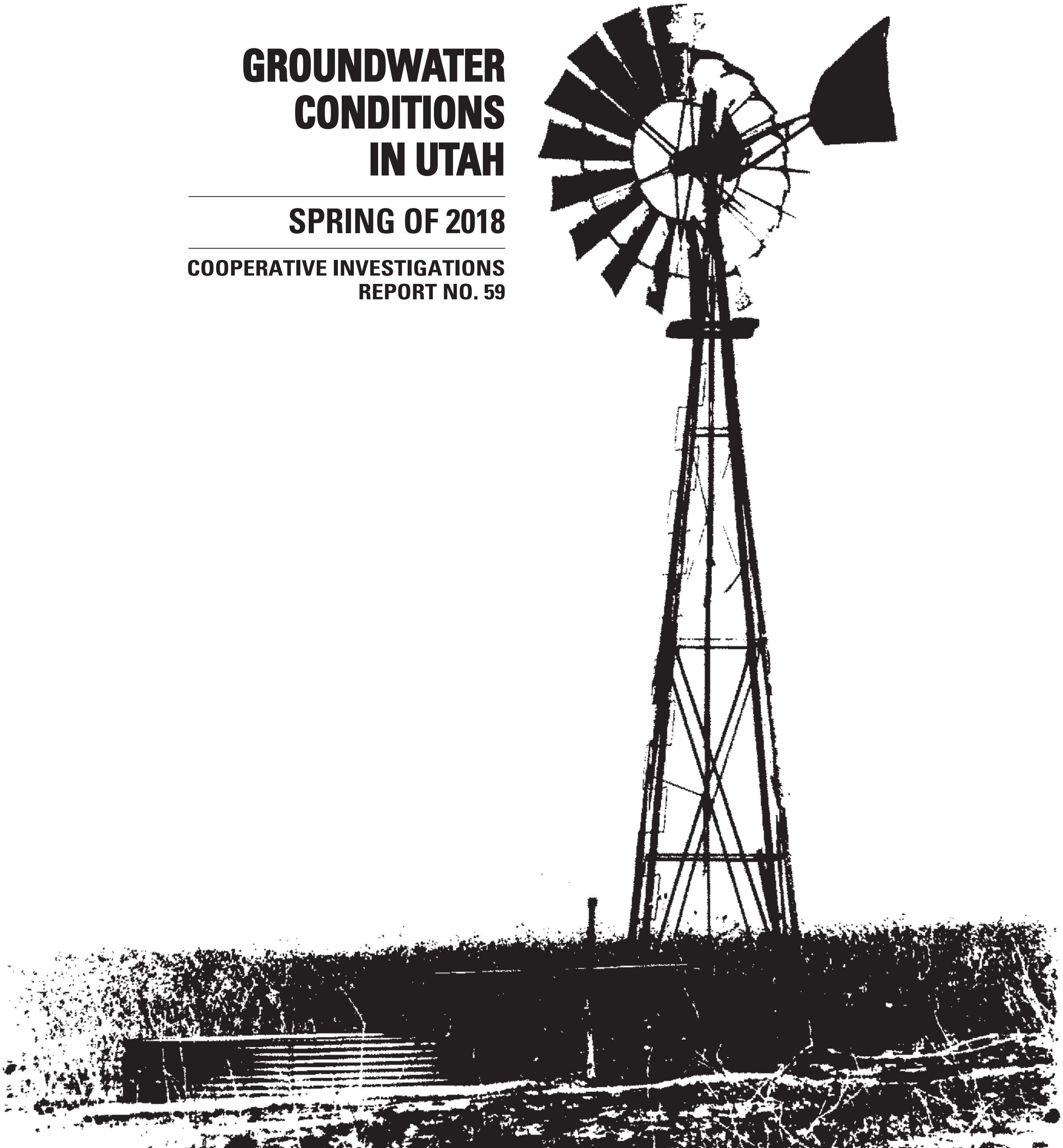
GROUNDWATER CONDITIONS IN UTAH

SPRING OF 2018

COOPERATIVE INVESTIGATIONS
REPORT NO. 59



UTAH DEPARTMENT OF NATURAL RESOURCES and
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

U.S. GEOLOGICAL SURVEY

GROUNDWATER CONDITIONS IN UTAH, SPRING OF 2018

By
Lincoln R. Smith and others
U.S. Geological Survey

Prepared by the U.S. Geological Survey
in cooperation with the Utah Department of Natural Resources,
Division of Water 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 29). 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 (μS/cm at 25 °C). 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.

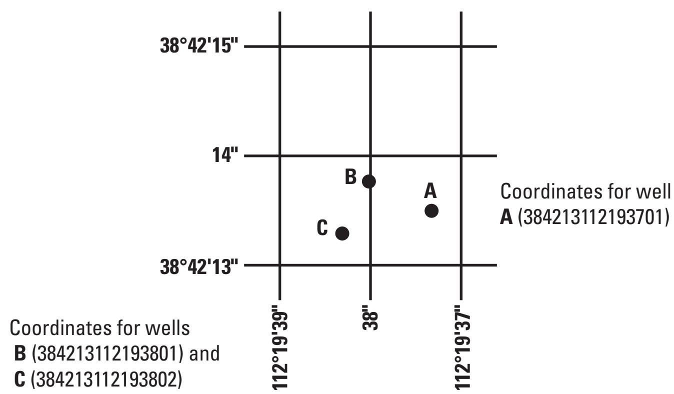
Land-surface datum (lsd)—A datum plane that is approximately at land surface at each groundwater observation well.

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

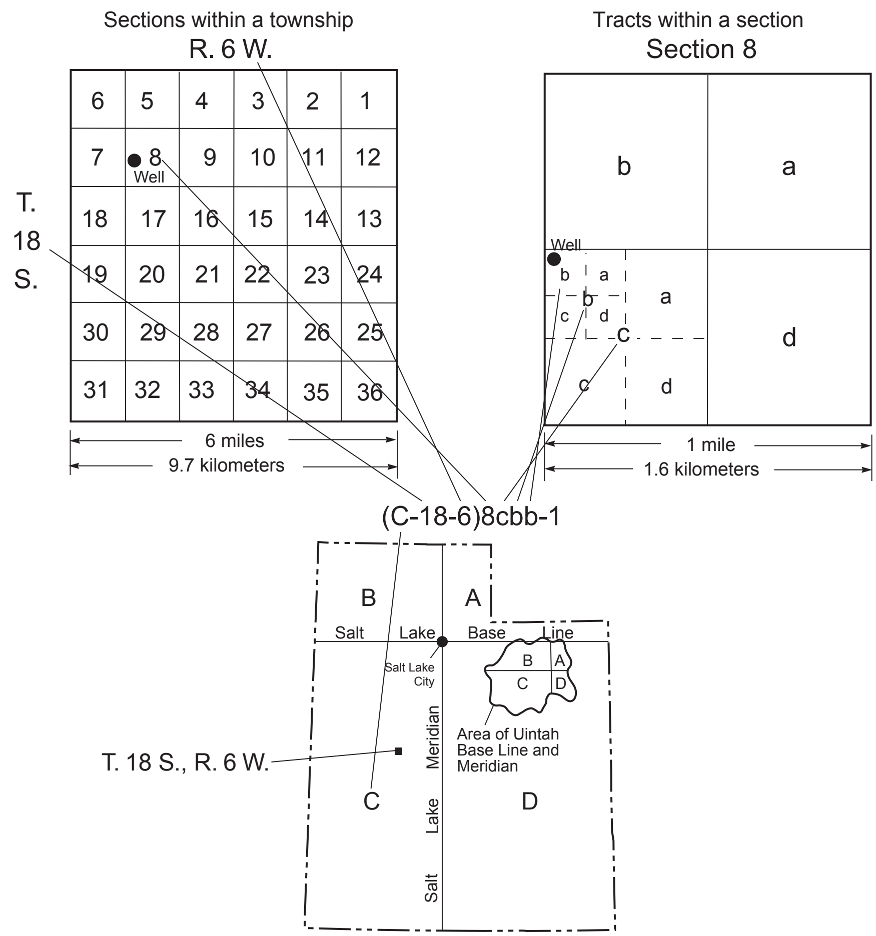
Wells by Latitude and Longitude

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 2018

By Lincoln R. Smith and others
U.S. Geological Survey

Introduction

This is the fifty-fifth 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 2017. 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 https://waterrights.utah.gov/techinfo/wwwpub/GW2018.pdf. Groundwater conditions in Utah for calendar year 2016 are reported in Burden and others (2017) and are available online at https://waterrights.utah.gov/techinfo/wwwpub/GW2017.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 can 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 2017 was about 962,400 acre-feet (table 2), which is 76,300 acre-feet less than the total for 2016 and about 39,000 acre-feet less than the 2007–2016 average annual withdrawal (table 3). The decrease in withdrawal resulted mostly from decreased withdrawals for irrigation and public supply. The total estimated withdrawal for public supply was about 266,700 acre-feet, which is 44,600 acre-feet less than the estimate for 2016 (Burden and others, 2017). Withdrawal for irrigation was about 564,300 acre-feet, which is 22,600 acre-feet less than in 2016. Withdrawal for industrial use was about 111,500 acre-feet, which is 6,700 acre-feet less than the value for 2016. Withdrawal for domestic and stock use was almost 20,000 acre-feet, about the same as in 2016.

From 2016 to 2017, groundwater withdrawals decreased in 11 of the 16 areas of groundwater development discussed in this report (table 2). Withdrawal in the Milford area of Escalante Valley increased about 5,500 acre-feet, the largest increase in any of the groundwater development areas shown on figure 1. Withdrawal in Salt Lake Valley decreased about 34,000 acre-feet, the largest decrease in any of the areas. The 2017 total withdrawal was less than the average annual withdrawal for 2007–2016 in 8 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 2017 at 13 of 27 weather stations included in this report, was more than the long-term average (Western Regional Climate Center, accessed July 1, 2018, at http://www.wrcc.dri.edu). The greatest increase in precipitation from average was 9.0 inches at Laketown. The greatest decrease in precipitation from average was 5.4 inches at Blanding.

During February and March 2018, 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 https://nwis.waterdata.usgs.gov/ut/nwis/gwlevels.

In 2017, 455 new wells were constructed, as reported by the Utah Division of Water Rights (table 2); this is 47 more wells than the total reported for 2016 (Burden and others, 2017). In 2017, 26 large-diameter wells (12 inches or more) were constructed (table 2), which is one more than in 2016. These new wells are used principally for withdrawal of water for public supply, irrigation, and industrial purposes.

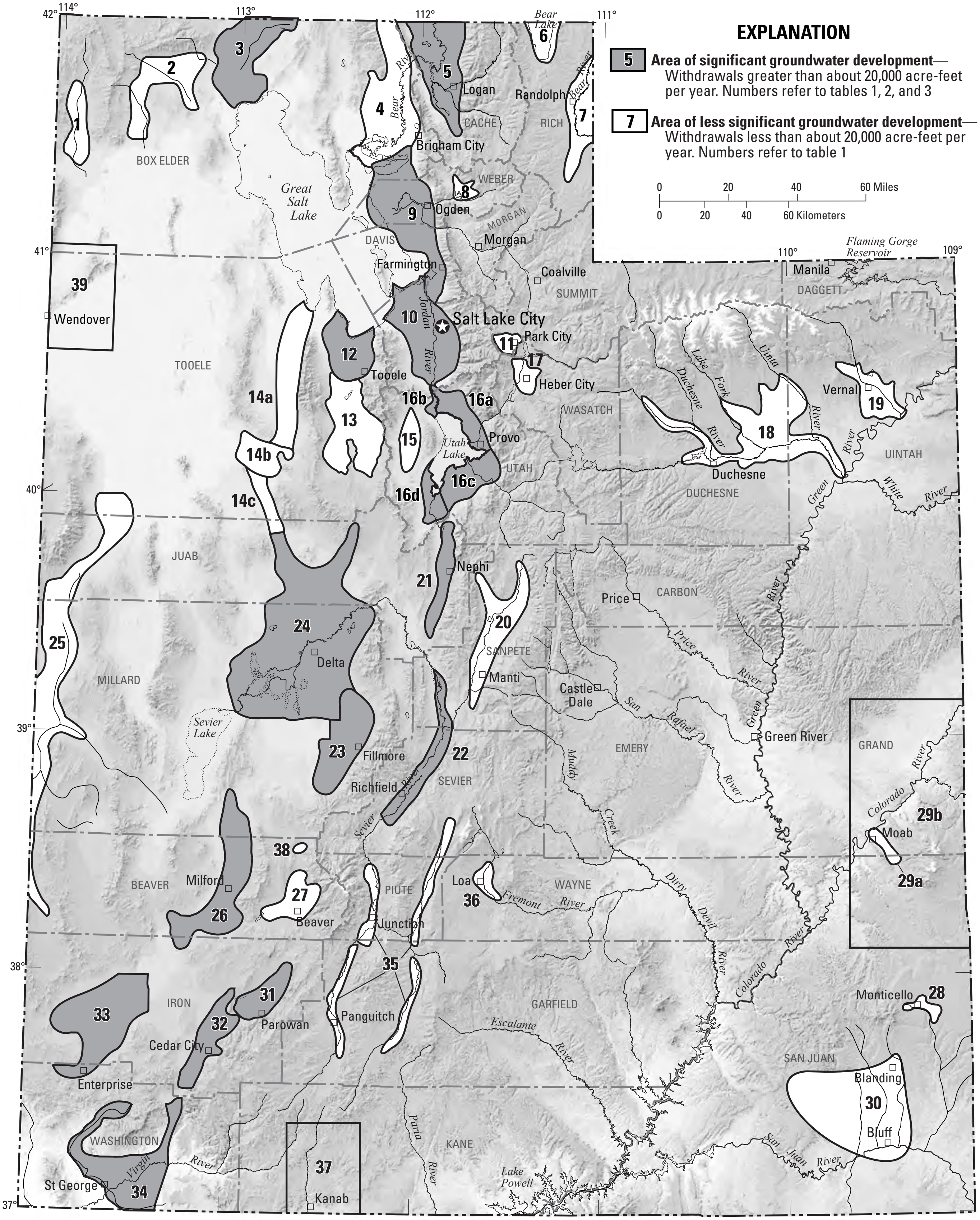


Figure 1. Areas of groundwater development in Utah specifically referred to in this report.

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

Number on 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, 2017.

Area	Number on figure 1	Number of wells[1] constructed in 2017		Estimated withdrawal from wells, in acre-feet (rounded)					
				2017					2016 total[2]
		Total	Diameter of 12 inches or more	Irrigation	Industrial[1]	Public supply[1]	Domestic and stock	Total	
Curlew Valley	3	0	0	33,200	0	30	80	33,300	34,300
Cache Valley	5	46	0	13,100	5,900	11,700	[3]1,500	32,200	30,000
East Shore area	9	1	0	3,600	2,600	30,900	[3]1,100	38,200	[4]42,000
Salt Lake Valley	10	5	0	200	[5]37,400	65,200	[3]490	103,300	137,300
Tooele Valley	12	14	0	[6,7]13,600	590	11,100	[3]910	26,200	26,000
Utah and Goshen Valleys	16	41	1	32,500	12,000	59,400	[3]1,800	105,700	118,800
Northern Utah Valley-east[8]	16a	(9)	0	(2,000)	(9,700)	(39,600)	(600)	(51,900)	(60,400)
Northern Utah Valley-west[8]	16b	(2)	0	0	0	(4,600)	(200)	(4,800)	(5,200)
Southern Utah Valley[8]	16c	(28)	(1)	(7,000)	(2,300)	(14,900)	(900)	(25,100)	(29,100)
Goshen Valley[8]	16d	(2)	0	(23,500)	0	(300)	(100)	(23,900)	(24,100)
Juab Valley	21	7	1	19,400	120	[9]430	480	20,400	32,500
Sevier Desert	24	10	0	44,700	3,600	2,900	890	52,100	56,500
Central Sevier Valley	22	15	1	29,600	80	3,500	840	34,000	32,400
Pahvant Valley	23	7	3	108,900	0	1,000	320	110,200	114,300
Cedar Valley, Iron County	32	13	3	30,700	100	8,700	2,600	42,100	39,400
Parowan Valley	31	2	1	[10]34,100	400	300	360	35,200	36,600
Escalante Valley									
Milford area	26	3	2	46,800	[11]22,600	1,100	130	70,600	65,100
Beryl-Enterprise area	33	15	5	86,200	[12]1,900	1,100	650	89,900	95,000
Central Virgin River area	34	12	3	5,200	530	23,100	2,400	31,200	[4]33,400
Other areas[13,14]	([15])	264	6	62,500	23,700	46,200	5,400	137,800	145,100
Total	—	455	26	564,300	111,520	266,660	19,950	962,400	[4]1,038,700

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

[2]From Burden and others (2017, table 2).

[3]From Maupin and others, 2014.

[4]Revised from previous report in this series.

[5]Includes some use for air conditioning, about 1,800 acre-feet, of which about 92 percent was injected back into the aquifer.

[6]Includes some domestic and stock use.

[7]Includes some flowing well discharge.

[8]Numbers for Northern Utah Valley-east, Northern Utah Valley-west, Southern Utah Valley, and Goshen Valley, presented within parentheses, are a subtotal of total withdrawal for Utah and Goshen Valleys.

[9]Previously included some springs.

[10]Includes some stock use.

[11]Includes 19,500 acre-feet for geothermal power generation, of which about 99 percent was injected back into the aquifer.

[12]Withdrawal used for heating greenhouses, of which about 95 percent was injected back into the aquifer.

[13]Withdrawal totals are estimated minimum. See "Other Areas" section of this report for withdrawal estimates (table 4).

[14]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.

[15]Refer to table 4 in report for other areas and associated numbers on figure 1.

Table 3. Total annual withdrawal of water from wells in significant areas of groundwater development in Utah, 2007–2016.

Area	Number on figure 1	Thousands of acre-feet[1] (rounded)										2007–2016 average (rounded)	2017
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		
Curlew Valley	3	38	44	34	39	32	42	40	35	34	34	37	33
Cache Valley	5	36	34	31	33	30	38	38	27	31	30	33	32
East Shore area	9	[2]58	[2]60	[2]51	[2]48	[2]41	[2]52	[2]55	[2]46	[2]40	[2]42	49	38
Salt Lake Valley	10	151	135	137	140	126	167	153	145	132	137	142	103
Tooele Valley	12	[2]27	[2]28	25	24	21	30	25	22	25	26	25	26
Utah and Goshen Valleys	16	126	[2]120	[2]105	[2]106	[2]90	[2]113	[2]115	107	102	119	110	106
Northern Utah Valley[3]	(16a,b)	(72)	[2](67)	[2](60)	[2](58)	[2](45)	[2](62)	(60)	(54)	(52)	(66)	(60)	(57)
Southern Utah Valley[3]	(16c)	(38)	(34)	(30)	(31)	(28)	[2](35)	(35)	(31)	(28)	(29)	(32)	(25)
Goshen Valley[3]	(16d)	(16)	(19)	(15)	(17)	(17)	[2](16)	[2](20)	(22)	(22)	(24)	(19)	(24)
Juab Valley	21	26	26	21	22	15	28	27	29	31	33	26	20
Sevier Desert	24	34	44	48	46	20	24	[2]46	53	55	57	43	52
Central Sevier Valley	22	19	24	27	26	31	28	28	31	30	32	28	34
Pahvant Valley	23	89	94	104	106	89	114	103	118	128	114	106	110
Cedar Valley, Iron County	32	40	40	38	38	34	40	39	43	40	39	39	42
Parowan Valley	31	34	38	37	34	32	38	32	38	34	37	35	35
Escalante Valley													
Milford area	26	49	51	56	62	53	67	68	67	68	65	61	71
Beryl-Enterprise area	33	92	93	93	90	84	91	93	103	93	95	93	90
Central Virgin River area	34	33	29	33	29	28	29	29	31	34	[2]33	31	31
Other areas	([4])	155	144	130	134	123	156	145	159	144	145	144	138
Total	—	[2]1,007	[2]1,004	[2]970	[2]977	[2]849	[2]1,057	[2]1,036	[2]1,054	[2]1,021	[2]1,038	1,001	[5]961

[1]From previous reports in this series.

[2]Revised from previous report in this series.

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

[4]Refer to table 4 in report for other areas and associated numbers on figure 1.

[5]Difference in totals between tables 2 and 3 result from rounding to nearest thousand acre-feet.

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 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. Water generally moves south toward Locomotive Springs and Great Salt Lake.

The principal source of water in Curlew Valley is groundwater, which is used mainly for irrigation (table 2). The groundwater reservoir consists primarily of confined artesian aquifers in alluvial and lacustrine basin-fill deposits and some water-table (unconfined) conditions in 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 2017 was about 33,300 acre-feet, which is 1,000 acre-feet less than the 2016 value and about 4,000 acre-feet less than the average annual withdrawal for 2007–2016 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2018 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 2017 was about 14.6 inches, which is 2.4 inches less than in 2016 and 3.5 inches more than the average annual precipitation for 1930–2017.

Water levels in Curlew Valley generally rose, or declined slightly, from March 2017 to March 2018. However, one well in particular, located roughly 3 miles west of Snowville, featured a significantly large rise of nearly 58 feet. Excluding this well, the largest rise, about 2.5 feet, occurred in a well about 11 miles west of Snowville. The largest decline, about 1.3 feet, occurred in a well about 15 miles west of Snowville. These larger increases and decreases in water level are 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 industrial-scale 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 1972–2017 and 1971–2017, respectively, is shown in figure 3. Dissolved-solids concentrations in water from both wells have generally increased since the early 1970s.

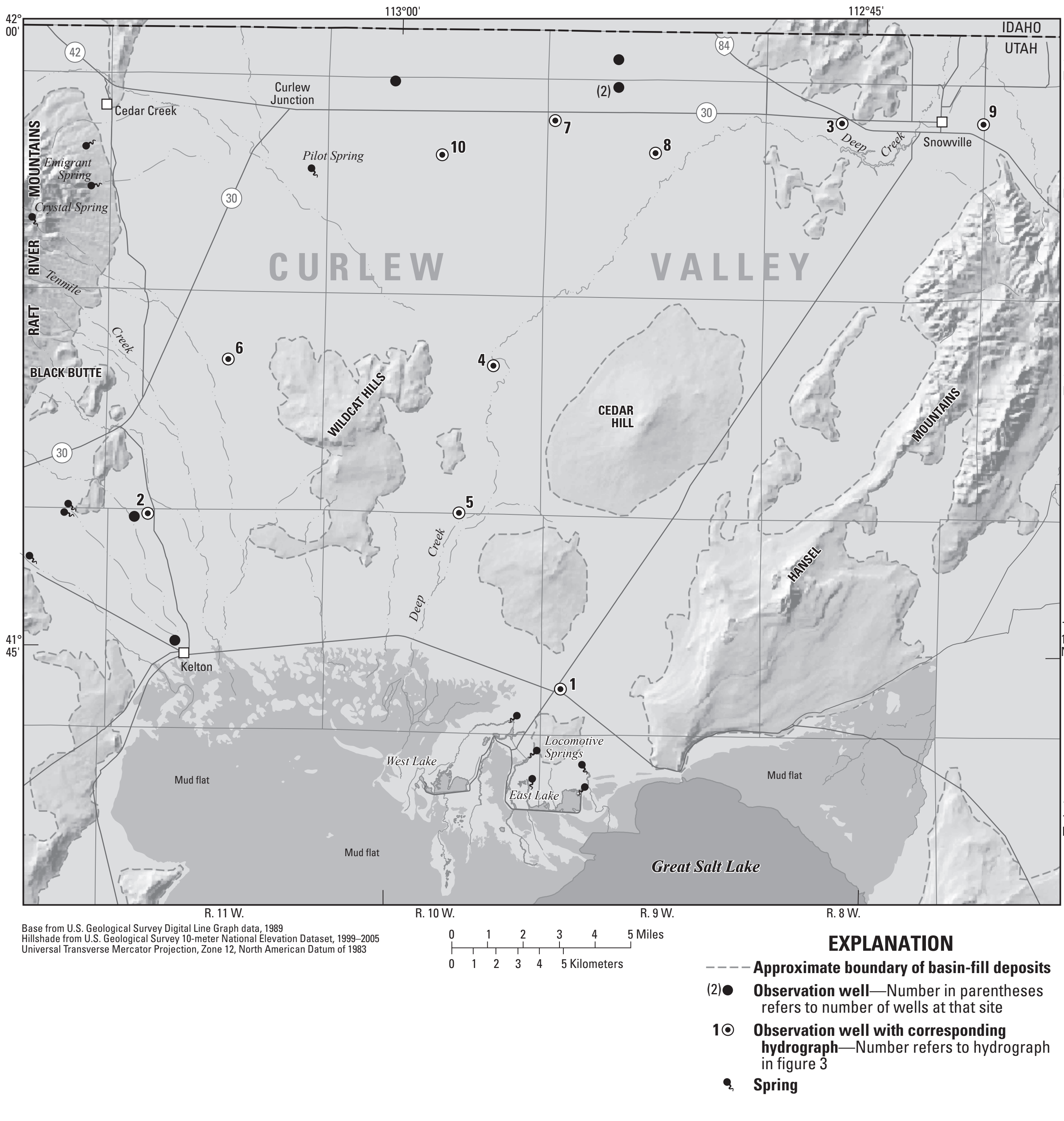


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2018.

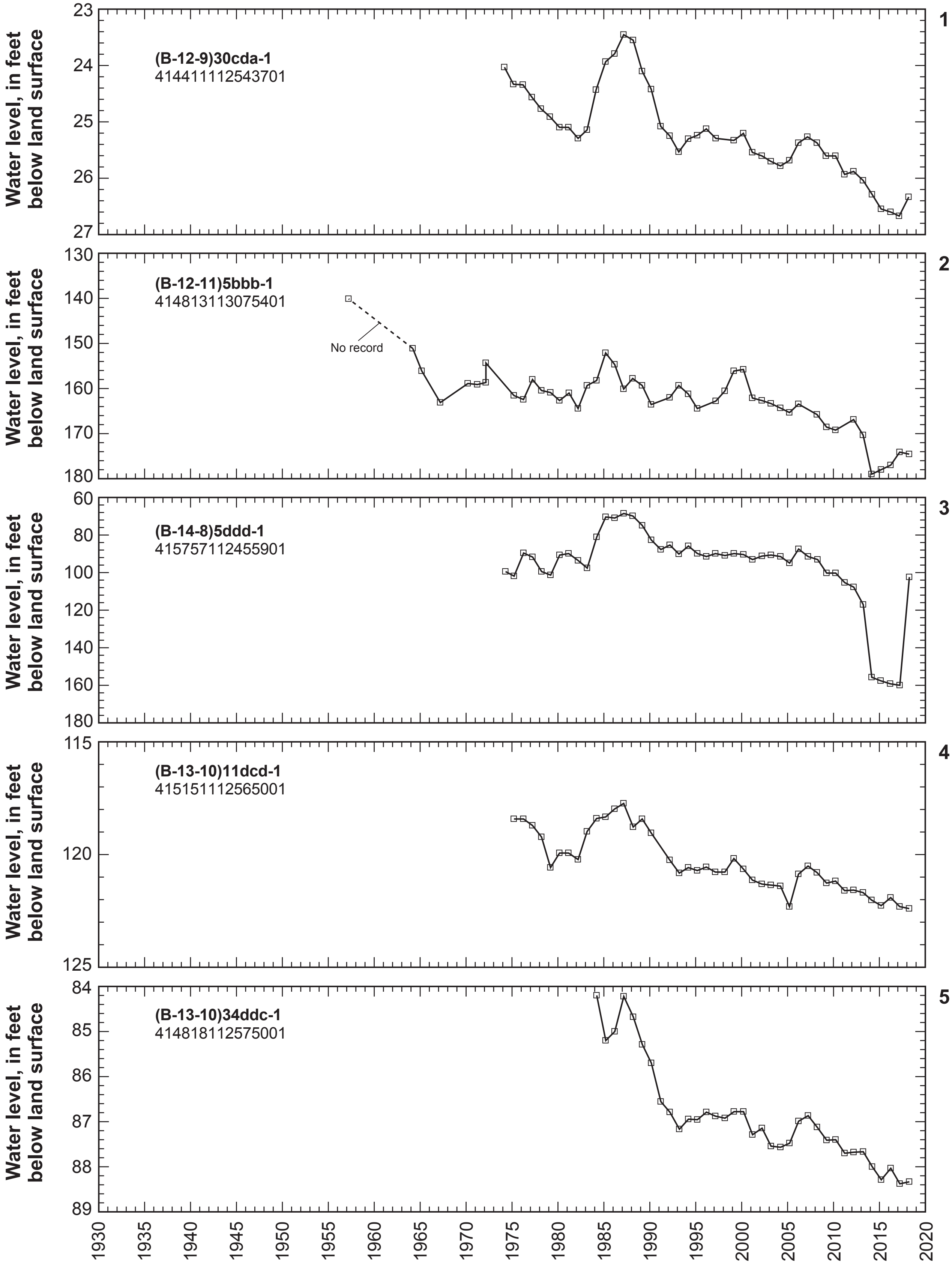


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

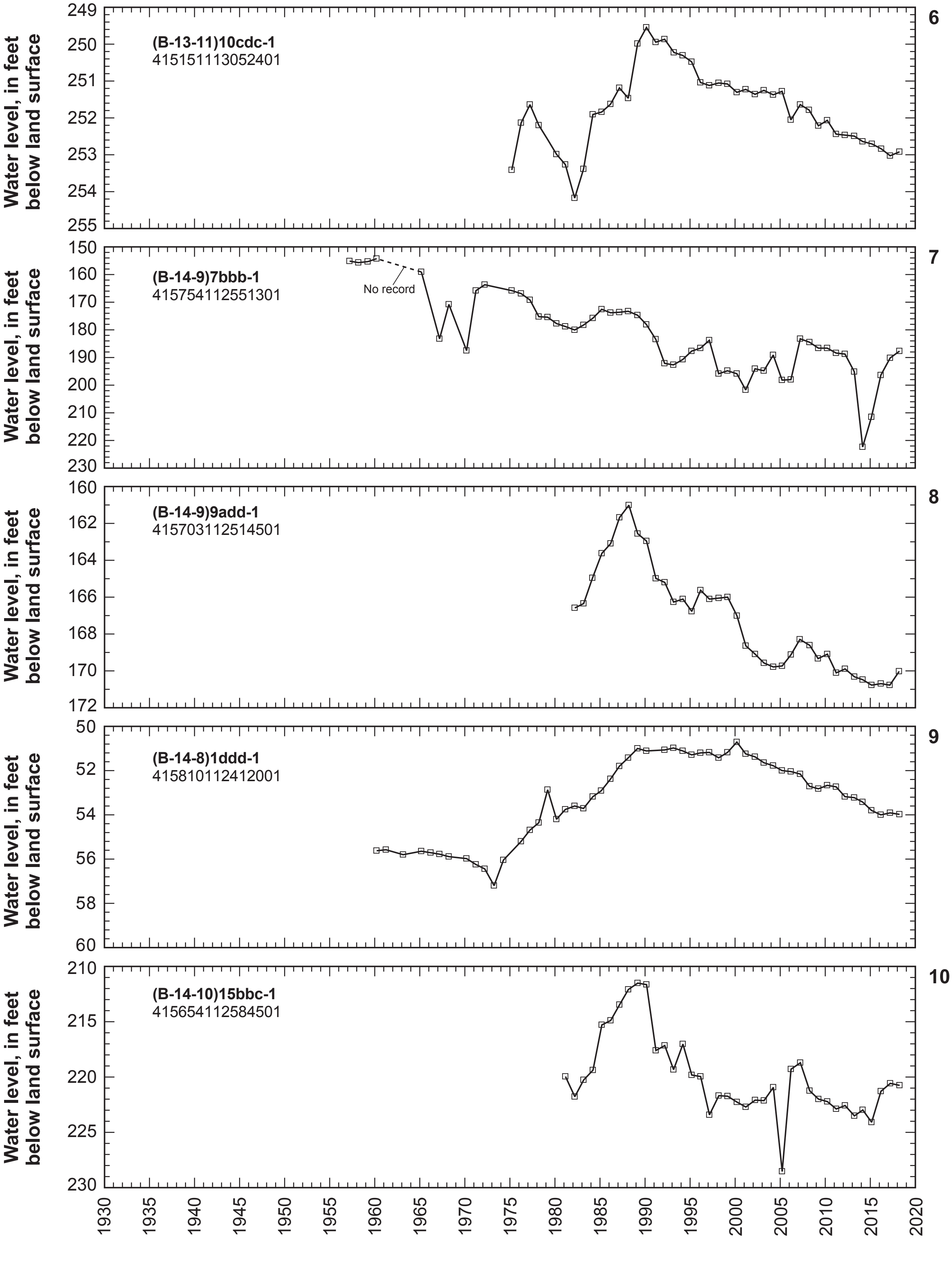


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

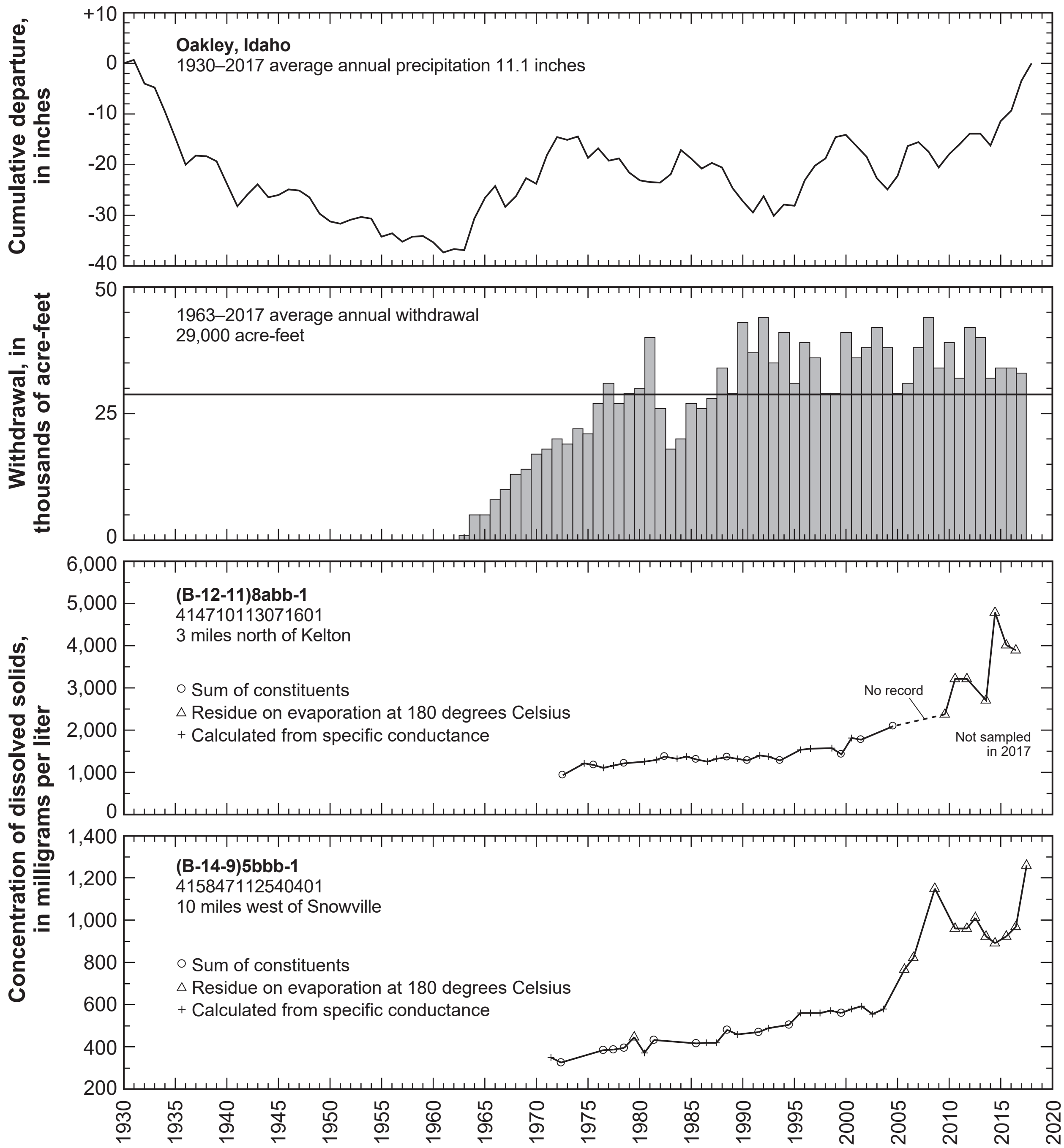


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cache Valley

By Phillip H. Klebba

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, and is used primarily for irrigation and public supply (table 2). 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 2017 was about 32,200 acre-feet, which is 2,200 acre-feet more than in 2016 and about 1,000 acre-feet less than the average annual withdrawal for 2007–2016 (tables 2 and 3). Withdrawal for irrigation was 13,100 acre-feet, of which an estimated 11,800 acre-feet was from flowing wells. Irrigation withdrawals were 500 acre-feet less than in 2016. Withdrawal for public supply was 11,700 acre-feet, which is 1,300 acre-feet more than in 2016.

The location of wells in Cache Valley in which the water level was measured during March 2018 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 2017 was about 307,300 acre-feet, which is 151,900 acre-feet more than the 2016 total and 127,500 acre-feet more than the 1941–2017 average annual discharge. Precipitation at Logan, Utah State University, was about 25.0 inches in 2017. This is about 0.6 inch less than for 2016 and about 6.6 inches more than the average annual precipitation for 1930–2017.

Water levels throughout the valley generally rose from March 2017 to March 2018. Rises are probably the result of greater-than-average precipitation and less-than-average withdrawals. 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 2017 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 concentration of dissolved solids in the August 2017 sample was 253 mg/L.

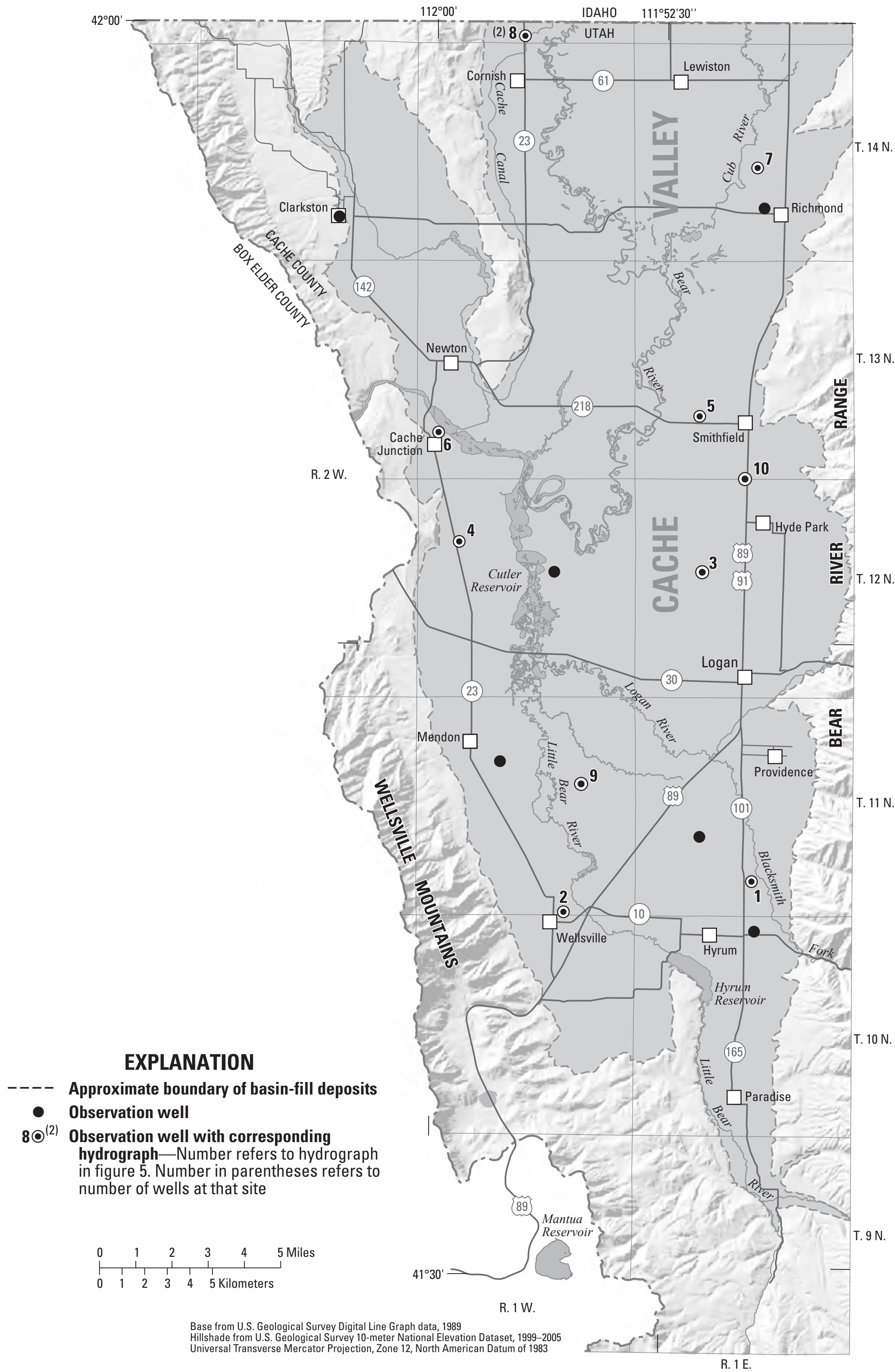


Figure 4. Location of wells in Cache Valley in which the water level was measured during March 2018.

