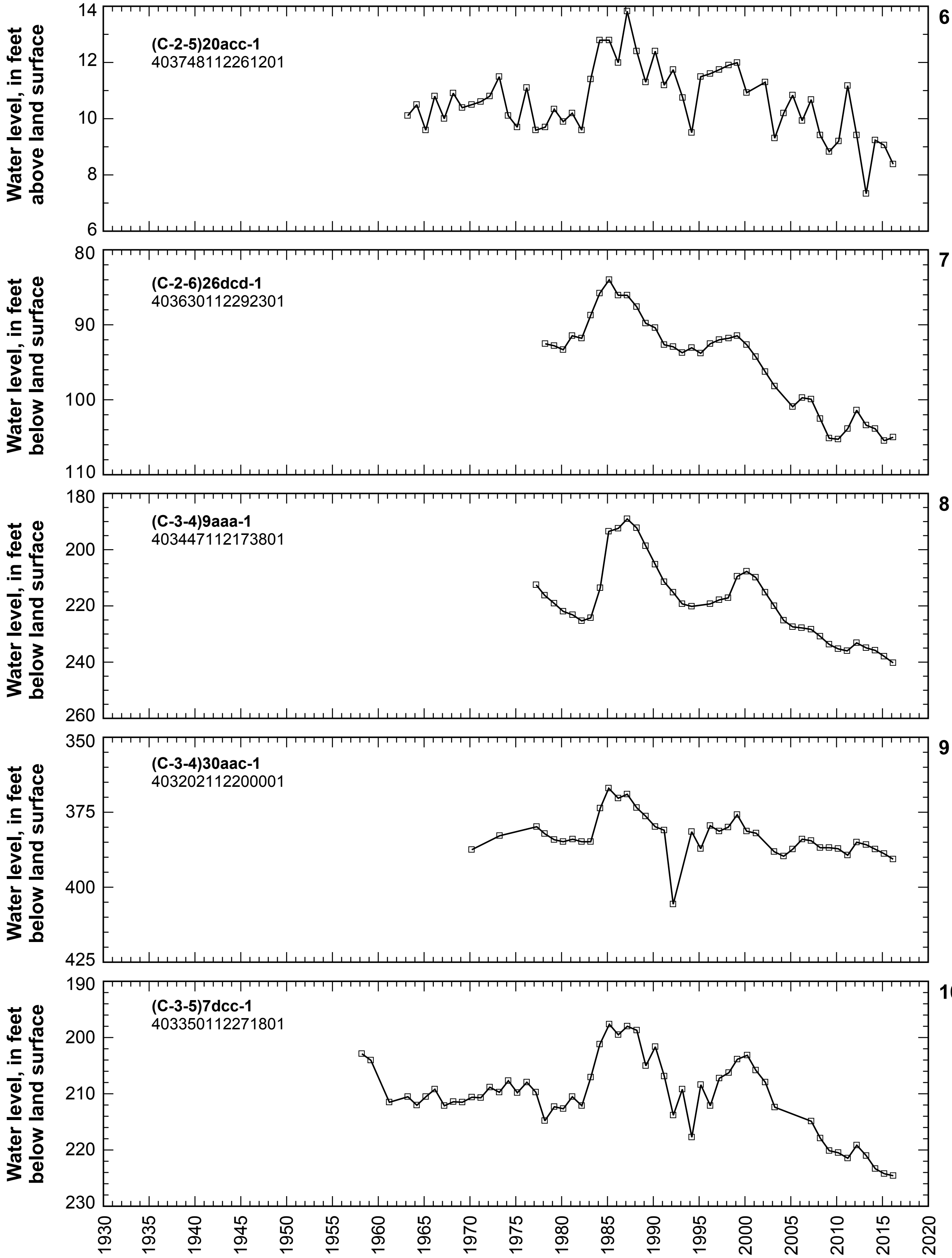


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

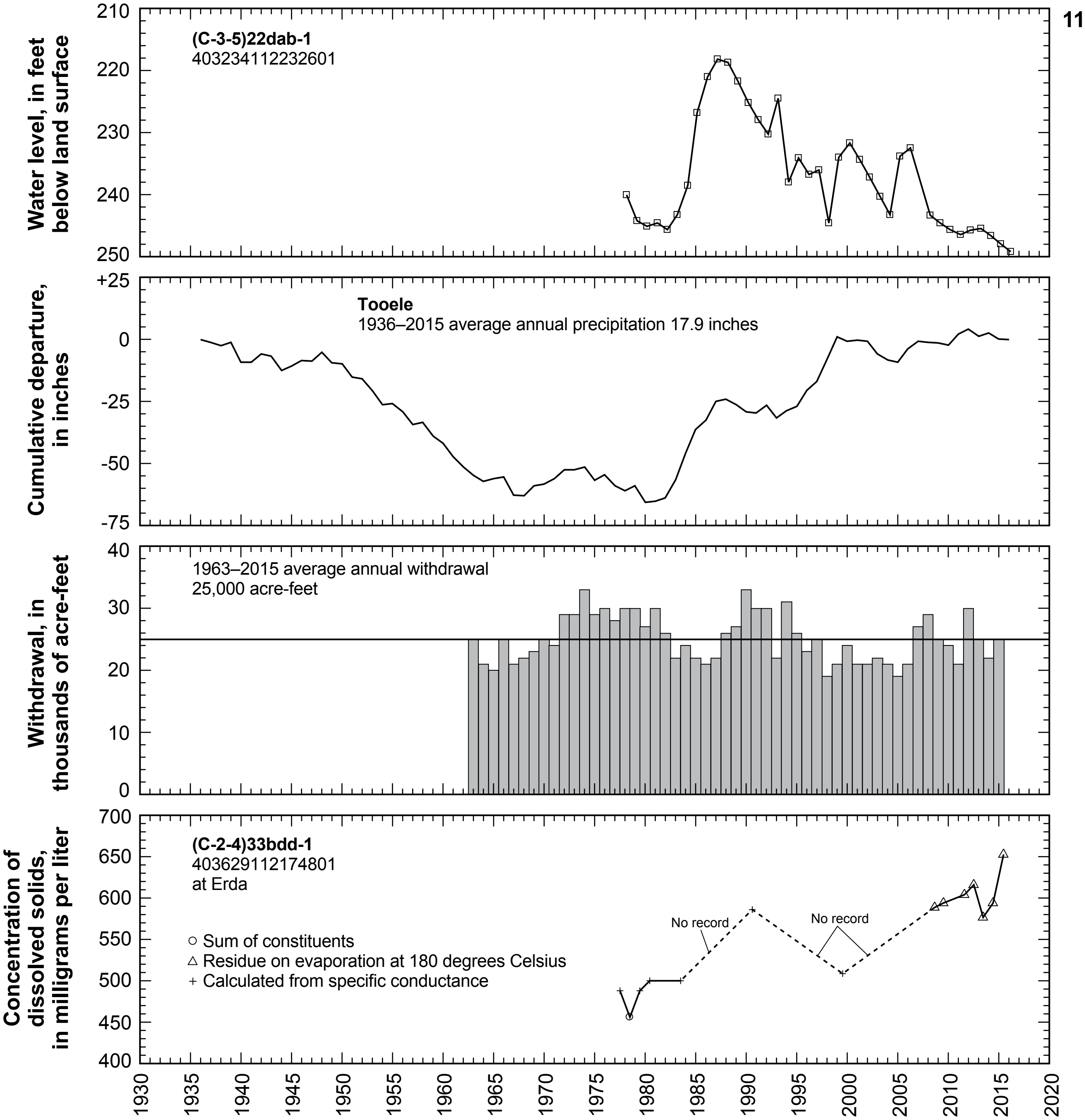


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

Utah and Goshen Valleys

By Lincoln Smith

Utah Valley is bounded by the Traverse Mountains, the Wasatch Range, West Mountain, and the northern extension of Long Ridge. The valley is divided into two groundwater basins, northern and southern, which are separated by Provo Bay in northern Utah Valley (fig. 13). Northern Utah Valley is further divided by the Jordan River into two subbasins, northern Utah Valley-east and northern Utah Valley-west. Goshen Valley is bounded by West Mountain, Long Ridge, the Lake Mountains, and the East Tintic Mountains. Groundwater in Utah and Goshen Valleys occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions, but most wells discharge from artesian aquifers. 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.

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 2015 was about 102,000 acre-feet, which is 5,000 acre-feet less than the value for 2014, and also 5,000 acre-feet less than the average annual withdrawal for 2005–2014 (tables 2 and 3). Withdrawal in northern Utah Valley (-east and -west) was about 51,900 acre-feet, which is 1,900 acre-feet less than the value for 2014. Total estimated withdrawal in northern Utah Valley-west was about 2,600 acre-feet, or about 5 percent of the total withdrawal in northern Utah Valley. Withdrawal in southern Utah Valley was 28,300 acre-feet, which is 2,300 acre-feet less than the value for 2014. Withdrawal in Goshen Valley was 22,100 acre-feet, which is 400 acre-feet less than the value for 2014. The overall decrease in total pumpage from all three valleys in 2015 was mainly due to decreased estimates for domestic and stock use, resulting from a change in the source of data[1].

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2016 is shown in figure 13. Water levels declined from March 2015 to March 2016 in most of the wells measured in Utah and Goshen Valleys. Declines are probably due to continued large withdrawals for public supply and irrigation. Overall, water levels have declined since the mid- to late 1980s. There have been intervening periods (1983–86, 1993–98, 2005–07, 2009–11) when water levels generally rose. These periods correspond to greater-than-average precipitation.

The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, Utah, and to concentration of dissolved solids in water from three wells is shown in figure 14. Discharge of Spanish Fork at Castilla, Utah in 2015 was about 125,700 acre-feet, which is 43,700 acre-feet less than the 1933–2015 average annual discharge and 20,100 acre-feet less than in 2014. Precipitation at Silver Lake Brighton in 2015 was about 34.0 inches, which is about 8.2 inches less than the long-term average (1931–2015) and about 10.0 inches less than in 2014. Precipitation at Spanish Fork Power House in 2015 was about 14.9 inches, which is about 4.3 inches less than the long-term average (1930–2015) and about 5.0 inches less than the value for 2014.

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 the mouth of the Provo River, and (D-9-1)36bbc-1, located 1 mile north of Santaquin, is shown in figure 14. The concentration of dissolved solids in water from well (C-9-1)28ccb-1 has ranged from 498 to 1,970 mg/L with a median value of 796 mg/L. The concentration of dissolved solids in the June 2015 sample was 1,680 mg/L. The dissolved-solids concentration in water from well (D-7-2)4cbb-2 has ranged from 270 to 539 mg/L with a median value of 321 mg/L. The concentration of dissolved solids in the June 2015 sample was 312 mg/L. The dissolved-solids concentration in water from well (D-9-1)36bbc-1 has ranged from 166 to 311 mg/L with a median value of 294 mg/L. The concentration of dissolved solids in the June 2015 sample was 295 mg/L.

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[1] Maupin and others, 2014.

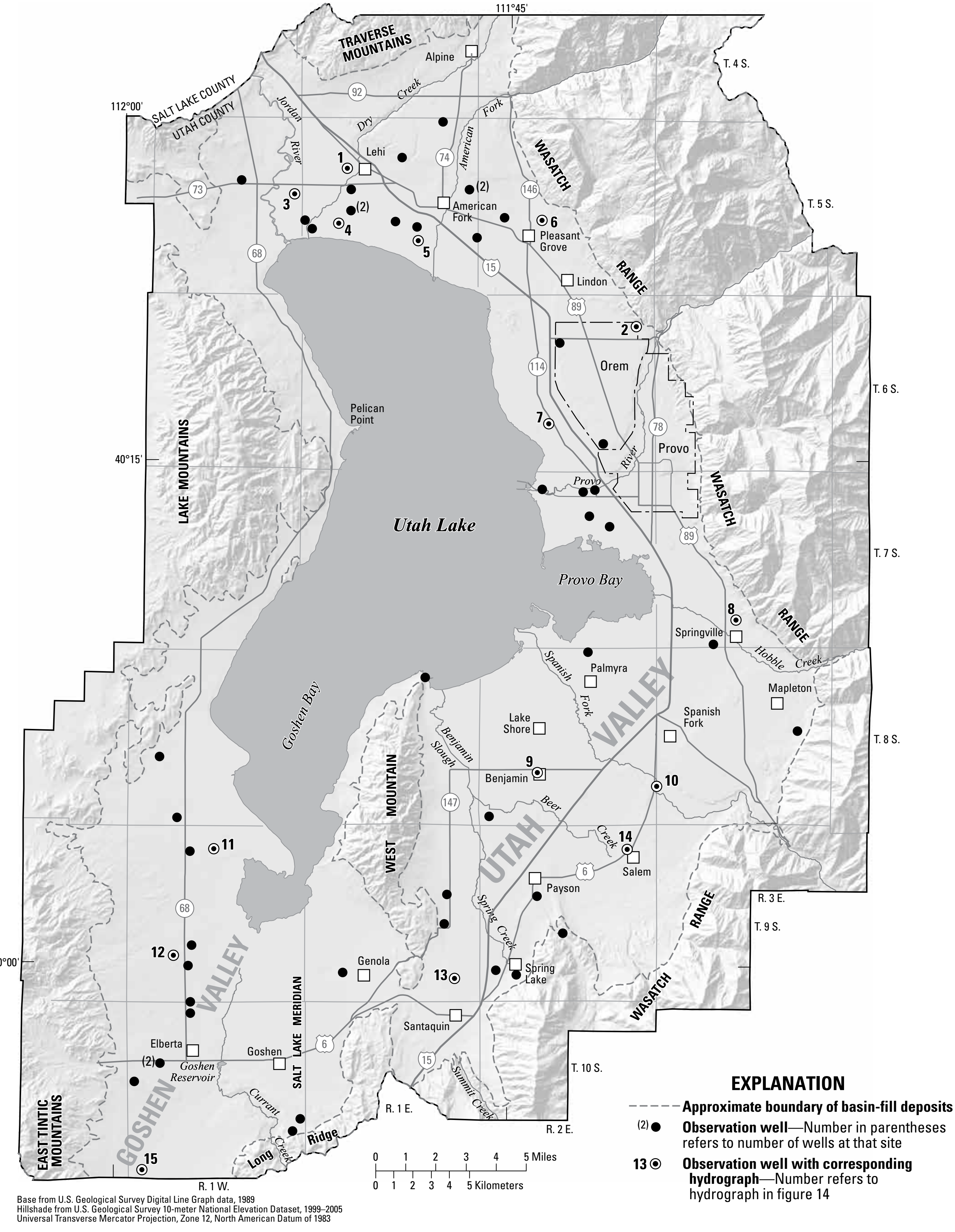

Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2016.

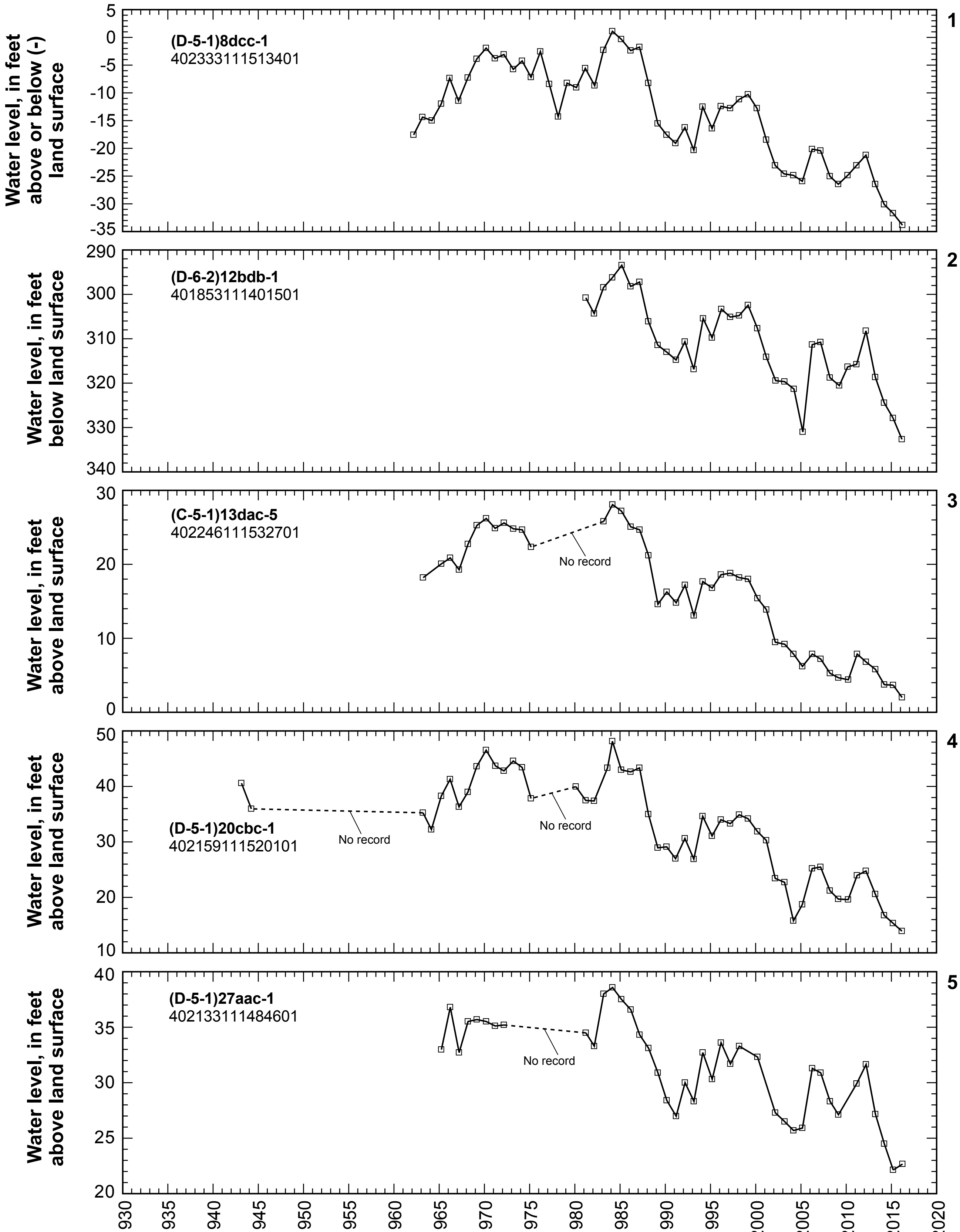

Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

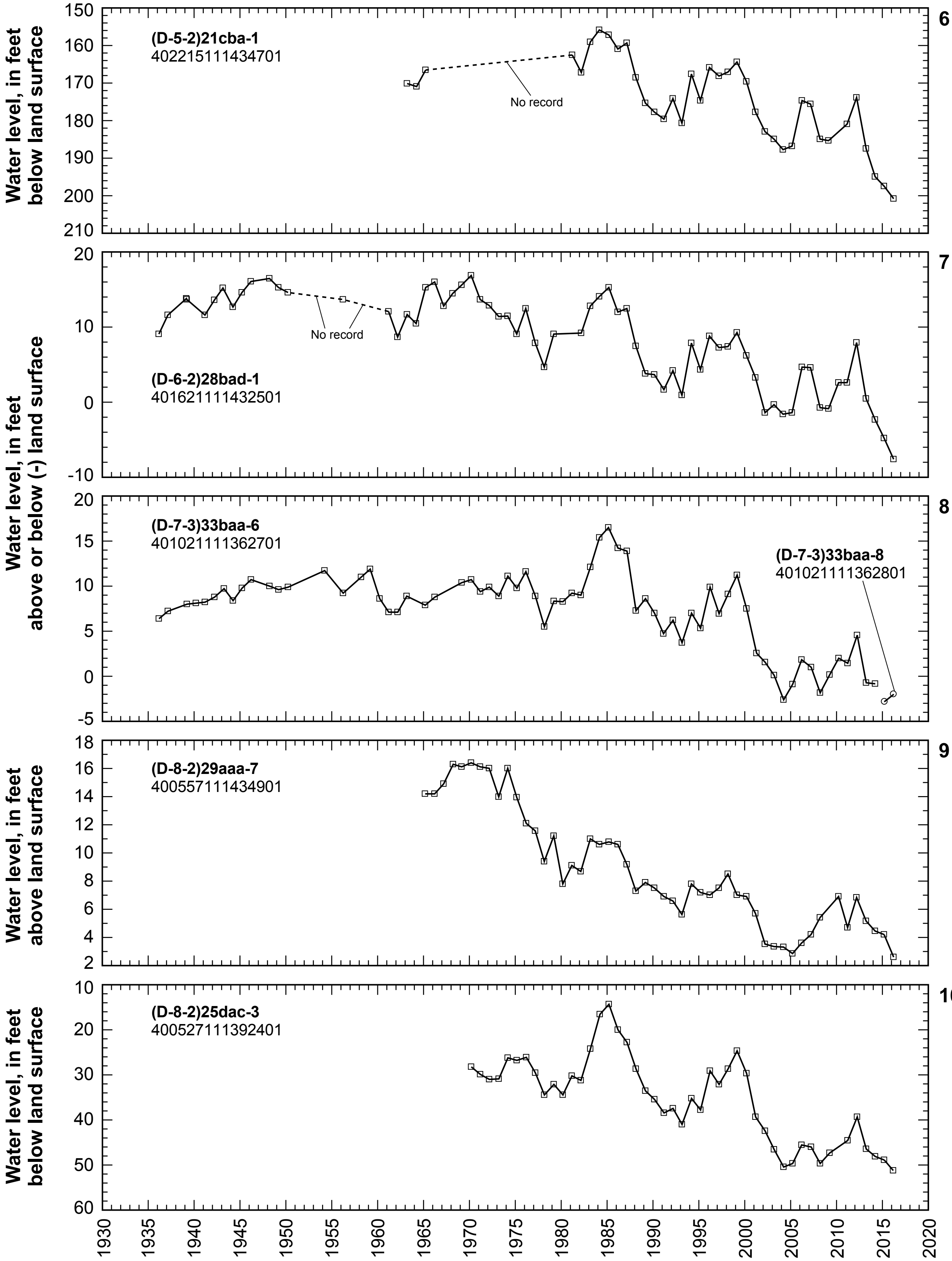

Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

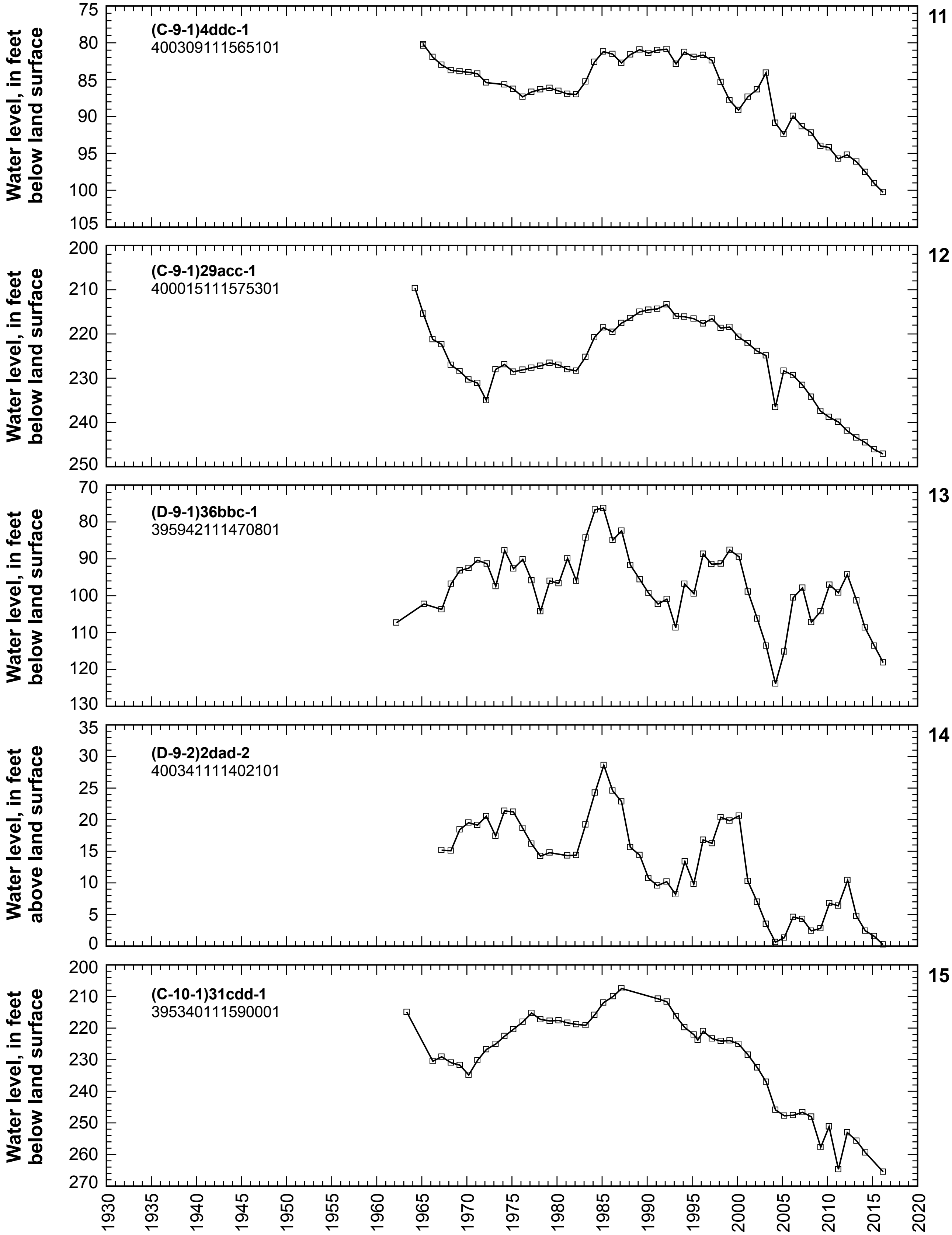

Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

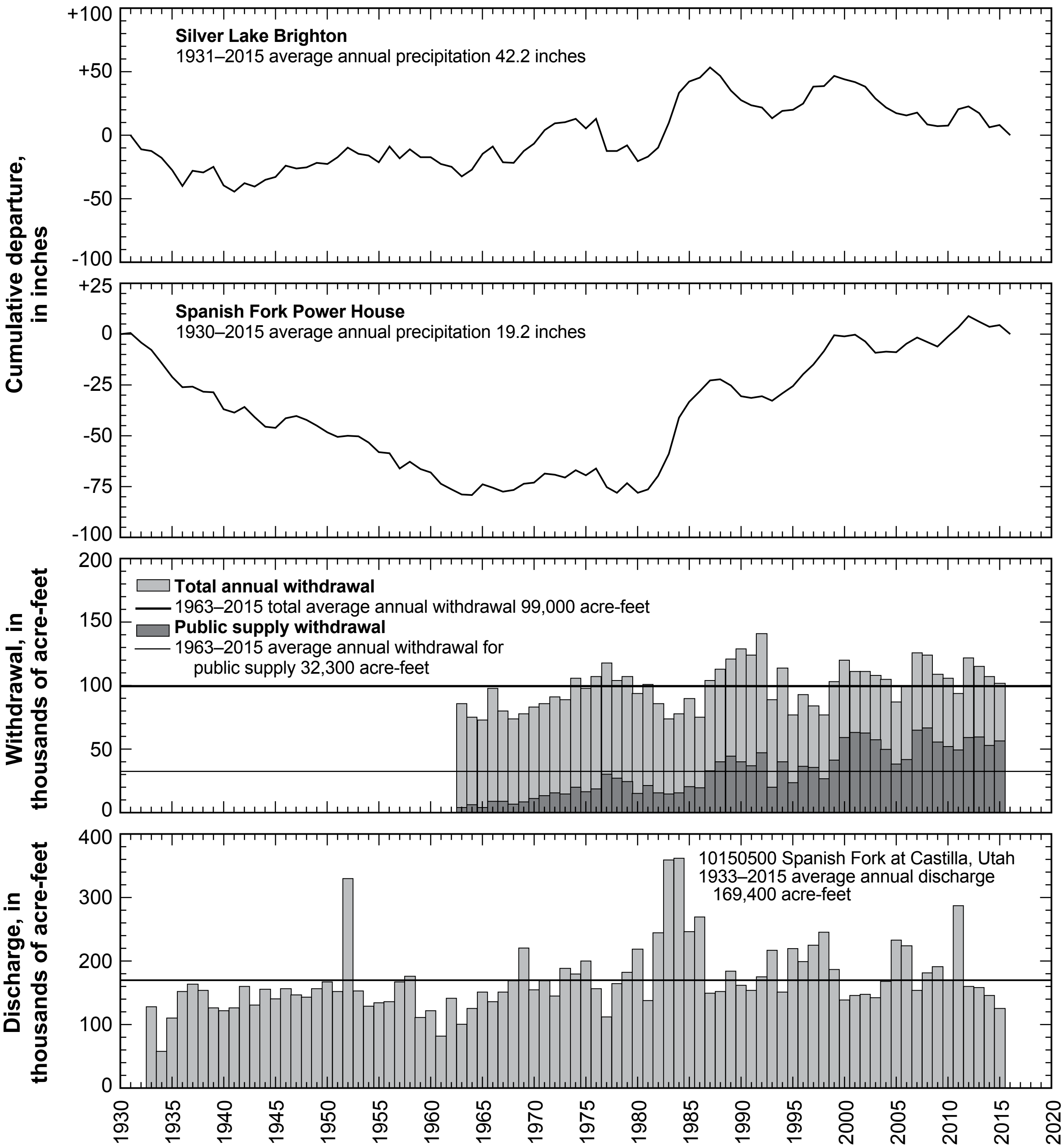

Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

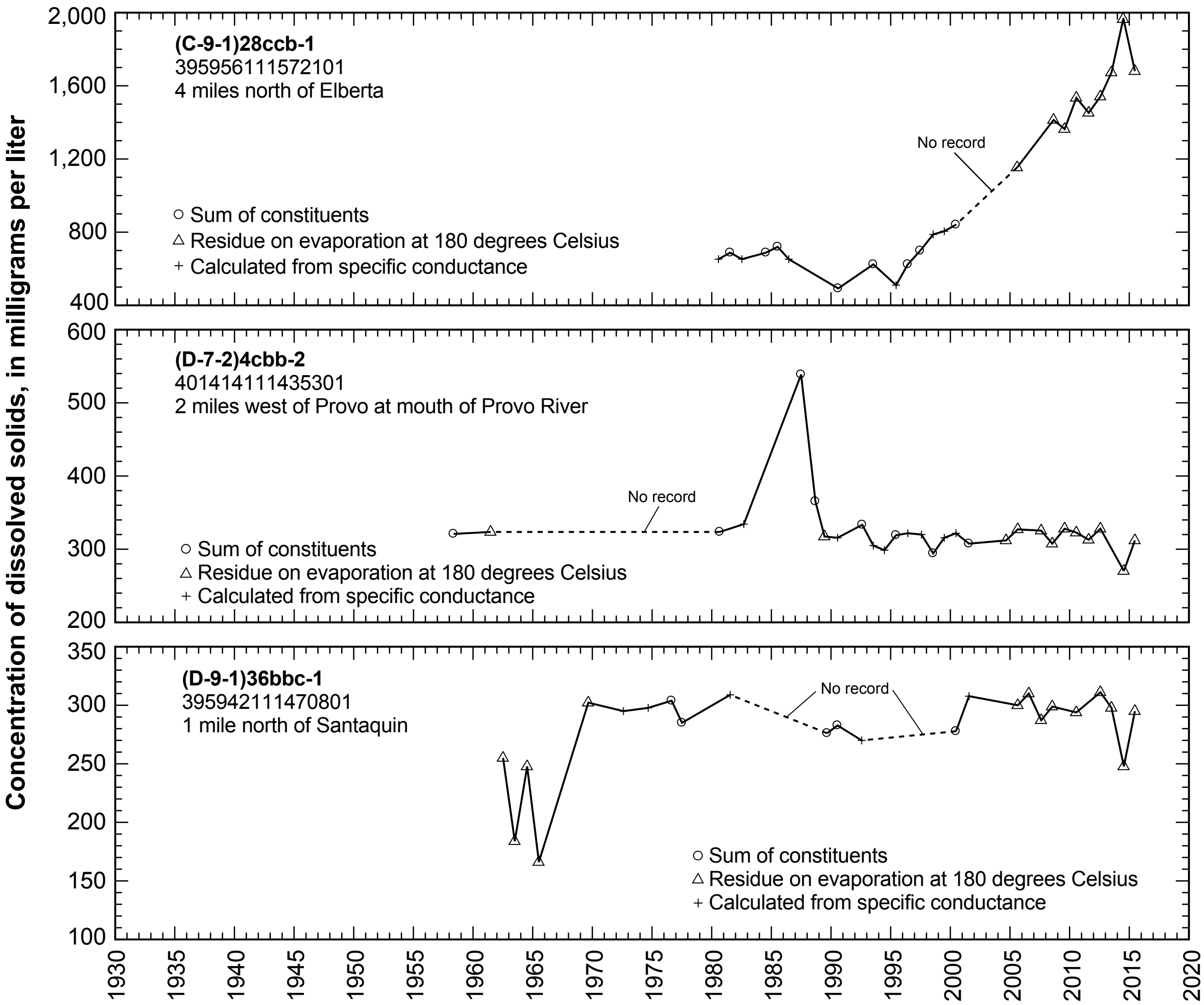

Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

Juab Valley

By Robert J. Eacret

Juab Valley, in central Utah, is about 30 miles long and 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. 15). 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.

Total estimated withdrawal of water from wells in Juab Valley in 2015 was about 31,000 acre-feet, which is 2,000 acre-feet more than the amount reported for 2014 and 8,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3). The increase was mainly due to increased withdrawals for irrigation.

The location of wells in Juab Valley in which the water level was measured during March 2016 is shown in figure 15. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1, is shown in figure 16. Precipitation at Nephi during 2015 was about 11.5 inches, which is about 2.6 inches less than the average annual precipitation for 1935–2015, and about 0.2 inch more than in 2014.

Water levels declined in all of the wells measured in Juab Valley from March 2015 to March 2016 (fig. 16). Declines are probably the result of continued large withdrawals for irrigation and less-than-average precipitation. Water levels generally rose from 1978 to their highest level in 1985–87. This rise corresponds to a period of greater-than-average precipitation during 1978–86. Water levels generally declined from the late 1980s to 2016, although there was a substantial rise in some wells from 1993 to 1999.

The concentration of dissolved solids in water from well (C-14-1)26dbd-1, located 2 miles west of Levan, is shown in figure 16. The dissolved-solids concentration in the water sample collected in August 2015 was 844 mg/L.

