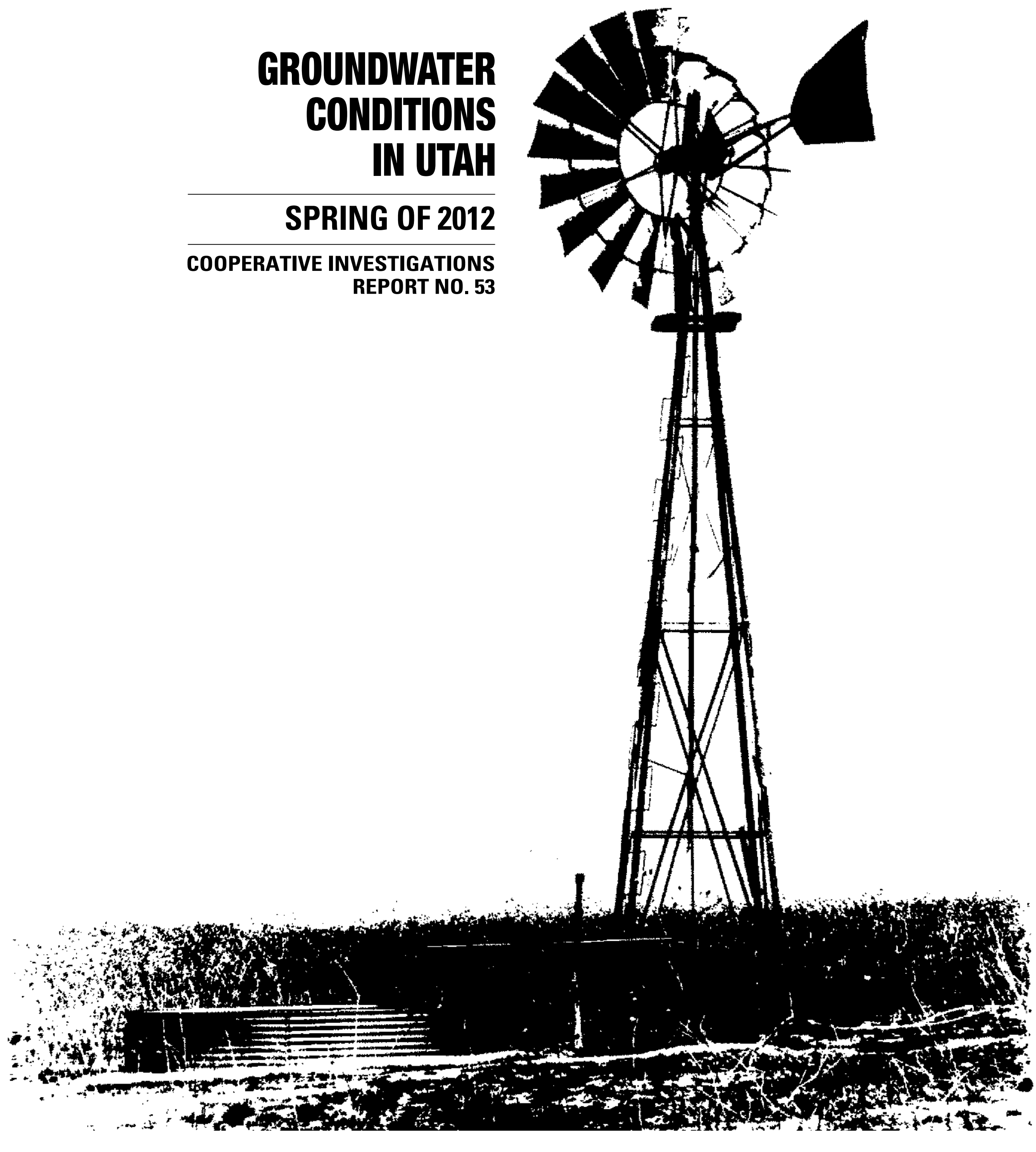
GROUNDWATER CONDITIONS IN UTAH

SPRING OF 2012

COOPERATIVE INVESTIGATIONS REPORT NO. 53



UTAH DEPARTMENT OF NATURAL RESOURCES and
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

U.S. GEOLOGICAL SURVEY

GROUNDWATER CONDITIONS IN UTAH, SPRING OF 2012

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

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

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Contents

Figures

Tables

Conversion Factors, Datums, and Water-Quality Units

Multiply	By	To obtain
acre-foot	1,233	cubic meter
foot	0.3048	meter
gallon per minute	0.06308	liter per second
inch	25.4	millimeter
mile	1.609	kilometer
square mile	2.59	square kilometer

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

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

Specific conductance is a measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25 degrees Celsius. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids concentration 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–micrometer membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

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

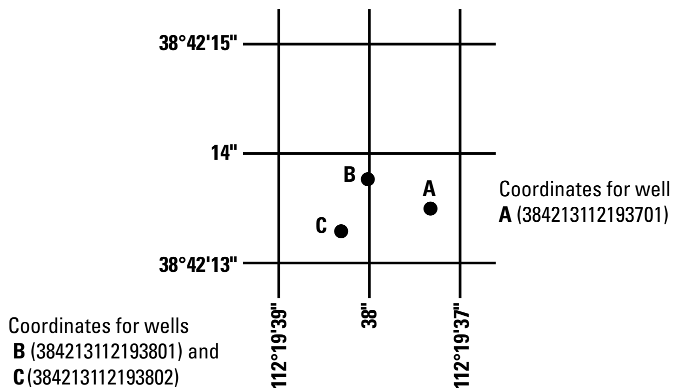
Maximum Contaminant Level (MCL)—The maximum concentration of a substance that is allowed in public drinking-water systems, as established by the U.S. Environmental Protection Agency (EPA).

Precipitation—The total annual precipitation in inches, rounded to tenths of an inch. For selected locations, is computed from monthly total precipitation (rain, sleet, hail, snow, etc.). Data supplied by the National Oceanic and Atmospheric Administration (NOAA) and the 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

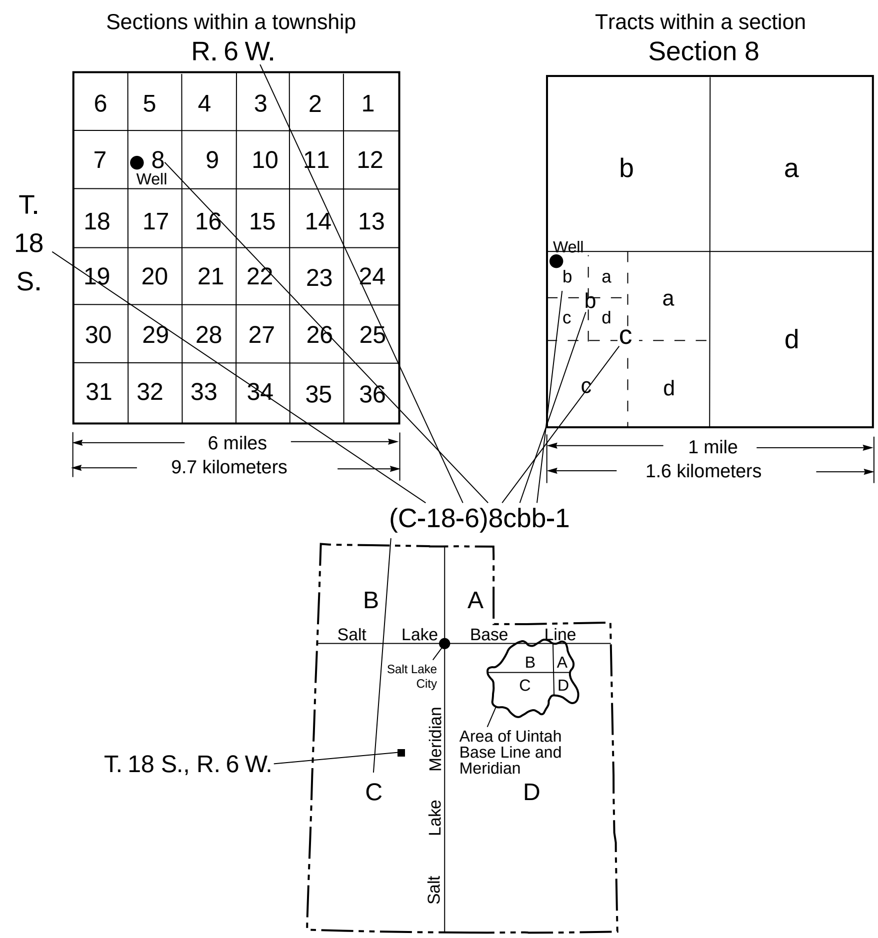
Wells by Latitude and Longitude

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 a well are the same, a sequential number such as “01,” “02,” and so forth, would be assigned. Even though the site number is based on latitude and longitude, it may not reflect the accurate location of the site. When error corrections or new technology locate a site more accurately, latitude-longitude coordinates will change but the site number will not. In addition to the well number that is based on latitude and longitude for each well, another well number is assigned based on the U.S. Bureau of Land Management system of land subdivision.



Wells by the Cadastral System of Land Subdivision

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



Surface-Water Sites— Downstream Order and Station Number

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

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

Groundwater Conditions in Utah, Spring of 2012

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

Introduction

This is the forty-ninth 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 withdrawal from wells, water-level changes, precipitation, streamflow, and chemical quality of water. Information on well construction included in this report refers only to wells constructed for new appropriations of groundwater. Supplementary data are included in reports of this series only for those years or areas 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 2011. Most of the reported data were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights, and the Utah Department of Environmental Quality, Division of Water Quality. This report is also available online at *http://www.waterrights.utah.gov/techinfo/* and *http://ut.water.usgs.gov/publications/GW2012.pdf*. Groundwater conditions in Utah for calendar year 2010 are reported in Burden and others (2011) and available online at *http://ut.water.usgs.gov/publications/GW2011.pdf*.

Analytical results associated with water samples collected from each area of groundwater development were compared to State of Utah Maximum Contaminant Levels (MCLs) and secondary drinking-water standards of routinely measureable substances present in water supplies. The MCLs and secondary drinking-water standards can be accessed online at *http://www.rules.utah.gov/publicat/code/r309/r309-200.htm#T5*. The U.S. Environmental Protection Agency (EPA) drinking-water standards can be accessed at *http://www.epa.gov/safewater/mcl.html#mcls*. Maximum Contaminant Levels and secondary drinking-water standards were developed for public water systems and do not apply to the majority of wells sampled during this study.

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 may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. The largest yields are obtained from coarse-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 yield 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 contains open fractures. Most wells that penetrate consolidated rock are in the eastern and southern parts of the State in areas where water cannot be obtained readily from unconsolidated deposits.

Summary of Conditions

The total estimated withdrawal of water from wells in Utah during 2011 was about 849,000 acre-feet (table 2), which is about 123,000 acre-feet less than the revised total for 2010 and 68,000 acre-feet less than the 2001–2010 average annual withdrawal (table 3). The decrease in withdrawal resulted mostly from decreased irrigation use. The total estimated withdrawal for irrigation was about 462,000 acre-feet, which is about 83,000 acre-feet less than in 2010. Withdrawal for industry was about 98,000 acre-feet, which is 7,000 acre-feet less than the value for 2010. Withdrawal for public-supply use was about 225,000 acre-feet, which is 37,000 acre-feet less than in 2010. Withdrawal for domestic and stock use was about 64,000 acre-feet, which is 1,000 acre-feet more than in 2010.

From 2010 to 2011, groundwater withdrawal decreased in 15 of the 16 areas of groundwater development discussed in this report (table 2). Withdrawal in the Sevier Desert decreased about 26,000 acre-feet, the largest decrease of any of the groundwater development areas shown in figure 1. Withdrawal in the central Sevier Valley increased about 5,000 acre-feet, the only increase of any of the areas. The 2011 withdrawal was less than the average annual withdrawal for 2001–2010 in 14 of the 16 areas (tables 2 and 3).

The amount of water withdrawn from wells is related to demand and availability of water from other sources, which, in turn, are partly related to local climatic conditions. Precipitation during calendar year 2011 at 20 of 27 weather stations included in this report (Western Region Climate Center, 2011), was greater than the long-term average. The greatest increase in precipitation from average was 6.9 inches at Pineview Dam. The greatest decrease in precipitation from average was 2.0 inches at Bluff.

During February and March 2012, about 650 water-level measurements were made in wells for areas included in this report. Most water-level data included in the hydrographs in this report are from measurements made during February and March, but may include some water-level measurements made in April and May. Many of the wells in this report have additional water-level measurements made throughout the year which are not included in this report. All water-level data are available online at *http://nwis.waterdata.usgs.gov/ut/nwis/gwlevels*.

In 2011, 265 wells were constructed for new appropriations of groundwater, as determined by the Utah Division of Water Rights (table 2), which is 62 fewer wells than the total reported for 2010. In 2011, 21 large-diameter wells (12 inches or more) were constructed for new appropriations of groundwater (table 2), which is 3 fewer than the total reported for 2010. These are principally for withdrawal of water for public supply, irrigation, or industrial use.

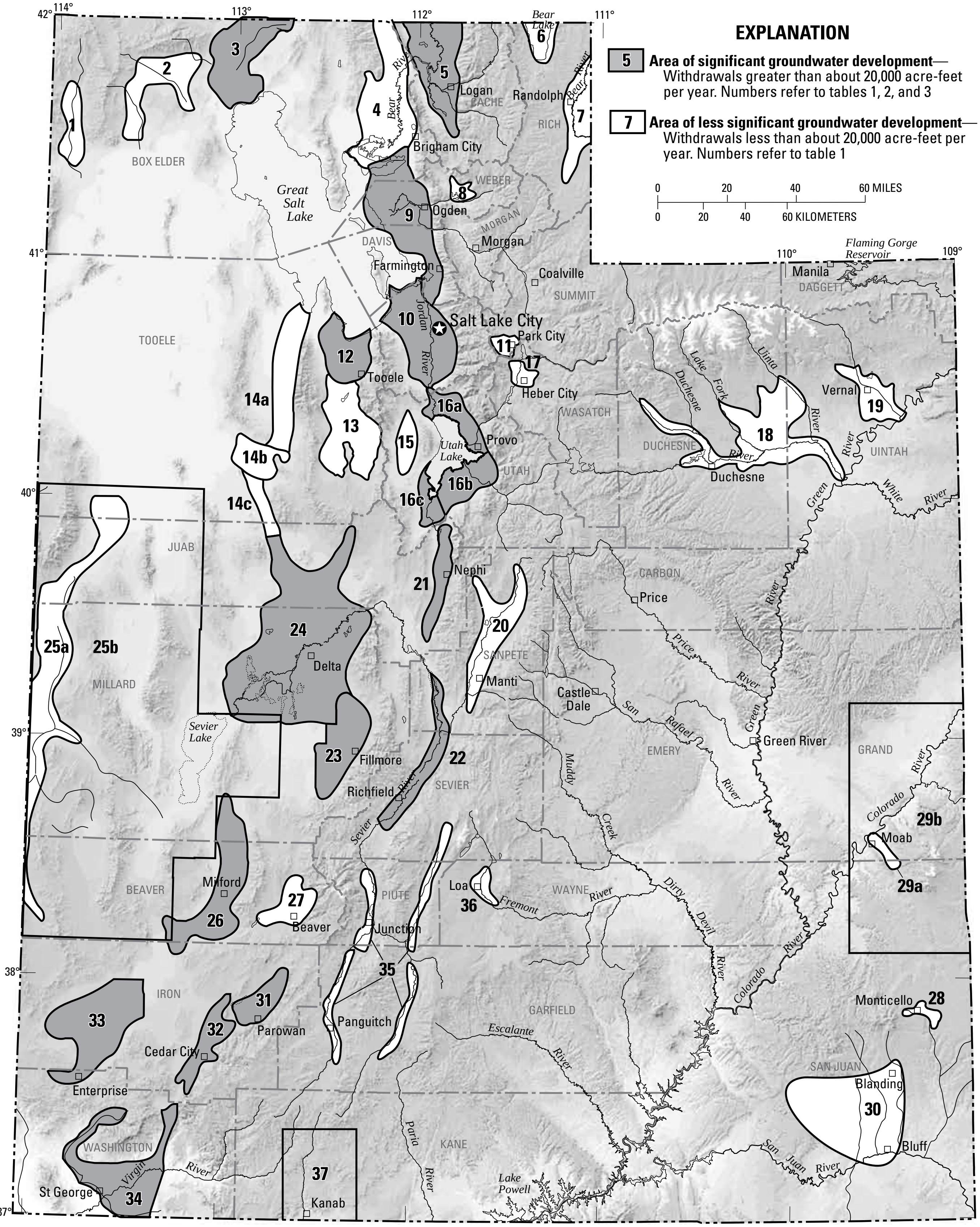


Figure 1. Areas of groundwater development in Utah specifically referred to in this report.

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

[Do., ditto]

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

Table 2. Number of wells constructed and estimated withdrawal of water from wells in Utah, 2011.

Area	Number in figure 1	Number of wells[1] constructed in 2011		Estimated withdrawal from wells (acre-feet)					
				2011					2010 total[2, 3] (rounded)
		Total	Diameter of 12 inches or more	Irrigation	Industrial[1]	Public supply[1]	Domestic and stock	Total (rounded)	
Curlew Valley	3	2	0	32,100	0	200	100	32,000	39,000
Cache Valley	5	25	0	13,400	6,000	8,300	2,000	30,000	33,000
East Shore area	9	3	0	7,200	3,800	21,000	5,000	37,000	43,000
Salt Lake Valley	10	6	3	400	[4]27,400	76,100	22,000	126,000	140,000
Tooele Valley	12	9	0	[5,6]11,100	1,100	7,400	1,200	21,000	24,000
Utah and Goshen Valleys	16	18	1	35,900	9,100	32,800	16,700	94,000	[3]106,000
Northern Utah Valley[8]	16a	4	1	(12,100)	(5,400)	(23,900)	(8,100)	(49,500)	([3,7]58,100)
Southern Utah Valley[8]	16b	13	0	(7,100)	(3,700)	(8,800)	(8,500)	(28,100)	(30,900)
Goshen Valley[8]	16c	1	0	(16,700)	(0)	(100)	(100)	(16,900)	(17,200)
Juab Valley	21	2	0	13,800	80	[9]250	400	15,000	22,000
Sevier Desert	24	8	1	12,000	5,300	1,400	1,200	20,000	46,000
Central Sevier Valley	22	15	0	27,000	40	2,800	1,400	31,000	26,000
Pahvant Valley	23	5	2	88,400	0	600	320	89,000	106,000
Cedar Valley, Iron County	32	10	1	23,700	100	7,400	2,400	34,000	38,000
Parowan Valley	31	4	2	[10]31,500	200	300	350	32,000	34,000
Escalante Valley									
Milford area	26	4	2	32,200	[11]20,400	700	140	53,000	62,000
Beryl-Enterprise area	33	6	1	79,200	[12]3,700	460	650	84,000	90,000
Central Virgin River area	34	8	3	6,000	1,100	18,000	2,400	28,000	29,000
Other areas[13, 14]		140	5	48,500	20,000	46,800	7,500	123,000	134,000
Total (rounded)		265	21	462,000	98,000	225,000	64,000	849,000	[3]972,000

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

[2] From Burden and others (2011, table 2).

[3] Revised.

[4] Includes some use for air conditioning, about 2,300 acre-feet. About 95 percent was injected back into the aquifer.

[5] Includes some domestic and stock use.

[6] Includes some flowing well discharge.

[7] Previously included some use by Cedar Valley, Utah County (Other Areas).

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

[9] Previously included some springs.

[10] Includes some stock use.

[11] Includes 18,300 acre-feet for geothermal power generation. About 99 percent was injected back into the aquifer.

[12] Includes 2,740 acre-feet for heating greenhouses. 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 for other areas (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.

Table 3. Total annual withdrawal of water from wells in significant areas of groundwater development in Utah, 2001–2010.

Area	Number in figure 1	Thousands of acre-feet[1] (rounded) 2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2001–2010 average (rounded)	2011
Curlew Valley	3	36	[2]38	42	38	29	31	38	44	34	39	37	32
Cache Valley	5	32	33	27	27	29	31	36	34	31	33	31	30
East Shore area	9	57	49	49	46	41	46	52	54	46	43	48	37
Salt Lake Valley	10	151	[2]140	130	125	110	131	151	135	137	140	135	126
Tooele Valley	12	21	21	22	21	[2]18	[2]21	[2]27	[2]28	25	24	23	21
Utah and Goshen Valleys	16	[2]111	[2]111	[2]108	[2]105	[2]87	[2]99	126	[2]120	[2]105	[2]106	108	94
Northern Utah Valley[3]	16a	([2]67)	([2]64)	([2]68)	([2]66)	([2]46)	(58)	(72)	([2]67)	([2]60)	([2]58)	(63)	(49)
Southern Utah Valley[3]	16b	(32)	(36)	(33)	(30)	(31)	(29)	(38)	(34)	(30)	(31)	(32)	(28)
Goshen Valley[3]	16c	(12)	(11)	(7)	(9)	(10)	(12)	(16)	(19)	(15)	(17)	(13)	(17)
Juab Valley	21	29	29	27	26	14	21	26	26	21	22	24	15
Sevier Desert	24	19	36	28	41	24	20	34	44	48	46	34	20
Central Sevier Valley	22	12	11	15	15	17	16	19	24	27	26	18	31
Pahvant Valley	23	80	89	86	85	80	86	89	94	104	106	90	89
Cedar Valley, Iron County	32	32	42	39	40	30	35	40	40	38	38	37	34
Parowan Valley	31	[2]33	39	31	37	27	33	34	38	37	34	34	32
Escalante Valley													
Milford area	26	42	52	50	44	40	45	49	51	56	62	49	53
Beryl-Enterprise area	33	81	99	92	98	68	79	92	93	93	90	89	84
Central Virgin River area	34	27	27	28	26	29	32	33	29	33	29	29	28
Other areas		114	131	128	129	111	130	155	144	130	134	131	123
Total (rounded)		[2]877	[2]947	[2]902	[2]903	[2]754	[2]856	[2]1,001	[2]998	[2]965	[2]972	917	849

[1] From previous reports in this series.

[2] Revised.

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

Major Areas of Groundwater Development

Curlew Valley

By David V. Allen

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

The Utah part of Curlew Valley (Utah subbasin) covers about 550 square miles in Box Elder County. It is an arid to semiarid, largely uninhabited area, with a community center at Snowville. Average annual precipitation in the Utah subbasin is less than 8 inches on the valley floor, and is substantially more in the mountains.

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

Total estimated withdrawal of water from wells in Curlew Valley in 2011 was about 32,000 acre-feet, which is 7,000 acre-feet less than the value for 2010 and 5,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2012 is shown in figure 2. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3.

Precipitation at Grouse Creek in 2011 was about 8.8 inches, which is about 3.4 inches less than in 2010 and about 2.3 inches less than the average annual precipitation for 1959–2011.

Water levels in Curlew Valley generally rose or declined less than about 2.5 feet from March 2011 to March 2012. The largest rise, about 2.3 feet, was observed in a well about 4 miles north of Kelton. The largest decline, about 2.4 feet, was observed in a well about 3 miles west of Snowville.

The concentration of dissolved solids in water samples collected from well (B-12-11)8abb-1, 3 miles north of Kelton, and well (B-14-9)5bbb-1, 10 miles west of Snowville, from 1972–2011 and 1971–2011, respectively, is shown in figure 3. The dissolved-solids concentration in water from both wells remained the same in September 2011 as in July 2010. The dissolved-solids concentration in water samples from both wells has generally increased since the early 1970s.

Physical properties and results of chemical analyses for water from three wells in Curlew Valley are shown in tables 5 and 6, and the location of the wells is plotted in figure 41. The concentrations of dissolved solids and chloride in the water samples from wells (B-14-8)11bca-1, (B-14-9)5bbb-1, and (B-14-9)7bbb-1, exceeded the secondary drinking-water standards for these constituents (500 and 250 mg/L, respectively). In addition, water from well (B-14-8)11bca-1 exceeded the secondary standard for sulfate (250 mg/L).