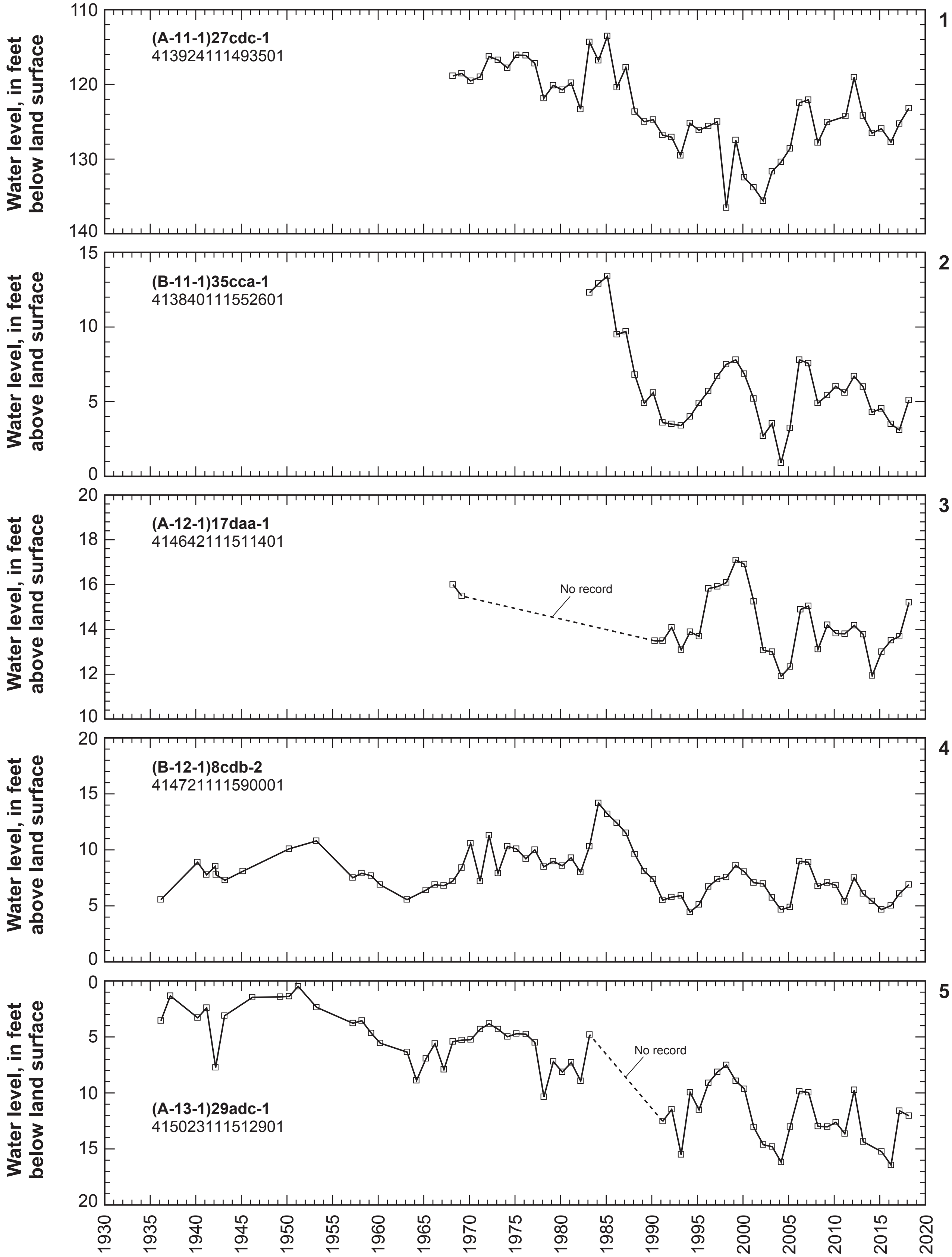


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

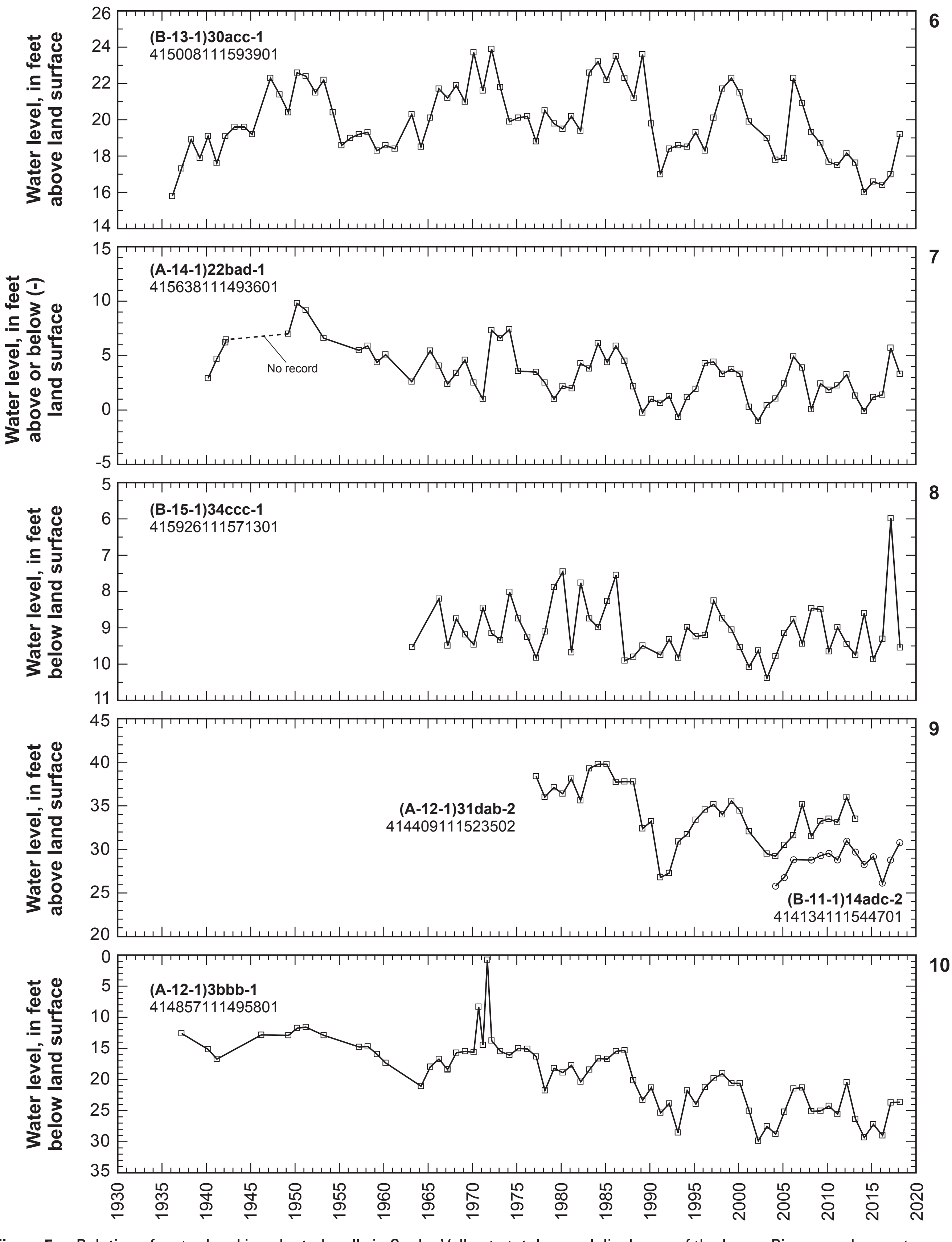


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

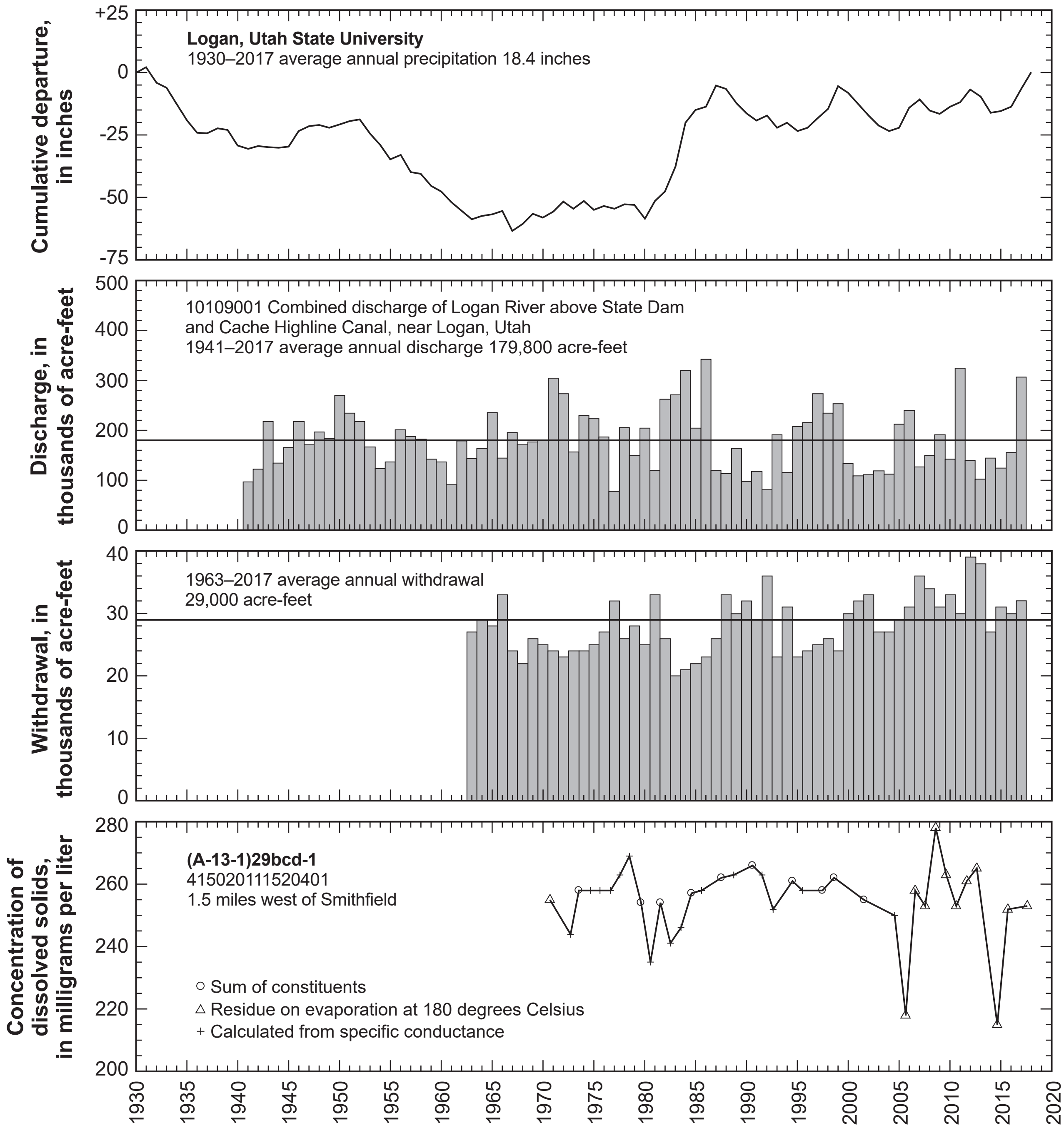


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

East Shore Area

By Katherine K. Jones

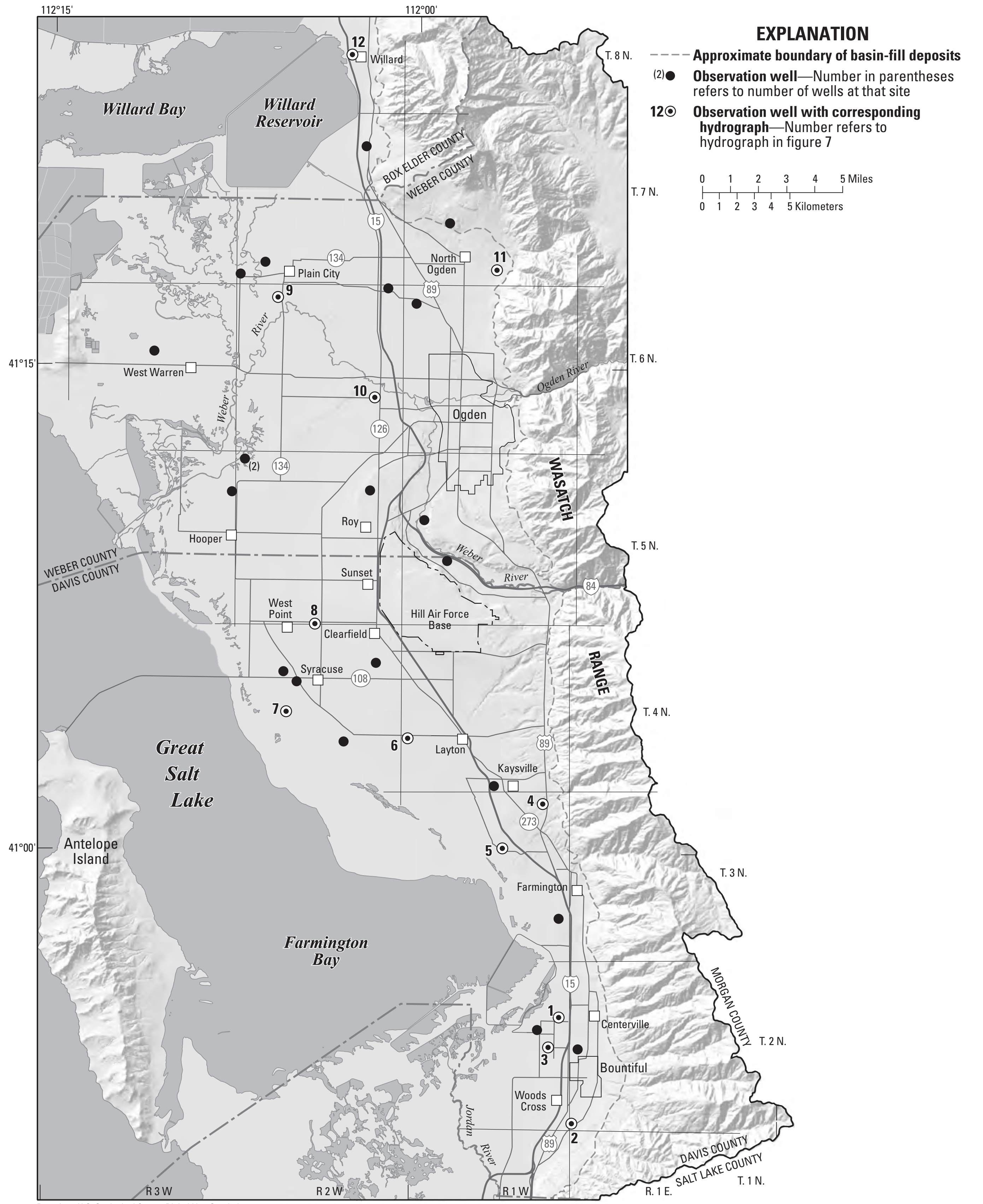
The East Shore area is in north-central Utah between the Wasatch Range and Great Salt Lake within Davis, Weber, and Box Elder Counties (fig. 6). Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions, but most of the water withdrawn by wells is from the artesian aquifers, and is used primarily for public supply (table 2). 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 2017 was about 38,200 acre-feet, which is 3,800 acre-feet less than the revised value for 2016 and about 11,000 acre-feet less than the average annual withdrawal for 2007–2016 (tables 2 and 3). Withdrawal for public supply was 30,900 acre-feet in 2017, about 3,800 acre-feet less than the revised value of 34,700 acre-feet for 2016. Withdrawal for irrigation was about 3,600 acre-feet, which is 800 acre-feet more than was reported for 2016. Withdrawal for industrial use was about 2,600 acre-feet, which is 400 acre-feet less than in 2016.

The location of wells in the East Shore area in which the water level was measured during March 2018 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 2017 was about 30.0 inches, which is about 0.5 inch less than the average annual precipitation for 1949–2017 and about 4.5 inches less than in 2016.

Water levels rose from March 2017 to March 2018 in most of the wells measured in the East Shore area. Rises are probably due to less withdrawal 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 2017, is shown in figure 7. The median concentration during this period was 391 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 2017 were much less variable, ranging from 362 to 399 mg/L. The dissolved-solids concentration in the water sample collected in June 2017 (376 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 2018.

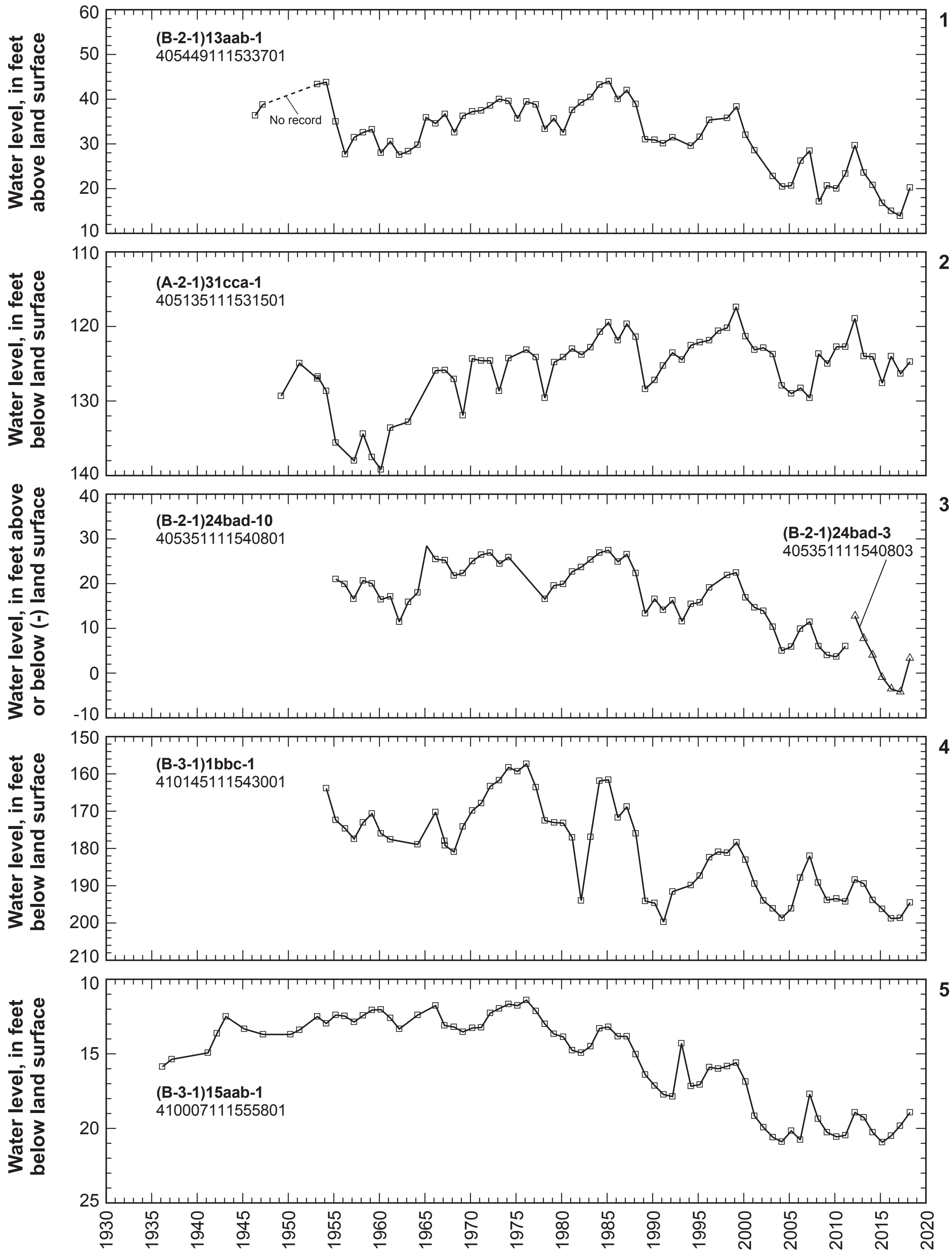


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

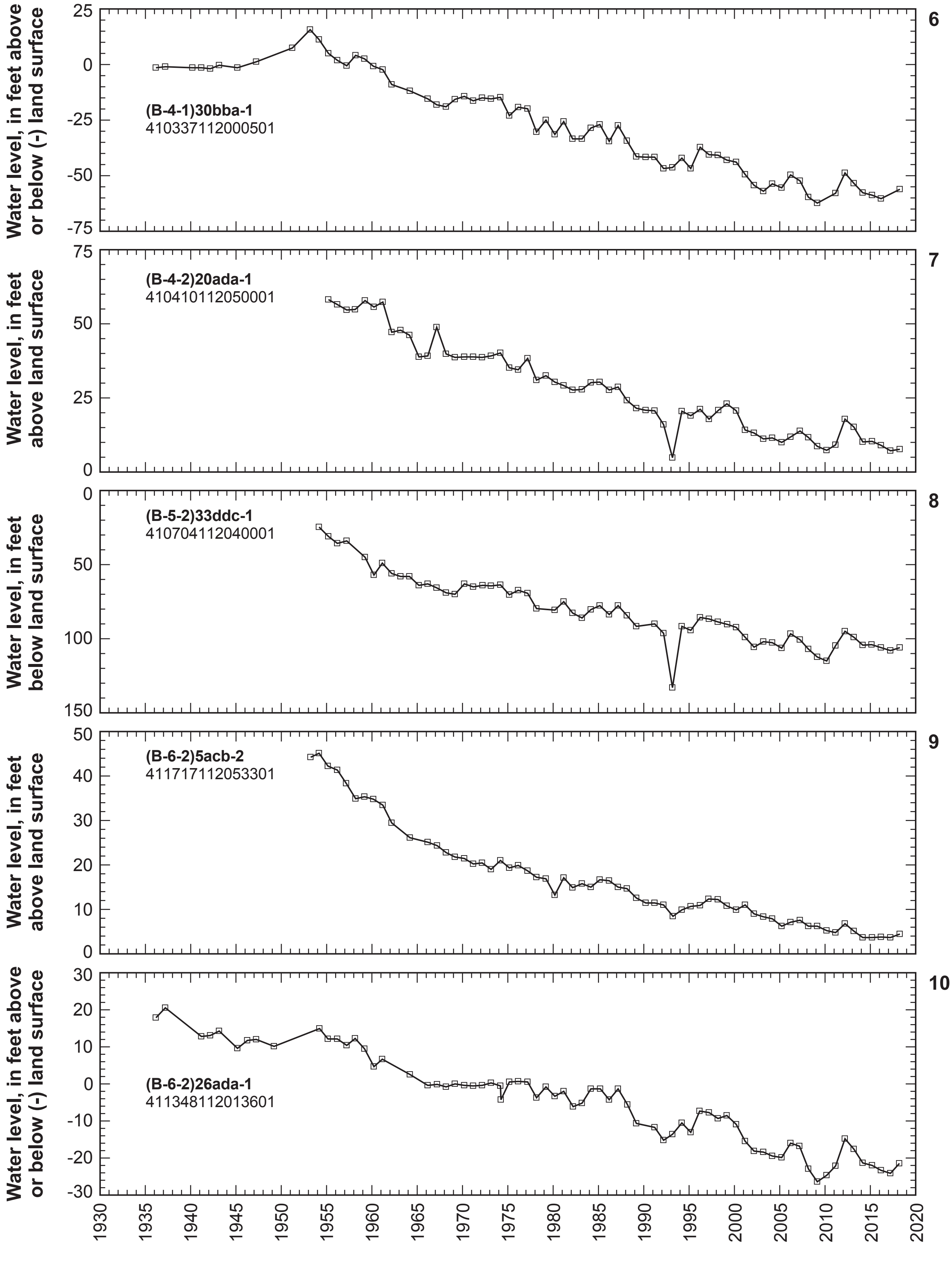


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

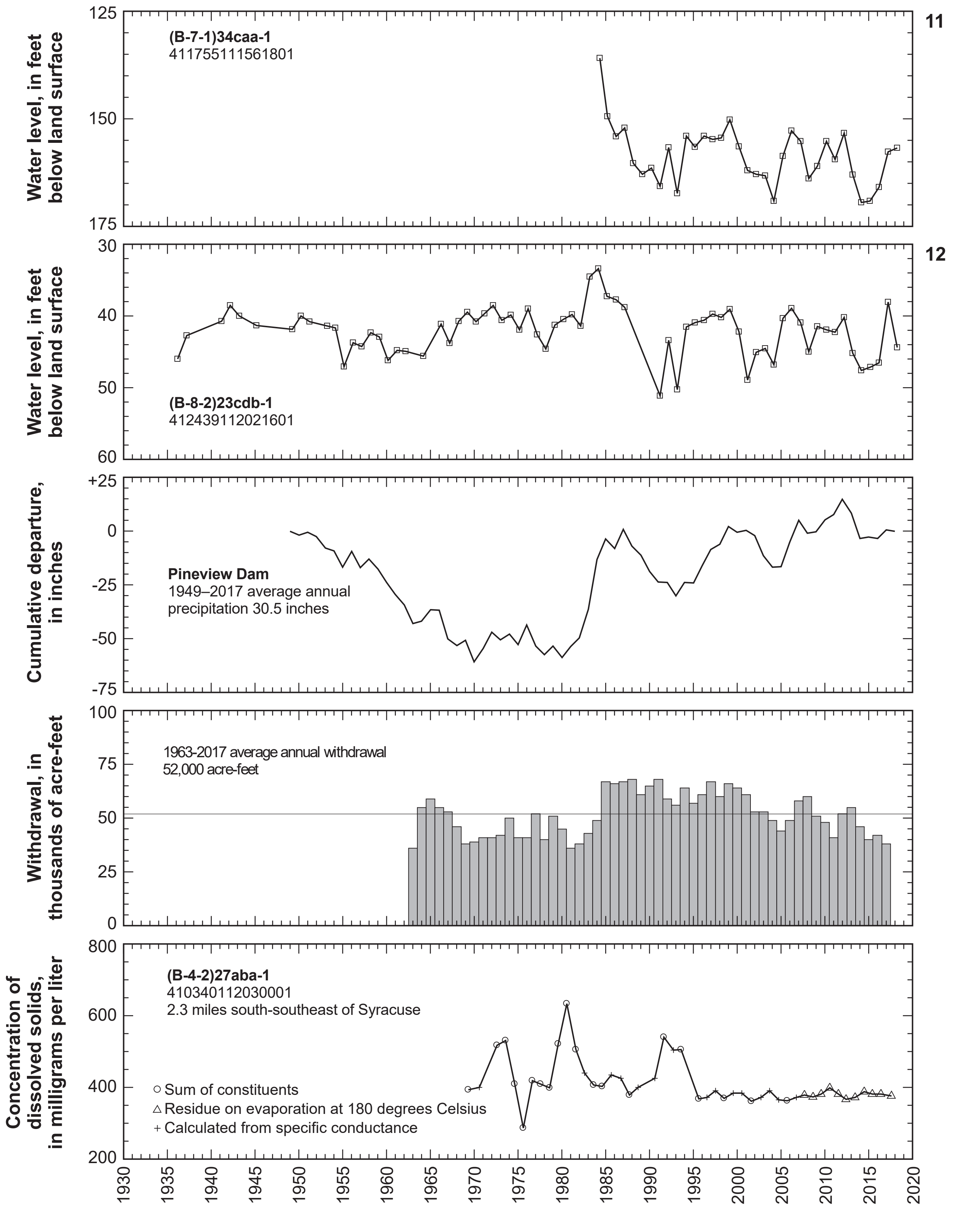


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

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, and is used primarily for public supply and industrial purposes (table 2). 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 2017 was about 103,300 acre-feet, which is 34,000 acre-feet less than in 2016 and about 39,000 acre-feet less than the average annual withdrawal for 2007–2016 (tables 2 and 3). Withdrawal for public supply was about 65,200 acre-feet, which is 29,100 acre-feet less than the total for 2016. Withdrawal for industrial use was about 37,400 acre-feet, which is 5,000 acre-feet less than the total for 2016. The decrease in total withdrawals is likely due to an increase in available surface water from snowmelt runoff.

The location of wells in Salt Lake Valley in which the water level was measured during February 2018 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 2017 was about 16.0 inches, about 1.2 inches more than in 2016 and about 0.8 inch more than the average annual precipitation for 1931–2017.

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 44.4 inches in 2017, which is 5.0 inches more than in 2016 and about 2.2 inches more than the average annual precipitation for 1931–2017.

Water-level changes were mostly very small from February 2017 to February 2018 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. Water levels have generally declined since 1987.

The concentrations of dissolved solids and dissolved chloride (from 1931–2017 and 1935–2017, 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 711 mg/L. The concentration of dissolved solids has generally increased since about 1947. The dissolved-solids concentration from the water sample in June 2017 was 814 mg/L. The dissolved chloride concentration generally increased from 44 mg/L in February 1948 to 194 mg/L in July 2012, but has generally decreased since then, with a median value of 120 mg/L. The chloride concentration in the water sample from June 2017 was 180 mg/L.

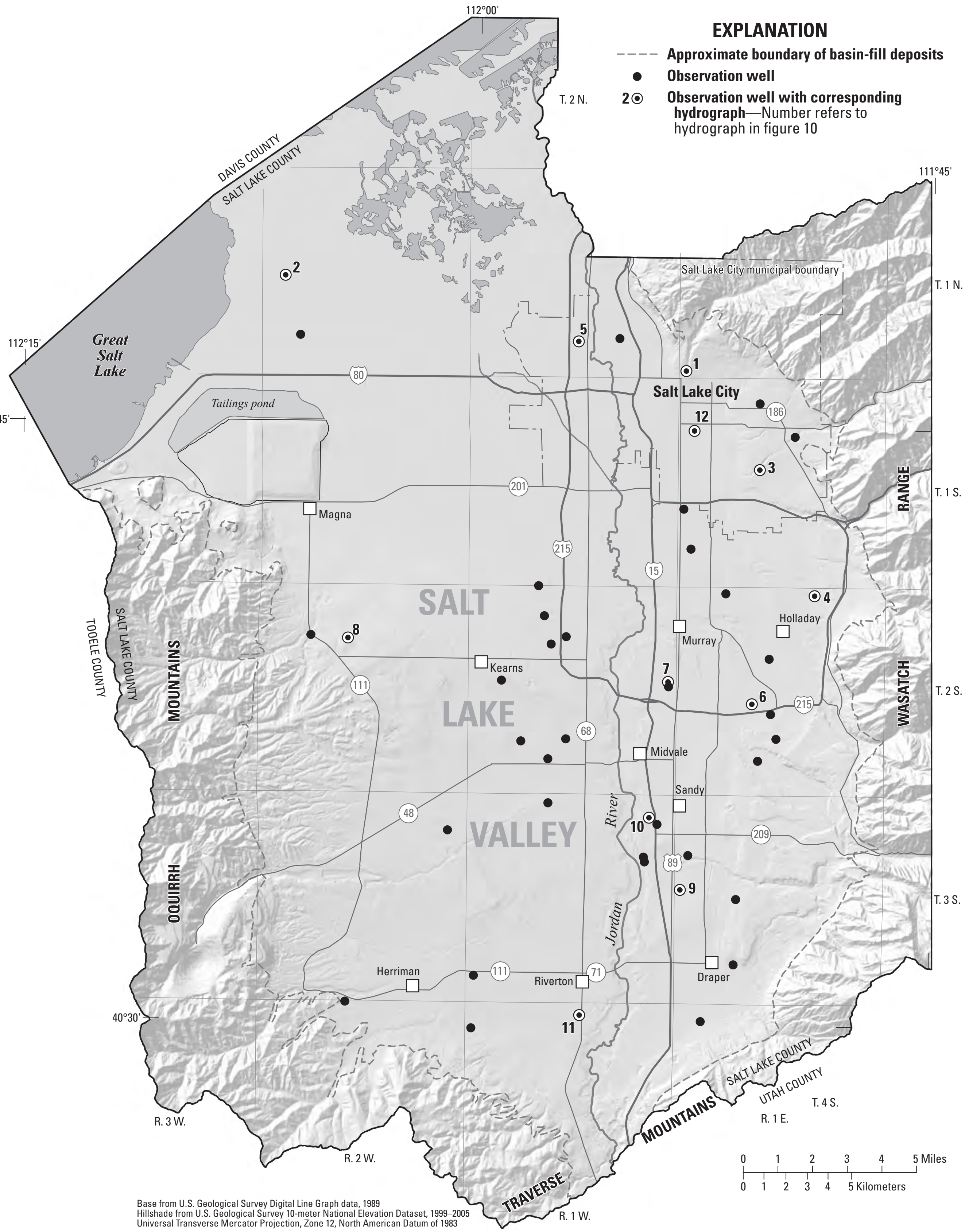


Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 2018.

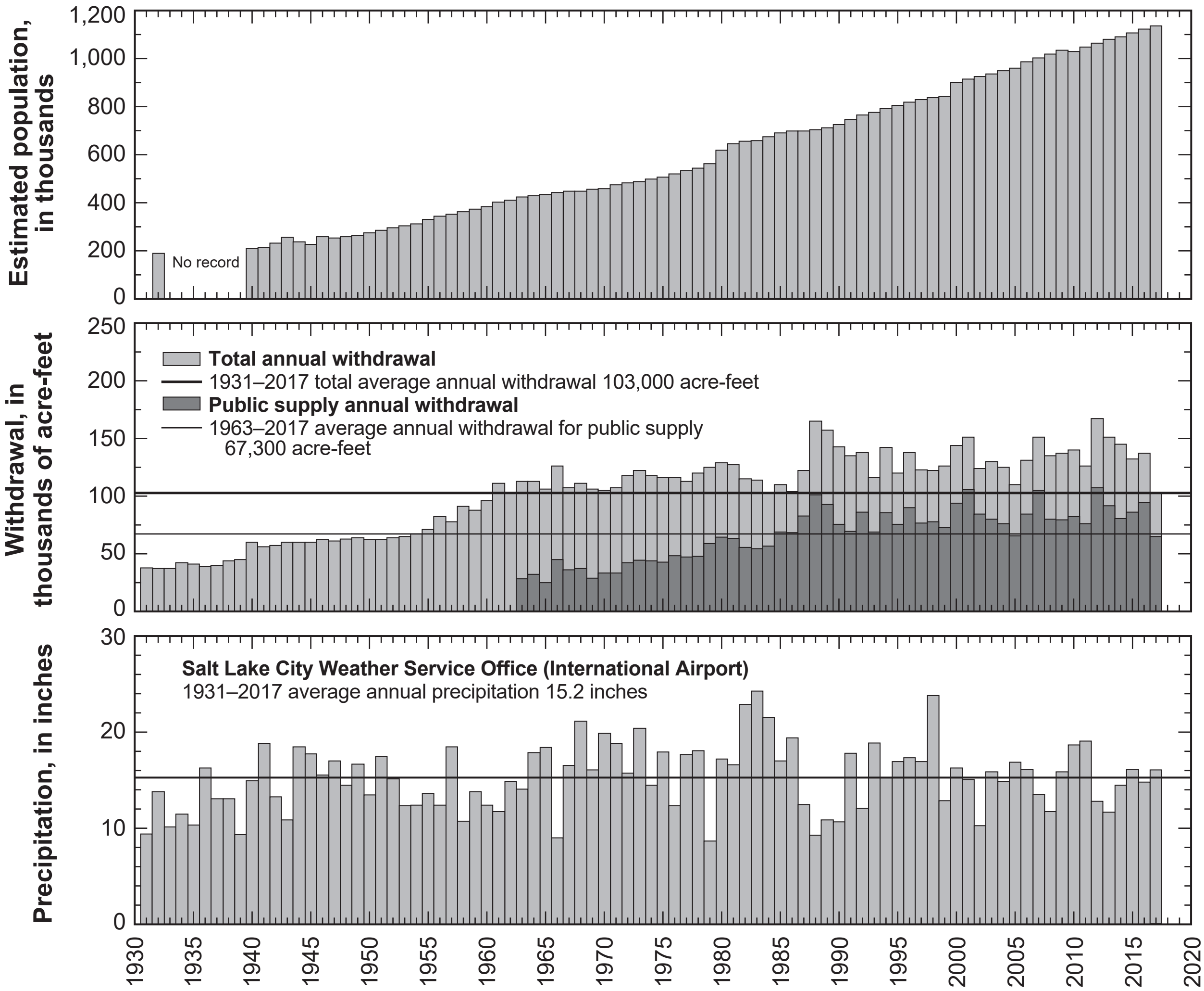


Figure 9. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

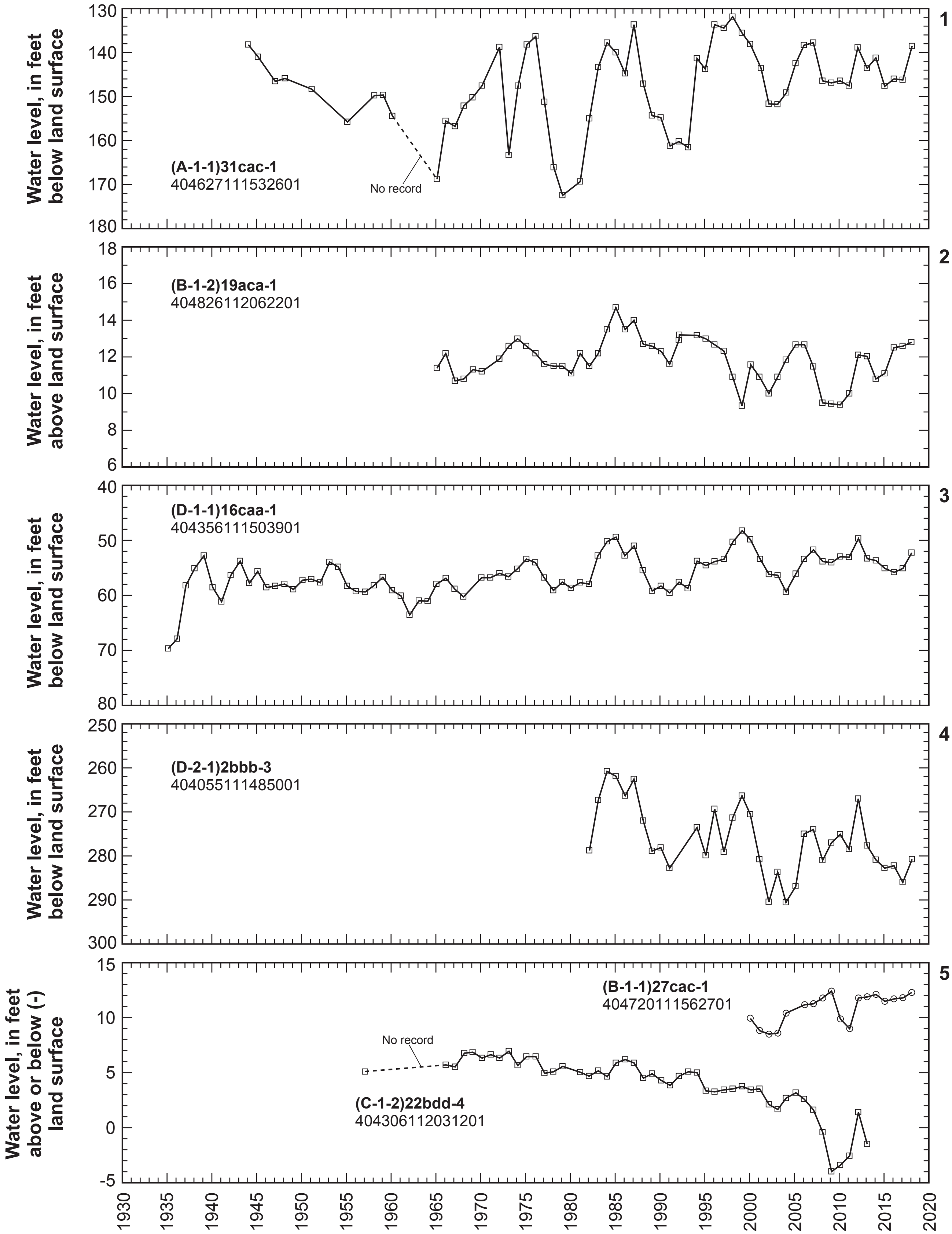


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

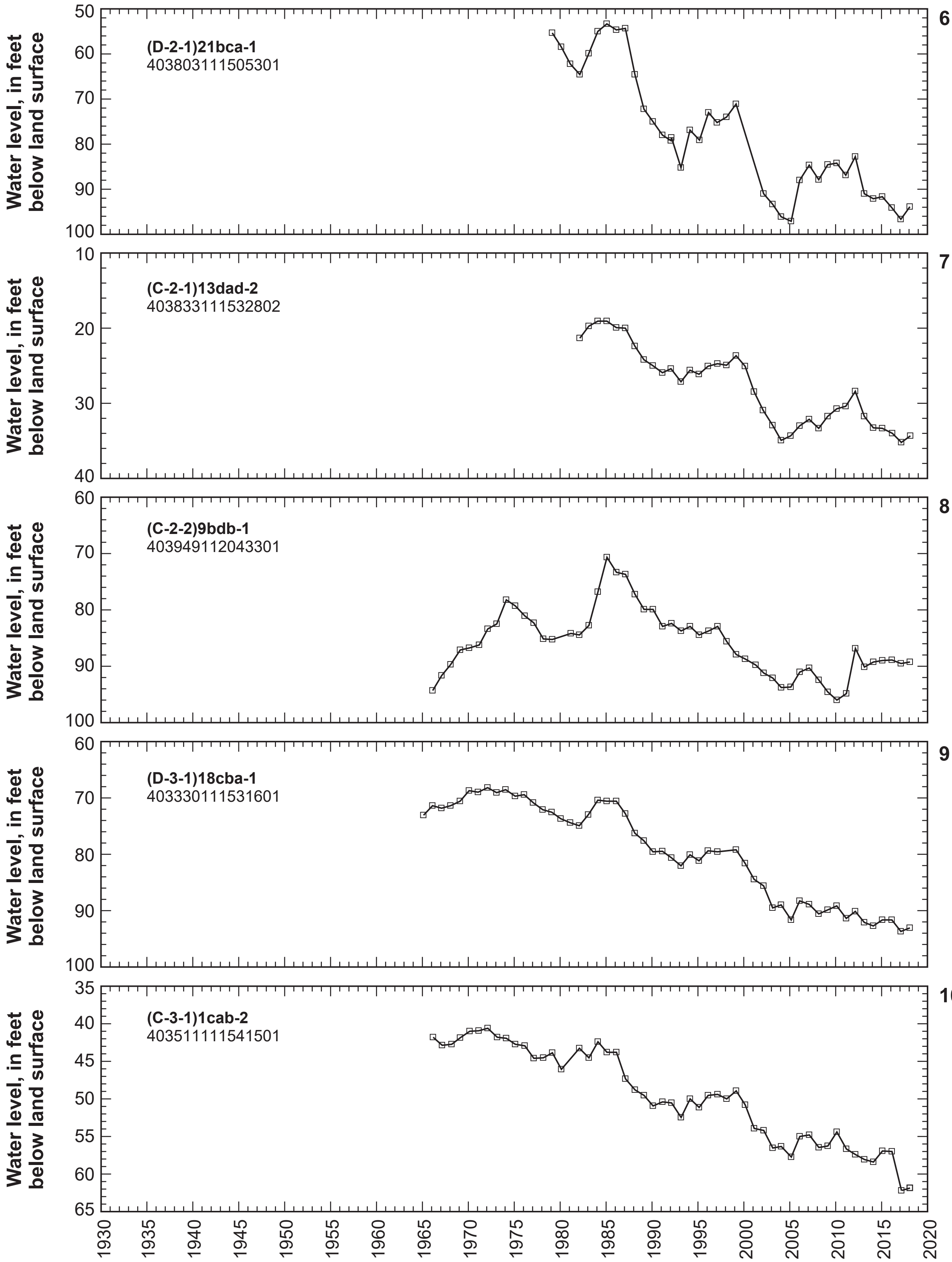


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

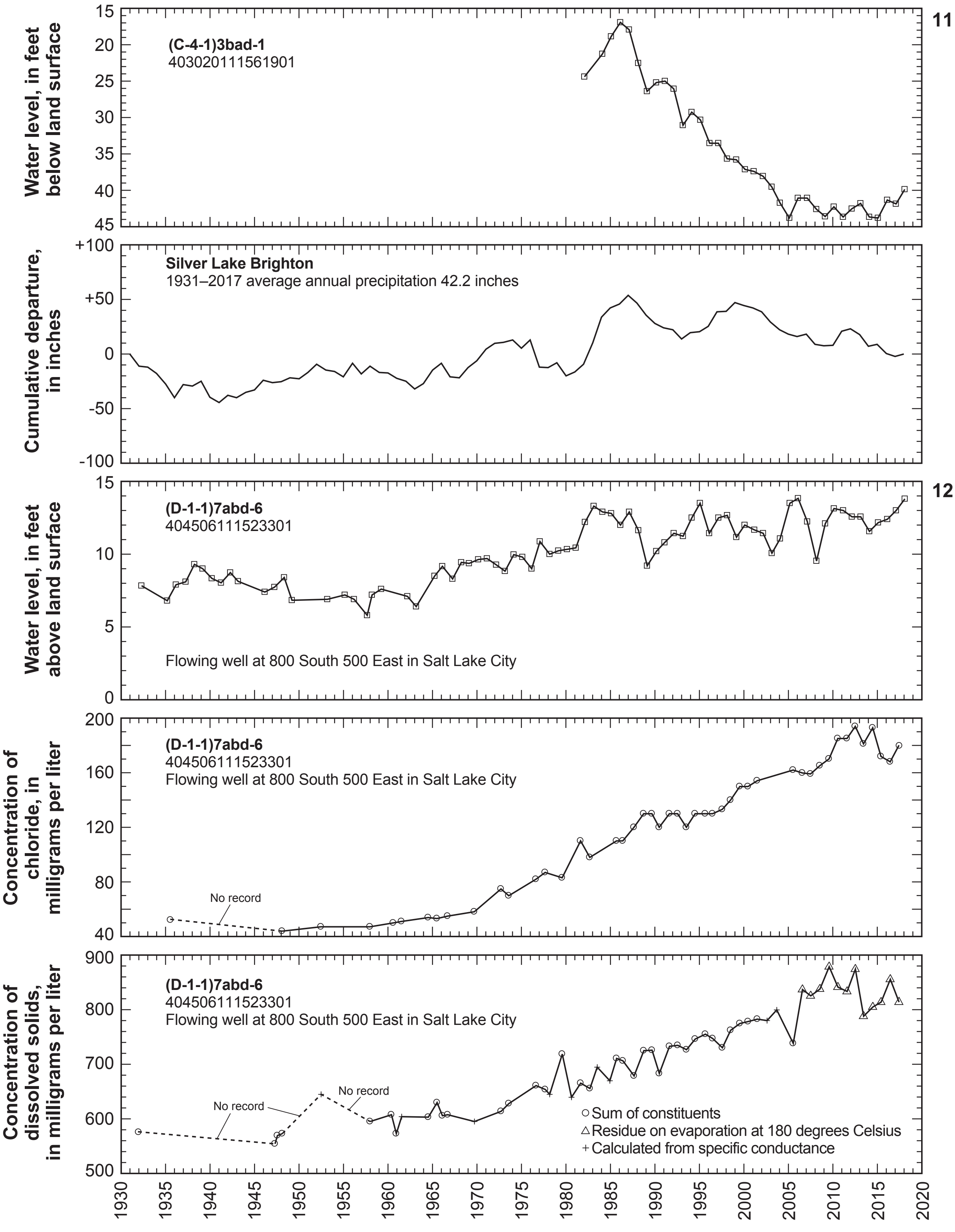


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from 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 consolidated rock 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, and is used primarily for irrigation and public supply (table 2).

Total estimated withdrawal of water from wells in Tooele Valley in 2017 was about 26,200 acre-feet, which is the same as the total for 2016 and about 1,000 acre-feet more than the average annual withdrawal for 2007–2016 (tables 2 and 3). Withdrawal for irrigation was about 13,600 acre-feet, which is 1,800 acre-feet more than the total for 2016. Withdrawal for public supply was about 11,100 acre-feet, which is 1,600 acre-feet less than in 2016.

The location of wells in Tooele Valley in which the water level was measured during March 2018 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 2017 was about 17.9 inches, which is about 1.7 inches more than in 2016 and about 0.1 inch more than the average annual precipitation for 1936–2017.

Water levels were generally stable from March 2017 to March 2018 in most of the wells measured in Tooele Valley. The largest rise, about 4.7 feet, occurred in a well about 3 miles northeast of Tooele. The largest decline, about 3 feet, occurred in a well about 6 miles north of Tooele. Water levels in most of the wells measured in Tooele Valley have declined since records began, many going back 60 years or more.

The concentration of dissolved solids in water samples collected from well (C-2-4)33bdd-1, located at Erda, from 1977 to 2017, is shown in figure 12. The concentration has ranged from 456 to 681 mg/L, with a median value of 596 mg/L.

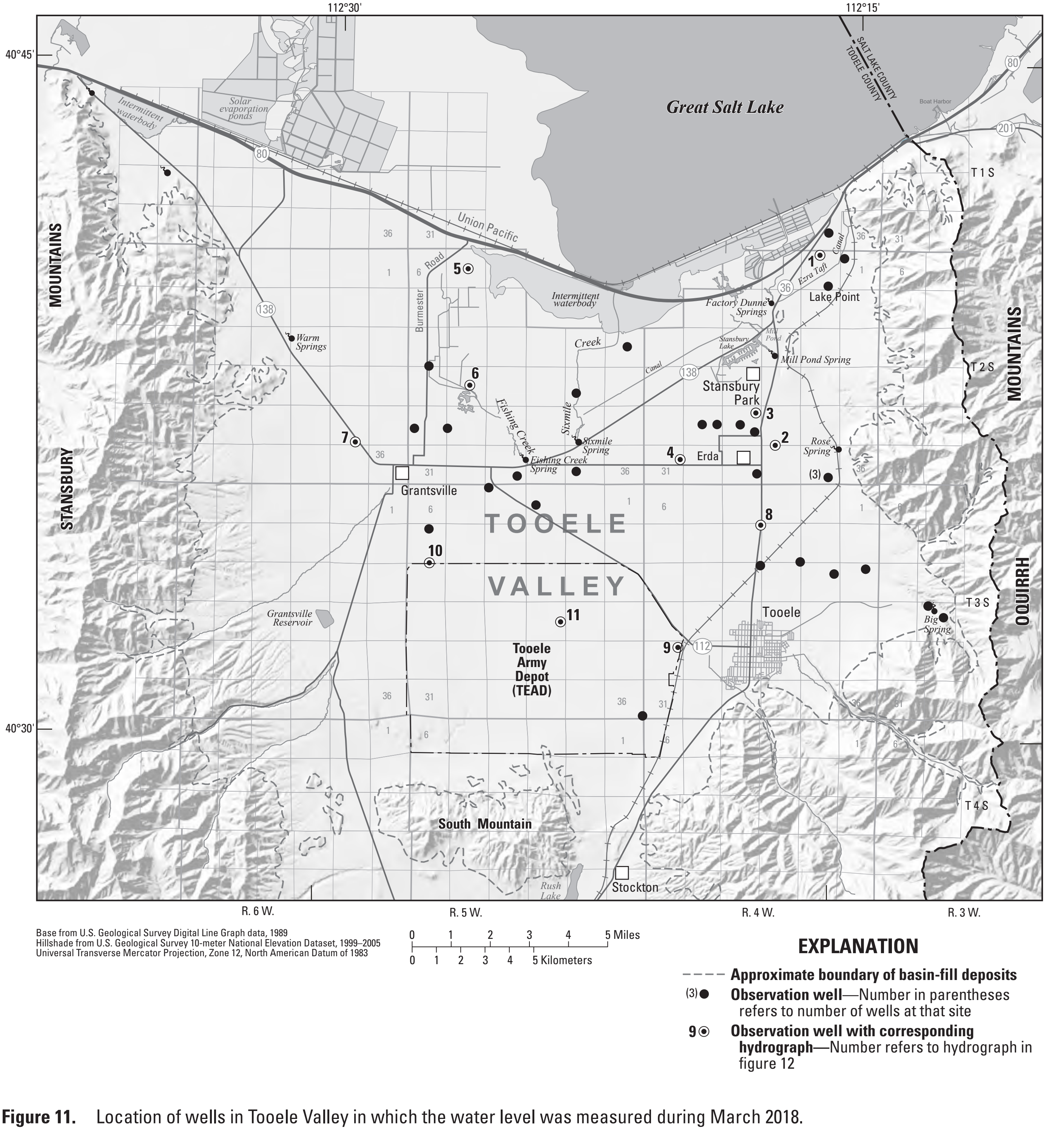


Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 2018.