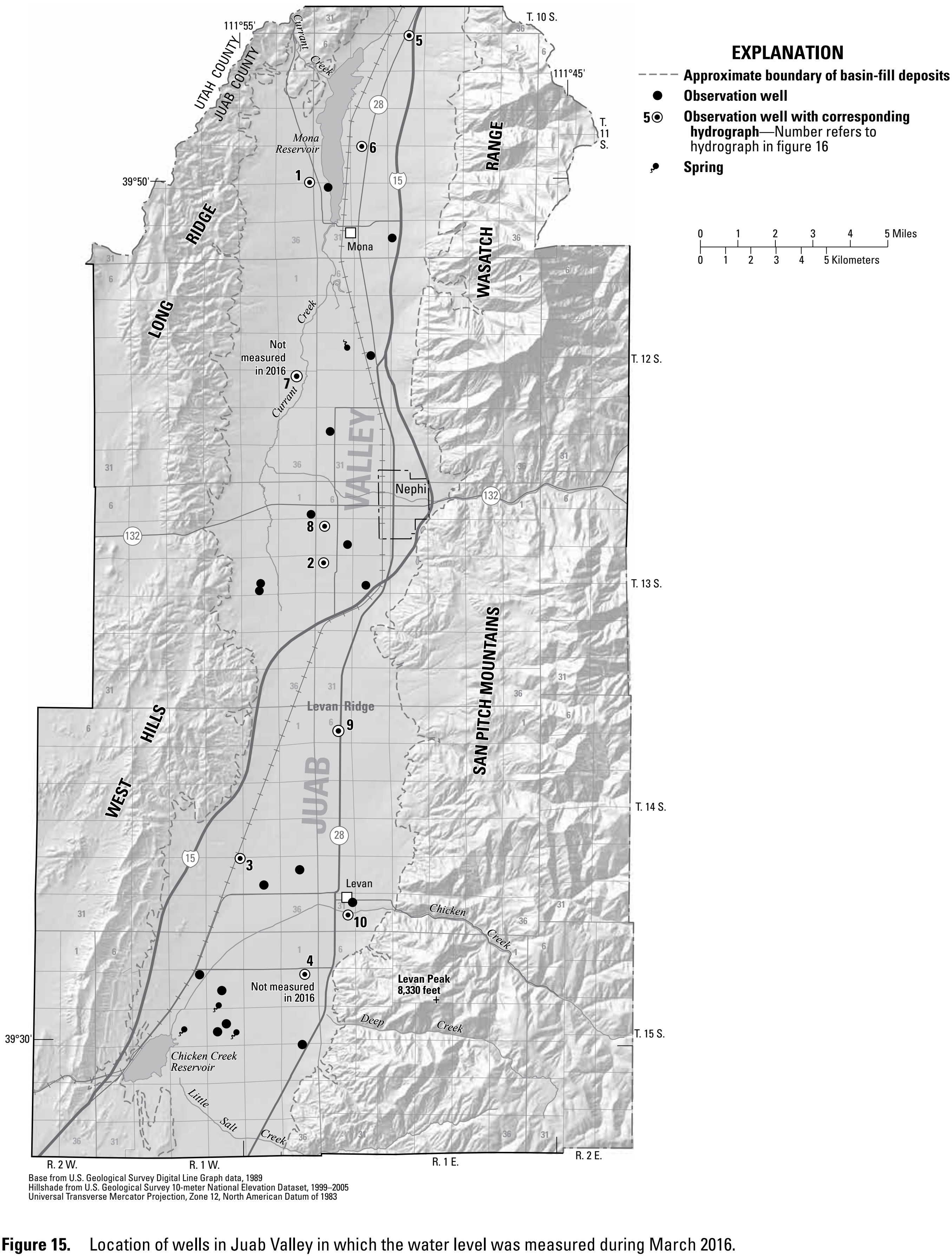

Figure 15. Location of wells in Juab Valley in which the water level was measured during March 2016.

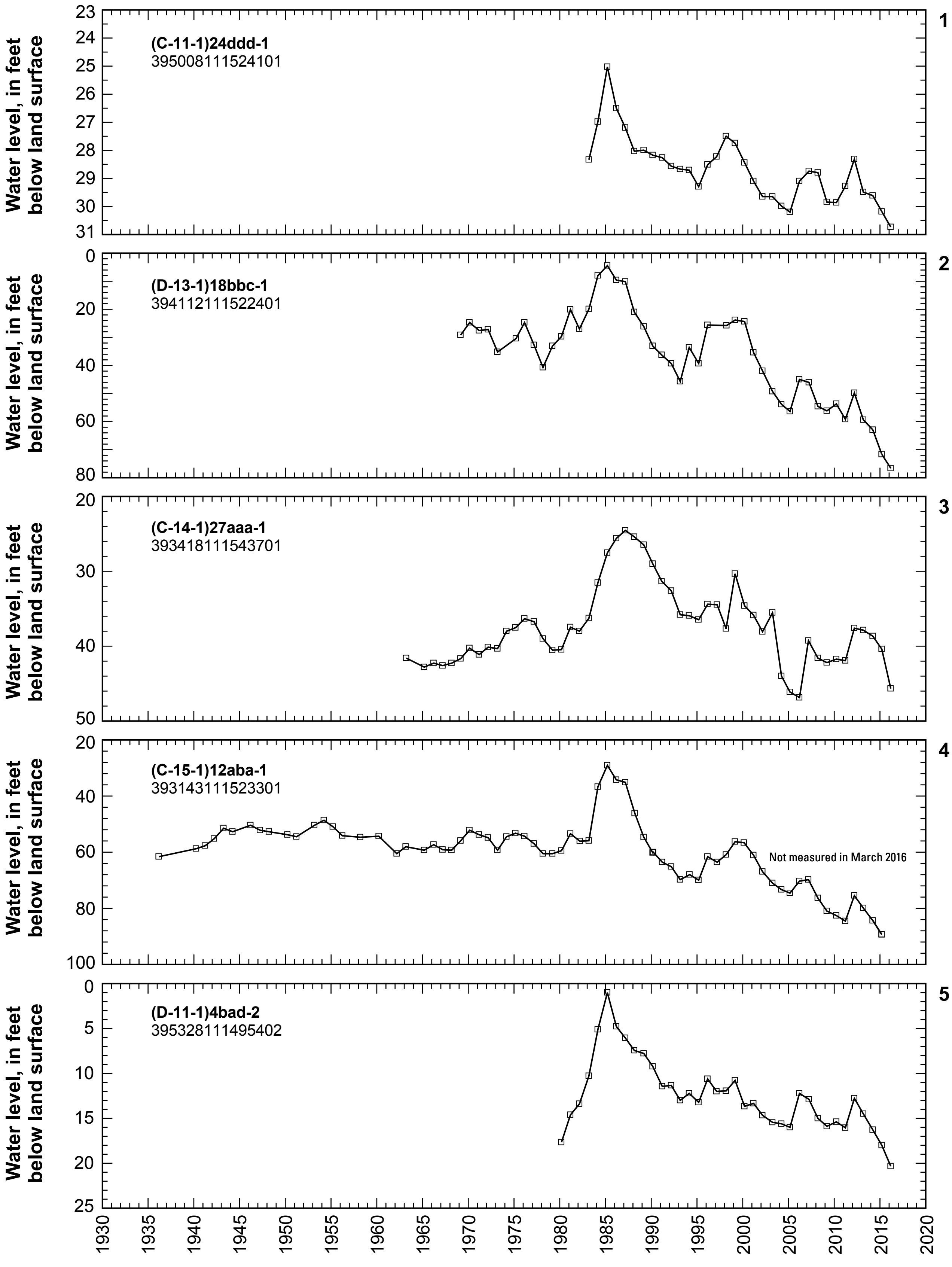

Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.

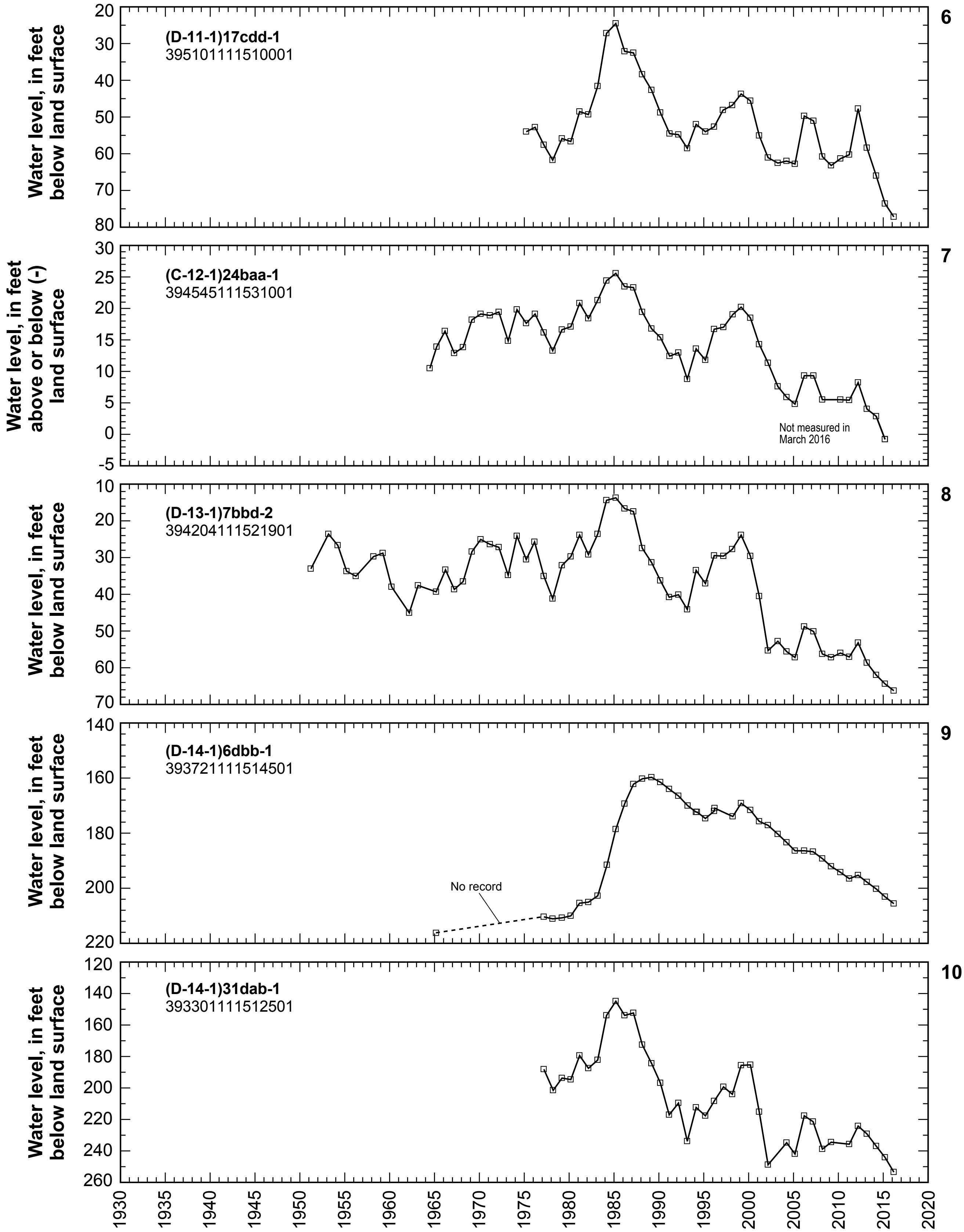

Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.—Continued

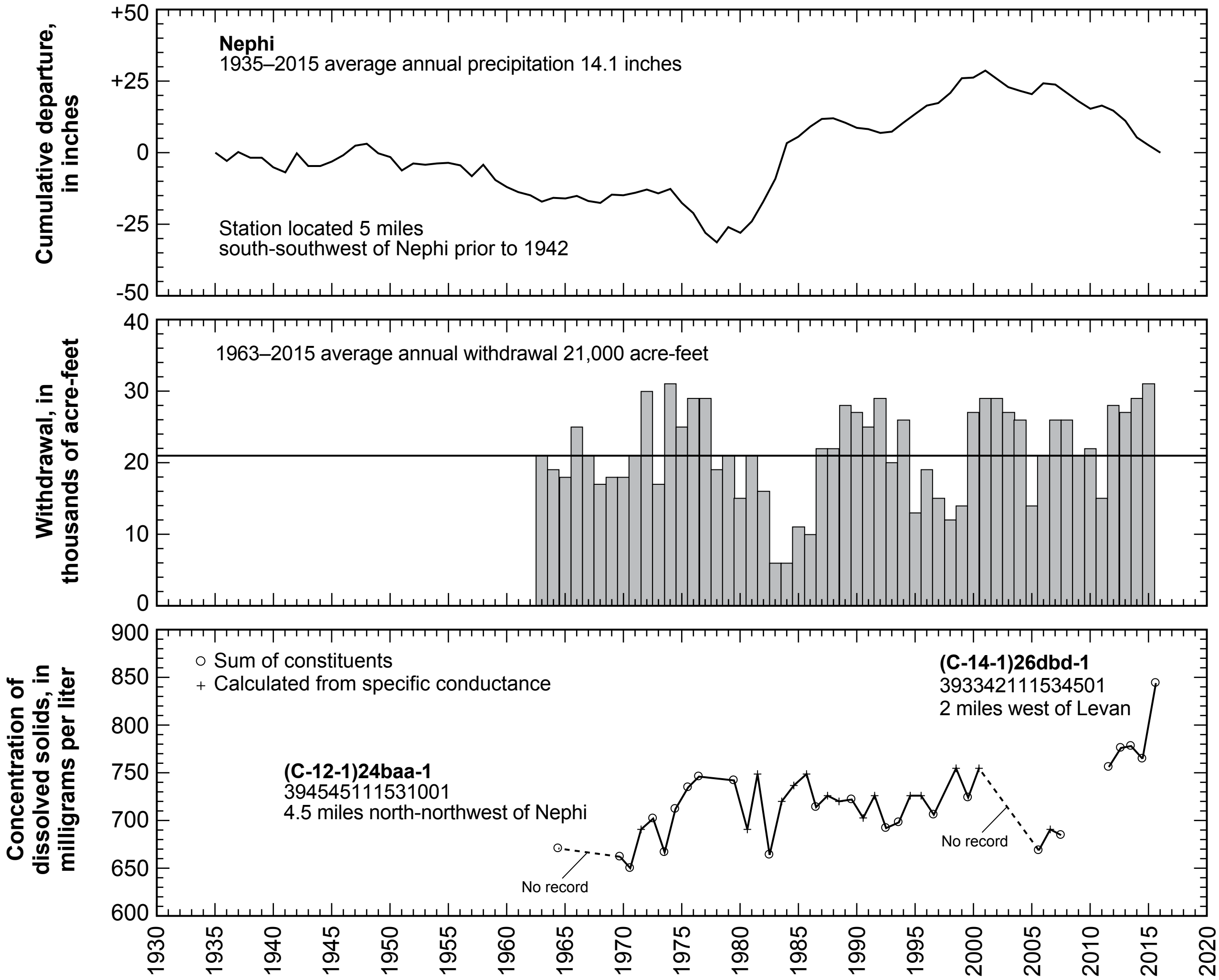

Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.—Continued

Sevier Desert

By Travis L. Gibson

The part of the Sevier Desert described here covers about 2,000 square miles in northern Millard and southern Juab Counties (figs. 17 and 18). It principally includes the broad, gently sloping areas that radiate from the Canyon and Gilson Mountains to the east, the Drum Mountains to the west, and several non-continuous 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 2015 was about 55,000 acre-feet, which is 2,000 acre-feet more than the total for 2014 and about 19,000 acre-feet more than the 2005–2014 average annual withdrawal (tables 2 and 3). The increase in withdrawals was mainly due to increased pumpage for industrial and public-supply use.

The location of wells in the Sevier Desert in which the water level was measured during March 2016 is shown in figures 17 and 18. The relation of the water level in selected observation wells to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1 is shown in figure 19.

Discharge of the Sevier River near Juab in 2015 was 119,800 acre-feet, which is 2,400 acre-feet more than in 2014 and 59,300 acre-feet less than the long-term average (1935–2015). Precipitation at Oak City was about 10.3 inches in 2015, about 2.6 inches less than the 1930–2015 average annual precipitation and 1.4 inches less than in 2014.

Most water levels in the shallow artesian and deep artesian aquifers declined from March 2015 to March 2016 (fig. 19). In the shallow artesian aquifer, most water levels declined between 0 and 2 feet. In the deep artesian aquifer, most water levels declined between 1 and 3 feet. Declines are probably the result of increased withdrawals and less-than-average precipitation.

Periods when the water level in the shallow and deep aquifers generally rose (including 1980–89, 1995–99, 2006–07, and 2010–12) correspond to greater-than-average precipitation, less-than-average groundwater withdrawals, and greater than average discharge of the Sevier River, with apparent persistent recharge occurring to the deep aquifer in years following greater-than-average surface-water availability. Periods when the water level in the shallow and deep aquifers generally declined (including 1988–94, 2001–05, 2008–10, and 2013–14) correspond to less-than-average precipitation, greater-than-average groundwater withdrawals, and less-than-average discharge of the Sevier River.

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 2015, is shown in figure 19. The concentration has ranged from 1,490 to 2,340 mg/L, with a median value of 2,030 mg/L. The dissolved-solids concentration in the water sample from July 2015 was 2,120 mg/L.

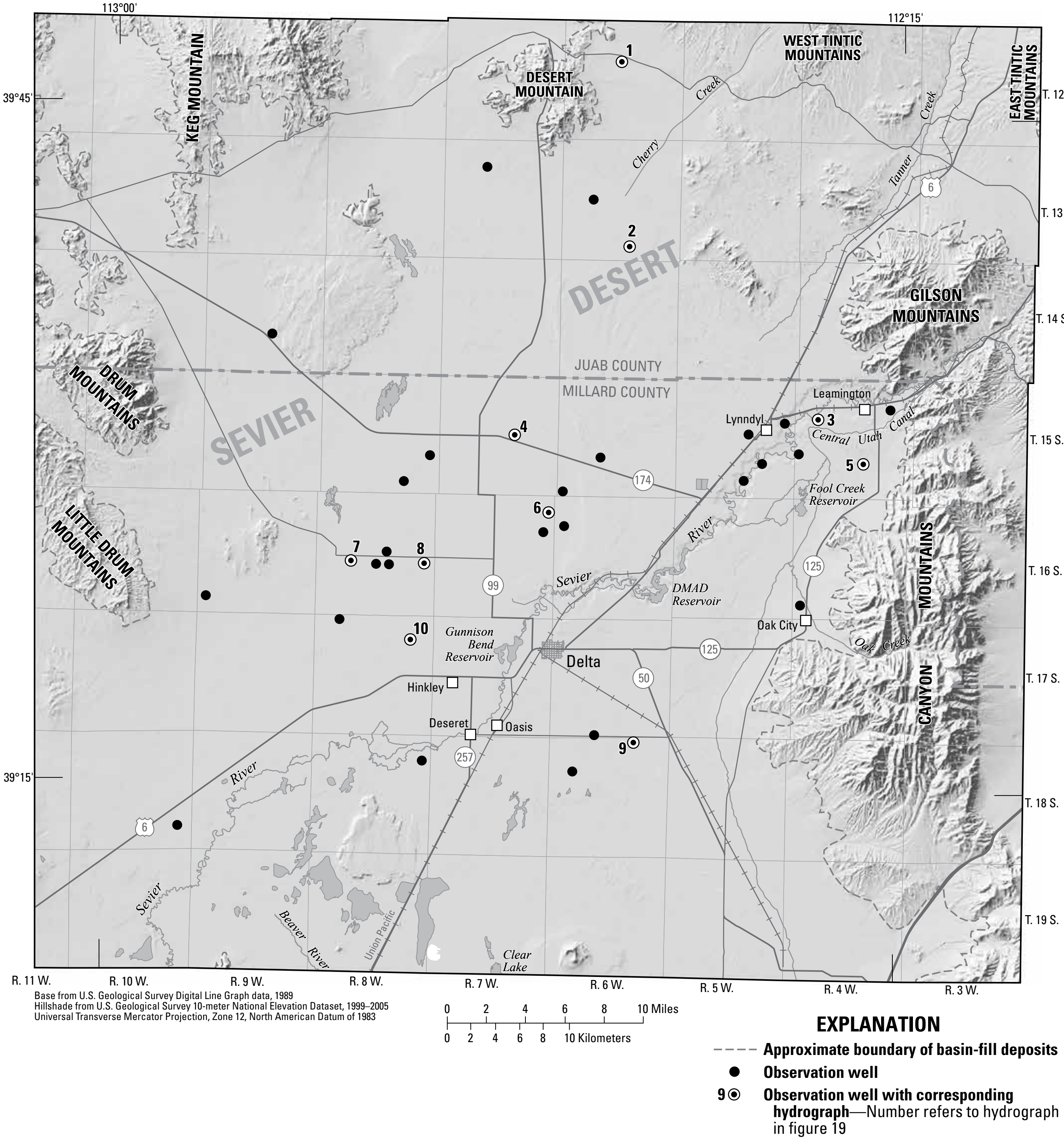

Figure 17. Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2016.

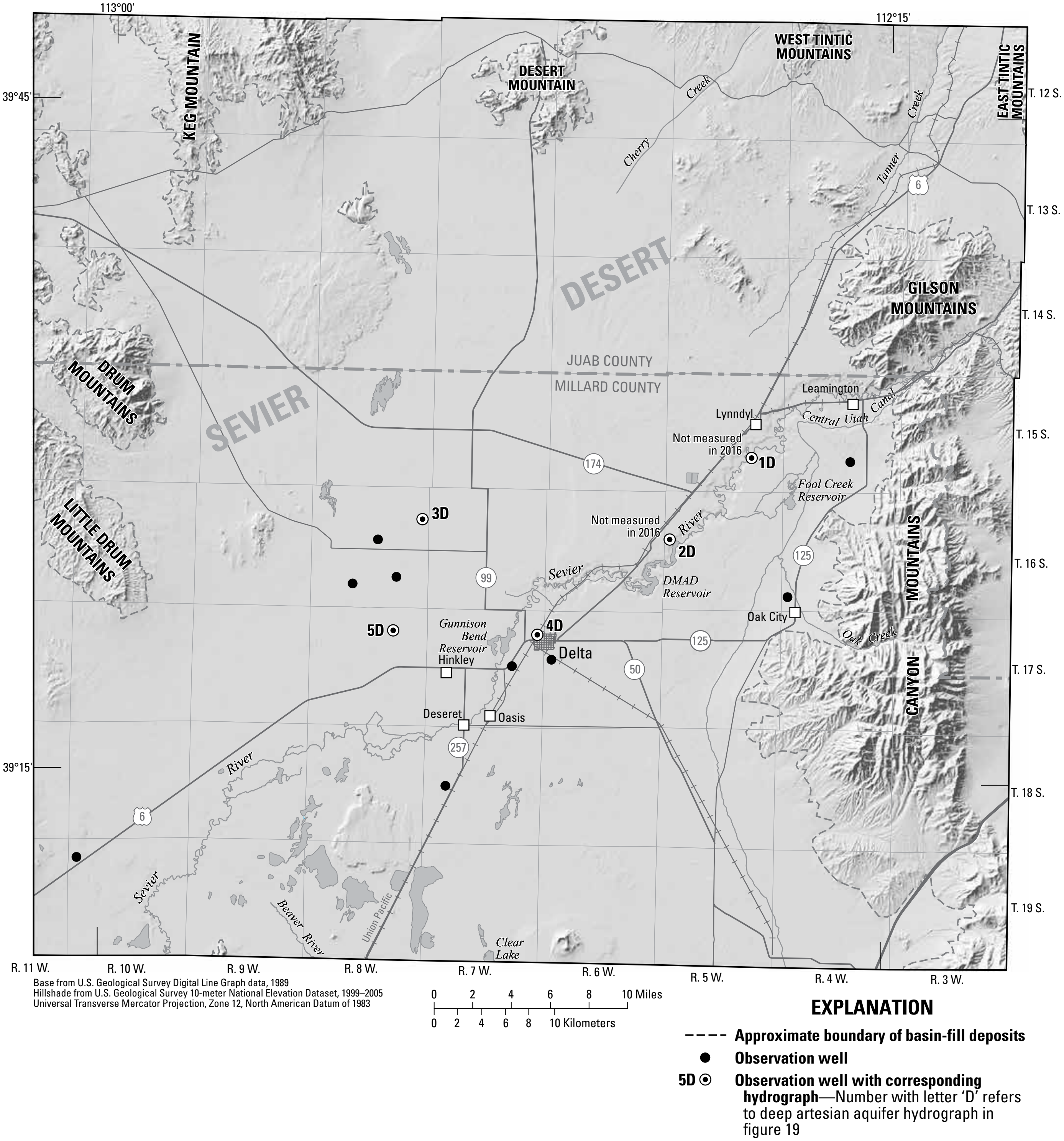

Figure18. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2016.

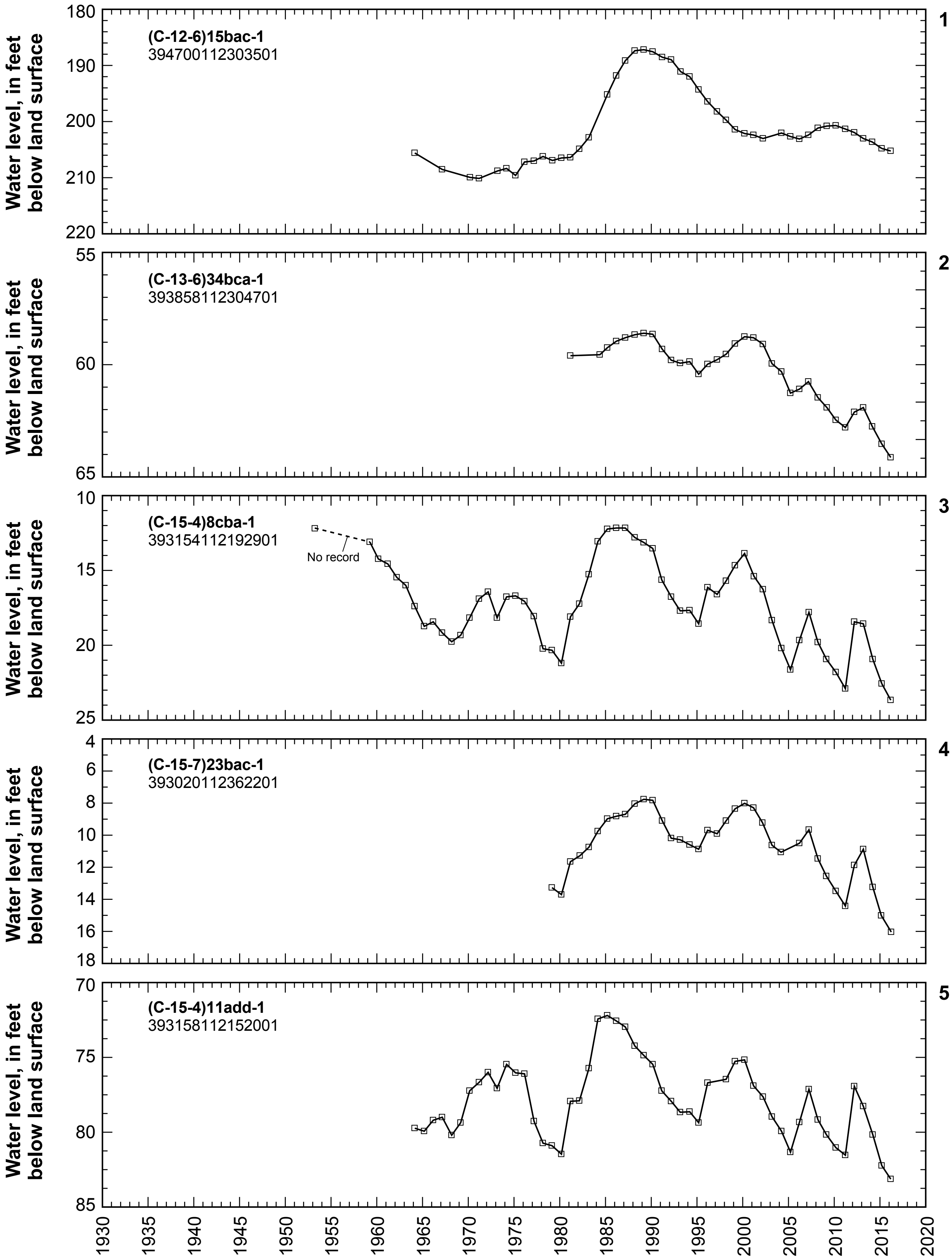

Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.

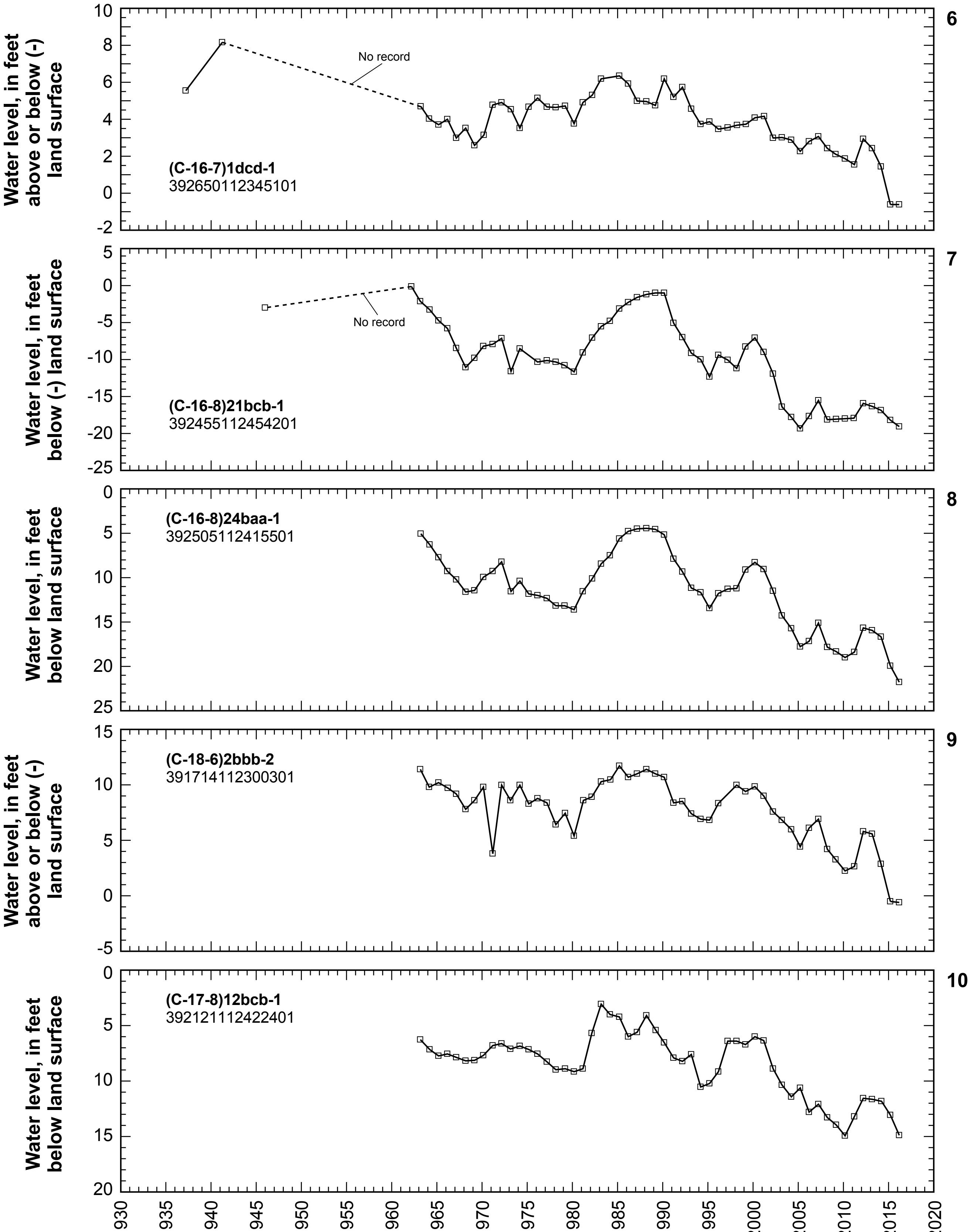

Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

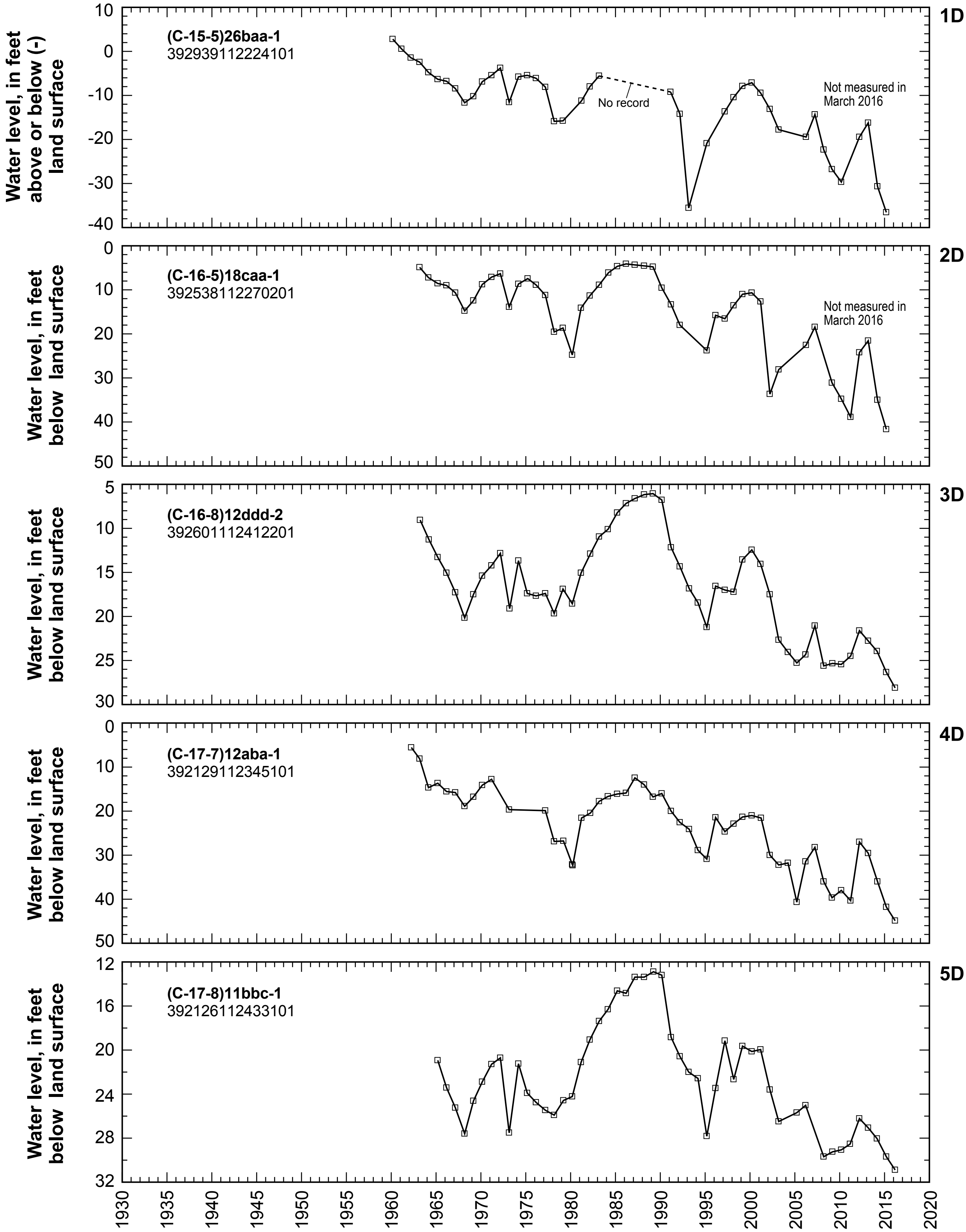

Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

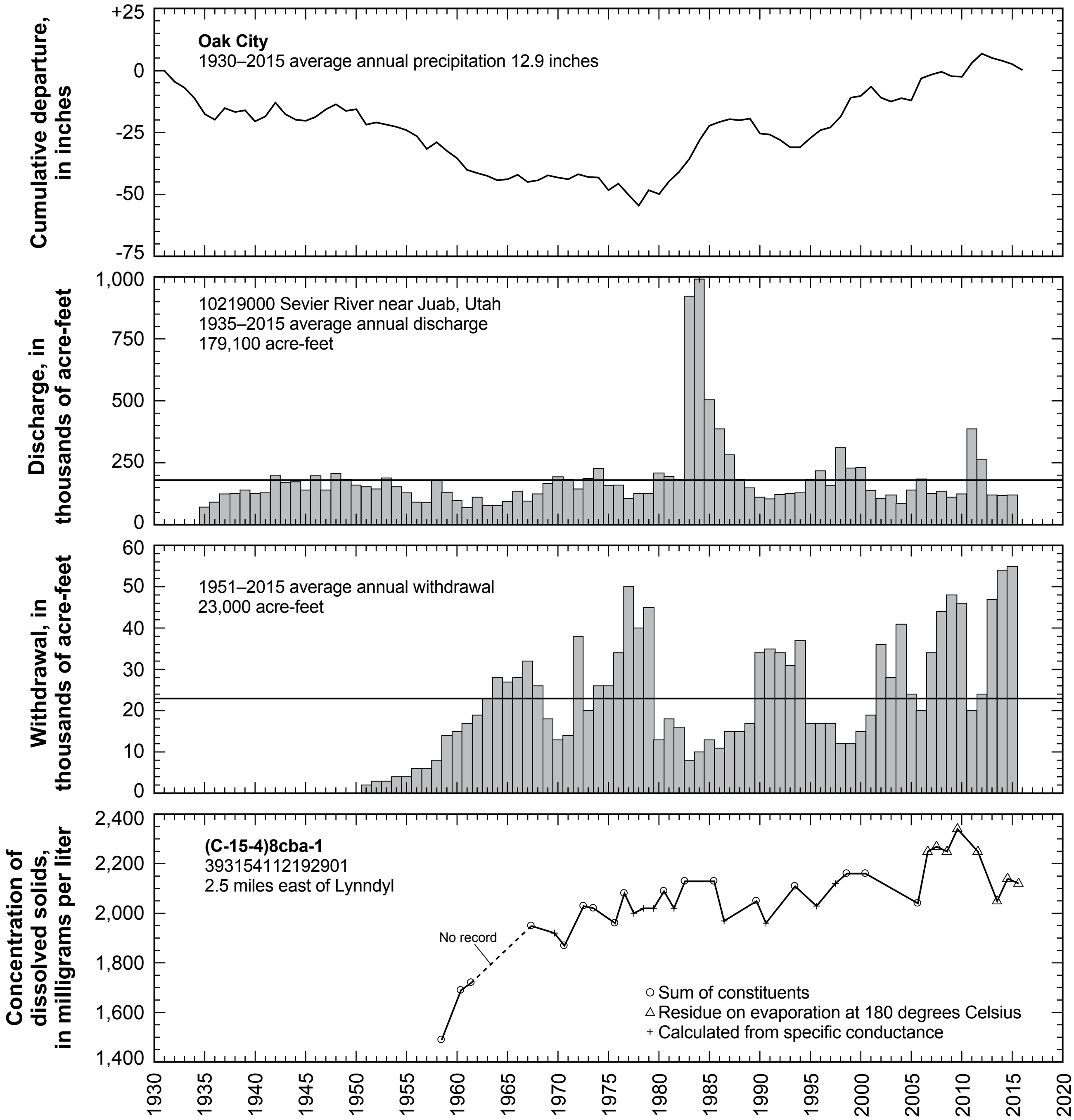

Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

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. 20). 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 2015 was about 30,000 acre-feet, which is 1,000 acre-feet less than reported for 2014 and 5,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3).