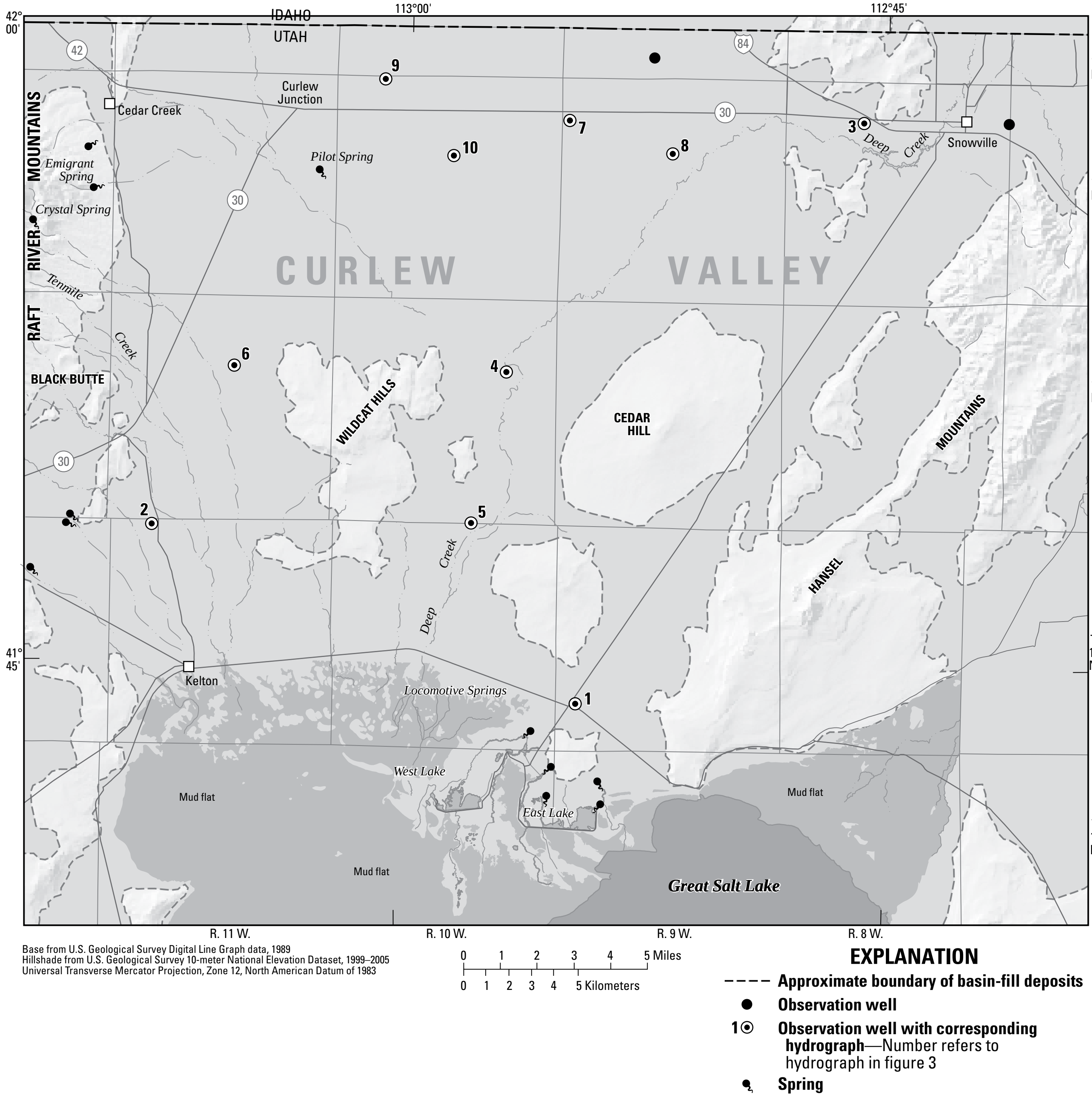


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2012.

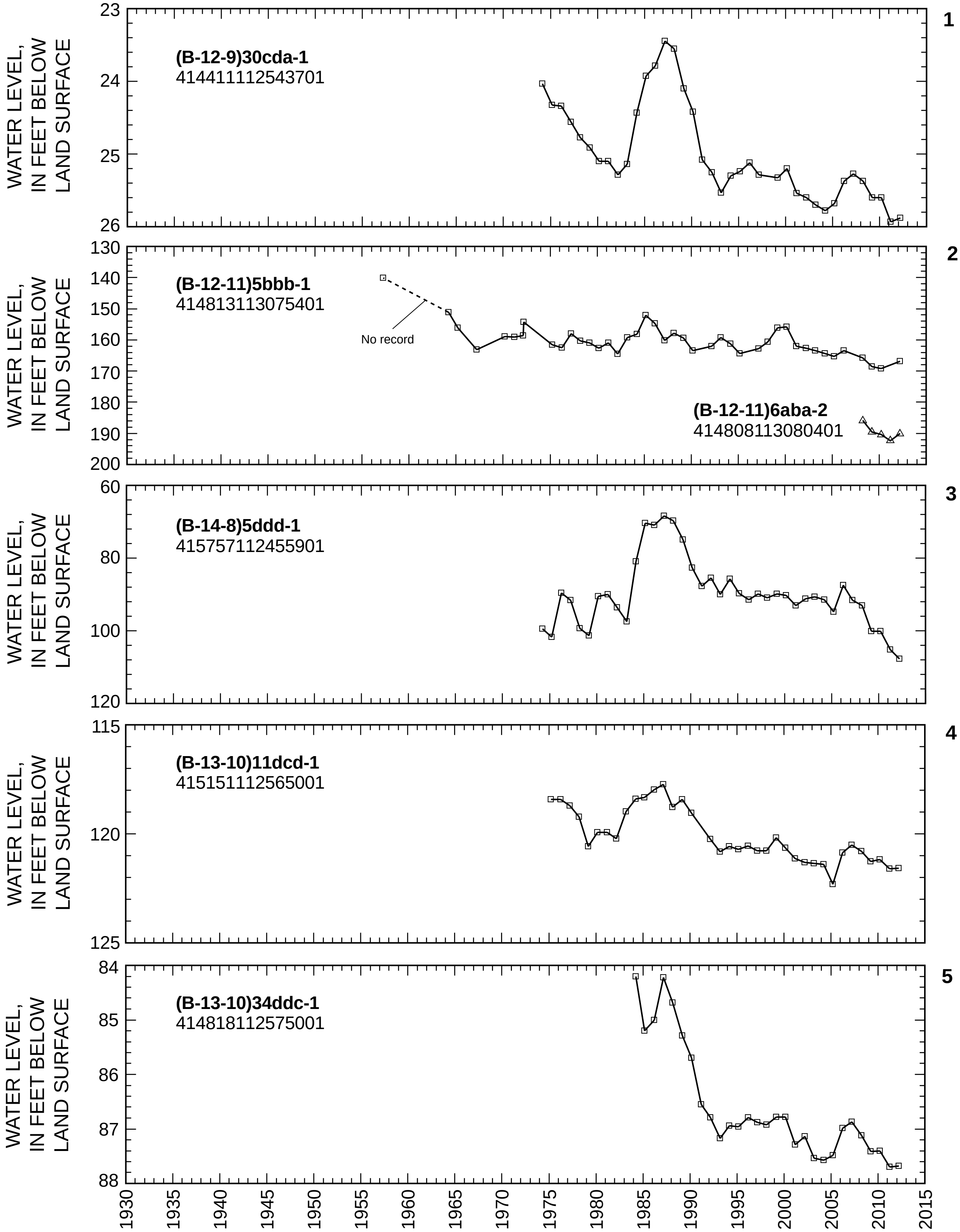


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

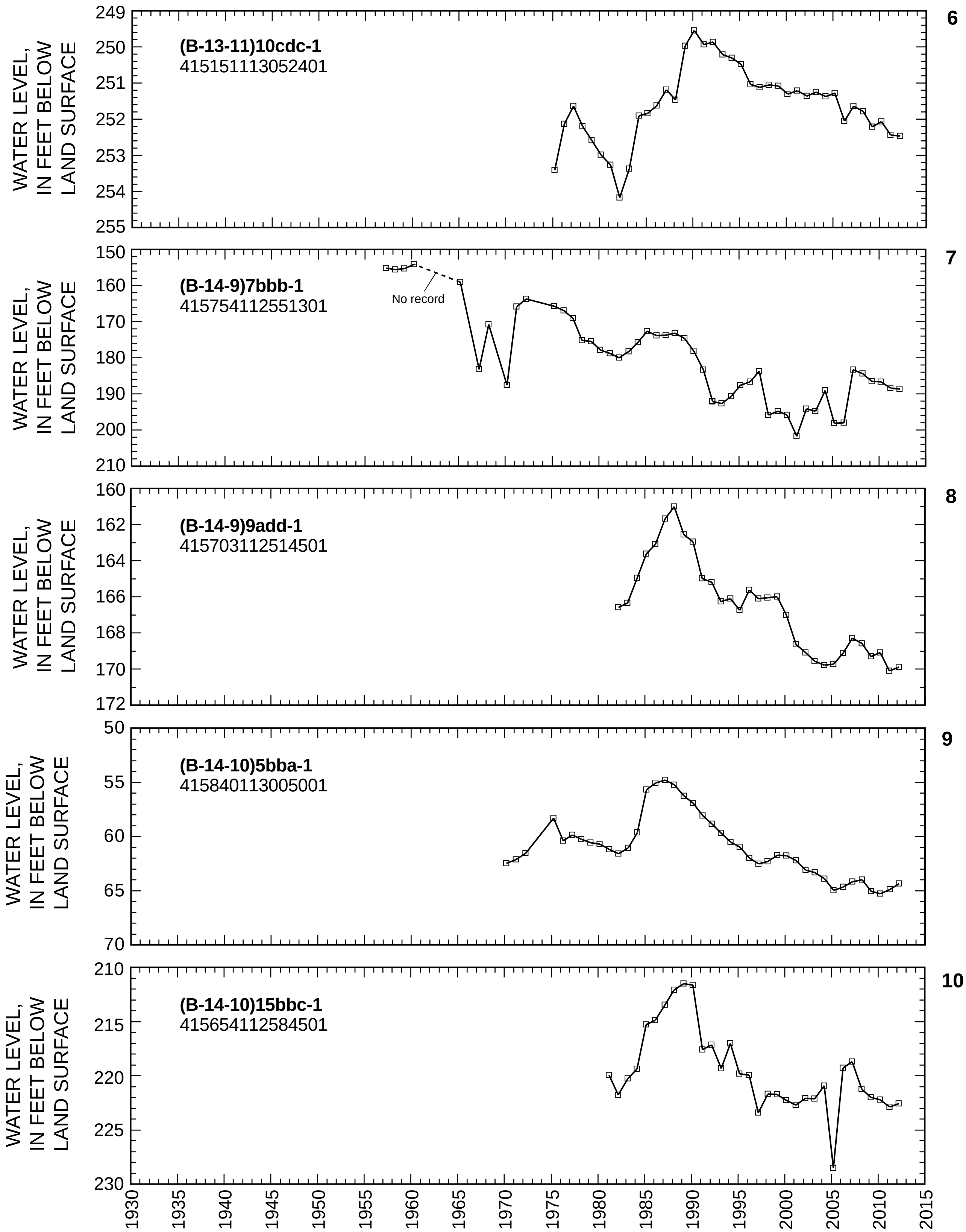


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

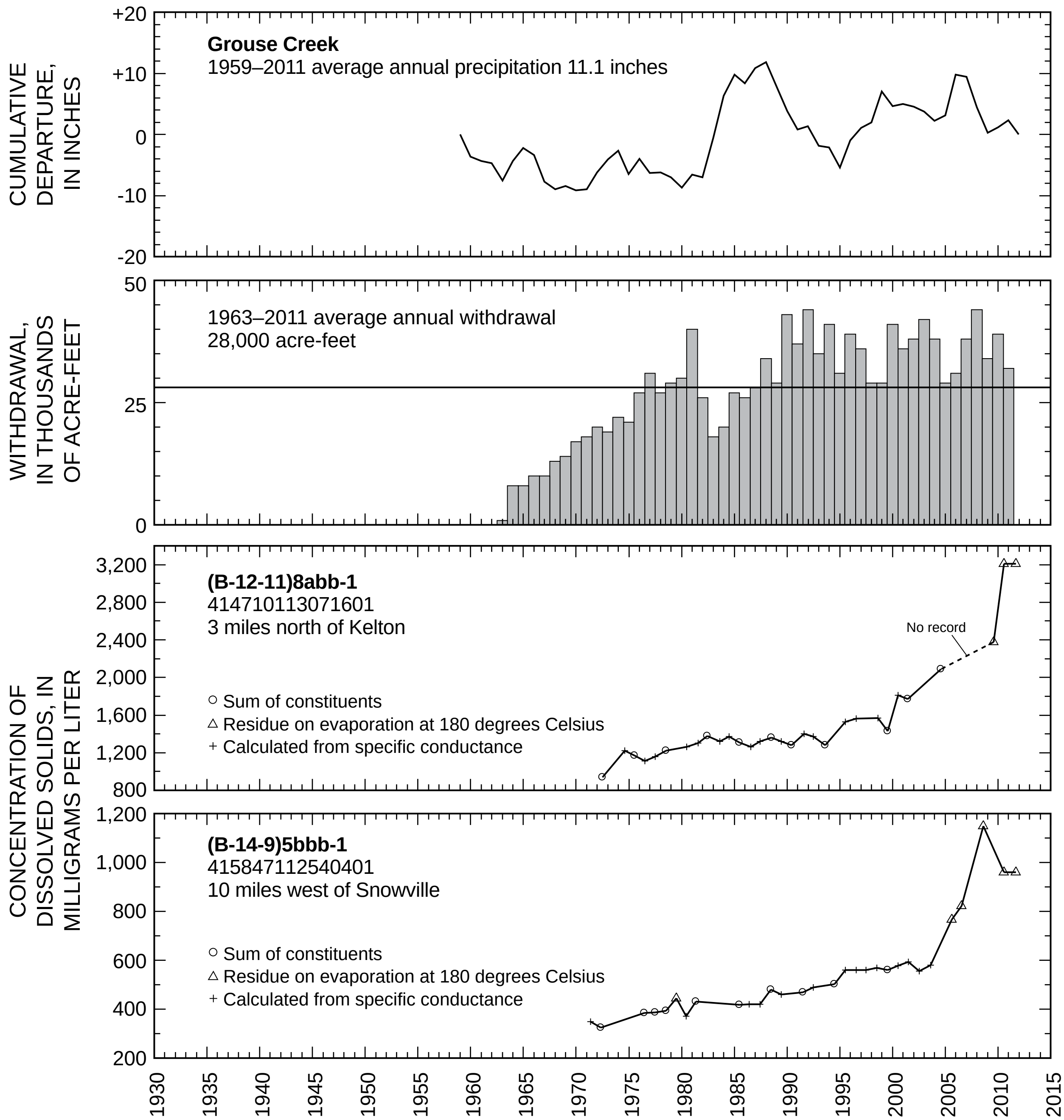


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cache Valley

By Christopher M. Holt

Cache Valley covers about 450 square miles in Cache County where it is bounded on the east by the Bear River Range and on the southwest by the Wellsville Mountains (fig. 4). Groundwater occurs in unconsolidated basin-fill deposits in the valley, under both water-table and artesian conditions. Recharge to the groundwater system occurs principally along the margins of the valley, and groundwater moves toward the center of the valley and west toward Cache Junction.

Total estimated withdrawal of water from wells in Cache Valley in 2011 was about 30,000 acre-feet, which is 3,000 acre-feet less than in 2010 and 1,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3). Withdrawal for irrigation was 13,400 acre-feet (largely from flowing wells), which is about 2,400 acre-feet less than in 2010. Withdrawal for public supply was 8,300 acre-feet, 1,300 acre-feet less than in 2010.

The location of wells in Cache Valley in which the water level was measured during March 2012 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, near Logan, and Logan, Hyde Park, and Smithfield Canal at Head, near Logan) during 2011 was about 324,000 acre-feet, which is 182,000 acre-feet more than the 2010 total of 142,000 acre-feet and 143,000 acre-feet more than the 1941–2011 average annual discharge. Precipitation at Logan, Utah State University was about 23.5 inches in 2011. This is about 3.5 inches more than for 2010 and about 5.2 inches more than the average annual precipitation for 1930–2011.

Water levels throughout the valley generally rose slightly from March 2011 to March 2012. This is consistent with increased precipitation in 2011 compared to 2010. 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.

The concentration of dissolved solids in water samples collected from well (A-13-1)29bcd-1, located 1.5 miles west of Smithfield, from 1970 to 2011, is shown in figure 5. The concentration has ranged from 223 to 278 mg/L, with a median value of 258 mg/L. The water sample collected in August 2011 had a dissolved-solids concentration of 261 mg/L, similar to the median value. There is little variability in the data and no apparent trends. This is consistent with the relatively small range (55 mg/L) and standard deviation (11.0 mg/L) associated with the data.

Physical properties and results of chemical analyses for water from five wells in Cache Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentration of manganese in the water samples from wells (A-13-1)29bcd-1, (B-12-1)8cdb-2, and (B-13-1)30acc-1 exceeded the secondary drinking-water standard for this constituent (50 µg/L). Also water from well (B-12-1)8cdb-2 exceeded the secondary standard for fluoride (2.0 mg/L) and the MCL for arsenic (10 µg/L). Water from well (B-13-1)30acc-1 exceeded the secondary drinking-water standard for iron (300 µg/L).

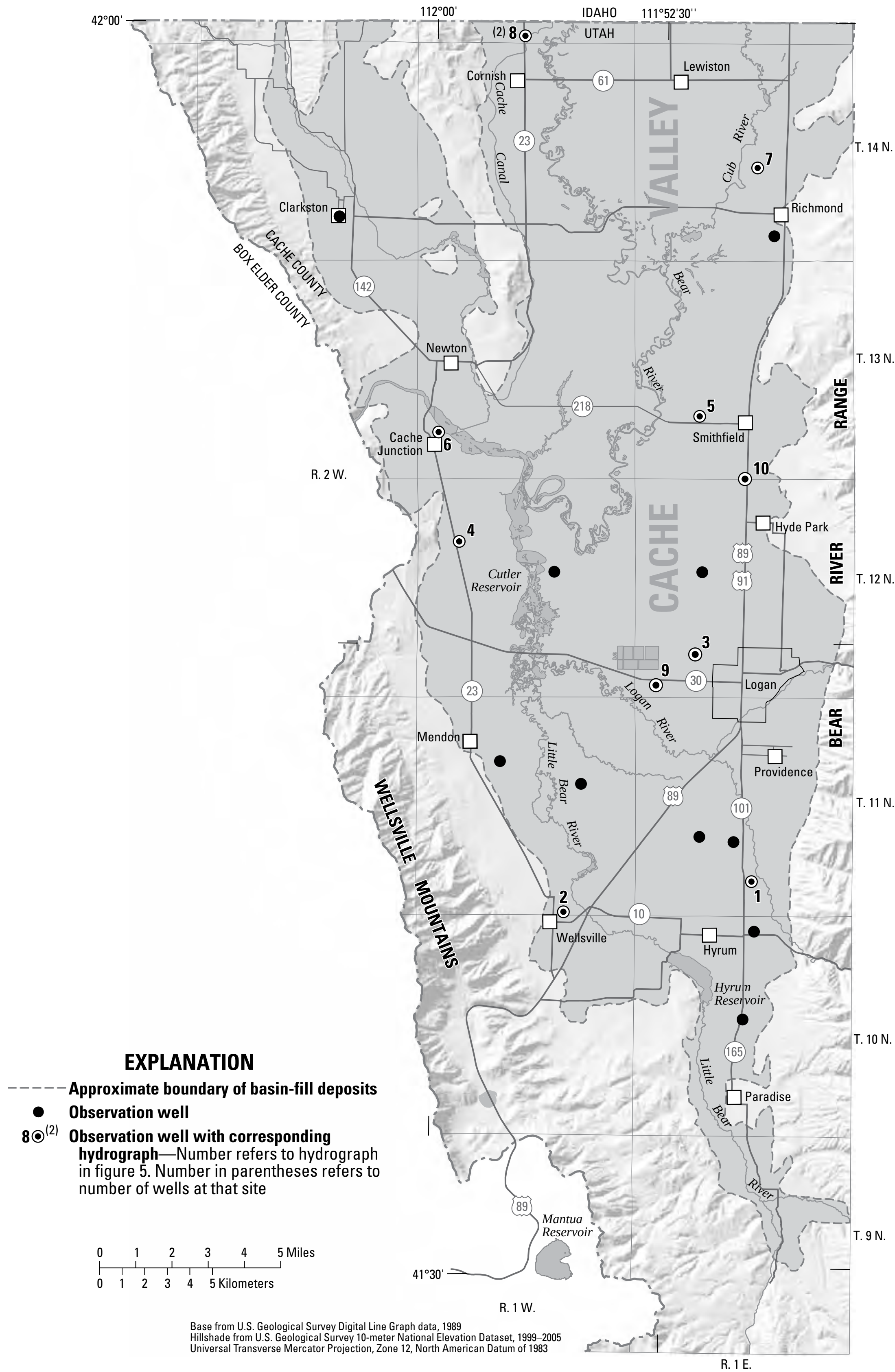


Figure 4. Location of wells in Cache Valley in which the water level was measured during March 2012.