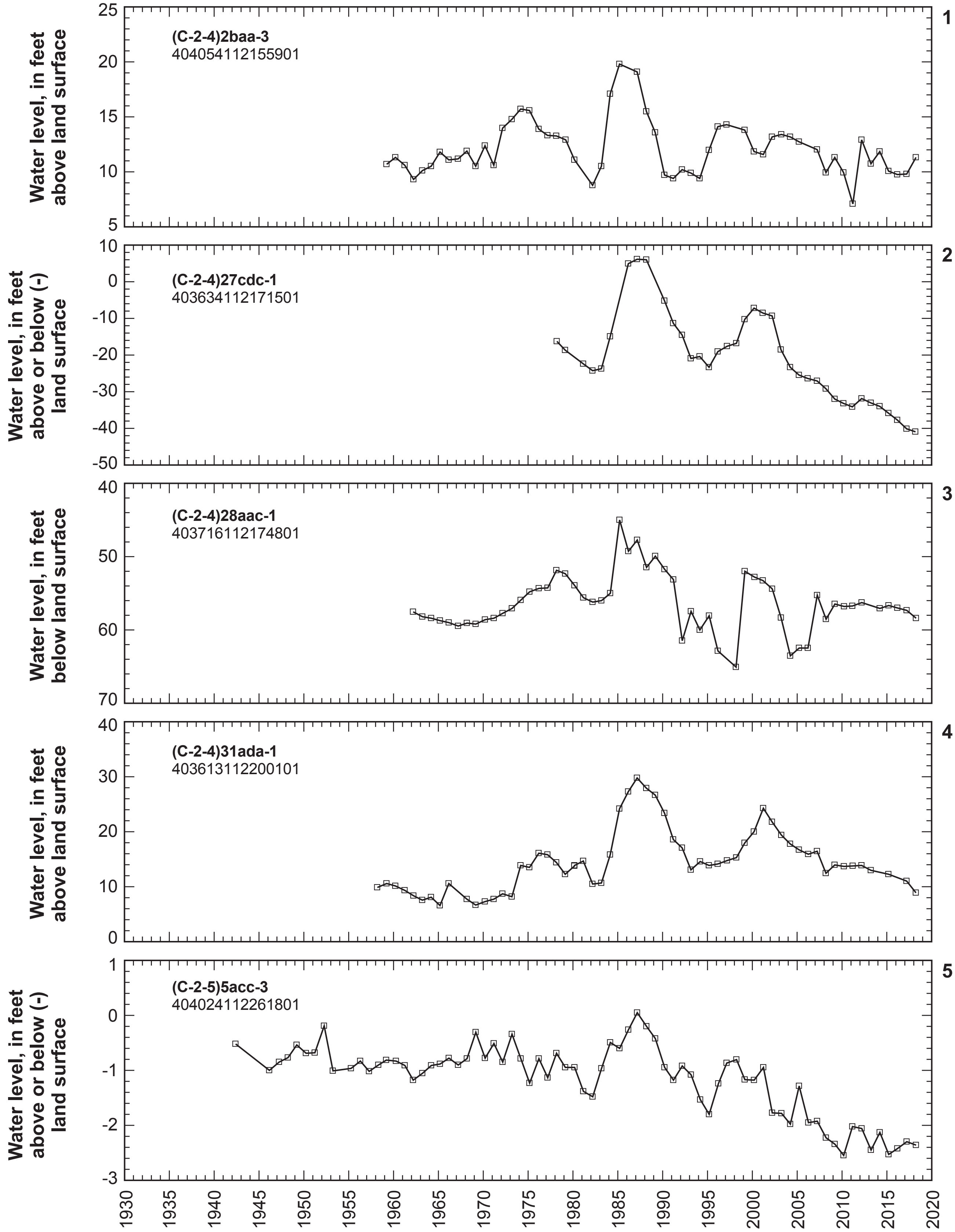


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.

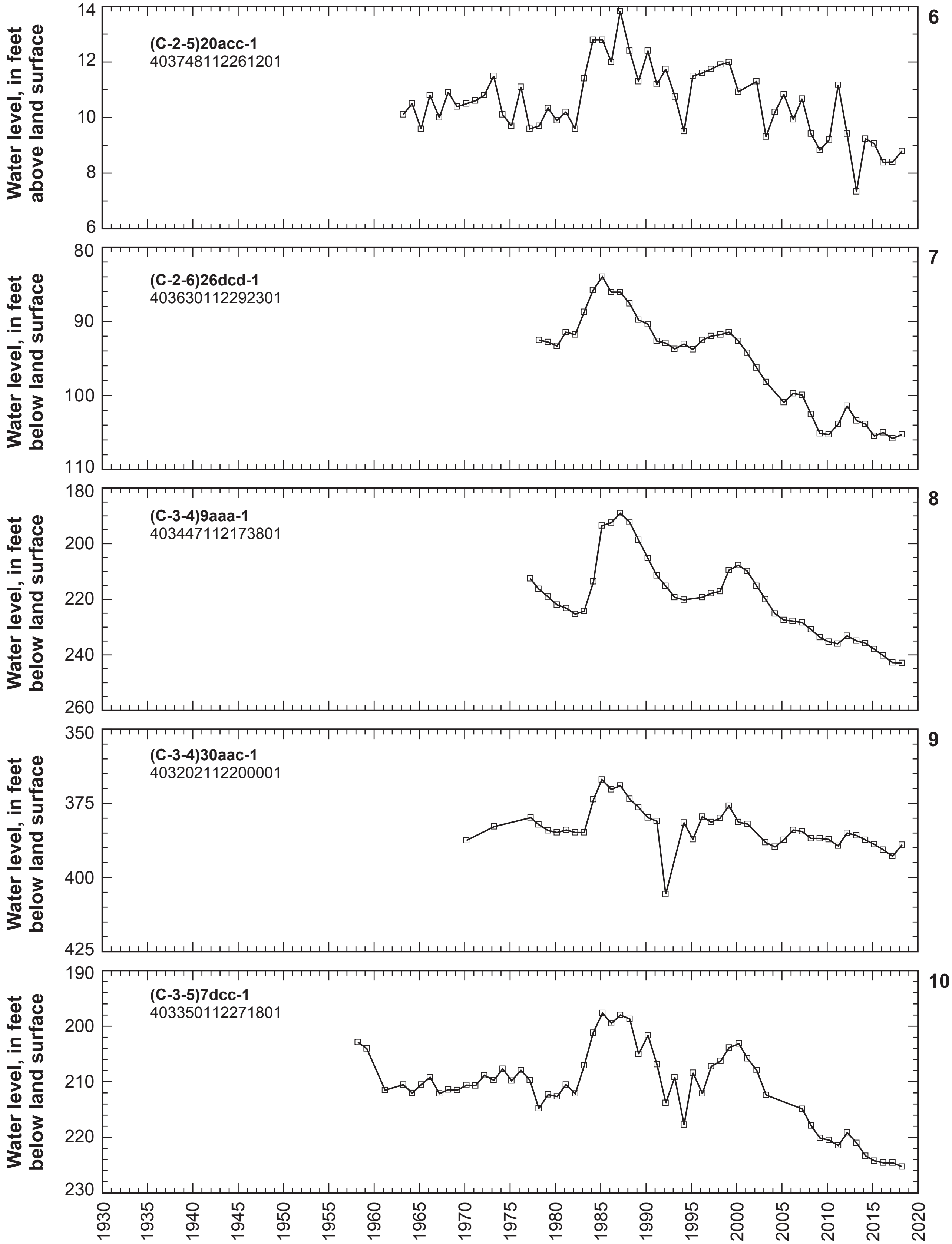


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

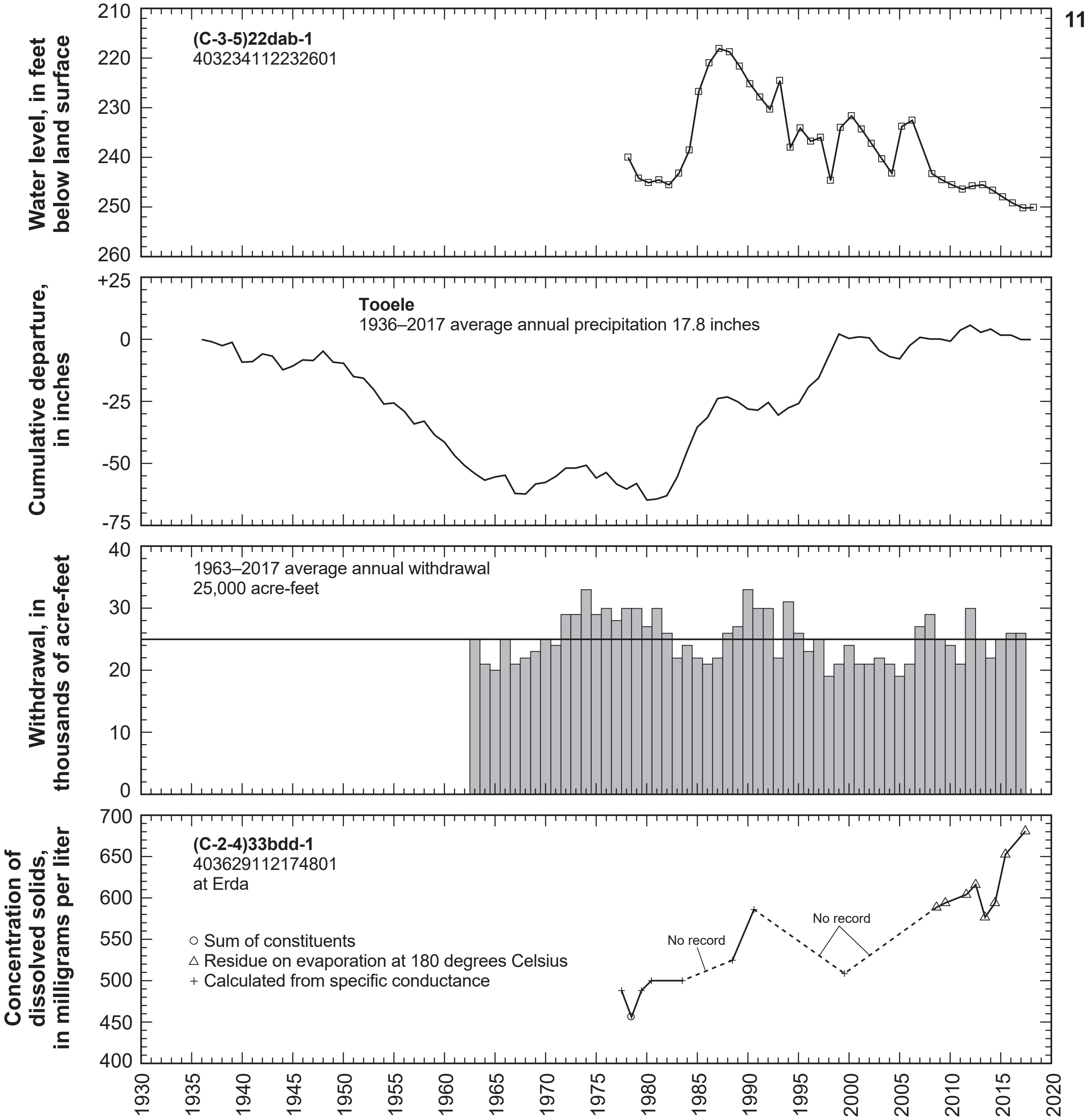


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

Utah and Goshen Valleys

By Lincoln Smith

Utah Valley is bounded by the 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 (fig. 13). Groundwater in Utah and Goshen Valleys occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions, but most of the water is withdrawn from wells that discharge from artesian aquifers, and is used primarily for public supply and irrigation (table 2). 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 2017 was about 105,700 acre-feet, which is 13,100 acre-feet less than the value for 2016, and almost 4,000 acre-feet less than the average annual withdrawal for 2007–2016 (tables 2 and 3). Withdrawal in northern Utah Valley (-east and -west) was about 56,700 acre-feet, which is 8,900 acre-feet less than the value for 2016. Total estimated withdrawal in northern Utah Valley-west was about 4,800 acre-feet, or about 8 percent of the total withdrawal in northern Utah Valley. Withdrawal in southern Utah Valley was 25,100 acre-feet, which is 4,000 acre-feet less than the value for 2016. Withdrawal in Goshen Valley was 23,900 acre-feet, about the same as the value for 2016. The overall decrease in total withdrawals from all three valleys was mainly due to decreased withdrawals for public supply.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2018 is shown in figure 13. Water levels rose from March 2017 to March 2018 in most of the wells measured in Utah and Goshen Valleys. The rise corresponds to a significant decrease in withdrawals for public supply in 2017. Overall, water levels in both valleys have declined since the mid- to late 1980s; however, 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 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 2017 was about 183,100 acre-feet, which is 14,000 acre-feet more than the 1933–2017 average annual discharge and 58,600 acre-feet more than in 2016.

Precipitation at Silver Lake Brighton in 2017 was about 44.4 inches, which is about 2.2 inches more than the long-term average (1931–2017) and about 5.0 inches more than in 2016. Precipitation at Spanish Fork Power House in 2017 was about 22.1 inches, which is about 2.9 inches more than the long-term average (1930–2017) and about 4.5 inches more than in 2016.

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 814 mg/L. The concentration of dissolved solids in the June 2017 sample was 1,700 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. This well was not sampled in 2017. 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. This well also was not sampled in 2017.

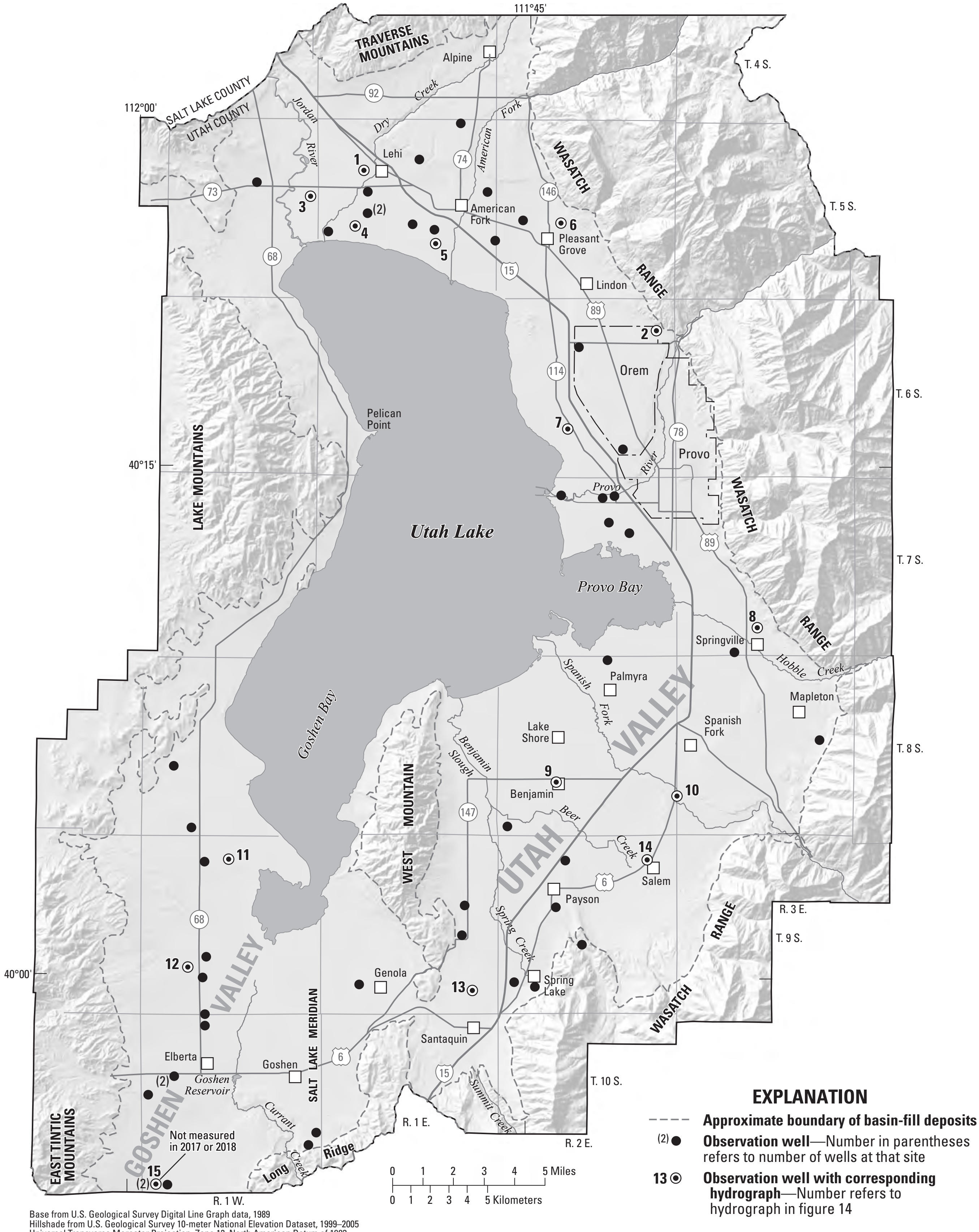


Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2018.

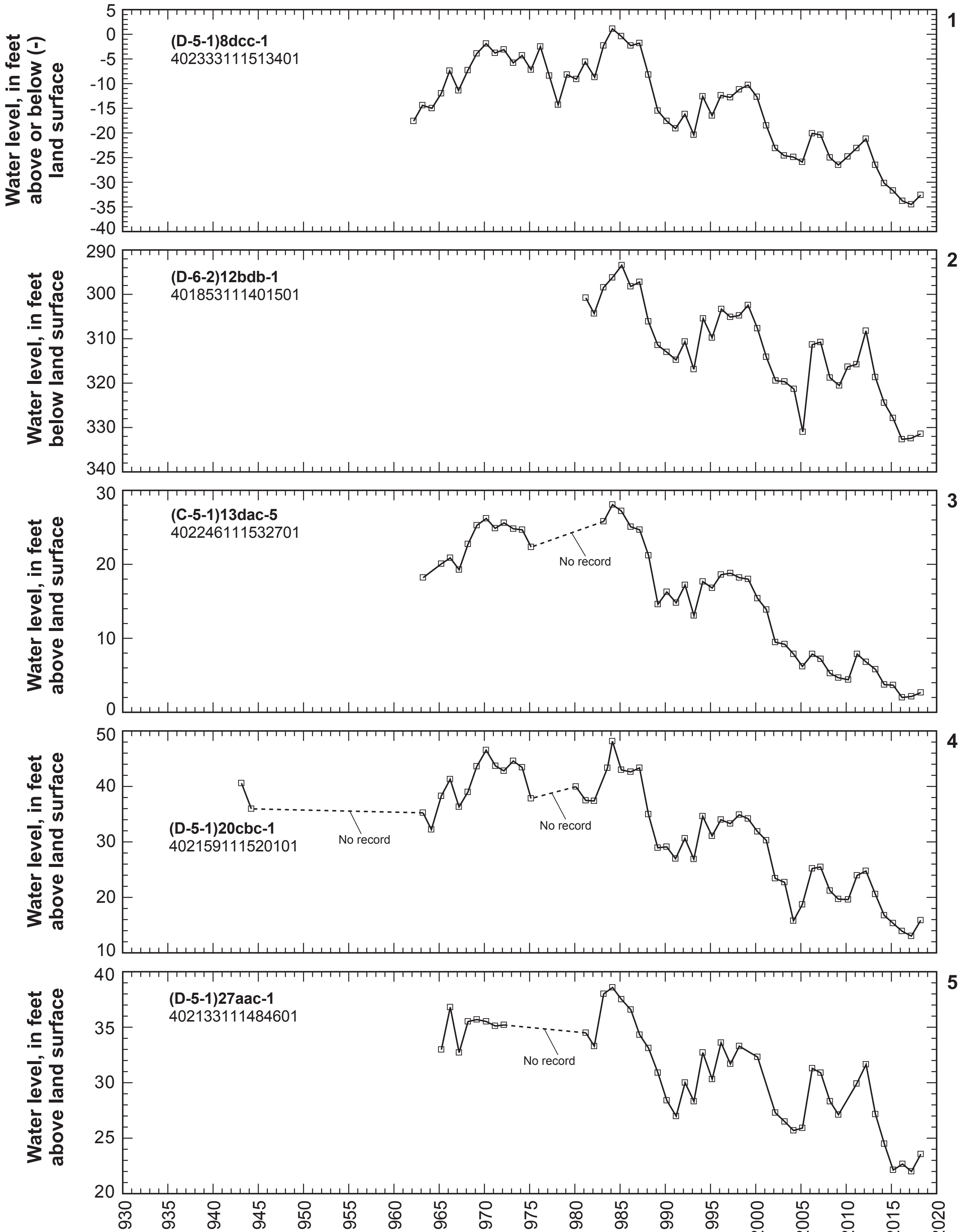


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

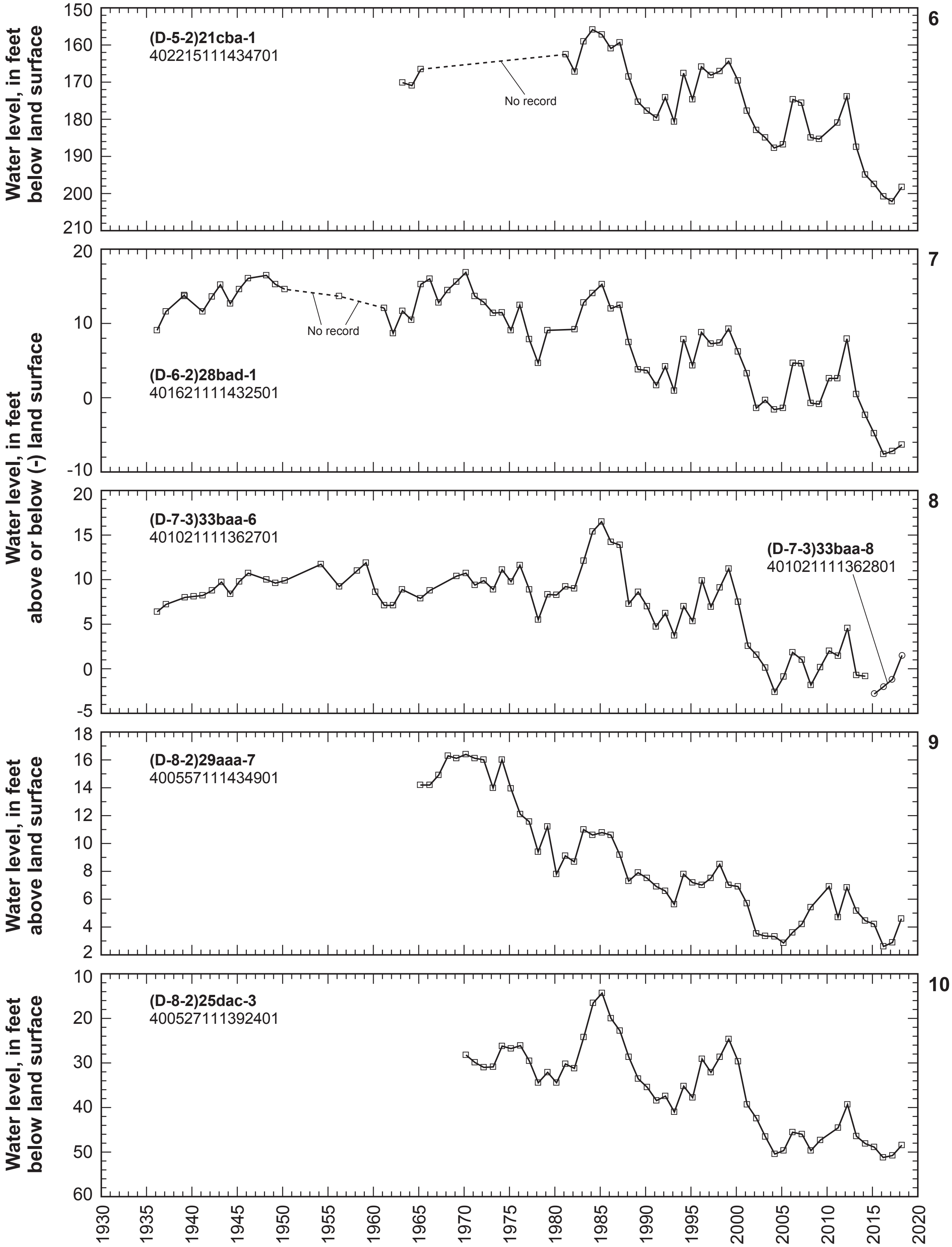


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

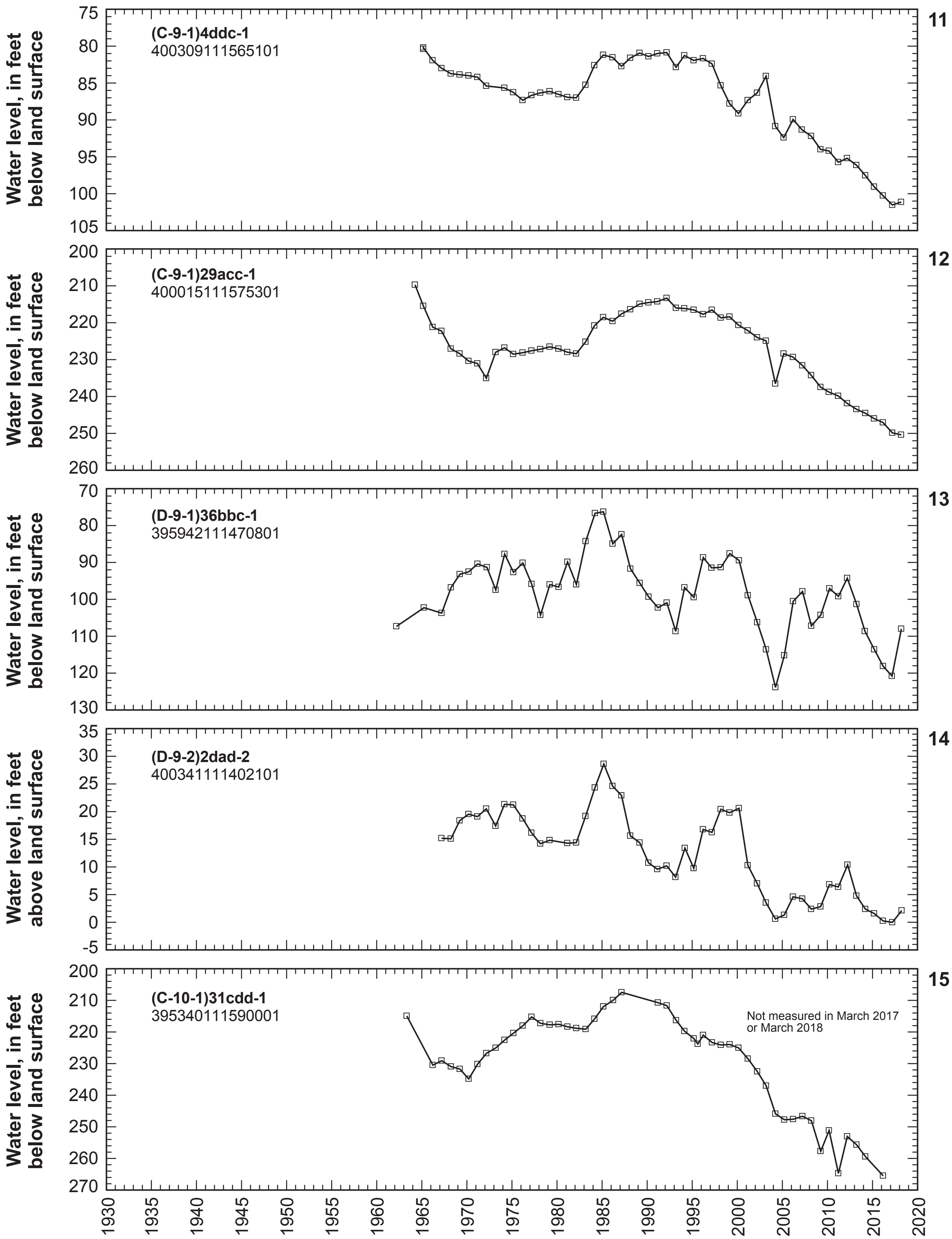


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

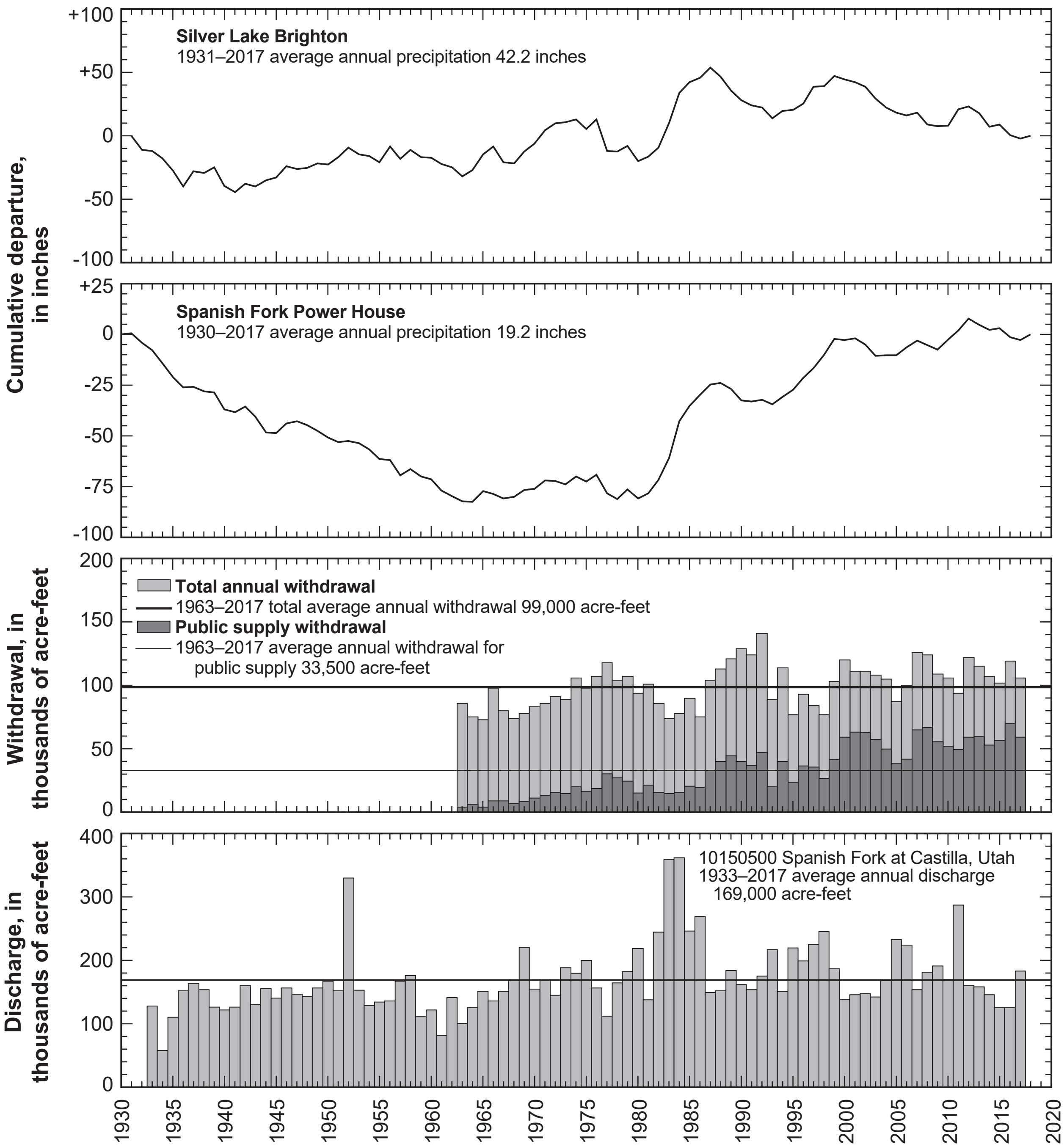


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

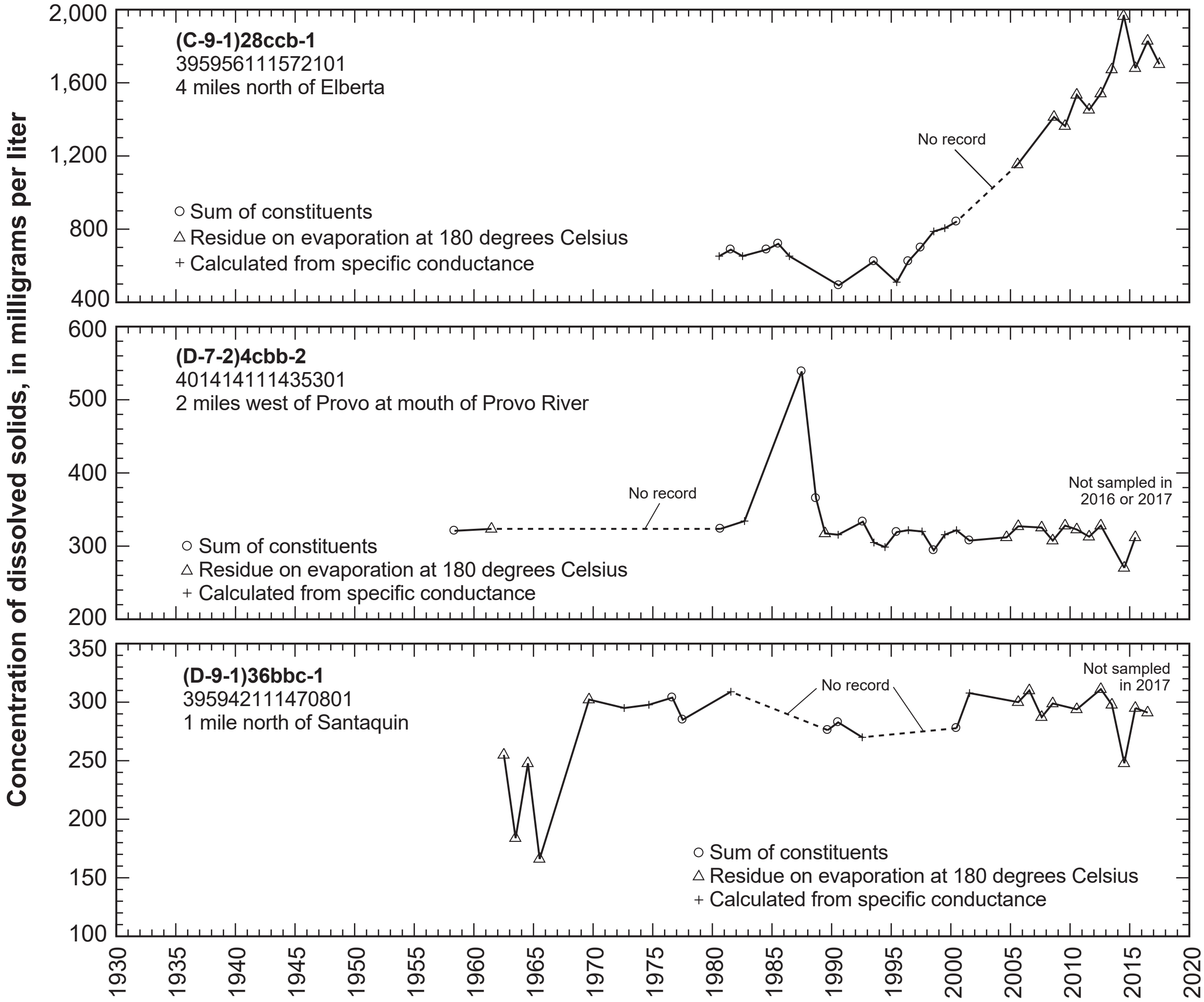


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish 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, and is used primarily for irrigation (table 2). 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 2017 was about 20,400 acre-feet, which is 12,100 acre-feet less than the amount reported for 2016 and 5,600 acre-feet less than the average annual withdrawal for 2007–2016 (tables 2 and 3). The decrease was mainly due to decreased withdrawals for irrigation.

The location of wells in Juab Valley in which the water level was measured during March 2018 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 2017 was about 13.9 inches, which is about 0.2 inch less than the average annual precipitation for 1935–2017, and 3.1 inches more than in 2016.

Water levels rose in most of the wells measured in Juab Valley from March 2017 to March 2018 (fig. 16). Rises are probably the result of less than normal withdrawals for irrigation and near-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 2018, 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. This well replaces (C-12-1)24baa-1. The dissolved-solids concentration in the water sample collected in August 2017 was 867 mg/L.

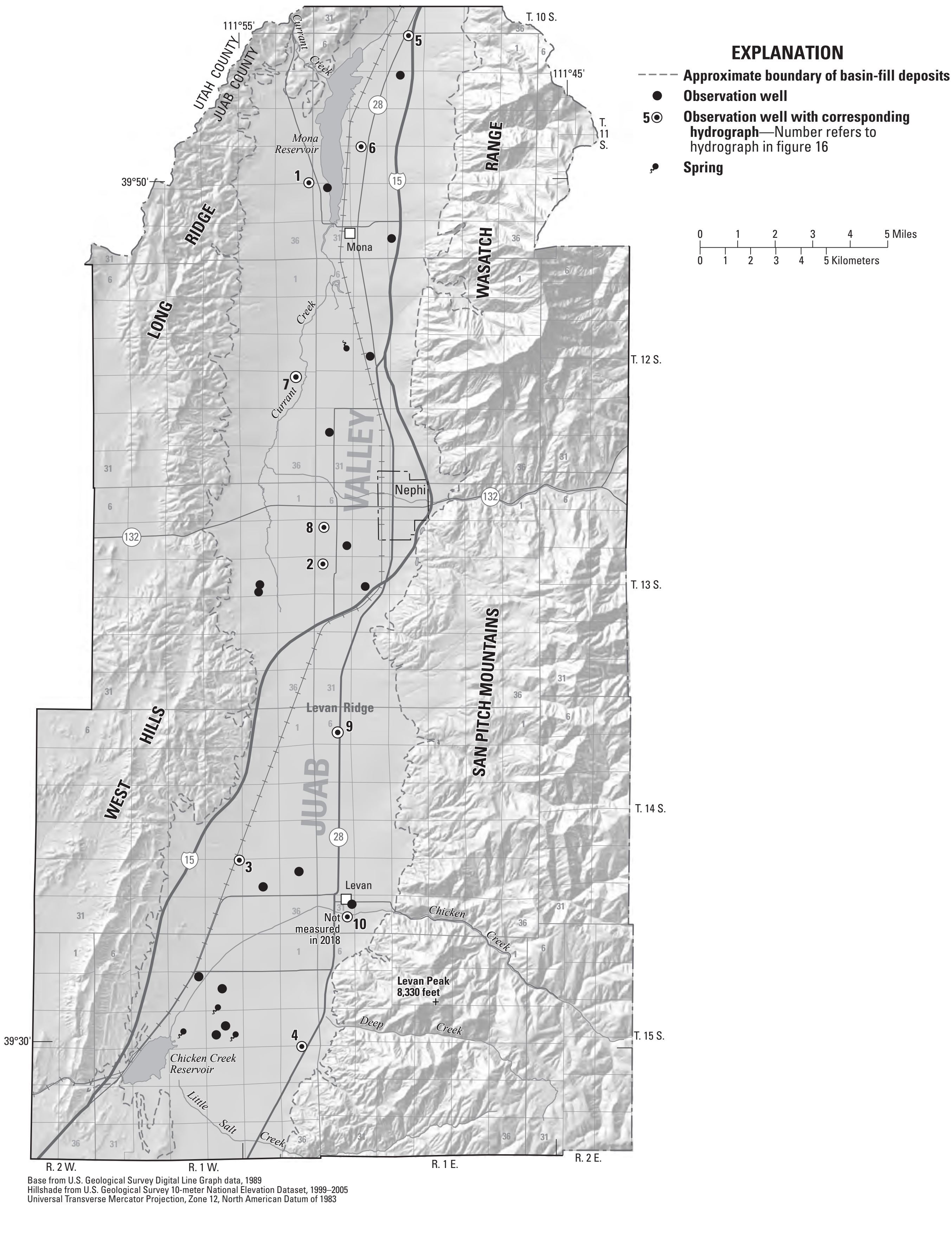


Figure 15. Location of wells in Juab Valley in which the water level was measured during March 2018.

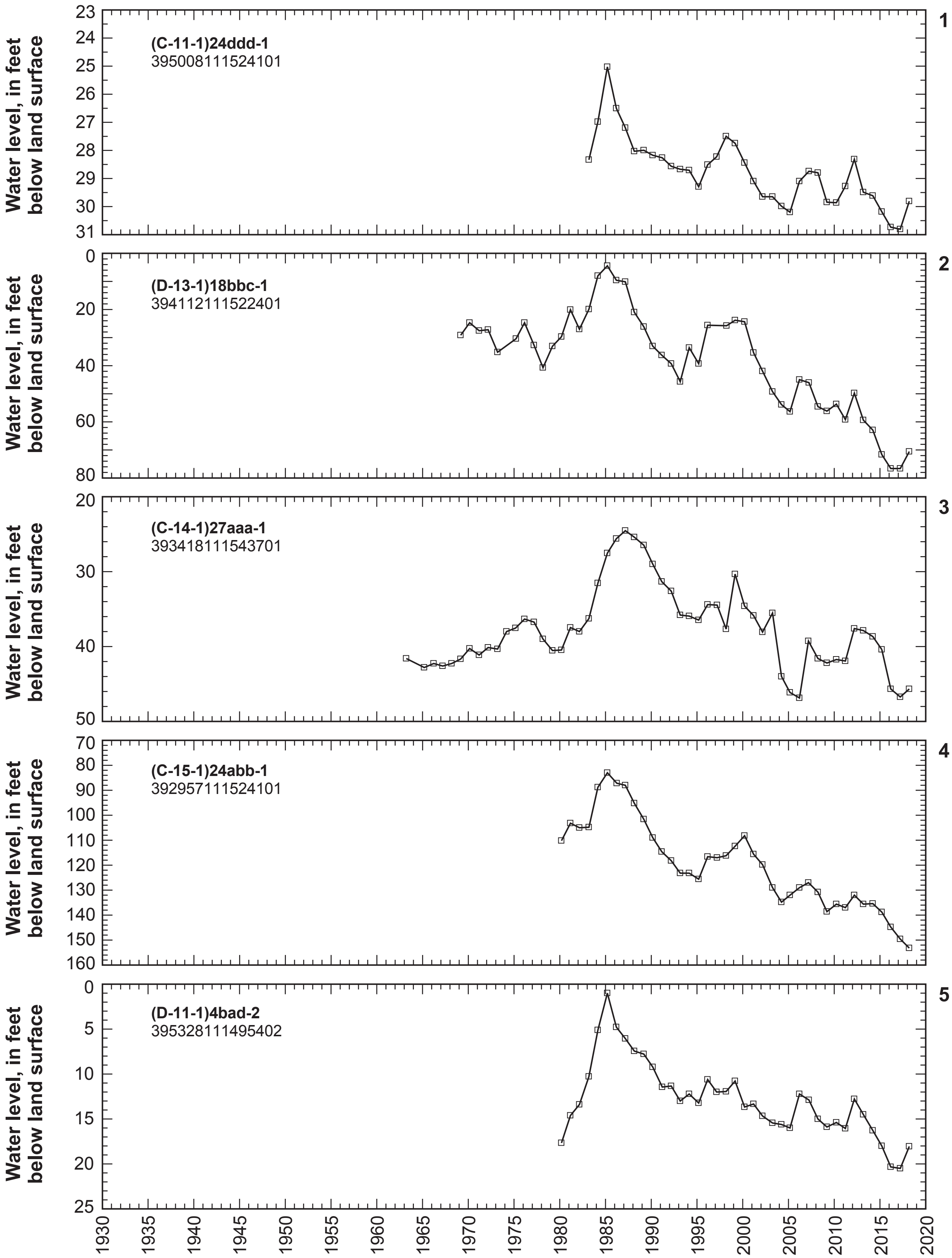


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.

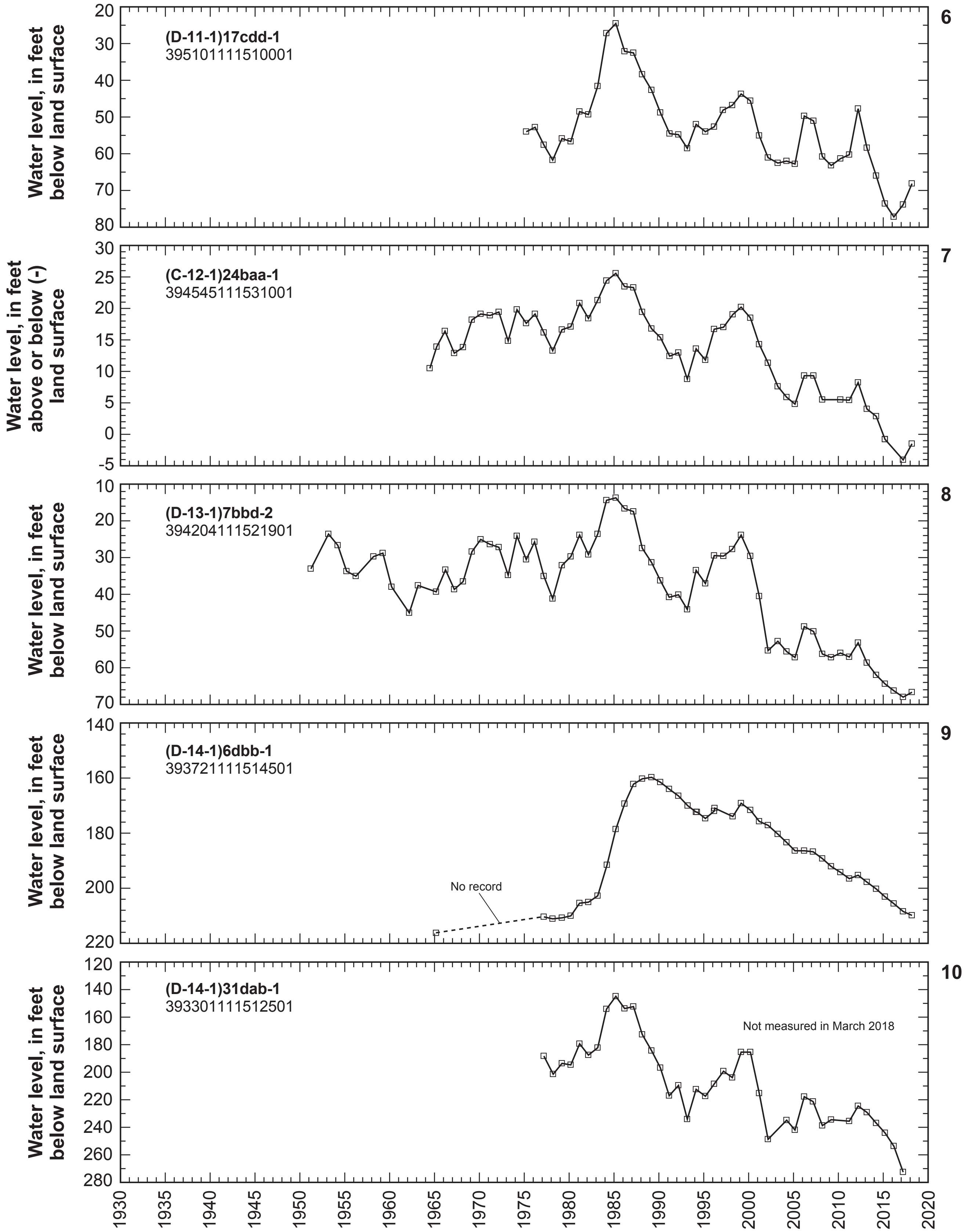


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.—Continued

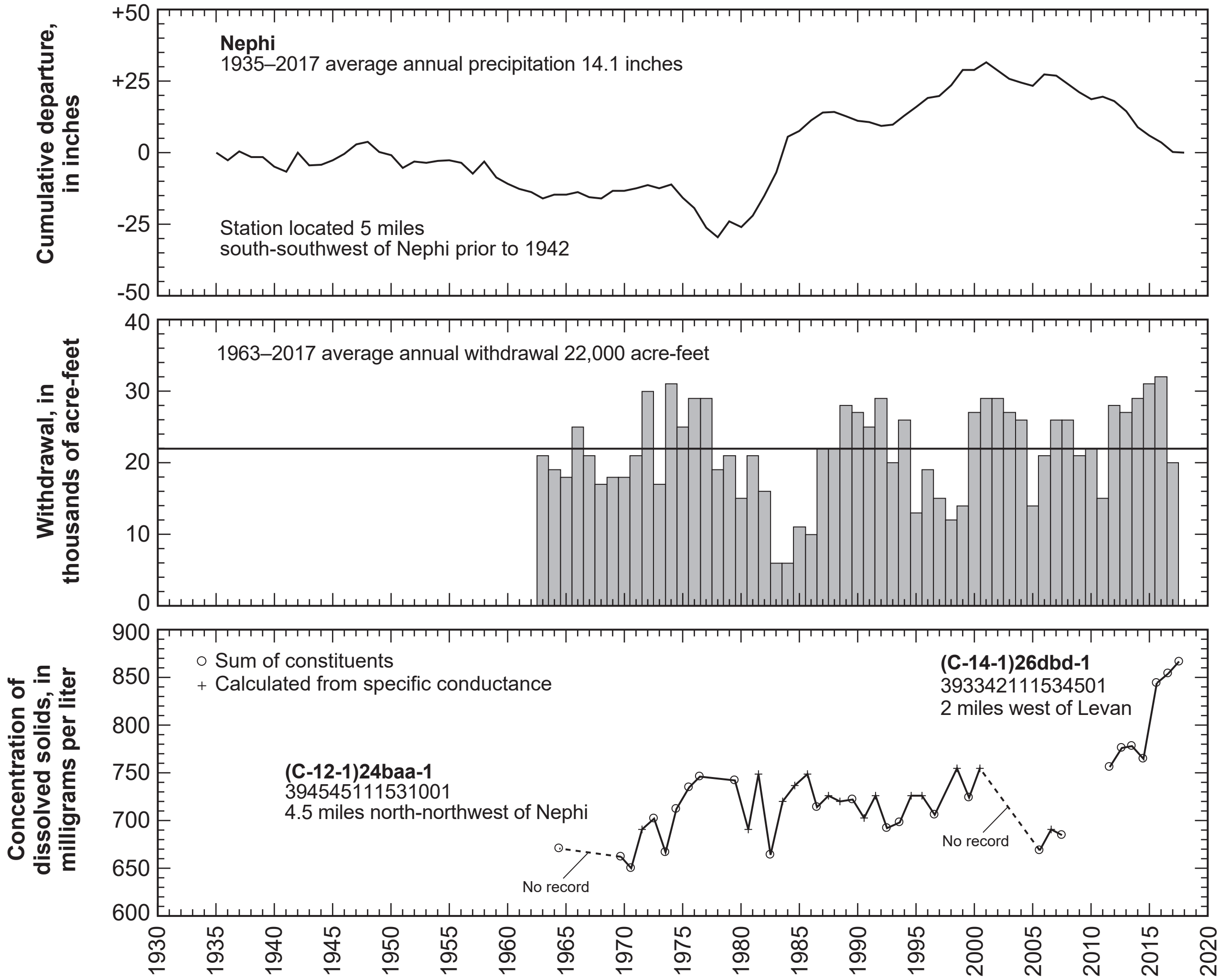


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.—Continued

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 basin-fill deposits under water-table and artesian conditions, and is used primarily for irrigation (table 2). 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 2017 was about 52,100 acre-feet. This is 4,400 acre-feet less than the total for 2016 and about 9,000 acre-feet more than the 2007–2016 average annual withdrawal (tables 2 and 3). The overall decrease in withdrawal was entirely due to decreased pumpage for industrial use.