The location of 24 wells in central Sevier Valley in which the water level was measured during March 2016 is shown in figure 20. The relation of the water level in selected observation wells to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 21.

Discharge of the Sevier River at Hatch, Utah, in 2015 was about 47,300 acre-feet, which is about 32,400 acre-feet less than the 1940–2015 average annual discharge. Precipitation at Richfield Radio KVSC was about 11.0 inches in 2015, which is about 2.9 inches more than the 1950–2015 average annual precipitation and 1.0 inch more than in 2014.

Water levels in central Sevier Valley generally declined in most areas from March 2015 to March 2016. 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.

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 2015, is shown in figure 21. The concentration has ranged from 307 to 630 mg/L. There were substantial increases and decreases in dissolved-solids concentrations during the mid- to late 1960s and 1980s. Dissolved-solids concentrations in samples collected from 1990 through 2015 show little variability and are generally near the median value (410 mg/L) for all sample concentrations.

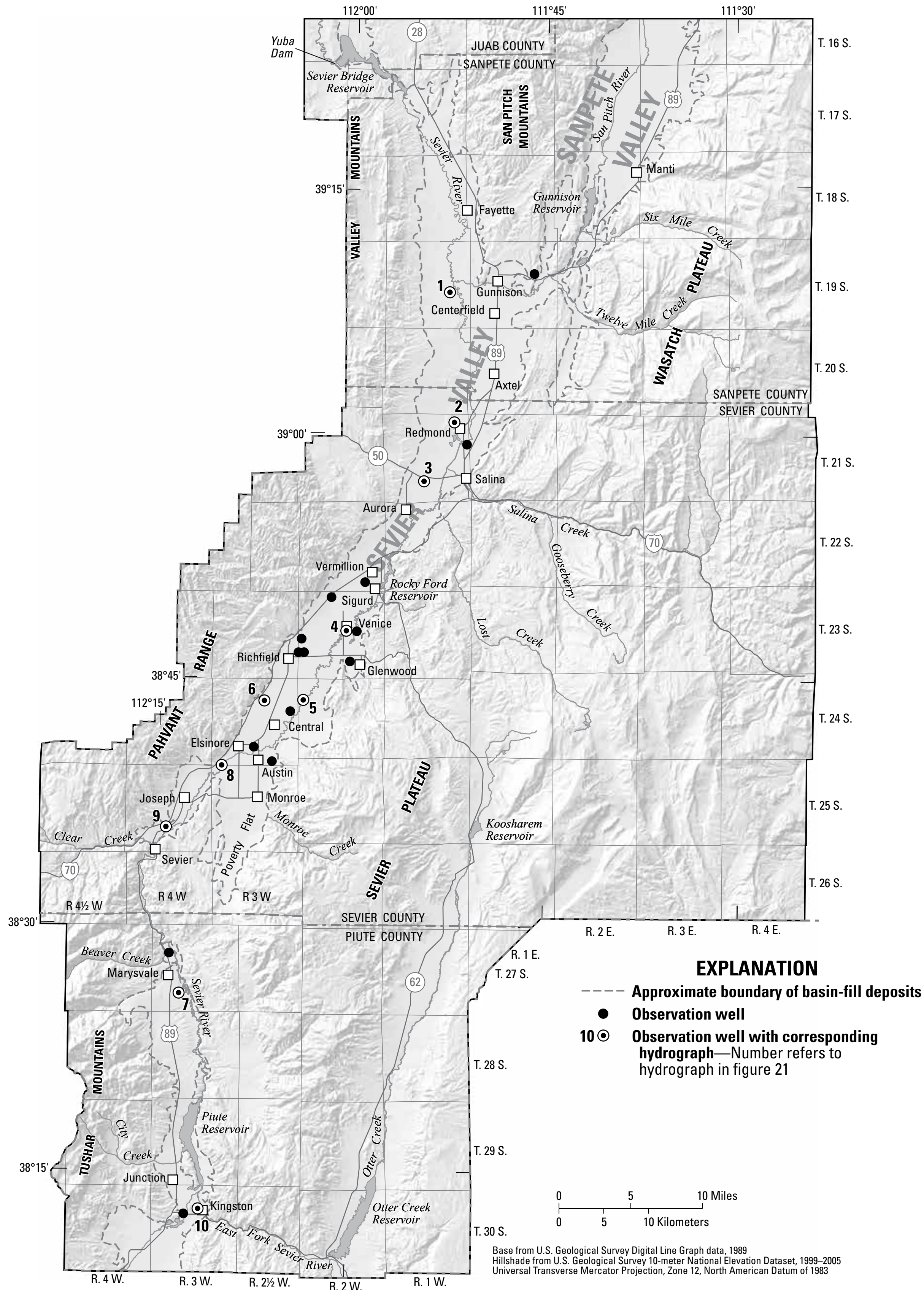

Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 2016.

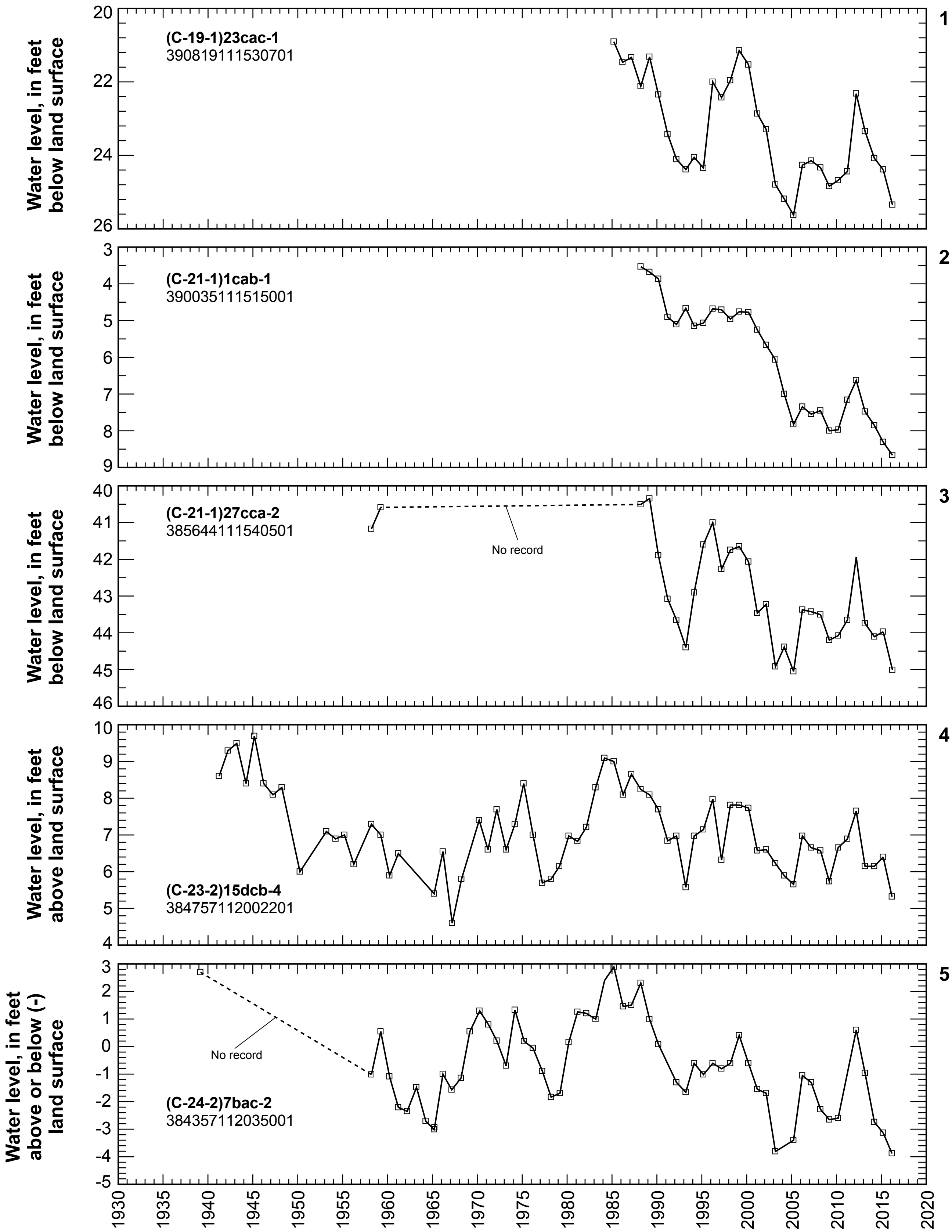

Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

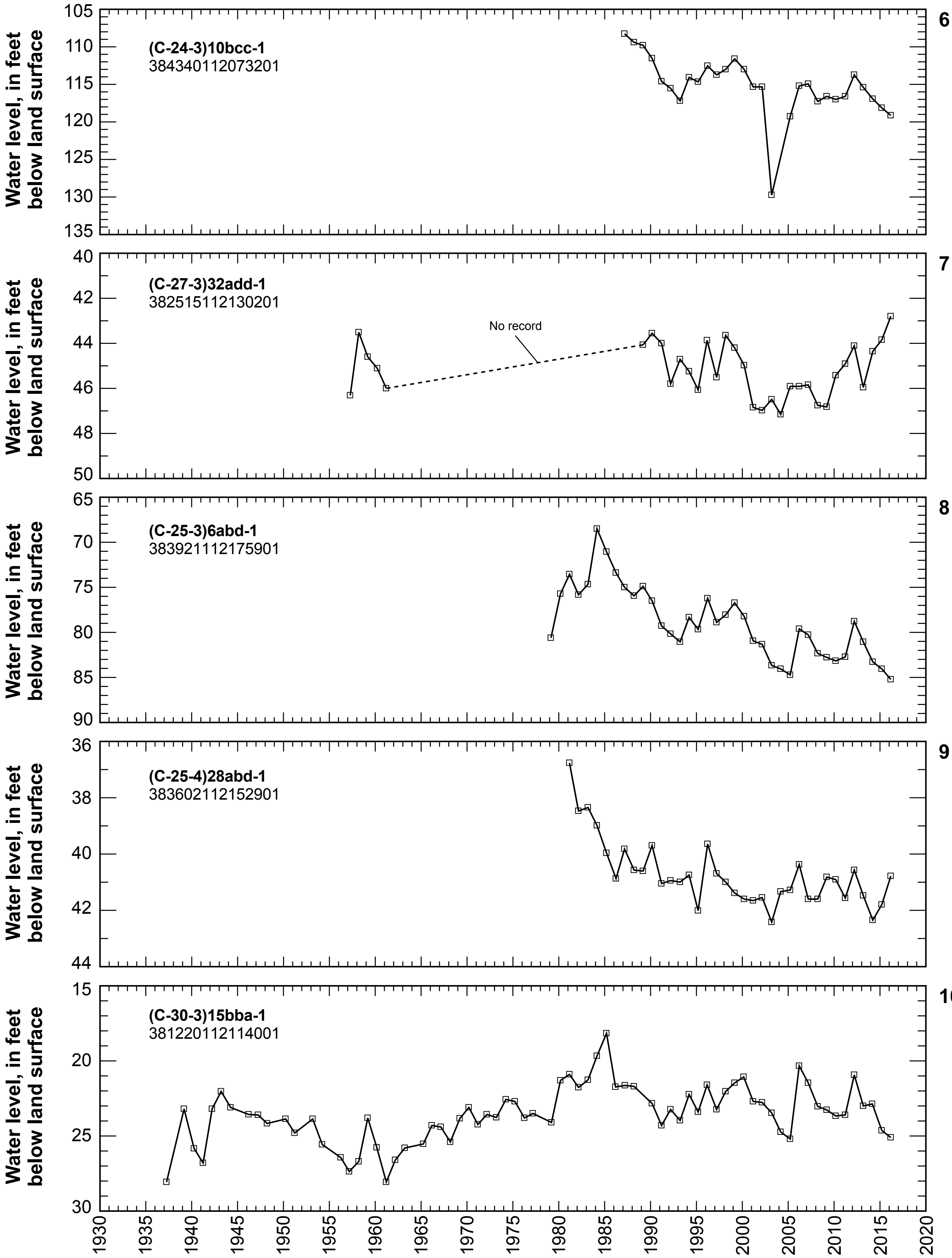

Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

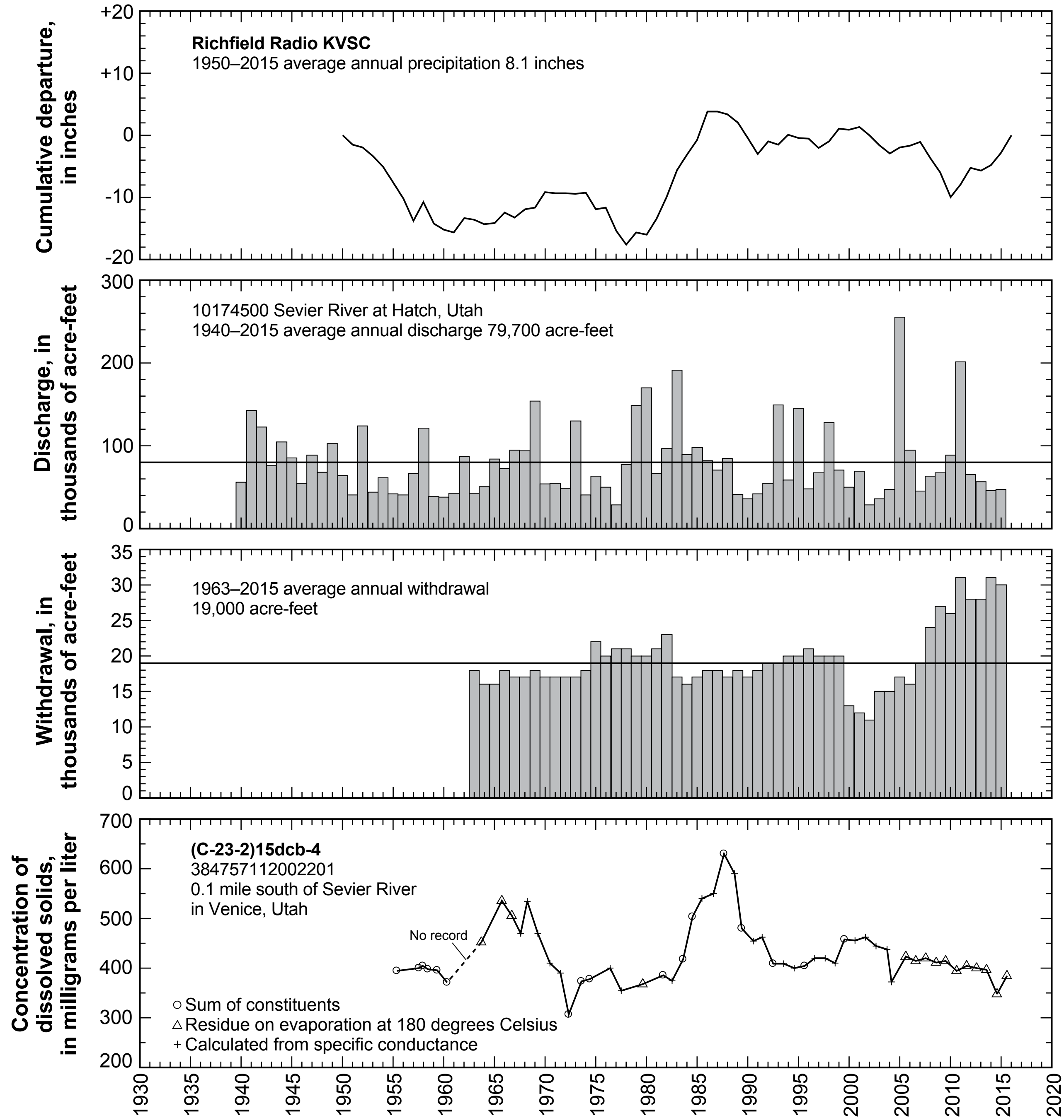

Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

Pahvant Valley

By Nickolas R. Whittier

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. 22). The area of the valley is about 300 square miles. Groundwater drains west to the valley from the mountainous terrain to the east. Groundwater occurs in basin-fill deposits and basalt in the valley under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Pahvant Valley in 2015 was about 128,000 acre-feet, which is about 10,000 acre-feet more than was reported in 2014 and 30,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3). Withdrawal for irrigation in 2015 was about 127,000 acre-feet, which is 10,000 acre-feet more than was reported in 2014.

The location of wells in Pahvant Valley in which the water level was measured during March 2016 is shown in figure 22. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 23.

Precipitation at Fillmore during 2015 was about 12.0 inches, which is about 3.2 inches less than the average annual precipitation for 1930–2015 and about 4.9 inches less than in 2014.

Water levels declined from March 2015 to March 2016 in all parts of Pahvant Valley for which data are available. Water-level declines of more than 8 feet occurred in several wells north of Flowell. These declines are probably the result of continued large localized 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 rose substantially from 1982 to 1985 as a result of greater-than-average precipitation and decreased withdrawals for irrigation. Water levels generally have declined steeply throughout the valley since the mid- to late 1980s.

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 1954 to 1958 and 1960 to 2015, respectively, and from well (C-23-6)8abd-1, located in the Kanosh area, from 1957 to 2015, is shown in figure 23. 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 these wells have ranged from 707 to 1,080 mg/L. The concentration of dissolved solids in the water sample collected in June 2015 was 1,030 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. The concentration of dissolved solids in the water sample collected from this well in June 2015 was 5,770 mg/L. These increases are probably due to continued large withdrawals for irrigation.

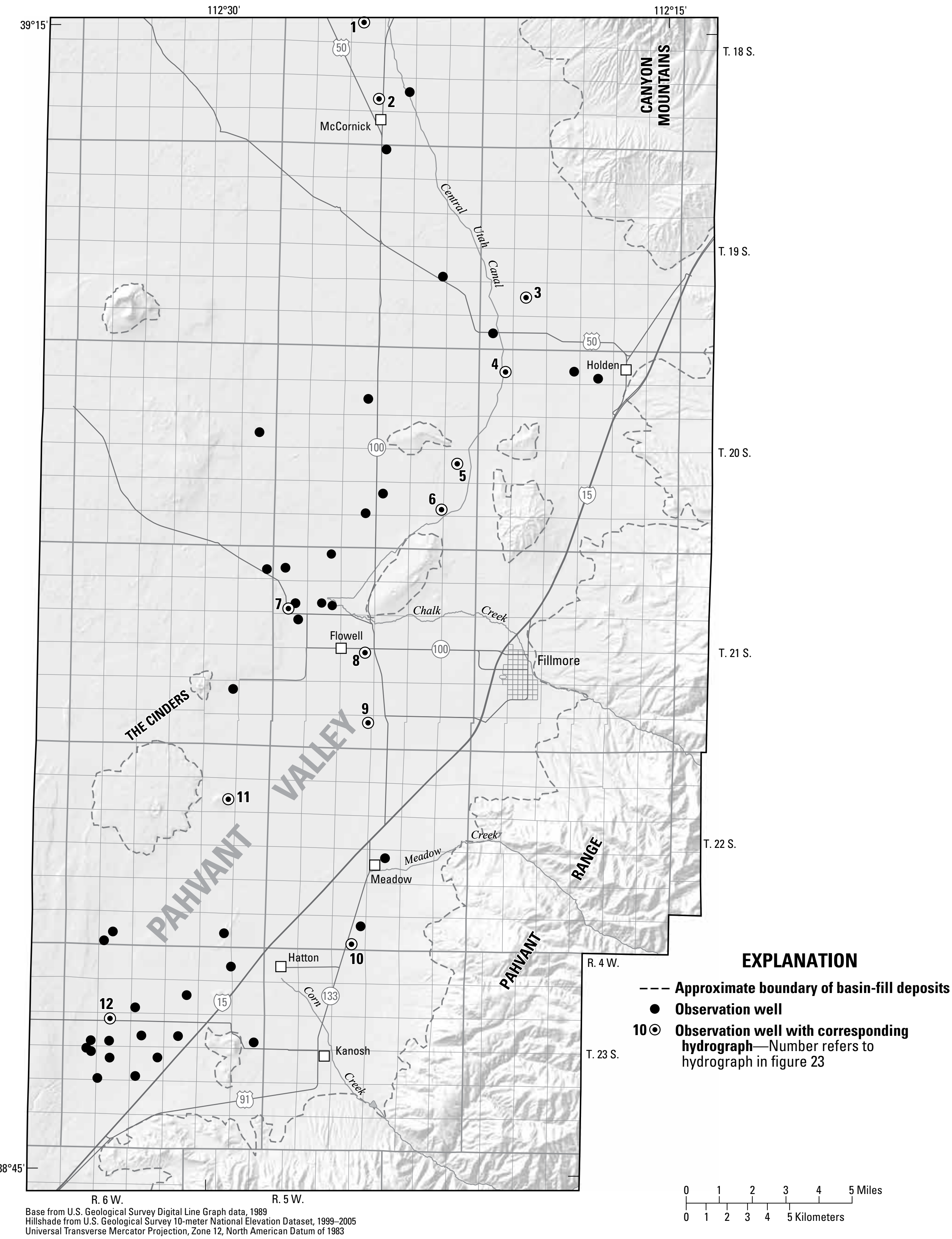

Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 2016.

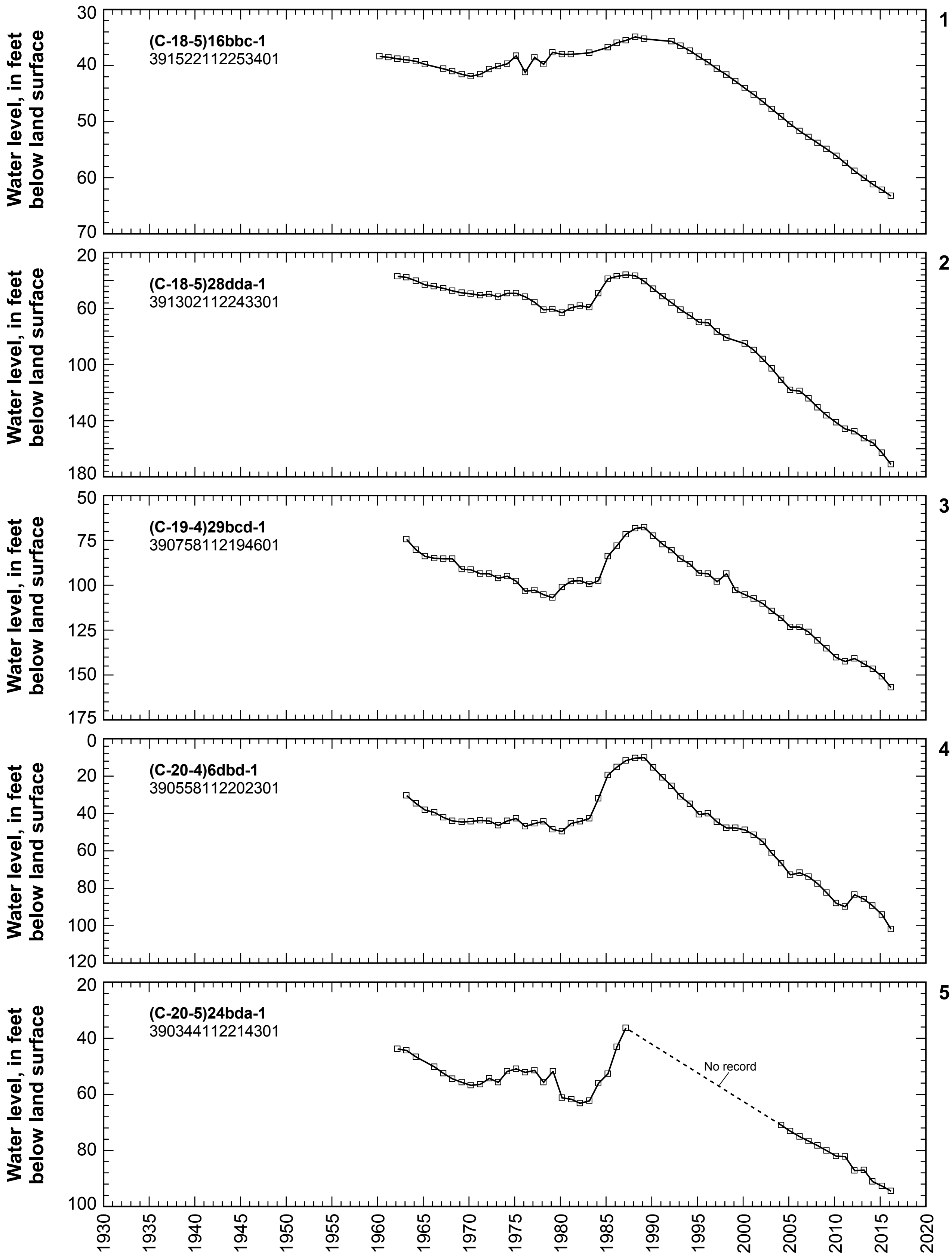

Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

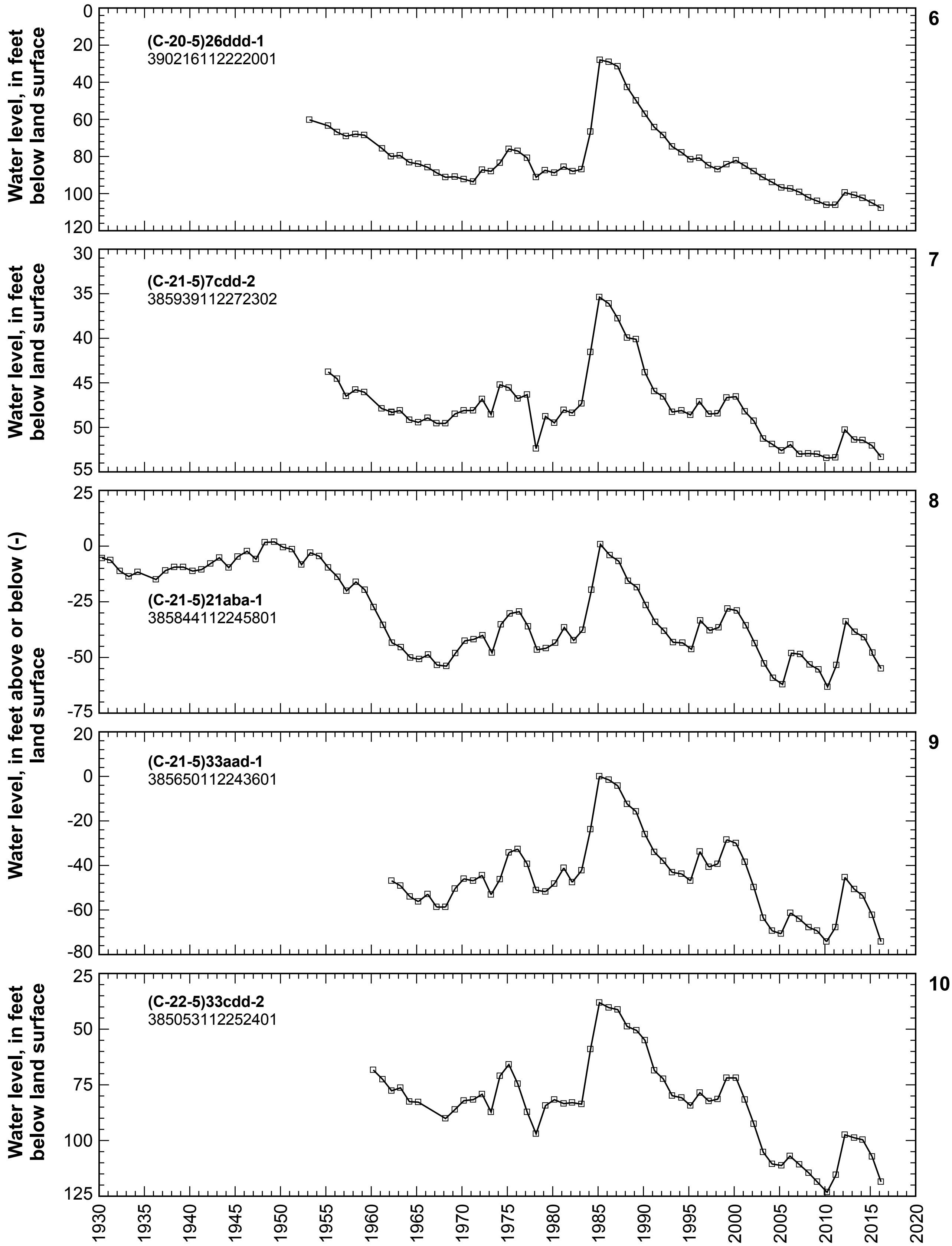

Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

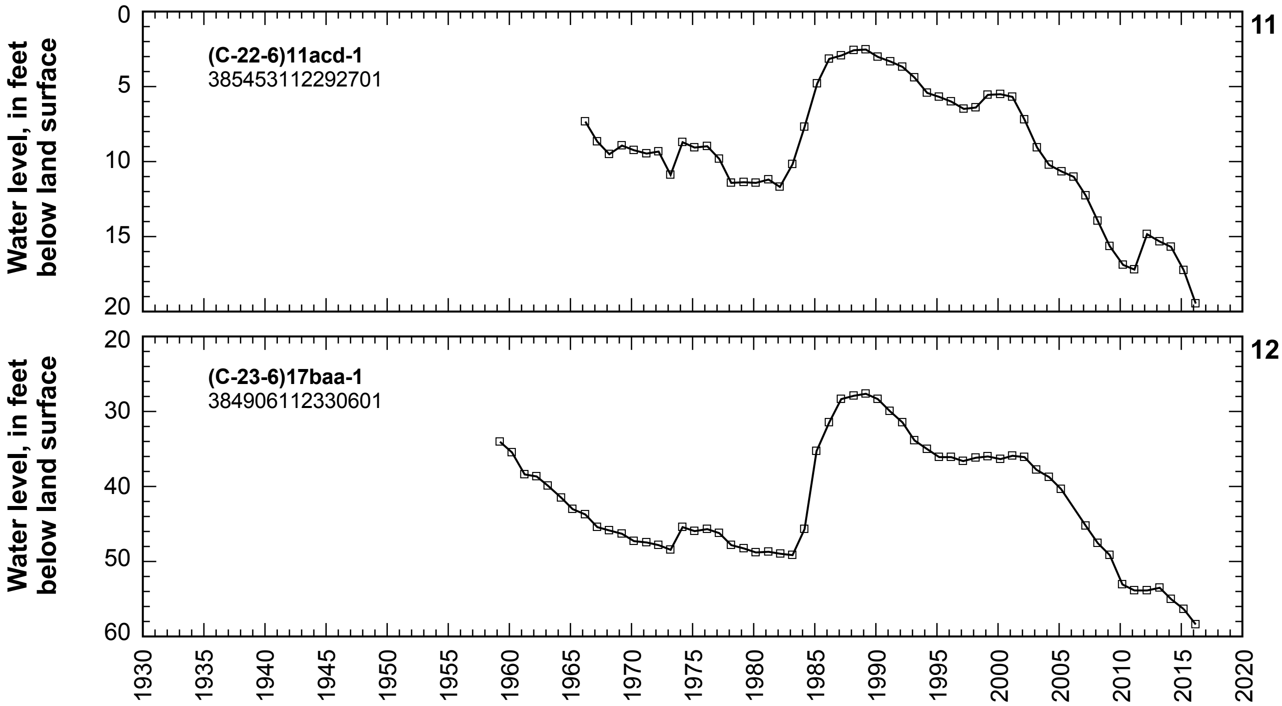

Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

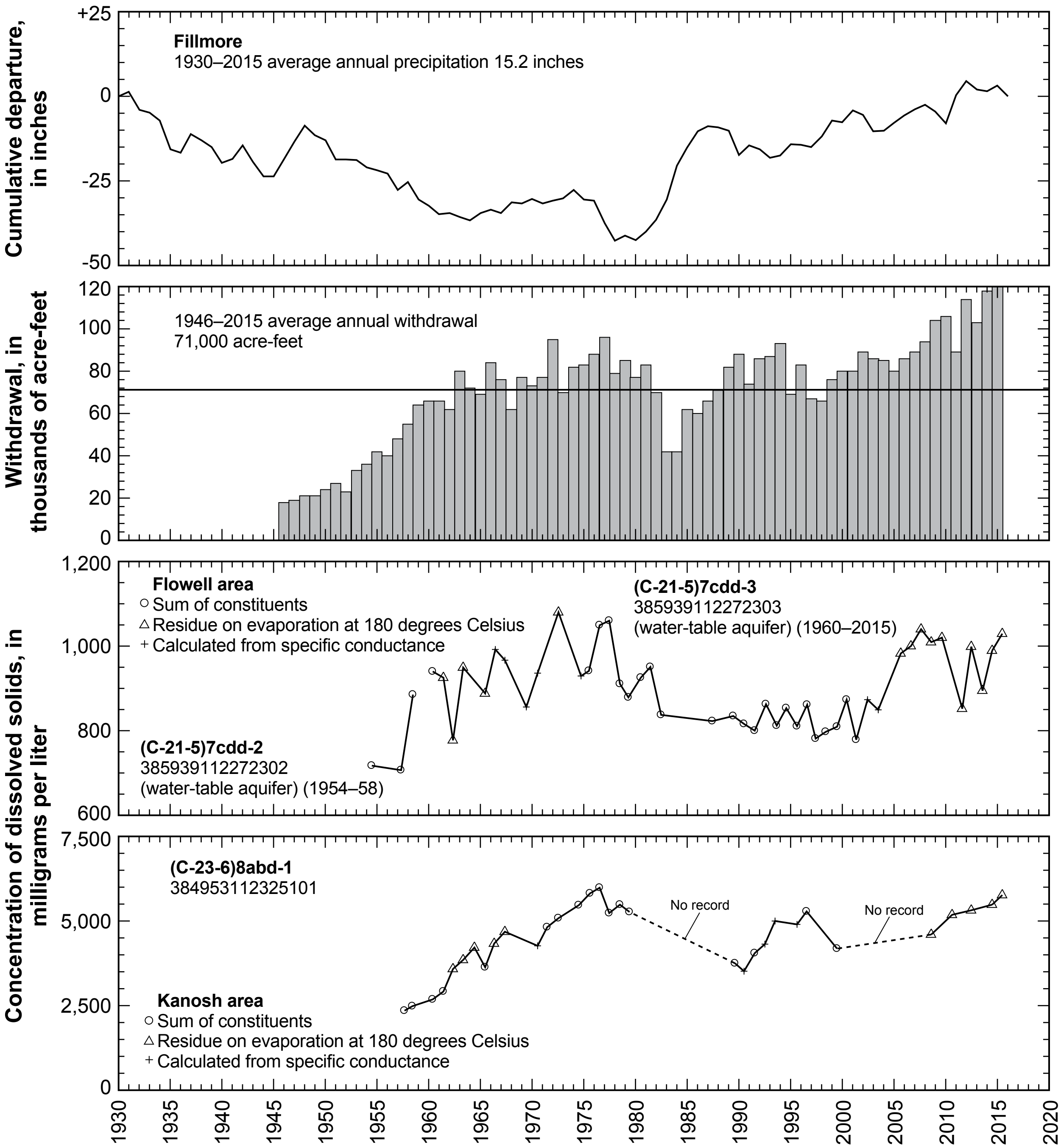

Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cedar Valley, Iron County

By Andrew D. Freel

Cedar Valley is in eastern Iron County, southwestern Utah, and lies along the western edge of the Hurricane Cliffs. 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. 24). 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 2015 was about 40,000 acre-feet, which is 3,000 acre-feet less than in 2014 and 2,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3).