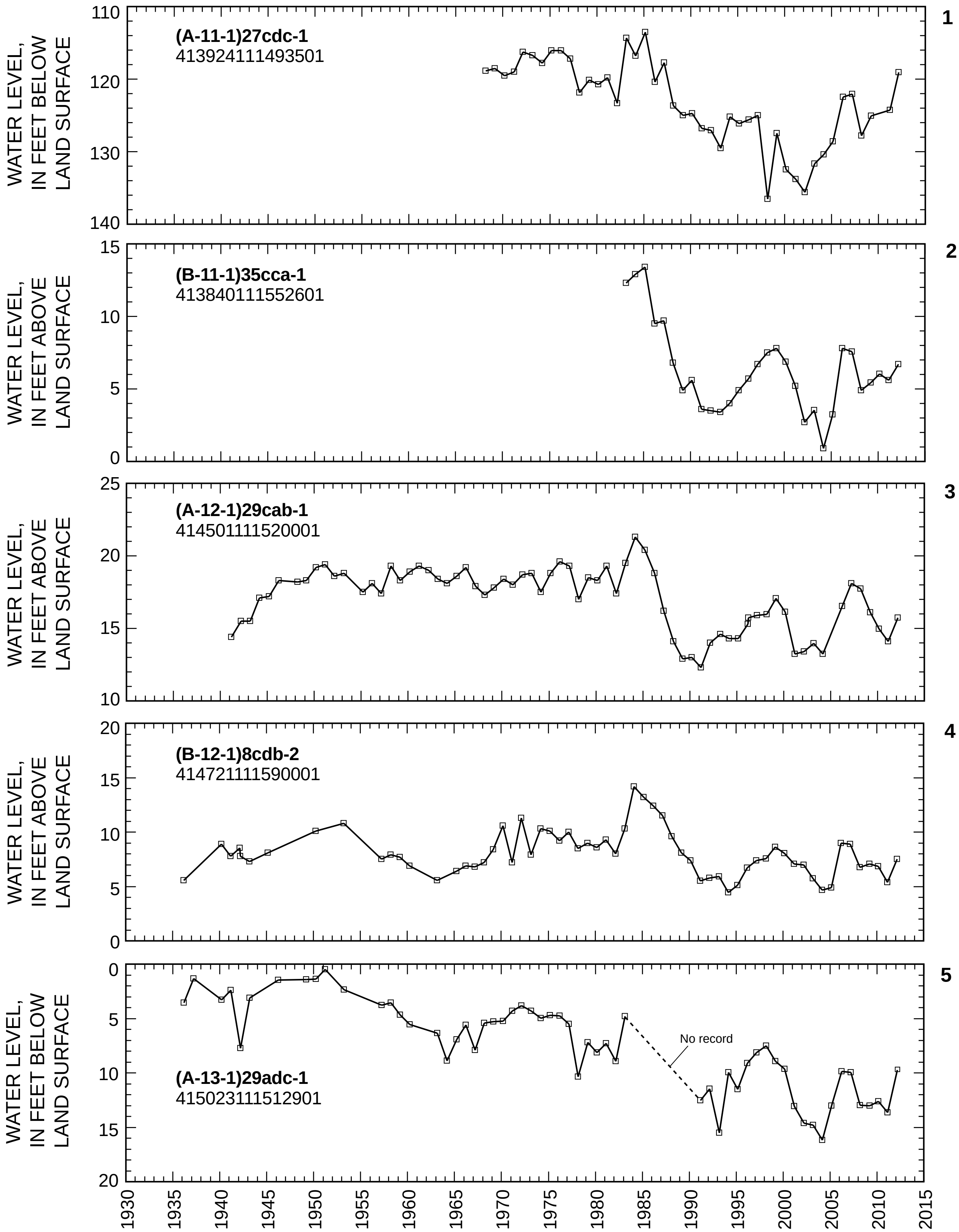


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

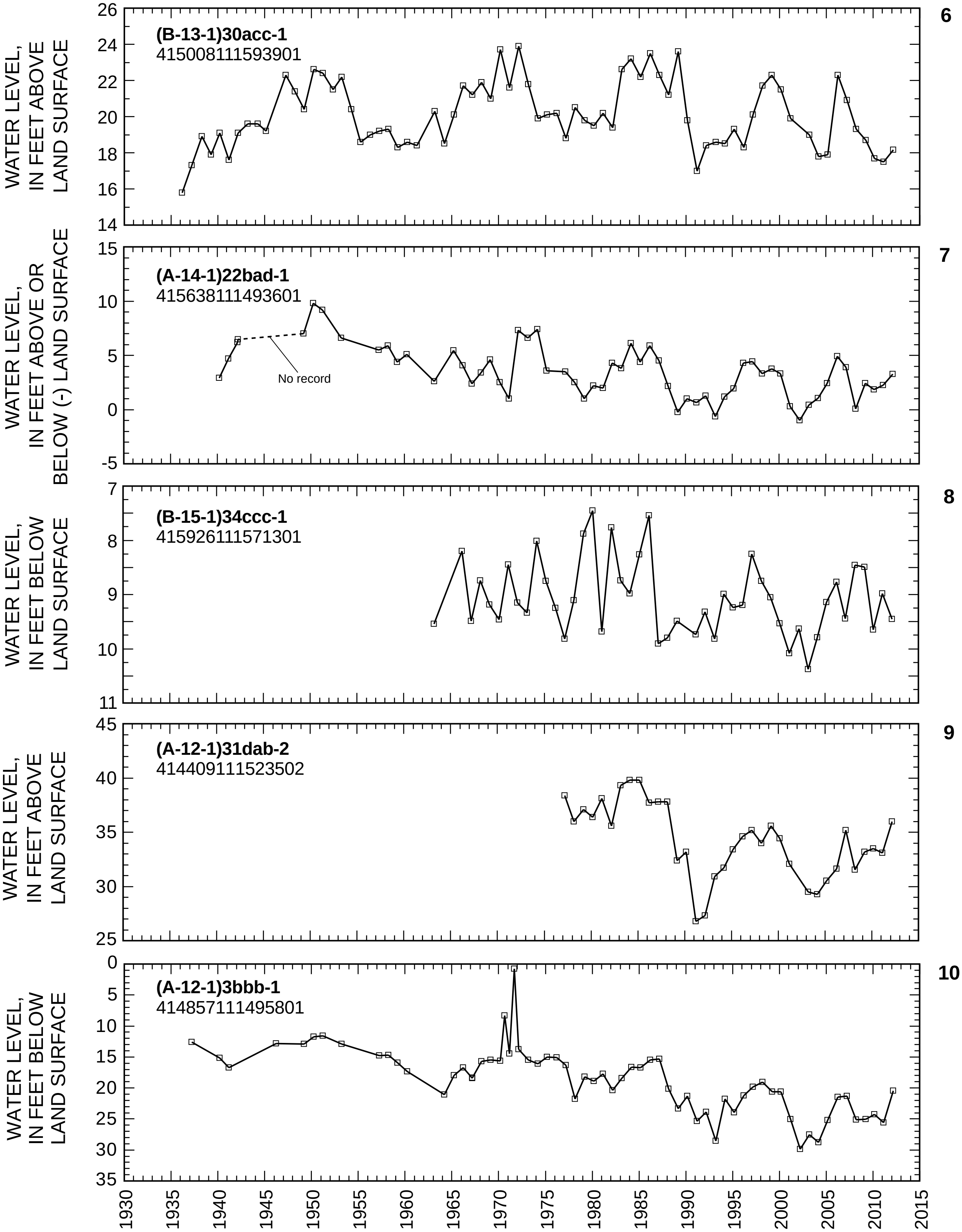


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

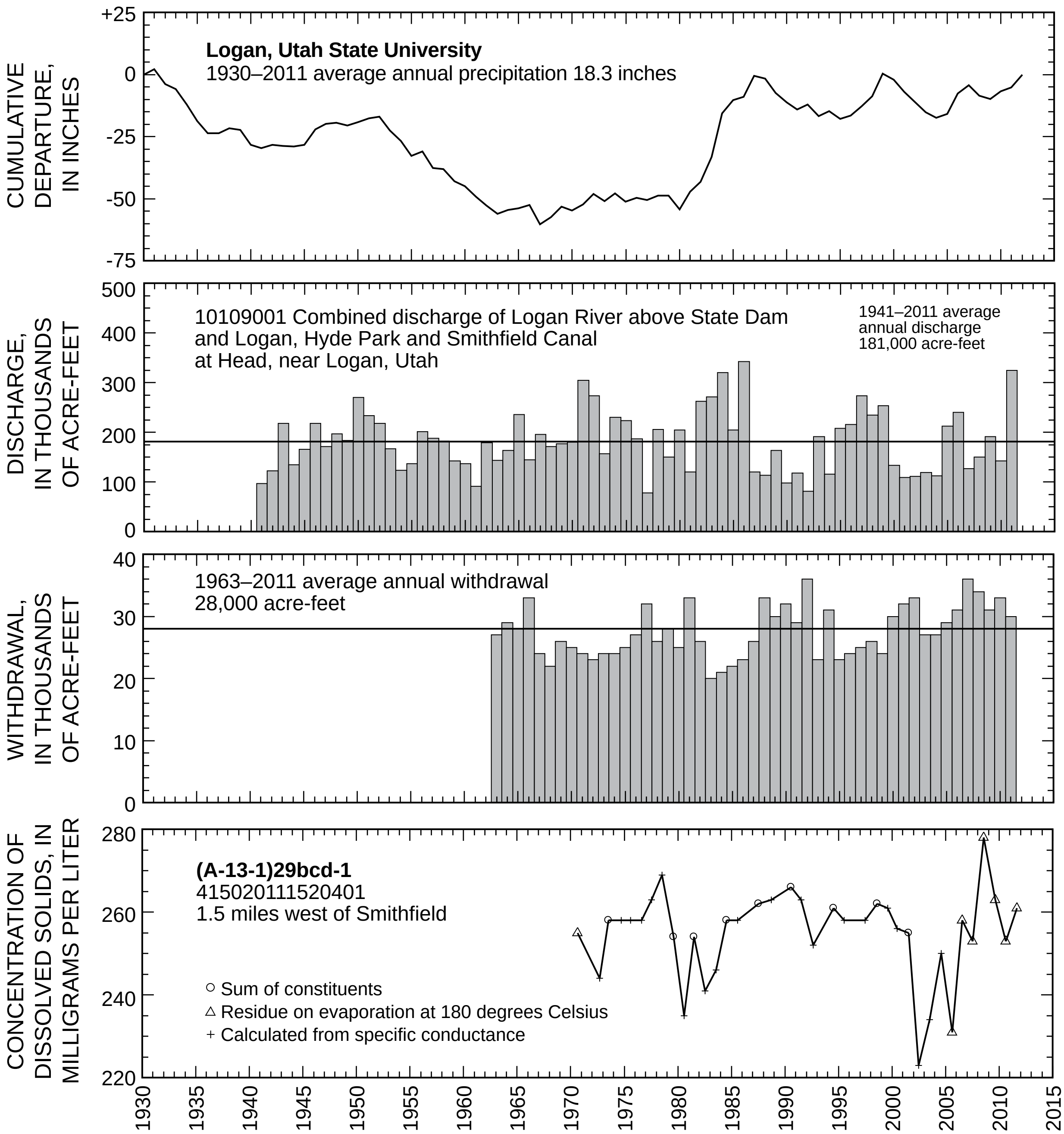


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

East Shore Area

By Martel J. Fisher

The East Shore area is in north-central Utah between the Wasatch Range and Great Salt Lake within Davis, Weber, and Box Elder Counties (fig. 6). Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions, but most of the water withdrawn by wells is from the artesian aquifers. Water enters the artesian aquifers along the contact between the Wasatch Range and the eastern edge of the basin-fill deposits, and generally moves westward toward Great Salt Lake.

Total estimated withdrawal of water from wells in the East Shore area in 2011 was about 37,000 acre-feet, which is 6,000 acre-feet less than was reported for 2010 and 11,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3). Withdrawal for public supply was 21,000 acre-feet in 2011, about 6,200 acre-feet less than in 2010. Withdrawal for irrigation was about 7,200 acre-feet, which is the same as in 2010. Withdrawal for industrial use was about 3,800 acre-feet, which is about 200 acre-feet more than in 2010.

The location of wells in the East Shore area in which the water level was measured during March 2012 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 2011 was about 37.7 inches, which is about 6.9 inches more than the average annual precipitation for 1949–2011 and about 4.8 inches more than in 2010.

Water levels rose from March 2011 to March 2012 in most of the wells measured in the East Shore area. Rises are probably due to less withdrawal for public supply use and greater-than-average precipitation. Water levels have generally declined since the mid-1980s in wells south of Kaysville in the East Shore area and have generally declined since the mid-1950s in wells north of Kaysville. Declines are probably due to continued large withdrawals for public supply (table 2).

The concentration of dissolved solids in water samples collected from well (B-4-2)27aba-1, 2.3 miles south-southeast of Syracuse, from 1969 to 2011, is shown in figure 7. The concentration has ranged from 287 to 633 mg/L with a median value of 399 mg/L. From 1969 to 1993, dissolved-solids concentrations in water samples varied by as much as 346 mg/L; however, concentrations in water samples collected from 1995 to 2011 varied by less than 40 mg/L. The dissolved-solids concentration in the water sample collected in July 2011 (381 mg/L) compares well to the median value.

Physical properties and results of chemical analyses for water from five wells in the East Shore area are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentration of manganese in the water samples from wells (B-5-2)6cdd-2 and (B-8-2)26bcd-1 exceeded the secondary drinking-water standard for this constituent (50 µg/L). Water from wells (B-4-2)27aba-1 and (B-8-2)26bcd-1 exceeded the secondary standard for iron (300 µg/L), and water from well (B-4-2)27aba-1 exceeded the MCL for arsenic (10 µg/L).

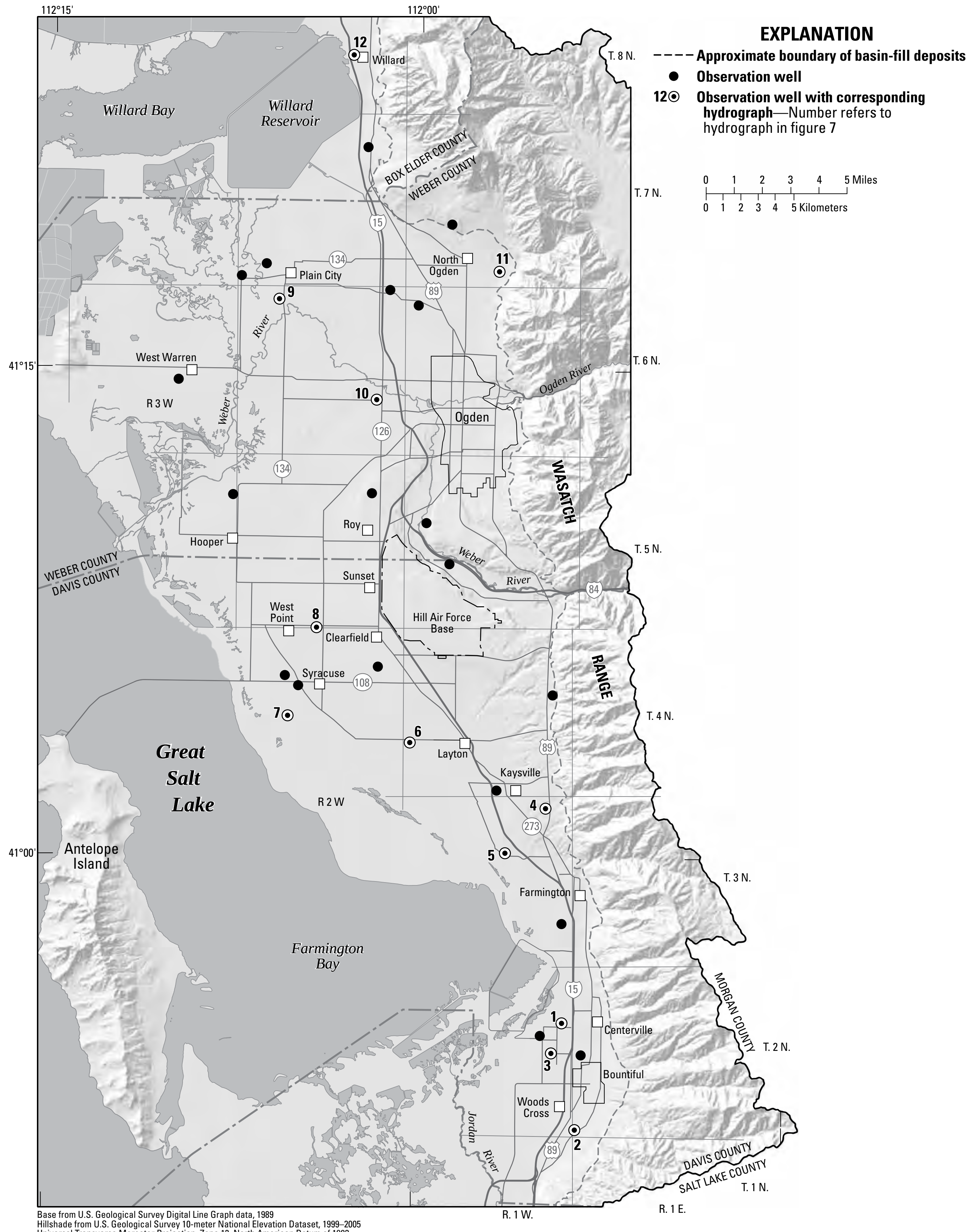


Figure 6. Location of wells in the East Shore area in which the water level was measured during March 2012.

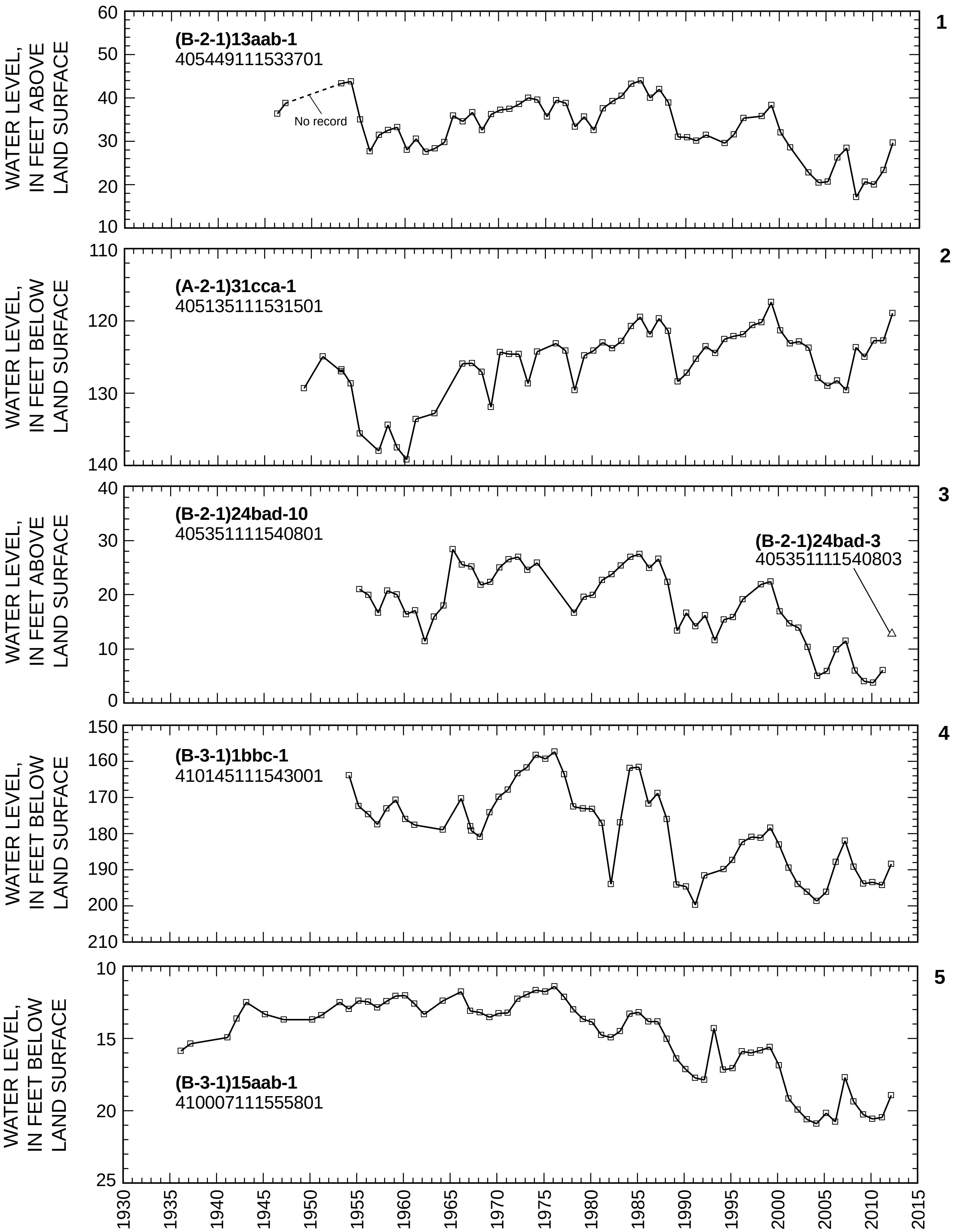


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

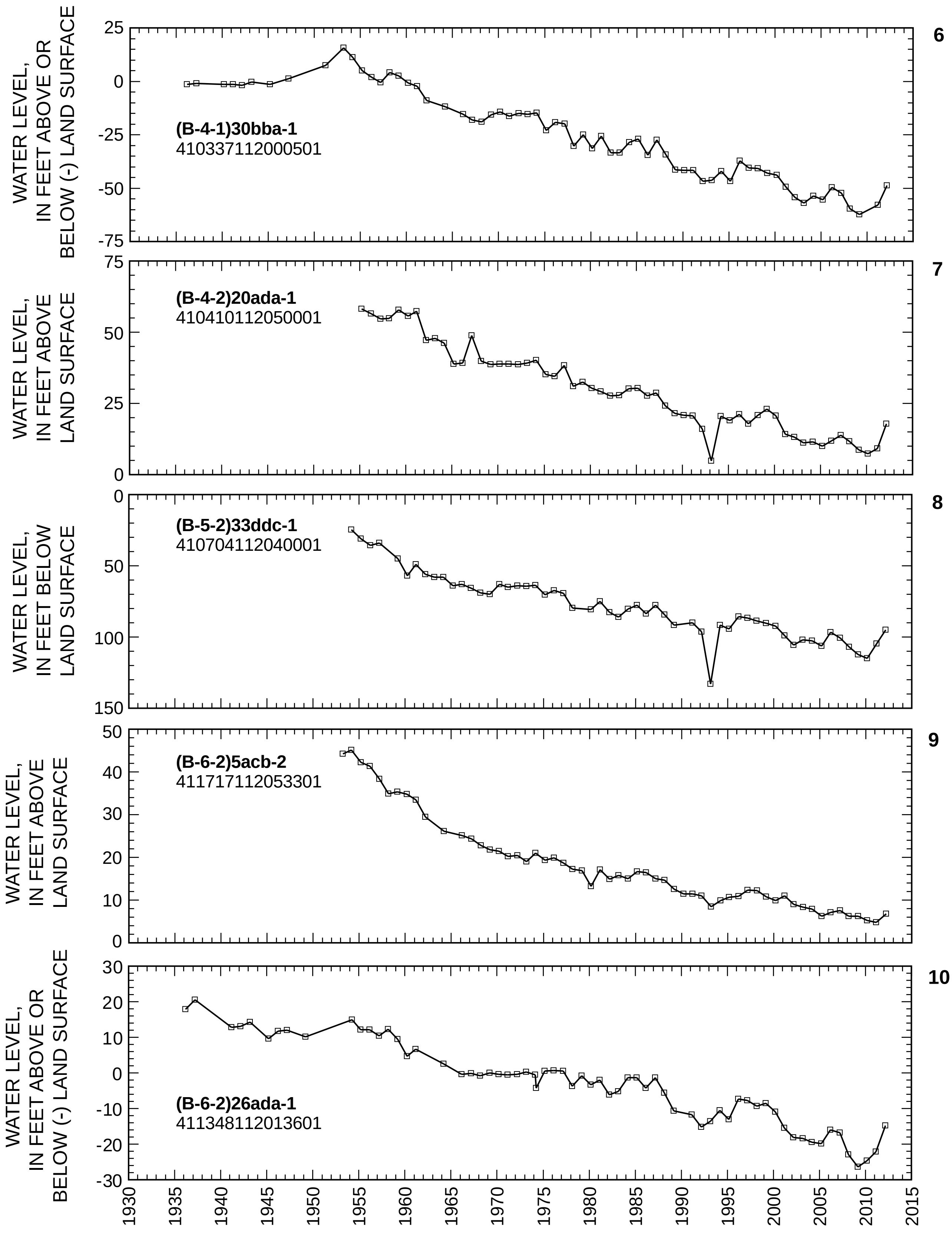


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

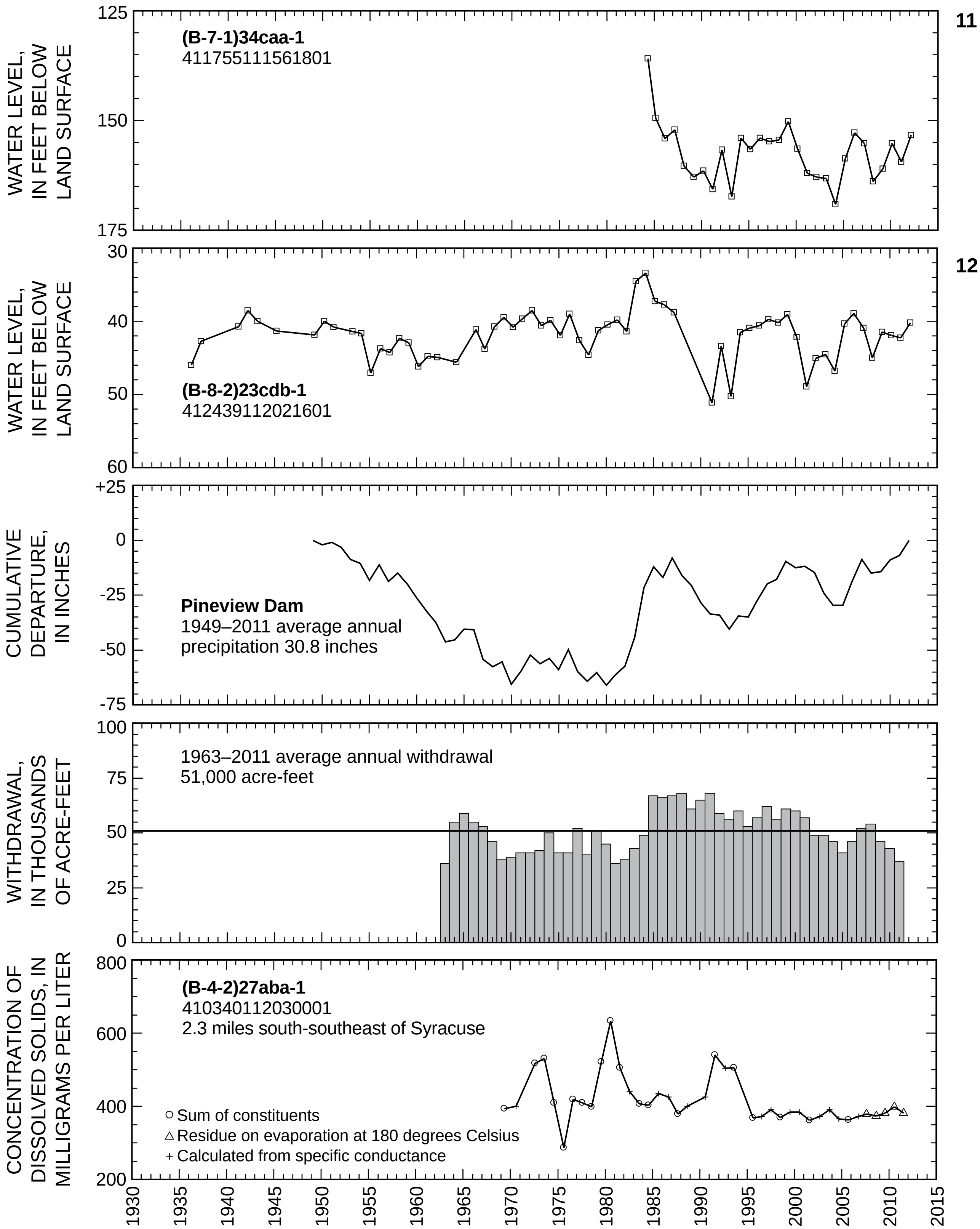


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

Salt Lake Valley

By Christopher M. Holt

Salt Lake Valley covers about 400 square miles between the Wasatch Range and the Oquirrh and Traverse Mountains in Salt Lake County (fig. 8). Groundwater occurs in unconsolidated deposits in the valley under water-table and artesian conditions. Recharge to the aquifers occurs mainly along the area where the mountains border the valley. In the southwestern part of the valley, groundwater moves from the base of the Oquirrh Mountains eastward toward the Jordan River. In the northwestern part of the valley, the direction of movement is mostly toward Great Salt Lake. In the eastern half of the valley, groundwater moves westward from the base of the Wasatch Range toward the Jordan River. The Jordan River drains both surface water and groundwater from the valley.