The location of wells in the Sevier Desert in which the water level was measured during March 2018 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)8bcd-1 is shown in figure 19.

Discharge of the Sevier River near Juab in 2017 was 99,900 acre-feet, which is 8,400 acre-feet less than in 2016 and 77,400 acre-feet less than the long-term average (1935–2017). Precipitation at Oak City was about 12.2 inches in 2017, about 0.7 inch less than the 1930–2017 average annual precipitation and 2.0 inches less than in 2016.

Most water levels in the shallow artesian and deep artesian aquifers declined from March 2017 to March 2018 (fig. 19). In the shallow artesian aquifer, most water levels declined between 0 and 2 feet, but some wells increased between 0 and 1 foot. In the deep artesian aquifer, most water levels declined between 0 and 4 feet, but some wells increased between 2 and 7 feet.

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, decreased groundwater withdrawals, and greater-than-average discharge of the Sevier River. Periods when the water level in the shallow and deep aquifers generally declined (including 1988–94, 2001–05, 2008–10, and 2013–18) correspond to less-than-average precipitation, increased groundwater withdrawals, and less-than-average discharge of the Sevier River. Overall, most water levels have generally declined since records began in the early 1960s.

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. Overall, the dissolved-solids concentration in water from this well has increased since 1958. This well was replaced by well (C-15-4)8cba-1 in 2016 and is completed in the same aquifer. The dissolved-solids concentration in the water sample from August 2017 was 2,170 mg/L.

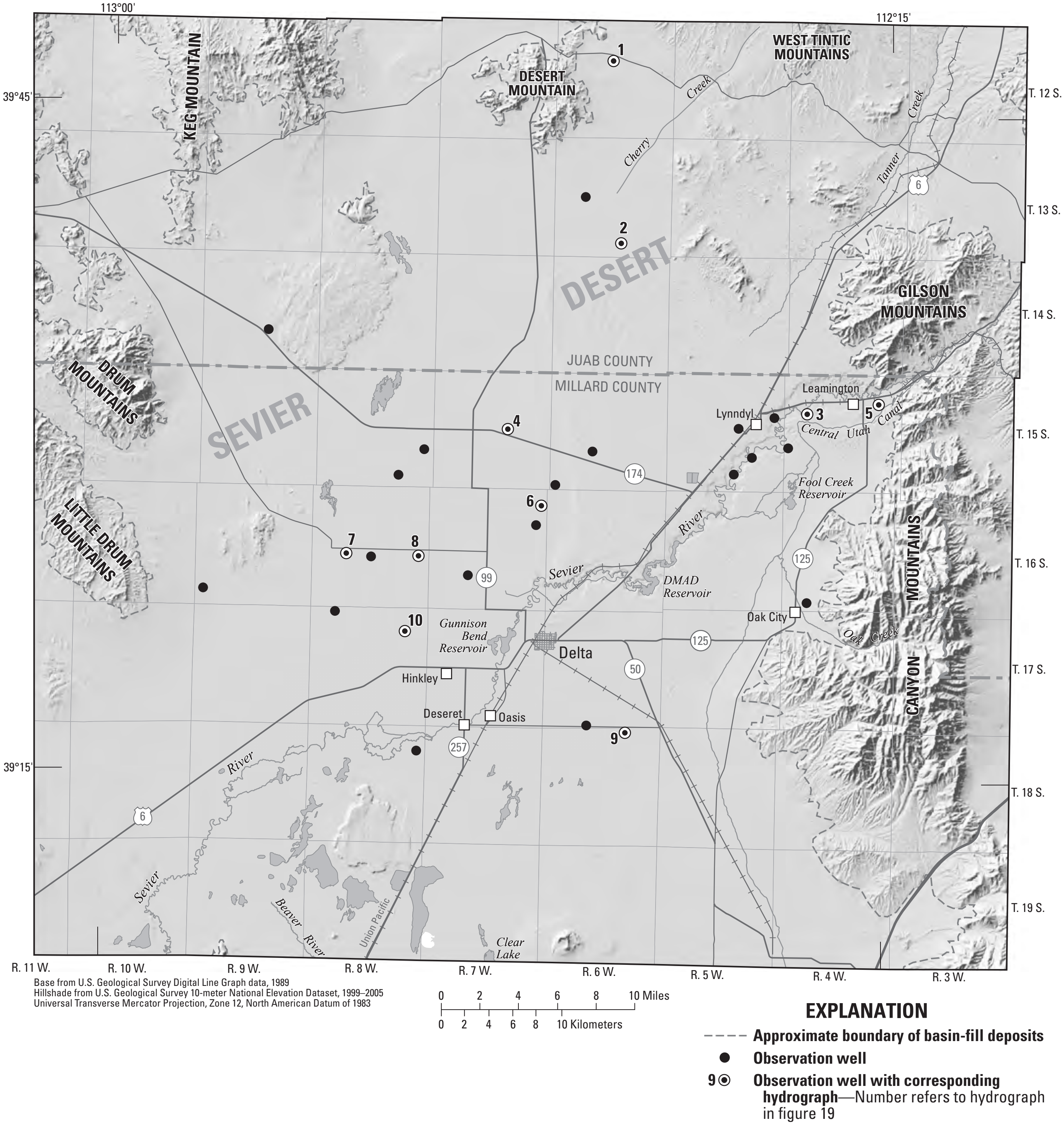
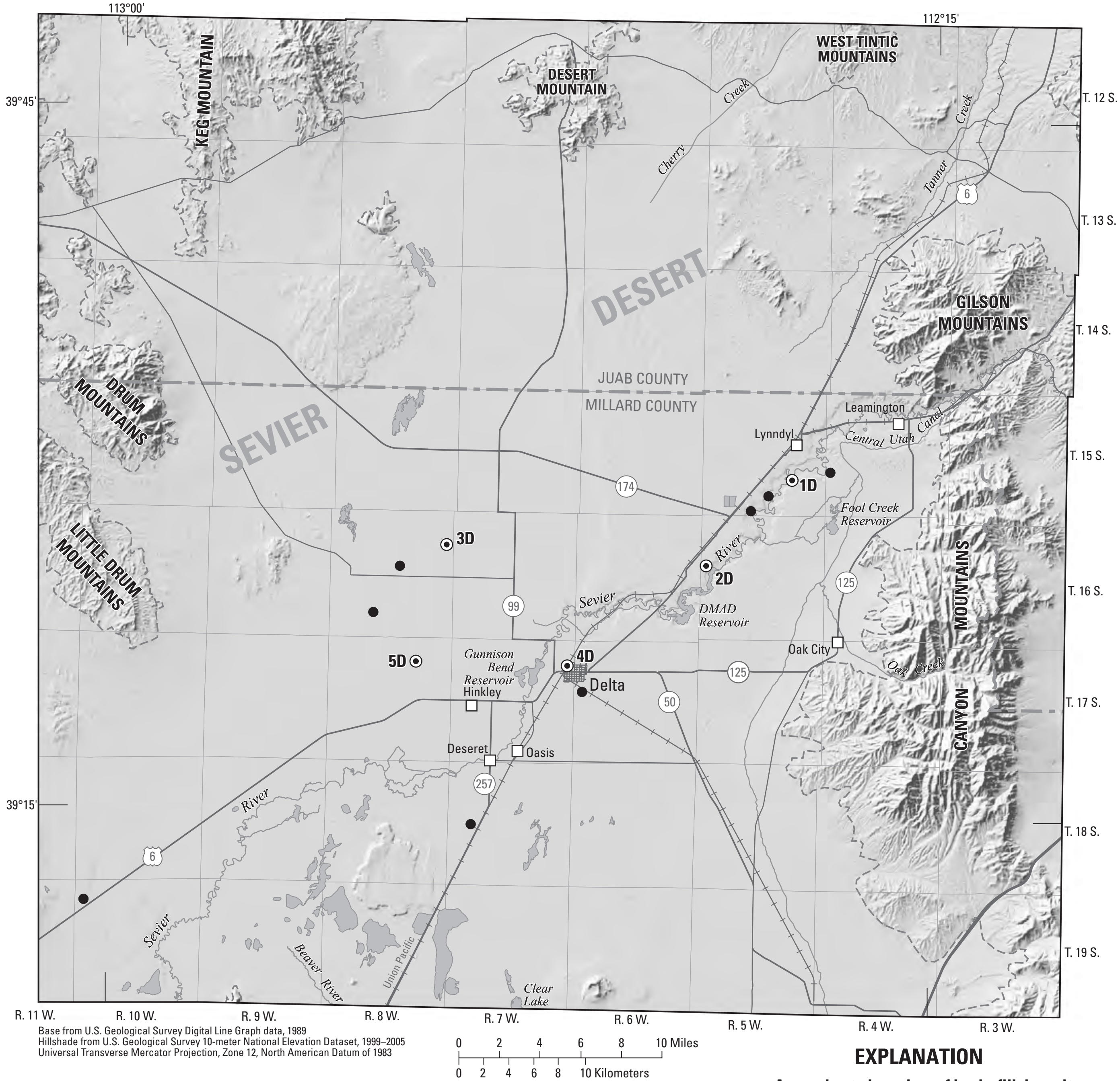


Figure 17. Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2018.



EXPLANATION

- - - - **Approximate boundary of basin-fill deposits**

● **Observation well**

5D ⊙ **Observation well with corresponding hydrograph**—Number with letter 'D' refers to deep artesian aquifer hydrograph in figure 19

Figure 18. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2018.

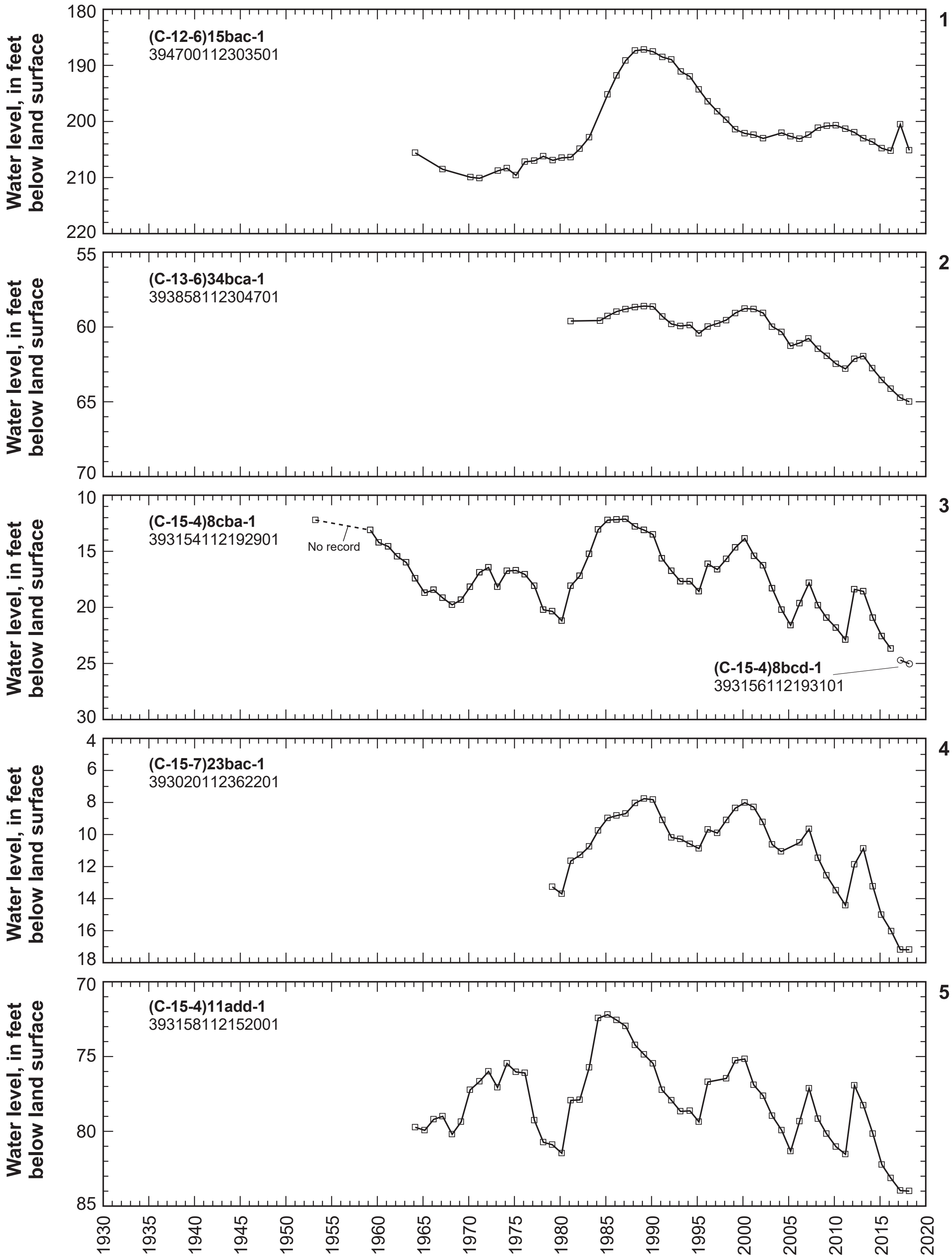


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8bcd-1.

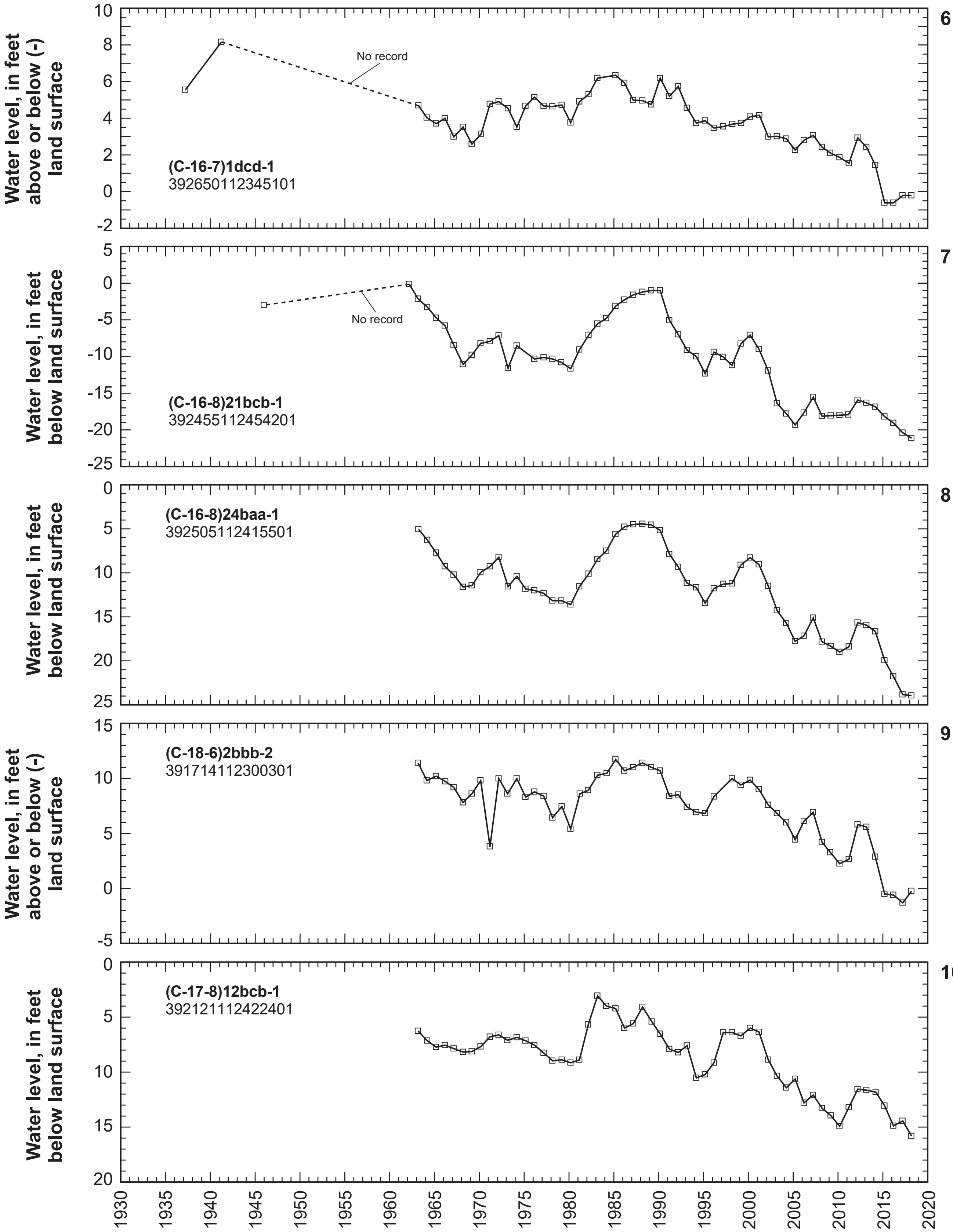


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8bcd-1.—Continued

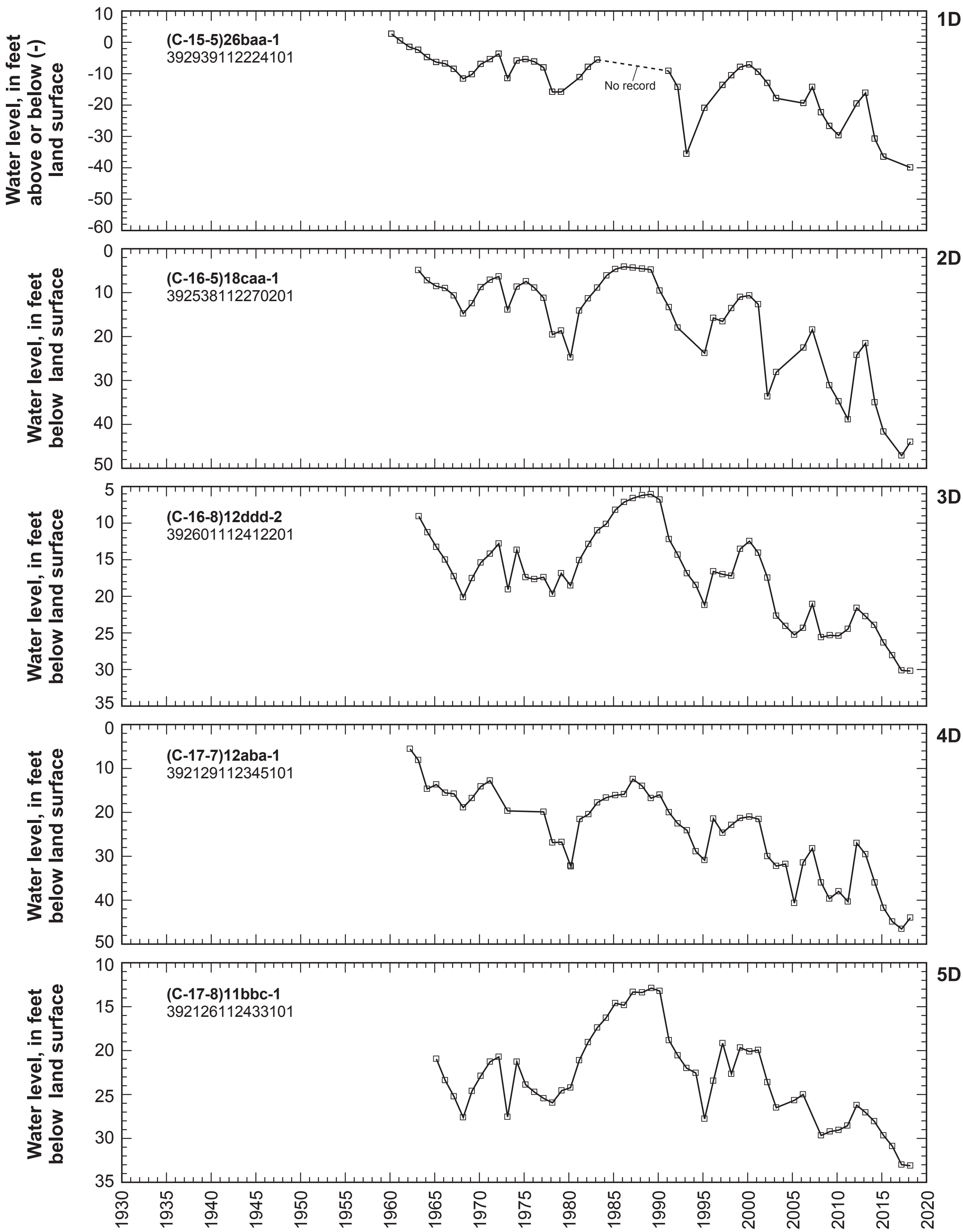


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8bcd-1.—Continued

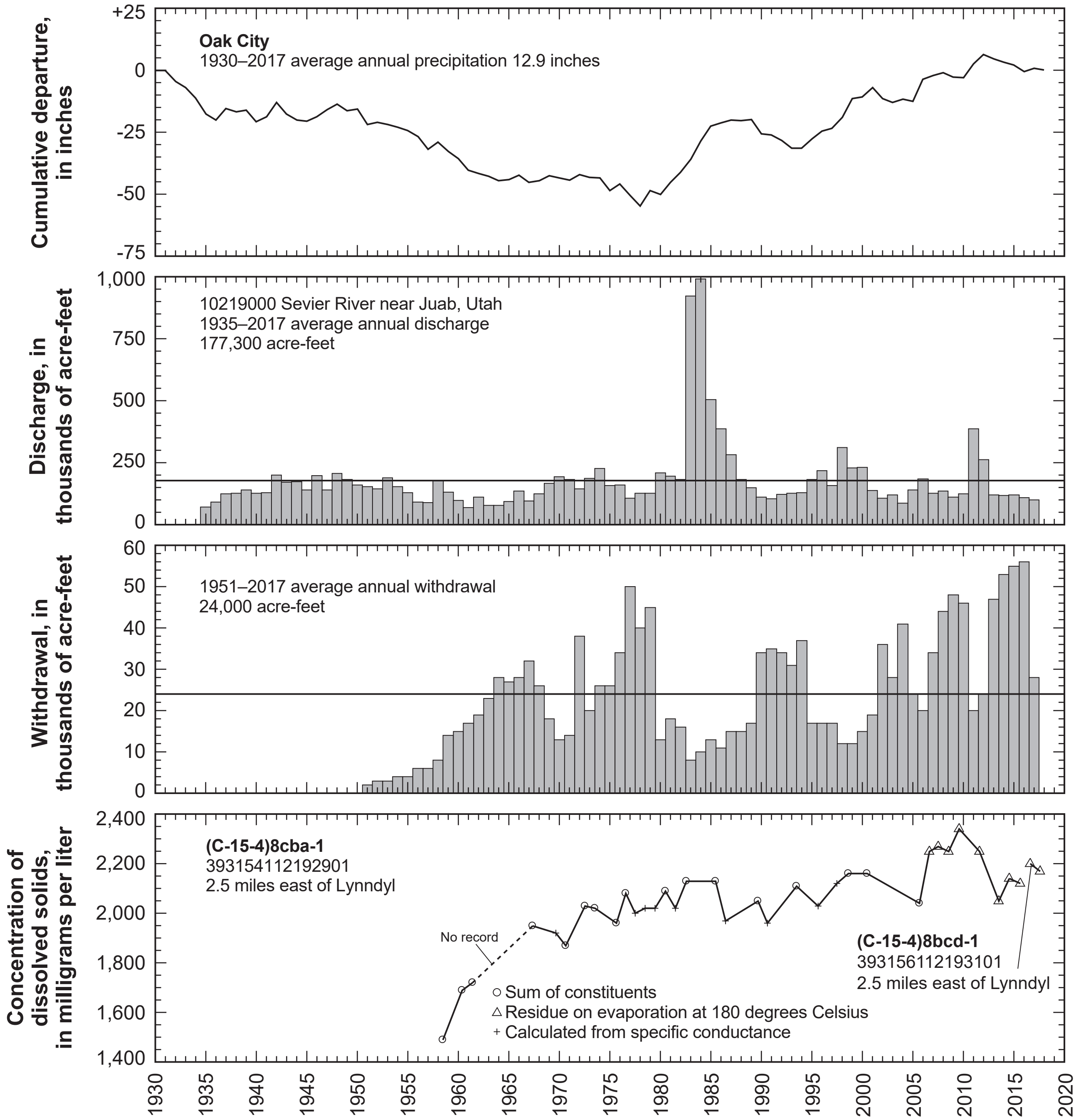


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8bcd-1.—Continued

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 south and 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, and is used primarily for irrigation (table 2).

Total estimated withdrawal of water from wells in central Sevier Valley in 2017 was about 34,000 acre-feet, which is 1,600 acre-feet more than was reported for 2016 and 6,000 acre-feet more than the average annual withdrawal for 2007–2016 (tables 2 and 3).

The location of 23 wells in central Sevier Valley in which the water level was measured during March 2018 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 2017 was about 98,800 acre-feet, which is 25,900 acre-feet more than in 2016, and 19,000 acre-feet more than the 1940–2017 average annual discharge. Precipitation at Richfield Radio KVSC was about 5.8 inches in 2017, which is about 2.3 inches less than the 1950–2017 average annual precipitation and 0.8 inch less than in 2016.

Water levels in central Sevier Valley indicated both small increases and declines throughout the valley from March 2017 to March 2018. Hydrographs for selected wells show that 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 the Sevier River in Venice, Utah, from 1955 to 2017, is shown in figure 21. The concentration has ranged from 307 to 630 mg/L during this period. There were substantial increases and decreases in dissolved-solids concentration during the mid- to late 1960s and 1980s. Dissolved-solids concentrations in samples collected after 2004 show little variability and are generally near the median value (410 mg/L). The dissolved-solids concentration in the water sample from July 2017 was 406 mg/L.

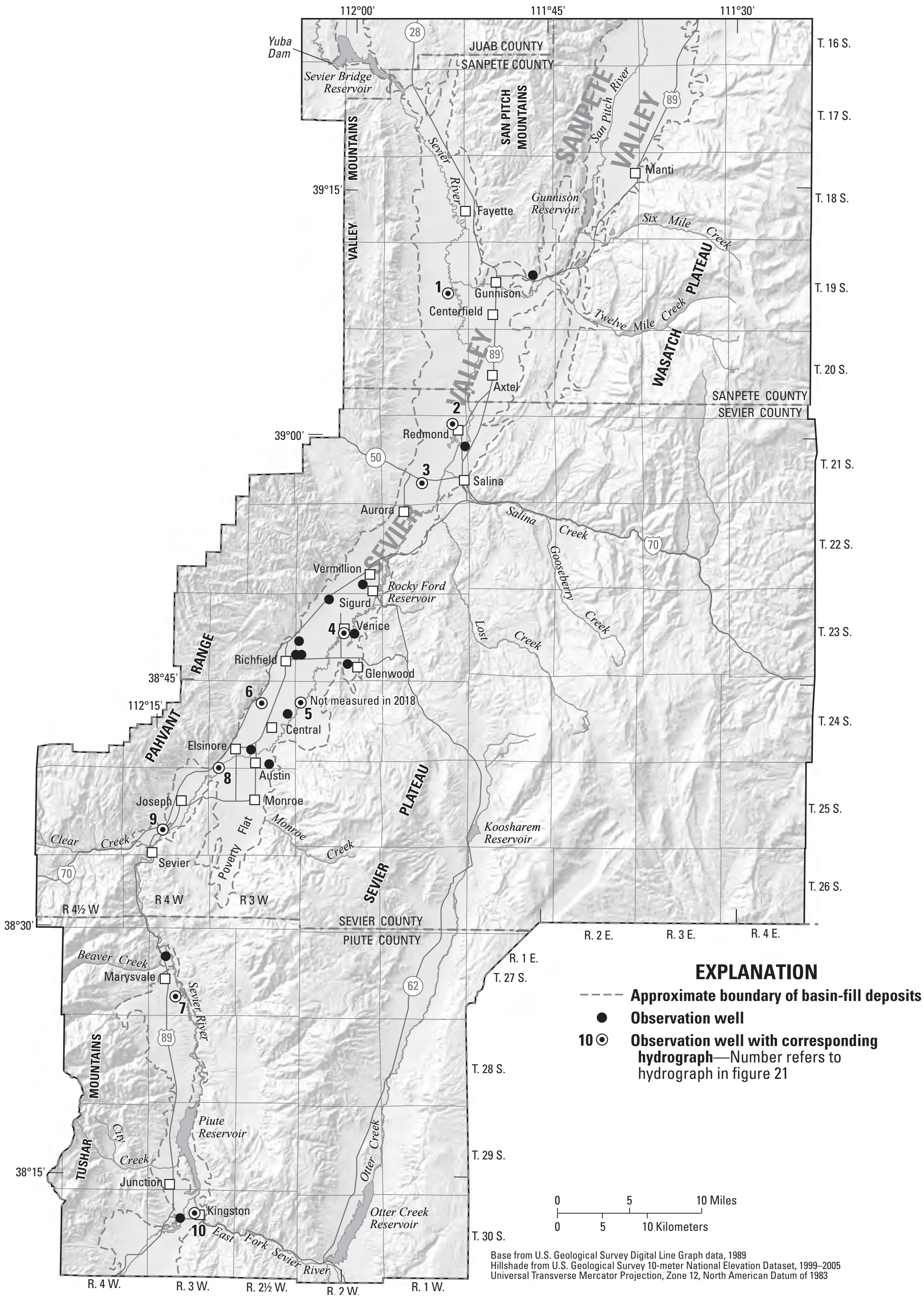


Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 2018.

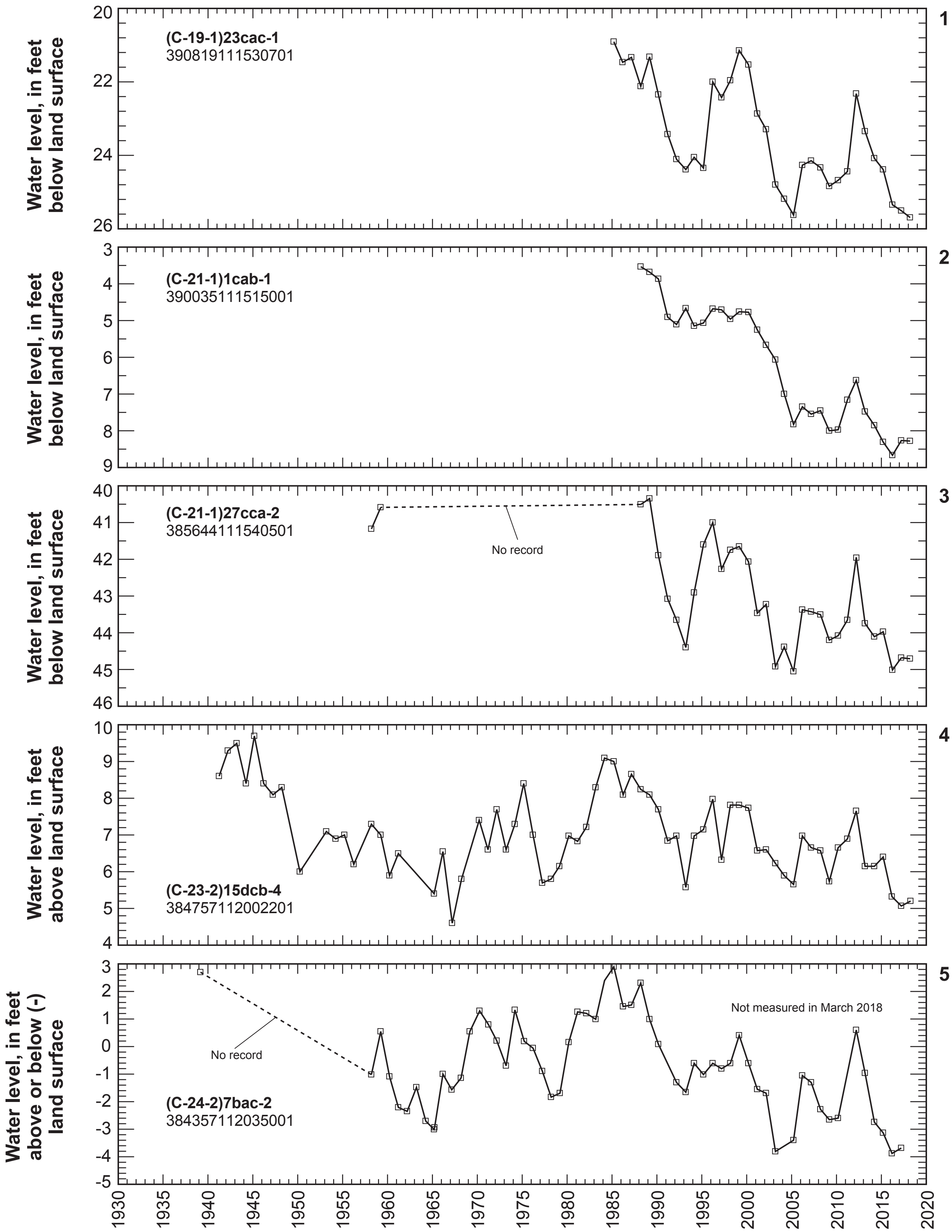


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

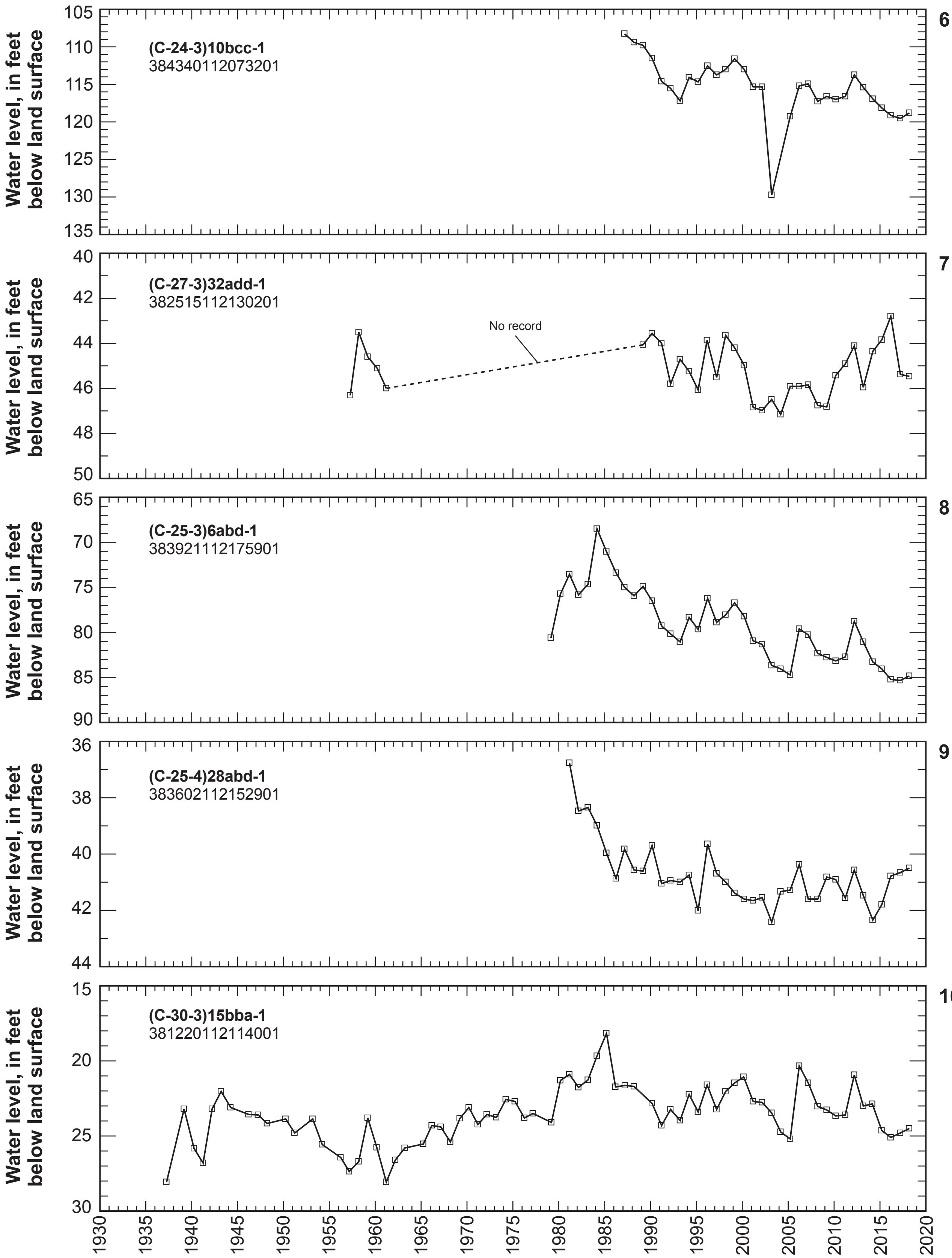


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

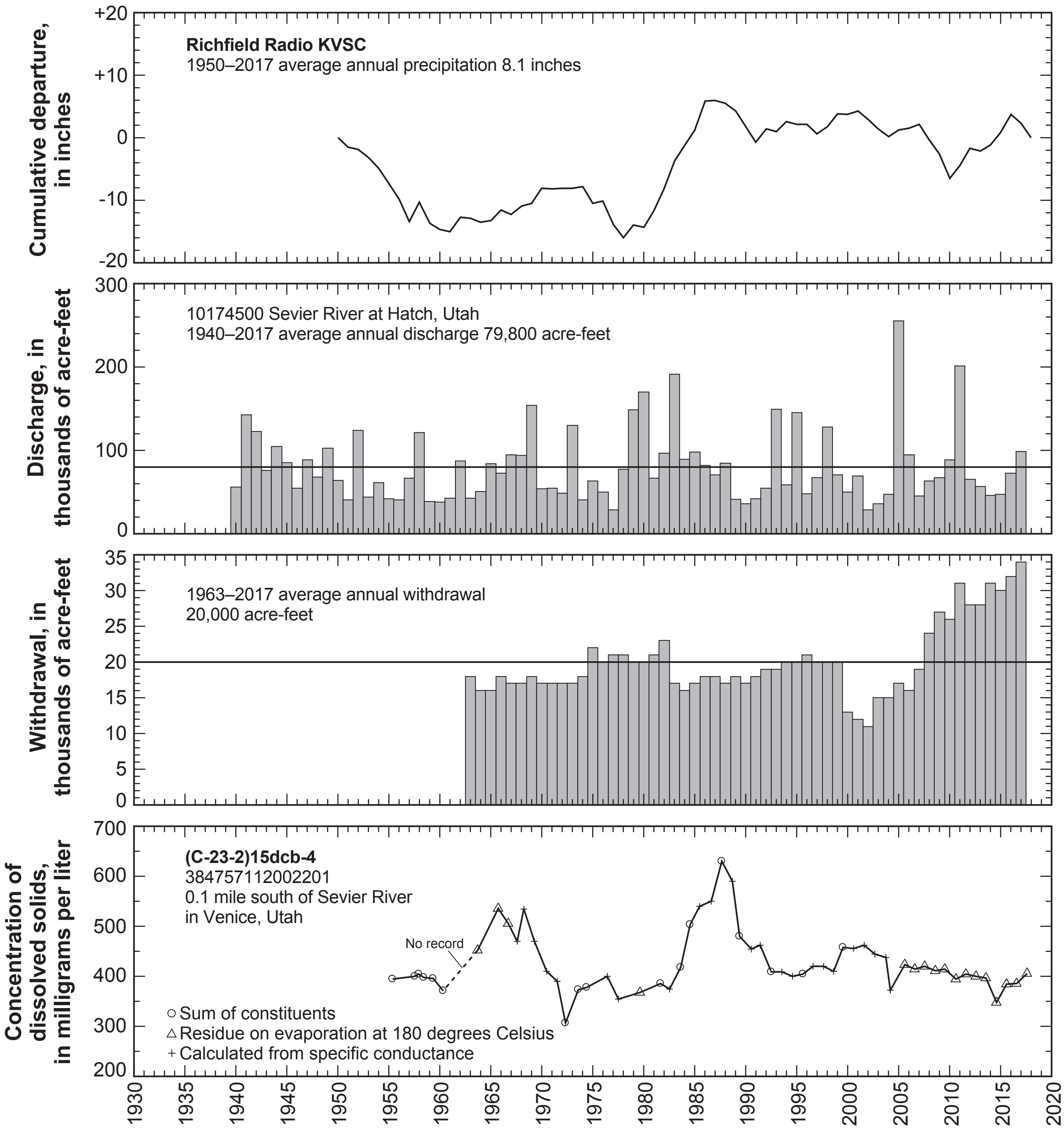


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from 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 unconsolidated basin-fill deposits and basalt in the valley under both water-table and artesian conditions, and is used primarily for irrigation (table 2).

Total estimated withdrawal of water from wells in Pahvant Valley in 2017 was about 110,200 acre-feet, which is about 4,000 acre-feet less than was reported in 2016 and 4,000 acre-feet more than the average annual withdrawal for 2007–2016 (tables 2 and 3). Withdrawal for irrigation in 2017 was about 109,000 acre-feet, which is 4,000 acre-feet less than was reported in 2016.

The location of wells in Pahvant Valley in which the water level was measured during March 2018 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 2017 was about 14.2 inches, which is about 1.0 inch less than the average annual precipitation for 1930–2017 and about 2.0 inches less than in 2016.

Water levels generally declined from March 2017 to March 2018 in nearly all parts of Pahvant Valley for which data are available. Water-level declines of more than 4 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 well (C-21-5)7cdd-3, located in the Flowell area, from 1960 to 2017, and from well (C-23-6)8abd-1, located in the Kanosh area, from 1957 to 2017, is shown in figure 23. The dissolved-solids concentration in water samples from well (C-21-5)7cdd-3 has ranged from 778 to 1,080 mg/L. The concentration of dissolved solids in the water sample collected in June 2017 was 1,070 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 2017 was 5,870 mg/L. These increases are probably due to continued large withdrawals for irrigation.

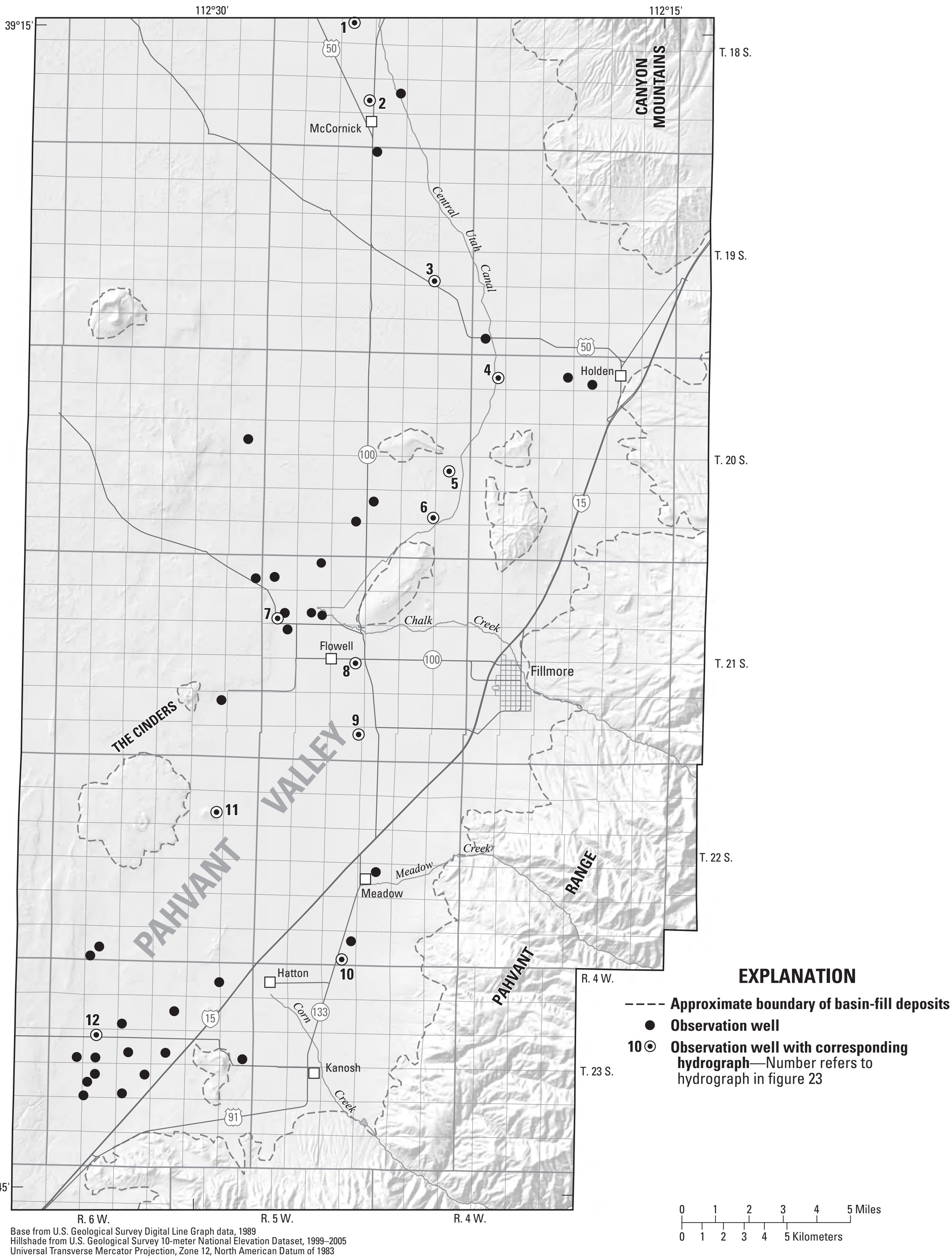


Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 2018.