The location of wells in Cedar Valley in which the water level was measured during March 2016 is shown in figure 24. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 25.

Precipitation at Cedar City Federal Aviation Administration Airport in 2015 was about 13.4 inches, which is about 3.6 inches more than the total for 2014 and 2.5 inches more than the average annual precipitation for 1949–2015. Discharge of Coal Creek was about 15,400 acre-feet in 2015, which is 3,600 acre-feet more than in 2014, and 8,900 acre-feet less than the average annual discharge for 1936 and 1939–2015.

Groundwater levels declined from March 2015 to March 2016 in most parts of Cedar Valley. The largest decline, nearly 11 feet, was measured in a well near the Cedar City Airport. Water-level declines probably resulted from locally increased withdrawals.

The concentration of dissolved solids in water samples collected from well (C-37-12)23abd-1, located about 2.0 miles northeast of Kanarraville, from 1991 to 2015, and well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, from 1977 to 2015, is shown in figure 25. The dissolved-solids concentrations in water from both wells have generally increased, probably due to localized pumpage for irrigation.

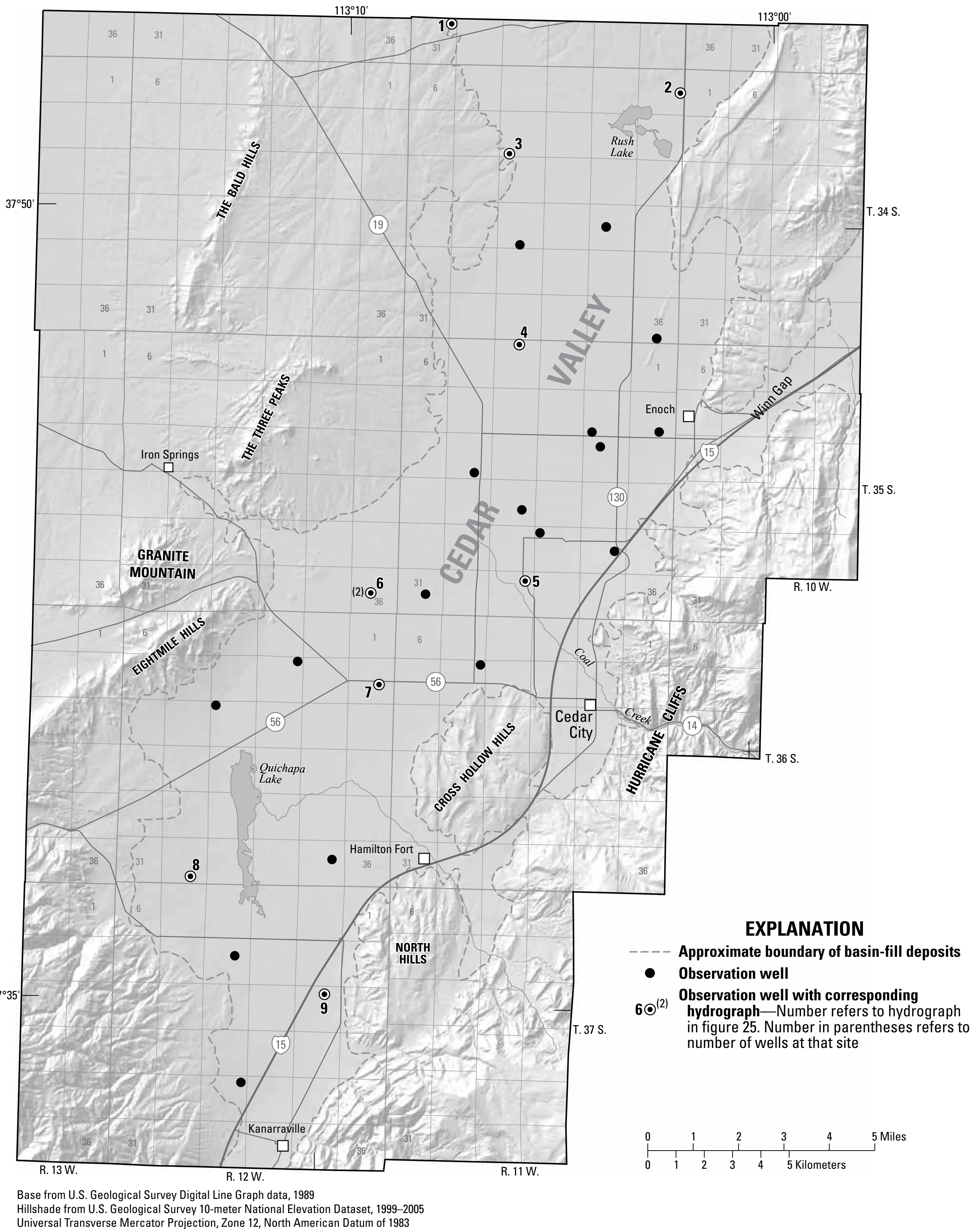

Figure 24. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2016.

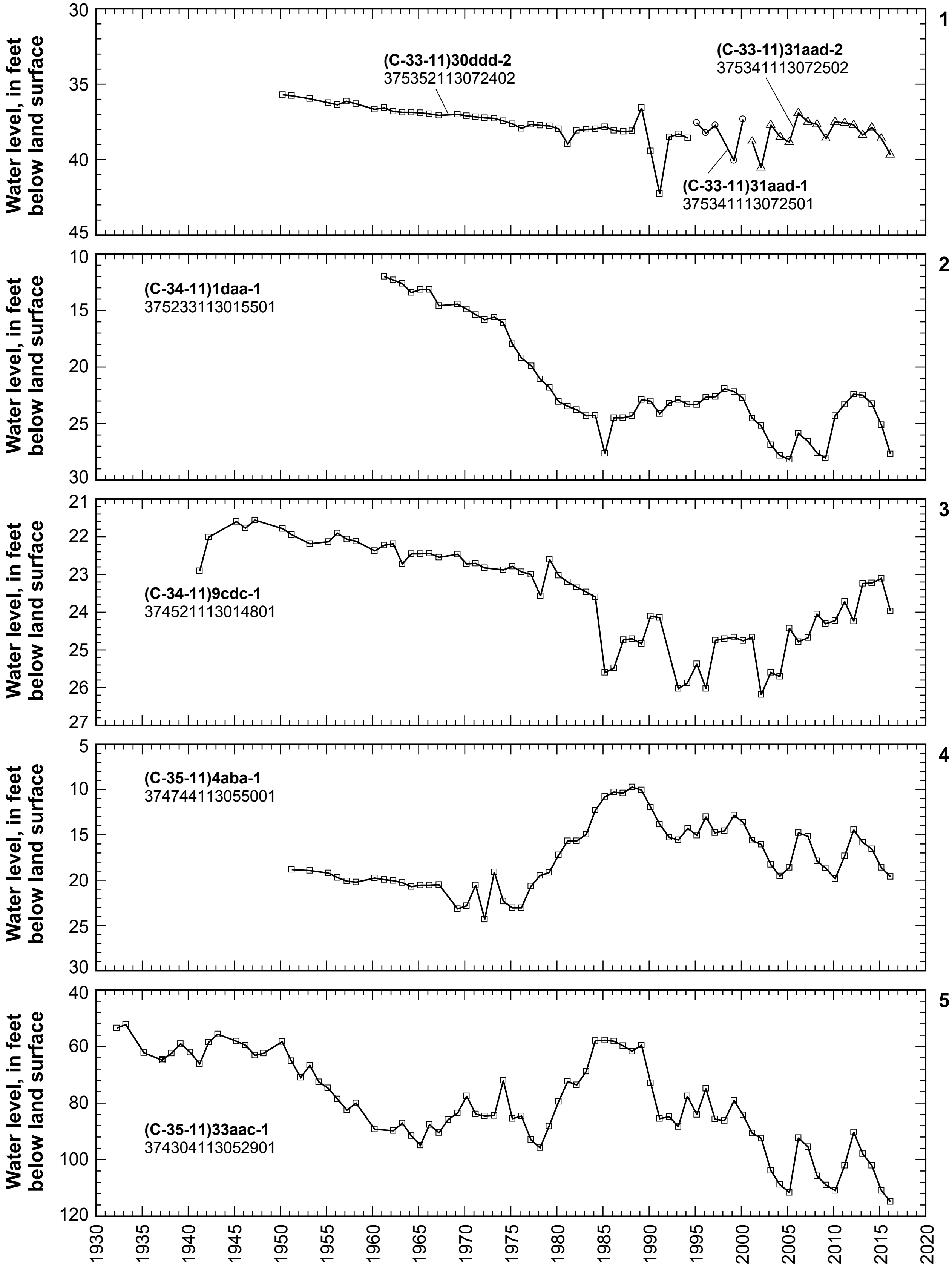

Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

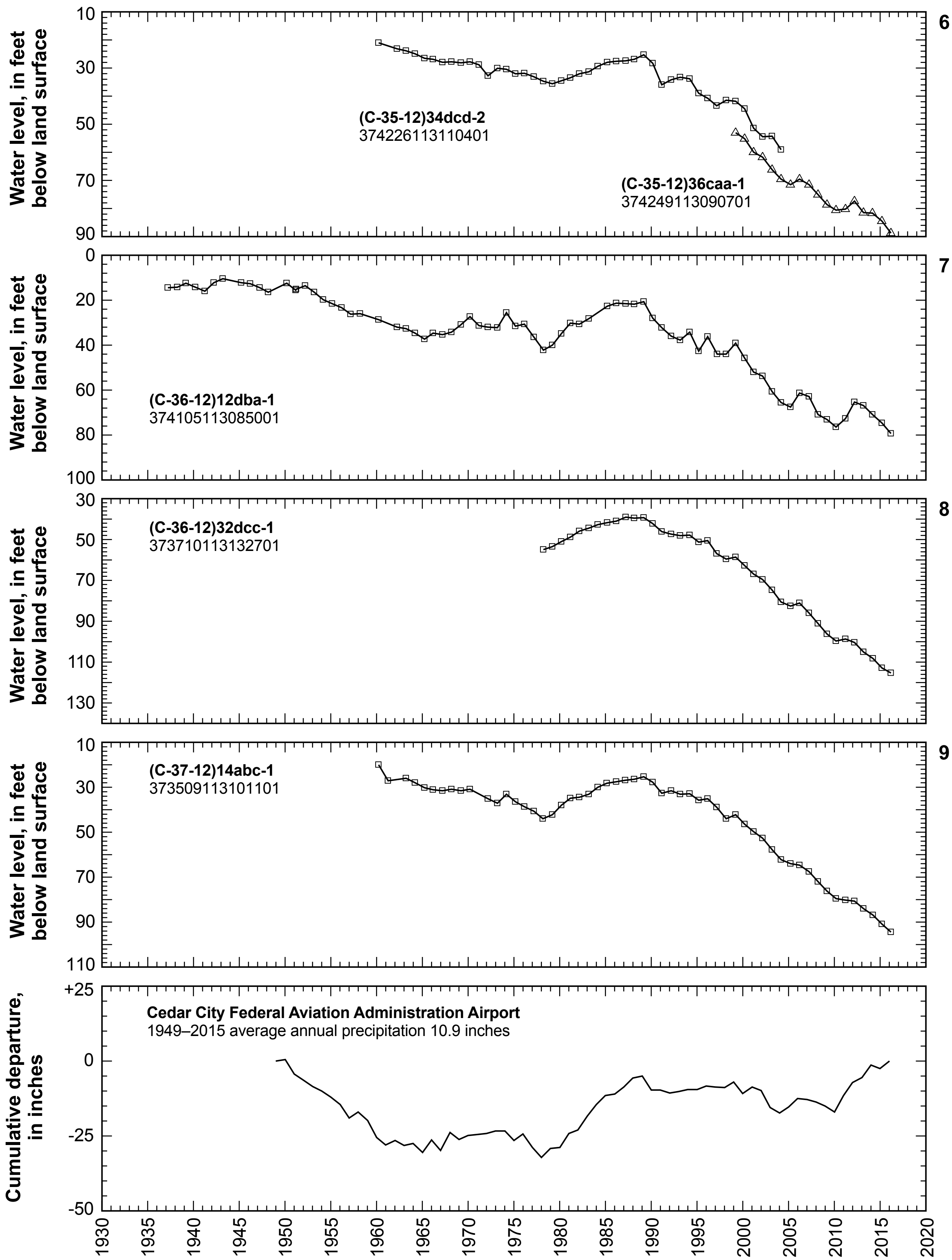

Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

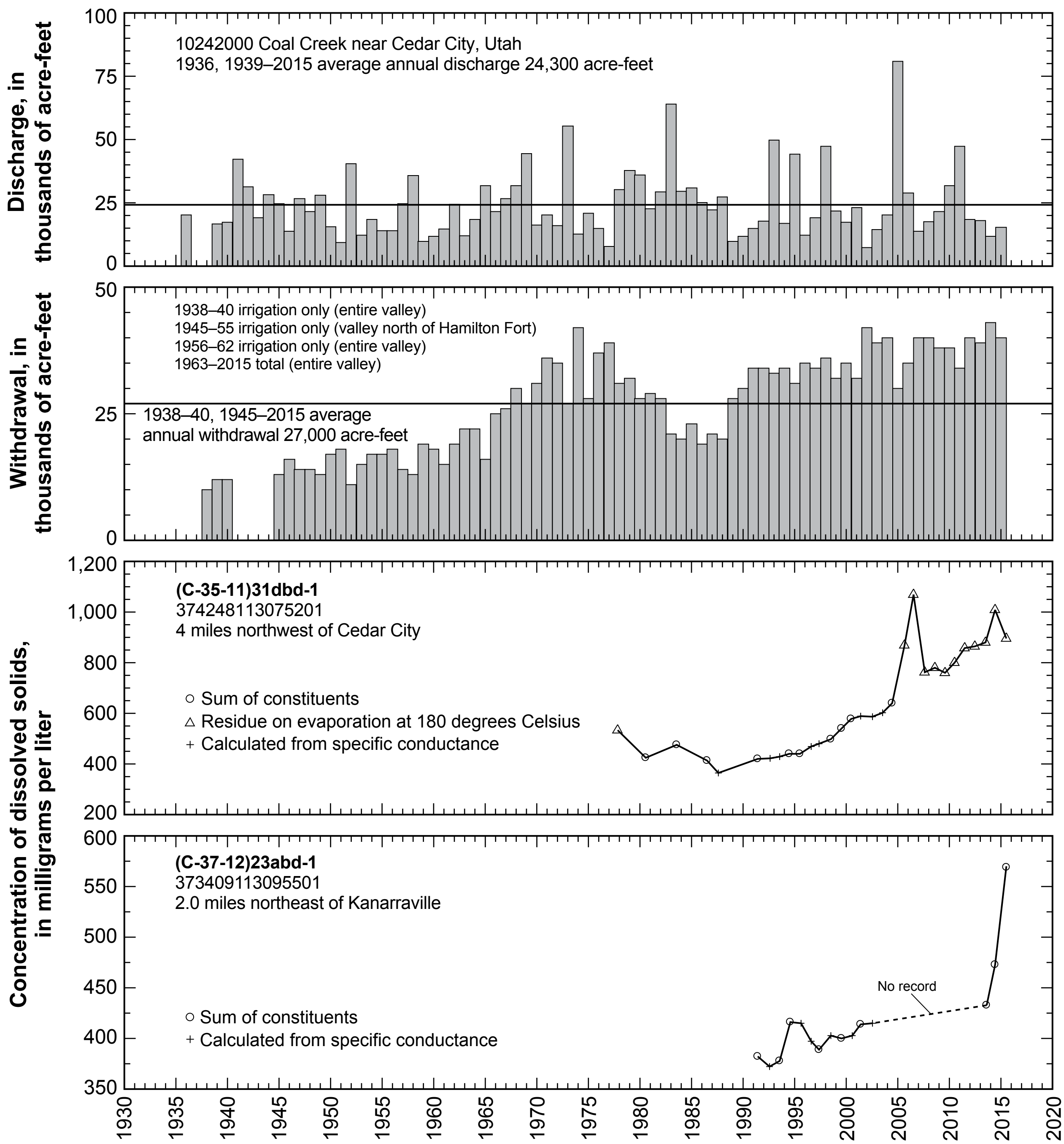

Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

Parowan Valley

By Andrew D. Freel

Parowan Valley is in northern Iron County, southwestern Utah. The valley covers about 160 square miles west of the Hurricane Cliffs and east of Black Mountain, and includes the towns of Paragonah and Parowan (fig. 26). 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 2015 was about 34,000 acre-feet, which is about 4,000 acre-feet less than was reported for 2014 and the same as the average annual withdrawal for 2005–2014 (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 2016 is shown in figure 26. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 27.

Precipitation at Cedar City Federal Aviation Administration Airport in 2015 was about 13.4 inches, which is about 3.6 inches more than the value for 2014 and 2.5 inches more than the average annual precipitation for 1949–2015.

Water levels declined from March 2015 to March 2016 in all parts of Parowan Valley for which data are available. The largest decline, more than 3 feet, was measured in a well northwest of Parowan. Water levels in Parowan Valley generally have declined since 1950. Some rises occurred during 1973–74, 1983–85, 1996–99, 2006, and 2012. Declines in water levels are probably the result of continued large local withdrawals for irrigation.

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 2015, is shown in figure 27. The water sample collected in July 2015 had a dissolved-solids concentration of 349 mg/L. With the exception of relatively high dissolved-solids concentrations in water samples collected in 1970, 1973, and 1974, concentrations have varied little.

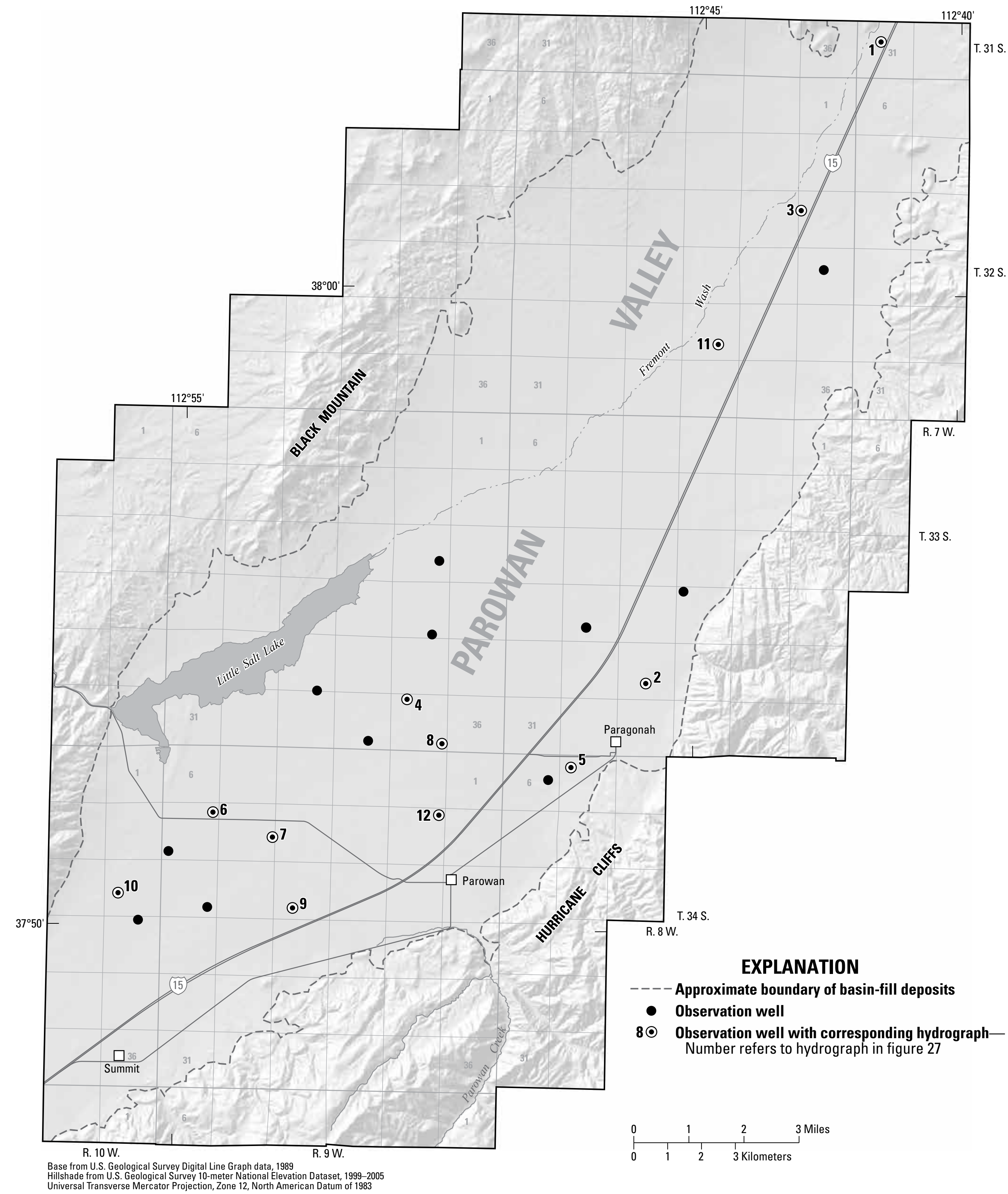

Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 2016.

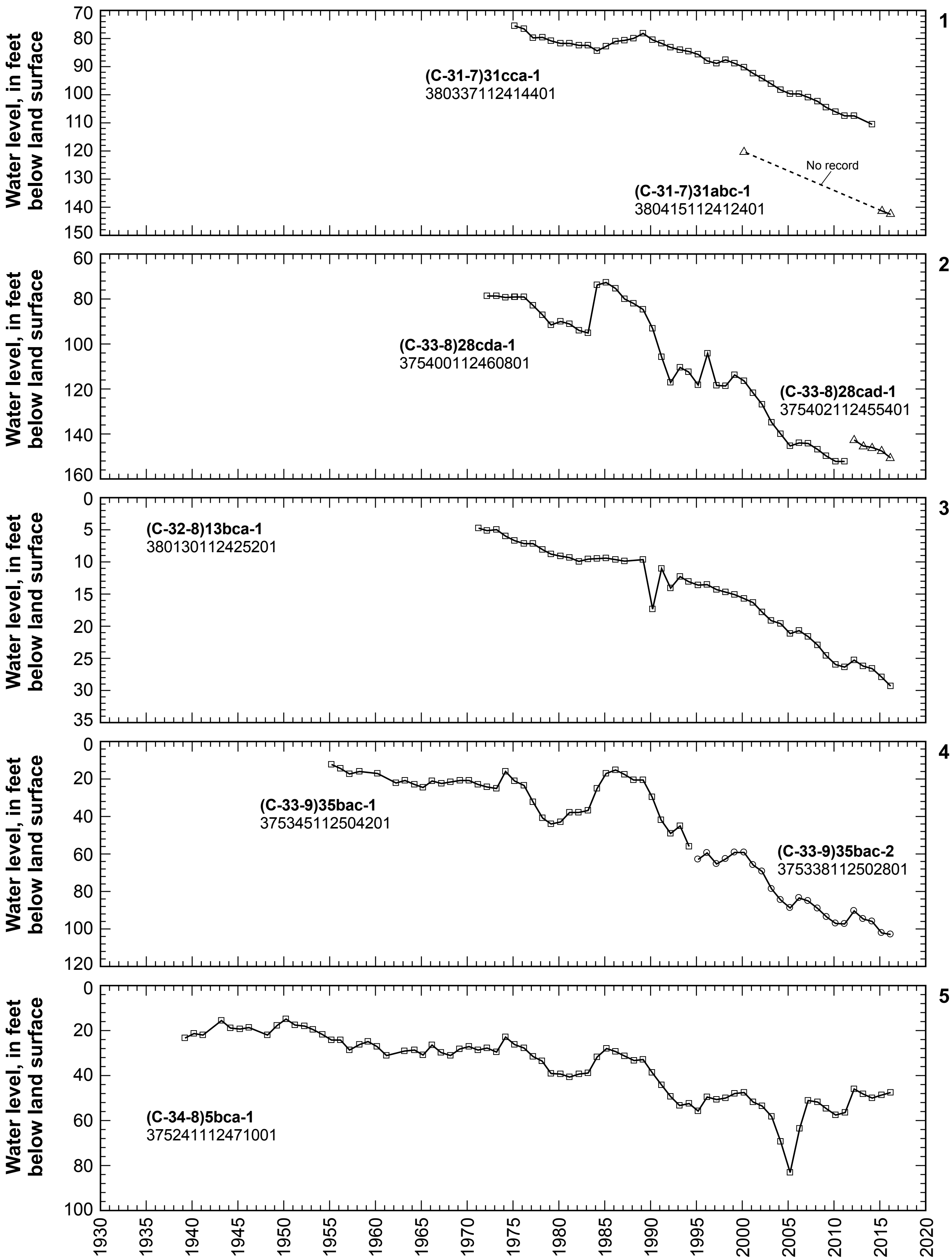

Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

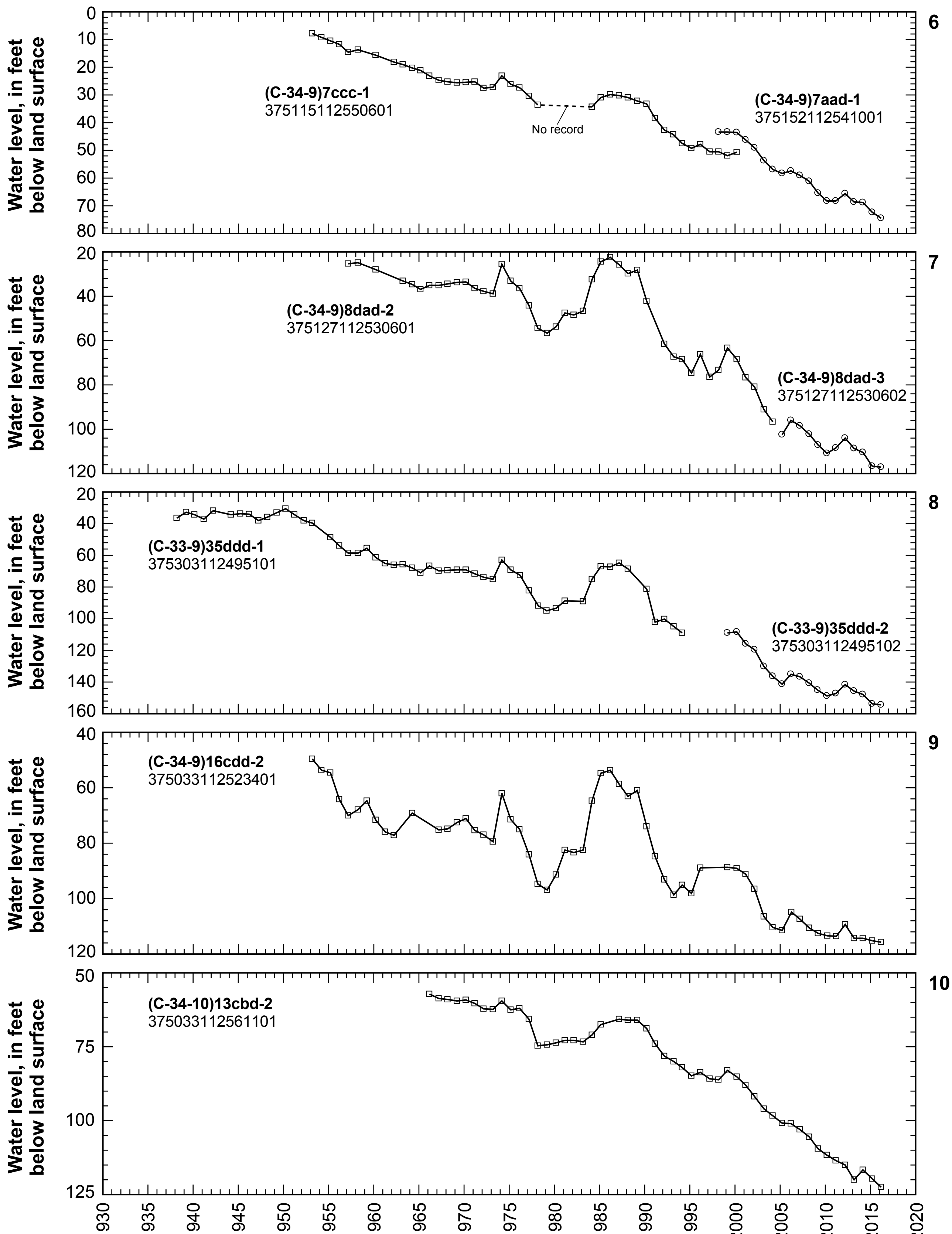

Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

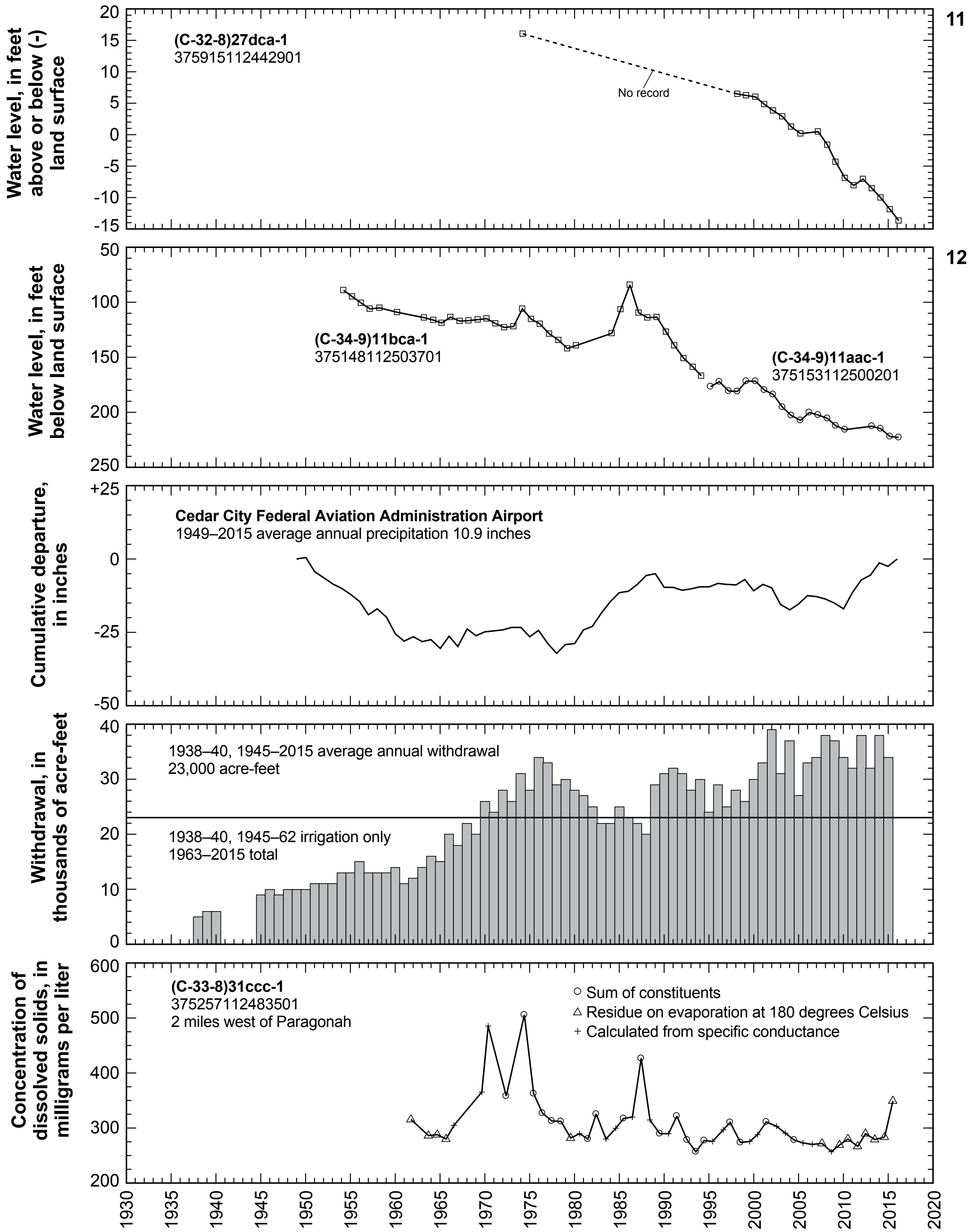

Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

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 and east of the San Francisco Mountains, the southern part of Millard County, and a small area in the northern part of Iron County (fig. 28). 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 2015 was about 68,000 acre-feet, which is 1,000 acre-feet more than was reported for 2014 and 12,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3).

The location of wells in the Milford area in which the water level was measured during March 2016 is shown in figure 28. 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 29. Precipitation at Black Rock in 2015 was about 8.2 inches, about 2.7 inches less than in 2014 and about 0.8 inch less than the 1952–2015 average annual precipitation.

Water levels declined from March 2015 to March 2016 in most of 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 early 1950s, 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, greatly reduced withdrawals, and increased recharge to the basin-fill aquifer from record flow in the Beaver River during 1983–84.

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 2015, is shown in figure 29. The dissolved-solids concentration in the July 2015 sample was 439 mg/L. With the exception of a relatively high dissolved-solids concentration in the water sample collected in 2001 (909 mg/L), concentrations have varied little.