Total estimated withdrawal of water from wells in Salt Lake Valley in 2011 was about 126,000 acre-feet, which is 14,000 acre-feet less than in 2010 and 9,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3). Withdrawal for public supply was about 76,100 acre-feet, which is 6,100 acre-feet less than the total for 2010. Withdrawal for industrial use was about 27,400 acre-feet, which is 7,500 acre-feet less than the total for 2010.

The location of wells in Salt Lake Valley in which the water level was measured during February 2012 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 the Salt Lake City Weather Service Office (International Airport) are shown in figure 9. Precipitation at Salt Lake City during 2011 was about 19.1 inches, about 0.4 inch more than in 2010 and about 3.8 inches more than the average annual precipitation for 1931–2011.

The relation of the water level in selected observation wells completed in the principal aquifer to cumulative departure from average annual precipitation at Silver Lake Brighton, and the relation of the water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well are shown in figure 10. Precipitation at Silver Lake Brighton was about 44.7 inches in 2011, which is about 10.3 inches less than in 2010 and about 2.2 inches more than the average annual precipitation for 1931–2011.

Water levels rose from February 2011 to February 2012 in most of the wells measured in Salt Lake Valley. Rises are probably the result of less withdrawal for public supply and industrial use, and greater-than-average precipitation. The water level in most of the observation wells was highest during 1985–87, which corresponds to a period of much-greater-than-average precipitation. Levels have generally declined since 1987, except in the northeast part of the valley, where water levels have fluctuated but overall have risen.

The concentration of dissolved solids in water samples collected from well (D-1-1)7abd-6, a flowing well at 800 South 500 East in Salt Lake City, from 1931 to 2011, is shown in figure 10. The concentration has ranged from 554 to 879 mg/L with a median value of 695 mg/L. The concentration of dissolved solids increased from 576 mg/L in December 1931 to 879 mg/L in July 2009. The dissolved-solids concentration in July 2011 (831 mg/L) decreased 48 mg/L from July 2009.

Physical properties and results of chemical analyses for water from five wells in Salt Lake Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The dissolved-solids concentration in water samples from all five wells exceeded the secondary drinking-water standards for this constituent (500 mg/L). Water from well (B-1-2)29ccc-1 also exceeded the MCL for dissolved-solids concentration (2,000 mg/L) and arsenic (10 µg/L), and the secondary drinking-water standards for iron (300 µg/L), manganese (50 µg/L), sulfate (250 mg/L), and chloride (250 mg/L). Water from well (B-1-1)27cac-1 exceeded the MCL for arsenic and the secondary standard for iron.

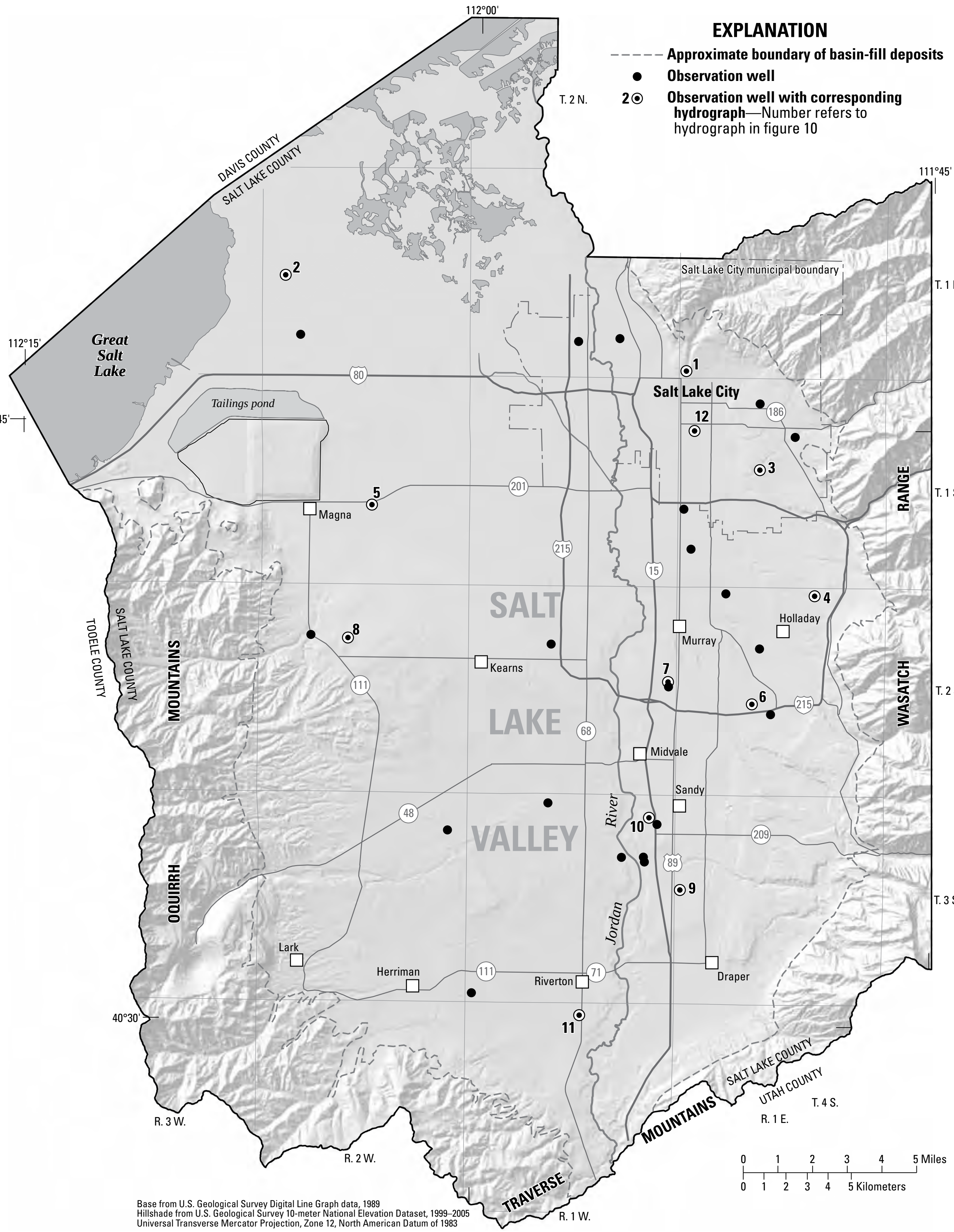


Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 2012.

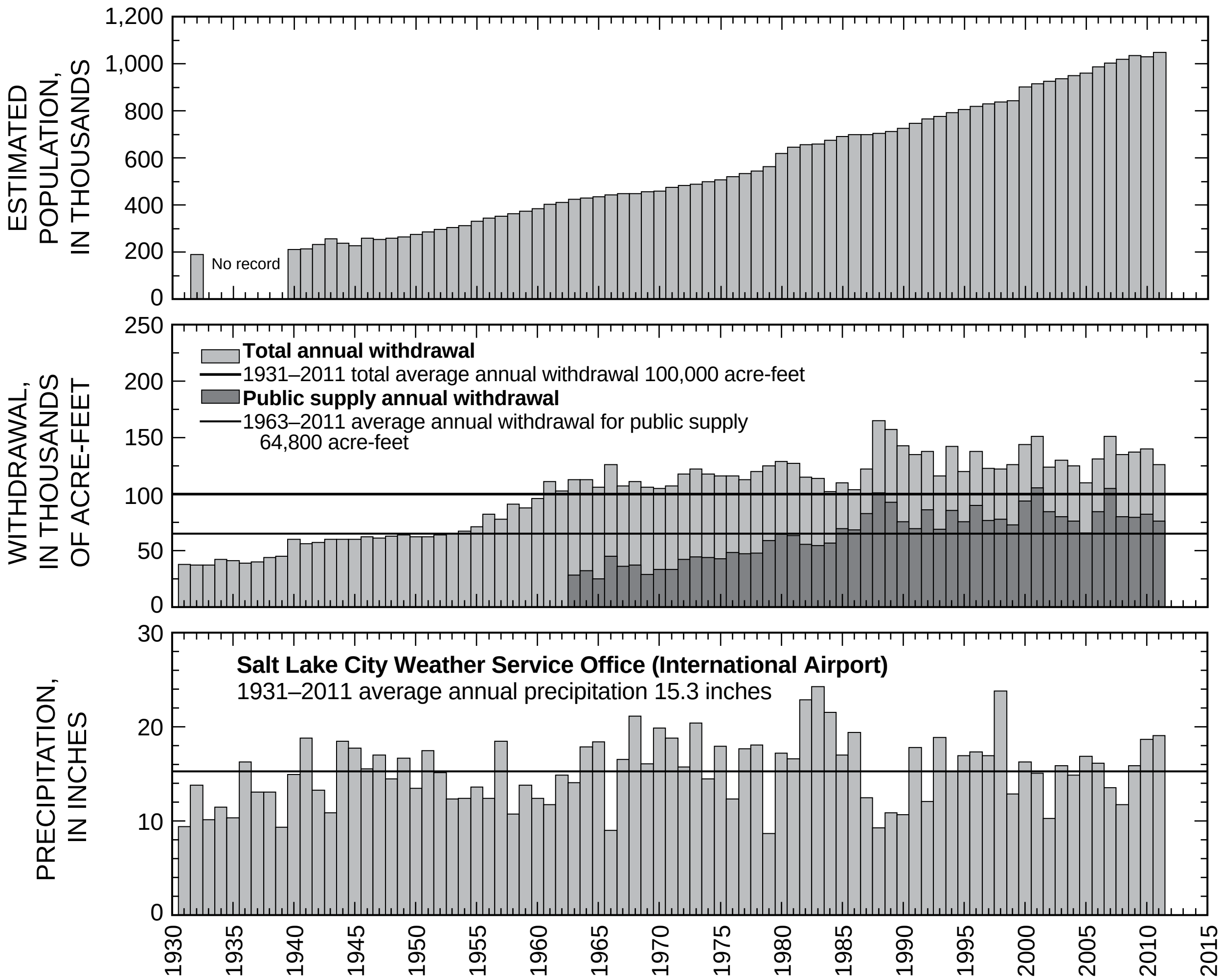


Figure 9. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

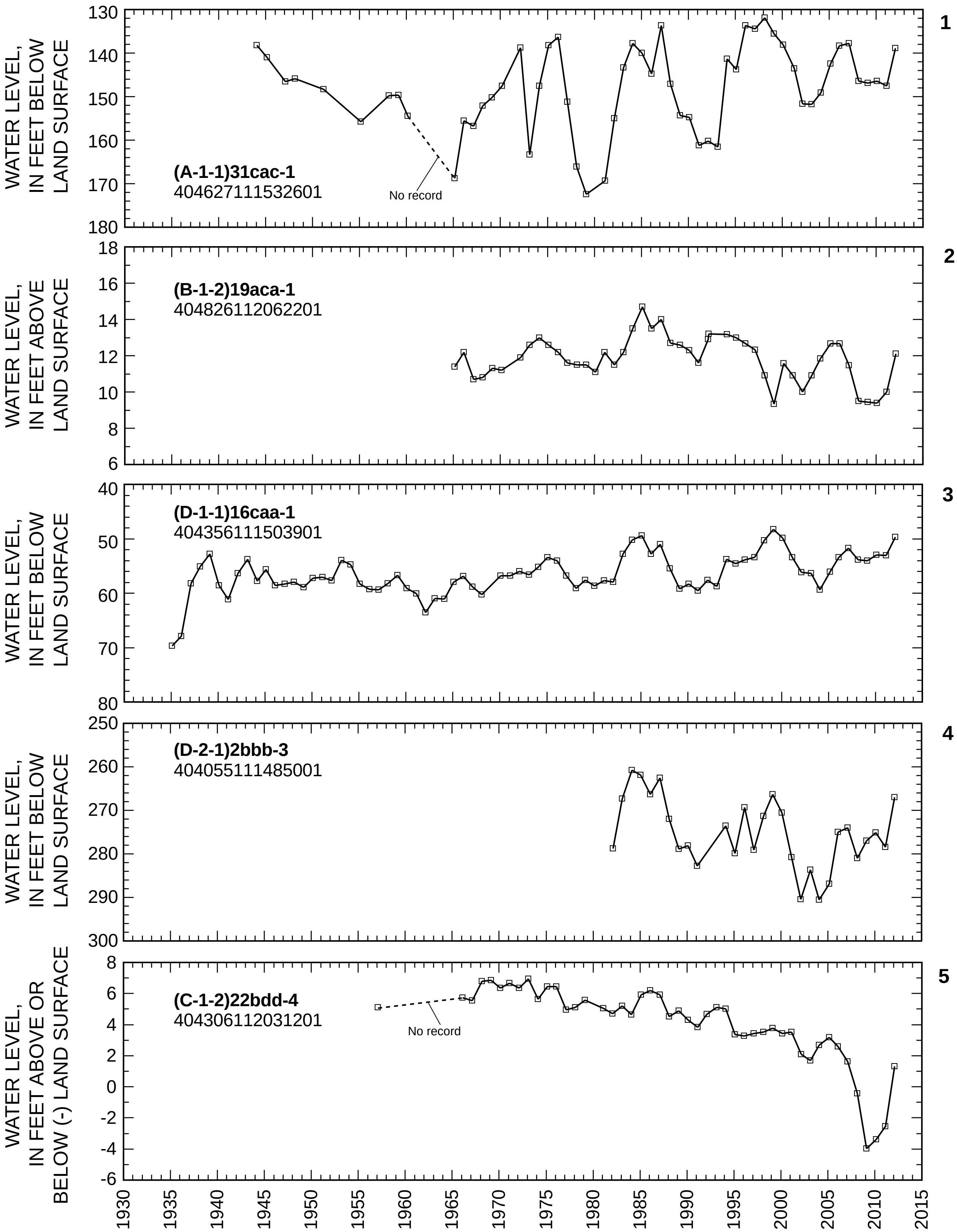


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

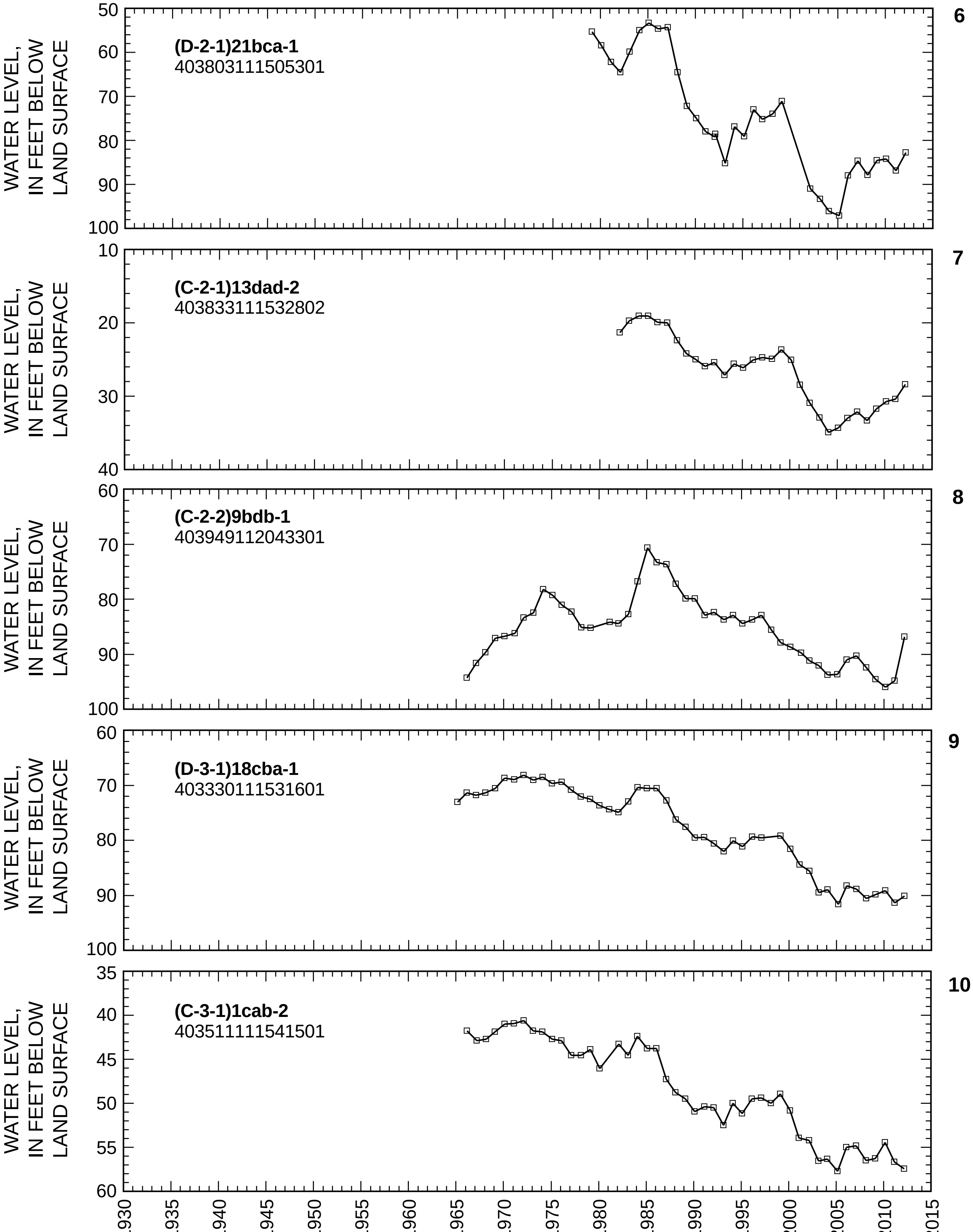


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

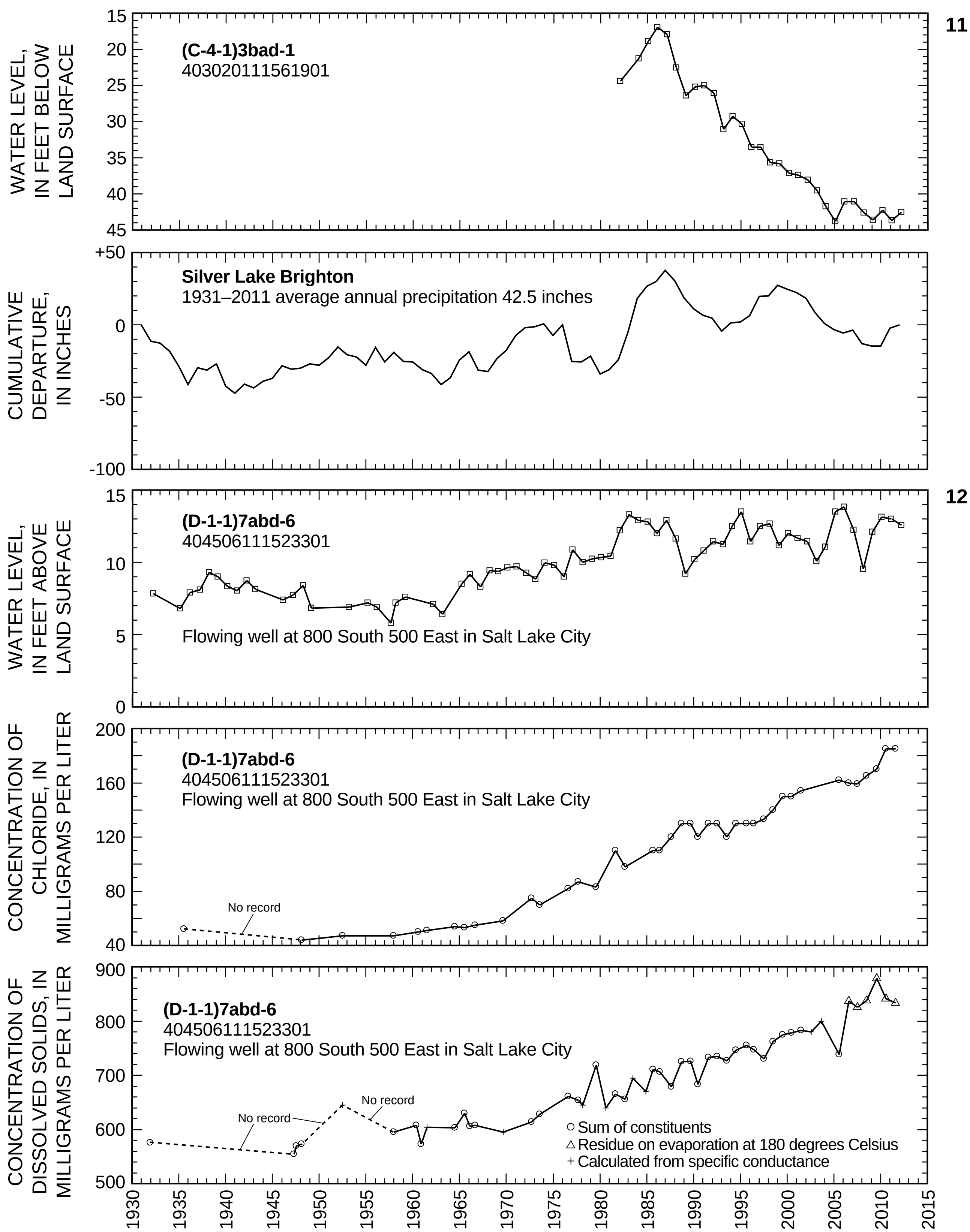


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

Tooele Valley

By Paul Downhour

Tooele Valley lies between the Stansbury and Oquirrh Mountains and extends south from Great Salt Lake to South Mountain. The total area of the valley is about 250 square miles within Tooele County (fig. 11). Groundwater occurs in the bedrock and unconsolidated basin-fill deposits in Tooele Valley under both water-table and artesian conditions, but most of the water withdrawn by wells is from artesian aquifers in the unconsolidated deposits.