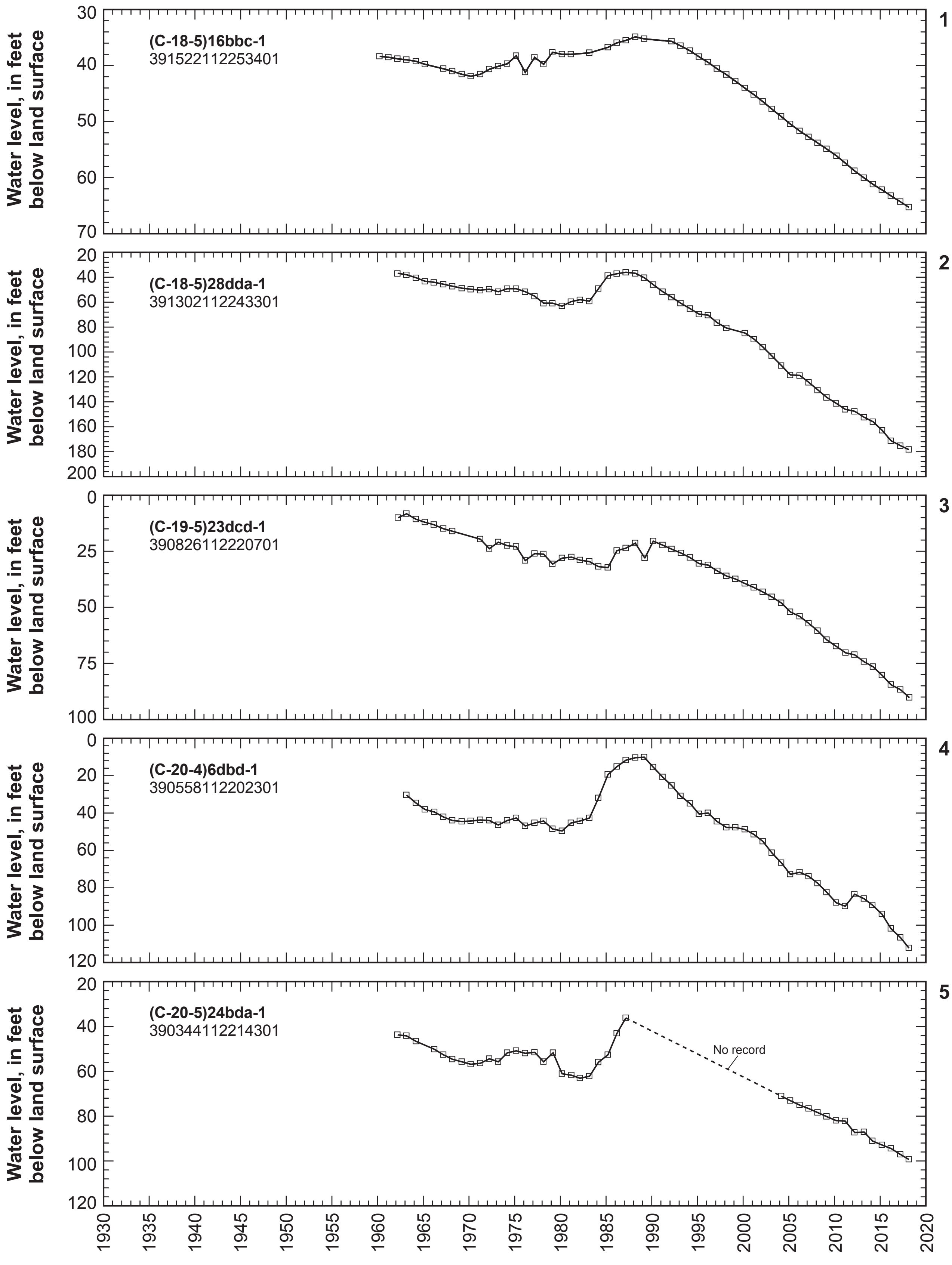


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

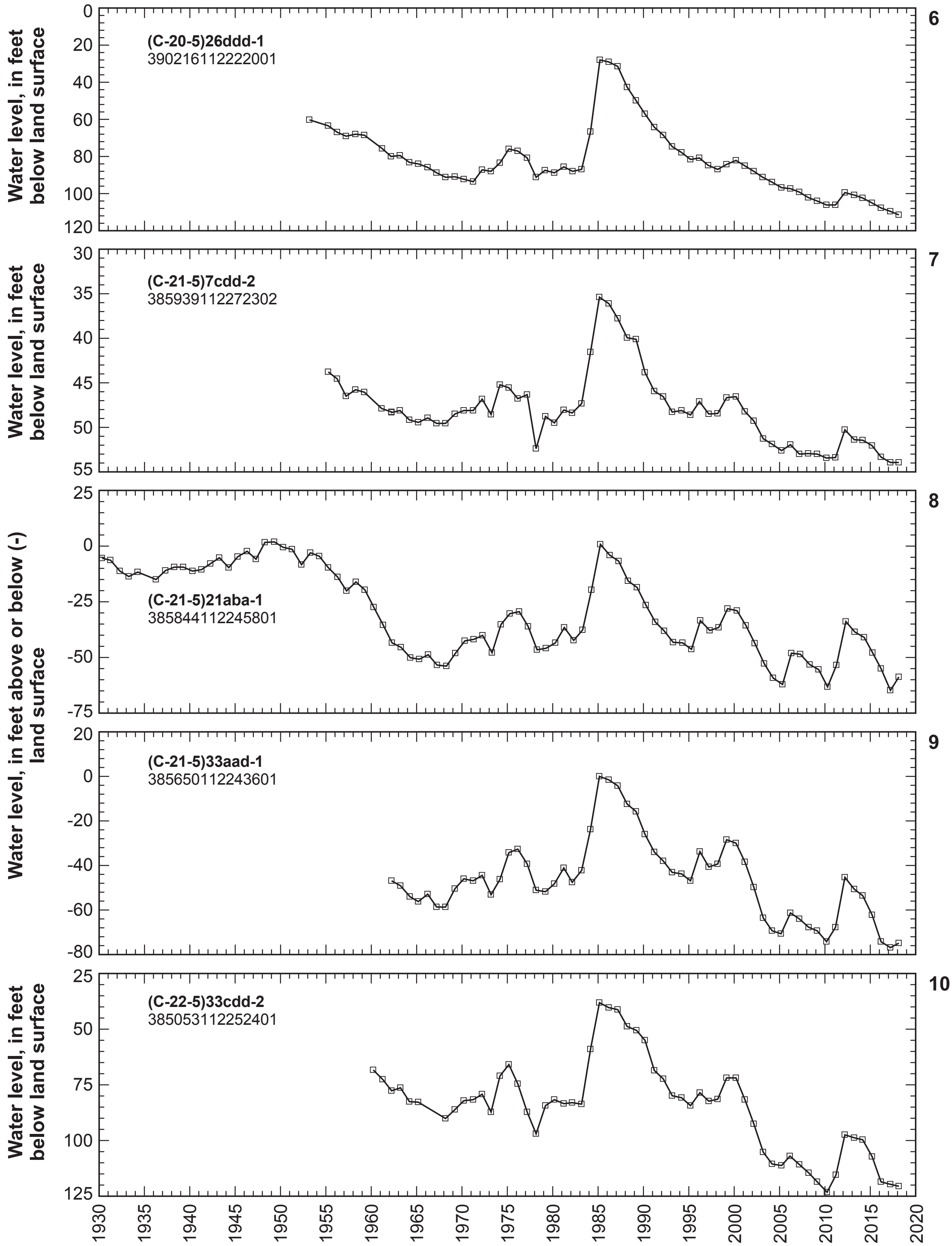


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

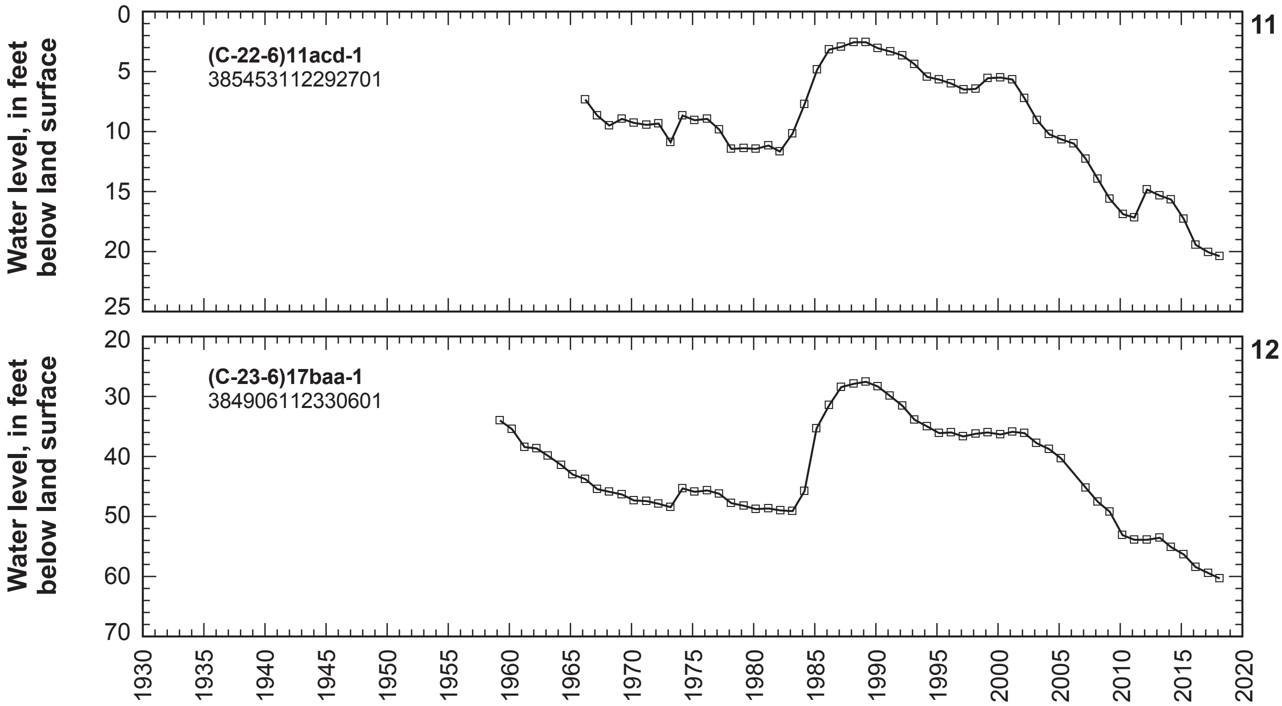


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

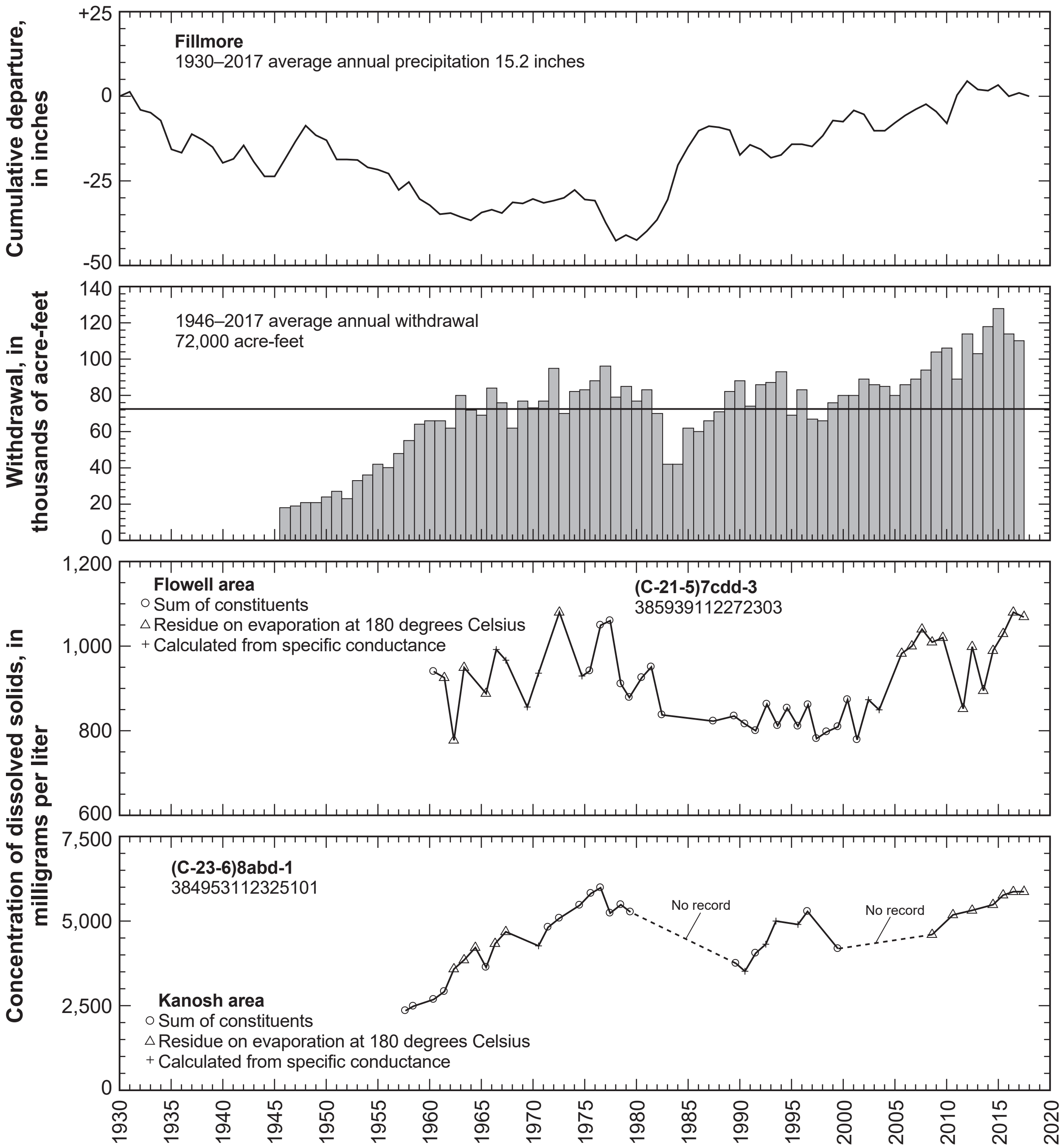


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cedar Valley, Iron County

By Brandon P. Douglas

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 Dry 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, and is used primarily for irrigation (table 2). The principal source of recharge to the basin-fill aquifer is water from Coal Creek.

Total estimated withdrawal of water from wells in Cedar Valley in 2017 was about 42,100 acre-feet, which is 2,700 acre-feet more than in 2016 and about 3,000 acre-feet more than the average annual withdrawal for 2007–2016 (tables 2 and 3).

The location of wells in Cedar Valley in which the water level was measured during March 2018 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 2017 was about 9.6 inches, which is 1.2 inches less than the total for 2016 and 1.3 inches less than the average annual precipitation for 1949–2017. Discharge of Coal Creek was about 23,500 acre-feet in 2017, which is about the same as that in 2016, and 800 acre-feet less than the average annual discharge for 1936 and 1939–2017.

Groundwater levels declined from March 2017 to March 2018 in most parts of Cedar Valley, with the exception of an area just north of Cedar City where water levels increased. The largest decline, about 5.2 feet, was measured in a well near Kanarraville. Water-level declines are probably the result of continued large withdrawals for irrigation.

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 2017, and well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, from 1977 to 2017, is shown in figure 25. The dissolved-solids concentrations in water from both wells have generally increased. Since 2013, the concentration of dissolved solids in water from well (C-37-12)23abd-1 has increased from 433 to 748 mg/L. These increases are probably due to localized pumpage for irrigation.

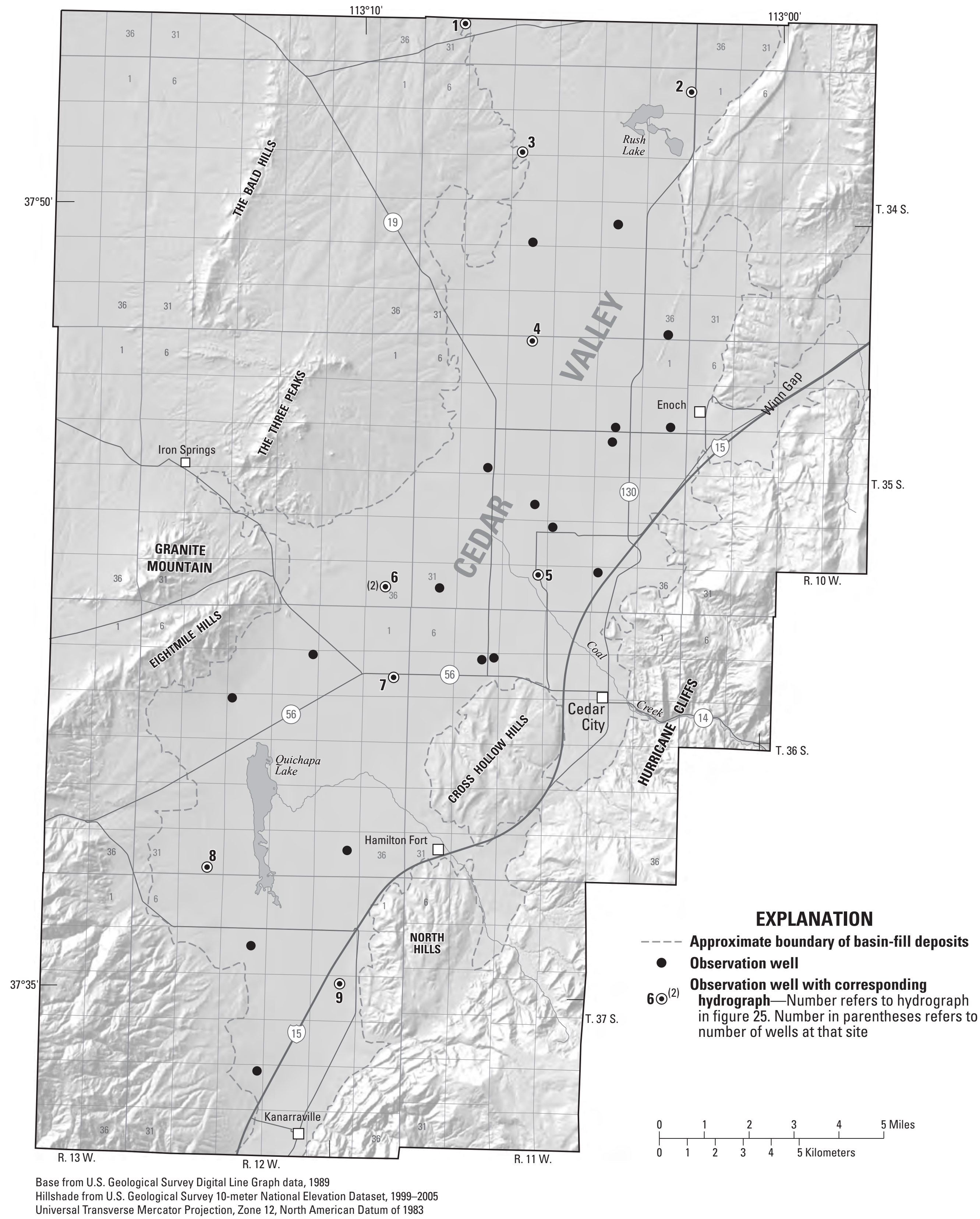


Figure 24. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2018.

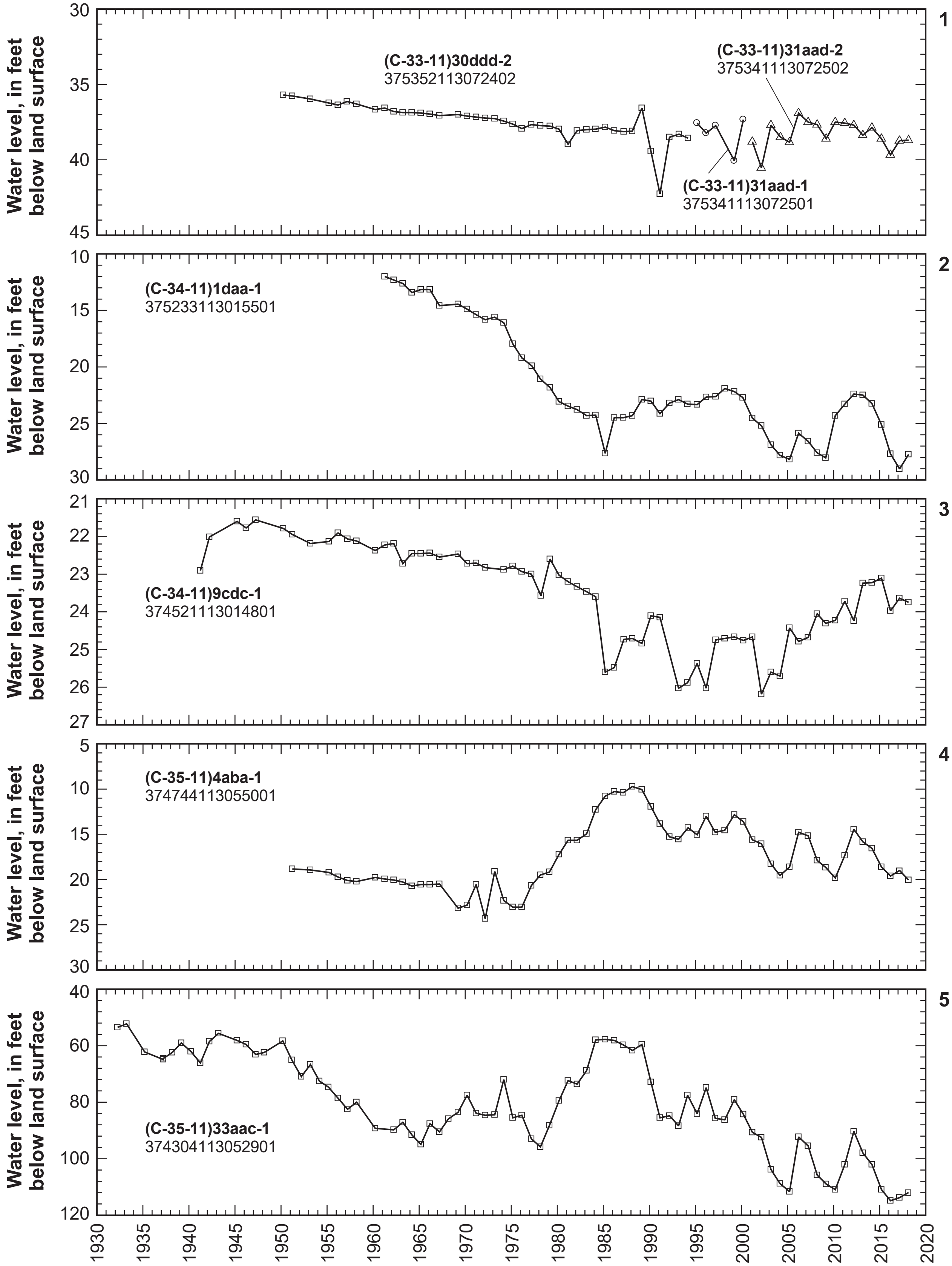


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

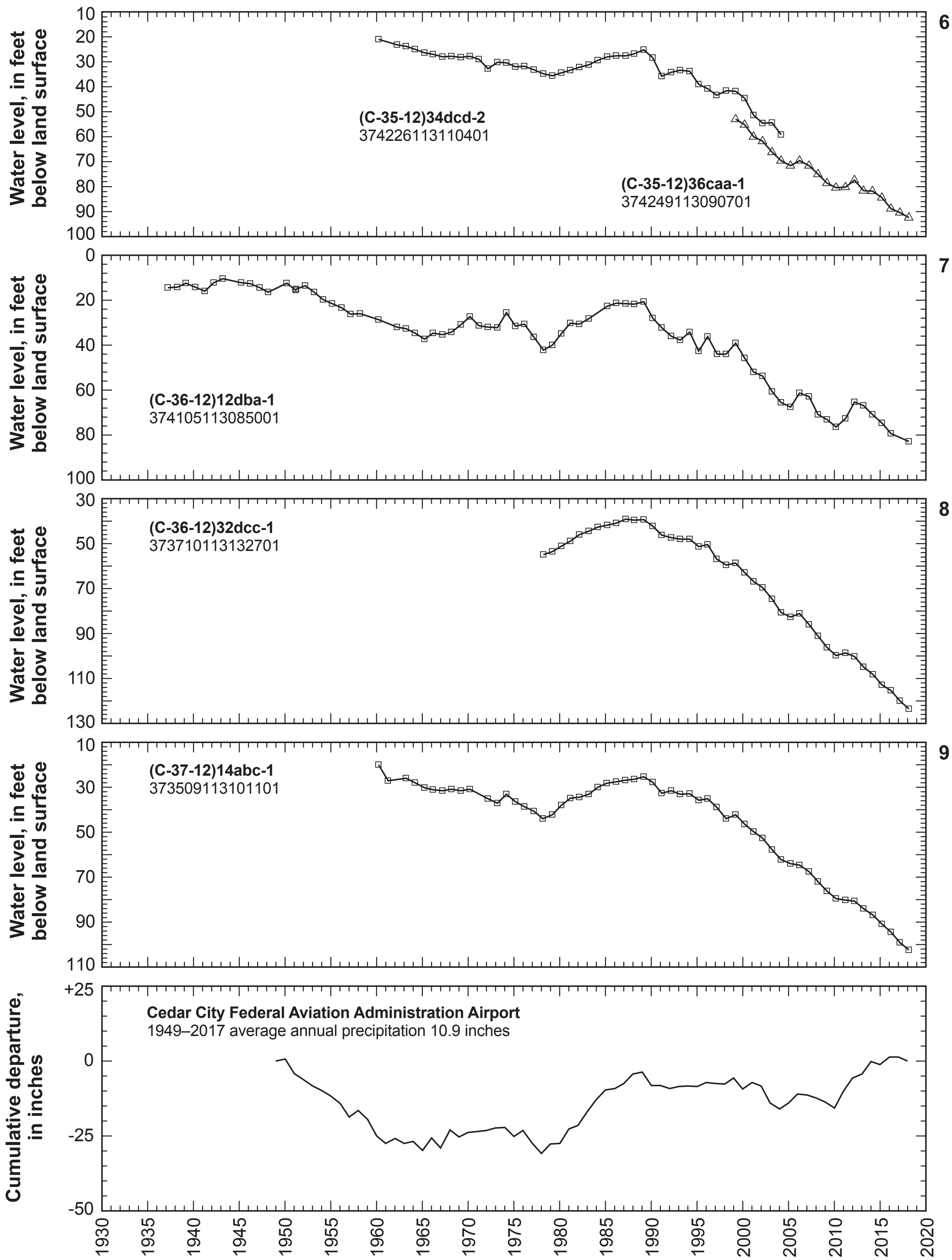


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

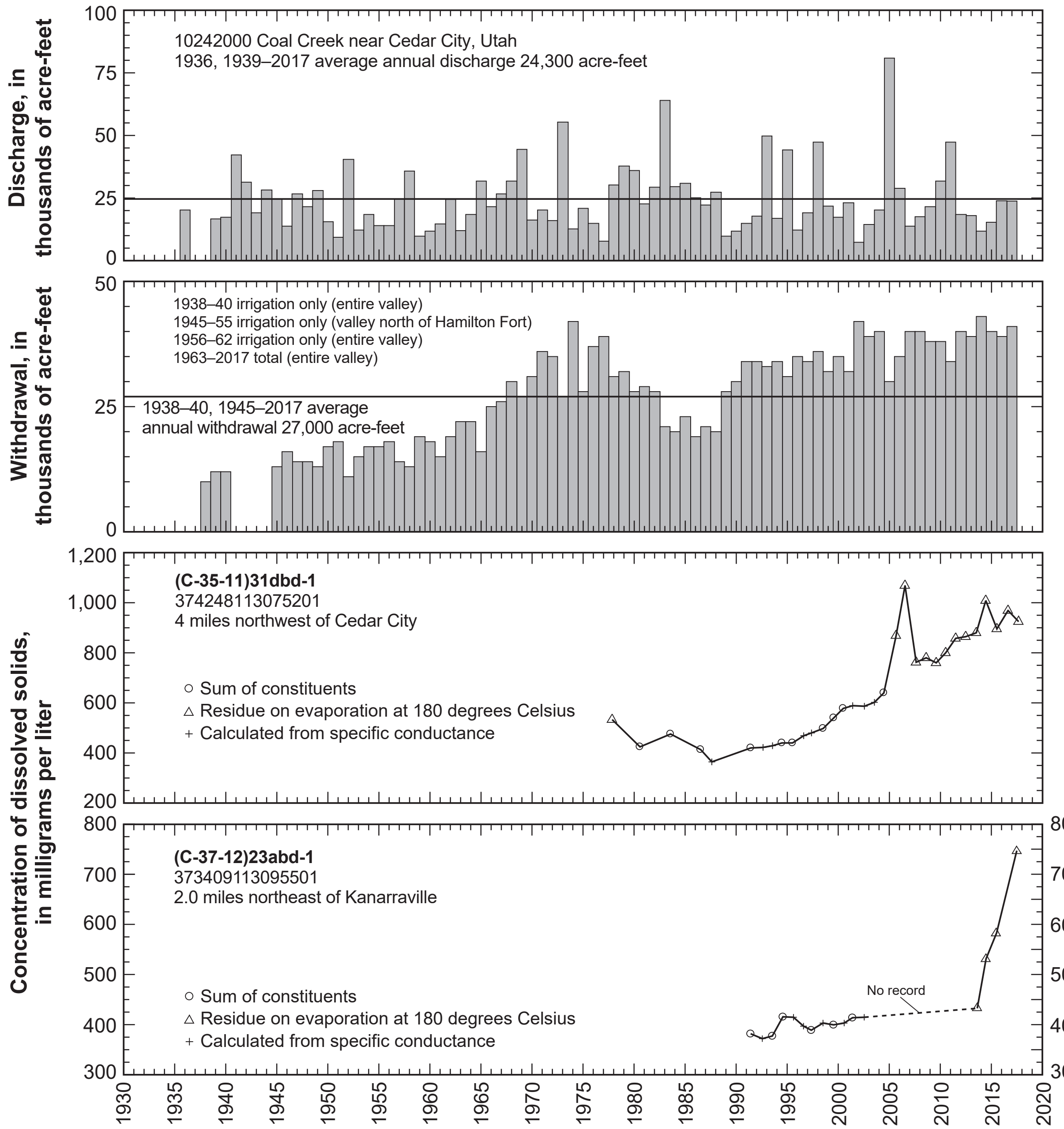


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

Parowan Valley

By Brandon P. Douglas

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, Parowan, and Summit (fig. 26). Groundwater occurs in unconsolidated basin-fill deposits and consolidated rock under water-table conditions, and is used primarily for irrigation (table 2).

Total estimated withdrawal of water from wells in Parowan Valley in 2017 was about 35,200 acre-feet, which is 1,400 acre-feet less than was reported for 2016 and is about the same as the average annual withdrawal for 2007–2016 (tables 2 and 3). The increase is mainly due to increased withdrawals for irrigation.

The location of wells in Parowan Valley in which the water level was measured during March 2018 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 2017 was about 9.6 inches, which is 1.2 inches less than the value for 2016 and 1.3 inches less than the average annual precipitation for 1949–2017.

Water levels declined from March 2017 to March 2018 in some parts of Parowan Valley; in other parts of the valley water levels remained nearly the same or increased. The largest decline, about 2.9 feet, was measured in a well north of Paragonah. Water levels in Parowan Valley generally have declined since 1950. For example, the water level in well (C-34-9)16cdd-2, located in the southwest part of the valley, has declined more than 65 feet since 1953. Declines in water levels are most likely the result of continued large local withdrawals for irrigation. Some rises occurred during 1973–74, 1983–85, 1996–99, 2006, and 2012, which correspond to periods of greater-than-average precipitation.

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 2017, is shown in figure 27. The water sample collected in July 2017 had a dissolved-solids concentration of 305 mg/L. With the exception of relatively high dissolved-solids concentrations in water samples collected in 1970, 1974, and 1987, concentrations have varied little.

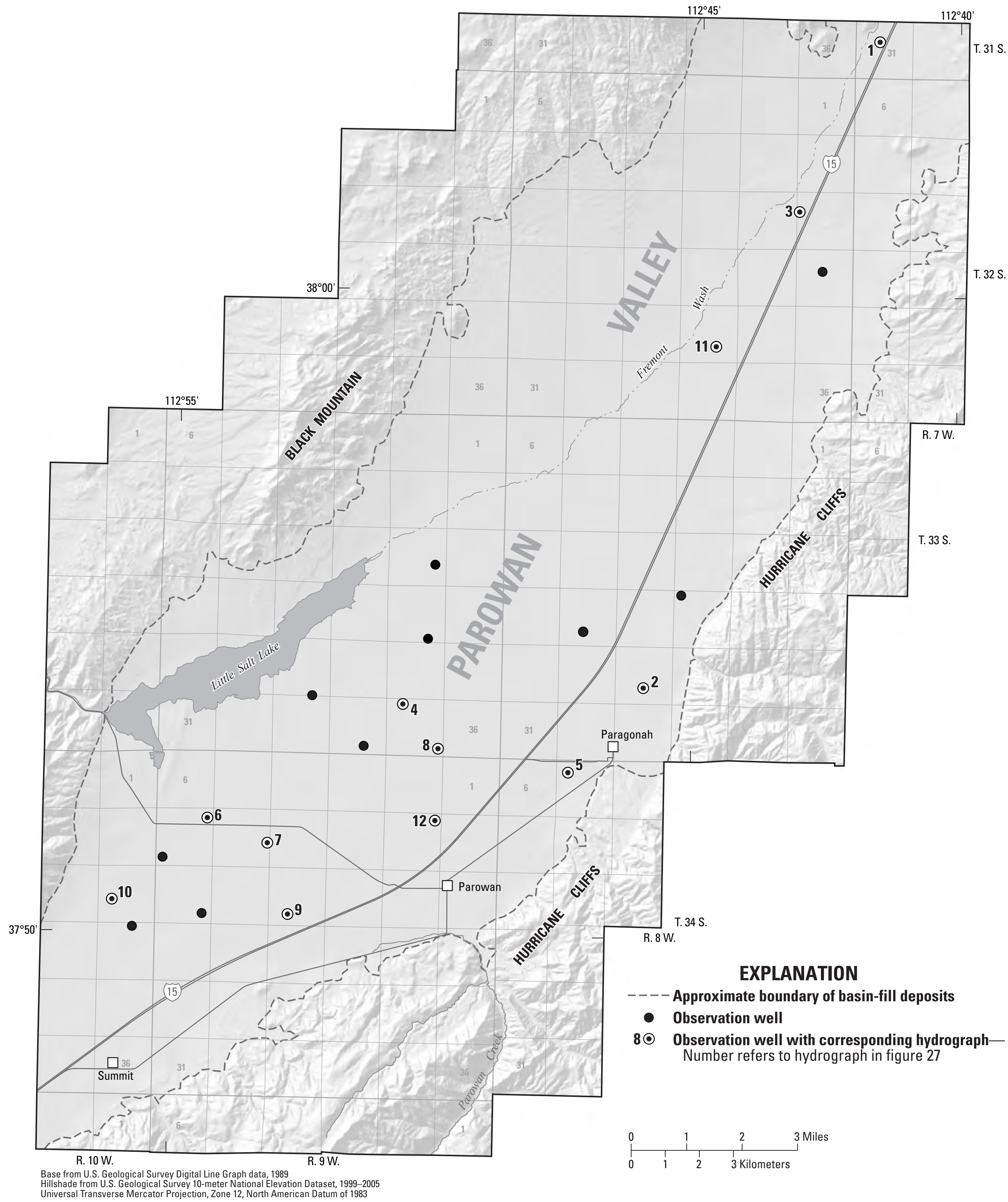


Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 2018.

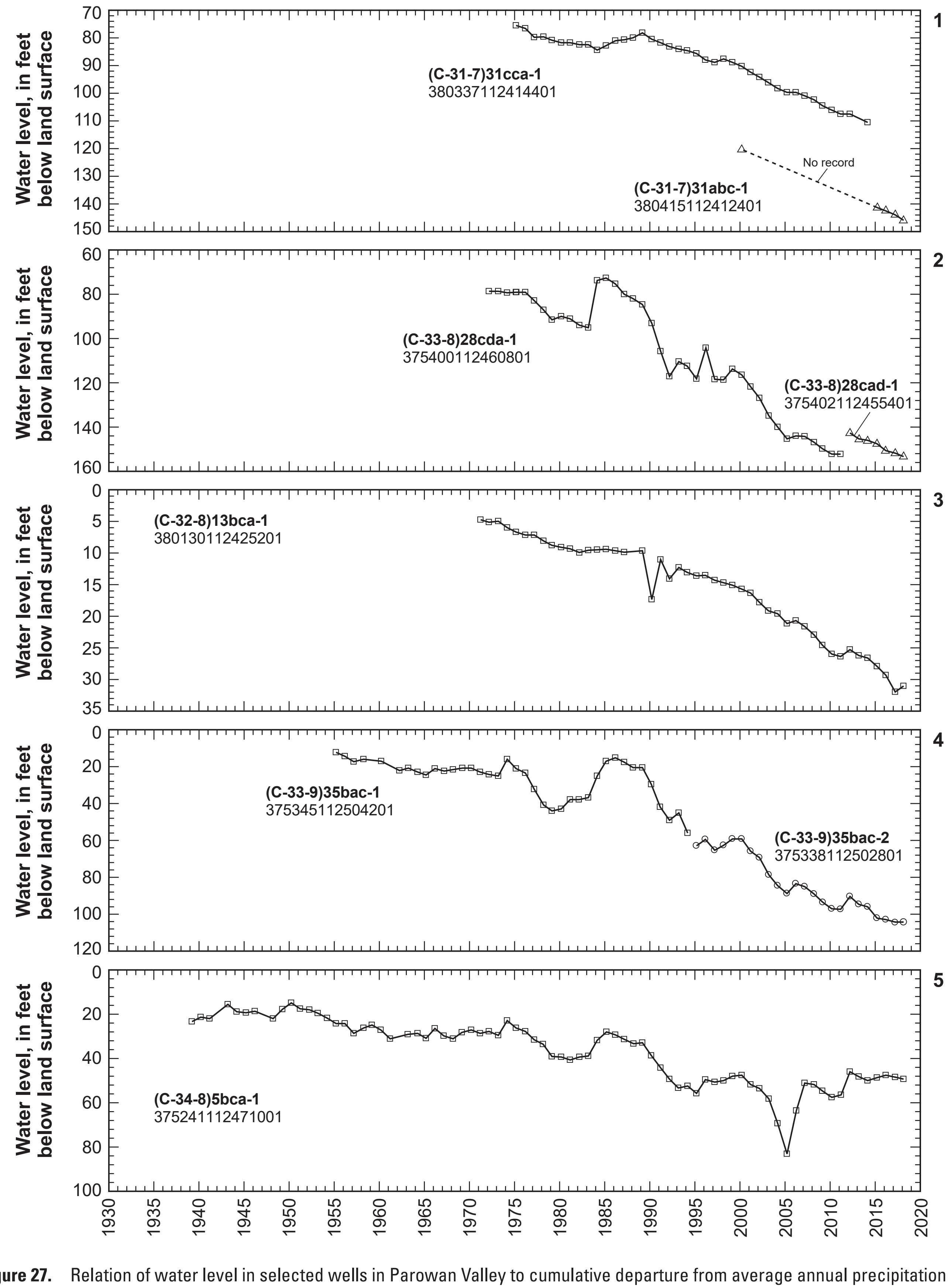


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

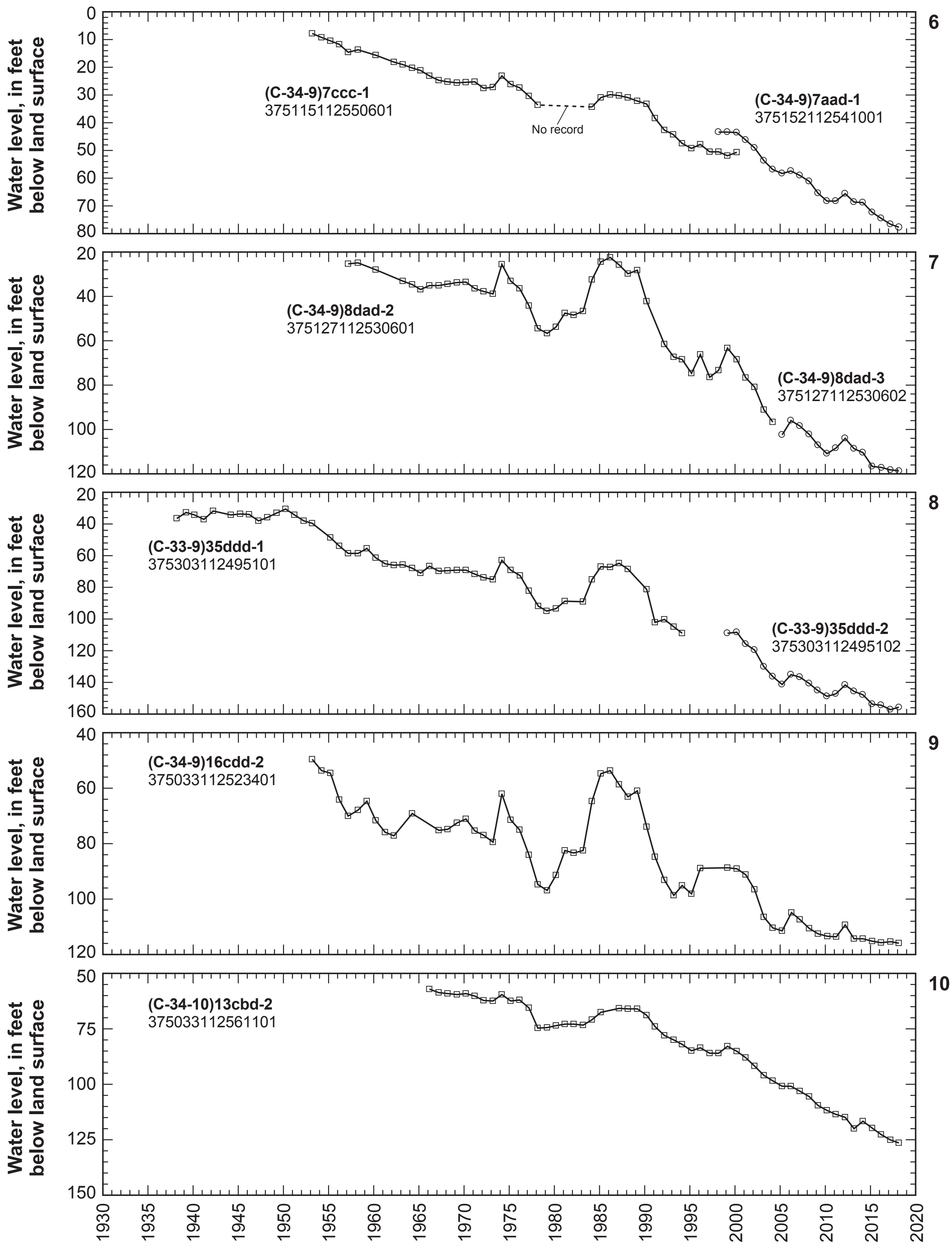


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

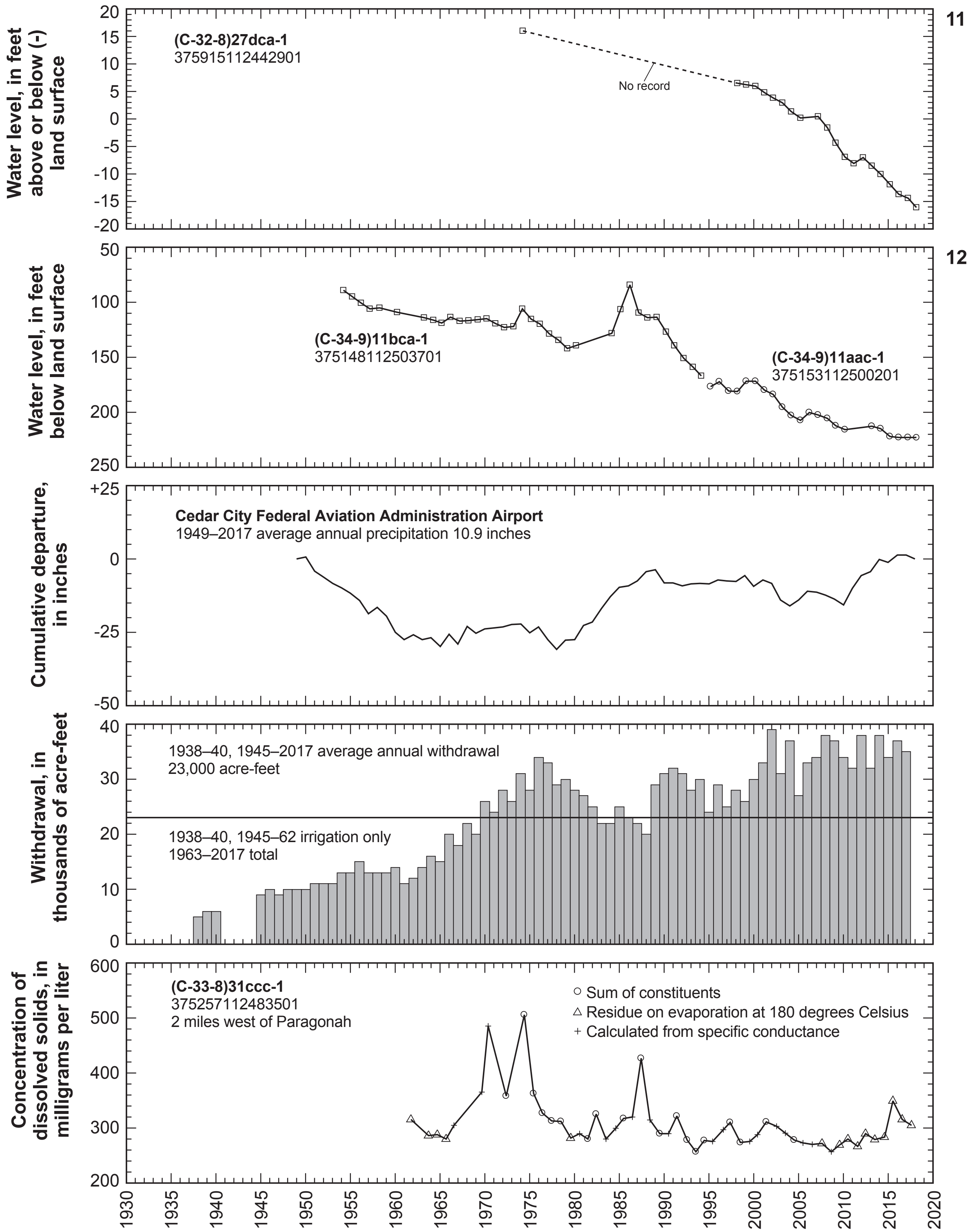


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

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, and is used primarily for irrigation and industrial purposes (table 2).