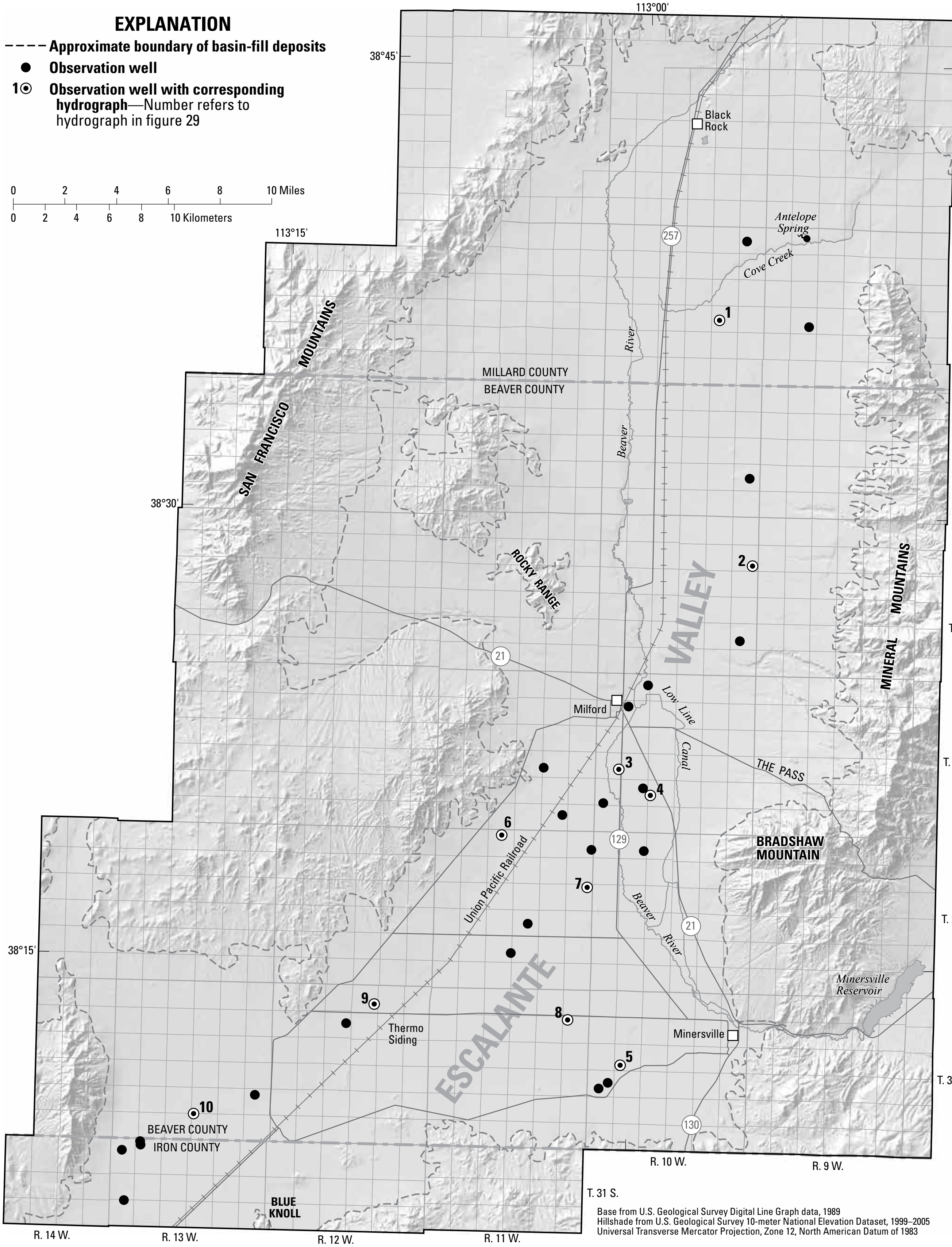

Figure 28. Location of wells in the Milford area in which the water level was measured during March 2016.

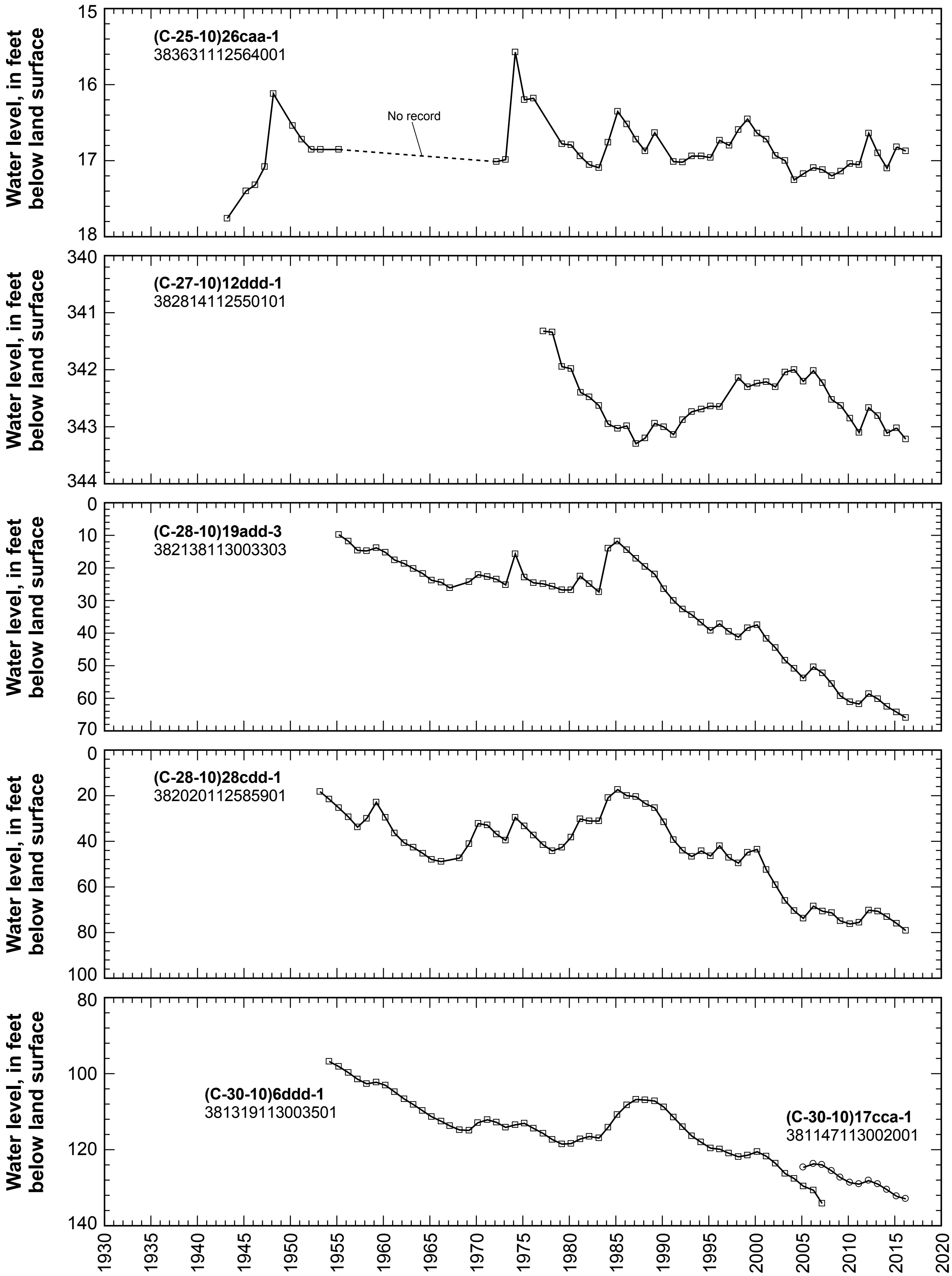

Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.

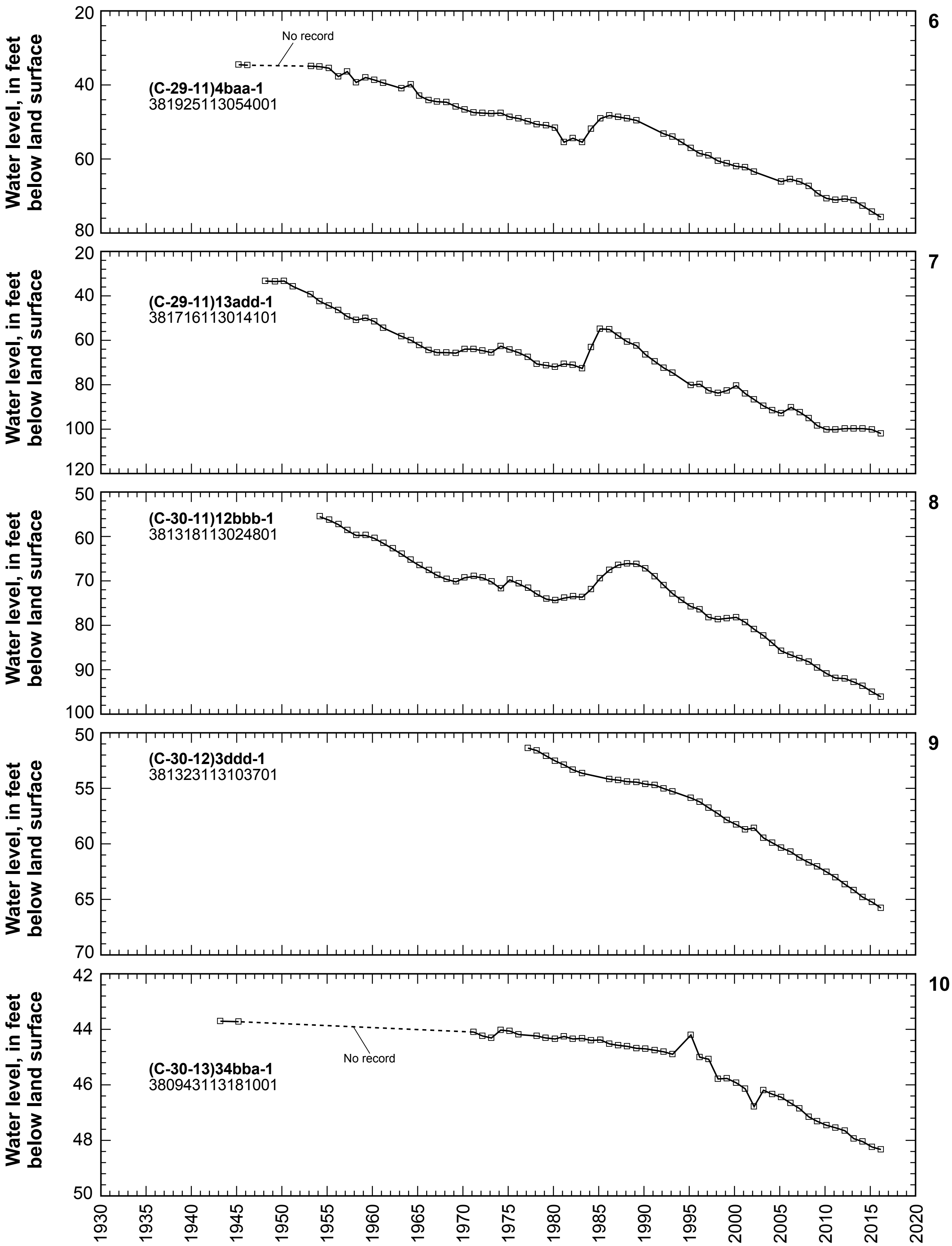

Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

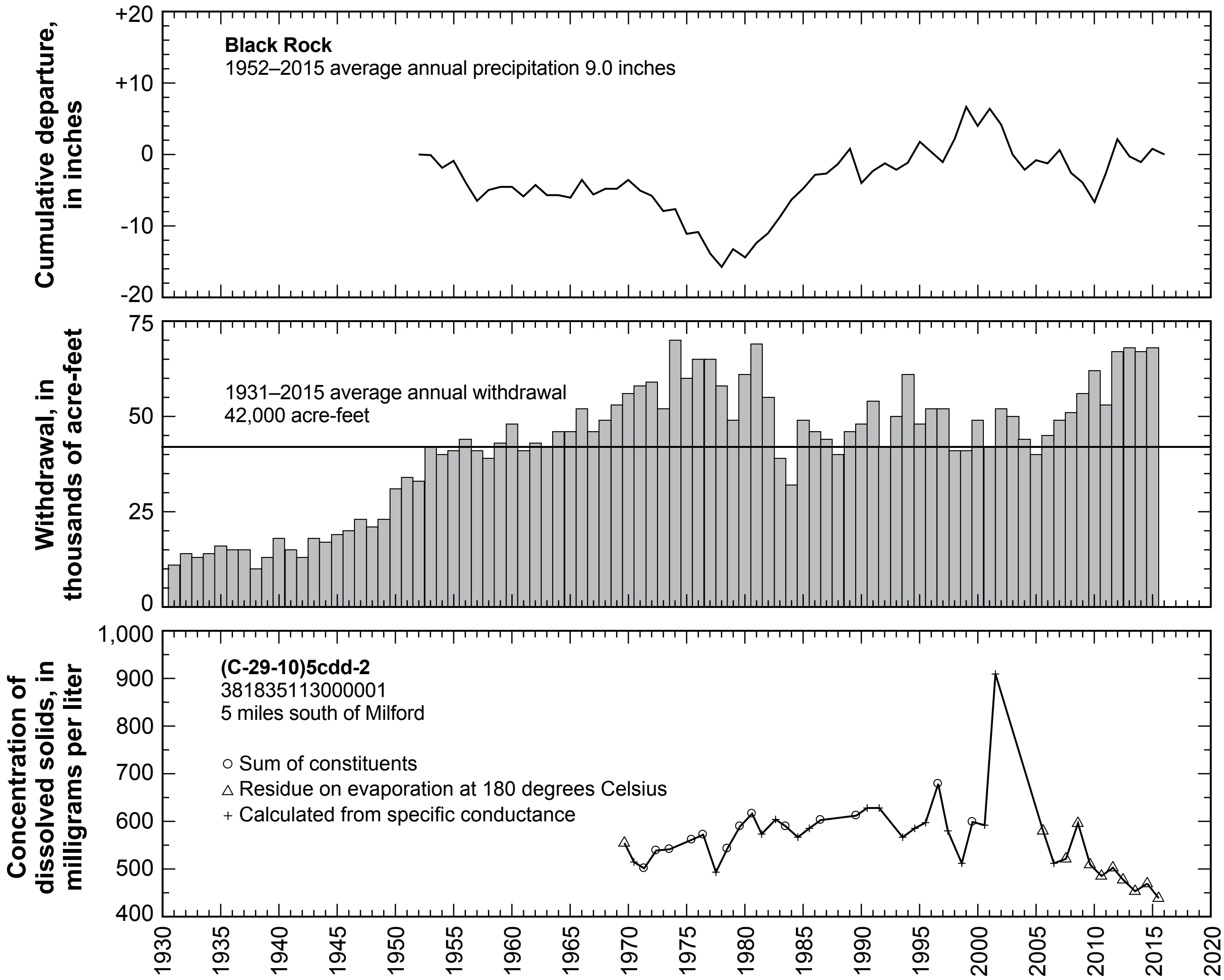

Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

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. 30). Groundwater occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 2015 was about 93,000 acre-feet, which is 10,000 acre-feet less than in 2014 and 4,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3).

The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2016 is shown in figure 30. 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-3 is shown in figure 31.

Precipitation at Enterprise in 2015 was about 13.9 inches, which is about 0.1 inch less than the average annual precipitation for 1955–2015 and about 0.7 inch less than in 2014.

Water levels declined from March 2015 to March 2016 in most of the wells measured in the Beryl-Enterprise area. Water levels throughout most of the area have declined steadily since 1950 and have shown little or no recovery, even during periods of greater-than-average precipitation. For example, water-level measurements in well (C-36-16)29daa-1, about 5 miles northeast of Enterprise, have shown a decline of nearly 142 feet from March 1948 to March 2016 (fig. 31). Declines such as this are a result of continued large withdrawals for irrigation beginning in about 1950.

The concentration of dissolved solids in water samples collected from well (C-34-16)28dcc-3, located 6 miles south-southeast of Beryl, is shown in figure 31. The concentration of dissolved solids in the water sample collected in August 2015 was 549 mg/L.

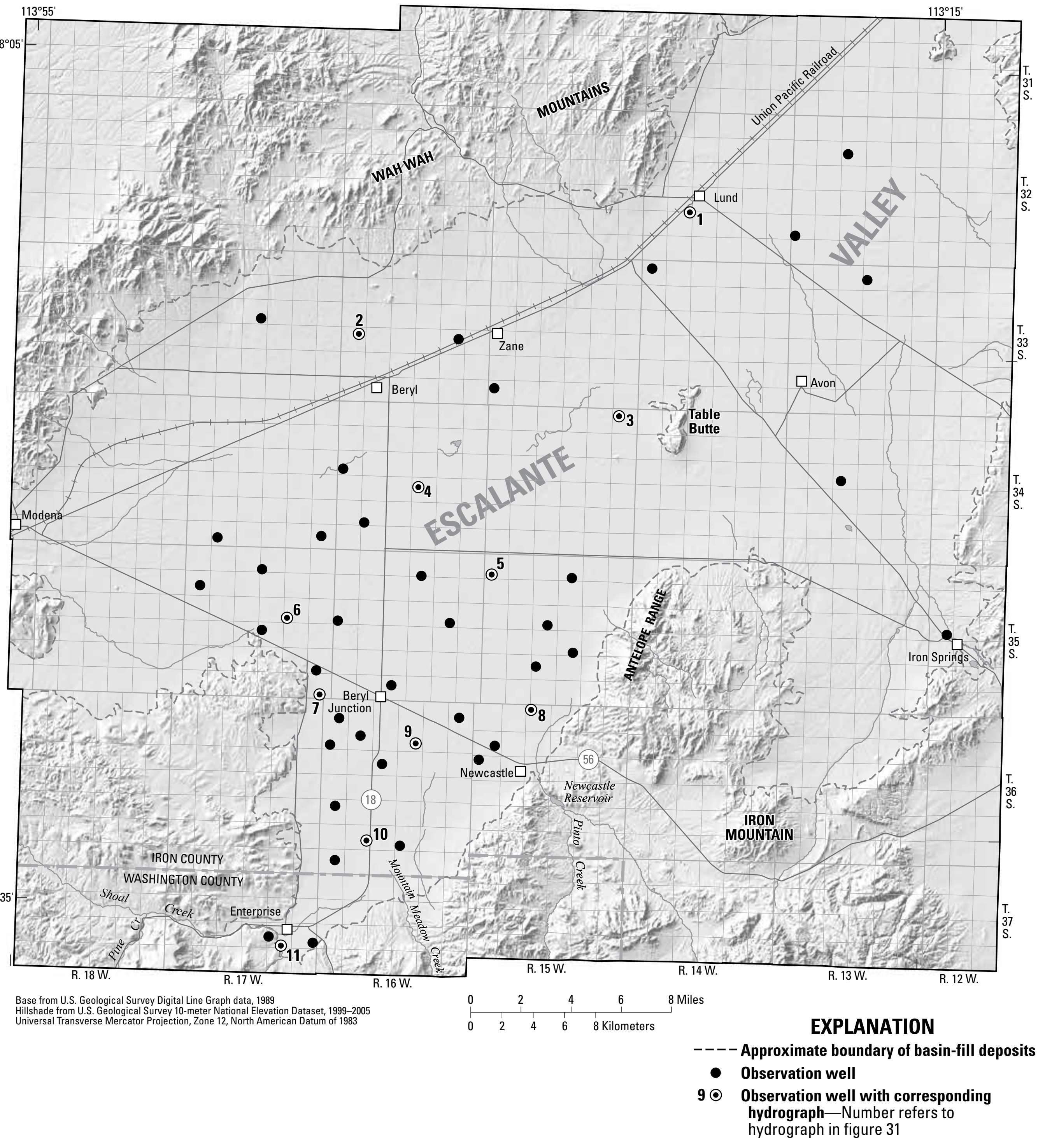

Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2016.

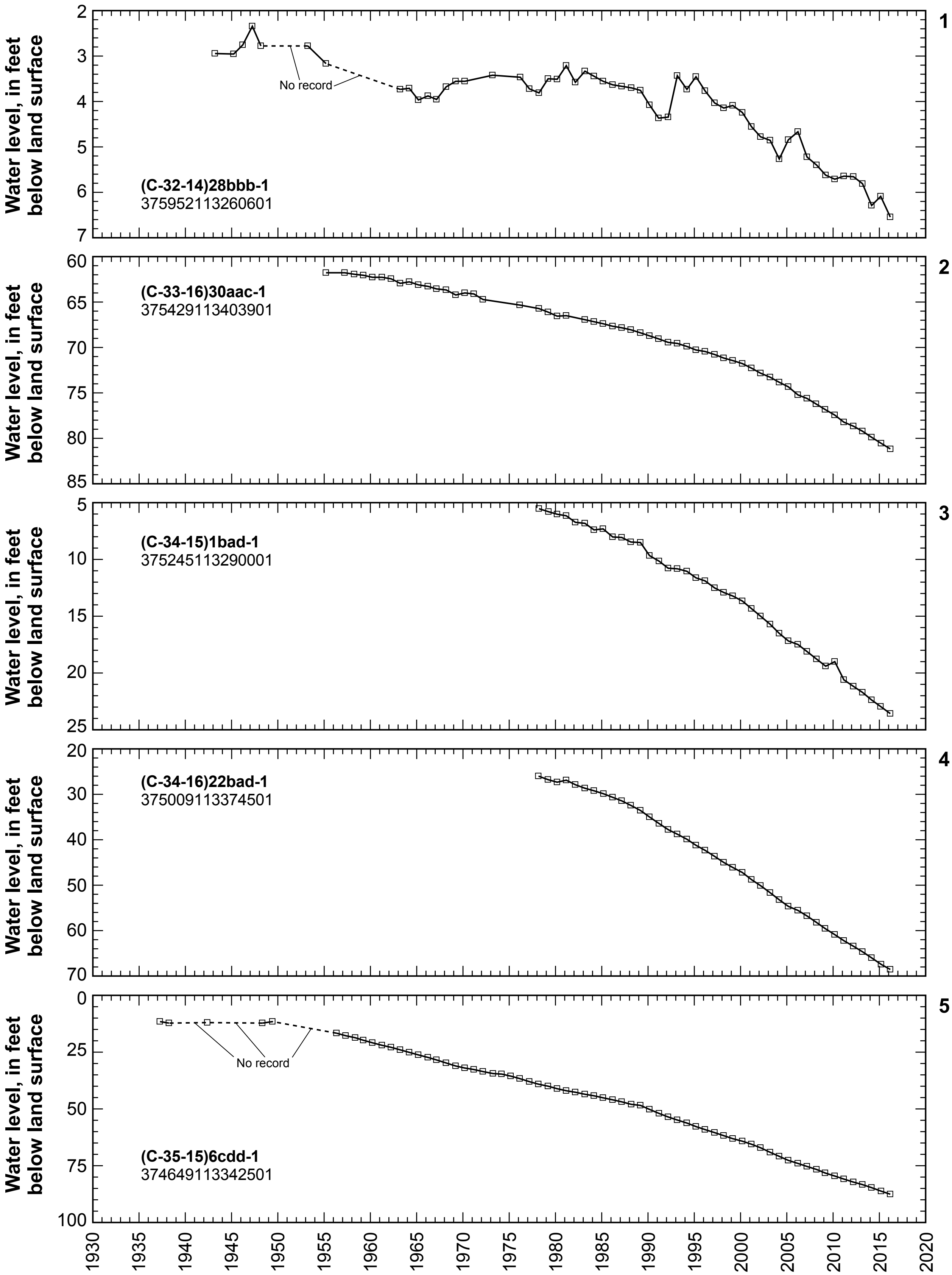

Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.

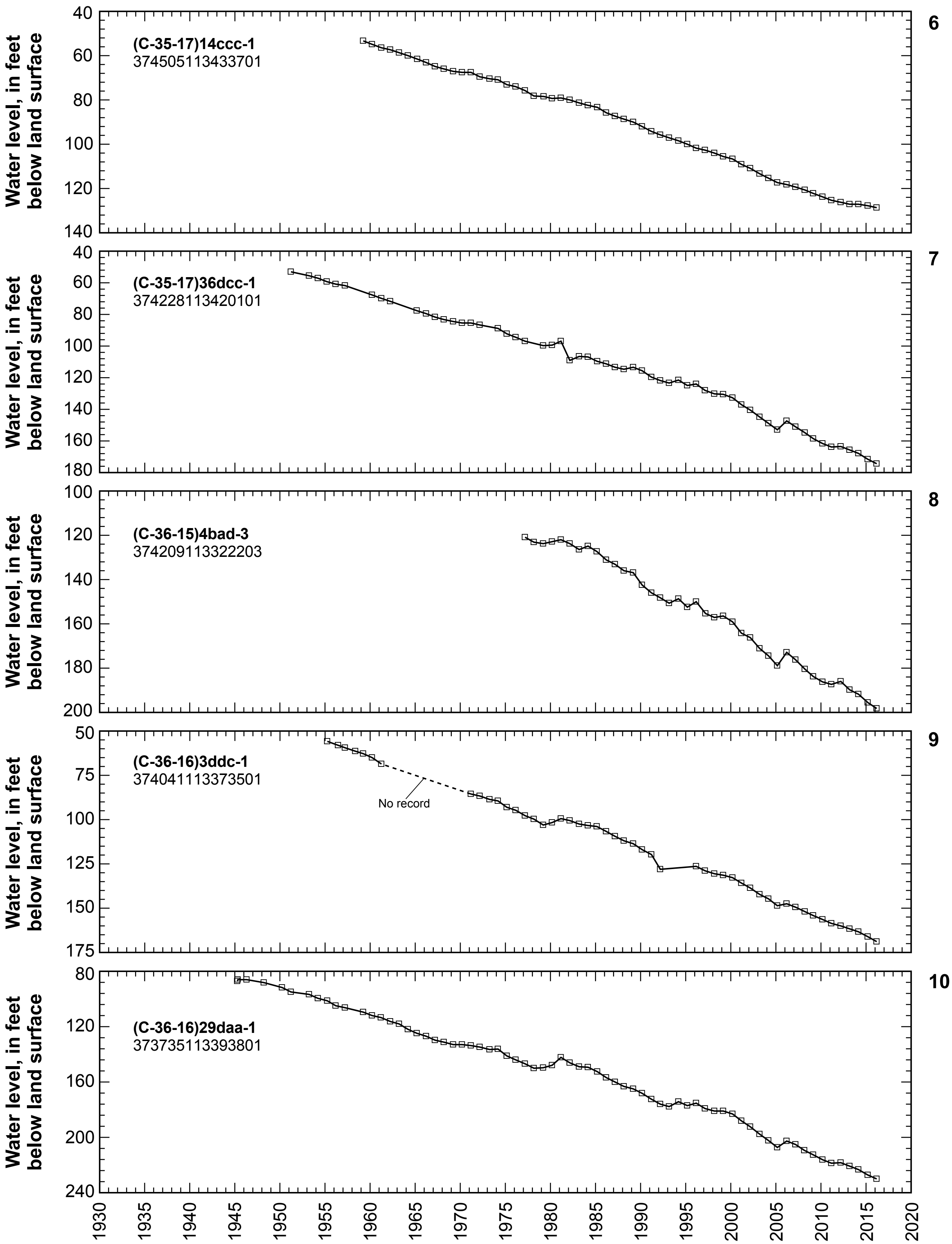

Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.—Continued

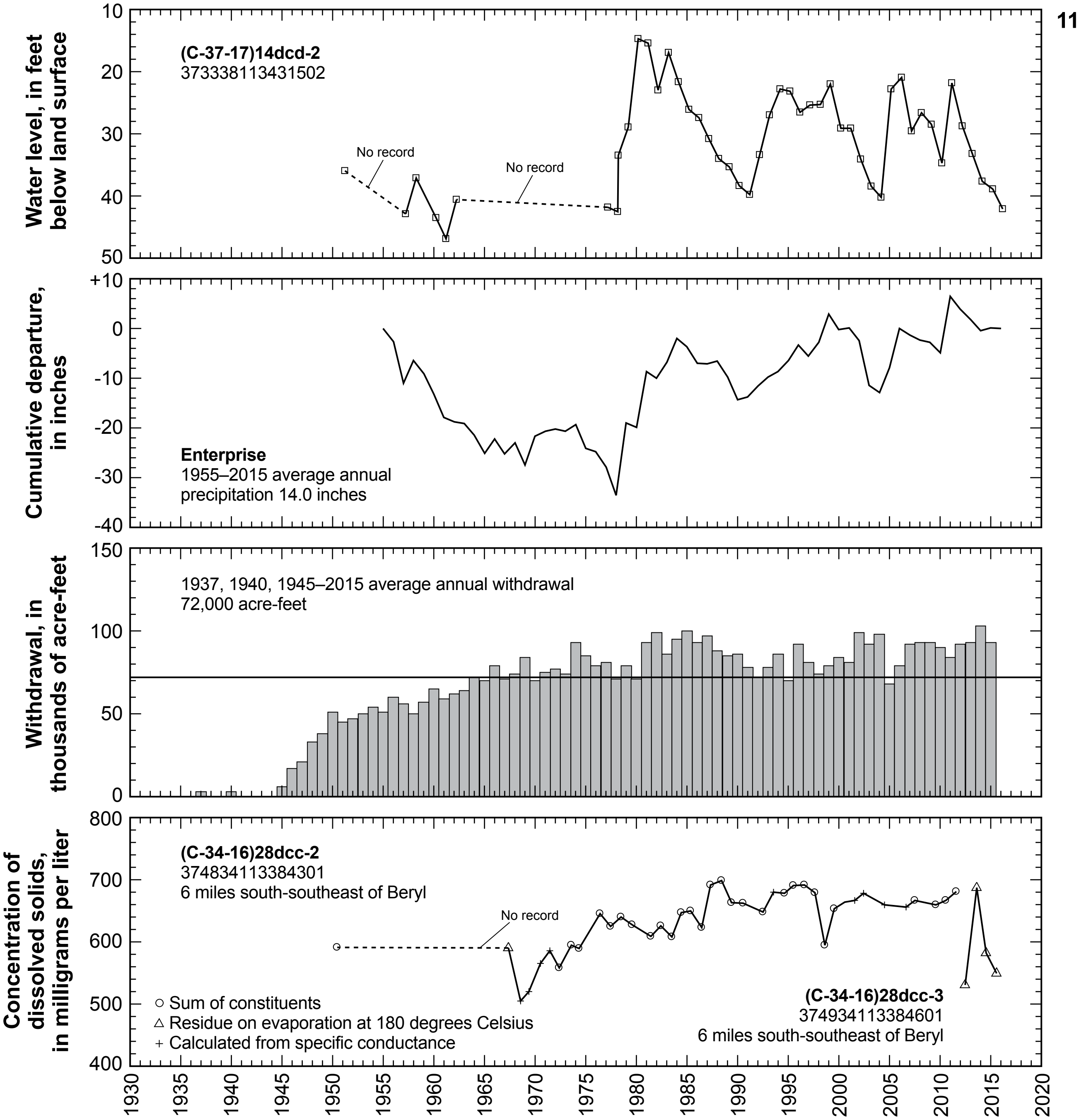

Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.—Continued

Central Virgin River Area

By Howard K. Christiansen

The central Virgin River area extends north from the Arizona border in Washington County and includes the Santa Clara and Virgin River drainages. The region is bounded on the west by the Beaver Dam and Bull Valley Mountains, on the north by the northern flank of the Pine Valley Mountains, and on the east and southeast by the Hurricane Cliffs (fig. 32). Groundwater is withdrawn from valley-fill aquifers and used primarily for irrigation. Water is also withdrawn from consolidated rock and valley-fill aquifers for public-supply use. 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 2015 was about 34,000 acre-feet, which is 3,000 acre-feet more than in 2014 and 4,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3). The increase is mainly due to increased withdrawals for public-supply use.

The location of wells in the central Virgin River area in which the water level was measured during February 2016 is shown in figure 32. The relation of the water level in selected observation wells to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2 is shown in figure 33.

Discharge of the Virgin River at Virgin, Utah, in 2015 was about 80,500 acre-feet, which is 2,100 acre-feet more than the value for 2014 and about 51,400 acre-feet less than the long-term average for 1931–70 and 1979–2015. Precipitation at La Verkin in 2015 was about 12.1 inches, which is about 1.3 inches more than the average annual precipitation for 1951–2015 and 0.5 inch more than in 2014.

Water levels from February 2015 to February 2016 declined, or rose only slightly, in most of the central Virgin River area. The largest decline, about 5 feet, occurred in a well southeast of New Harmony. Declines are probably the result of continued large withdrawals for public-supply and irrigation use.

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 2013, is shown in figure 33. 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 on one graph to give an extended temporal record for this constituent. This well was not sampled in 2015.

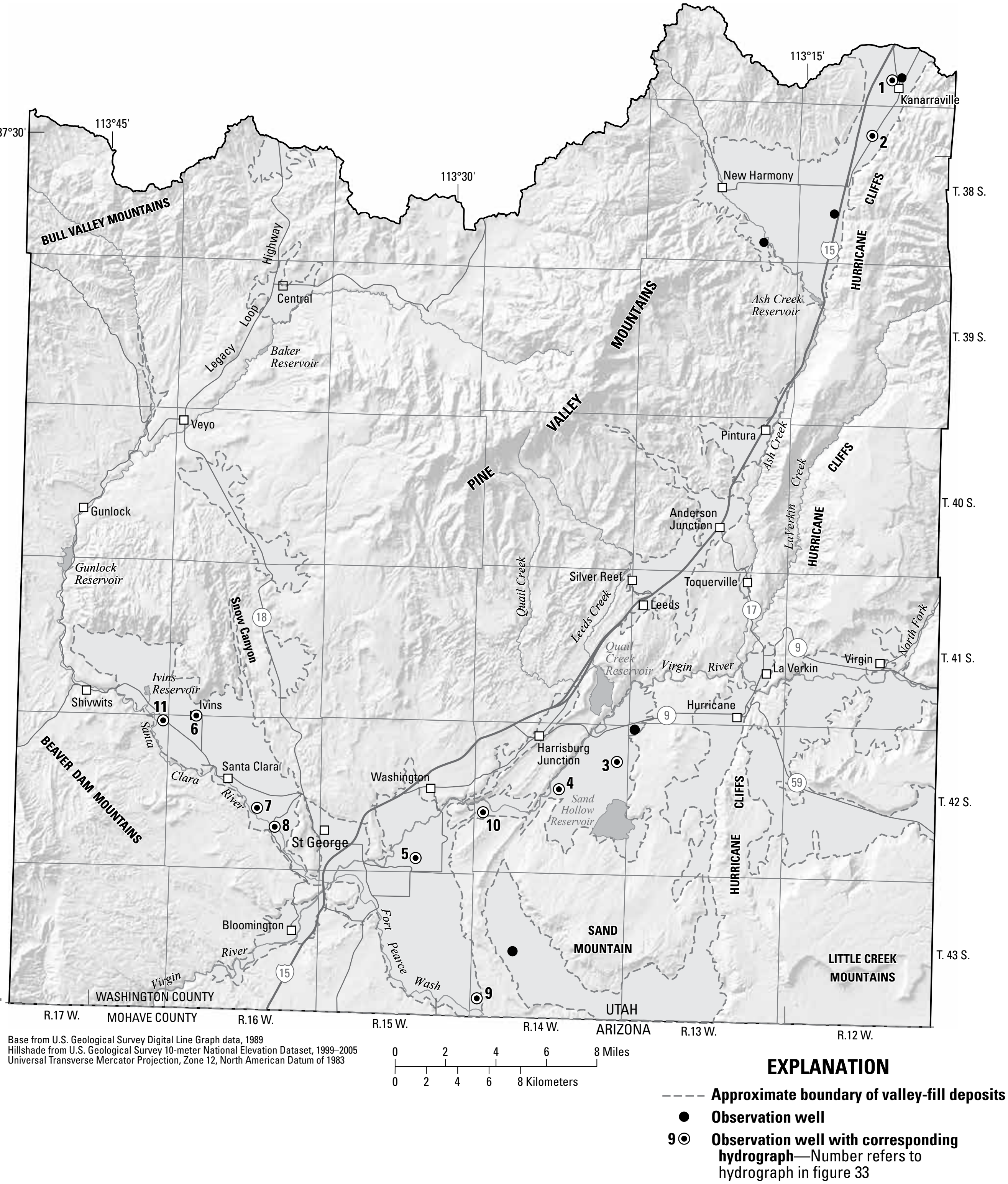

Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 2016.