Total estimated withdrawal of water from wells in Tooele Valley in 2011 was about 21,000 acre-feet, which is about 3,000 acre-feet less than the total for 2010 and 2,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3). Withdrawal for irrigation was about 11,100 acre-feet, which is 500 acre-feet less than the total for 2010. Withdrawal for public supply was about 7,400 acre-feet, which is 2,600 acre-feet less than in 2010. Withdrawal for industrial use was about 1,100 acre-feet, which is 100 acre-feet less than in 2010.

The location of wells in Tooele Valley in which the water level was measured during March 2012 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 2011 was about 19.9 inches, which is about 2.4 inches less than in 2010 and about 2.0 inches more than the average annual precipitation for 1936–2011.

Water levels rose from March 2011 to March 2012 in most of the wells measured in Tooele Valley. The largest rise, more than 34 feet, occurred in a well several miles east of Tooele near the base of the Oquirrh Mountains. However, most of the observed rises were less than 5 feet. Rises were probably the result of decreased withdrawals for public-supply use and greater-than-average precipitation.

The concentration of dissolved solids in water samples collected from well (C-2-4)33bdd-1, located at Erda, from 1977 to 2011, is shown in figure 12. The concentration has ranged from 456 to 604 mg/L with a median value of 504 mg/L. The maximum value was measured in the water sample collected in August 2011. The dissolved-solids concentration has generally increased since 1977.

Physical properties and results of chemical analyses for water from five wells in Tooele Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The dissolved-solids concentration in water samples from all five wells exceeded the secondary drinking-water standards for this constituent (500 mg/L), and water from one well, (C-3-5)11bad-1, also exceeded the MCL (2,000 mg/L). Water from well (C-3-5)11bad-1 exceeded the secondary drinking-water standard for iron (300 µg/L). The concentration of chloride in water samples from four wells, (C-2-4)28cbc-2, (C-2-5)33dcd-1, (C-2-5)35add-1, and (C-3-5)11bad-1, exceeded the secondary drinking-water standard for this constituent (250 mg/L).

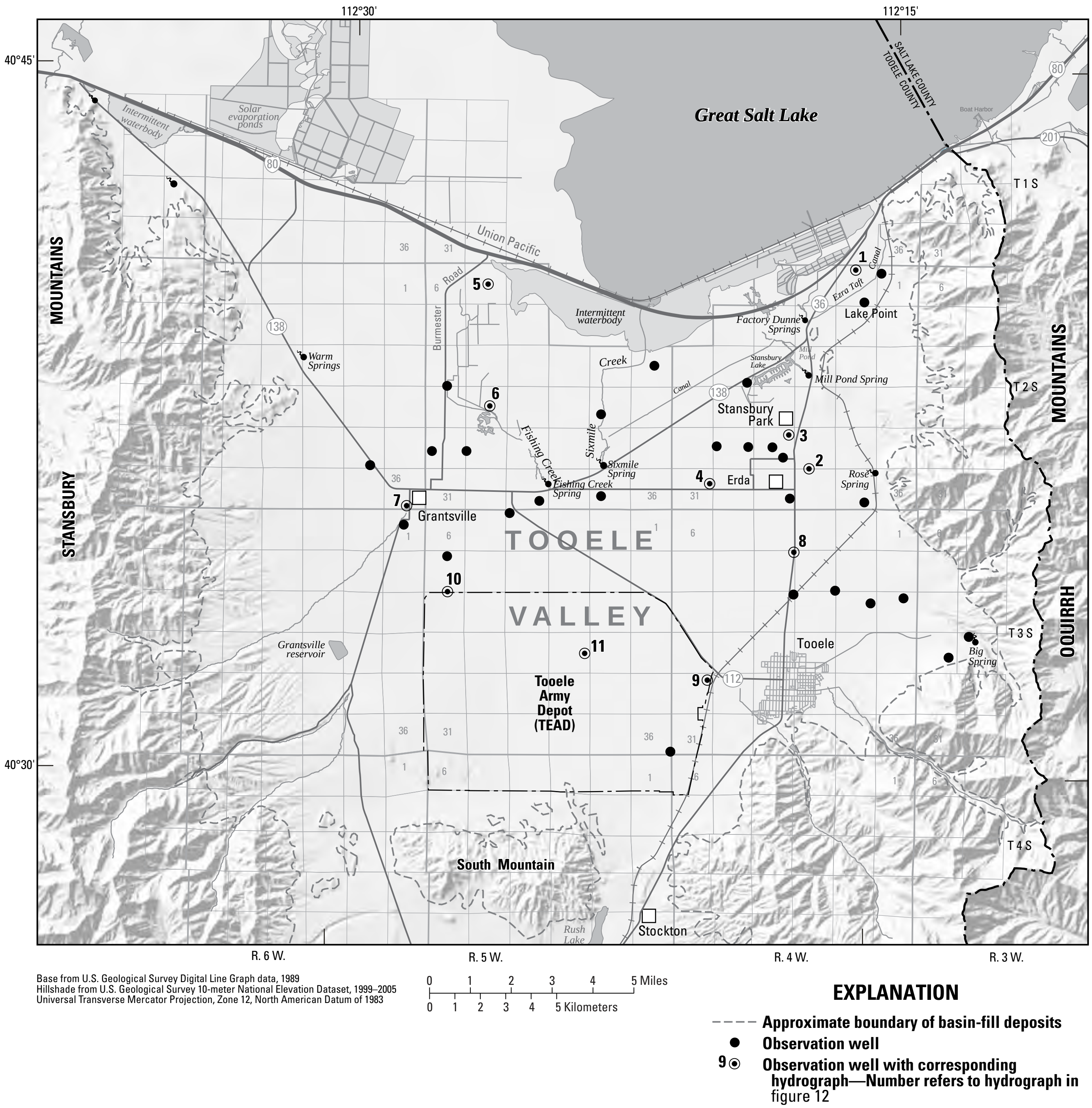


Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 2012.

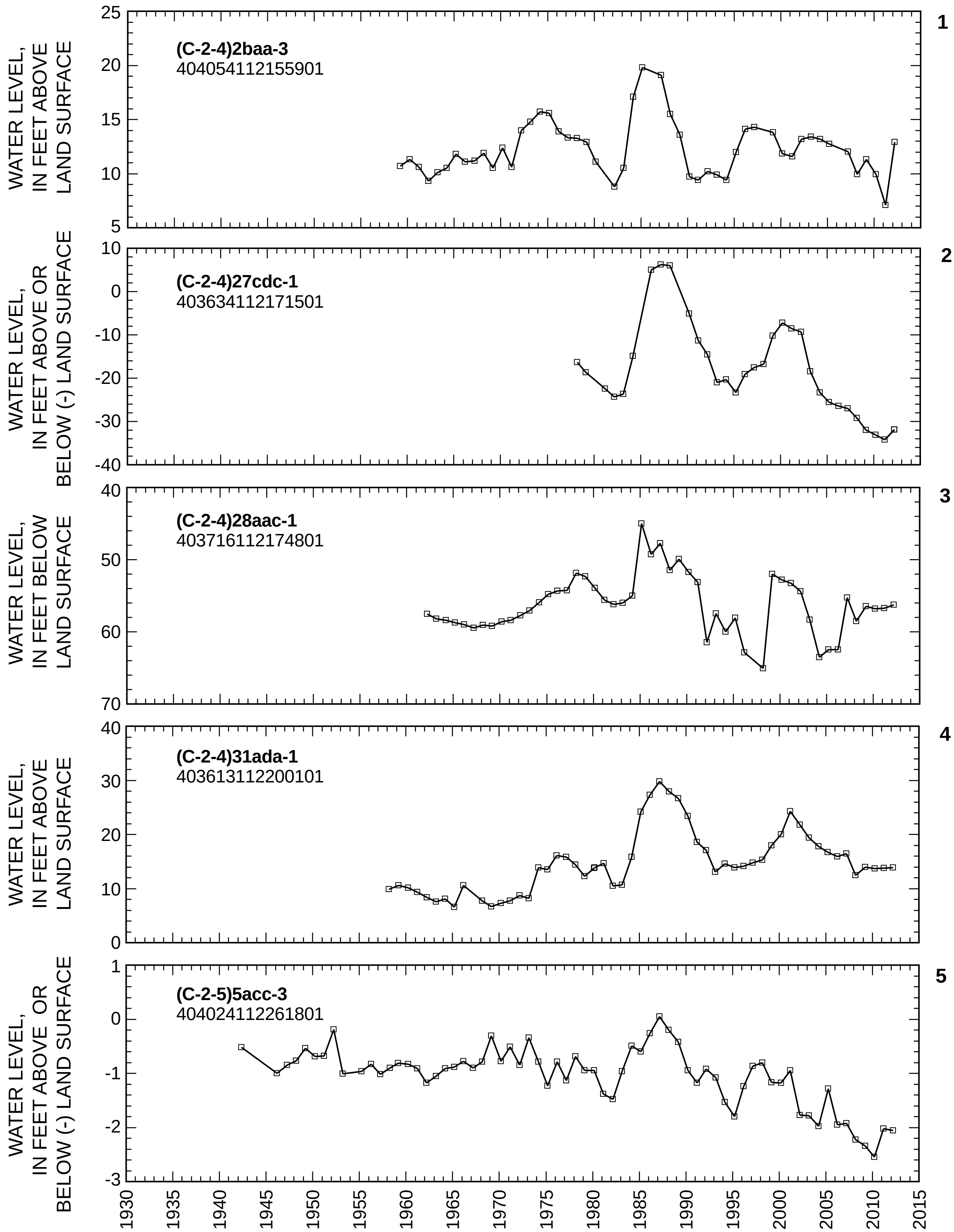


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.

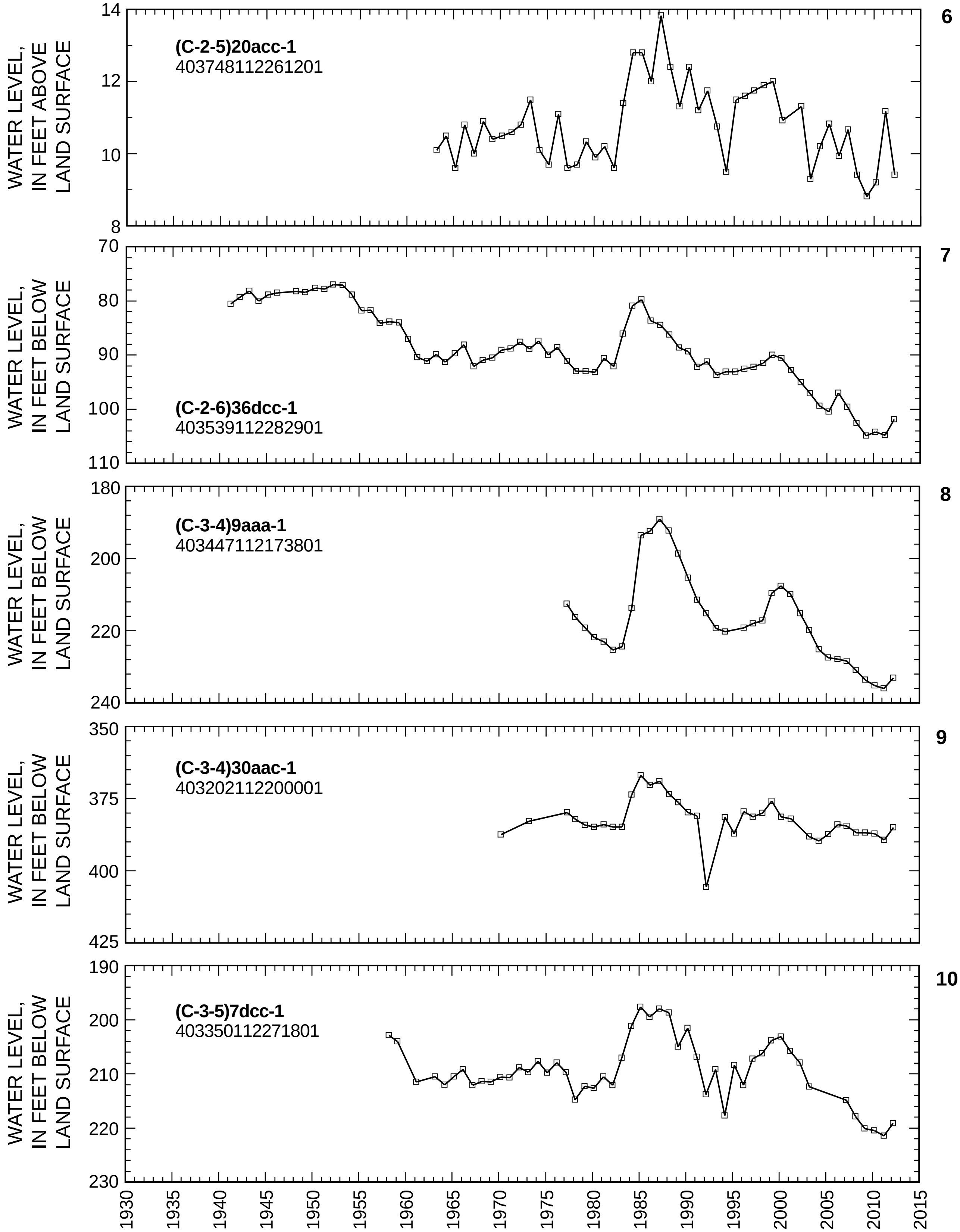


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

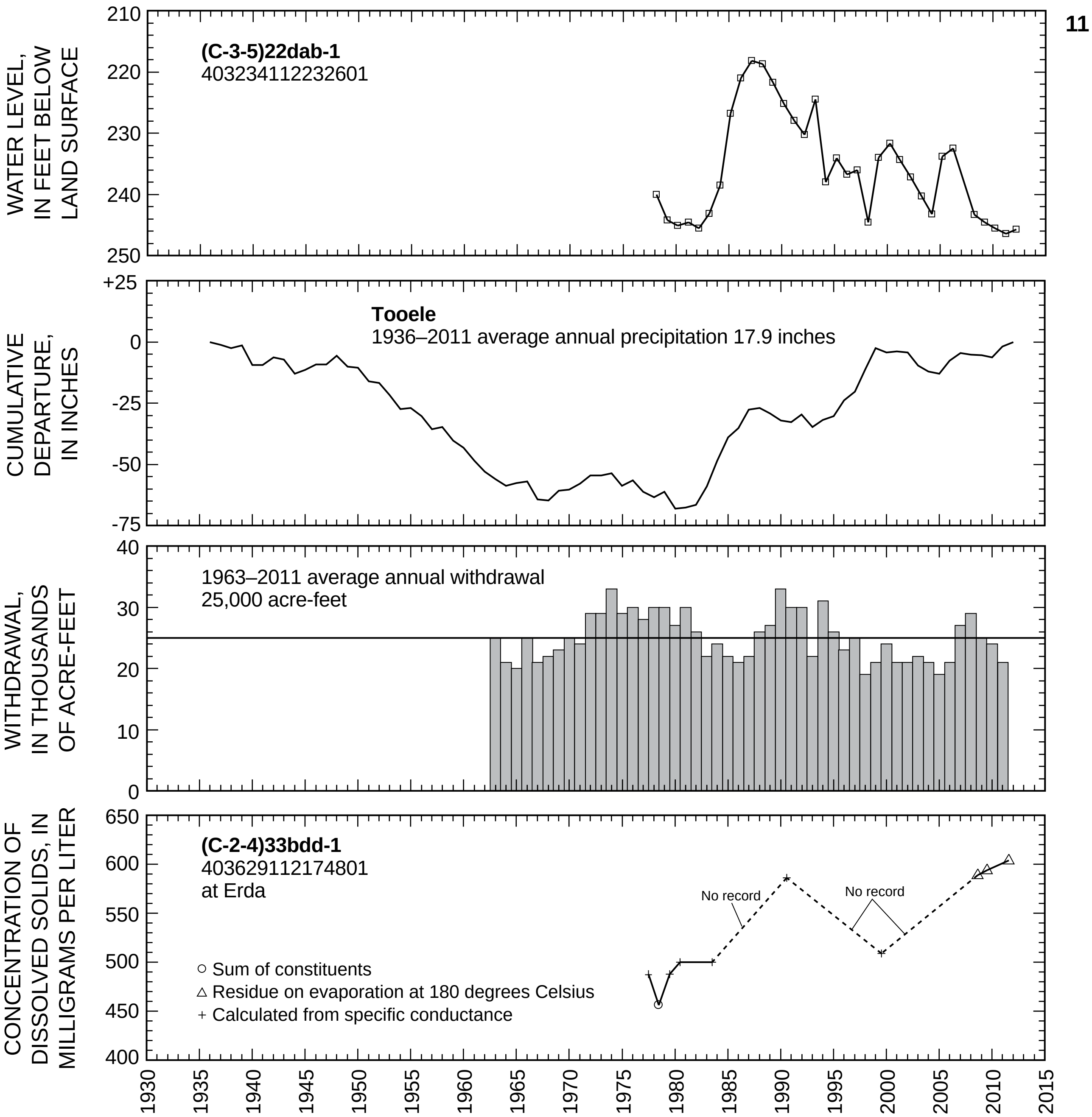


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

Utah and Goshen Valleys

By Lincoln Smith

Utah Valley, in Utah County, is divided into two groundwater basins, northern and southern, which are separated by Provo Bay in northern Utah Valley (fig. 13). Groundwater occurs in unconsolidated basin-fill deposits in the valley. The principal groundwater recharge area for the basin-fill deposits is in the eastern part of the valley, along the base of the Wasatch Range.

Utah Valley is bounded by the Wasatch Range, West Mountain, and the northern extension of Long Ridge. Goshen Valley is bounded by West Mountain, Long Ridge, the Lake Mountains, and the East Tintic Mountains (fig. 13). Groundwater in Utah and Goshen Valleys occurs in the basin-fill deposits under both water-table and artesian conditions, but most wells discharge from artesian aquifers.

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 2011 was about 94,000 acre-feet, which is 12,000 acre-feet less than the revised value for 2010, and 14,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3). Withdrawal in northern Utah Valley was about 49,500 acre-feet, which is 8,600 acre-feet less than the revised value for 2010. Withdrawal in southern Utah Valley was about 28,100 acre-feet, which is 2,800 acre-feet less than in 2010. Withdrawal in Goshen Valley was about 16,900 acre-feet, which is 300 acre-feet less than in 2010. The decrease in total pumpage from all three valleys was mainly due to decreased withdrawals for public supply use.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2012 is shown in figure 13. Water levels rose from March 2011 to March 2012 in most of the wells measured in Utah and Goshen Valleys. Rises were probably due to decreased pumpage because of greater-than-average precipitation and increased availability of surface water. Water levels in all three parts of Utah Valley generally rose in the early 1980s. The rise corresponds to a period of greater-than-average precipitation and recharge from surface water. Water levels generally declined from 1985 to 1993 in Utah Valley and generally rose from 1993 to 1998. This rise is the result of greater-than-average precipitation during this period. Water levels generally declined throughout Utah Valley from March 1999 to March 2005. Water levels in some wells reached their lowest level for their period of record, many dating back to 1935. From March 2005 to March 2007, most water levels in Utah and Goshen Valleys rose as a result of average to greater-than-average precipitation in 2005 and 2006 following 6 years of less-than-average precipitation.

The relation of the water level in selected observation wells to cumulative departure from average 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, and to concentration of dissolved solids in water from three wells is shown in figure 14. Discharge of Spanish Fork at Castilla in 2011 was about 287,500 acre-feet, which is 117,000 acre-feet more than the 1933–2011 annual average. Precipitation at Silver Lake Brighton in 2011 was about 44.7 inches, which is about 2.2 inches more than the long-term average (1931–2011) and about 10.2 inches less than in 2010. Precipitation at Spanish Fork Power House in 2011 was about 25.0 inches, which is about 5.7 inches more than the long-term average (1930–2011) and about 1.3 inches more than in 2010.

The concentration of dissolved solids in water samples collected from wells (C-9-1)28ccb-1, located 4 miles north of Elberta, (D-7-2)4cbb-2, located 2 miles west of Provo at mouth of Provo River, and (D-9-1)36bbc-1, located 1 mile north of Santaquin, is shown in figure 14. The concentration of dissolved solids in water from well (C-9-1)28ccb-1 has ranged from 498 to 1,540 mg/L with a median value of 705 mg/L. The concentration of dissolved solids in water from this well decreased 80 mg/L in August 2011 from the maximum value in July 2010. The dissolved-solids concentration in water from well (D-7-2)4cbb-2 has ranged from 278 to 539 mg/L with a median value of 320 mg/L. Water collected in 2011 had a dissolved-solids concentration of 313 mg/L, near the median value. The dissolved-solids concentration in water from well (D-9-1)36bbc-1 has ranged from 153 to 310 mg/L with a median value of 286 mg/L. This well was not sampled in 2011.

Physical properties and results of chemical analyses for water from eight wells in Utah Valley (includes northern and southern Utah Valleys) and Goshen Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. For Goshen Valley, the dissolved-solids concentrations in water samples from all three wells exceeded the secondary drinking-water standard (500 mg/L) and water from two wells, (C-9-1)3ddb-1 and (C-9-1)28ccb-1, exceeded the secondary standard for chloride concentration (250 mg/L). The concentration of nitrate plus nitrite in water from wells (C-9-1)28ccb-1 and (C-10-1)31cdd-1 exceeded the MCL for this constituent (10 mg/L). For southern Utah Valley, the water sample from well (D-8-2)31cdb-2 exceeded the secondary drinking-water standard for chloride (250 mg/L), and the MCL for dissolved-solids concentration (2,000 mg/L). Water from all three wells sampled in southern Utah Valley exceeded the secondary drinking-water standard for manganese (50 µg/L), and water from two wells, (C-7-2)4cbb-2 and (D-7-2)11caa-2, had concentrations of iron that exceeded the secondary standard (300 µg/L). Results of analyses of water sampled from the two wells in northern Utah Valley, (D-5-1)27aac-1 and (D-6-2)17aca-1, did not exceed secondary drinking-water standards or MCLs.