Total estimated withdrawal of water from wells in the Milford area of Escalante Valley in 2017 was about 70,600 acre-feet, which is 5,500 acre-feet more than was reported for 2016 and 9,600 acre-feet more than the average annual withdrawal for 2007–2016 (tables 2 and 3).

The location of wells in the Milford area in which the water level was measured during March 2018 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 2017 was about 8.8 inches, about 2.0 inches more than in 2016 and about 0.1 inch less than the 1952–2017 average annual precipitation.

Water levels declined from March 2017 to March 2018 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 2017, is shown in figure 29. The dissolved-solids concentration in the July 2017 sample was 451 mg/L.

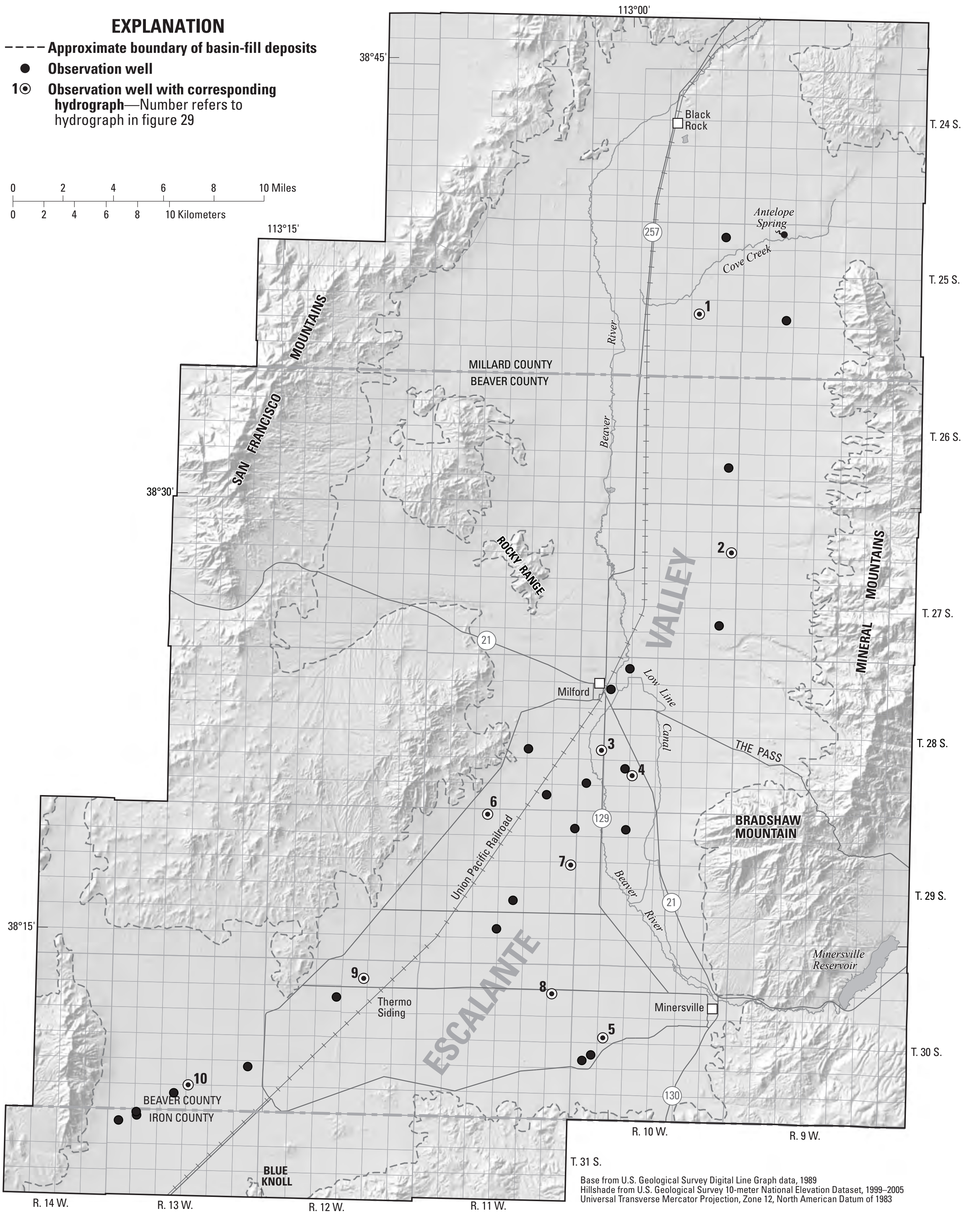


Figure 28. Location of wells in the Milford area in which the water level was measured during March 2018.

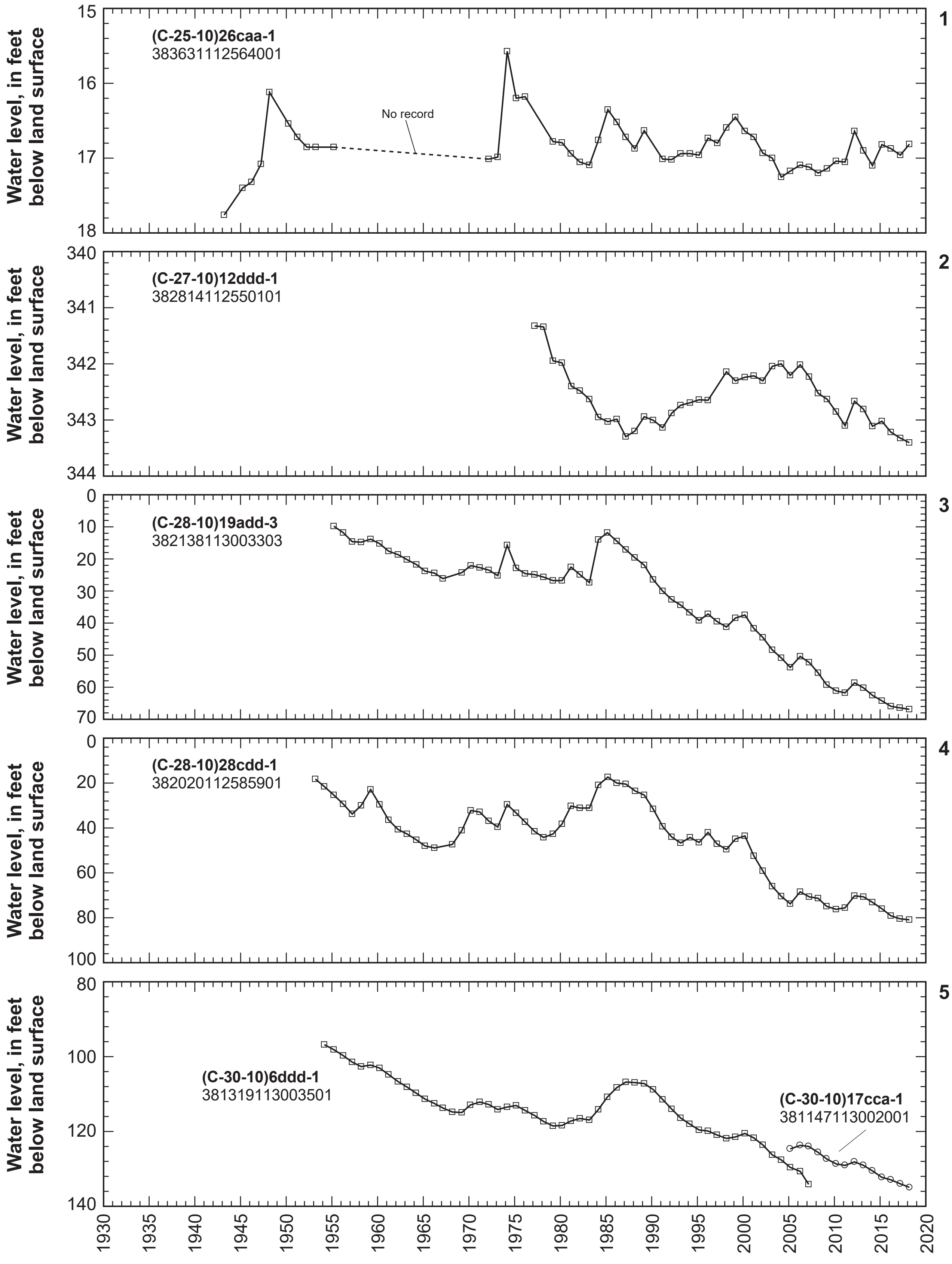


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.

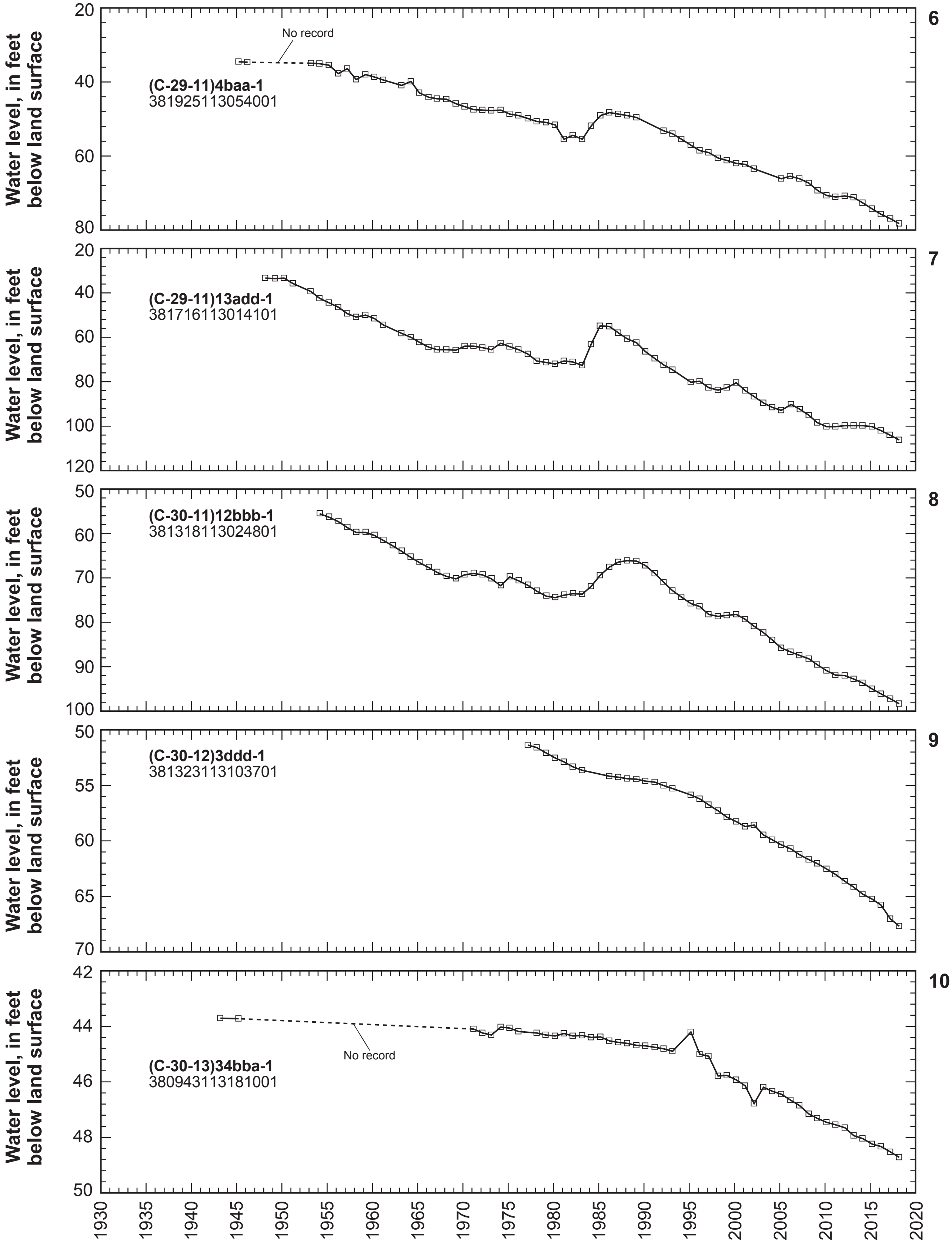


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

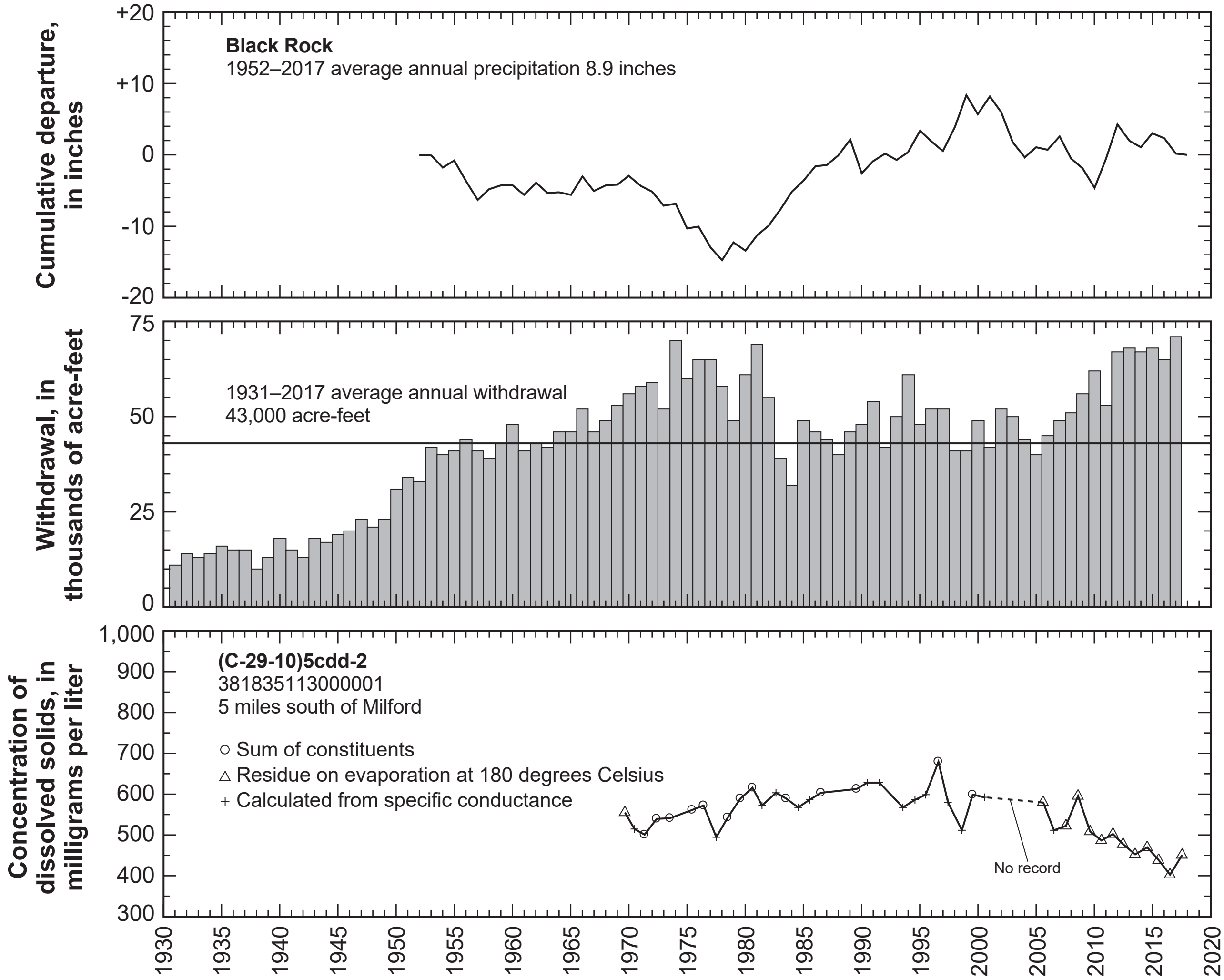


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

Escalante Valley

Beryl-Enterprise Area

By Douglas V. LaBonté

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 2017 was about 90,000 acre-feet, which is 5,000 acre-feet less than in 2016 and 3,000 acre-feet less than the average annual withdrawal for 2007–2016 (tables 2 and 3).

The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2018 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 2017 was about 16.0 inches, which is 1.9 inches more than the average annual precipitation for 1955–2017 and about 0.2 inch less than in 2016.

Water levels declined from March 2017 to March 2018 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 140 feet from March 1948 to March 2018 (fig. 31). These aforementioned declines are the result of continuous large withdrawals for the purpose of irrigation beginning around 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 during June 2017 was 645 mg/L.

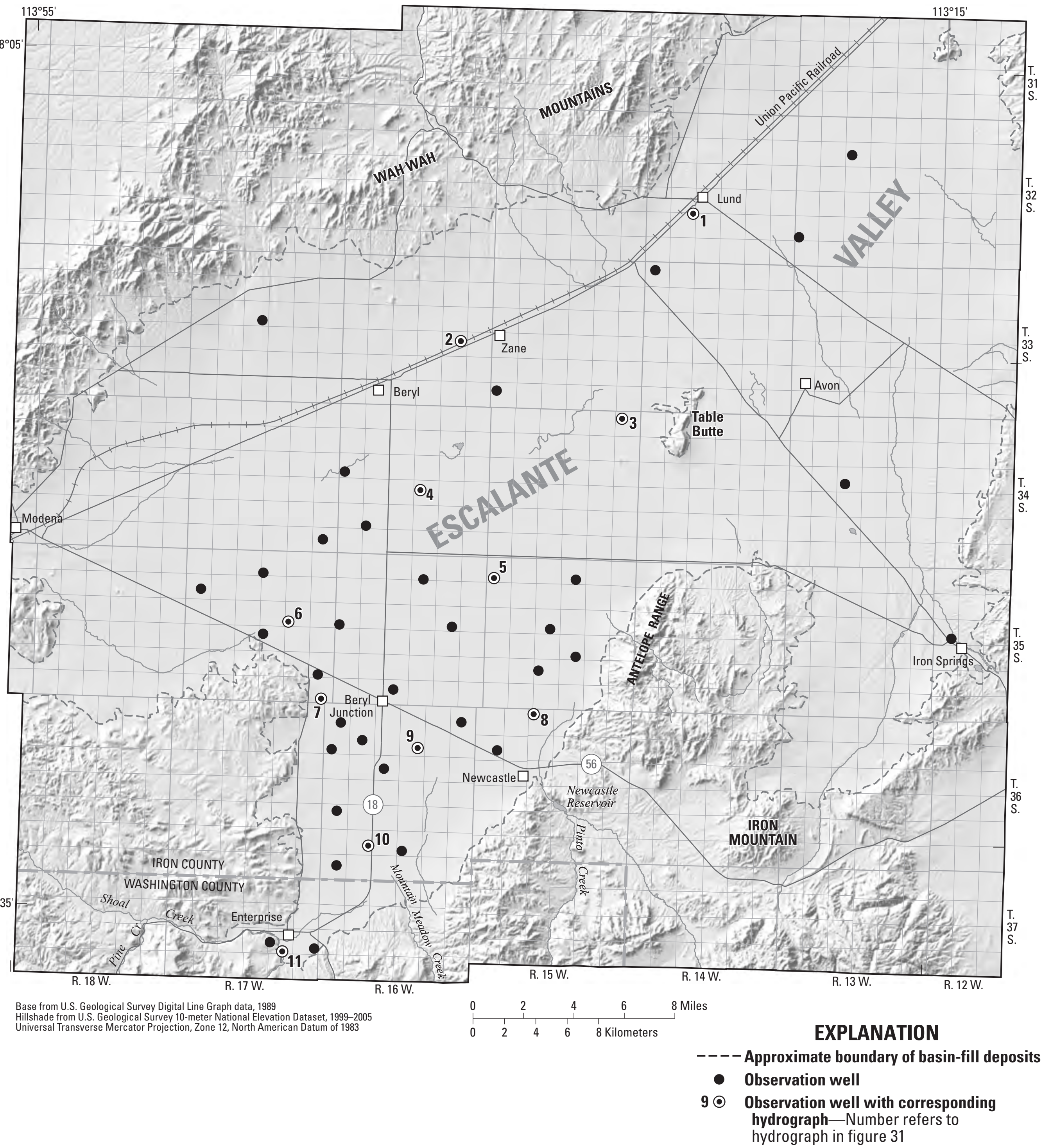


Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2018.

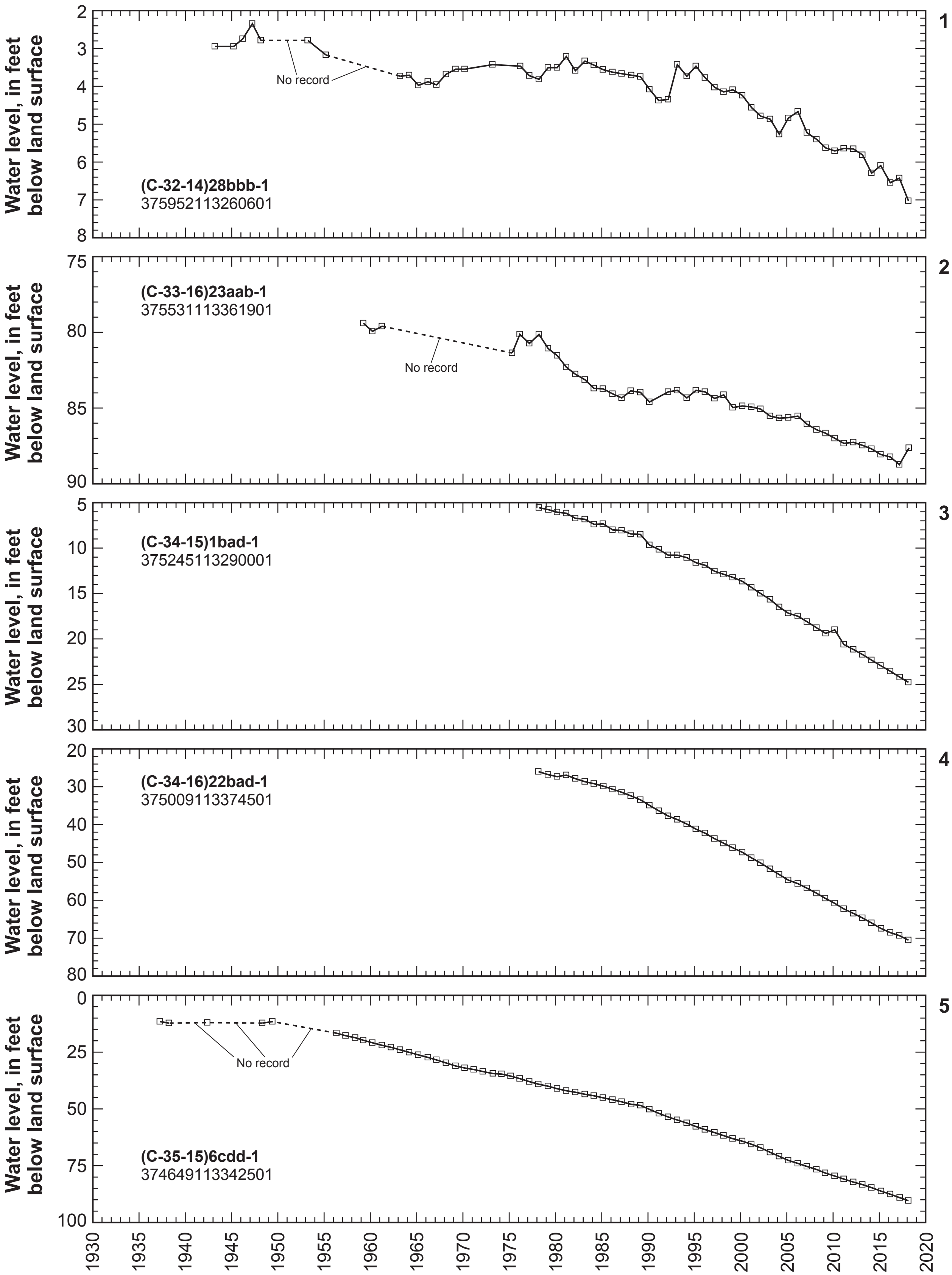


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.

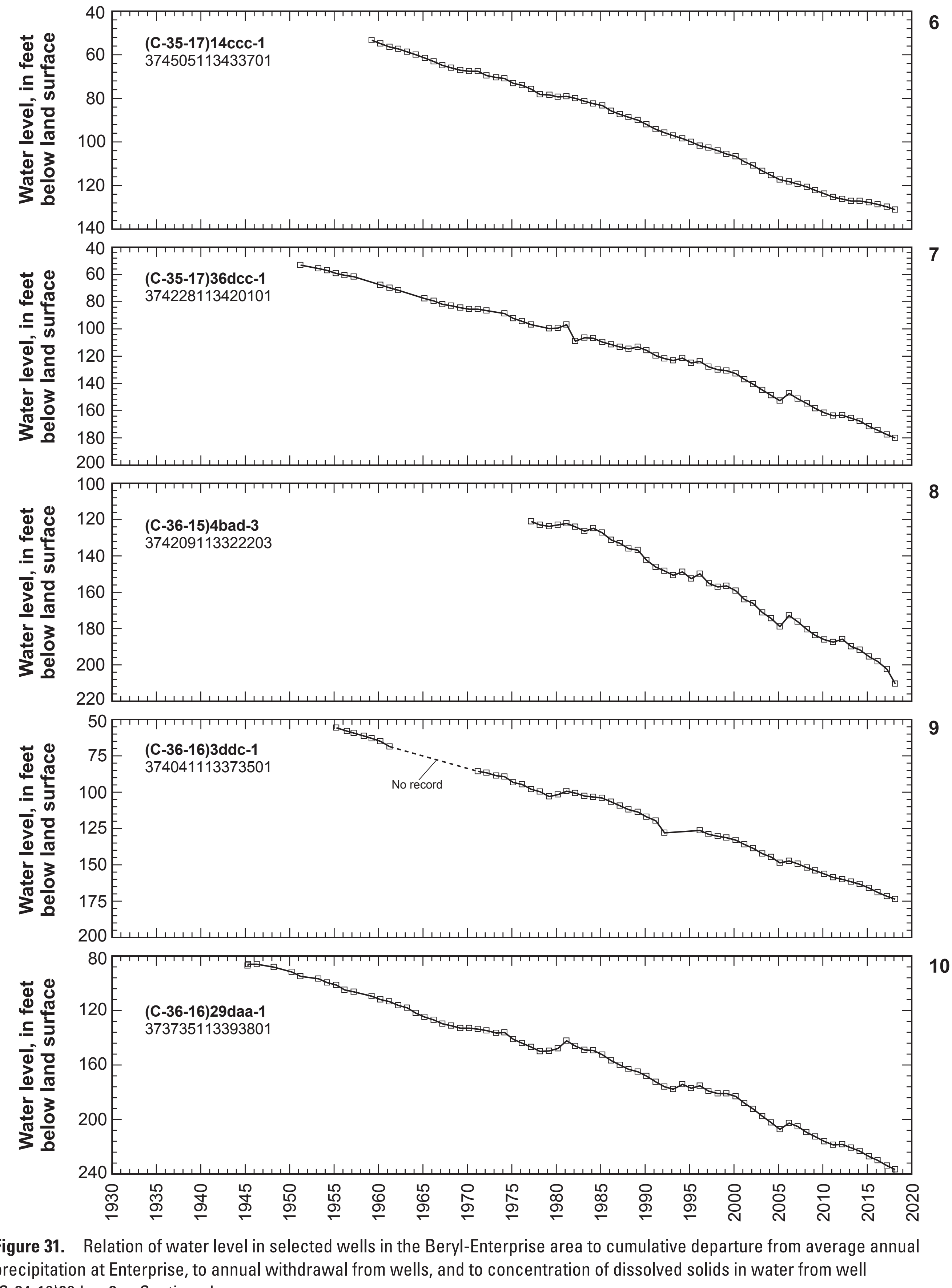


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.—Continued

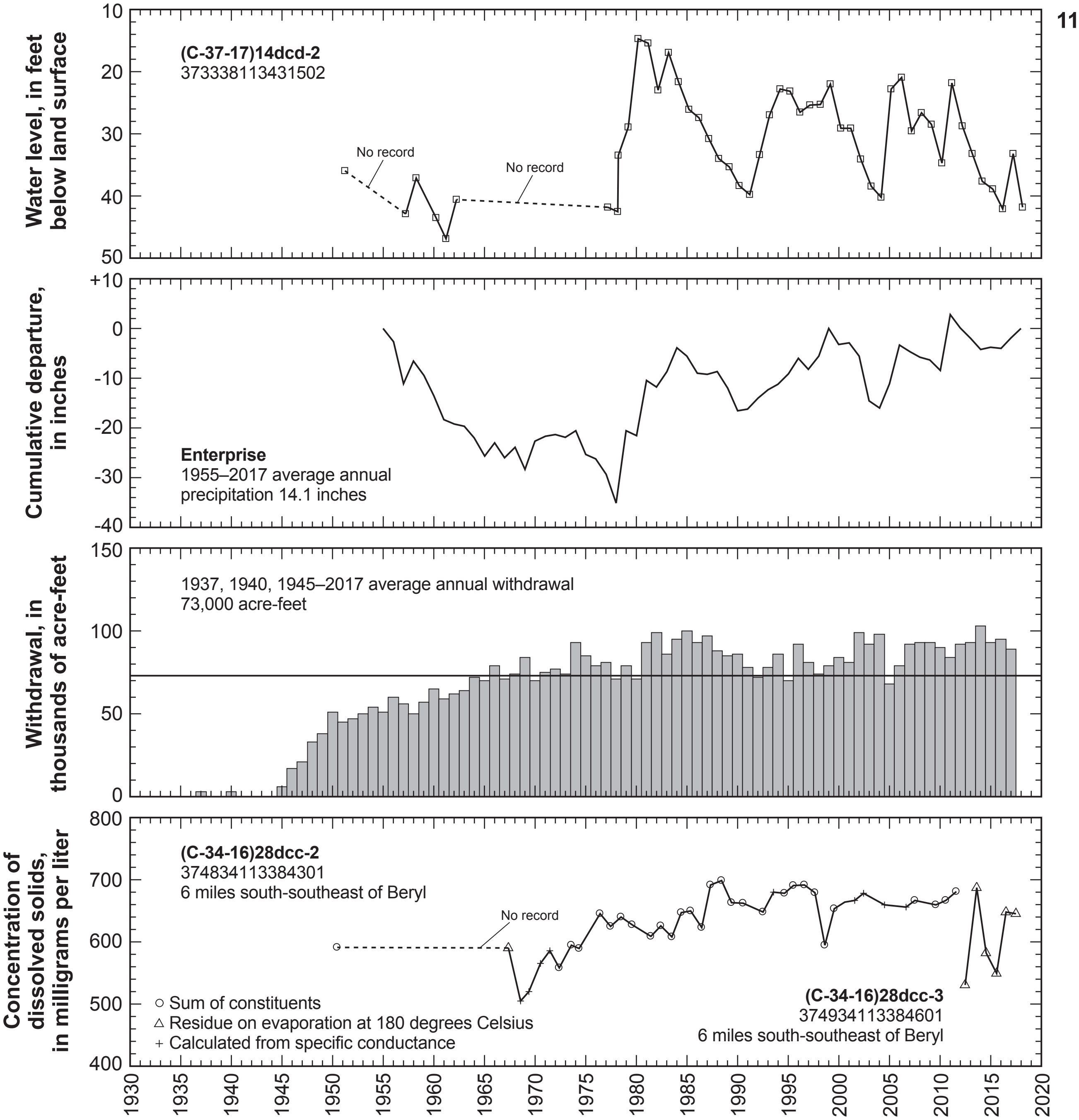


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.—Continued

Central Virgin River Area

By Douglas V. LaBonté

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). Water is withdrawn from consolidated rock and valley-fill aquifers and used primarily for public supply. Groundwater is also withdrawn from valley-fill aquifers and used for irrigation. 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 2017 was about 31,200 acre-feet, which is 2,200 acre-feet less than the revised value for 2016 and about the same as the average annual withdrawal for 2007–2016 (tables 2 and 3).

The location of wells in the central Virgin River area in which the water level was measured during February 2018 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 2017 was about 149,500 acre-feet, which is 35,600 acre-feet more than the value for 2016 and about 17,600 acre-feet more than the long-term average for 1931–70 and 1979–2017. Precipitation at La Verkin in 2017 was about 11.5 inches, which is 0.7 inch more than the average annual precipitation for 1951–2017 and 2.8 inches less than in 2016.

Water levels from February 2017 to February 2018 declined, or rose only slightly, in most of the central Virgin River area. The largest decline, about 5 feet, occurred in the southeast part of the area. Declines are probably the result of continued large withdrawals for irrigation and public supply.

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 2017, 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. The concentration of dissolved solids in the water sample collected in June 2017 was 295 mg/L.

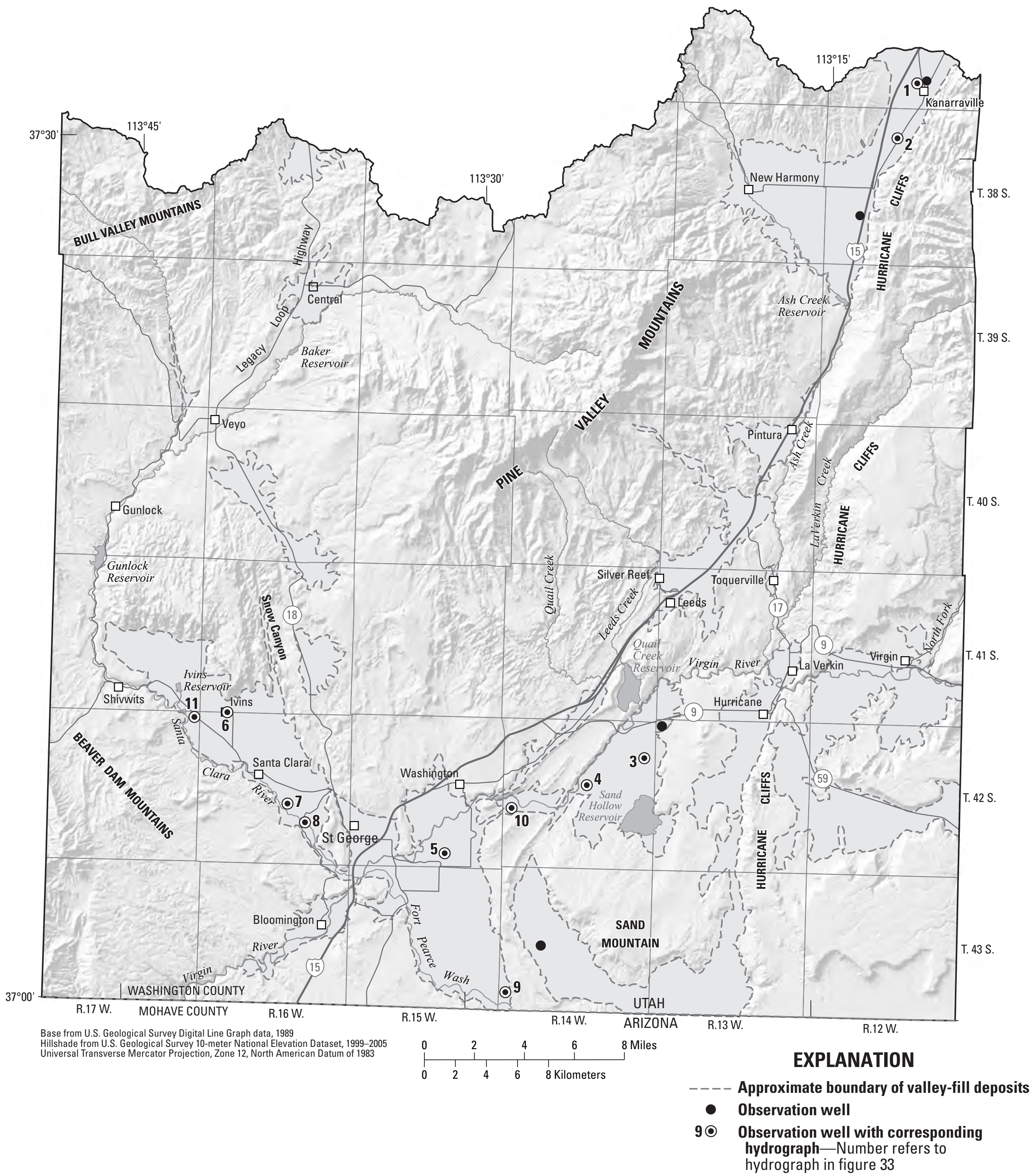


Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 2018.

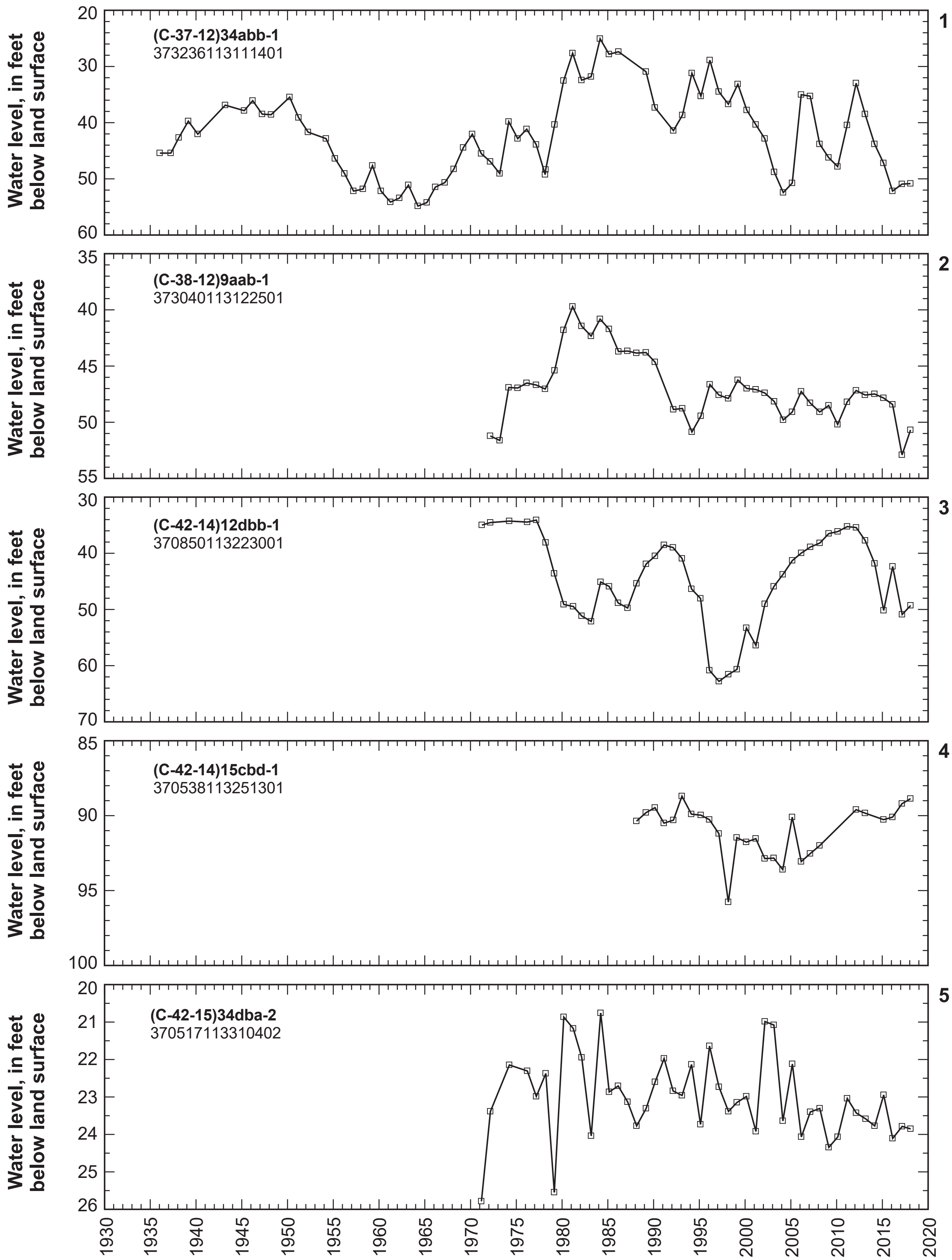


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

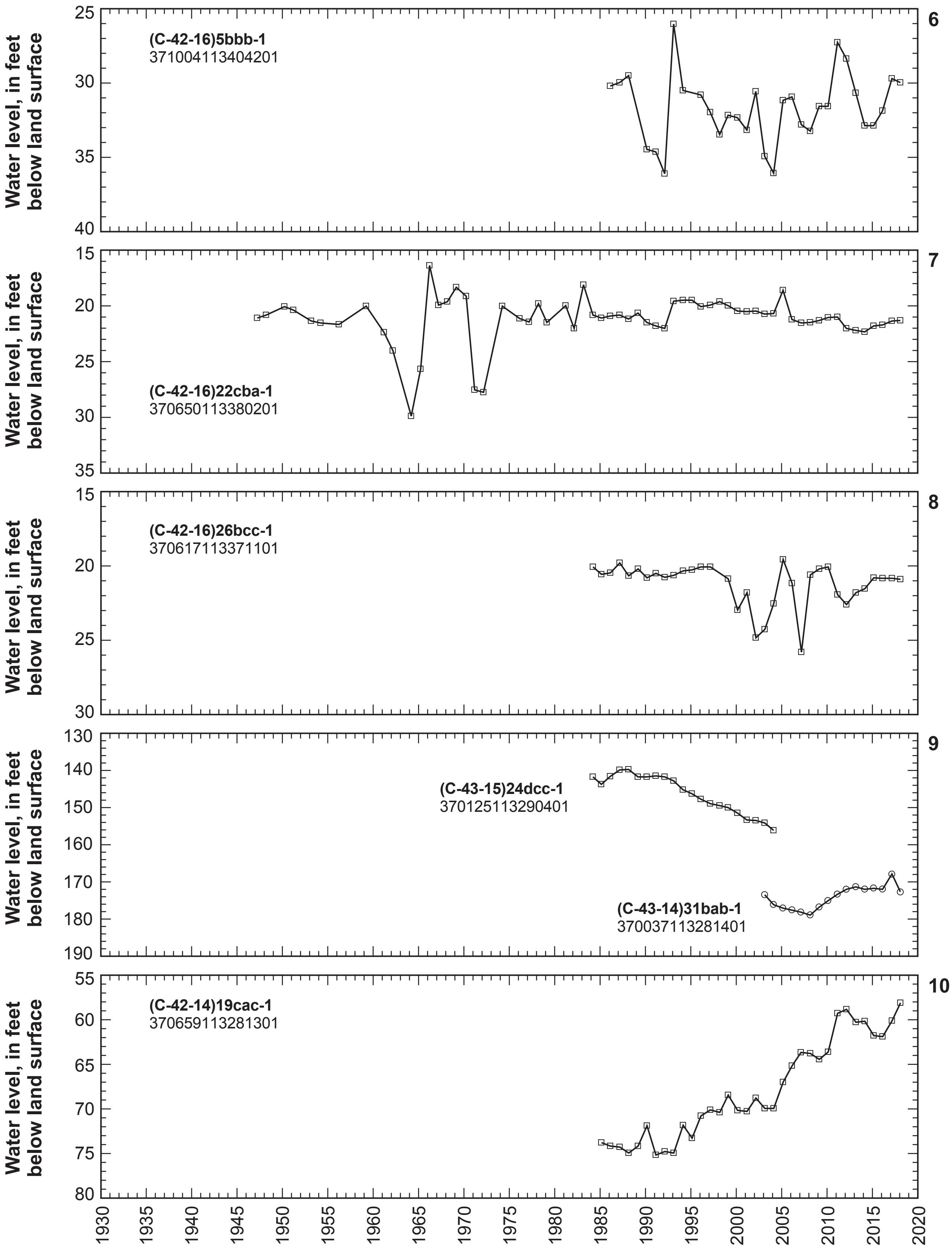


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

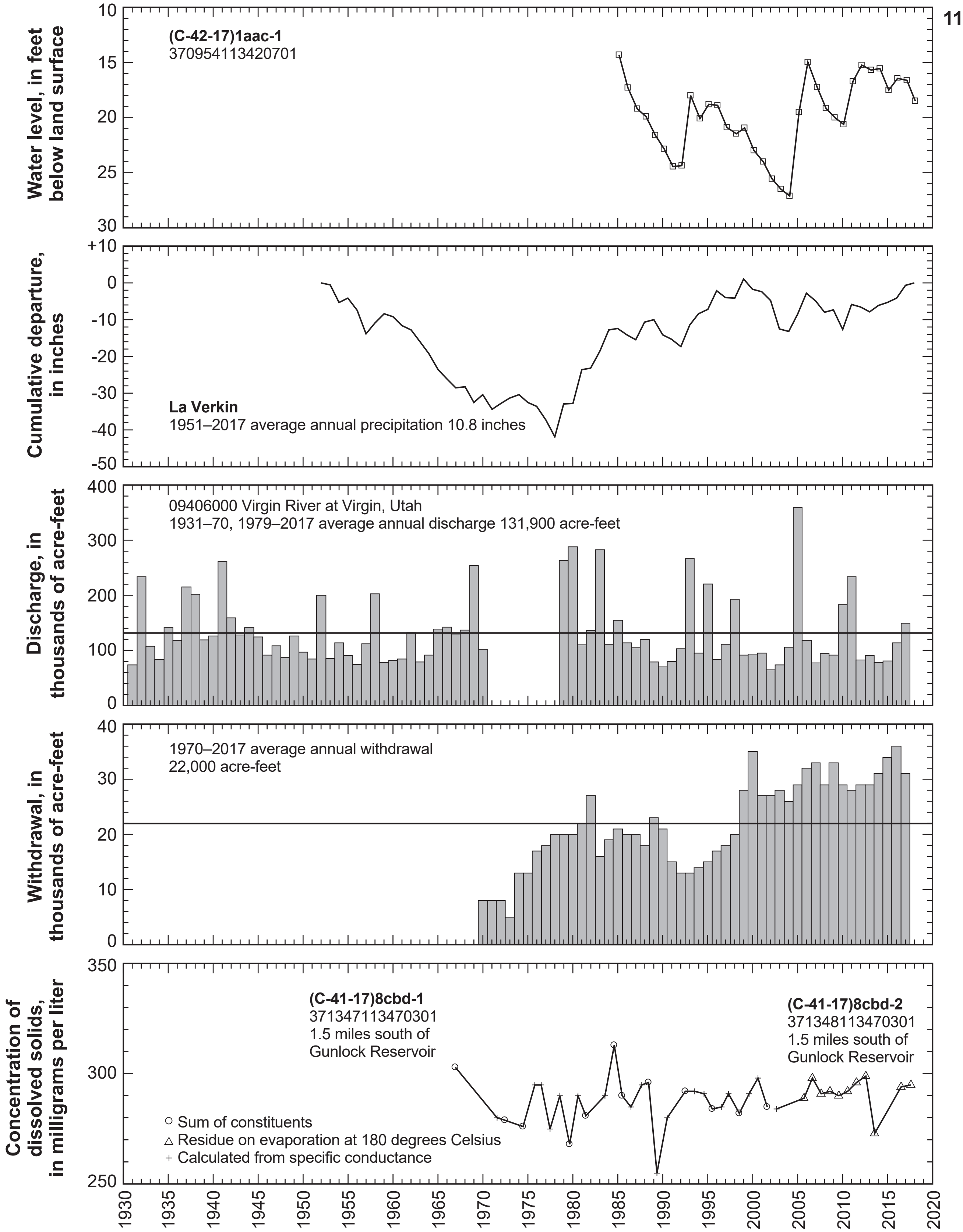


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from 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 with less significant groundwater development (table 4; fig. 1) in 2017 was about 137,800 acre-feet, which is about 7,300 acre-feet less than in 2016 and 6,000 acre-feet less than the average annual withdrawal for 2007–2016 (tables 2 and 3). The largest decreases were due to decreased withdrawals for irrigation and public supply. In most of the areas listed in table 4, withdrawals in 2017 were less than in 2016, except in Ogden Valley, Cedar Valley (Utah County), and Remainder of State, where public supply or industrial use increased slightly.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2018, 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 2017 to March 2018.