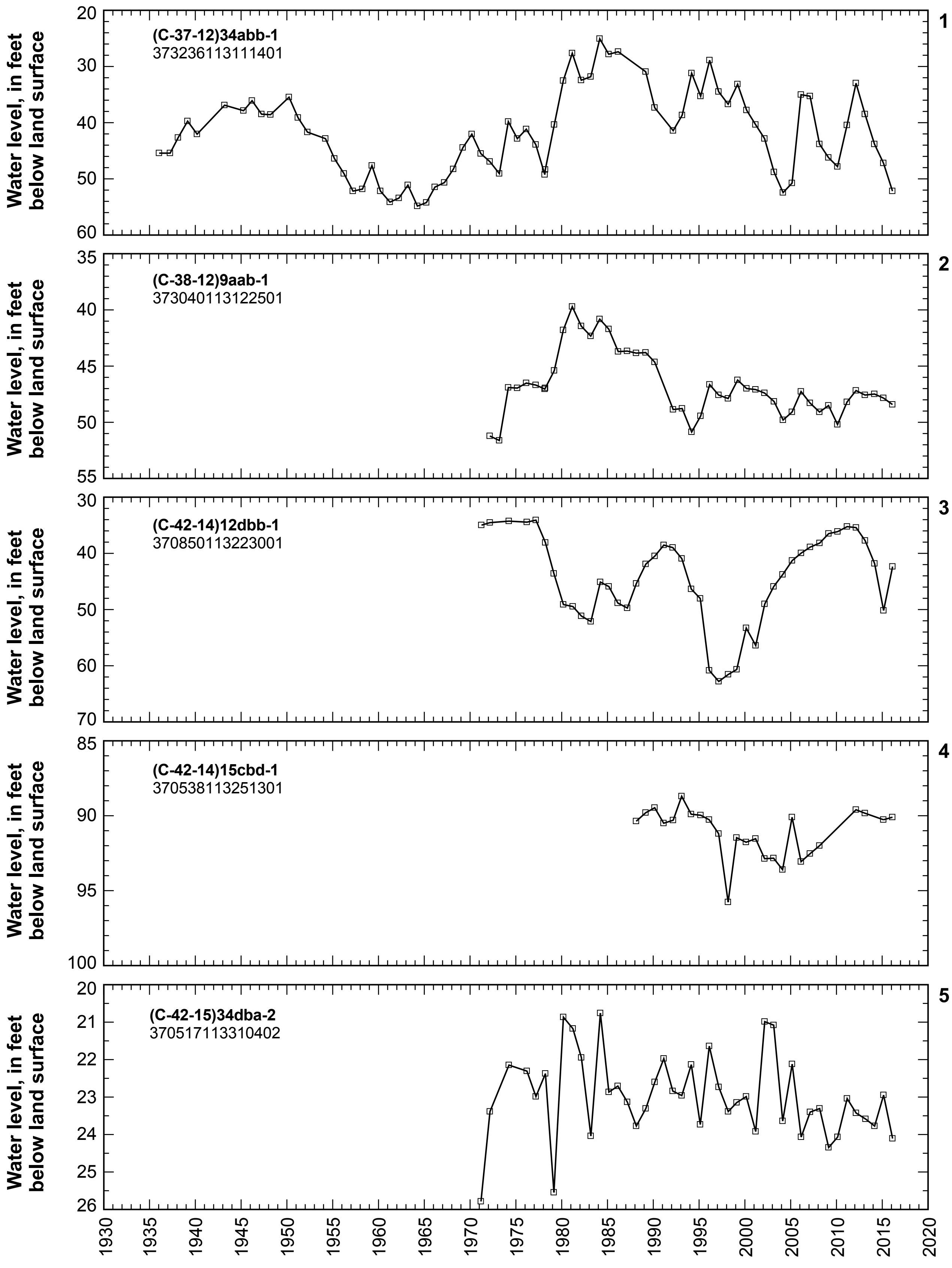

Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

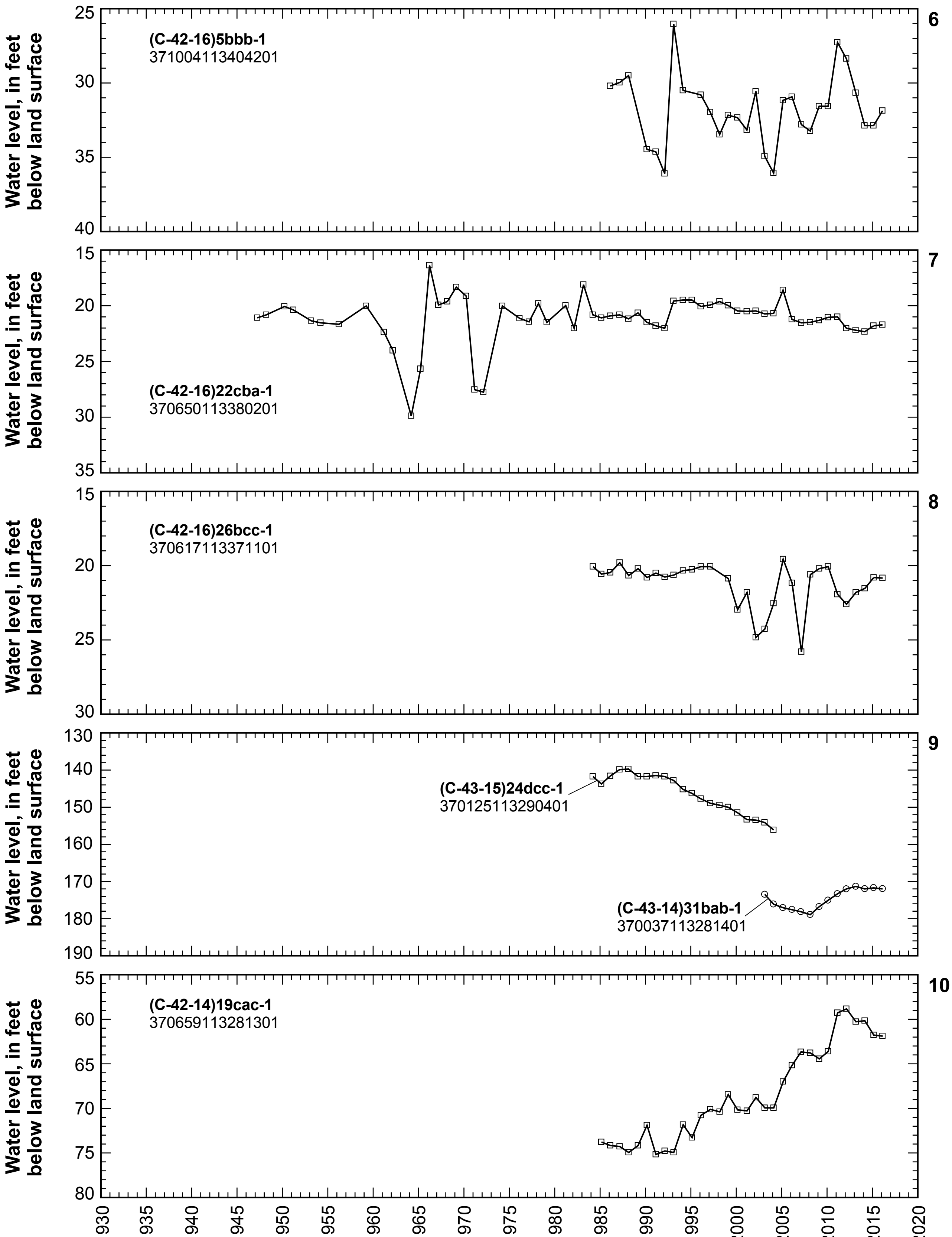

Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

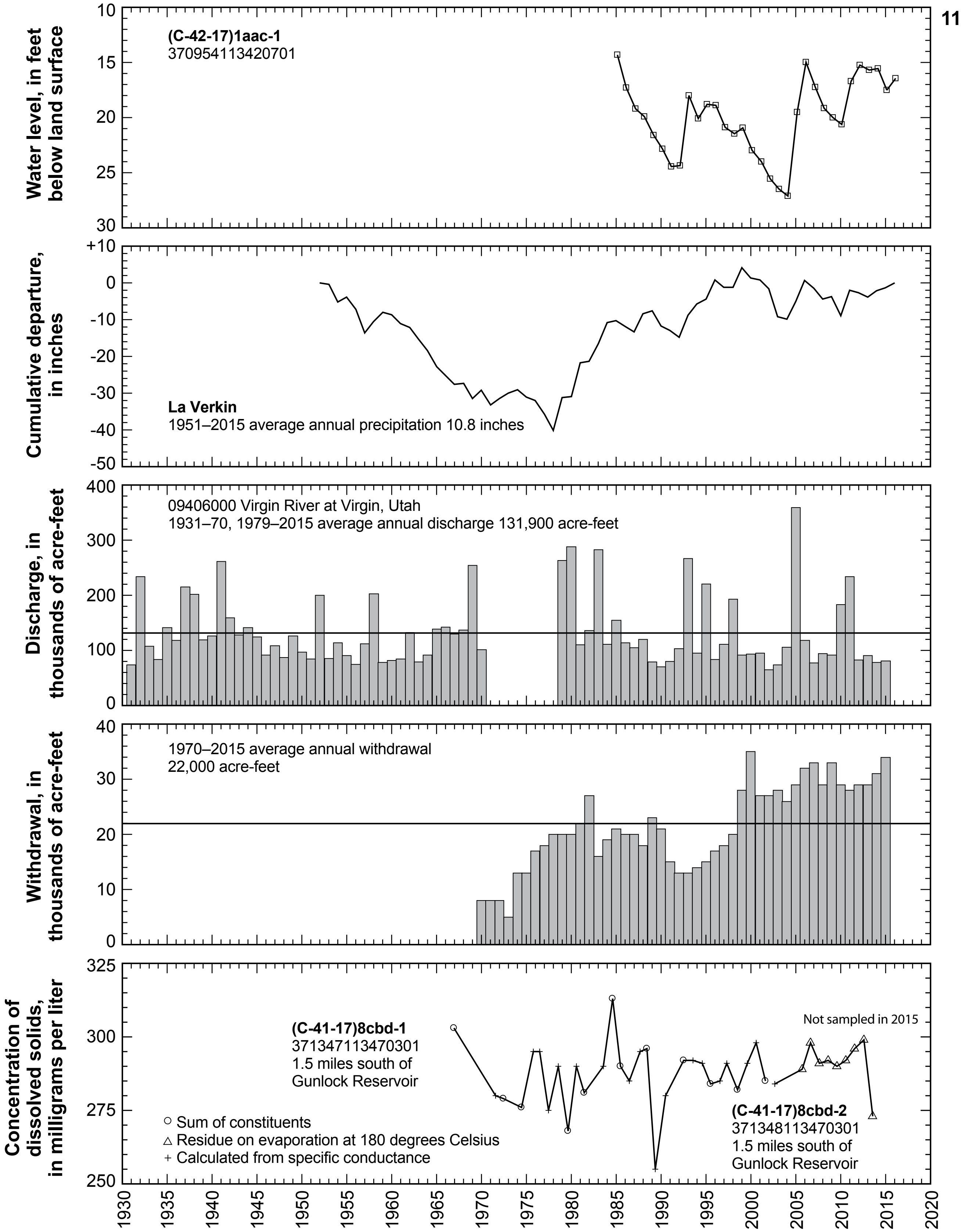

Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

Other Areas

By Martel J. Fisher

Total estimated withdrawal of water from wells in other areas of Utah (table 4) in 2015 was about 144,000 acre-feet, which is 15,000 acre-feet less than in 2014 and 5,000 acre-feet more than the average annual withdrawal for 2005–2014 (tables 2 and 3). The largest decreases were due to decreased withdrawals for irrigation and industrial use. In most of the areas listed in table 4, withdrawals in 2015 were less than in 2014, except in Grouse Creek Valley and lower Bear River area, where irrigation use increased.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2016, is shown in figure 34. The relation of the water level in selected observation wells in Cedar Valley to cumulative departure from average annual precipitation at Provo BYU is shown in figure 35.

Water levels in selected wells in Cedar Valley generally rose during the 1970s. Water levels rose sharply from the early to mid-1980s as a result of greater-than-average precipitation, and then declined during the mid- to late 1980s and early 1990s. Water levels in these wells have been relatively stable since 1995. Water levels declined in most of the wells from March 2015 to March 2016.

The location of wells in Sanpete Valley in which the water level was measured during March 2016 is shown in figure 36. The relation of the water level in selected observation wells in Sanpete Valley to cumulative departure from average annual precipi-tation at Manti is shown in figure 37.

Water levels in 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 declined in all of the selected observation wells from March 2015 to March 2016.

The location of wells in Snake Valley in which the water level was measured during March 2016 is shown in figure 38. The relation of the water level in selected observation wells in Snake Valley to cumulative departure from average annual precipitation at Callao is shown in figure 39.

Water levels in all of the selected wells in Snake Valley declined from March 2015 to March 2016. 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.

The relation of the water level in selected wells in other areas of Utah (table 4) to cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 40. Water levels declined or rose only slightly in most of the selected observation wells from March 2015 to March 2016.

Table 4. Estimated withdrawal of water from wells in other areas of Utah, 2015.

Number in figure 1	Area	Estimated withdrawal from wells (acre-feet)					
		2015					2014 total (rounded)
		Irrigation	Industrial [1]	Public supply [1]	Domestic and stock	Total (rounded)	
1	Grouse Creek Valley	1,900	0	20	40	2,000	1,600
2	Park Valley area	1,600	0	0	30	1,600	1,800
4	Lower Bear River area	4,100	470	6,700	200	11,500	11,000
8	Ogden Valley	0	0	10,900	630	11,500	12,400
13	Rush Valley	5,200	280	170	70	5,700	5,700
14	Skull Valley, Dugway area, and Old River Bed	2,400	4,500	740	20	7,700	8,400
15	Cedar Valley, Utah County	10	0	5,400	80	5,500	6,500
20	Sanpete Valley	6,900	710	1,200	1,100	9,900	14,100
25	Snake Valley	21,400	0	90	100	21,600	23,100
27	Beaver Valley	10,200	20	280	480	11,000	12,300
	Remainder of State	11,800	19,100	22,800	2,600	56,300	61,700
Total (rounded)		65,500	25,100	48,300	5,400	144,000	159,000

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

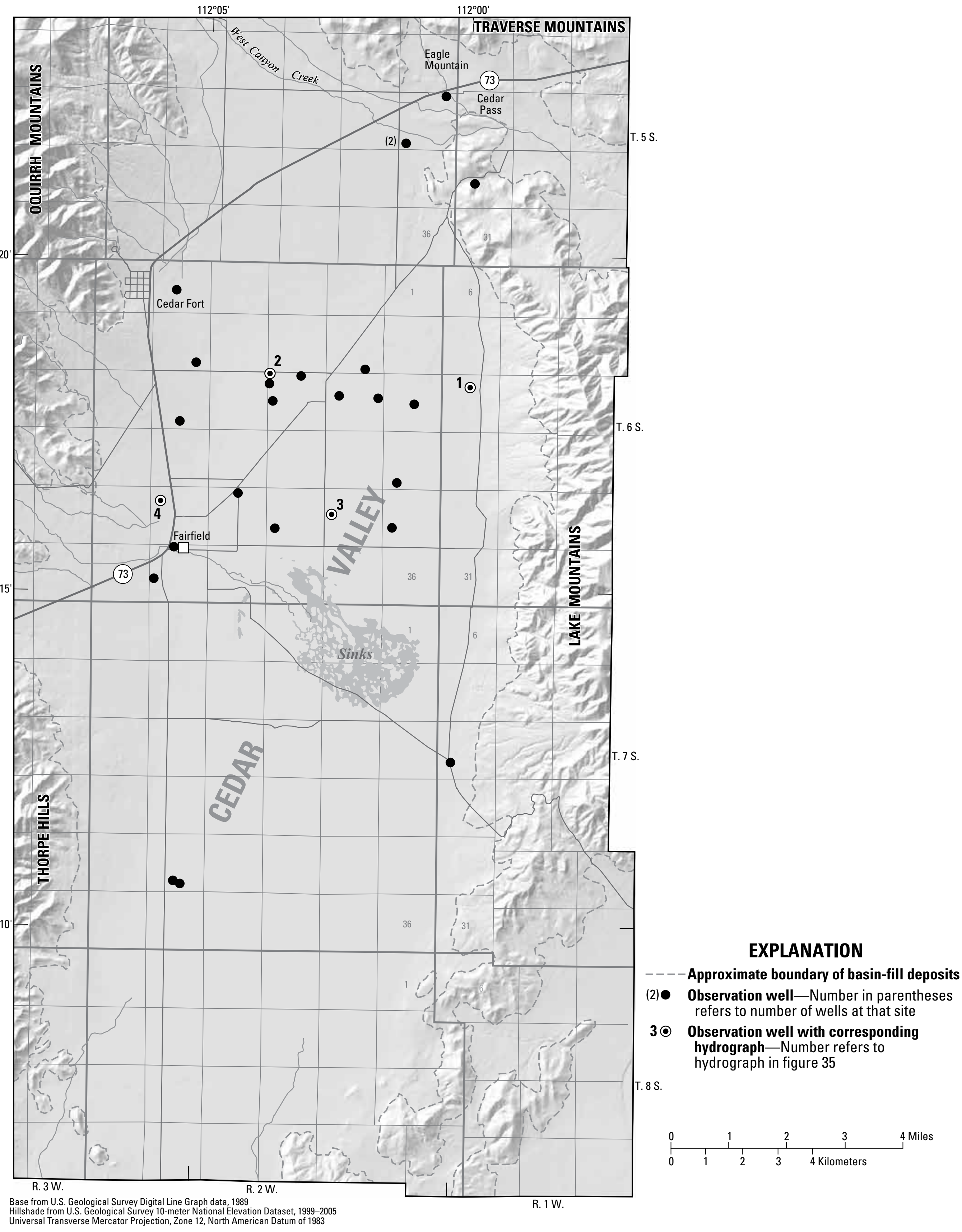

Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2016.

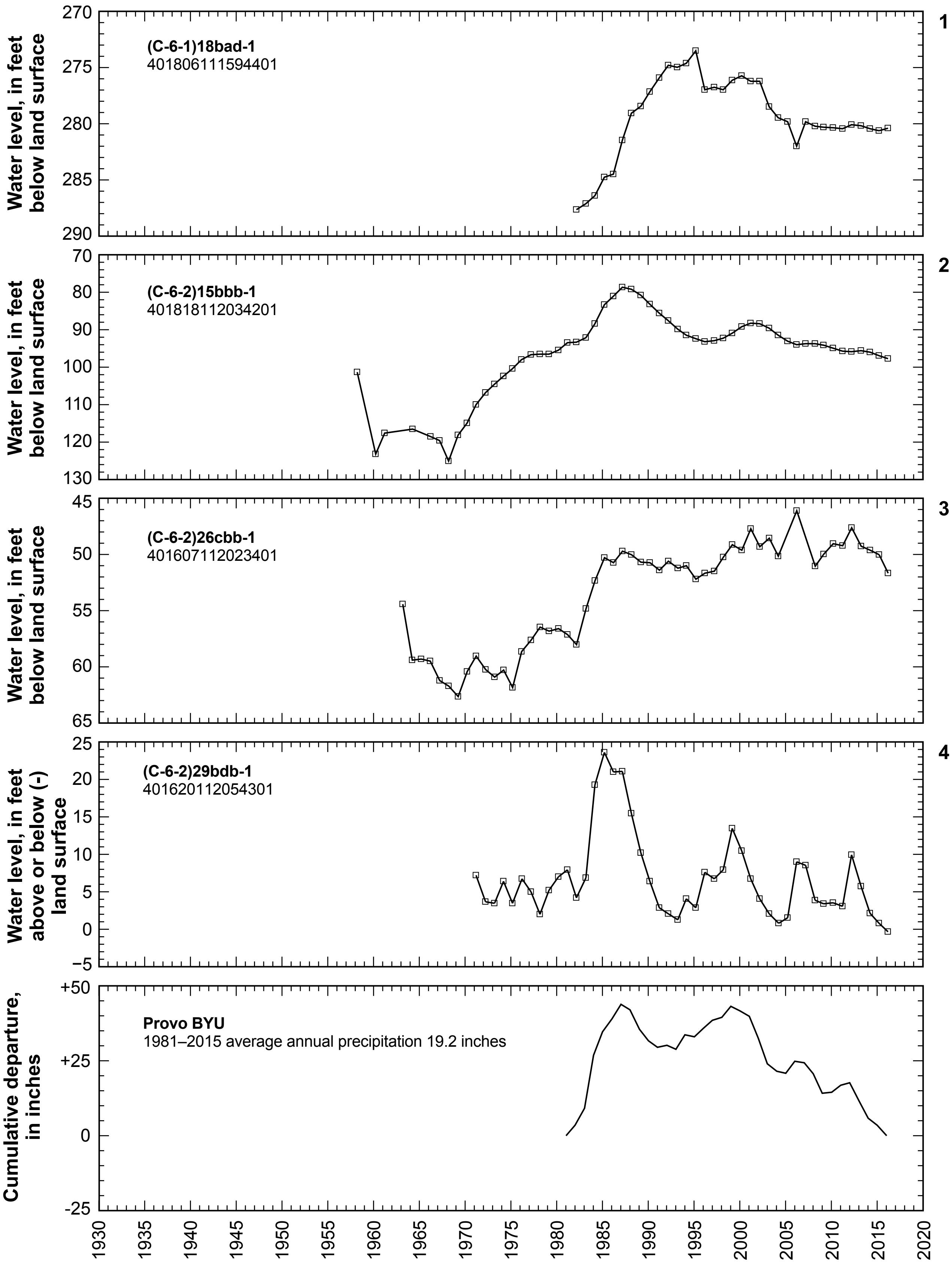

Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Provo BYU.

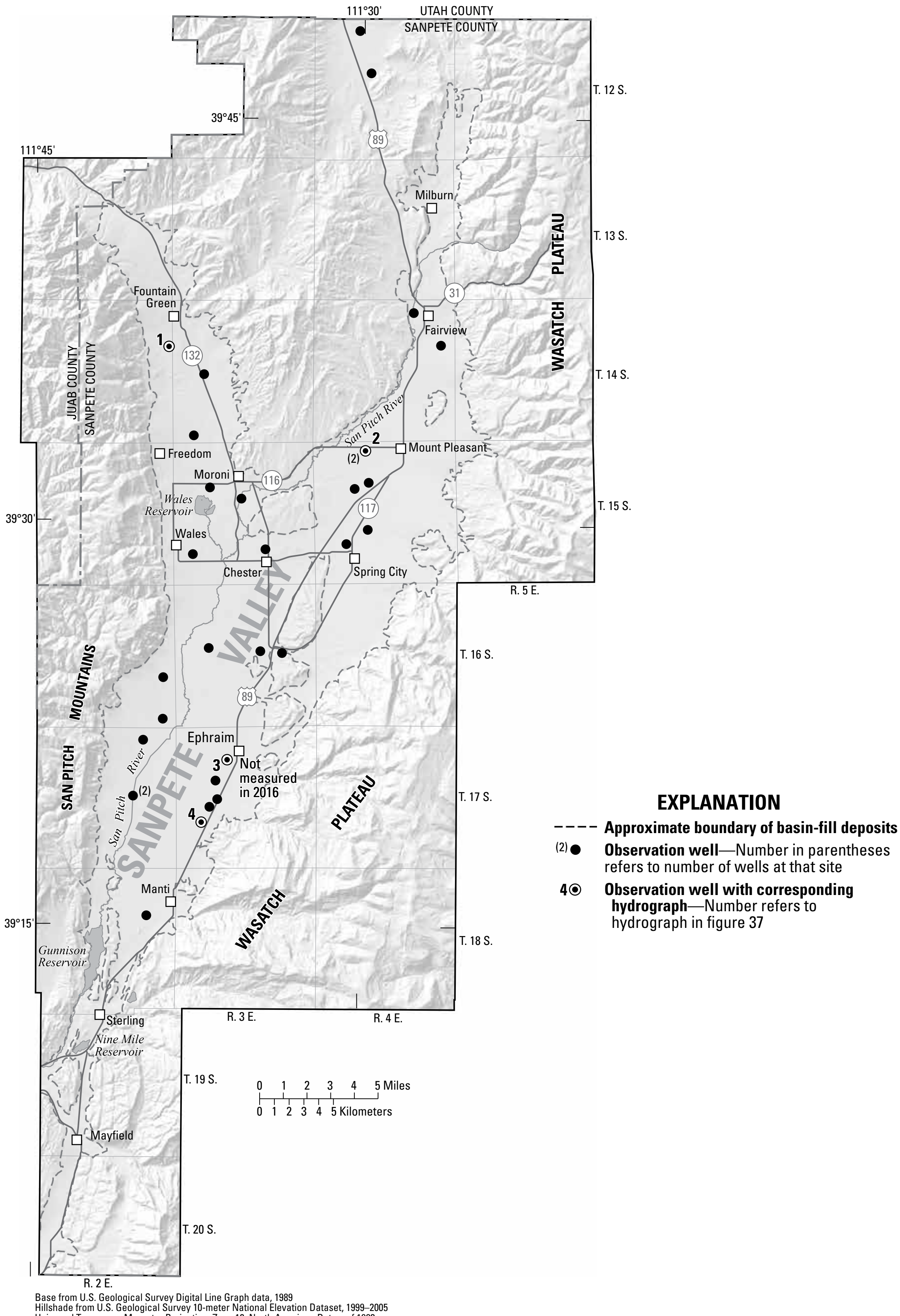

Figure 36. Location of wells in Sanpete Valley in which the water level was measured during March 2016.

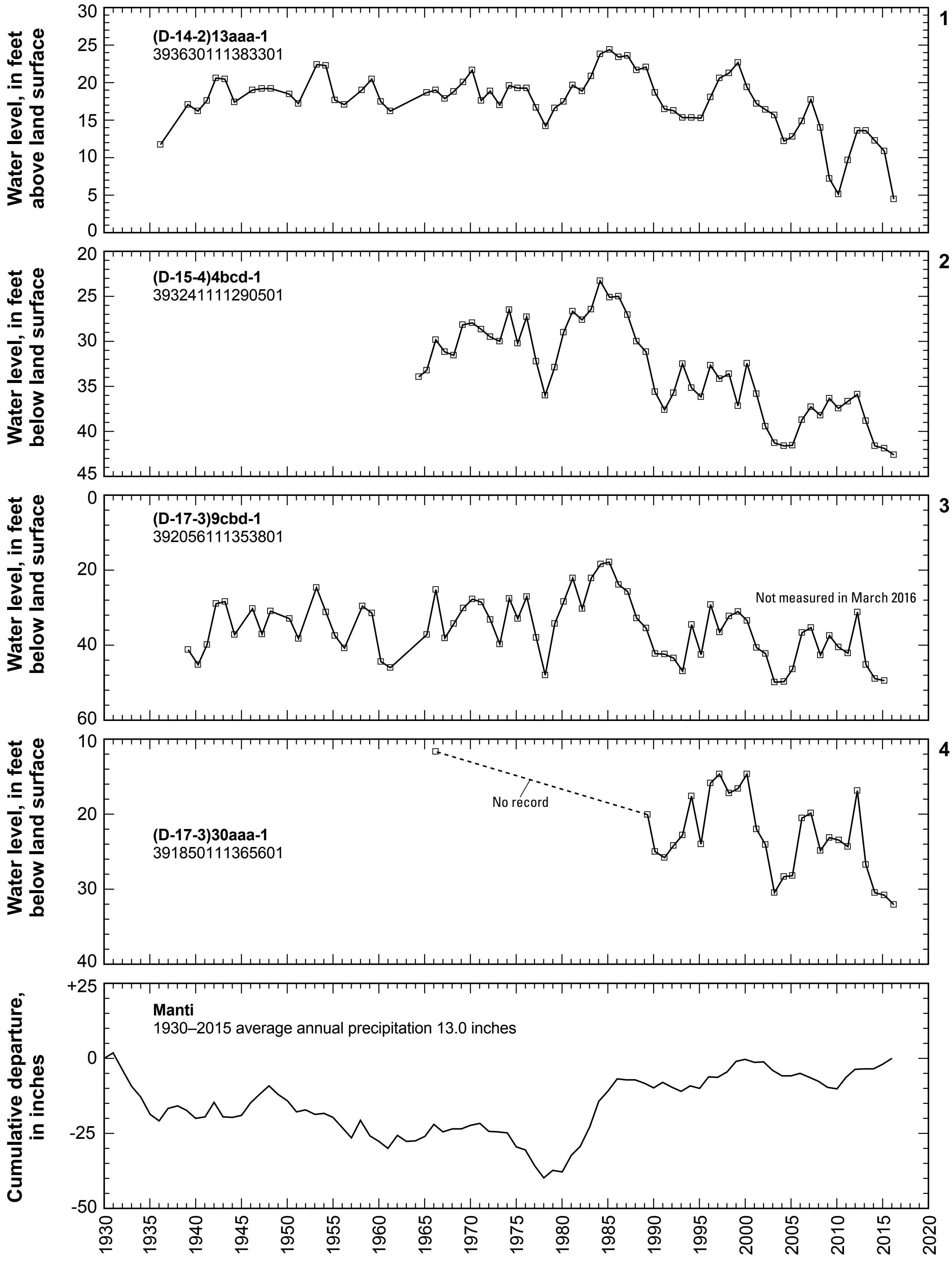

Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

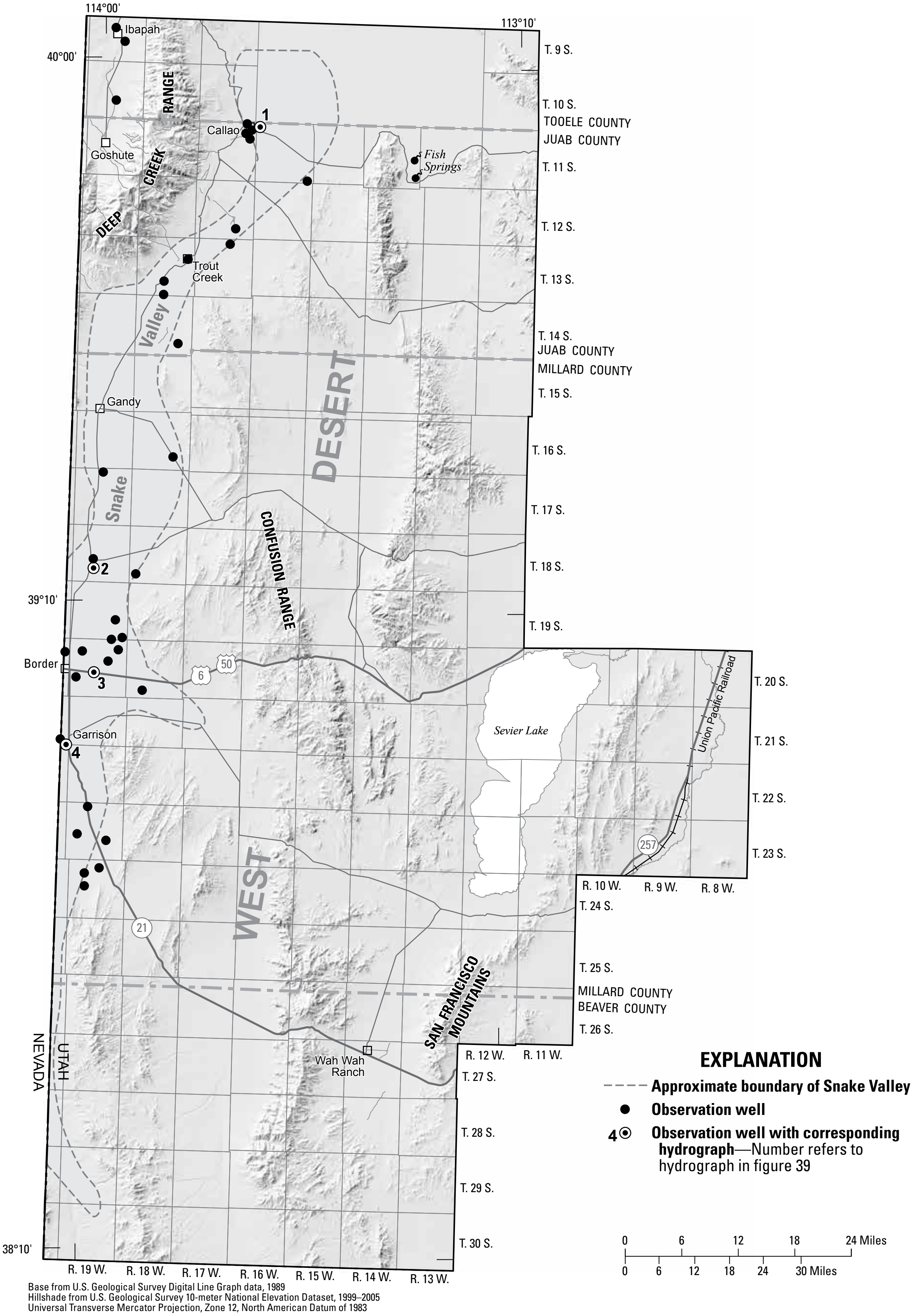

Figure 38. Location of wells in Snake Valley in which the water level was measured during March 2016.

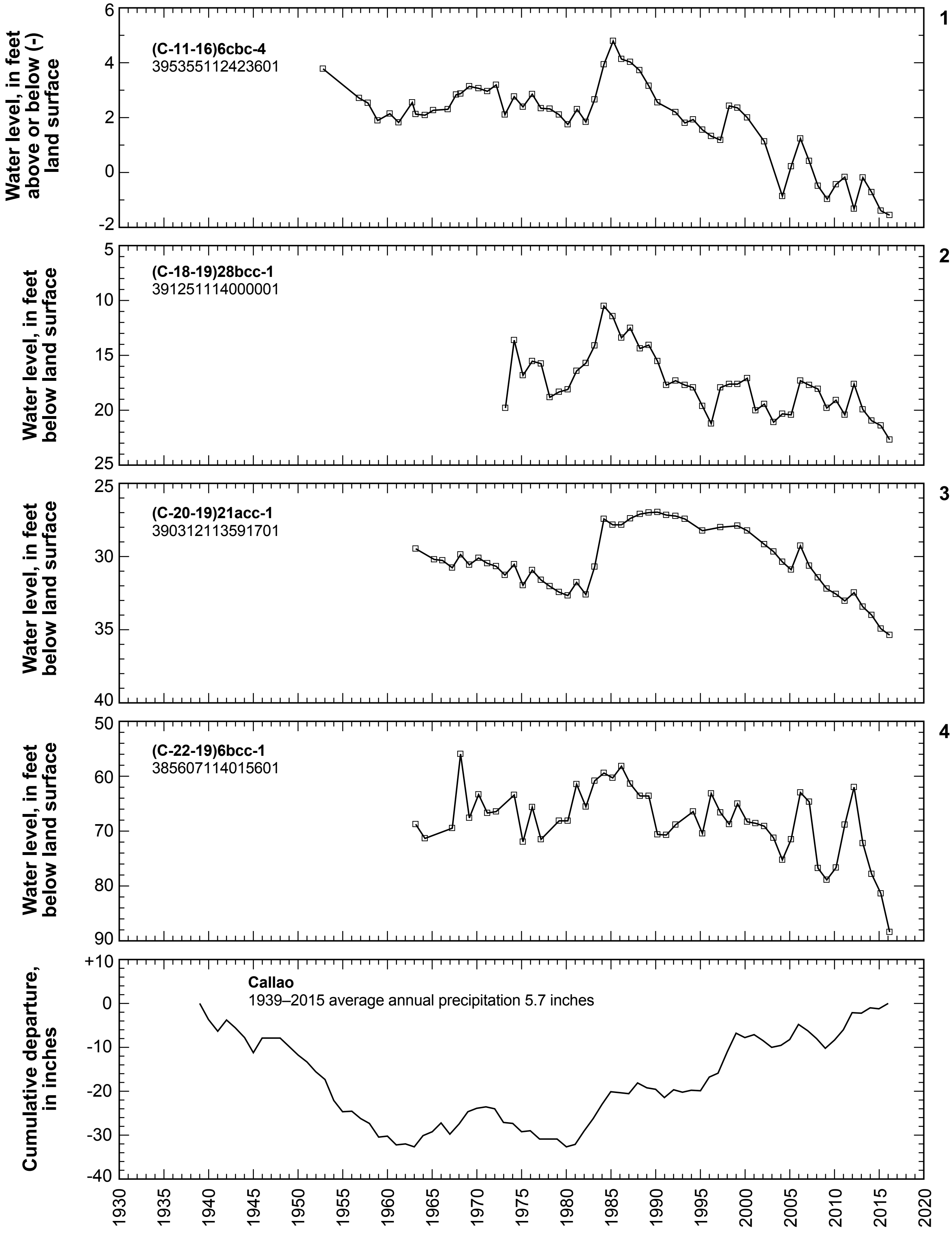

Figure 39. Relation of water level in selected wells in Snake Valley to cumulative departure from average annual precipitation at Callao.