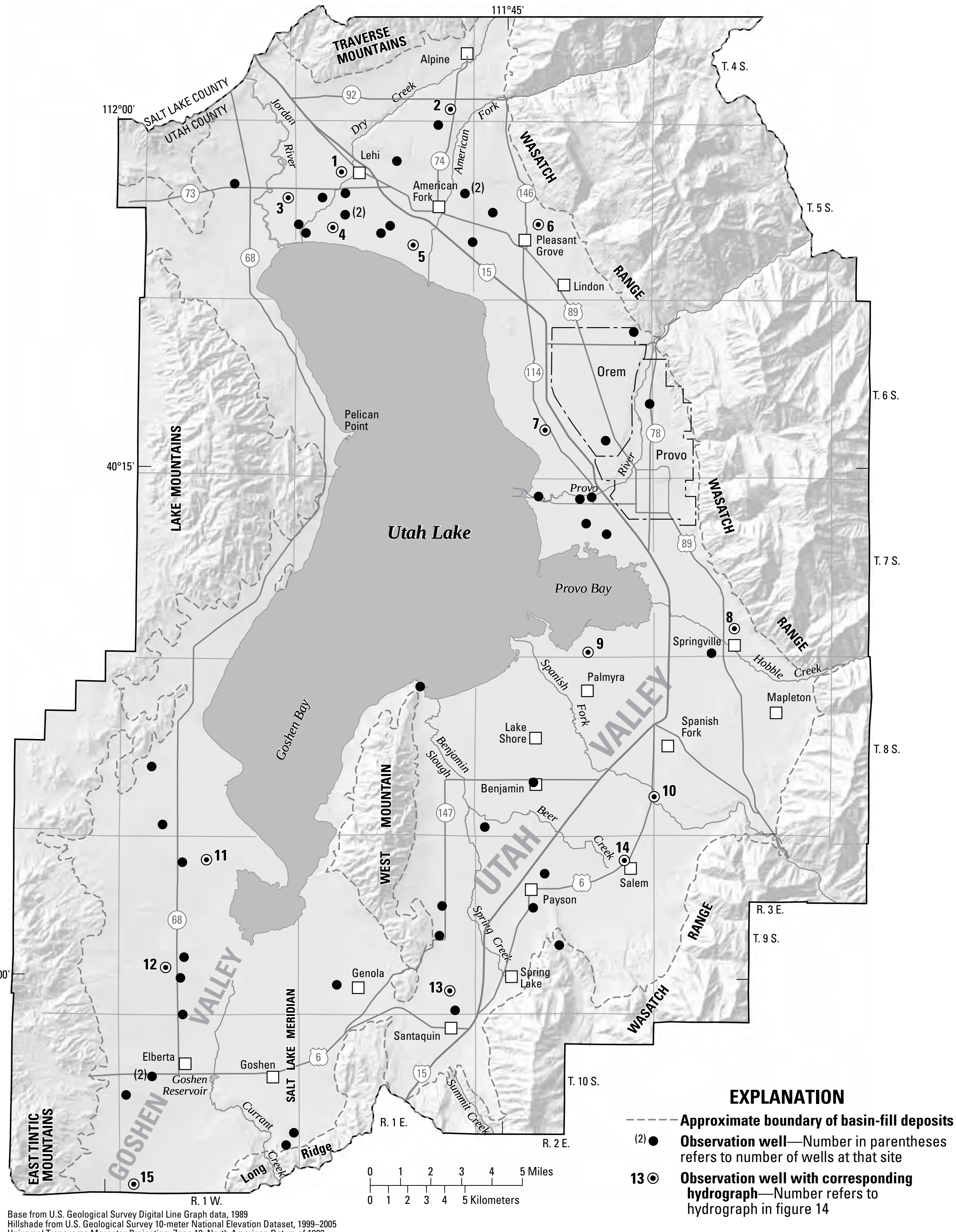


Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2012.

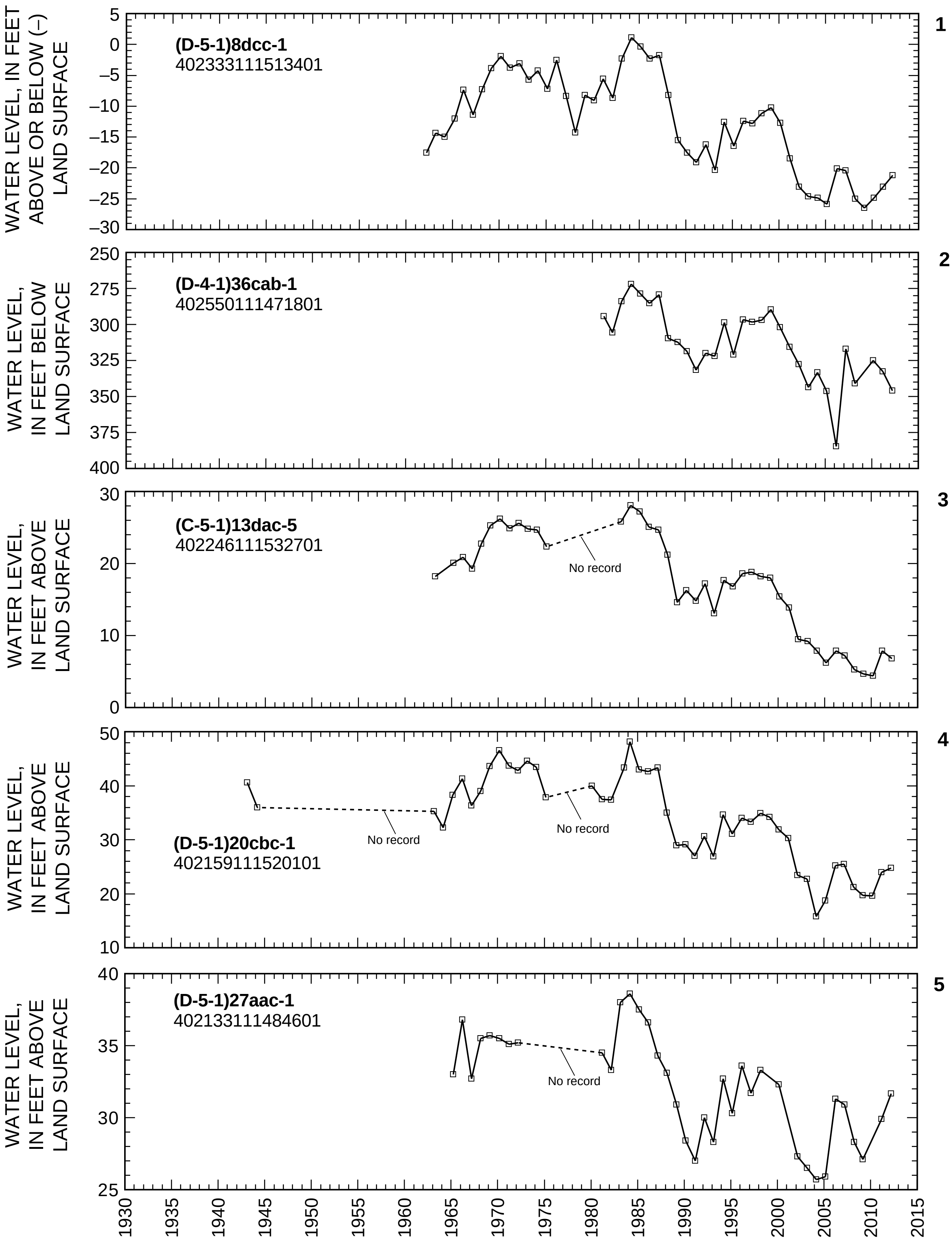


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

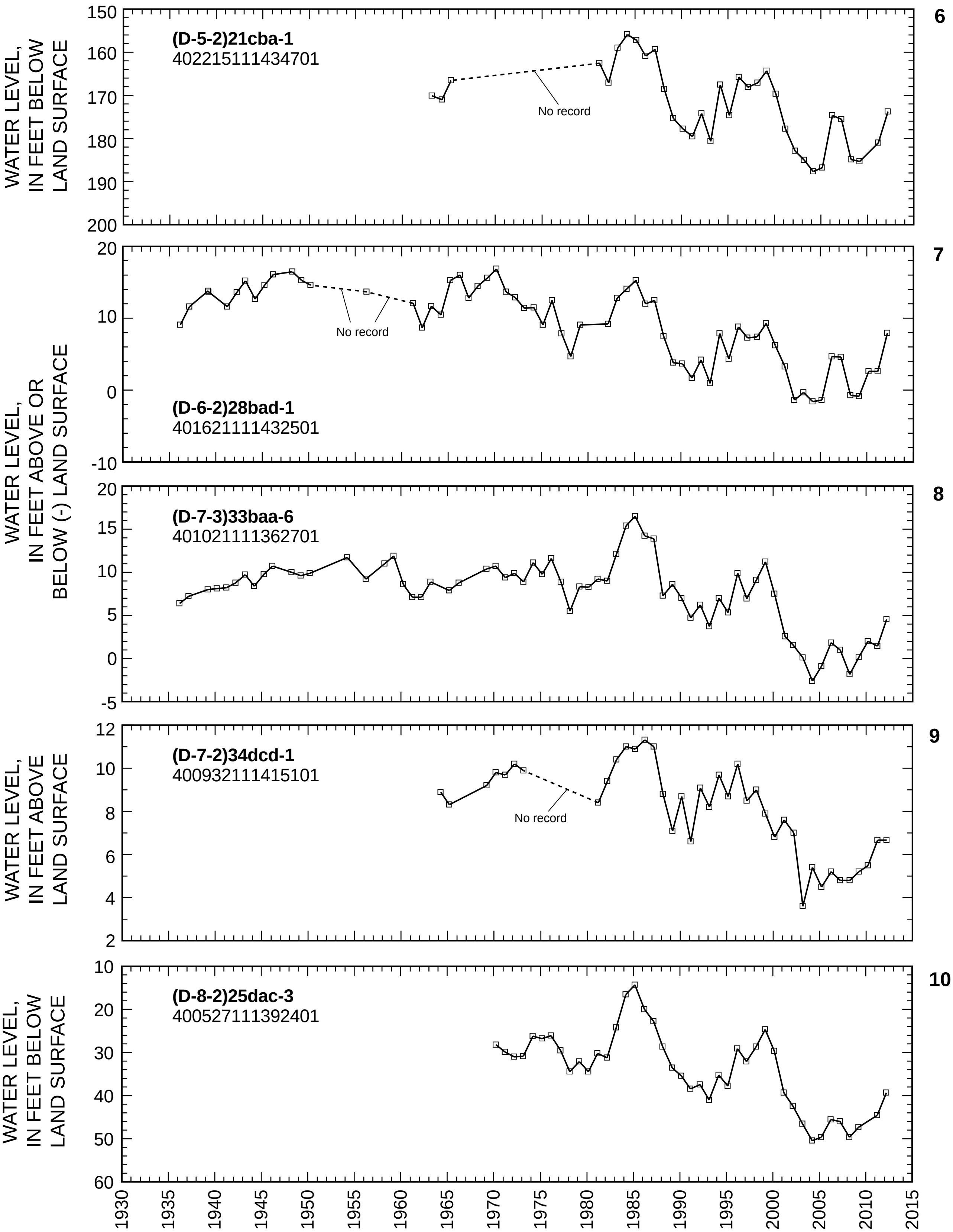


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

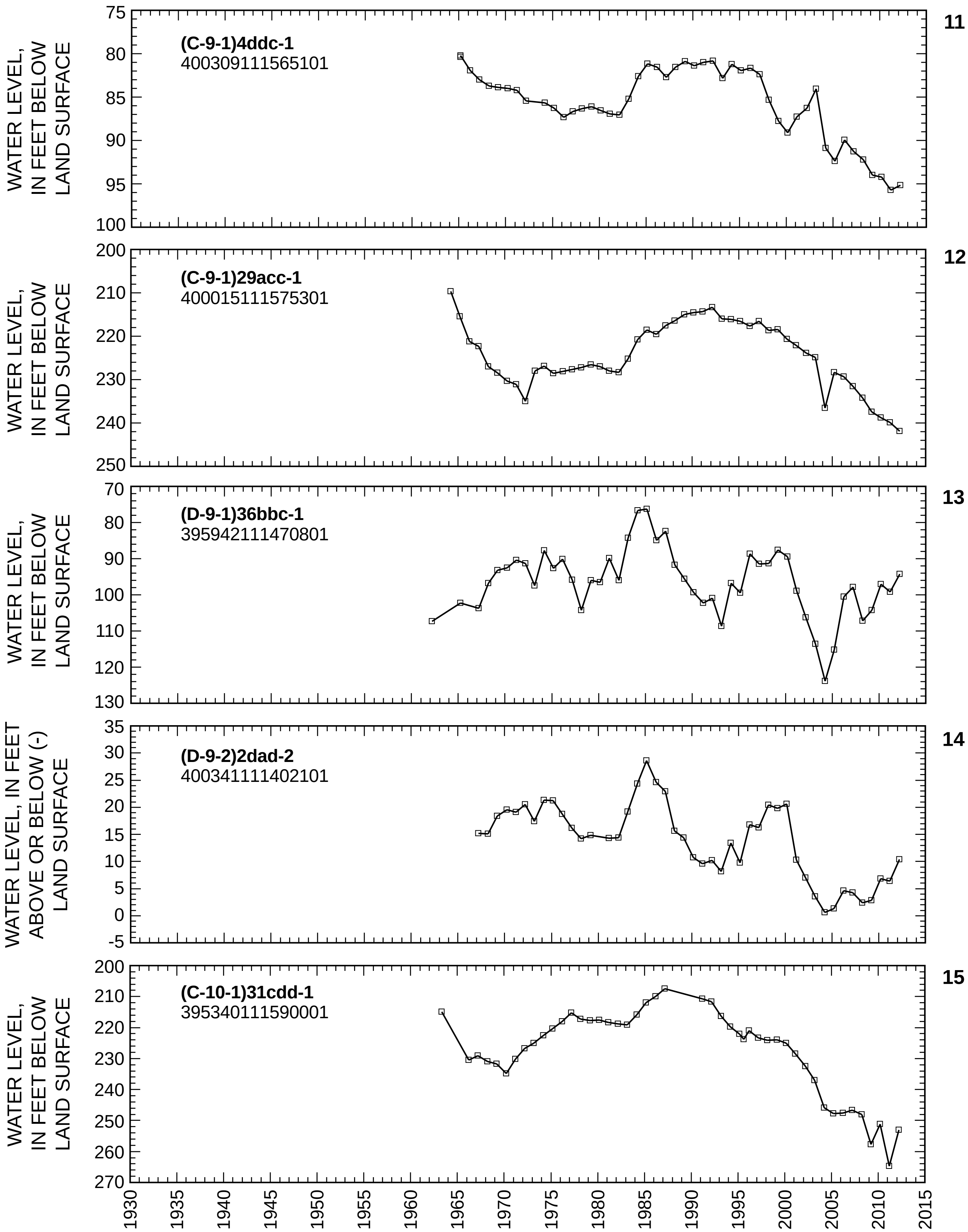


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

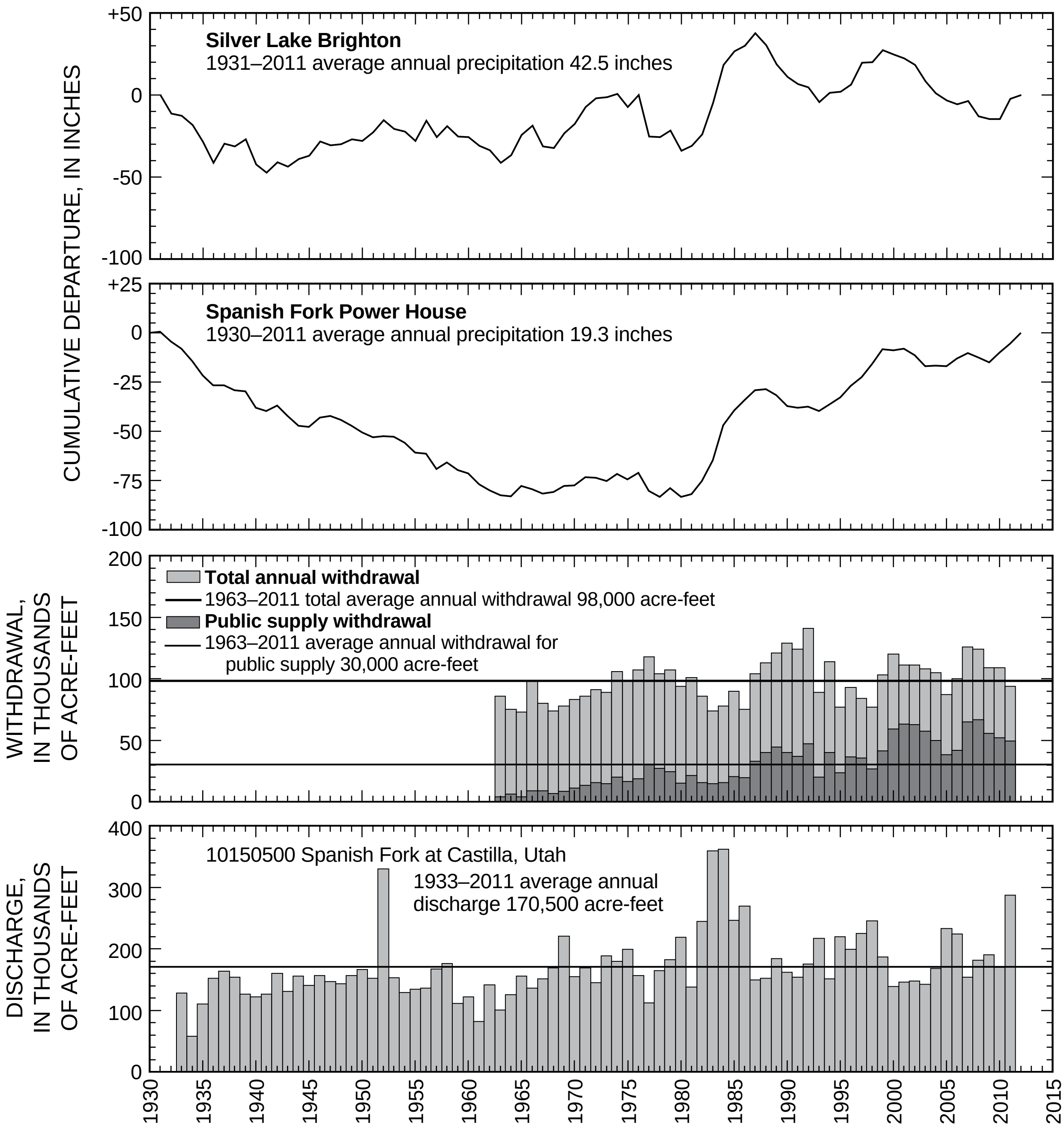


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

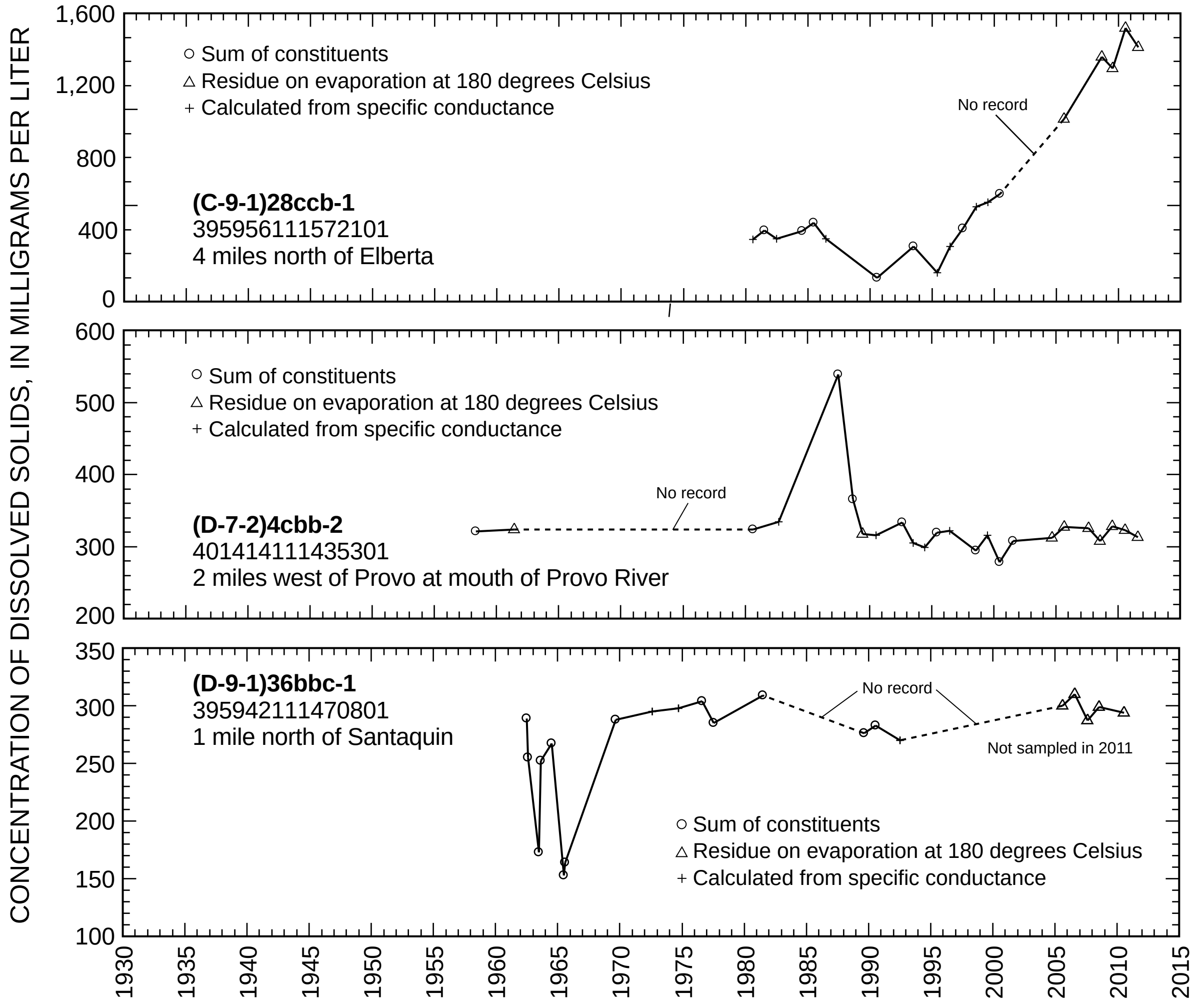


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

Juab Valley

By Robert J. Eacret

Juab Valley, in central Utah, is about 30 miles long and about 4 miles wide. It is bounded on the east side by the Wasatch Range and the San Pitch Mountains and on the west side by the West Hills and Long Ridge (fig. 15). Groundwater drains from the valley in two directions—in northern Juab Valley it drains north via Currant Creek into Utah Lake, and in southern Juab Valley it drains south via Chicken Creek into the Sevier River. The northern and southern parts of Juab Valley are separated topographically and hydrologically by Levan Ridge, a gentle rise near the midpoint of the valley floor.

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

Total estimated withdrawal of water from wells in Juab Valley in 2011 was about 15,000 acre-feet, which is 7,000 acre-feet less than the amount reported for 2010 and 9,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3).

The location of wells in Juab Valley in which the water level was measured during March 2012 is shown in figure 15. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Nephi and to annual withdrawal from wells, is shown in figure 16. Precipitation at Nephi during 2011 was about 12.4 inches, which is about 1.9 inches less than the average annual precipitation for 1935–2011, and about 2.7 inches less than in 2010.

Water levels rose in all of the wells measured in Juab Valley from March 2011 to March 2012, except in one well west of Levan in which the water level remained unchanged (fig. 16). Rises are probably the result of less withdrawal for irrigation. 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 2011, although there was a substantial rise from 1993 to 1999.

Physical properties and results of chemical analyses for water from three wells in Juab Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. Water samples from all three wells exceeded the secondary drinking-water standard for dissolved solids (500 mg/L). The water sample from well (D-13-1)5ddb-3 exceeded the secondary standard for chloride (250 mg/L), and water from wells (C-14-1)26dbd-1 and (C-15-1)1baa-1 exceeded the secondary standard for sulfate (250 mg/L).