The location of wells in Sanpete Valley in which the water level was measured during March 2018 is shown in figure 36. The relation of the water level in selected observation wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti is shown in figure 37.

Water levels in 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 2017 to March 2018.

The location of wells in Snake Valley in which the water level was measured during March 2018 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 2017 to March 2018. 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 to cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 40. Water levels rose or declined only slightly in most of the selected observation wells from March 2017 to March 2018.

Table 4. Estimated withdrawal of water from wells in other areas of Utah, 2017.

Number on figure 1	Area	Estimated withdrawal (acre-feet)					
		2017					2016 total (rounded)
		Irrigation	Industrial[1]	Public supply[1]	Domestic and stock	2017 total (rounded)	
1	Grouse Creek Valley	1,800	0	0	40	1,800	2,000
2	Park Valley area	1,600	0	0	30	1,600	2,000
4	Lower Bear River area	4,000	570	4,600	200	9,400	13,100
8	Ogden Valley	0	0	12,000	630	12,600	12,300
13	Rush Valley	4,800	270	180	70	5,300	5,400
14	Dugway area, Skull Valley, and Old River Bed	3,200	3,700	760	20	7,700	7,900
15	Cedar Valley, Utah County	800	0	5,900	80	6,800	6,600
20	Sanpete Valley	5,200	1,100	700	1,100	8,100	8,700
25	Snake Valley	18,300	0	80	100	18,500	20,300
27	Beaver Valley	10,200	10	390	500	11,100	12,600
	Remainder of State	12,600	18,000	21,600	2,600	54,800	54,100
Total		62,500	23,650	46,210	5,370	138,000	145,000

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

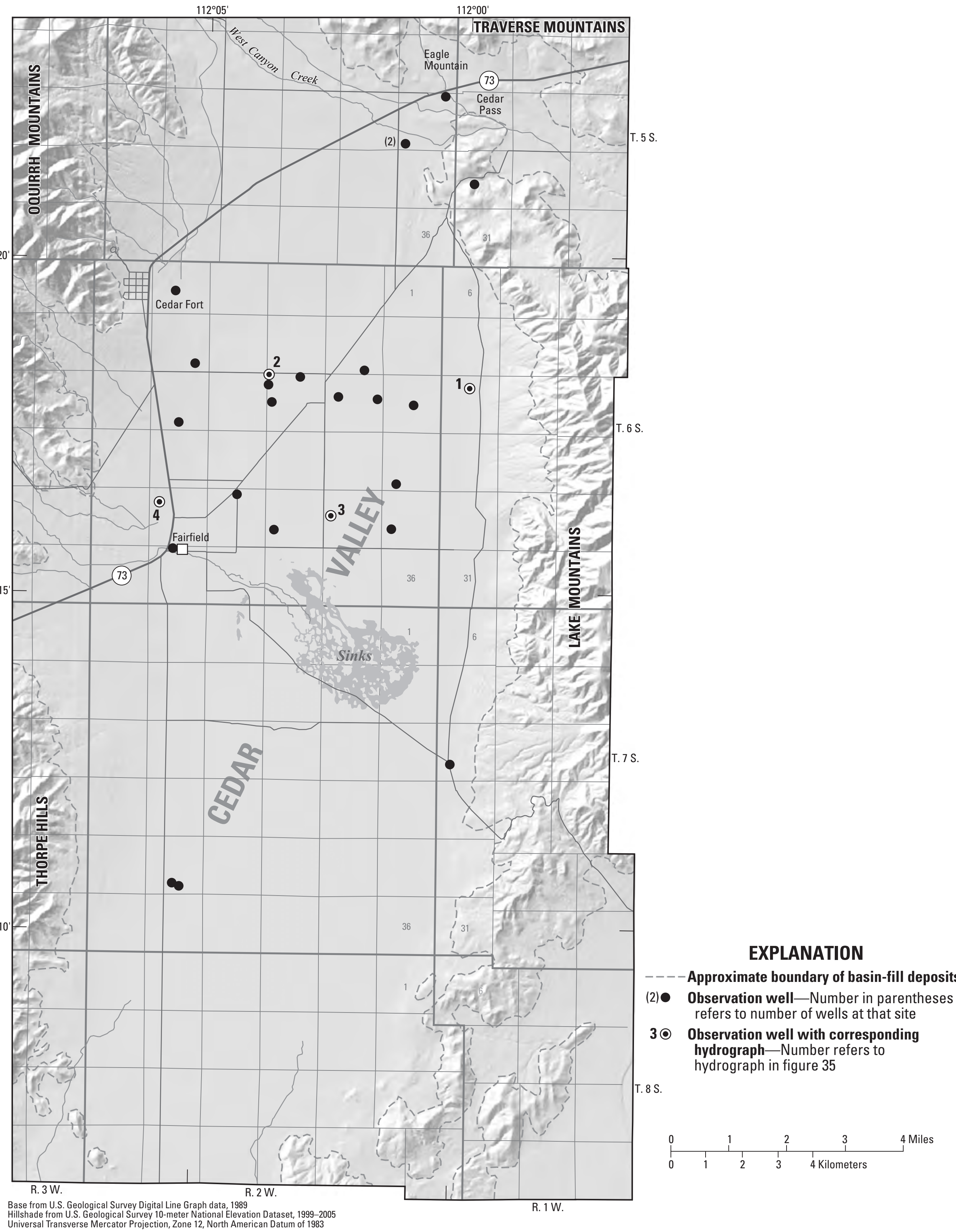


Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2018.

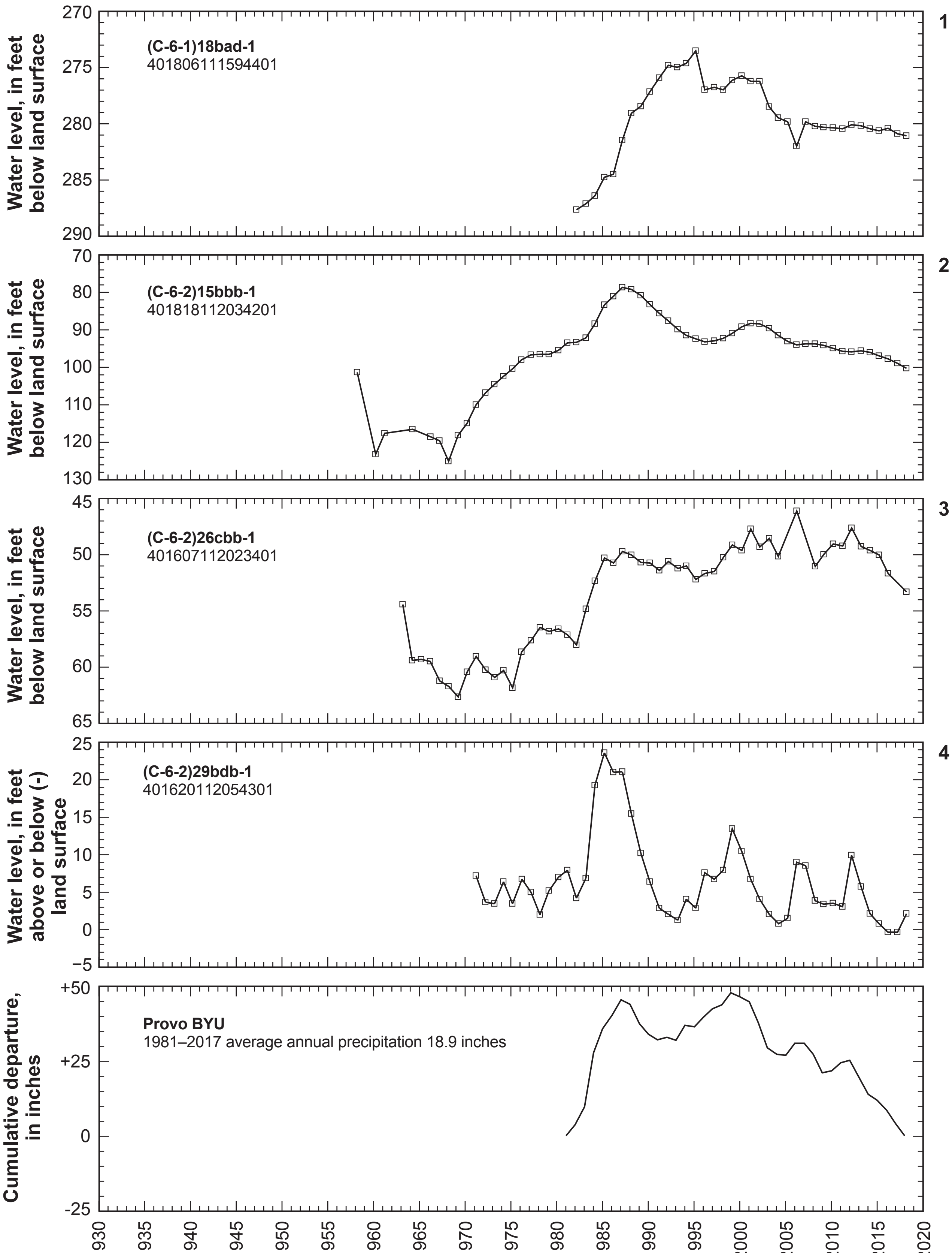
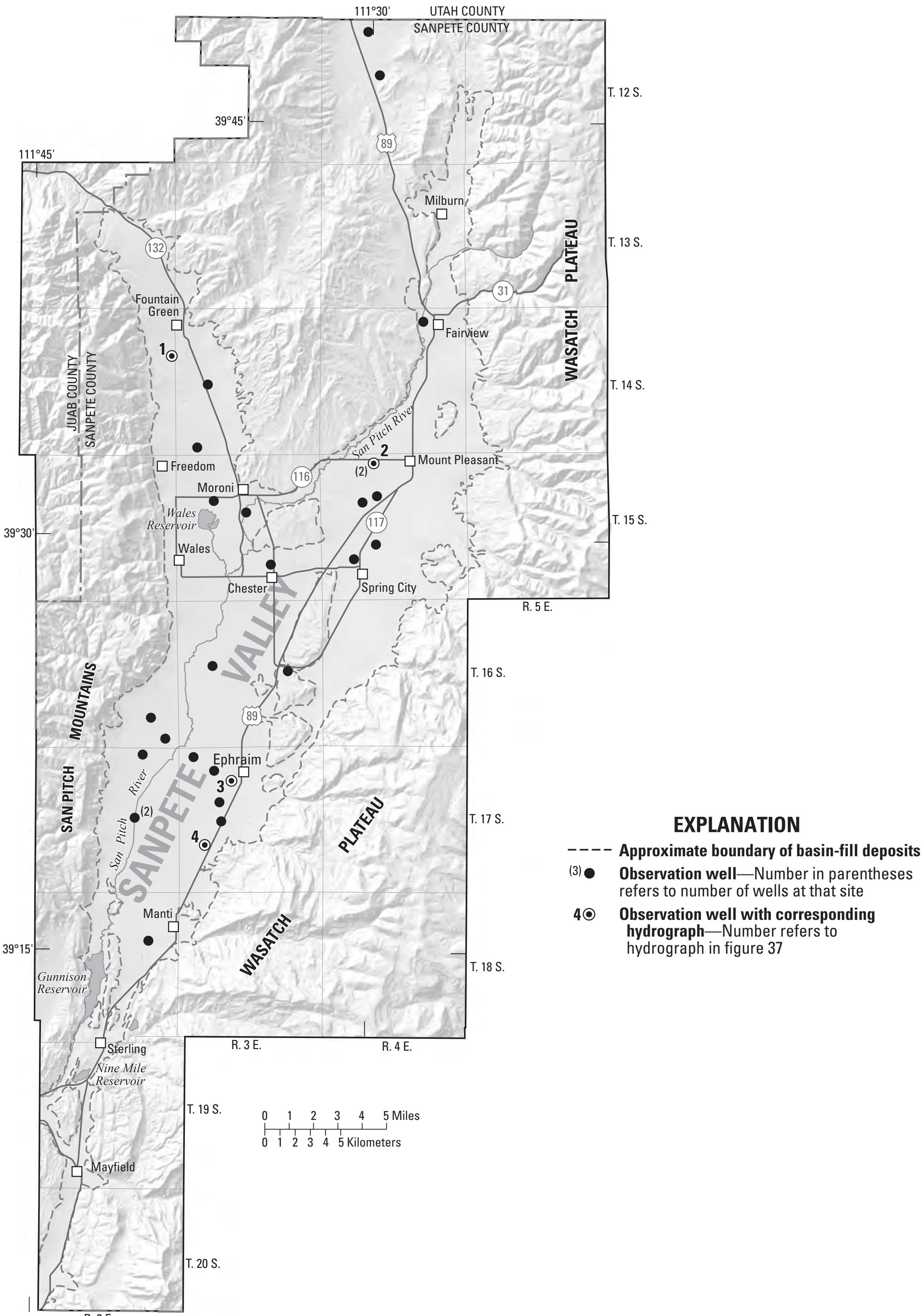


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Provo BYU.



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 36. Location of wells in Sanpete Valley in which the water level was measured during March 2018.

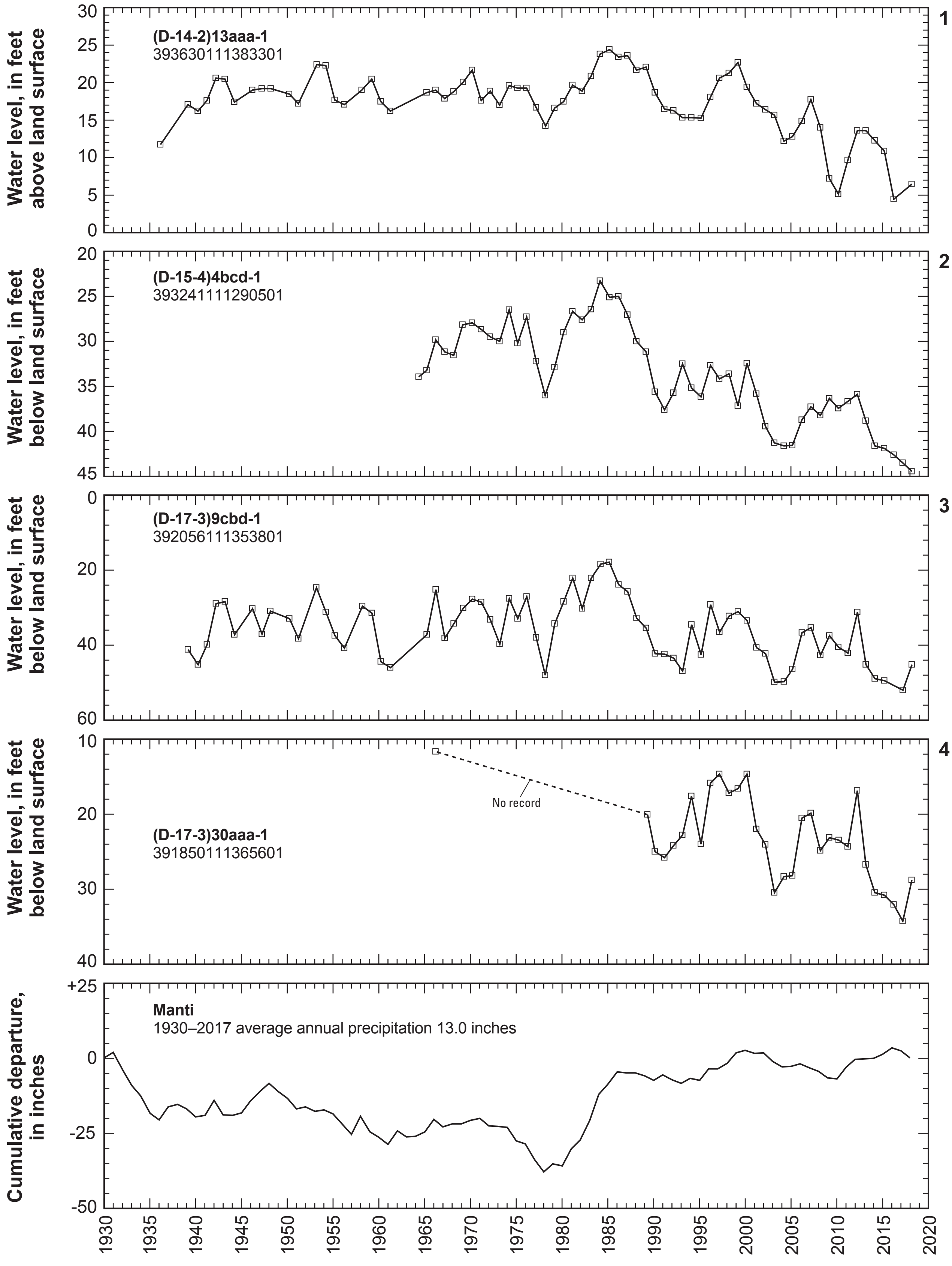


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

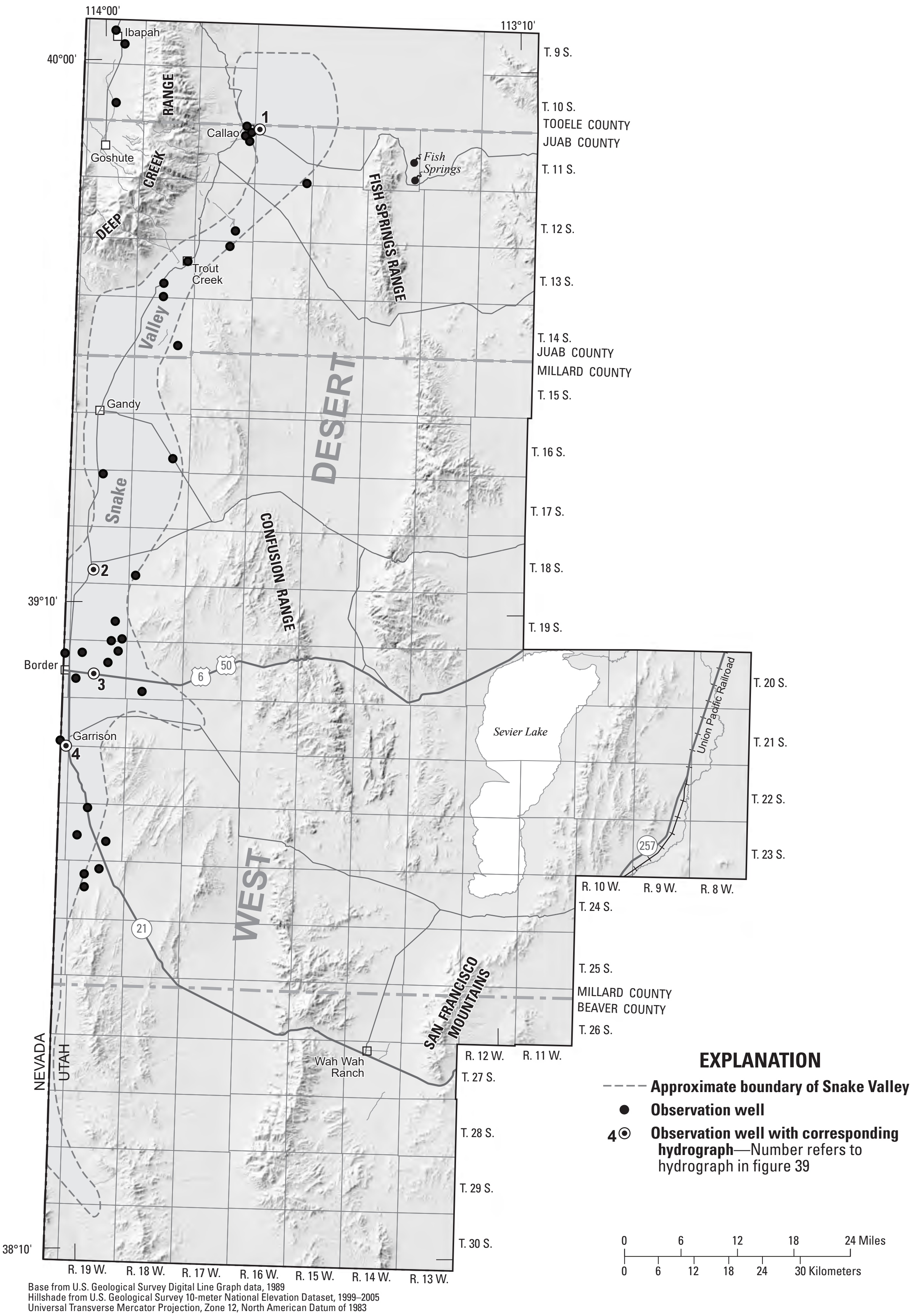


Figure 38. Location of wells in Snake Valley in which the water level was measured during March 2018.

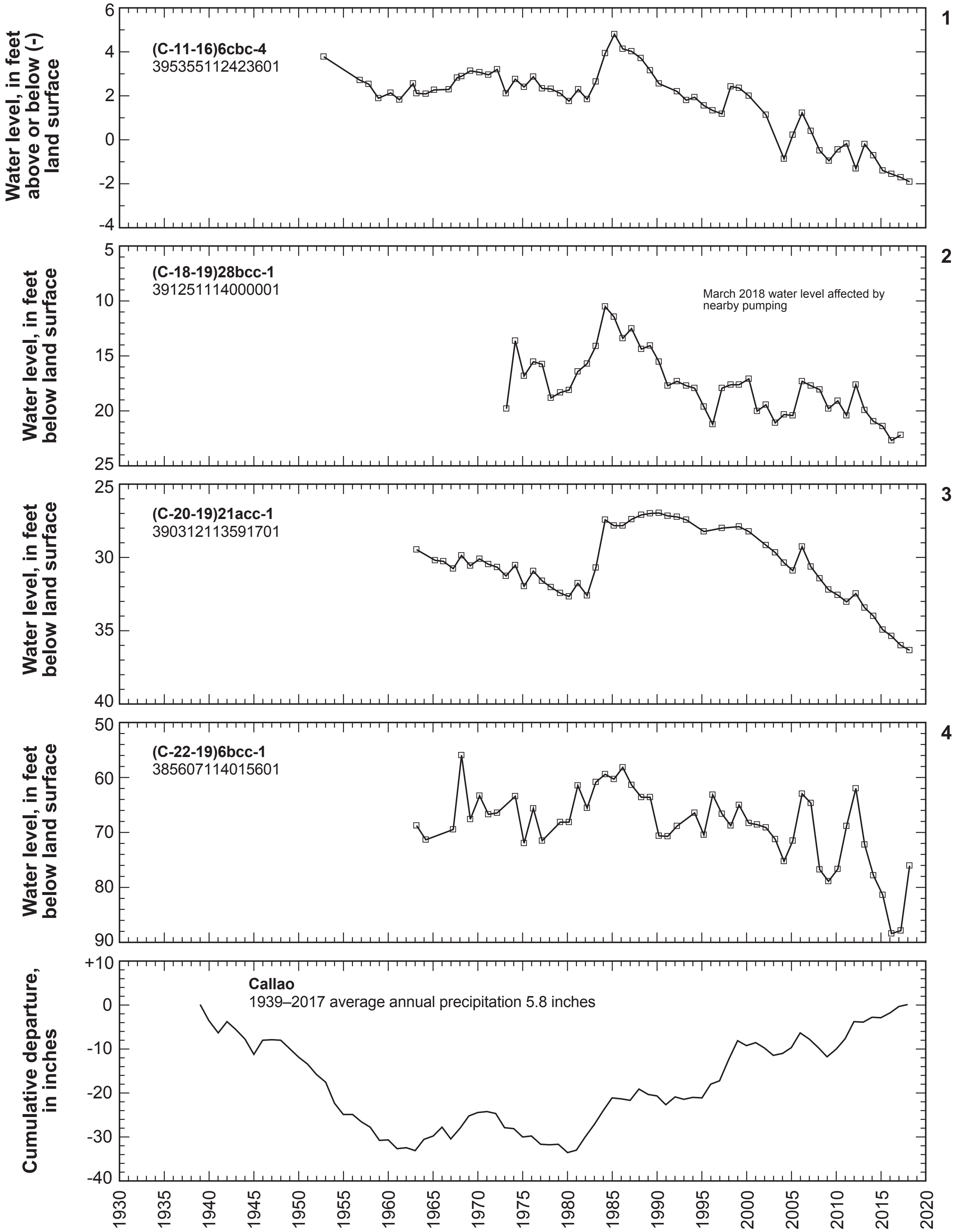


Figure 39. Relation of water level in selected wells in Snake Valley to cumulative departure from average annual precipitation at Callao.

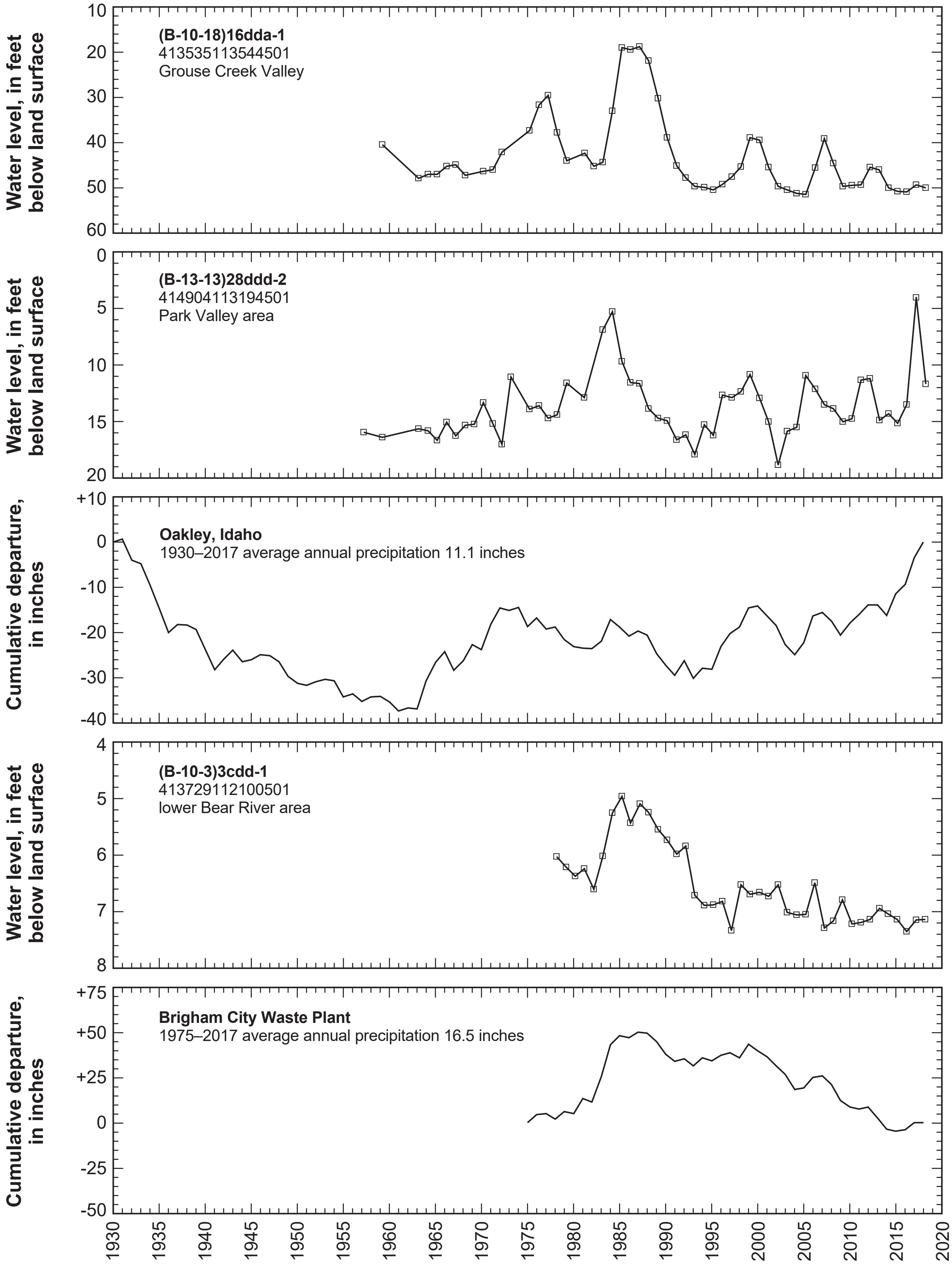


Figure 40. Relation of water level in selected wells in other areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

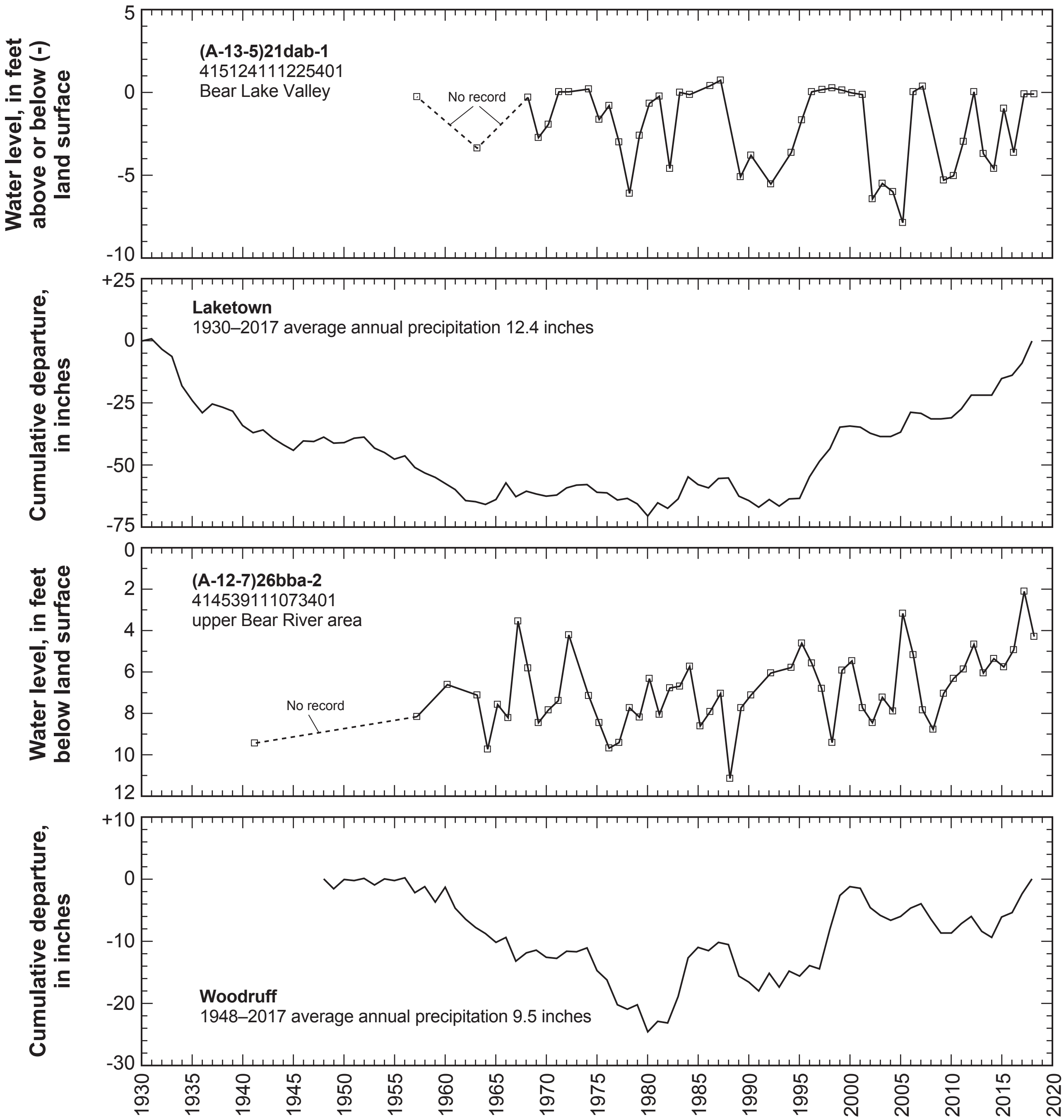


Figure 40. Relation of water level in selected wells in other areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