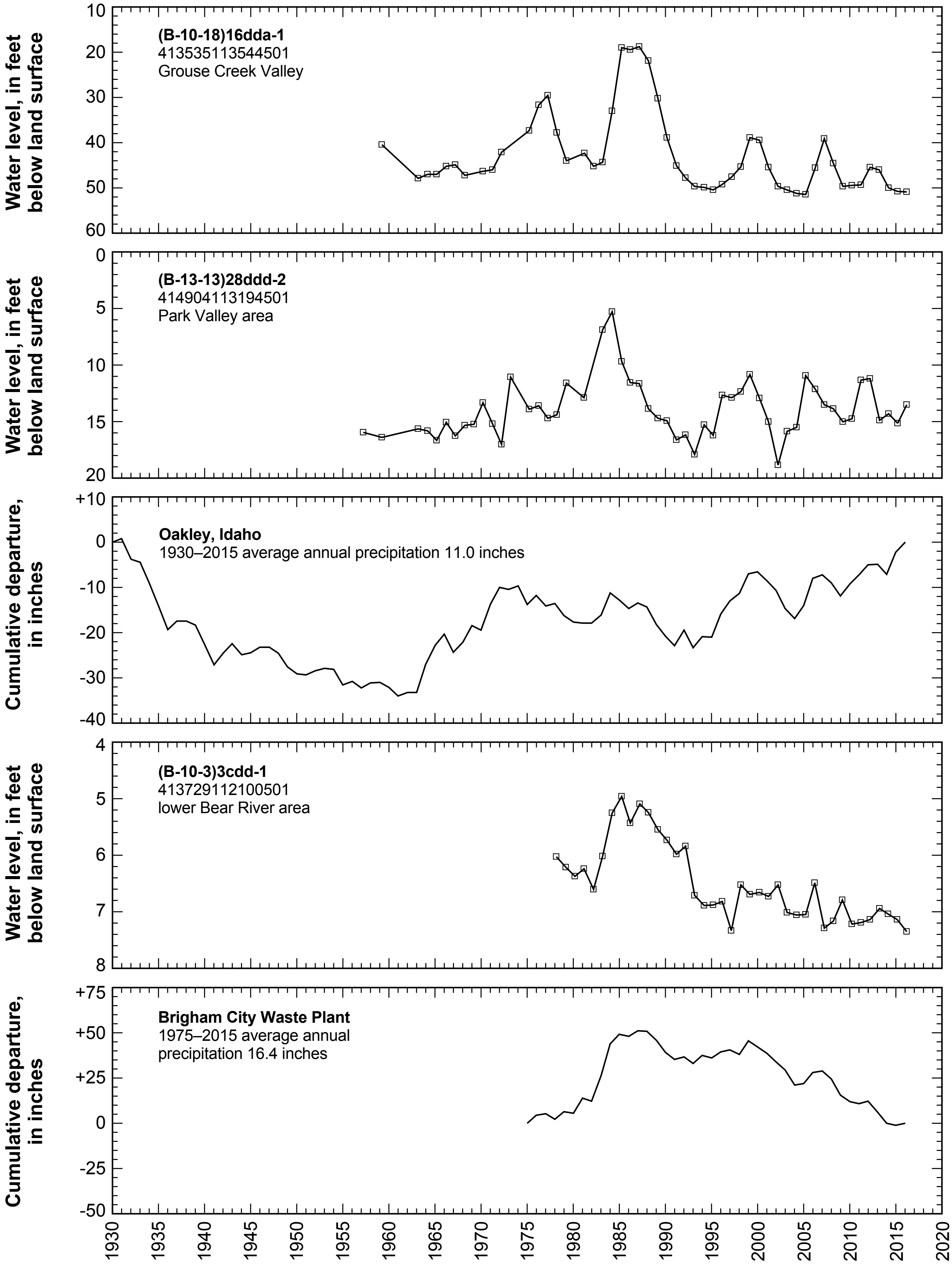

Figure 40. Relation of water level in selected wells in other areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

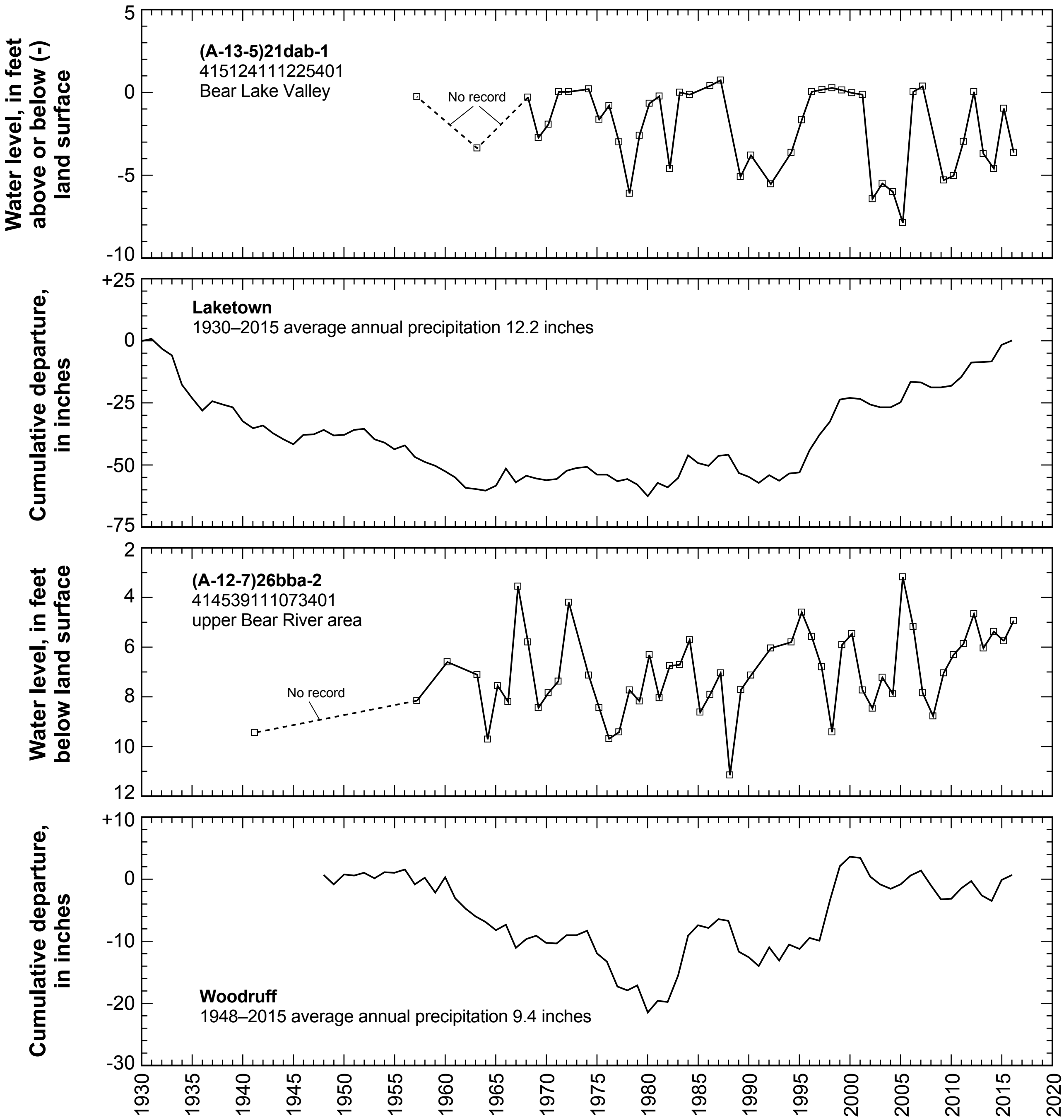

Figure 40. Relation of water level in selected wells in other areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

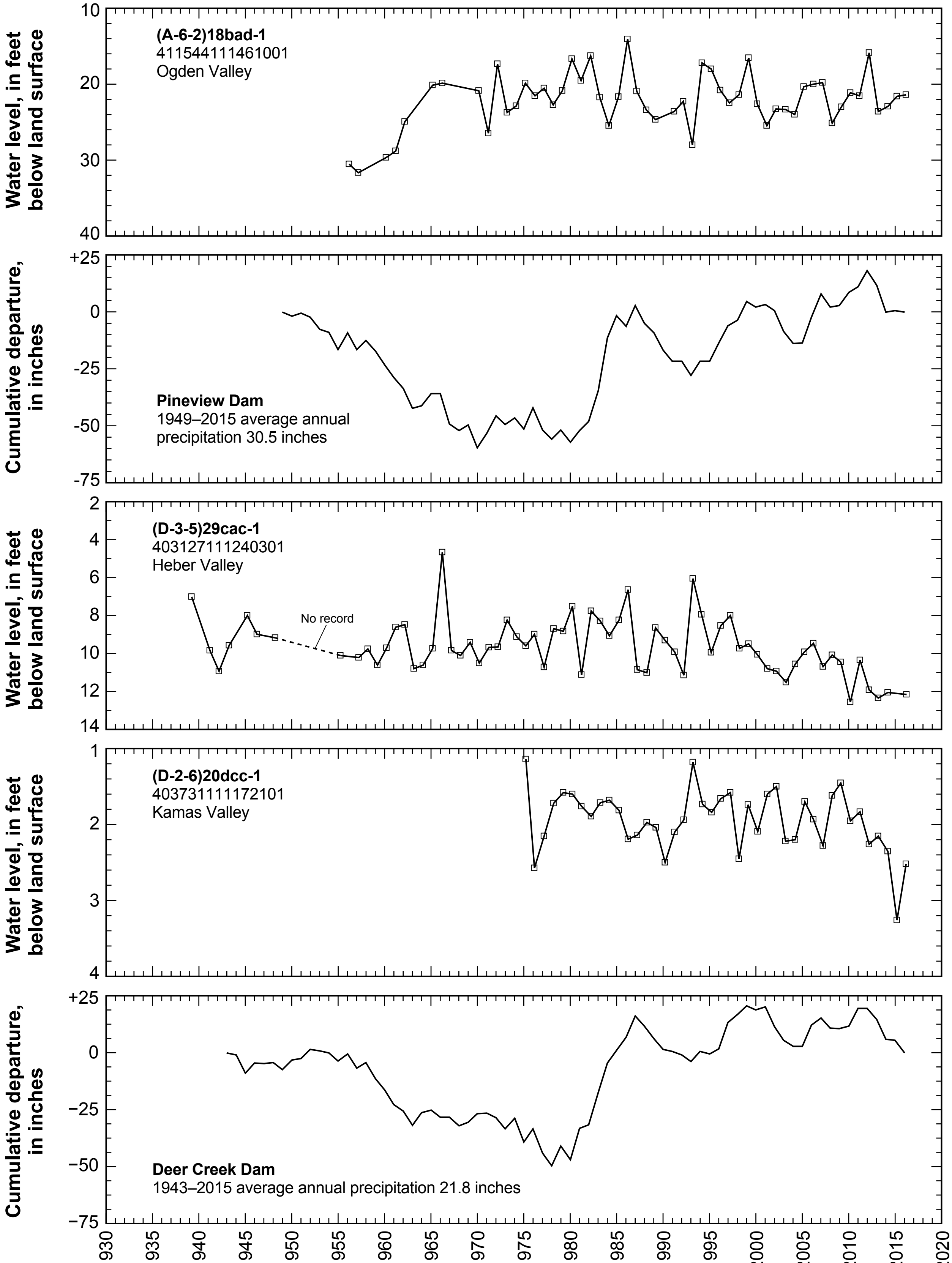

Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

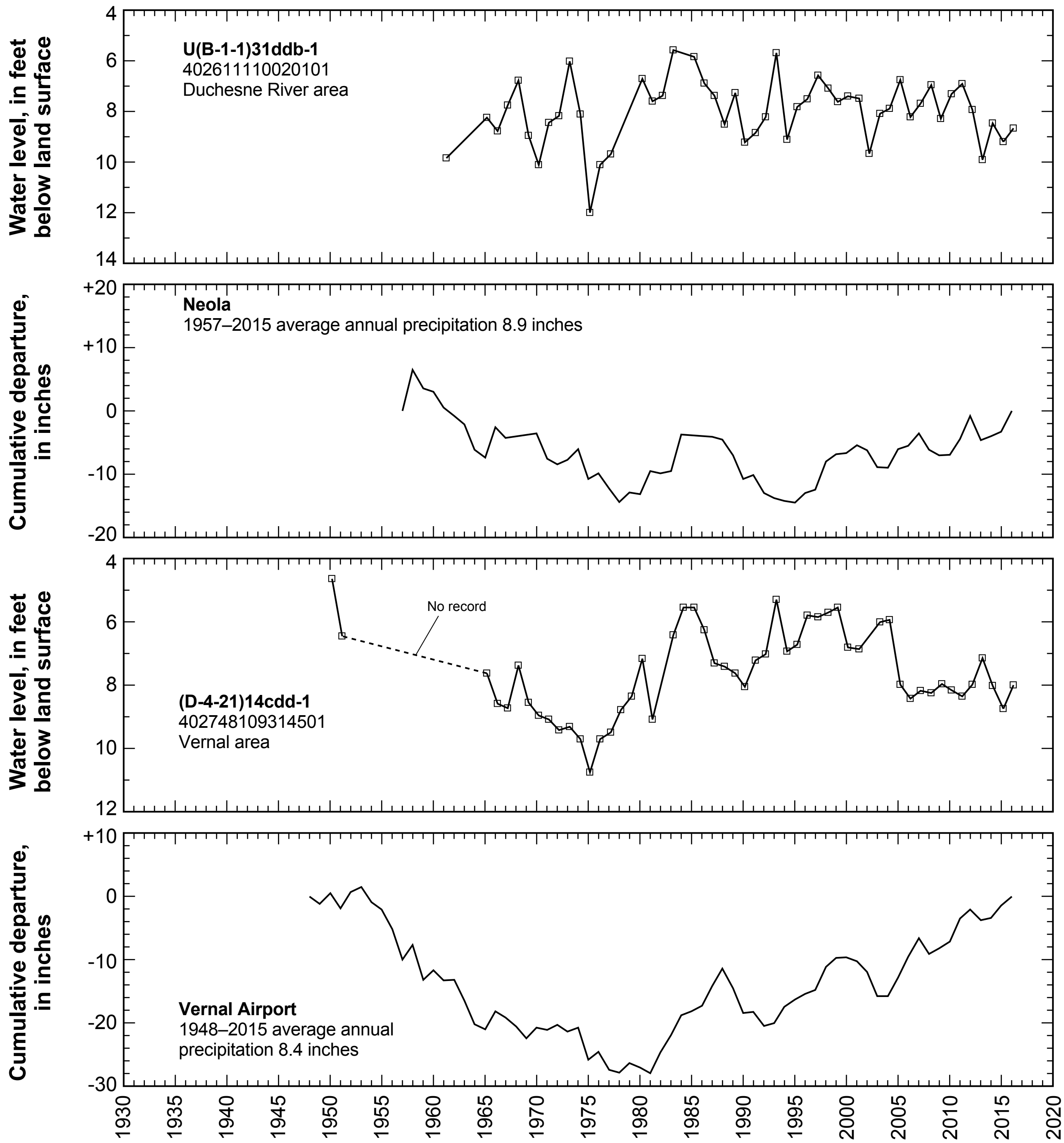

Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

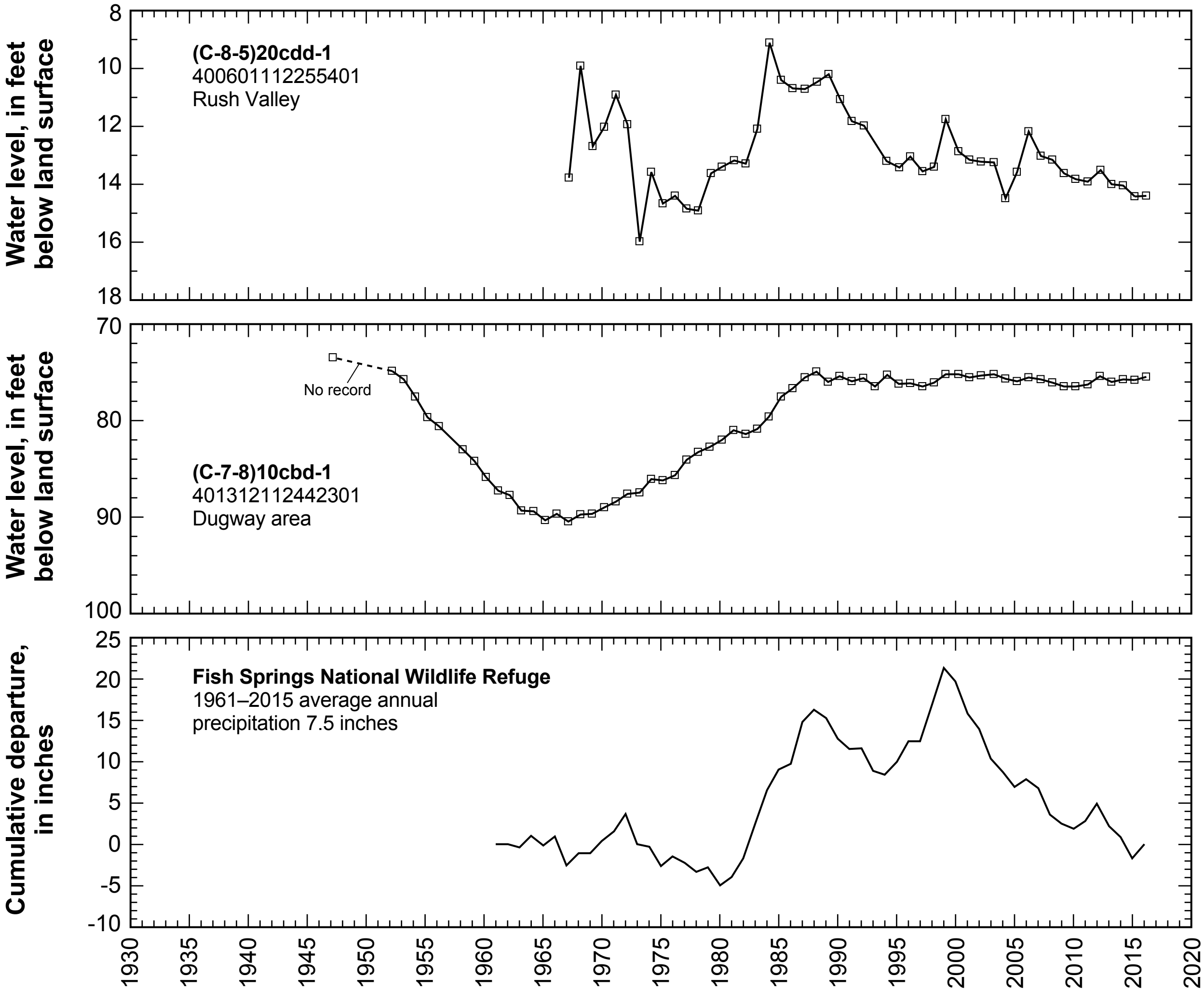

Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

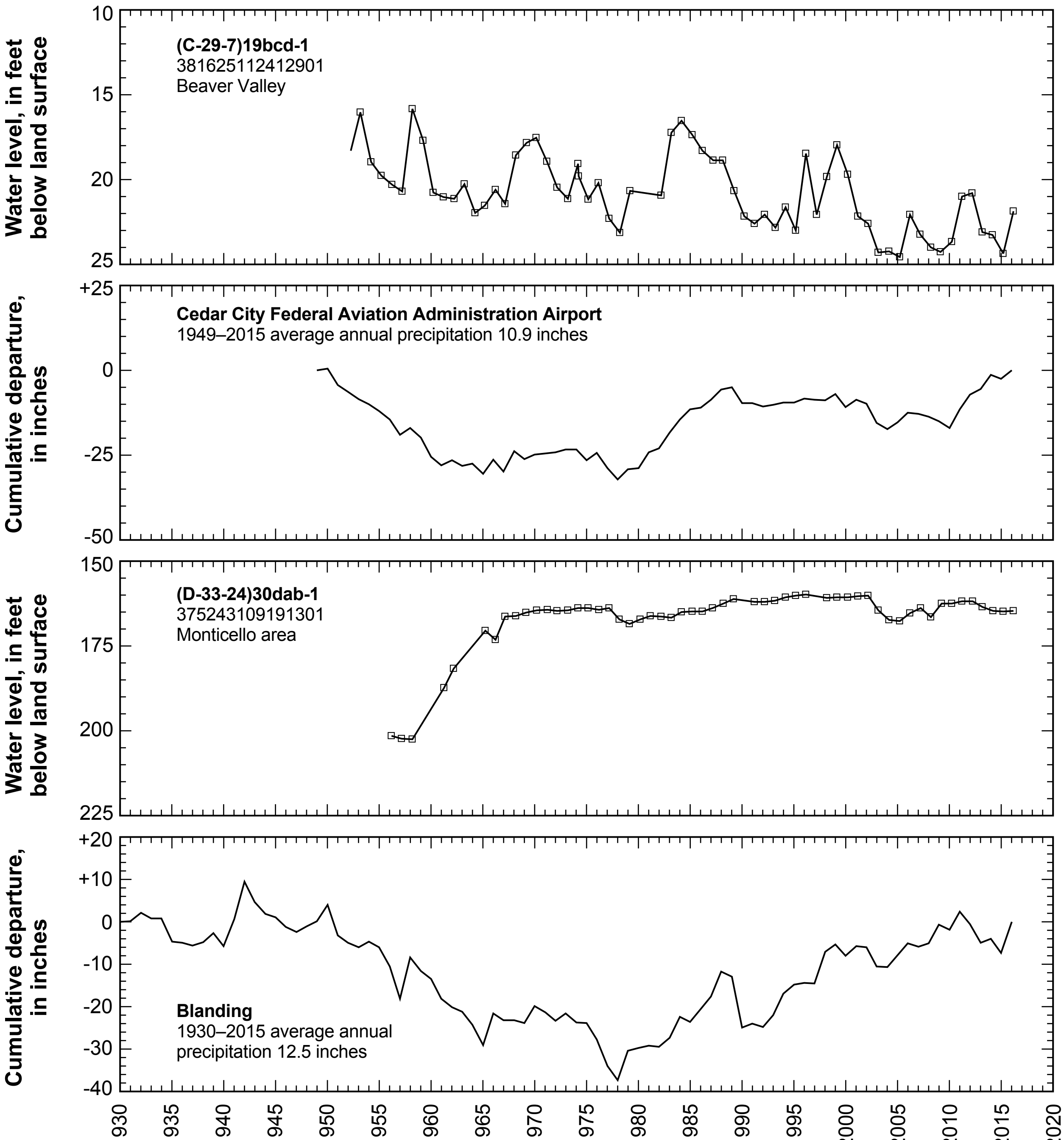

Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

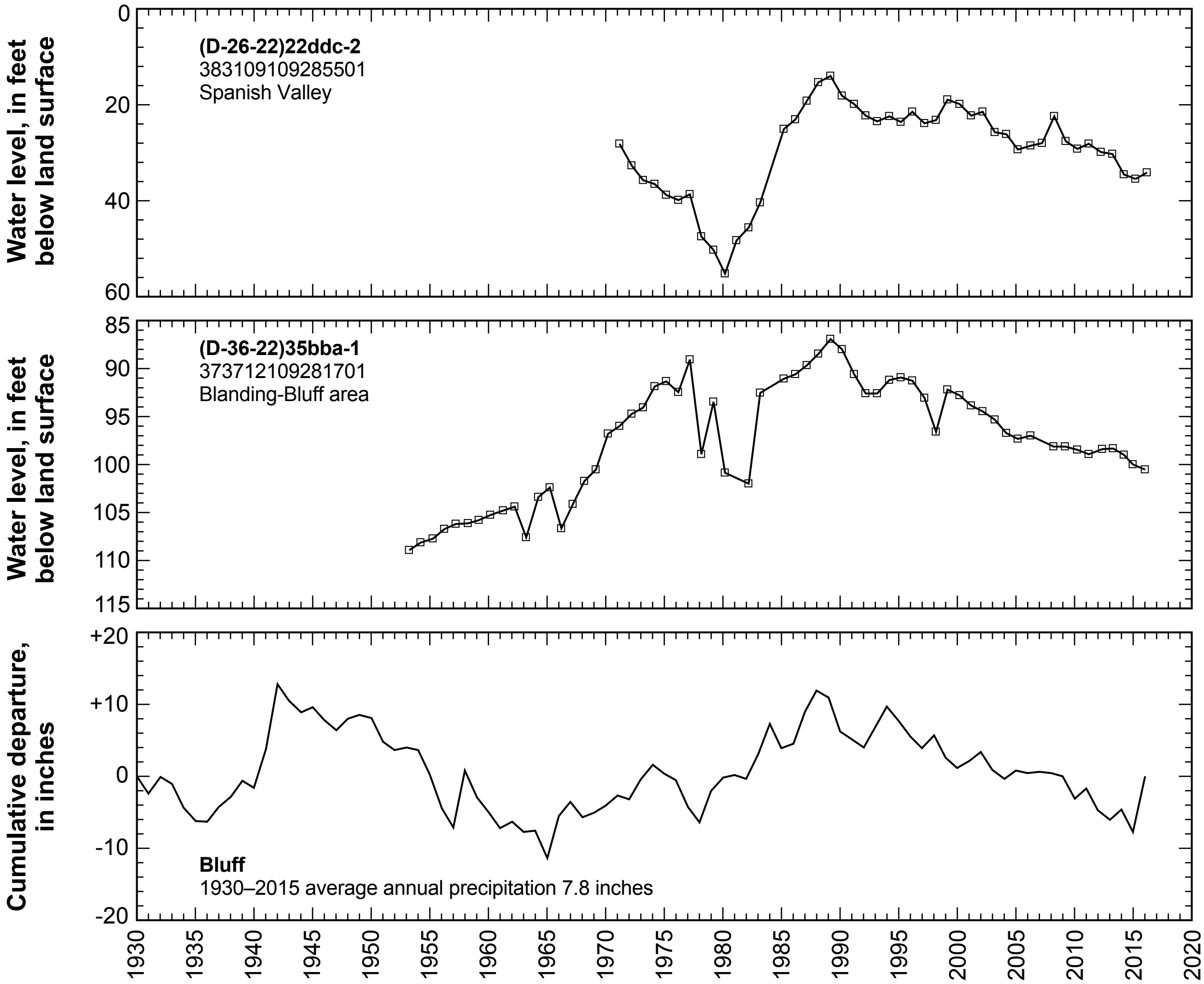

Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

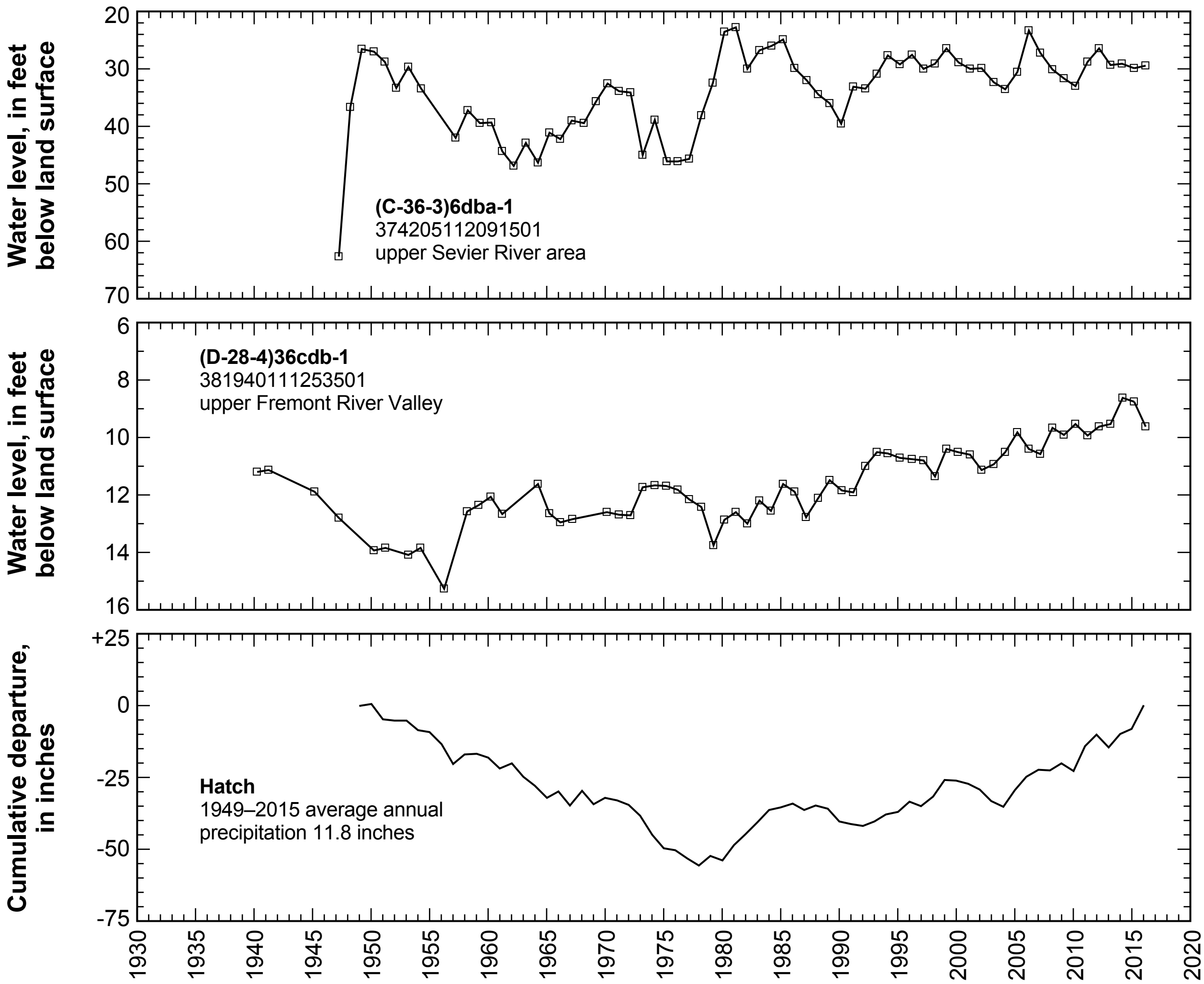

Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

Quality of Water from Selected Wells in Utah, Summer of 2015

From June through September 2015, 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 107 wells located in 20 counties (fig. 41). 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 (nitrate plus nitrite, 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 shown in table 5. Analytical results for trace elements are shown in table 6.

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. Sixteen field blank water samples were processed during the 2015 sampling period. Analytical results for all constituents in the field blanks were less than the laboratory reporting limits.

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 results of the environmental samples and within 2 percent for all constituents.

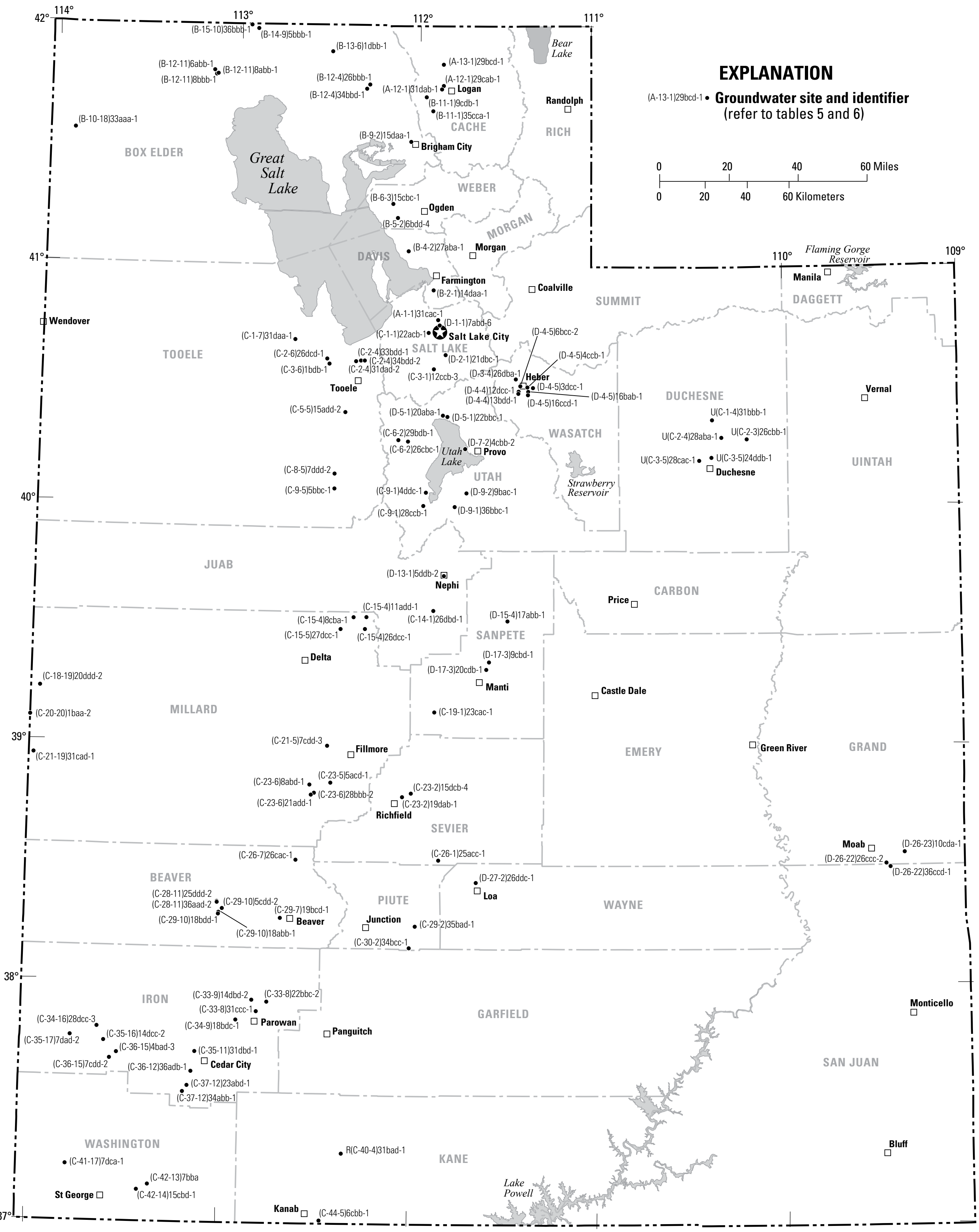

Figure 41. Location of groundwater sites sampled during the summer of 2015.

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2015.