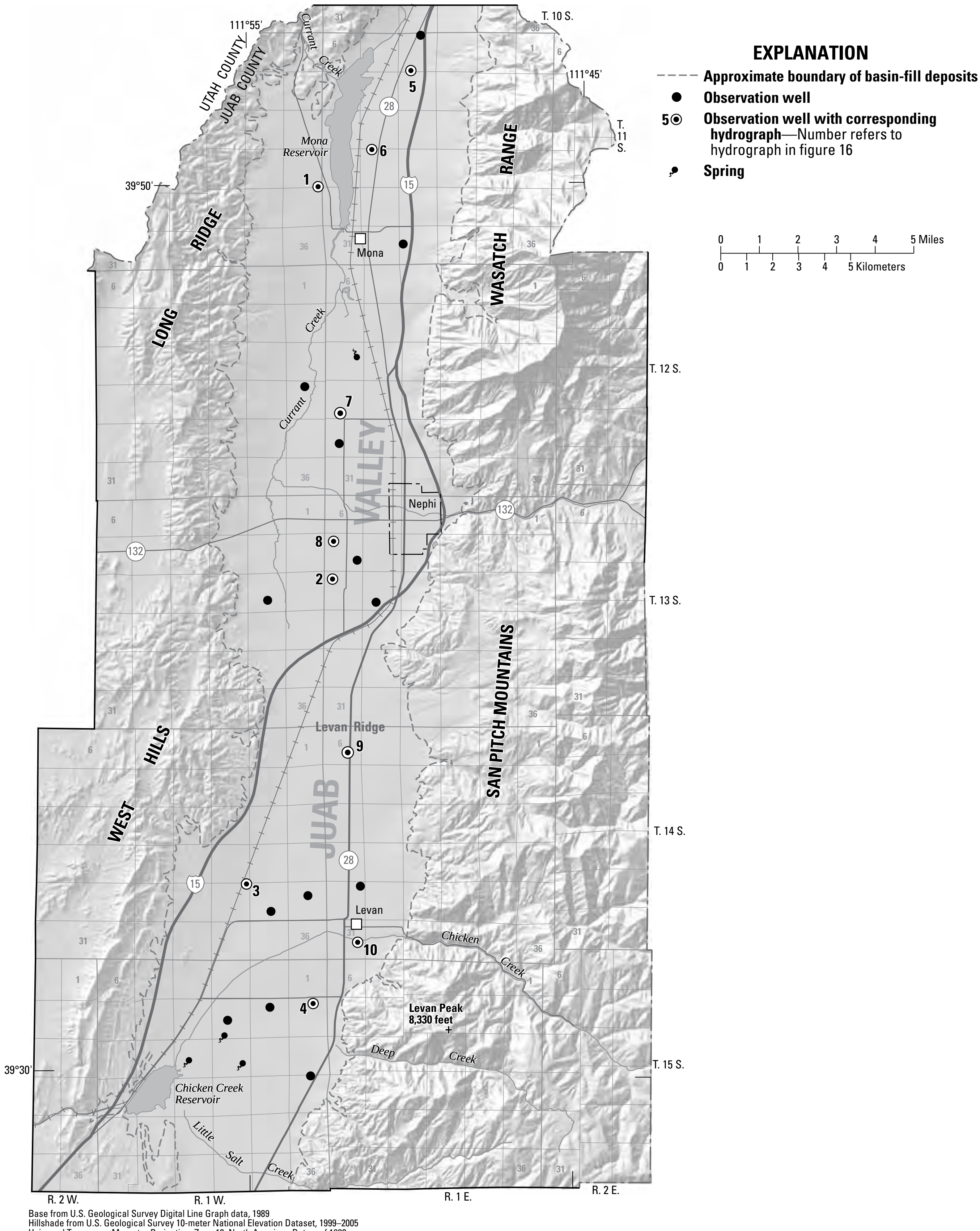


Figure 15. Location of wells in Juab Valley in which the water level was measured during March 2012.

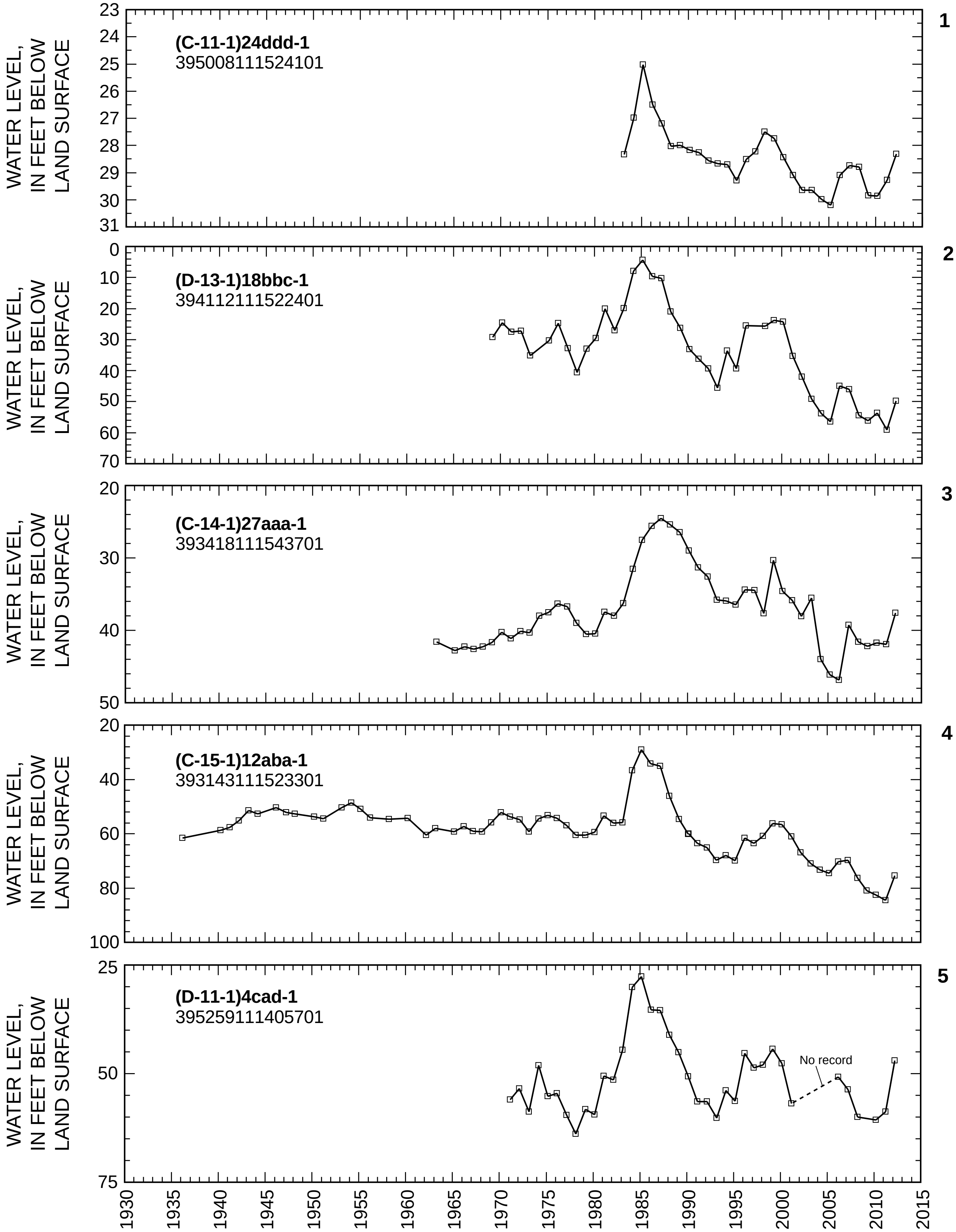


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi and to annual withdrawal from wells.

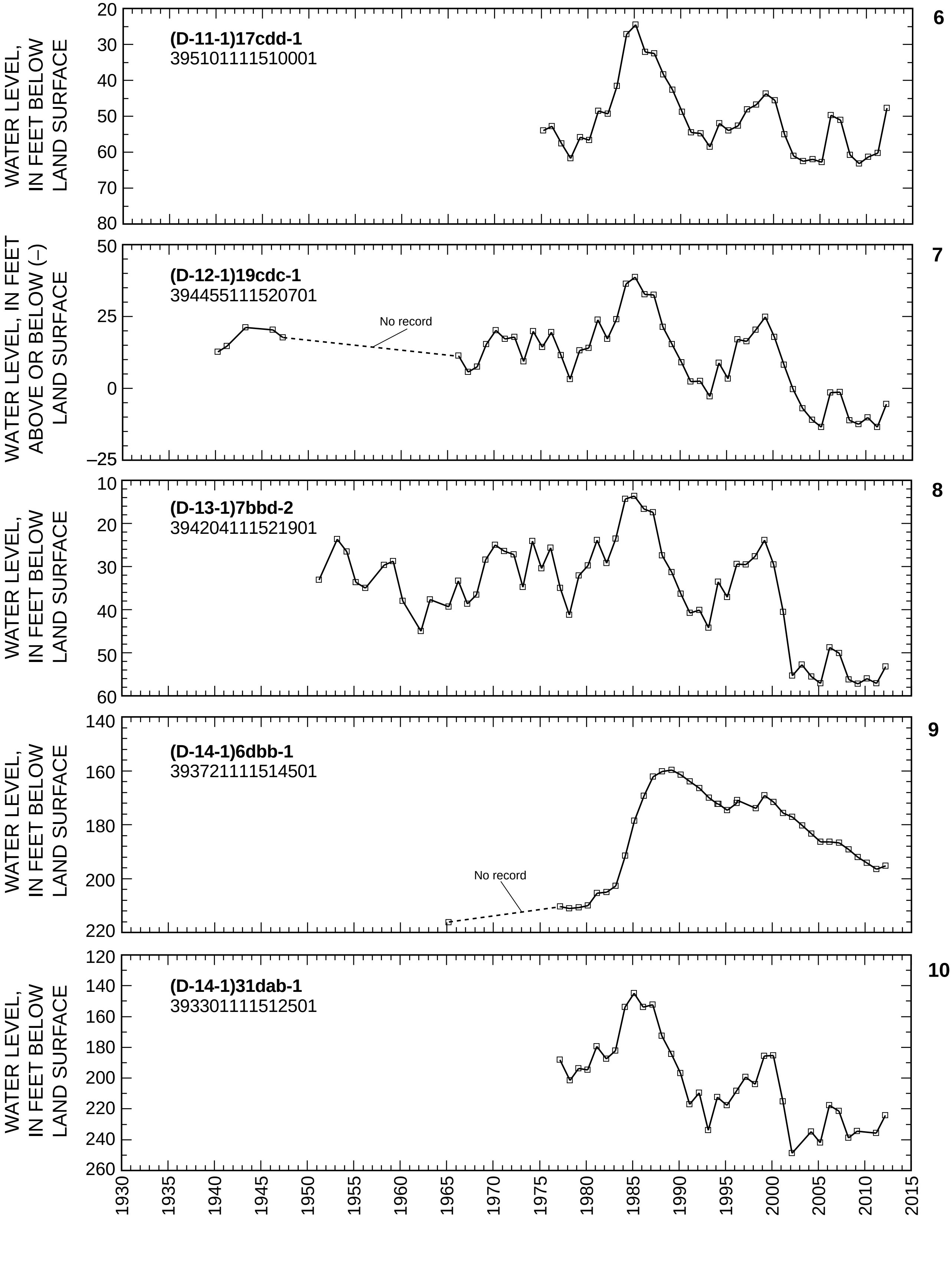


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi and to annual withdrawal from wells.—Continued

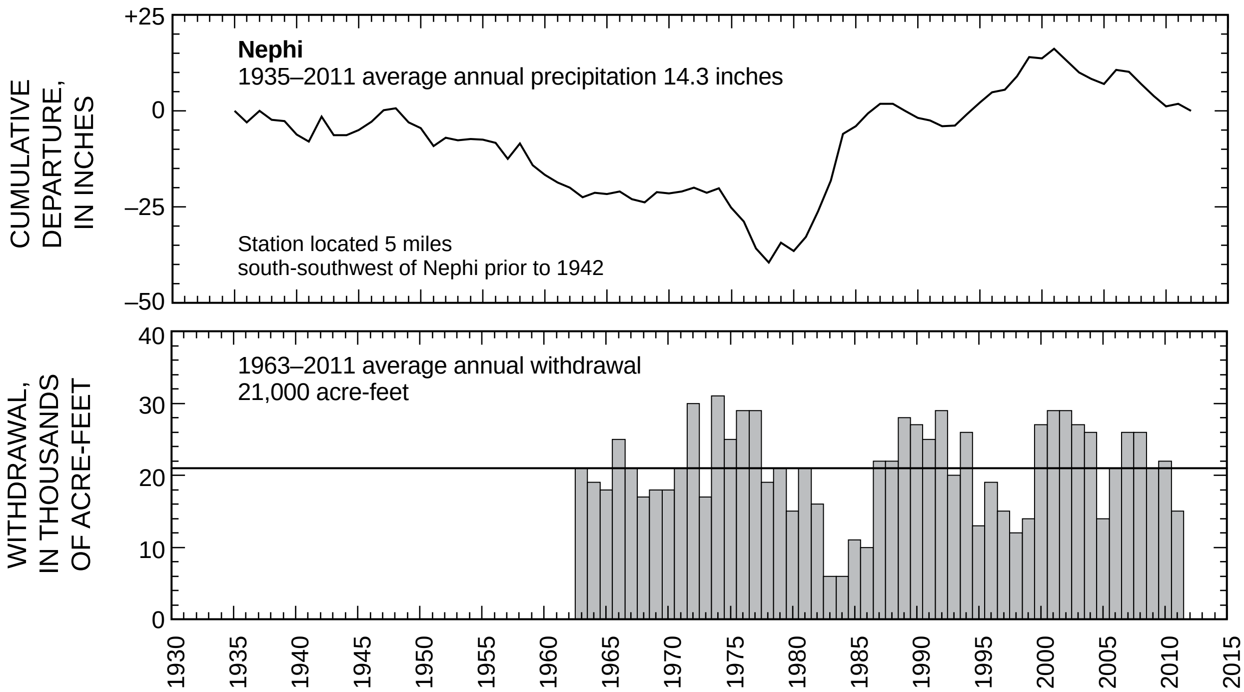


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi and to annual withdrawal from wells.—Continued

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 Mountains to the east, the Drum Mountains to the west, and several non-continuous mountains to the north. Groundwater occurs in the Sevier Desert in unconsolidated deposits under water-table and artesian conditions. Most of the groundwater is discharged from wells completed in either of two artesian aquifers—the shallow or deep artesian aquifer. The Sevier River enters the Sevier Desert from the east and is a source of recharge to the aquifers.

Total estimated withdrawal of water from wells in the Sevier Desert in 2011 was about 20,000 acre-feet, which is 26,000 acre-feet less than in 2010 and about 14,000 acre-feet less than the 2001–2010 average annual withdrawal (tables 2 and 3). The decrease in withdrawals was mainly due to less pumpage for irrigation, the result of increased availability of surface water from the Sevier River.

The location of wells in the Sevier Desert in which the water level was measured during March 2012 is shown in figures 17 and 18. The relation of the water level in selected observation wells to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1 is shown in figure 19.

Discharge of the Sevier River near Juab in 2011 was 386,900 acre-feet, 262,000 acre-feet more than in 2010 and 206,600 acre-feet more than the long-term average (1935–2011). Precipitation at Oak City was about 16.6 inches in 2011, about 3.6 inches more than the 1930–2011 average annual precipitation and about 2.0 inches less than in 2010.

Most water levels from March 2011 to March 2012 rose in both the shallow and deep artesian aquifers in the Sevier Desert, probably due to decreased withdrawals for irrigation and increased recharge to the artesian aquifers from greater-than-average precipitation and streamflow. Water levels in both the shallow and deep aquifers generally rose from 1980 to 1987, which corresponds to a period of greater-than-average precipitation and less-than-average withdrawal. Water levels in both aquifers began declining during 1987–90 and continued to decline until 1995. Levels generally rose or remained stable from about 1995 to 1999. Rises during this period probably resulted from decreased groundwater withdrawals because of increased precipitation and greater availability of surface water for irrigation. Water levels generally declined from March 2001 to March 2005, probably as a result of 4 years of less-than-average surface-water supplies and increased withdrawals from wells. Water levels measured in March 2006 and March 2007 generally rose in both aquifers, probably due to increased precipitation and availability of surface water. Water levels in the shallow and deep aquifers generally declined from March 2008 to March 2010, and have generally risen since March 2010.

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 2011, is shown in figure 19. The concentration has ranged from 1,490 to 2,340 mg/L, with a median value of 2,030 mg/L. The concentration of dissolved solids in the water sample collected in August 2011 was 2,250 mg/L.

Physical properties and results of chemical analyses for water from three wells in the Sevier Desert are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The dissolved-solids concentration in water samples from wells (C-15-4)8cba-1 and (C-15-5)15dad-1 exceeded the secondary drinking-water standard for this constituent (500 mg/L). Water from well (C-15-4)8cba-1 also exceeded the MCL for dissolved solids (2,000 mg/L), and the secondary standards for chloride (250 mg/L), sulfate (250 mg/L), and manganese (50 µg/L). Water from well (C-17-6)26dbb-1 exceeded the MCL for arsenic (10 µg/L).

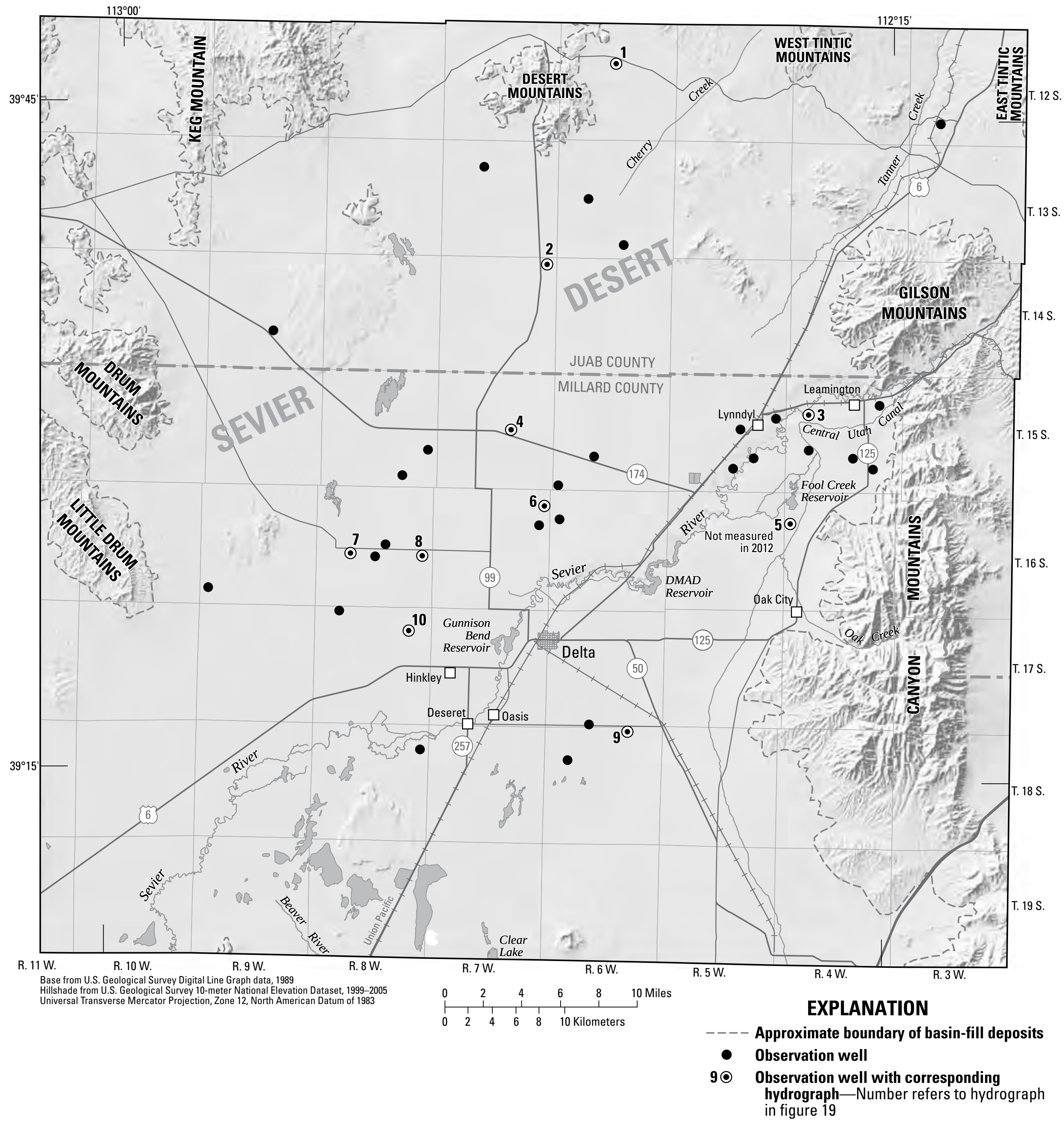


Figure 17. Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2012.

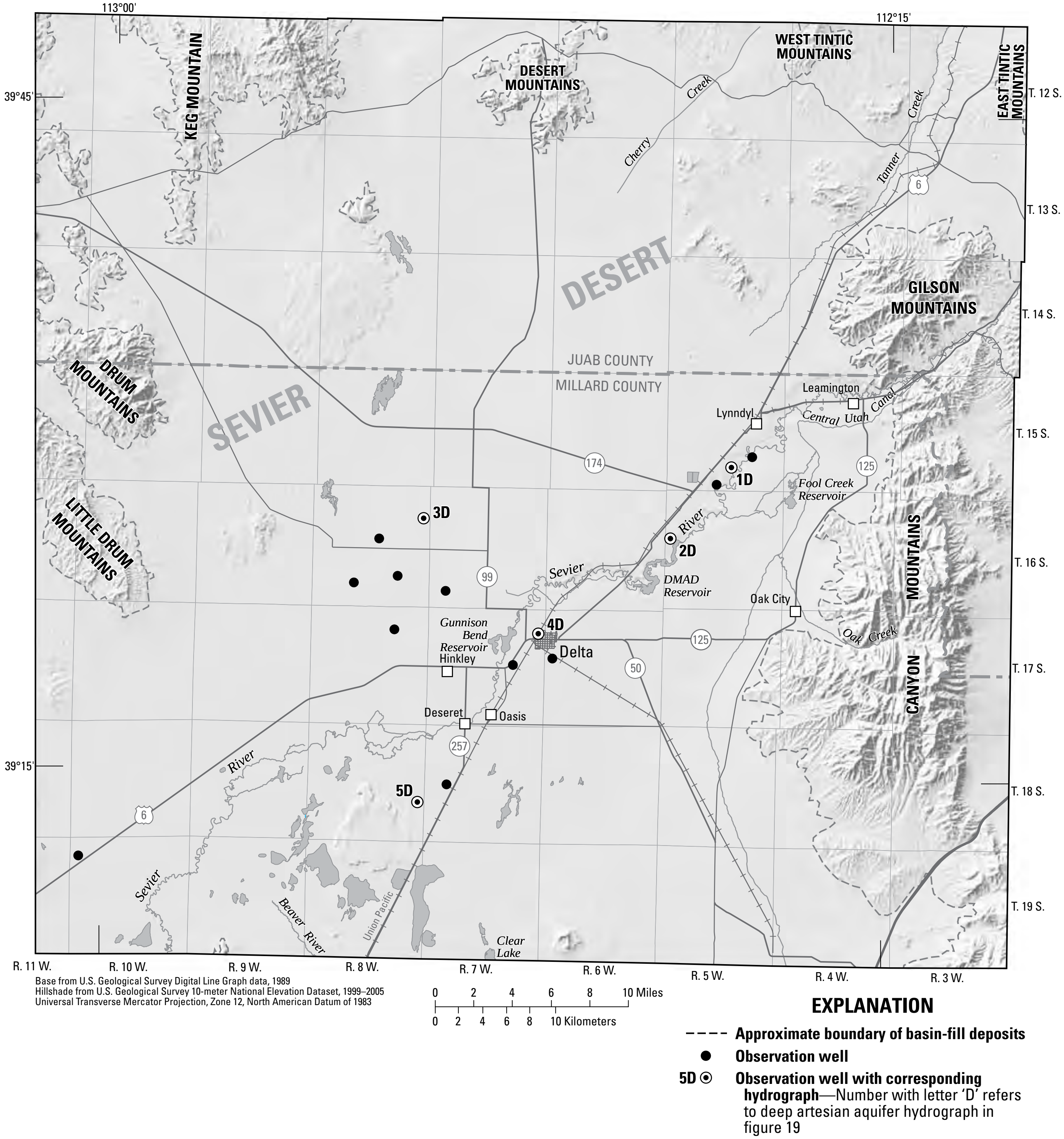


Figure 18. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2012.