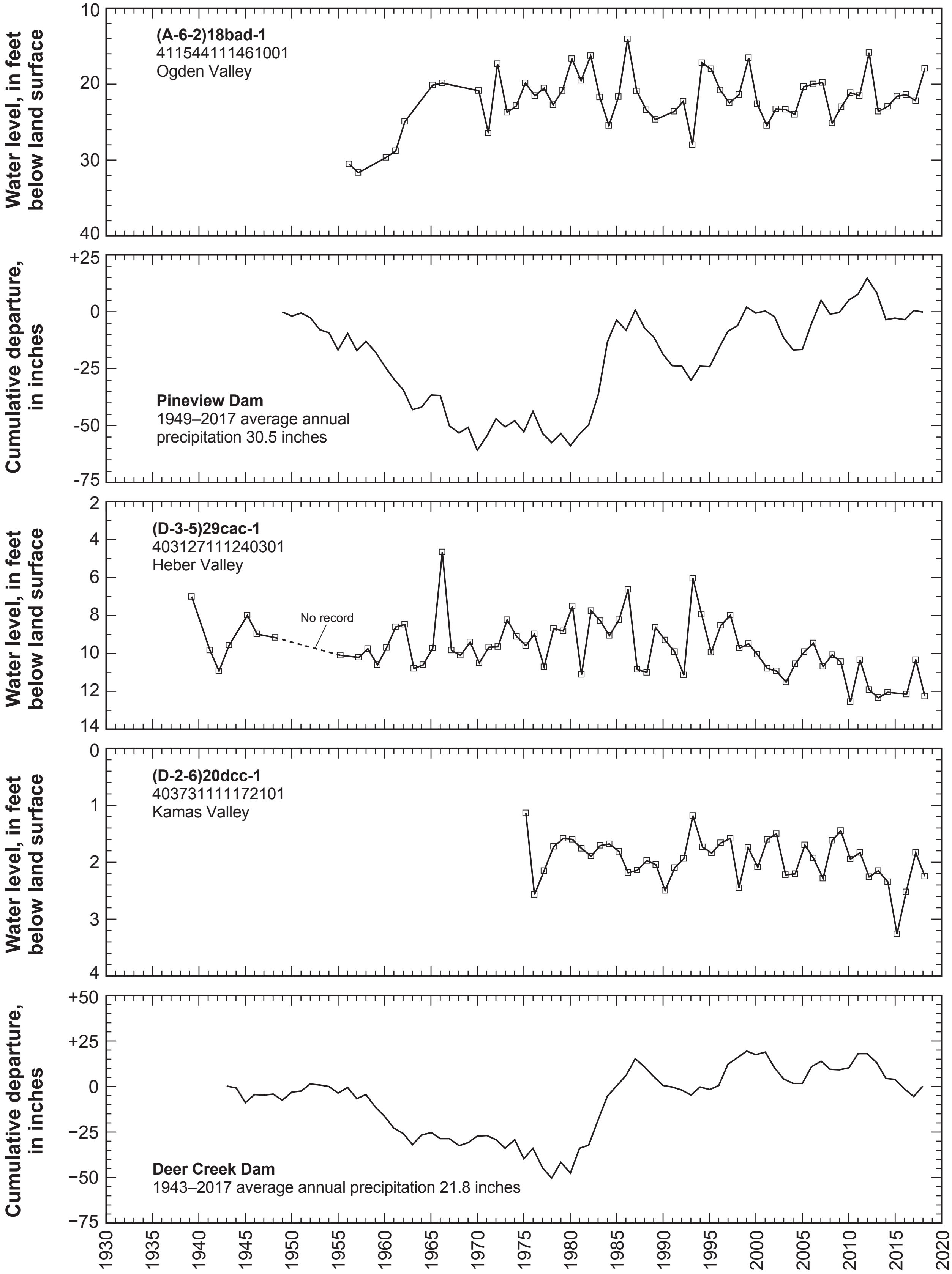


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

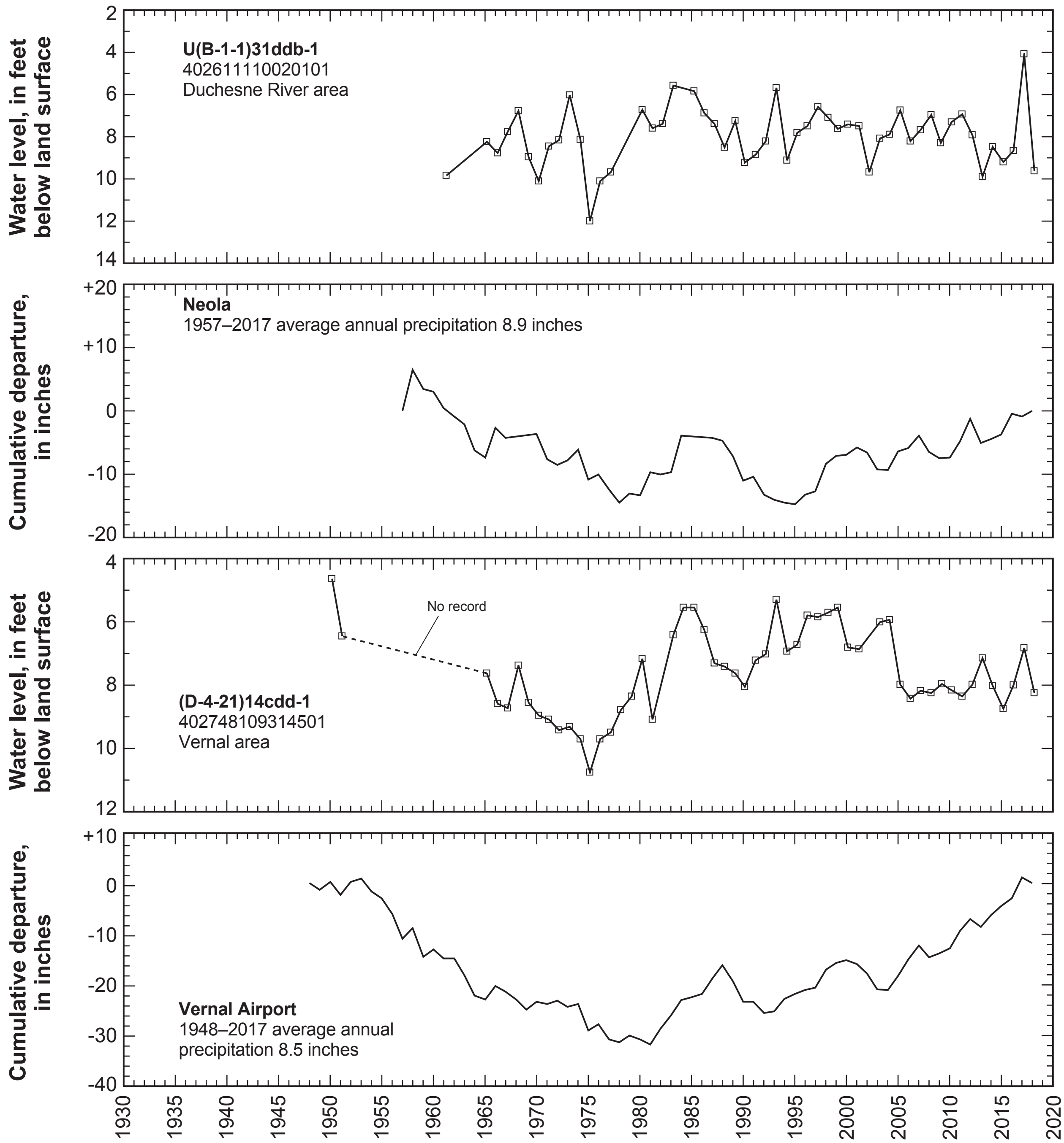


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

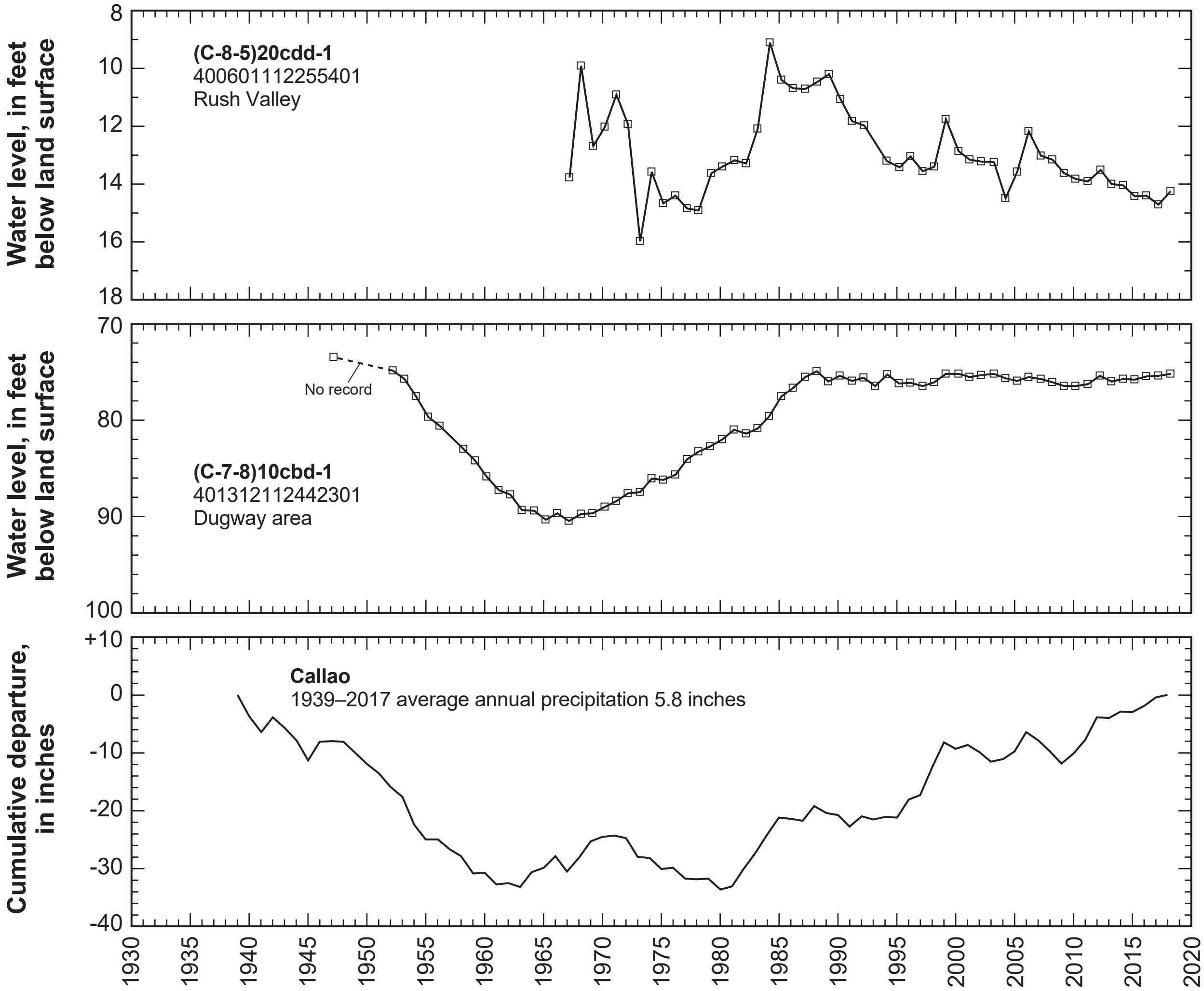


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

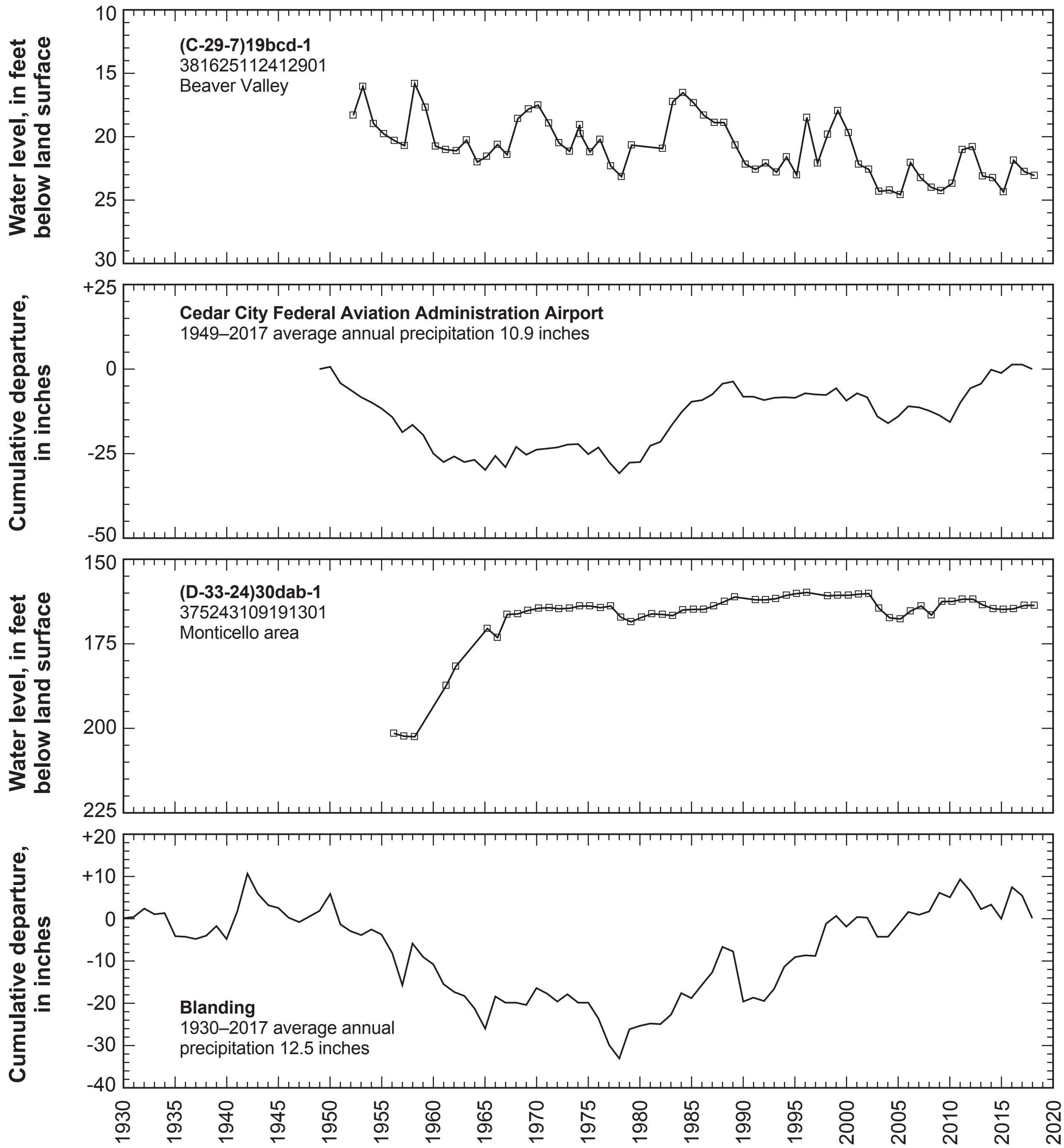


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

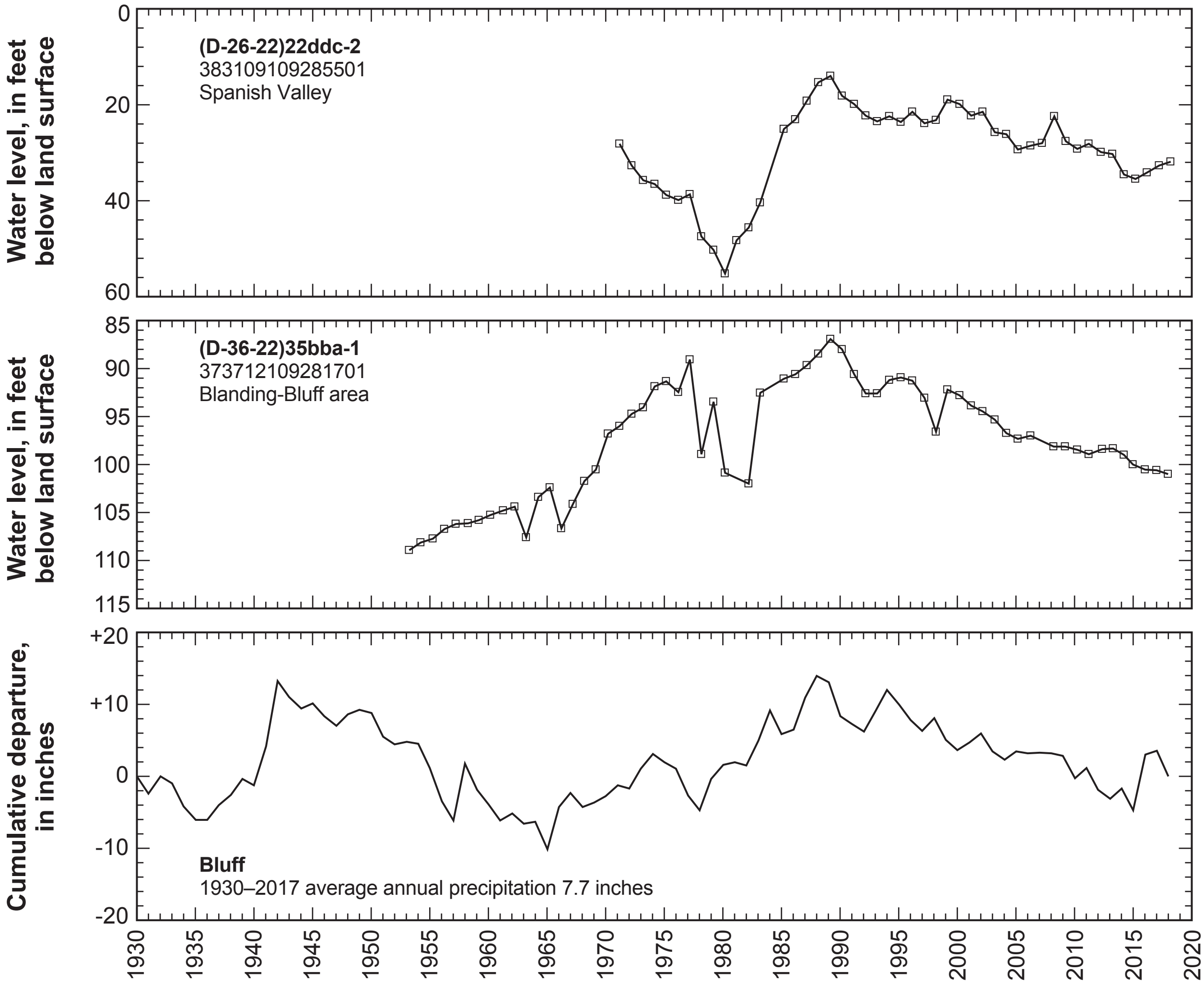


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

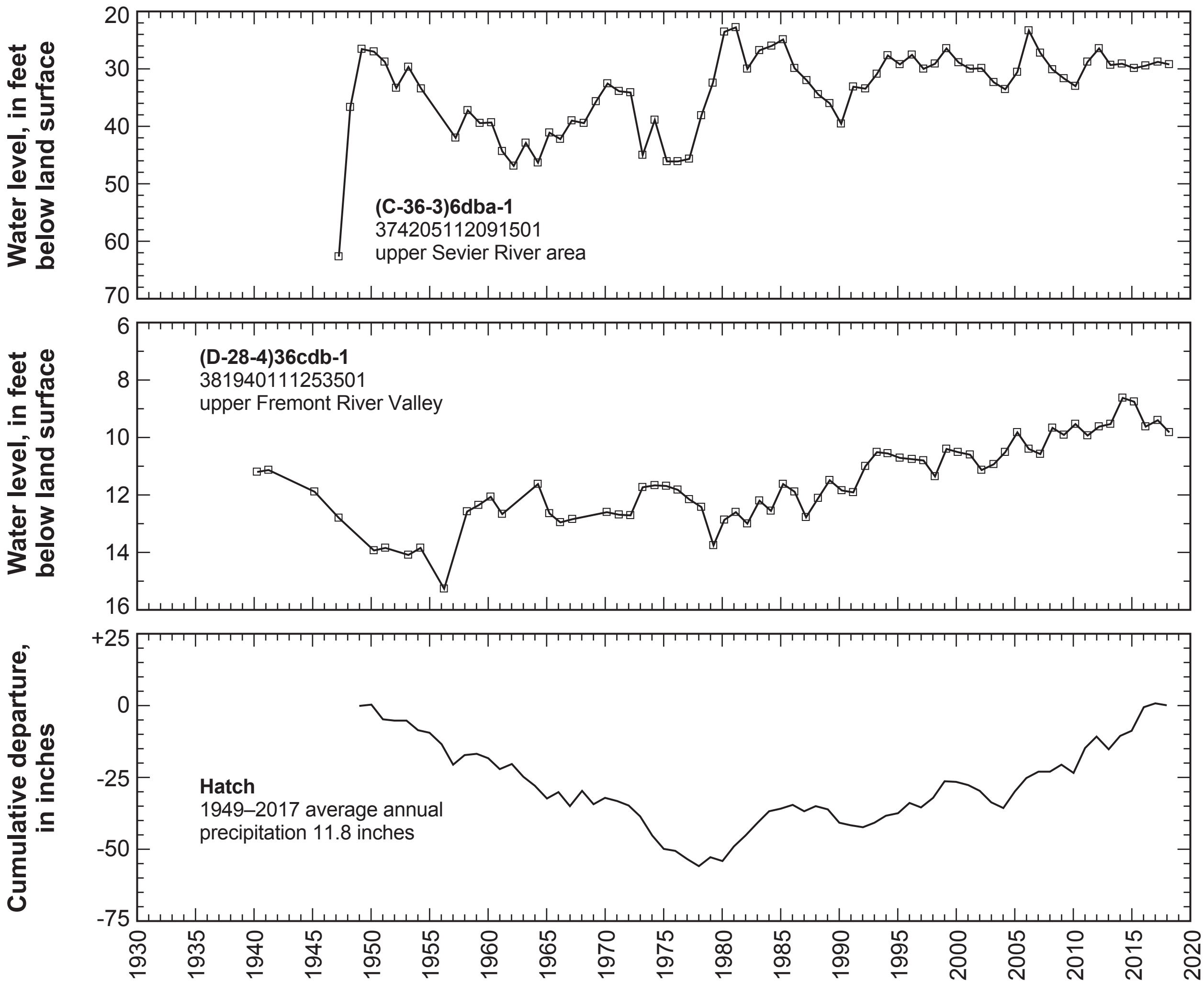


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

Quality of Water from Selected Wells in Utah, Summer of 2017

From June through September 2017, 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 102 wells located in 20 counties (fig. 41). Samples were collected during this time period to limit seasonal variability in the data. The majority of the 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. Seventeen field blank water samples were processed during the summer of 2017 sampling period. Analytical results for all constituents in the field blanks were less than the laboratory reporting limits.

One replicate water sample also was collected at well (C-20-4)6dbd-1. 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 sample were in good agreement with the results of the environmental sample and within 2 percent for all constituents.

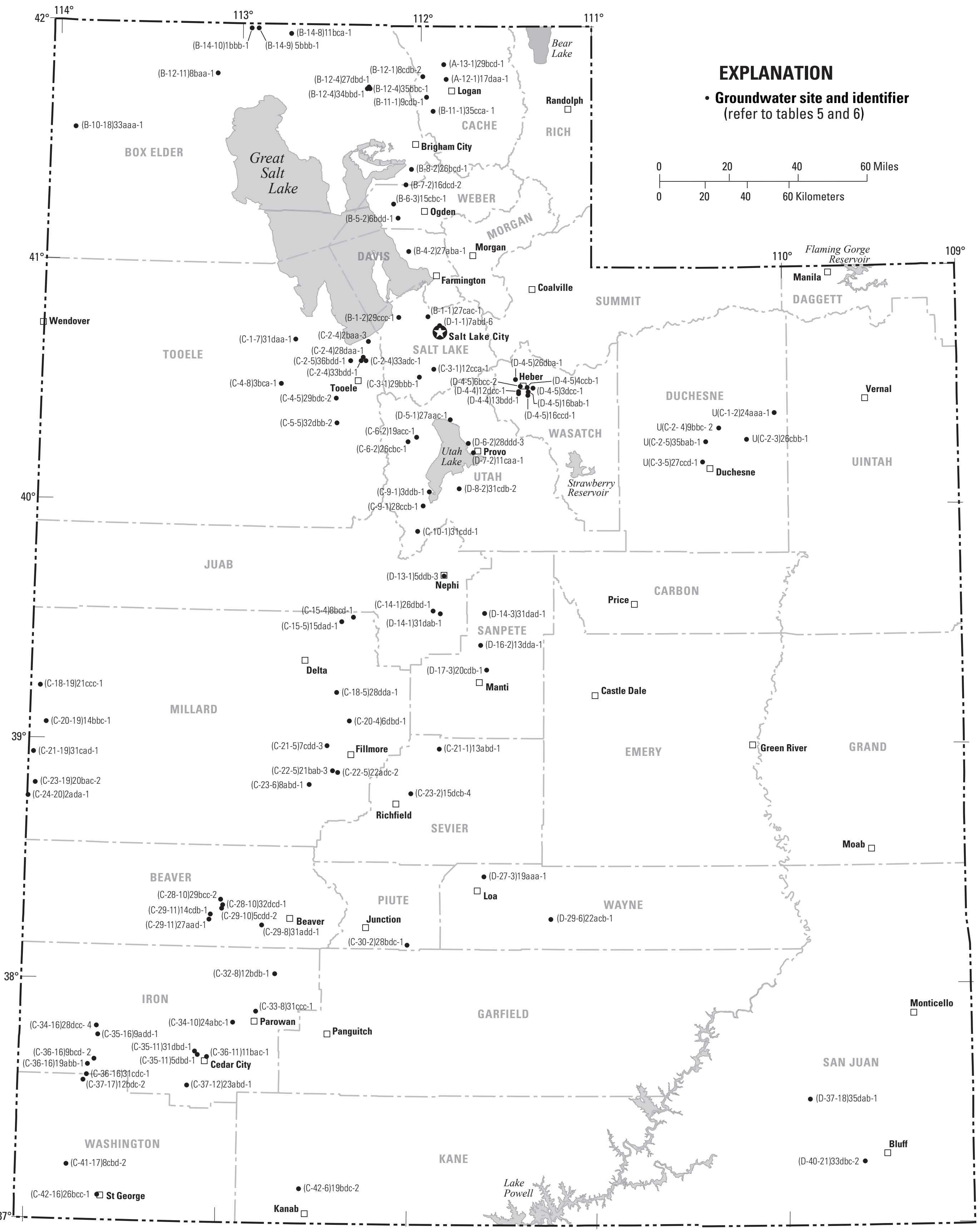


Figure 41. Location of groundwater sites sampled during the summer of 2017.

Table 5. Physical properties and concentrations of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2017.

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; <, 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- 8)31add- 1	381435112471401	20170801	7.2	907	12.1	322	91.5	22.7
Escalante Valley, Milford area								
(C-28-10)29bcc- 2	382046113002702	20170711	7.5	831	21.6	330	73.8	35.5
(C-28-10)32dcd- 1	381927112594501	20170711	7.1	1,400	15.1	507	150	32.3
(C-29-10) 5cdd- 2	381835113000001	20170711	7.2	730	15.8	322	96.0	20.0
(C-29-11)14cdb- 1	381700113033401	20170711	7.1	827	19.3	330	95.7	22.2
(C-29-11)27aad- 1	381543113035501	20170711	7.3	677	18.7	241	72.1	14.9
Box Elder County								
Curlew Valley								
(B-12-11) 8baa- 1	414721113072601	20170621	8.2	644	18.7	210	58.0	15.8
(B-14- 8)11bca- 1	415737112431601	20170621	7.2	2,940	11.6	744	166	80.2
(B-14- 9) 5bbb- 1	415847112540401	20170621	7.4	1,520	17.6	540	155	36.9
(B-14-10) 1bbb- 1	415845112562201	20170621	7.6	573	15.8	217	60.0	16.2
East Shore area								
(B- 8- 2)26bcd- 1	412405112022501	20170802	7.5	189	15.0	35.7	7.04	4.40
Grouse Creek Valley								
(B-10-18)33aaa- 1	413300113543001	20170622	7.4	776	12.3	297	87.2	19.3
Lower Bear River area								
(B-12- 4)27dbd- 1	414454112173101	20170811	7.4	2,230	17.1	628	136	69.6
(B-12- 4)34bbd- 1	414406112173601	20170811	7.3	2,260	17.8	648	141	72.1
(B-12- 4)35bbc- 1	414406112163601	20170811	7.4	1,540	16.9	412	91.0	44.9
Cache County								
Cache Valley								
(A-12- 1)17daa- 1	414642111511401	20170804	7.2	519	20.1	244	58.3	23.8
(A-13- 1)29bcd- 1	415020111520401	20170804	7.7	448	13.4	194	40.9	22.3
(B-11- 1) 9cdb- 1	414209111574001	20170804	7.1	944	10.9	351	95.7	27.2
(B-11- 1)35cca- 1	413840111552601	20170804	7.2	704	11.8	220	55.7	19.7
(B-12- 1) 8cdb- 2	414721111590001	20170804	7.7	757	12.9	138	30.2	15.2
Davis County								
East Shore area								
(B- 4- 2)27aba- 1	410340112030001	20170802	8.1	614	17.9	49.1	12.6	4.29
Duchesne County								
Duchesne River area								
U(C- 1- 2)24aaa- 1	402319110025601	20170808	7.7	352	13.6	173	50.1	11.6
U(C- 2- 4) 9bbc- 2	401933110210201	20170809	7.7	240	15.5	178	40.7	18.5
U(C- 2- 3)26cbb- 1	401641110115801	20170809	9.0	859	12.6	6.23	1.48	0.62
U(C- 2- 5)35bab- 1	401611110251502	20170809	9.7	588	13.3	3.09	0.72	0.32
U(C- 3- 5)27ccd- 1	401104110263001	20170810	8.0	626	10.1	269	52.9	33.3
Iron County								
Cedar Valley								
(C-35-11) 5dbd- 1	374149113063901	20170731	—	1,200	12.9	655	136	76.8
(C-35-11)31dbd- 1	374248113075201	20170822	6.9	1,160	13.3	659	130	81.2
(C-36-11)11bac- 1	374122113034801	20170731	7.3	2,290	20.8	1,480	323	163
(C-37-12)23abd- 1	373409113095501	20170802	7.4	1,050	15.8	498	115	51.3

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
5.84	81.5	279	0.177	66.0	0.56	49.6	81.8	604	2.49	0.066
4.21	34.4	100	0.315	132	0.44	33.6	121	496	0.949	0.014
5.85	37.2	215	0.426	153	0.25	38.9	130	755	4.58	0.039
4.57	26.1	229	0.171	54.0	0.25	36.5	65.6	451	2.55	0.048
6.42	36.1	103	0.275	144	0.38	44.6	101	551	2.54	0.020
6.10	36.4	119	0.174	84.0	0.37	46.0	77.8	419	2.19	0.033
2.49	42.1	118	0.090	118	0.12	12.9	25.5	432	0.211	0.005
18.2	342	272	0.504	637	0.69	50.2	289	1,810	1.17	0.048
14.1	57.6	122	0.310	381	0.17	58.5	23.3	1,260	2.18	0.029
7.07	28.7	153	0.068	76.8	0.25	61.9	24.5	399	0.36	0.030
3.55	27.1	76	0.013	6.67	0.09	14.6	9.94	116	0.59	0.140
8.17	41.9	186	0.169	96.9	0.31	55.3	53.5	496	0.485	0.042
4.31	183	183	0.736	536	0.22	22.9	95.5	1,310	3.23	0.015
4.35	186	144	0.767	538	0.21	22.9	99.9	1,290	3.34	0.016
4.60	137	162	0.301	327	0.20	22.7	70.4	888	2.69	0.017
6.55	18.0	253	0.016	11.1	0.23	26.0	12.6	312	2.06	0.023
1.57	25.7	218	0.015	8.65	0.10	10.9	11.0	253	0.139	0.009
8.09	48.0	389	0.101	77.5	0.61	51.4	0.08	531	< 0.040	0.069
10.6	52.6	299	0.070	50.4	0.35	47.0	0.05	393	< 0.040	0.307
7.21	118	291	0.066	53.8	2.31	67.0	34.3	486	< 0.040	0.065
5.43	126	266	0.052	42.9	0.35	32.8	0.19	376	< 0.040	0.609
3.91	4.49	134	<0.010	1.14	0.66	8.20	46.7	211	< 0.040	<0.004
1.56	2.54	126	0.040	4.29	0.27	8.19	31.2	184	< 0.040	<0.004
0.77	204	372	<0.020	3.43	1.92	8.05	83.6	543	< 0.040	0.020
0.32	139	291	0.012	1.24	0.22	10.3	19.2	356	< 0.040	0.087
1.24	115	354	0.025	18.6	0.61	15.2	110	520	< 0.040	0.026
3.75	33.0	282	0.084	30.2	0.22	24.1	319	895	3.9	0.011
2.52	12.4	136	0.048	13.2	0.23	22.1	485	924	2.57	0.011
4.73	39.8	240	0.120	40.4	0.24	22.9	1,160	2,160	7.3	0.008
1.79	43.3	141	0.447	83.7	0.08	20.1	286	748	2.65	0.017

Table 5. Physical properties and concentrations of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2017.—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; <, 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
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc- 4	374934113384601	20170621	7.9	852	13.5	327	100	18.6
(C-35-16) 9add- 1	374623113381301	20170621	7.4	594	12.9	258	79.0	14.7
(C-36-16) 9bcd- 2	374014113391101	20170621	7.3	408	15.2	175	55.7	8.62
(C-36-16)19abb- 1	373854113411501	20170621	7.5	391	13.6	167	52.5	8.78
(C-36-16)31cdc- 1	373621113413201	20170621	7.3	375	15.1	152	47.2	8.36
(C-37-17)12bdc- 2	373456113423501	20170621	7.1	505	12.7	212	66.8	11.0
Parowan Valley								
(C-32- 8)12bdb- 1	380218112424401	20170801	7.7	532	18.8	215	64.1	13.3
(C-33- 8)31ccc- 1	375257112483501	20170801	7.4	520	14.8	226	47.8	25.9
(C-34-10)24abc- 1	375006112554801	20170731	6.9	393	14.5	159	32.2	19.0
Juab County								
Juab Valley								
(C-14- 1)26dbd- 1	393342111534501	20170713	7.8	1,210	14.4	539	113	62.5
(D-13- 1) 5ddb- 3	394226111502101	20170713	7.3	1,740	12.1	527	142	42.0
(D-14- 1)31dab- 1	393301111512501	20170713	7.2	1,270	13.9	648	172	53.3
Kane County								
Kanab area								
(C-42- 6)19bdc- 2	370843112340602	20170808	7.9	275	20.4	130	23.9	17.1
Millard County								
Pahvant Valley								
(C-18- 5)28dda- 1	391302112243301	20170620	7.0	820	18.3	376	81.1	42.0
(C-20- 4) 6dbd- 1	390558112202301	20170620	6.8	1,820	19.1	997	274	75.6
(C-21- 5) 7cdd- 3	385939112272303	20170620	7.1	1,580	11.9	602	131	66.6
(C-22- 5)21bab- 3	385323112253401	20170620	7.1	1,120	14.9	300	81.4	23.4
(C-22- 5)22adc- 2	385303112234801	20170620	7.0	1,180	15.3	322	84.4	27.0
(C-23- 6) 8abd- 1	384953112325101	20170620	7.0	8,540	15.9	2,300	555	222
Sevier Desert								
(C-15- 4) 8bcd- 1	393156112193101	20170817	7.1	3,340	13.7	974	215	106
(C-15- 5)15dad- 1	393046112231301	20170817	7.6	945	16.9	310	59.0	39.6
Snake Valley								
(C-18-19)21ccc- 1	391319113595501	20170712	7.8	332	21.5	117	27.8	11.5
(C-20-19)14bbc- 1	390416113573801	20170712	7.7	397	14.2	163	38.0	16.6
(C-21-19)31cad- 1	385640114012401	20170712	7.4	592	12.6	298	73.7	27.6
(C-23-19)20bac- 2	384900114003001	20170712	7.4	1,040	16.8	387	53.6	61.3
(C-24-20) 2ada- 1	384538114024301	20170817	7.5	745	13.0	309	65.9	35.1
Piute County								
Upper Sevier River area								
(C-30- 2)28bdc- 1	381003112010301	20170807	7.3	396	19.3	170	41.4	16.1
Salt Lake County								
Salt Lake Valley								
(B- 1- 1)27cac- 1	404720111562701	20170616	7.7	968	13.6	158	31.9	19.2
(B- 1- 2)29ccc- 1	404704112060401	20170616	8.1	8,490	16.4	222	32.6	34.0
(C- 3- 1)12cca- 1	403410111542501	20170619	7.2	2,140	19.3	462	113	43.8
(C- 3- 1)29bbb- 1	403207111590801	20170619	6.9	2,400	16.1	888	242	68.9
(D- 1- 1) 7abd- 6	404506111523301	20170616	7.1	1,340	14.6	575	138	56.2

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
8.10	36.0	126	0.554	149	1.07	69.9	71.7	645	1.23	0.027
5.01	17.2	142	0.299	85.2	0.21	52.7	26.6	449	1.7	0.036
3.45	14.6	149	0.130	32.8	0.23	42.0	10.9	280	1.38	0.041
4.65	14.1	157	0.099	22.9	0.24	50.4	10.4	275	1.09	0.043
5.59	19.0	160	0.090	19.9	0.23	59.9	9.43	279	1.07	0.060
4.72	24.4	192	E0.119	26.1	0.22	51.3	15.2	345	3.15	0.074
6.49	18.0	116	0.264	60.6	0.19	57.4	50.8	386	2.07	0.024
2.69	23.3	187	0.079	28.9	0.16	29.8	25.4	305	2.05	0.027
4.49	22.5	161	0.054	18.0	0.33	44.0	23.3	265	0.841	0.021
3.65	69.5	197	0.065	73.7	0.27	21.5	338	867	1.51	0.022
3.93	163	234	0.080	302	0.16	25.4	137	1,010	3.9	0.028
2.00	44.1	224	0.057	57.2	0.22	13.6	381	891	2.18	0.008
2.19	3.80	120	0.043	5.64	0.07	14.8	4.53	152	2.18	0.015
1.71	31.8	233	0.136	109	0.10	22.1	27.6	481	1.81	0.015
5.71	56.6	207	0.249	141	0.58	19.2	598	1,450	2.28	0.010
5.88	137	309	0.296	197	0.17	29.5	257	1,070	6.14	0.023
12.7	111	243	0.240	175	0.99	14.5	72.6	654	1.09	0.010
16.2	112	248	0.240	188	0.64	13.5	74.7	703	0.521	0.010
88.0	988	334	2.61	1,950	1.08	44.1	1,190	5,870	1.5	0.049
8.54	390	376	0.547	579	0.18	30.4	549	2,170	0.34	0.029
3.59	66.0	160	0.166	171	0.32	29.0	58.2	534	0.253	0.018
1.98	23.3	126	0.046	21.4	0.11	13.9	12.5	188	0.274	0.008
1.42	19.6	155	0.071	27.2	0.32	21.4	11.9	221	0.099	0.012
1.44	14.0	214	0.069	21.9	0.07	17.6	14.1	347	4.41	0.009
4.74	84.4	378	0.154	80.5	0.97	52.8	85.6	631	0.394	0.061
4.03	33.3	170	0.167	80.0	0.52	39.5	104	495	0.935	0.019
4.77	16.7	181	0.058	10.4	0.29	34.3	14.0	243	0.266	0.040
10.4	160	467	0.101	57.3	0.45	32.1	0.08	590	< 0.040	0.257
21.6	1,740	316	1.68	2,310	1.44	23.0	189	4,870	< 0.040	0.132
20.8	242	198	0.305	433	0.41	30.3	204	1,260	0.292	0.007
4.65	170	220	0.491	429	0.07	31.5	297	1,540	2.07	0.024
3.10	60.4	291	0.099	180	0.16	20.0	163	814	4.26	0.040

Table 5. Physical properties and concentrations of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2017.—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; <, 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
San Juan County								
Upper Colorado River area								
(D-37-18)35dab- 1	373130109534501	20170907	8.3	1,040	13.5	525	96.2	69.1
(D-40-21)33dbc- 2	371545109364402	20170907	9.6	488	17.7	6.2	1.73	0.46
Sanpete County								
Sanpete Valley								
(D-14- 3)31dad- 1	393311111371701	20170821	7.8	501	13.2	234	53.9	24.2
(D-16- 2)13dda- 1	392511111382001	20170821	7.6	1,140	14.0	367	63.1	50.8
(D-17- 3)20cdb- 1	391904111363001	20170821	7.7	725	11.5	364	58.7	52.8
Sevier County								
Central Sevier Valley								
(C-21- 1)13abd- 1	385910111512101	20170807	7.5	752	19.0	147	30.7	17.0
(C-23- 2)15dcb- 4	384757112002201	20170807	7.3	663	14.1	322	65.0	38.8
Tooele County								
Rush Valley								
(C- 4- 5)29bdc- 2	402637112261301	20170706	7.8	935	21.1	270	60.7	28.7
(C- 5- 5)32dbb- 2	402024112254601	20170706	8.0	1,260	10.2	456	132	30.7
Skull Valley								
(C- 1- 7)31daa- 1	404113112395801	20170605	7.5	7,820	18.7	598	113	76.4
(C- 4- 8) 3bca- 1	403006112442201	20170605	7.3	876	17.1	289	87.8	16.9
Tooele Valley								
(C- 2- 4) 2baa- 3	404054112155901	20170607	7.5	1,610	17.5	229	53.9	23.1
(C- 2- 4)28daa- 1	403657112173901	20170607	7.4	920	16.6	369	91.4	34.1
(C- 2- 4)33bdd- 1	403629112174801	20170606	7.5	1,050	14.6	319	82.3	27.6
(C- 2- 4)34adc- 1	403608112164201	20170607	7.5	862	14.9	361	80.4	39.0
(C- 2- 5)36bdd- 1	403605112214201	20170606	7.4	1,730	18.3	311	78.5	27.9
Utah County								
Cedar Valley								
(C- 6- 1)19acc- 1	401702111594001	20170707	7.6	660	23.0	213	39.7	27.6
(C- 6- 2)26cbc- 1	401600112023401	20170707	7.5	595	11.5	277	46.8	38.8
Goshen Valley								
(C- 9- 1) 3ddb- 1	400325111552501	20170628	7.5	1,460	18.3	355	95.4	28.4
(C- 9- 1)28ccb- 1	395956111572101	20170628	7.3	2,640	17.3	933	246	77.3
(C-10- 1)31cdd- 1	395340111590001	20170628	—	—	—	379	95.5	34.1
Northern Utah Valley								
(D- 5- 1)27aac- 1	402133111484601	20170626	7.3	679	11.3	341	80.1	34.1
(D- 6- 2)28ddd- 3	401541111425001	20170628	7.4	609	13.5	302	82.5	23.3
(D- 7- 2)11caa- 1	401325111410901	20170626	7.4	650	13.9	317	76.8	30.4
Southern Utah Valley								
(D- 8- 2)31cdb- 2	400423111454001	20170626	6.9	3,170	30.1	357	92.9	30.4

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
8.07	43.9	323	0.170	22.7	0.30	7.69	243	681	< 0.040	<0.004
0.90	113	216	0.025	3.00	0.11	11.2	28.1	292	< 0.040	0.008
1.21	13.3	197	0.055	26.9	0.07	13.9	22.5	275	2.25	0.015
3.43	96.7	218	0.114	151	0.49	27.1	141	677	< 0.040	0.015
1.60	20.5	256	0.069	22.7	0.35	20.9	77.6	411	4.38	0.014
4.37	94.5	114	0.082	109	0.55	42.9	91.2	454	0.294	0.018
3.27	20.4	268	0.071	26.7	0.36	31.5	60.3	406	0.619	0.014
3.42	72.6	167	0.146	156	0.31	26.8	51.4	508	0.462	0.013
1.30	86.9	252	0.178	201	0.21	18.7	53.2	706	2.51	0.014
64.1	1,600	182	1.65	2,620	0.31	31.4	201	5,080	1.57	0.025
3.67	57.7	96	0.166	192	0.11	10.9	42.8	580	3.27	0.169
12.7	353	211	E0.310	530	0.29	12.9	37.5	1,230	0.554	0.012
1.64	53.2	176	0.107	49.3	0.08	13.9	212	608	2.91	0.023
2.23	120	173	0.146	187	0.12	13.4	111	681	1.76	0.022
1.45	53.1	218	0.089	45.3	0.07	14.4	176	532	3.14	0.023
3.28	222	200	0.237	380	0.17	18.3	62.2	949	3.77	0.014
3.32	54.9	196	0.086	55.8	0.58	32.5	57.1	392	1.86	0.018
2.80	20.6	224	0.052	33.3	0.30	56.5	29.9	366	0.083	0.037
16.0	149	144	0.301	346	0.38	75.0	61.1	924	1.02	0.031
20.9	168	101	0.939	646	0.20	70.3	146	1,700	29	0.025
7.73	32.3	151	0.222	132	0.19	59.5	84.6	607	11.1	0.031
1.62	25.7	238	0.031	19.4	0.27	16.2	104	400	2.46	0.013
4.54	19.6	250	0.043	20.2	0.17	21.4	54.9	368	0.442	0.095
2.39	23.1	250	0.046	19.7	0.19	20.6	71.1	389	< 0.040	0.015
42.1	651	451	0.994	802	1.79	53.0	194	2,090	< 0.040	0.024

Table 5. Physical properties and concentrations of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2017.—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; <, 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
Wasatch County								
Heber Valley								
(D- 3- 4)26dba- 1	403146111272701	20170814	7.3	785	13.9	364	110	21.9
(D- 4- 4)12dcc- 1	402842111263101	20170815	6.8	768	12.8	351	99.3	25.1
(D- 4- 4)13bdd- 1	402810111263601	20170815	7.5	479	21.5	229	54.5	22.5
(D- 4- 5) 3dcc- 1	402937111214901	20170814	6.9	524	11.6	250	82.3	10.8
(D- 4- 5) 4ccb- 1	402946111233901	20170814	6.7	472	13.4	229	73.3	11.2
(D- 4- 5) 6bcc- 2	403003111255801	20170814	7.3	417	13.2	201	62.1	11.2
(D- 4- 5)16bab- 1	402840111232201	20170814	7.0	656	12.2	329	90.8	24.9
(D- 4- 5)16ccd- 1	402750111232701	20170815	7.3	471	14.7	229	58.2	20.3
Washington County								
Central Virgin River area								
(C-41-17) 8cbd- 2	371348113470301	20170807	7.7	486	18.0	224	65.5	14.7
(C-42-16)26bcc- 1	370617113371101	20170807	7.0	5,960	18.0	2,360	515	261
Wayne County								
Upper Fremont River Valley								
(D-27- 3)19aaa- 1	382717111365601	20170807	7.0	1,300	12.8	697	212	40.8
(D-29- 6)22acb- 1	381644111152501	20170823	7.2	1,080	19.1	564	164	37.9
Weber County								
East Shore area								
(B- 5- 2) 6bdd- 1	411153112064603	20170802	7.9	456	23.7	144	34.4	14.0
(B- 6- 3)15cbc- 1	411523112082101	20170802	8.2	407	15.8	33.6	8.06	3.28
(B- 7- 2)16dcd- 2	412011112041401	20170802	8.0	390	24.8	60.9	19.2	3.19

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
7.23	25.7	205	0.065	31.4	0.52	19.1	105	449	2.17	0.026
1.54	28.8	268	0.051	59.0	0.08	22.4	33.9	444	3.82	0.050
1.75	11.2	190	<0.010	23.6	0.31	11.5	17.5	261	0.33	0.012
3.18	8.08	174	0.031	39.8	0.08	36.0	9.87	374	7.92	0.090
2.65	5.99	176	0.029	24.6	0.08	38.4	14.8	319	5.27	0.097
1.73	7.12	166	0.021	13.7	0.07	24.7	22.9	266	2.16	0.056
1.58	15.8	294	0.030	26.0	0.18	28.6	21.3	413	2.98	0.041
3.46	10.2	205	0.020	16.2	0.18	15.0	24.3	265	0.68	0.027
1.99	15.8	155	0.074	16.2	0.26	22.0	38.2	295	0.427	0.014
14.6	782	295	1.29	300	0.53	23.5	2,740	5,640	19.3	0.028
3.86	39.7	213	0.057	11.3	0.09	31.4	495	1,020	3.02	0.040
5.29	22.4	202	0.059	16.2	0.26	27.8	341	772	0.126	0.012
8.87	36.8	217	0.031	16.6	0.24	34.8	0.11	272	< 0.040	0.155
9.56	76.3	196	0.034	15.9	0.29	21.5	0.18	251	< 0.040	0.258
9.23	61.6	189	0.018	9.03	1.23	34.2	1.98	257	< 0.040	0.037

Table 6. Concentrations of trace elements in water samples collected from selected wells in Utah, summer of 2017.

[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- 8)31add- 1	381435112471401	20170801	4.6	49	2.32	2.76	0.78	21
Escalante Valley, Milford area								
(C-28-10)29bcc- 2	382046113002702	20170711	6.9	13.1	<0.20	2.05	4.6	12.8
(C-28-10)32dcd- 1	381927112594501	20170711	2.4	<10.0	<0.20	0.595	1.5	35.5
(C-29-10) 5cdd- 2	381835113000001	20170711	2.5	13.7	<0.20	0.576	0.58	25
(C-29-11)14cdb- 1	381700113033401	20170711	3.7	<10.0	<0.20	1.33	0.76	13.4
(C-29-11)27aad- 1	381543113035501	20170711	3.7	<10.0	<0.20	1.52	0.77	8.15
Box Elder County								
Curlew Valley								
(B-12-11) 8baa- 1	414721113072601	20170621	1.6	<10.0	2.83	0.995	0.54	3.9
(B-14- 8)11bca- 1	415737112431601	20170621	9.7	24.6	8.13	2.99	6.1	7.16
(B-14- 9) 5bbb- 1	415847112540401	20170621	1.9	14.5	<0.20	0.727	2.2	1.72
(B-14-10) 1bbb- 1	415845112562201	20170621	4.7	<10.0	<0.20	1.38	1.3	2.53
East Shore area								
(B- 8- 2)26bcd- 1	412405112022501	20170802	0.8	<10.0	0.88	0.777	0.31	0.18
Grouse Creek Valley								
(B-10-18)33aaa- 1	413300113543001	20170622	7	12.7	0.26	4.69	2.7	5.87
Lower Bear River area								
(B-12- 4)27dbd- 1	414454112173101	20170811	0.66	<20.0	<0.40	0.96	23.5	1.91
(B-12- 4)34bbd- 1	414406112173601	20170811	0.66	25.9	0.76	0.861	25.9	1.89
(B-12- 4)35bbc- 1	414406112163601	20170811	0.85	<10.0	<0.20	0.615	3.7	1.36
Cache County								
Cache Valley								
(A-12- 1)17daa- 1	414642111511401	20170804	1.3	56.2	11.9	0.837	0.23	0.86
(A-13- 1)29bcd- 1	415020111520401	20170804	6.3	193	72	0.762	0.06	0.308
(B-11- 1) 9cdb- 1	414209111574001	20170804	14.3	1,700	309	0.189	0.06	<0.010
(B-11- 1)35cca- 1	413840111552601	20170804	24.4	1,510	178	0.664	<0.05	<0.010
(B-12- 1) 8cdb- 2	414721111590001	20170804	17.4	17.6	71.8	5.15	<0.05	1.69
Davis County								
East Shore area								
(B- 4- 2)27aba- 1	410340112030001	20170802	25.4	414	57.2	0.434	<0.05	<0.010
Duchesne County								
Duchesne River area								
U(C- 1- 2)24aaa- 1	402319110025601	20170808	<0.05	913	23.3	0.269	<0.05	0.046
U(C- 2- 4) 9bbc- 2	401933110210201	20170809	0.13	<10.0	4.28	0.515	<0.05	0.498
U(C- 2- 3)26cbb- 1	401641110115801	20170809	<0.05	25.8	1.06	1.52	<0.05	0.071
U(C- 2- 5)35bab- 1	401611110251502	20170809	0.7	<10.0	0.68	0.358	<0.05	0.174
U(C- 3- 5)27ccd- 1	401104110263001	20170810	6.6	502	53.7	4.74	<0.05	0.77
Iron County								
Cedar Valley								
(C-35-11) 5dbd- 1	374149113063901	20170731	0.44	10.6	<0.20	0.281	1	4.63
(C-35-11)31dbd- 1	374248113075201	20170822	0.89	17.6	0.23	0.46	1.3	3.7
(C-36-11)11bac- 1	374122113034801	20170731	0.38	<20.0	0.54	0.241	3.6	7.25
(C-37-12)23abd- 1	373409113095501	20170802	0.83	<10.0	<0.20	0.541	8.4	1.79

Table 6. Concentrations of trace elements in water samples collected from selected wells in Utah, summer of 2017.—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
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc- 4	374934113384601	20170621	16.4	<10.0	<0.20	1.48	2	3.57
(C-35-16) 9add- 1	374623113381301	20170621	2.8	<10.0	<0.20	0.406	1.5	2.93
(C-36-16) 9bcd- 2	374014113391101	20170621	3.1	<10.0	<0.20	0.515	0.64	1.95
(C-36-16)19abb- 1	373854113411501	20170621	2.7	<10.0	<0.20	0.988	0.43	3.37
(C-36-16)31cdc- 1	373621113413201	20170621	4	<10.0	<0.20	1.13	0.39	2.26
(C-37-17)12bdc- 2	373456113423501	20170621	4.9	<10.0	<0.20	0.669	0.63	4.03
Parowan Valley								
(C-32- 8)12bdb- 1	380218112424401	20170801	2.5	<10.0	<0.20	0.69	2	3.29
(C-33- 8)31ccc- 1	375257112483501	20170801	4.3	<10.0	<0.20	0.46	1.3	2.45
(C-34-10)24abc- 1	375006112554801	20170731	7.6	<10.0	<0.20	1.49	0.54	3.49
Juab County								
Juab Valley								
(C-14- 1)26dbd- 1	393342111534501	20170713	1.2	10.2	0.25	2.41	1.5	2.42
(D-13- 1) 5ddb- 3	394226111502101	20170713	0.61	<10.0	<0.20	0.489	1.9	1.88
(D-14- 1)31dab- 1	393301111512501	20170713	<0.25	19.2	0.52	0.513	0.84	0.639
Kane County								
Kanab area								
(C-42- 6)19bdc- 2	370843112340602	20170808	1.1	<10.0	<0.20	<0.050	0.36	0.477
Millard County								
Pahvant Valley								
(C-18- 5)28dda- 1	391302112243301	20170620	2.5	<10.0	<0.20	0.143	0.57	1.15
(C-20- 4) 6dbd- 1	390558112202301	20170620	3.1	19	0.25	1.08	2.2	0.785
(C-21- 5) 7cdd- 3	385939112272303	20170620	2.7	<10.0	<0.20	1.43	3.5	4.16
(C-22- 5)21bab- 3	385323112253401	20170620	0.57	12.4	0.5	2.09	0.78	0.448
(C-22- 5)22adc- 2	385303112234801	20170620	1.4	11.1	<0.20	0.842	0.63	0.65
(C-23- 6) 8abd- 1	384953112325101	20170620	10	54.1	<1.00	1.35	9.9	11.3
Sevier Desert								
(C-15- 4) 8bcd- 1	393156112193101	20170817	3.3	229	451	2.96	<0.15	6.33
(C-15- 5)15dad- 1	393046112231301	20170817	4.2	12.5	10.2	2.06	0.19	2.34
Snake Valley								
(C-18-19)21ccc- 1	391319113595501	20170712	0.82	<10.0	0.23	0.378	0.37	1.43
(C-20-19)14bbc- 1	390416113573801	20170712	4.5	<10.0	<0.20	2.67	0.29	2.3
(C-21-19)31cad- 1	385640114012401	20170712	0.89	<10.0	<0.20	0.195	0.35	3.06
(C-23-19)20bac- 2	384900114003001	20170712	22.7	15.3	0.65	12.6	7.6	9.04
(C-24-20) 2ada- 1	384538114024301	20170817	6.3	<10.0	<0.20	1.73	2.1	11.1
Piute County								
Upper Sevier River area								
(C-30- 2)28bdc- 1	381003112010301	20170807	8.3	<10.0	<0.20	1.46	0.26	2.73
Salt Lake County								
Salt Lake Valley								
(B- 1- 1)27cac- 1	404720111562701	20170616	25.1	1,240	55	0.517	0.06	<0.010
(B- 1- 2)29ccc- 1	404704112060401	20170616	207	864	89.2	17.1	<0.30	0.108
(C- 3- 1)12cca- 1	403410111542501	20170619	<0.15	489	45.4	2.44	2.4	7.2
(C- 3- 1)29bbb- 1	403207111590801	20170619	1.9	21.3	2.97	0.264	16.2	7.51
(D- 1- 1) 7abd- 6	404506111523301	20170616	1.1	<10.0	2.68	1.21	1.7	2.14

Table 6. Concentrations of trace elements in water samples collected from selected wells in Utah, summer of 2017.—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
San Juan County								
Upper Colorado River area								
(D-37-18)35dab- 1	373130109534501	20170907	1.5	4,090	31.9	0.619	<0.05	0.063
(D-40-21)33dbc- 2	371545109364402	20170907	30.2	<10.0	4.59	0.855	<0.05	0.115
Sanpete County								
Sanpete Valley								
(D-14- 3)31dad- 1	393311111371701	20170821	0.73	<10.0	<0.20	0.078	1.3	0.761
(D-16- 2)13dda- 1	392511111382001	20170821	0.71	24.1	61.7	9.52	<0.05	3.05
(D-17- 3)20cdb- 1	391904111363001	20170821	2.2	<10.0	<0.20	1.39	2.4	2.75
Sevier County								
Central Sevier Valley								
(C-21- 1)13abd- 1	385910111512101	20170807	2.1	<10.0	<0.20	0.685	0.43	0.936
(C-23- 2)15dcb- 4	384757112002201	20170807	0.61	59.1	10.7	3.42	1.2	6.2
Tooele County								
Rush Valley								
(C- 4- 5)29bdc- 2	402637112261301	20170706	1.9	28.8	0.48	1.38	0.5	1.59
(C- 5- 5)32dbb- 2	402024112254601	20170706	2	93.9	22.9	0.798	2.4	4.37
Skull Valley								
(C- 1- 7)31daa- 1	404113112395801	20170605	<0.50	<50.0	<1.00	0.252	<0.50	2.07
(C- 4- 8) 3bca- 1	403006112442201	20170605	0.96	<10.0	0.23	0.081	1.3	1.65
Tooele Valley								
(C- 2- 4) 2baa- 3	404054112155901	20170607	1.6	29.6	1.13	<0.400	0.43	<0.080
(C- 2- 4)28daa- 1	403657112173901	20170607	0.51	<10.0	1.03	0.342	5.8	1.64
(C- 2- 4)33bdd- 1	403629112174801	20170606	<0.50	<10.0	<0.20	<0.500	0.6	2.24
(C- 2- 4)34adc- 1	403608112164201	20170607	0.47	<10.0	<0.20	0.315	2.8	<0.080
(C- 2- 5)36bdd- 1	403605112214201	20170606	0.62	10.1	0.21	<0.500	0.65	1.87
Utah County								
Cedar Valley								
(C- 6- 1)19acc- 1	401702111594001	20170707	9.1	<10.0	<0.20	8.59	1.2	2.9
(C- 6- 2)26cbc- 1	401600112023401	20170707	5.6	16.8	19.7	4	0.26	3.96
Goshen Valley								
(C- 9- 1) 3ddb- 1	400325111552501	20170628	11.8	18.5	0.23	1.51	1.4	5.47
(C- 9- 1)28ccb- 1	395956111572101	20170628	3.9	<20.0	<0.40	1.6	9.9	6.56
(C-10- 1)31cdd- 1	395340111590001	20170628	4	<10.0	<0.20	0.812	3.2	2.63
Northern Utah Valley								
(D- 5- 1)27aac- 1	402133111484601	20170626	1.8	<10.0	0.3	1.32	4.1	3.53
(D- 6- 2)28ddd- 3	401541111425001	20170628	3.2	12.1	2.52	0.885	0.36	1.44
(D- 7- 2)11caa- 1	401325111410901	20170626	5.8	749	465	0.621	0.05	0.382
Southern Utah Valley								
(D- 8- 2)31cdb- 2	400423111454001	20170626	2.7	68	75.3	2.34	<0.40	2.33

Table 6. Concentrations of trace elements in water samples collected from selected wells in Utah, summer of 2017.—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	20170814	12.2	<10.0	0.25	0.866	0.39	0.894
(D- 4- 4)12dcc- 1	402842111263101	20170815	1.1	10.3	0.33	0.132	0.21	1.56
(D- 4- 4)13bdd- 1	402810111263601	20170815	1.2	<10.0	6.99	1.13	0.69	1.52
(D- 4- 5) 3dcc- 1	402937111214901	20170814	1.4	<10.0	0.37	0.087	0.13	1.32
(D- 4- 5) 4ccb- 1	402946111233901	20170814	1.4	<10.0	0.96	0.081	0.07	1.44
(D- 4- 5) 6bcc- 2	403003111255801	20170814	1.1	13.6	1.41	0.181	0.16	1.86
(D- 4- 5)16bab- 1	402840111232201	20170814	2	<10.0	<0.20	0.484	0.33	2.16
(D- 4- 5)16ccd- 1	402750111232701	20170815	1.5	<10.0	1	1.39	0.86	1.79
Washington County								
Central Virgin River area								
(C-41-17) 8cbd- 2	371348113470301	20170807	21.9	190	27.2	4.05	2	1.61
(C-42-16)26bcc- 1	370617113371101	20170807	1.9	113	2,480	5.13	18.7	84.8
Wayne County								
Upper Fremont River Valley								
(D-27- 3)19aaa- 1	382717111365601	20170807	1.2	18.4	0.25	0.253	0.59	23.4
(D-29- 6)22acb- 1	381644111152501	20170823	0.42	17	0.29	0.585	0.26	3.51
Weber County								
East Shore area								
(B- 5- 2) 6bdd- 1	411153112064603	20170802	12.5	178	132	0.423	<0.05	<0.010
(B- 6- 3)15cbc- 1	411523112082101	20170802	23.3	91.2	60.6	3.01	<0.05	<0.010
(B- 7- 2)16dcd- 2	412011112041401	20170802	4	60	45.9	2.6	<0.05	0.012

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