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; L, laboratory value; <, less than; E, estimated; —, no data]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	pH, field, in standard units	Specific conductance, field, in µS/cm at 25 °C	Water temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Beaver County								
Beaver Valley								
(C-29-7)19bcd-1	381625112412901	20150706	7.0	451	13.8	154	48	8.42
Cove Fort area								
(C-26-7)26cac-1	383101112365301	20150706	7.2	622	15.0	256	77.9	15
Escalante Valley, Milford area								
(C-28-11)25ddd-2	382020113014202	20150714	7.1	706	23.5	227	60.4	18.5
(C-28-11)36aad-2	382007113014002	20150714	7.8	1,420	16.6	652	183	47.3
(C-29-10)5cdd-2	381835113000001	20150714	7.6	885	15.6	334	100	20.3
(C-29-10)18abb-1	381737113010501	20150714	7.1	691	17.3	280	81.7	18.4
(C-29-10)18bdd-1	381712113011201	20150714	7.1	1,060	16.2	473	144	27.8
Box Elder County								
Curlew Valley								
(B-12-11)6abb-1	414813113082901	20150713	7.5	702	14.7	228	63.9	16.6
(B-12-11)8abb-1	414710113071601	20150713	7.0	6,370	13.8	2,280	639	166
(B-12-11)8bbb-1	414720113075201	20150713	7.0	2,620	14.5	677	190	49.2
(B-14-9)5bbb-1	415847112540401	20150713	6.9	1,470	17.3	533	155	35.3
(B-15-10)36bbb-1	415939112562201	20150713	7.2	504	25.5	199	58.8	12.6
Grouse Creek Valley								
(B-10-18)33aaa-1	413300113543001	20150714	6.8	967	12.6	361	106	23.1
Lower Bear River area								
(B-9-2)15daa-1	413057112023901	20150608	8.4	617	16.4	8.2	1.9	0.86
(B-12-4)26bbb-1	414510112163501	20150730	7.1	3,170	13.7	1,240	282	131
(B-12-4)34bbd-1	414406112173601	20150729	7.3	2,070	15.8	606	136	64.6
(B-13-6)1dbb-1	415320112290901	20150730	7.4	773	19.1	282	77.9	21.2
Cache County								
Cache Valley								
(A-12-1)29cab-1	414501111520001	20150908	7.4	504	20.7	235	57	22.5
(A-12-1)31dab-2	414409111523502	20150908	L8.0	415	16.8	209	48.7	21.2
(A-13-1)29bcd-1	415020111520401	20150908	7.7	454	13.6	200	41.7	23.4
(B-11-1)9cdb-1	414209111574001	20150908	7.0	948	11.1	345	92.7	27.5
(B-11-1)35cca-1	413840111552601	20150908	7.2	731	13.5	226	55.9	21
Davis County								
East Shore area								
(B-2-1)14daa-1	405353111544201	20150608	7.8	375	17.3	64	19.8	3.58
(B-4-2)27aba-1	410340112030001	20150608	7.9	611	13.8	46	12.1	3.89
Duchesne County								
Duchesne River area								
U(C-1-4)31bbb-1	402130110231301	20150902	7.4	938	10.9	491	107	54.4
U(C-2-3)26cbb-1	401641110115801	20150901	9.0	837	12.2	6.2	1.5	0.59
U(C-2-4)28aba-1	401706110201501	20150831	7.1	830	12.7	456	102	48.6
U(C-3-5)24ddb-1	401206110233101	20150901	8.7	3,910	13.0	28	5.3	3.65
U(C-3-5)28cac-1	401122110273101	20150831	9.0	2,940	13.2	2.6	0.68	0.22
Grand County								
Spanish Valley								
(D-26-22)26ccc-2	383024109283801	20150617	6.9	980	17.5	481	143	30.2
(D-26-23)10cda-1	383308109224601	20150615	7.3	300	15.0	162	34.9	18.1

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	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
6.76	31.5	157	0.06	21.7	0.86	44	34.9	307	1.78	0.038
2.71	22.7	150	0.16	87.4	0.19	41.4	26.2	478	1.31	0.037
3.84	57.5	124	0.13	65.5	0.62	33.6	121	451	0.60	0.02
7.99	40.5	134	0.40	209	0.24	45.7	266	933	4.34	0.024
5.23	27.7	230	0.17	53.1	0.26	35.7	66.3	439	2.41	0.124
4.62	29	123	0.26	74.4	0.4	33.7	72.9	422	7.24	0.029
6	31.7	169	0.47	125	0.33	36.2	120	677	15.1	0.051
2.79	50.9	164	0.10	104	0.13	16.3	28.3	393	0.31	0.01
15.3	263	114	1.2	1,780	<0.20	20.2	29.2	4,010	0.82	0.013
7.84	246	250	0.49	623	0.1	21.6	49.6	1,600	4	0.015
14	59.6	124	0.28	358	0.17	51.9	22.7	924	1.89	0.03
8.28	18.9	140	0.05	56.3	0.2	60.6	17.8	352	0.7	0.025
8.92	53.1	225	0.22	123	0.3	51.8	67.6	574	0.56	0.047
1.91	152	308	<0.03	13.6	0.62	16.9	1.1	394	<0.04	1.4
6.75	174	179	0.90	669	0.17	33.9	437	2,130	16.5	0.029
4.29	174	190	0.42	481	0.22	21.1	115	1,370	2.55	0.015
10.3	31.8	128	0.14	152	0.26	57.4	17.9	569	2.37	0.028
5.42	19.4	221	0.02	16.9	0.26	22.5	20.7	297	1.27	0.025
1.57	8.7	205	<0.01	7.1	0.12	11.8	11	221	0.48	0.018
1.64	27	229	<0.03	8.5	0.11	11	10.8	252	0.10	0.01
7.99	48.6	375	0.11	76.7	0.63	51.5	0.1	537	<0.04	0.158
10.9	55.1	305	E0.07	49.6	0.37	47.2	0.08	399	<0.04	0.478
0.67	63.8	167	<0.03	22.7	0.26	22.3	0.19	223	<0.04	0.276
5.44	125	265	0.05	43.3	0.35	31.4	0.11	381	<0.04	0.619
0.89	31.6	380	0.17	33.7	0.96	34.4	36.8	567	4.39	0.052
0.75	199	370	<0.06	3.5	1.8	7.2	81.4	532	<0.04	0.025
3.37	10.1	238	0.08	22.8	0.18	8.2	169	560	<0.04	<0.004
1.74	857	388	0.60	292	0.68	12.8	1,120	2,600	<0.04	0.096
0.73	742	1,480	E0.06	127	8.1	7.9	24.4	1,890	<0.04	0.261
2.21	43.8	137	<0.06	14.8	0.39	13.9	369	734	0.82	0.005
1.8	2.8	127	<0.03	0.79	0.25	9.6	33.7	176	<0.04	<0.004

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2015.—Continued

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; L, laboratory value; <, less than; E, estimated; —, no data]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	pH, field, in standard units	Specific conductance, field, in µS/cm at 25 °C	Water temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Iron County								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	20150706	L8.0	1,010	13.4	643	126	79.6
(C-36-12)36adb-1	373743113084201	20150707	7.2	847	14.8	460	111	44.3
(C-37-12)23abd-1	373409113095501	20150713	7.3	884	16.3	398	91.6	41.1
(C-37-12)34abb-1	373236113111401	20150707	7.0	808	12.0	438	112	38.3
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-3	374934113384601	20150804	7.3	761	13.5	295	88.5	17.9
(C-35-16)14dcc-2	374505113363001	20150804	7.2	331	13.9	138	37.1	10.9
(C-35-17)7dad-2	374617113470601	20150804	7.4	479	16.1	166	52.4	8.46
(C-36-15)4bad-3	374209113322203	20150804	7.5	801	21.1	142	45.1	7.02
(C-36-15)7cdd-2	374040113343102	20150804	7.5	928	24.9	188	48.6	16.3
Parowan Valley								
(C-33-8)22bbc-2	375523112451902	20150706	7.9	498	15.8	81	18.1	8.66
(C-33-8)31ccc-1	375257112483501	20150706	7.5	592	14.4	259	54	30.2
(C-33-9)14dbd-2	375548112500401	20150706	8.0	593	17.2	150	25.6	20.8
(C-34-9)18bdc-1	375046112545901	20150715	7.5	739	13.3	356	66.7	46
Juab County								
Juab Valley								
(C-14-1)26dbd-1	393342111534501	20150812	7.5	1,240	14.8	554	114	65.3
(D-13-1)5ddb-2	394225111502702	20150812	7.2	1,460	12.3	461	122	37.8
Kane County								
Kanab area								
(C-44-5)6cbb-1	370050112274501	20150810	7.0	2,130	14.9	751	189	67.8
R(C-40-4)31bad-1	371740112210601	20150810	7.1	2,060	11.6	1,130	156	181
Millard County								
Pahvant Valley								
(C-21-5)7cdd-3	385939112272303	20150626	7.2	1,540	11.8	580	127	63.7
(C-23-5)5acd-1	385026112261001	20150626	7.3	596	17.3	279	75.4	22
(C-23-6)8abd-1	384953112325101	20150626	6.9	8,130	15.8	2,310	564	219
(C-23-6)21add-1	384751112312201	20150626	7.4	1,240	14.4	368	68.1	48
(C-23-6)28bbb-2	384722112322101	20150626	7.0	6,340	13.3	2,240	403	301
Sevier Desert								
(C-15-4)8cba-1	393154112192901	20150812	7.2	3,380	13.8	1,030	225	113
(C-15-4)11add-1	393158112152001	20150812	7.2	2,040	14.3	570	127	61.3
(C-15-4)26dcc-1	392859112154601	20150812	7.3	953	15.3	410	109	33.5
(C-15-5)27dcc-1	392854112233801	20150812	7.8	481	21.5	163	32.8	19.6
Snake Valley								
(C-18-19)20ddd-2	391324114000001	20150811	7.6	336	22.6	130	32.2	12
(C-20-20)1baa-2	390604114025201	20150811	7.7	439	17.5	194	48.7	17.7
(C-21-19)31cad-1	385640114012401	20150811	7.4	502	12.1	268	61.7	27.6
Piute County								
Upper Sevier River area								
(C-29-2)35bad-1	381440111584001	20150727	7.2	468	13.3	199	55	15
(C-30-2)34bcc-1	380915112003001	20150727	7.8	313	14.8	116	35.8	6.4

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	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
2.46	12.2	132	<0.06	13.5	0.24	19.7	481	896	2.44	0.013
2	15.9	311	<0.06	7.1	0.13	18.4	162	567	1.57	0.013
1.65	39.5	163	0.33	60.3	0.08	19.7	206	583	2.52	0.021
1.9	15.3	305	<0.06	8.6	0.21	16.8	137	533	0.94	0.015
8.25	34.8	130	0.47	129	1.1	65.6	61.5	549	1.07	0.034
4.16	14.2	129	0.07	21.9	0.23	60.3	9.0	235	0.90	0.028
7.69	33.8	145	E0.08	21	0.63	66.8	68	350	0.90	0.029
4.61	117	153	0.14	41.8	1.6	51.5	185	543	0.88	0.033
3.87	120	120	0.13	43.2	1.5	42.4	280	617	0.49	0.02
1.57	73.7	132	0.07	66.2	0.43	24	17.4	287	0.48	0.025
2.84	26.2	223	0.11	37	0.16	27.8	31.8	349	2.15	0.032
2.29	61.8	113	0.14	102	0.45	20.7	28	339	0.1	0.019
3.61	17.5	180	0.36	79.9	0.2	33.8	79.3	426	1.4	0.023
4.07	80.1	225	<0.06	66.3	0.29	22.4	350	828	1.46	0.022
4.02	145	295	0.09	214	0.2	26.2	108	834	4.71	0.032
10.4	261	327	0.22	54	0.5	16.4	843	1,640	<0.04	0.007
10.8	118	389	<0.15	23.6	0.62	14.7	864	1,680	<0.04	0.007
5.5	131	312	0.27	180	0.15	27.6	247	1,030	5.83	0.026
1.95	26.2	245	0.06	32	0.12	21.1	26.2	346	1.09	0.036
81.4	917	327	2.5	1,920	1.0	40.2	1,210	5,770	1.8	0.053
5.36	125	184	0.34	200	0.37	28.3	142	776	5.62	0.014
13.5	579	177	2.8	1,610	0.34	30.9	760	4,230	41.7	0.021
9.2	408	422	0.53	573	0.2	31.1	543	2,120	0.36	0.032
5.68	244	267	0.29	311	0.4	25.6	314	1,270	1.26	0.025
1.75	49.6	165	0.18	74.9	0.11	14.2	179	607	11	0.017
2.28	37.8	117	0.06	47.7	0.18	27.9	42.9	281	0.75	0.014
1.82	24.8	128	0.04	18.6	0.11	14.9	9.3	185	0.16	0.008
1.32	20.2	136	0.10	33.8	0.14	18.1	27.9	248	0.62	0.011
1.52	15.6	201	0.06	17.9	0.08	18.1	13.8	287	1.77	0.01
5.89	14.5	181	0.16	26.4	0.2	50.5	16.7	281	1.02	0.081
3.27	17	126	0.04	9.5	0.27	38.3	8.5	187	2.62	0.176

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2015.—Continued

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; L, laboratory value; <, less than; E, estimated; —, no data]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	pH, field, in standard units	Specific conductance, field, in µS/cm at 25 °C	Water temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Salt Lake County								
Salt Lake Valley								
(A-1-1)31cac-1	404627111532601	20150828	6.9	1,190	13.8	504	123	47.7
(C-1-1)22acb-1	404315111561501	20150610	7.7	981	21.6	237	64.9	18.3
(C-3-1)12ccb-3	403409111542401	20150610	7.2	2,190	18.9	503	123	47.6
(D-1-1)7abd-6	404506111523301	20150610	7.0	1,350	14.3	621	152	58.5
(D-2-1)21dbc-1	403742111503201	20150828	7.5	382	11.9	173	46.6	13.7
San Juan County								
Spanish Valley								
(D-26-22)36ccd-1	382929109272101	20150616	6.9	1,080	17.0	524	158	31.4
Sanpete County								
Sanpete Valley								
(D-15-4)17abb-1	393113111294501	20150901	7.5	571	10.1	315	70.6	33.7
(D-17-3)9cbd-1	392056111353801	20150901	7.5	644	11.0	319	56.6	43.1
(D-17-3)20cdb-1	391904111363001	20150901	7.5	736	11.6	373	64.5	51.5
Central Sevier Valley								
(C-19-1)23cac-1	390819111530701	20150727	7.1	2,490	13.6	702	103	108
Sevier County								
Central Sevier Valley								
(C-23-2)15dcb-4	384757112002201	20150727	7.2	659	12.1	319	65.3	37.8
(C-23-2)19dab-1	384702112031001	20150727	7.4	628	19.4	326	61.9	41.5
Upper Sevier River area								
(C-26-1)25acc-1	383115111512501	20150727	6.8	115	10.3	39	11.5	2.52
Tooele County								
Rush Valley								
(C-5-5)15add-2	402310112231002	20150720	7.4	560	11.7	270	58.3	30.2
(C-8-5)7ddd-2	400745112263101	20150720	7.7	547	—	206	38.2	26.9
(C-9-5)5bbc-1	400401112262001	20150724	7.4	610	—	241	69.3	16.4
Skull Valley								
(C-1-7)31daa-1	404113112395801	20150615	7.6	8,320	17.6	515	96.8	66.4
Tooele Valley								
(C-2-4)31dad-2	403556112195401	20150617	7.1	1,380	17.3	413	107	35.5
(C-2-4)33bdd-1	403629112174801	20150616	7.3	1,020	14.3	312	79.7	27.5
(C-2-4)34bdd-2	403608112170301	20150617	7.4	926	13.4	400	95.3	39.4
(C-2-6)26dcd-1	403630112292301	20150616	7.4	627	16.3	252	62.5	23.4
(C-3-6)1bdb-1	403514112283701	20150616	7.5	1,090	15.0	439	128	28.6
Utah County								
Cedar Valley								
(C-6-2)26cbc-1	401600112023401	20150715	7.3	692	11.2	320	53.8	45.1
(C-6-2)29bdb-1	401620112054301	20150715	7.5	348	22.5	154	35.5	15.7
Goshen Valley								
(C-9-1)4ddc-1	400309111565101	20150622	7.5	1,430	17.0	373	95.9	32.5
(C-9-1)28ccb-1	395956111572101	20150622	7.4	2,480	18.1	820	213	70
Northern Utah Valley								
(D-5-1)20aba-1	402236111511501	20150622	7.8	297	11.6	138	31.9	14.1
(D-5-1)22bbc-1	402215111494801	20150929	7.7	400	11.4	202	47.3	20.4
(D-7-2)4cbb-2	401414111435301	20150622	7.7	538	12.8	259	64.8	23.6

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	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
3.67	71.7	188	0.07	174	0.22	21.4	92.3	631	4.65	0.019
3.68	114	129	0.12	129	0.46	24.9	117	598	<0.04	0.023
22.3	256	205	0.28	420	0.28	27.3	177	1,280	0.28	0.009
3.26	66.5	288	0.11	172	0.15	19.5	157	814	4.67	0.044
2.02	13.7	133	<0.03	25.3	0.18	11.7	32.5	234	1.48	0.011
2.77	47.6	145	0.14	17.5	0.3	12	416	812	3.32	0.005
1.25	10.6	252	<0.03	7.5	0.1	9.4	14.6	314	2.88	0.006
1.46	28.8	267	<0.03	8.0	0.18	13.1	36.8	349	1.91	0.008
1.67	23.2	249	0.08	25.9	0.36	22.3	81.1	432	4.44	0.014
3.12	305	577	0.31	308	0.53	40.7	343	1,560	6.1	0.066
3.21	20.2	269	0.07	26.2	0.38	36	49	385	0.96	0.046
2.25	17.7	310	0.04	13	0.19	15.6	19.9	358	2.85	0.02
1.84	6.6	48	<0.03	3.7	0.27	46.6	1.4	94	0.29	0.069
1.15	15.2	202	0.05	47.5	0.14	12.5	21.6	320	1.29	0.009
2.49	34.8	156	0.07	66.3	0.63	14.2	24.9	295	0.04	0.007
1.46	31	145	0.08	88.7	0.11	17.2	24.9	345	1.3	0.015
57	1,450	183	1.7	2,290	0.33	26.2	174	4,820	1.47	0.027
3.1	167	210	0.13	304	0.18	16.4	103	876	4.63	0.017
2.16	115	209	0.14	165	0.13	13.3	115	653	1.73	0.023
1.65	55.5	221	0.06	47	0.08	14.9	215	614	3.04	0.026
5.9	27.3	145	0.07	103	0.17	46.6	19.5	408	0.61	0.025
2.18	51.6	156	0.20	236	0.08	22.5	29	723	2.99	0.026
3.21	24.2	256	0.08	55.1	0.3	52.6	32.8	426	0.05	0.037
1.05	16.5	158	<0.03	12	0.16	10.1	7.1	196	<0.04	0.005
15.9	153	137	0.37	318	0.35	68.6	118	959	2.54	0.029
20.4	162	105	0.85	612	0.21	64.9	125	1,680	22.9	0.028
1.25	9.2	117	<0.03	6.6	0.19	11.3	23.1	181	1.7	0.009
1.04	9.8	155	<0.01	7.5	0.22	11.8	45.6	238	1.2	0.008
2.94	17.1	231	0.04	12.8	0.23	18.9	46.4	312	<0.04	0.031

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2015.—Continued

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; L, laboratory value; <, less than; E, estimated; —, no data]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	pH, field, in standard units	Specific conductance, field, in µS/cm at 25 °C	Water temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Southern Utah Valley								
(D-9-1)36bbc-1	395942111470801	20150622	7.6	526	10.9	267	68	23.6
(D-9-2)9bac-1	400311111432001	20150622	7.5	598	14.9	257	62.9	24.2
Wasatch County								
Heber Valley								
(D-3-4)26dba-1	403146111272701	20150826	6.8	824	13.4	403	120	24.7
(D-4-4)12dcc-1	402842111263101	20150825	6.5	820	11.4	386	108	28.2
(D-4-4)13bdd-1	402810111263601	20150825	7.4	479	21.7	241	58.5	23.1
(D-4-5)3dcc-1	402937111214901	20150826	6.6	494	11.1	249	82.3	10.5
(D-4-5)4ccb-1	402946111233901	20150827	6.5	456	14.1	234	75.4	11.1
(D-4-5)6bcc-2	403003111255801	20150827	6.8	393	12.2	195	60	11.1
(D-4-5)16bab-1	402840111232201	20150825	6.9	620	11.7	326	90.9	24.1
(D-4-5)16ccd-1	402750111232701	20150827	7.3	446	13.3	232	56.2	22.1
Washington County								
Central Virgin River area								
(C-41-17)7dca-1	371400113473001	20150804	7.0	730	18.5	384	104	30.1
(C-42-13)7bba	370915113213801	20150810	7.1	1,730	22.3	904	226	82.4
(C-42-14)15cbd-1	370538113251301	20150810	7.1	2,310	27.3	1,110	239	124
Wayne County								
Upper Fremont River Valley								
(D-27-2)26ddc-1	382544111392401	20150808	7.6	245	10.9	98	27.7	6.99
Weber County								
East Shore area								
(B-5-2)6bdd-4	411153112064601	20150608	7.9	440	15.7	156	38.6	14.4
(B-6-3)15cbc-1	411523112082101	20150608	8.2	412	15.7	32	7.8	3.16

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	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
1.46	7.7	223	0.04	23.9	0.21	16.7	20.3	295	2	0.012
9.63	33.7	247	0.05	32.1	0.25	52.7	37.4	403	3.38	0.038
6.22	29	190	0.09	34.1	0.5	19.9	113	544	2.66	0.03
1.62	30.7	291	<0.06	75.6	0.09	23.1	44	490	4.45	0.054
1.8	11.2	186	<0.03	22.7	0.32	12.7	17.6	263	0.34	0.013
3.26	8.4	196	<0.03	35.2	0.09	38.1	9.6	361	4.91	0.105
2.65	6.2	189	<0.03	23.7	0.09	40.9	14.7	332	4.49	0.098
1.96	8.1	178	<0.03	13.3	0.08	27.8	20.7	261	1.83	0.051
1.65	15.4	300	<0.03	21.8	0.17	30.2	21.4	379	2.79	0.04
1.18	8.4	193	<0.03	11.8	0.15	12.7	28.3	260	0.64	0.013
2.53	13.1	195	0.11	19.8	0.3	16.9	179	506	0.96	0.01
10.2	80.9	164	0.12	98.7	0.19	14.4	705	1,360	0.28	0.006
9.67	140	171	0.49	235	0.41	23.7	804	1,720	6.94	0.012
2.86	14	104	0.03	6.5	0.27	44.8	11.8	170	0.22	0.032
7.31	33.7	214	0.03	16.9	0.19	27.4	0.09	260	<0.04	0.172
9.83	78.7	198	0.04	16.4	0.3	21.5	0.21	239	<0.04	0.261

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2015.

[Date of sample: YYYYMMDD, year, month, day; µg/L, micrograms per liter; < , less than]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Beaver County								
Beaver Valley								
(C-29-7)19bcd-1	381625112412901	20150706	6.4	<4.0	3.03	3.1	0.46	17.7
Cove Fort area								
(C-26-7)26cac-1	383101112365301	20150706	2.5	<4.0	<0.2	0.31	1.4	3.89
Escalante Valley, Milford area								
(C-28-11)25ddd-2	382020113014202	20150714	20.5	6.9	0.52	2.25	1.5	9.05
(C-28-11)36aad-2	382007113014002	20150714	1.7	17.8	0.64	0.53	8.9	17.9
(C-29-10)5cdd-2	381835113000001	20150714	2.4	108	1.91	0.65	0.55	25.8
(C-29-10)18abb-1	381737113010501	20150714	4.5	8.5	0.23	1.48	0.78	15.6
(C-29-10)18bdd-1	381712113011201	20150714	2.6	<4.0	<0.2	1.17	1.1	33
Box Elder County								
Curlew Valley								
(B-12-11)6abb-1	414813113082901	20150713	1.3	8.2	0.37	0.54	0.78	1.95
(B-12-11)8abb-1	414710113071601	20150713	1.4	<40.0	<2.0	0.71	0.95	4.16
(B-12-11)8bbb-1	414720113075201	20150713	1.1	<8.0	<0.4	0.49	1.5	4.03
(B-14-9)5bbb-1	415847112540401	20150713	2	<4.0	<0.2	0.78	1.8	1.66
(B-15-10)36bbb-1	415939112562201	20150713	2.2	12.3	5.09	0.83	0.9	1.67
Grouse Creek Valley								
(B-10-18)33aaa-1	413300113543001	20150714	19.7	<4.0	<0.2	12.8	9.6	26.9
Lower Bear River area								
(B-9-2)15daa-1	413057112023901	20150608	0.15	259	11.9	0.43	<0.05	0.39
(B-12-4)26bbb-1	414510112163501	20150730	2.8	<16.0	<0.8	0.70	34.6	4.31
(B-12-4)34bbd-1	414406112173601	20150729	1	<8.0	<0.4	1.1	5.1	1.63
(B-13-6)1dbb-1	415320112290901	20150730	4.3	50.3	1.08	0.73	1.4	1.94
Cache County								
Cache Valley								
(A-12-1)29cab-1	414501111520001	20150908	1.3	290	2.98	0.72	0.16	0.62
(A-12-1)31dab-2	414409111523502	20150908	0.93	<4.0	<0.2	0.48	0.29	0.7
(A-13-1)29bcd-1	415020111520401	20150908	6	200	67.8	0.80	<0.05	0.3
(B-11-1)9cdb-1	414209111574001	20150908	12.3	1,840	301	0.16	0.07	<0.014
(B-11-1)35cca-1	413840111552601	20150908	20	3,020	194	0.71	<0.05	<0.014
Davis County								
East Shore area								
(B-2-1)14daa-1	405353111544201	20150608	1.4	1,170	63.9	1.09	<0.05	<0.014
(B-4-2)27aba-1	410340112030001	20150608	24.1	318	51.6	0.36	<0.05	<0.014
Duchesne County								
Duchesne River area								
U(C-1-4)31bbb-1	402130110231301	20150902	3	4.6	<0.2	1.85	0.9	6.45
U(C-2-3)26cbb-1	401641110115801	20150901	<0.1	67.3	1.24	1.66	<0.05	0.06
U(C-2-4)28aba-1	401706110201501	20150831	<0.1	195	8.89	0.30	0.07	0.61
U(C-3-5)24ddb-1	401206110233101	20150901	<0.2	<16.0	0.96	4.51	0.15	0.03
U(C-3-5)28cac-1	401122110273101	20150831	1	18.8	1.35	8.92	<0.15	3.44
Grand County								
Spanish Valley								
(D-26-22)26ccc-2	383024109283801	20150617	0.23	49.5	3.09	0.65	2.9	2.27
(D-26-23)10cda-1	383308109224601	20150615	0.93	42.6	36	1.71	<0.05	0.97

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2015.—Continued

[Date of sample: YYYYMMDD, year, month, day; µg/L, micrograms per liter; < , less than]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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
Iron County								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	20150706	0.86	<4.0	<0.2	0.51	1.4	3.36
(C-36-12)36adb-1	373743113084201	20150707	0.8	6.5	1.8	0.29	1.1	2.72
(C-37-12)23abd-1	373409113095501	20150713	0.88	5.7	<0.2	0.58	5.5	1.71
(C-37-12)34abb-1	373236113111401	20150707	0.31	4.5	<0.2	0.44	0.78	1.92
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-3	374934113384601	20150804	17.2	<4.0	<0.2	1.71	1.7	3.37
(C-35-16)14dcc-2	374505113363001	20150804	5.2	<4.0	<0.2	0.75	0.59	1.91
(C-35-17)7dad-2	374617113470601	20150804	6	<4.0	<0.2	0.83	0.6	5.68
(C-36-15)4bad-3	374209113322203	20150804	22.4	<4.0	0.3	8.93	0.36	1.51
(C-36-15)7cdd-2	374040113343102	20150804	25.1	6.9	<0.2	17.4	0.33	3.65
Parowan Valley								
(C-33-8)22bbc-2	375523112451902	20150706	9.5	13	4.62	1.25	0.14	0.77
(C-33-8)31ccc-1	375257112483501	20150706	3.5	<4.0	<0.2	0.35	1.6	2.45
(C-33-9)14dbd-2	375548112500401	20150706	11.3	5.2	0.79	2.23	0.19	1.43
(C-34-9)18bdc-1	375046112545901	20150715	2.6	6.8	<0.2	0.50	3.4	3.03
Juab County								
Juab Valley								
(C-14-1)26dbd-1	393342111534501	20150812	1.3	19.2	0.69	2.8	0.76	2.5
(D-13-1)5ddb-2	394225111502702	20150812	0.8	<4.0	<0.2	0.72	2.3	2.17
Kane County								
Kanab area								
(C-44-5)6cbb-1	370050112274501	20150810	17.4	—	823	5.89	0.06	1.37
R(C-40-4)31bad-1	371740112210601	20150810	0.26	336	198	1.11	0.05	12.2
Millard County								
Pahvant Valley								
(C-21-5)7cdd-3	385939112272303	20150626	2.1	<4.0	<0.2	1.44	2.6	3.47
(C-23-5)5acd-1	385026112261001	20150626	0.21	<4.0	<0.2	0.29	0.05	0.96
(C-23-6)8abd-1	384953112325101	20150626	9.5	32.8	<1.0	2.1	13	10.8
(C-23-6)21add-1	384751112312201	20150626	5.9	<4.0	<0.2	1.36	2.5	2.84
(C-23-6)28bbb-2	384722112322101	20150626	3.2	13.9	<0.4	1.33	15	13.4
Sevier Desert								
(C-15-4)8cba-1	393154112192901	20150812	3.6	208	449	2.88	0.15	6.63
(C-15-4)11add-1	393158112152001	20150812	6.3	<8.0	<0.4	1.13	1.8	6.5
(C-15-4)26dcc-1	392859112154601	20150812	2.1	11.7	0.25	0.25	3.8	1.08
(C-15-5)27dcc-1	392854112233801	20150812	6	<4.0	<0.2	0.54	0.42	2.54
Snake Valley								
(C-18-19)20ddd-2	391324114000001	20150811	0.88	<4.0	<0.2	0.45	0.26	1.43
(C-20-20)1baa-2	390604114025201	20150811	1.4	<4.0	<0.2	0.57	0.53	1.38
(C-21-19)31cad-1	385640114012401	20150811	0.97	<4.0	<0.2	0.26	0.27	2.39
Piute County								
Upper Sevier River area								
(C-29-2)35bad-1	381440111584001	20150727	1.6	<4.0	0.23	0.52	0.35	6.1
(C-30-2)34bcc-1	380915112003001	20150727	2.1	<4.0	0.33	0.64	0.23	1.16

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2015.—Continued

[Date of sample: YYYYMMDD, year, month, day; µg/L, micrograms per liter; < , less than]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Salt Lake County								
Salt Lake Valley								
(A-1-1)31cac-1	404627111532601	20150828	1.3	6	<0.2	1.6	1.4	2.62
(C-1-1)22acb-1	404315111561501	20150610	3.8	55.1	37.1	5.65	<0.05	0.19
(C-3-1)12ccb-3	403409111542401	20150610	0.45	1,690	51.7	2.21	1.3	6.1
(D-1-1)7abd-6	404506111523301	20150610	1.3	7.1	7.16	1.16	1.7	1.93
(D-2-1)21dbc-1	403742111503201	20150828	0.78	12.2	<0.2	2.27	0.46	6.49
San Juan County								
Spanish Valley								
(D-26-22)36ccd-1	382929109272101	20150616	0.71	7.1	0.23	0.77	5.4	13.8
Sanpete County								
Sanpete Valley								
(D-15-4)17abb-1	393113111294501	20150901	0.19	6.1	<0.2	0.26	0.43	1.04
(D-17-3)9cbd-1	392056111353801	20150901	0.36	<4.0	<0.2	1.1	0.96	2.07
(D-17-3)20cdb-1	391904111363001	20150901	2.3	<4.0	<0.2	1.41	2.4	2.37
Central Sevier Valley								
(C-19-1)23cac-1	390819111530701	20150727	8.6	<8.0	<0.4	6.4	4	12
Sevier County								
Central Sevier Valley								
(C-23-2)15dcb-4	384757112002201	20150727	4	5.7	<0.2	3.31	1.2	5.77
(C-23-2)19dab-1	384702112031001	20150727	1.9	4.0	<0.2	0.49	0.33	2.06
Upper Sevier River area								
(C-26-1)25acc-1	383115111512501	20150727	2.6	<4.0	<0.2	0.89	0.15	0.12
Tooele County								
Rush Valley								
(C-5-5)15add-2	402310112231002	20150720	1.6	<4.0	<0.2	0.70	1.5	1.98
(C-8-5)7ddd-2	400745112263101	20150720	20.4	<4.0	<0.2	2.87	0.11	1.96
(C-9-5)5bbc-1	400401112262001	20150724	1.7	4.7	<0.2	0.45	0.59	1.18
Skull Valley								
(C-1-7)31daa-1	404113112395801	20150615	4.2	10.5	0.33	0.99	0.62	1.64
Tooele Valley								
(C-2-4)31dad-2	403556112195401	20150617	1.2	6.6	0.21	0.58	3.4	2.09
(C-2-4)33bdd-1	403629112174801	20150616	1.4	4.3	<0.2	0.53	2.1	2.28
(C-2-4)34bdd-2	403608112170301	20150617	1.7	5.2	0.7	0.21	11.3	1.9
(C-2-6)26dcd-1	403630112292301	20150616	1.1	<4.0	<0.2	0.56	0.59	1.41
(C-3-6)1bdb-1	403514112283701	20150616	0.51	6.8	<0.2	0.24	0.85	1.82
Utah County								
Cedar Valley								
(C-6-2)26cbc-1	401600112023401	20150715	5.4	17.1	20.3	4.05	0.13	4.7
(C-6-2)29bdb-1	401620112054301	20150715	1	108	50.8	1.28	0.17	0.64
Goshen Valley								
(C-9-1)4ddc-1	400309111565101	20150622	11.4	<4.0	<0.2	2.1	2.5	5.57
(C-9-1)28ccb-1	395956111572101	20150622	4.1	<8.0	<0.4	1.97	8	6.4
Northern Utah Valley								
(D-5-1)20aba-1	402236111511501	20150622	1.2	<4.0	<0.2	1.8	1.1	2.98
(D-5-1)22bbc-1	402215111494801	20150929	0.83	<4.0	<0.2	2.07	1.4	1.92
(D-7-2)4cbb-2	401414111435301	20150622	2	825	70.1	0.92	<0.05	0.02
Southern Utah Valley								
(D-9-1)36bbc-1	395942111470801	20150622	0.46	<4.0	<0.2	0.54	1.5	1.58
(D-9-2)9bac-1	400311111432001	20150622	3	<4.0	0.33	1.42	1.1	2.3

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2015.—Continued

[Date of sample: YYYYMMDD, year, month, day; µg/L, micrograms per liter; < , less than]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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
Wasatch County								
Heber Valley								
(D-3-4)26dba-1	403146111272701	20150826	11.2	<4.0	<0.2	0.66	0.34	0.97
(D-4-4)12dcc-1	402842111263101	20150825	1.1	9.2	<0.2	0.15	0.18	2.04
(D-4-4)13bdd-1	402810111263601	20150825	1	9.2	5.34	1.03	0.6	1.5
(D-4-5)3dcc-1	402937111214901	20150826	1.3	4.5	0.92	0.13	0.14	1.3
(D-4-5)4ccb-1	402946111233901	20150827	1.2	4.7	0.93	0.08	0.05	1.21
(D-4-5)6bcc-2	403003111255801	20150827	1.2	<4.0	0.43	0.16	0.17	1.07
(D-4-5)16bab-1	402840111232201	20150825	1.8	4	<0.2	0.38	0.31	1.82
(D-4-5)16ccd-1	402750111232701	20150827	1.1	4.4	0.7	1.47	0.99	1.83
Washington County								
Central Virgin River area								
(C-41-17)7dca-1	371400113473001	20150804	9.9	<4.0	<0.2	1.45	1.3	1.56
(C-42-13)7bba	370915113213801	20150810	0.93	13.2	0.34	0.40	2.6	7.15
(C-42-14)15cbd-1	370538113251301	20150810	7.9	<8.0	0.41	2.62	7.6	12.2
Wayne County								
Upper Fremont River Valley								
(D-27-2)26ddc-1	382544111392401	20150808	15.6	5.3	18.7	1.44	0.13	3.15
Weber County								
East Shore area								
(B-5-2)6bdd-4	411153112064601	20150608	14	327	110	0.45	<0.05	<0.014
(B-6-3)15cbc-1	411523112082101	20150608	21.6	91.8	57.9	2.91	<0.05	<0.014

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