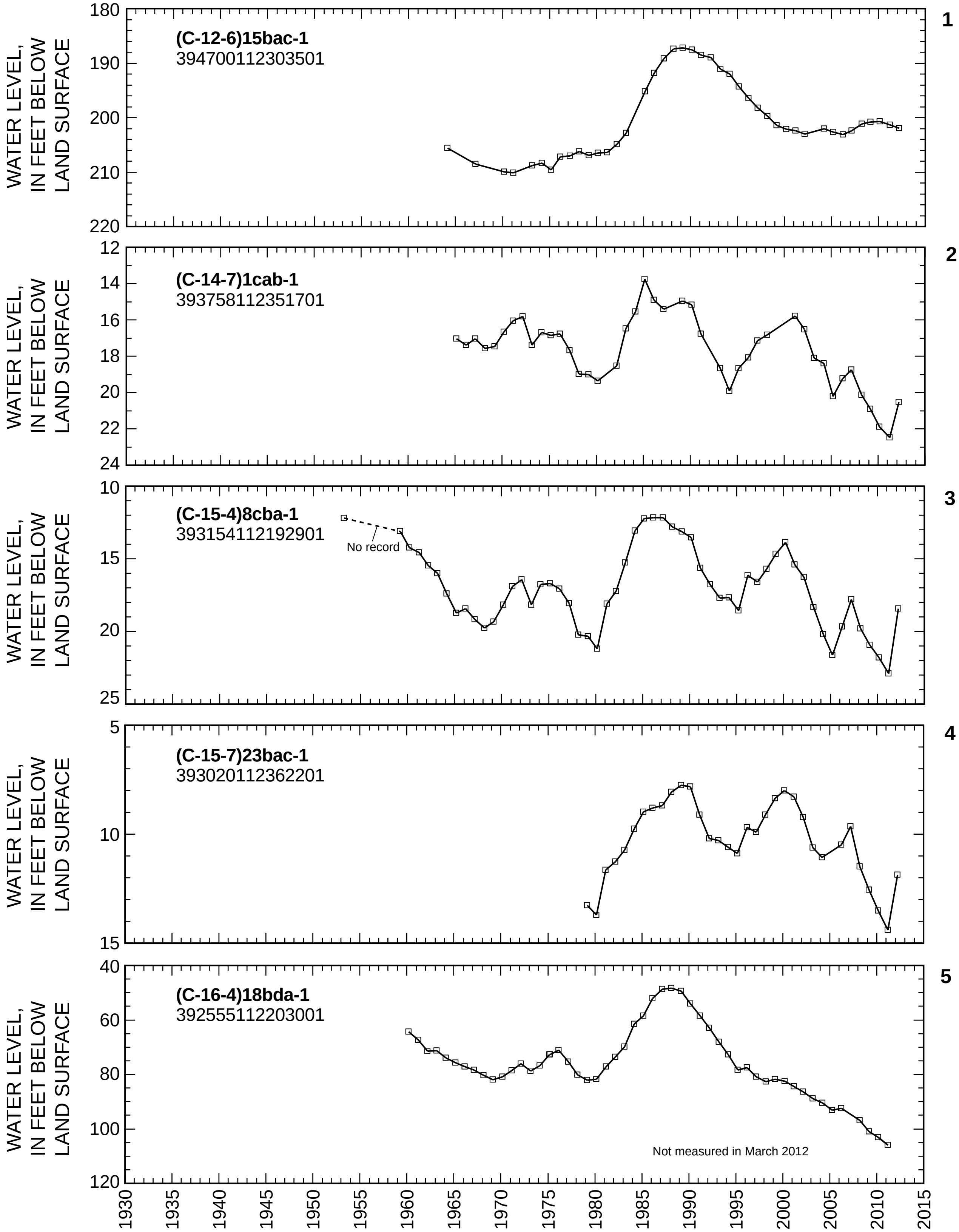


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.

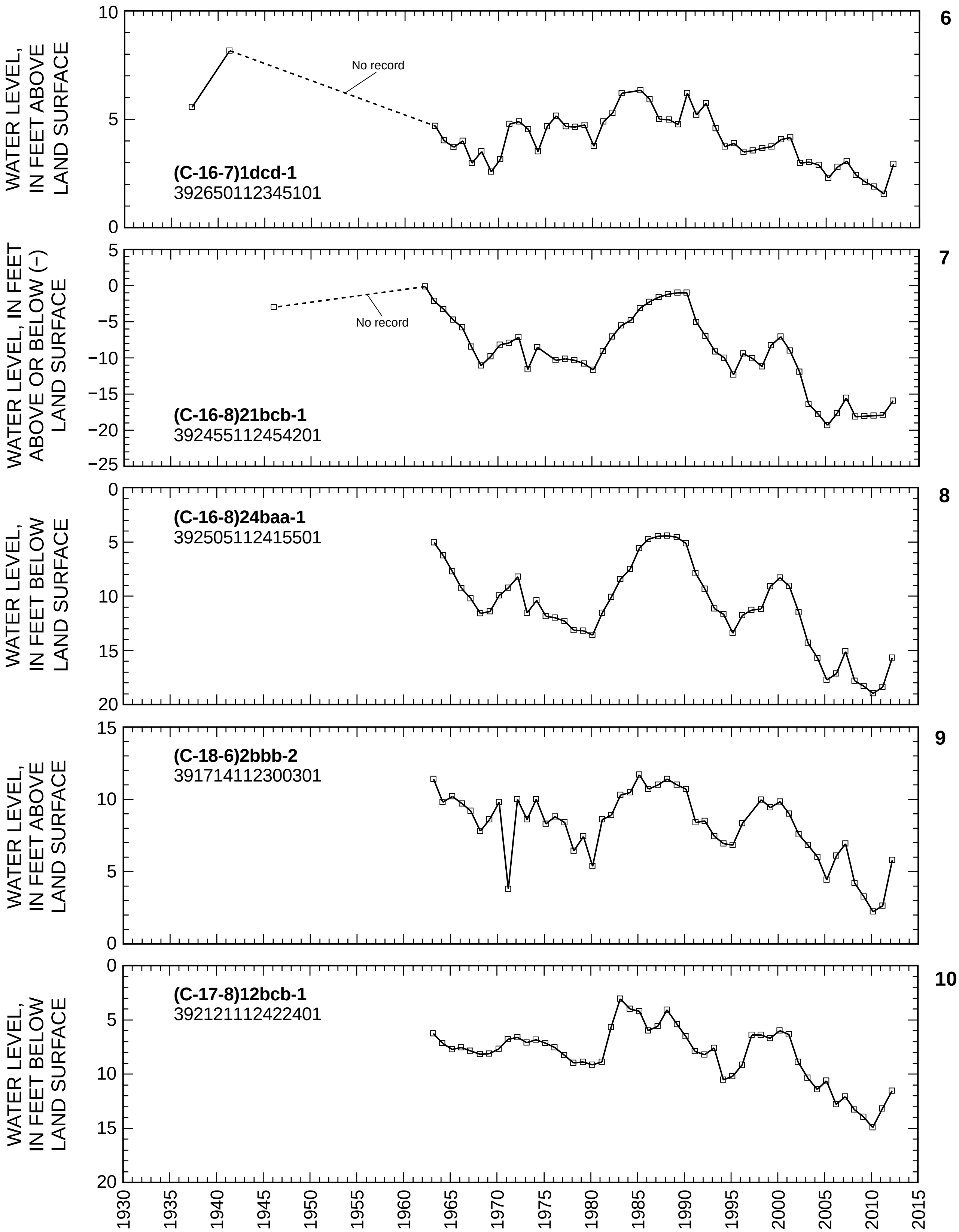


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

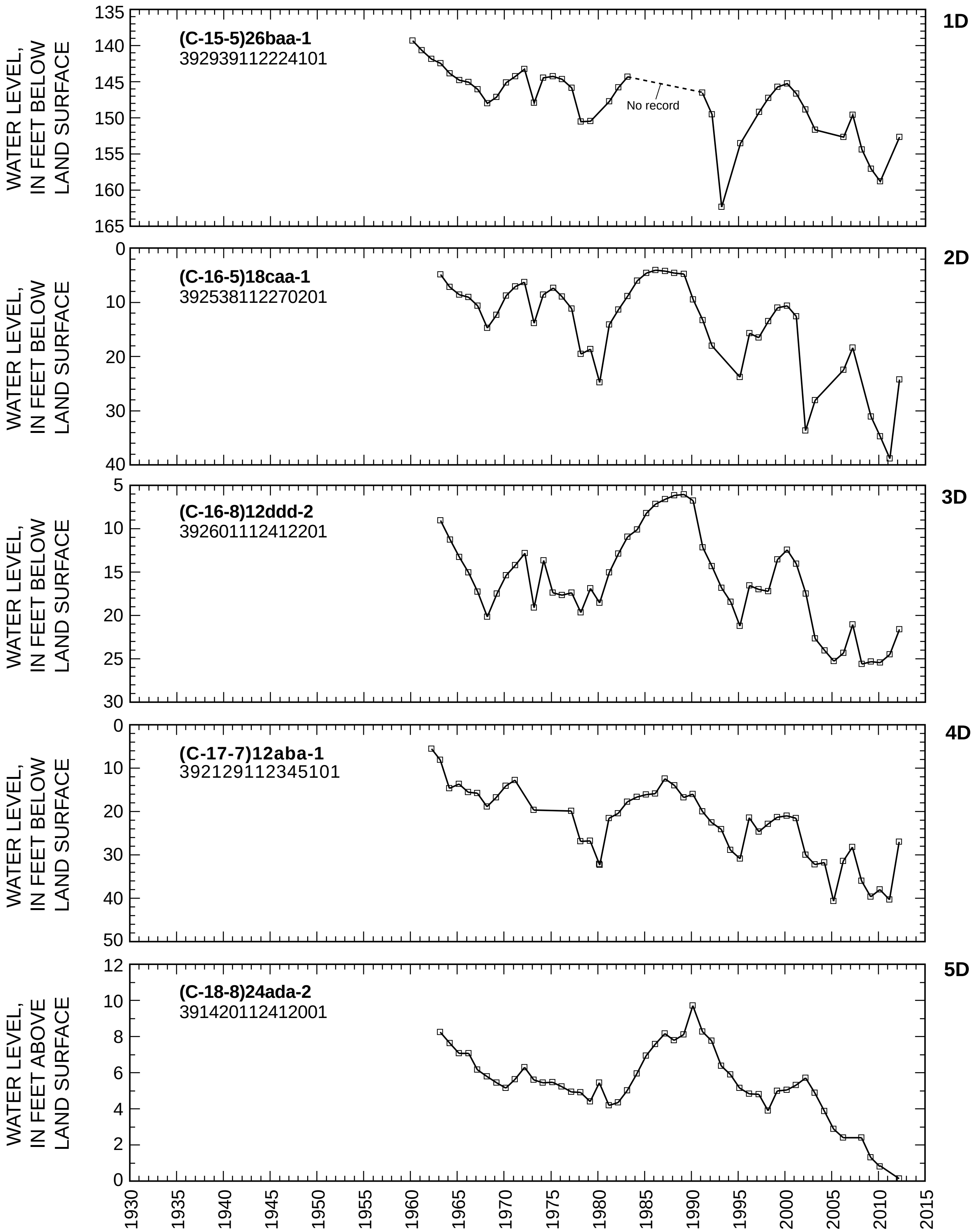


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

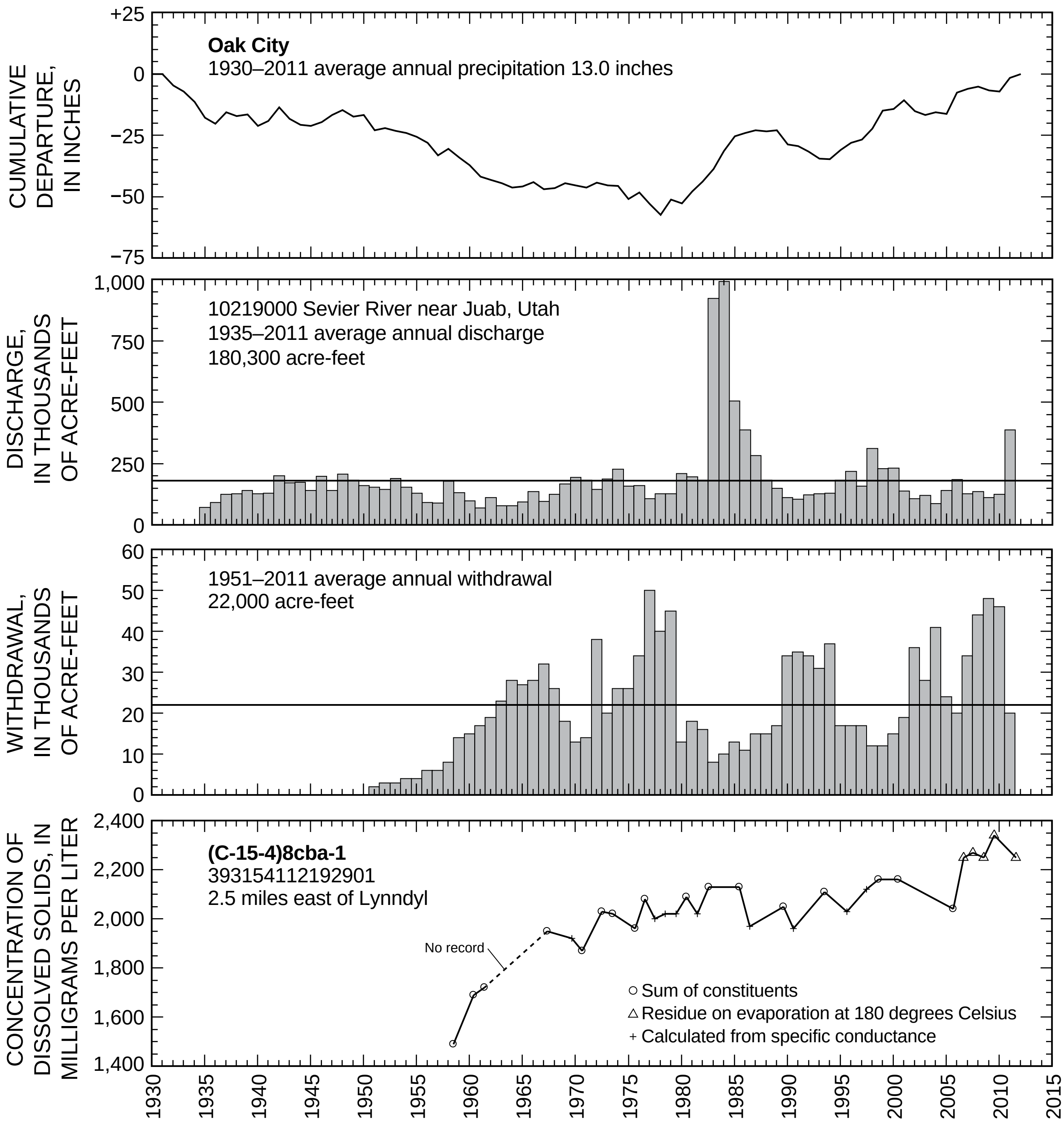


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

Central Sevier Valley

By Bradley A. Slaugh

Central Sevier Valley, located in northern Piute, Sevier, and southern Sanpete Counties, in south-central Utah, is surrounded by the Sevier and Wasatch Plateaus to the east and the Tushar Mountains, Valley Mountains, and Pahvant Range to the west (fig. 20). Altitude ranges from 5,100 feet on the valley floor at the north end of the valley near Gunnison to more than 12,000 feet in the Tushar Mountains. Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in central Sevier Valley in 2011 was about 31,000 acre-feet, which is 5,000 acre-feet more than reported for 2010 and 13,000 acre-feet more than the average annual withdrawal for 2001–2010 (tables 2 and 3).

The location of 25 wells in central Sevier Valley in which the water level was measured during March 2012 is shown in figure 20. The relation of the water level in selected observation wells to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 21.

Discharge of the Sevier River at Hatch in 2011 was about 201,200 acre-feet, which is about 120,200 acre-feet more than the 1940–2011 average annual discharge. Precipitation at Richfield Radio KVSC was about 10.8 inches in 2011, which is about 2.8 inches more than the 1950–2011 average annual precipitation and about 0.7 inch more than in 2010.

Water levels in central Sevier Valley generally rose from March 2011 to March 2012. Hydrographs for selected wells show that March water levels generally rose from about 1978 to 1985 and declined from 1985 to about 1993. Since 1993, water levels have fluctuated depending upon the amount and timing of precipitation and recharge to the basin-fill aquifer from snowmelt runoff.

The concentration of dissolved solids in water samples collected from well (C-23-2)15dcb-4, located 0.1 mile south of Sevier River in Venice, from 1955 to 2011, is shown in figure 21. The concentration has ranged from 307 to 630 mg/L, with a median value of 414 mg/L. Relative to the median value, there were modest (less than 220 mg/L) increases in dissolved-solids concentrations during the mid- to late 1960s and 1980s. Samples collected from 1990 through 2011 show little variation and are in close agreement with the median value.

Physical properties and results of chemical analyses for water from four wells in central Sevier Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. Water samples from two wells, (C-23-2)30baa-2 and (C-24-2)6abc-1, exceeded the secondary drinking-water standard for dissolved solids (500 mg/L). Water from well (C-21-1)13abd-1 slightly exceeded the MCL for arsenic (10 μg/L).

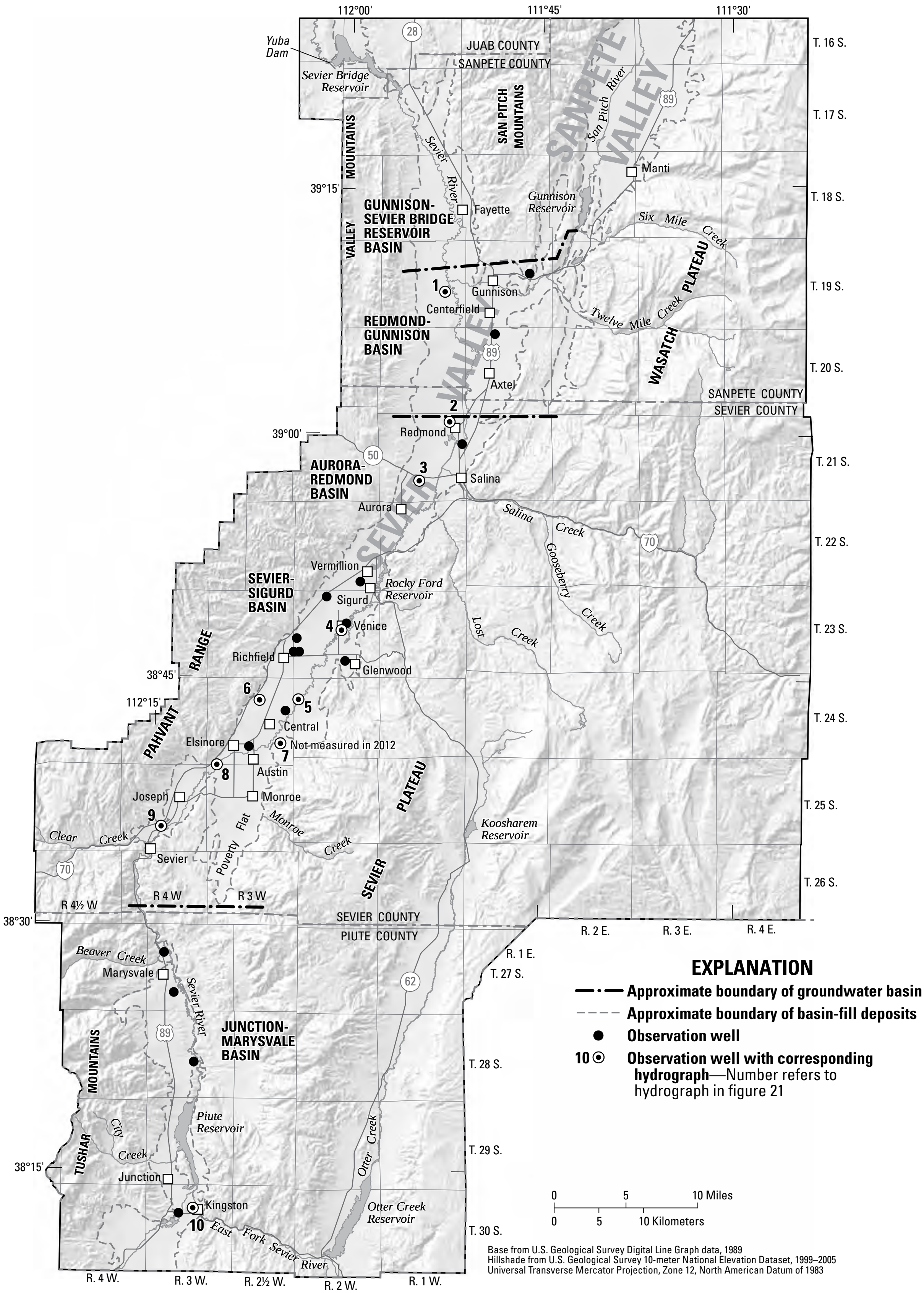


Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 2012.

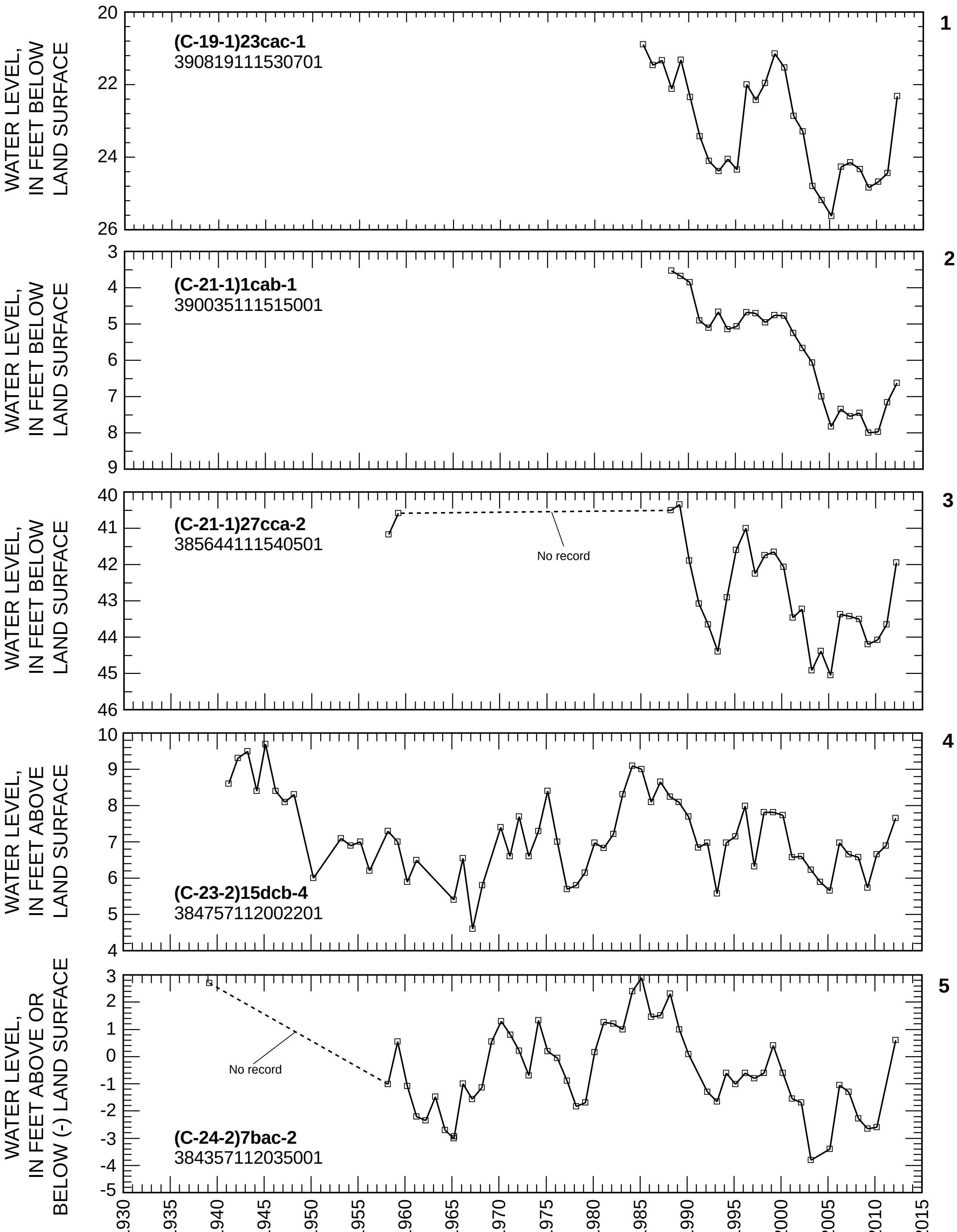


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

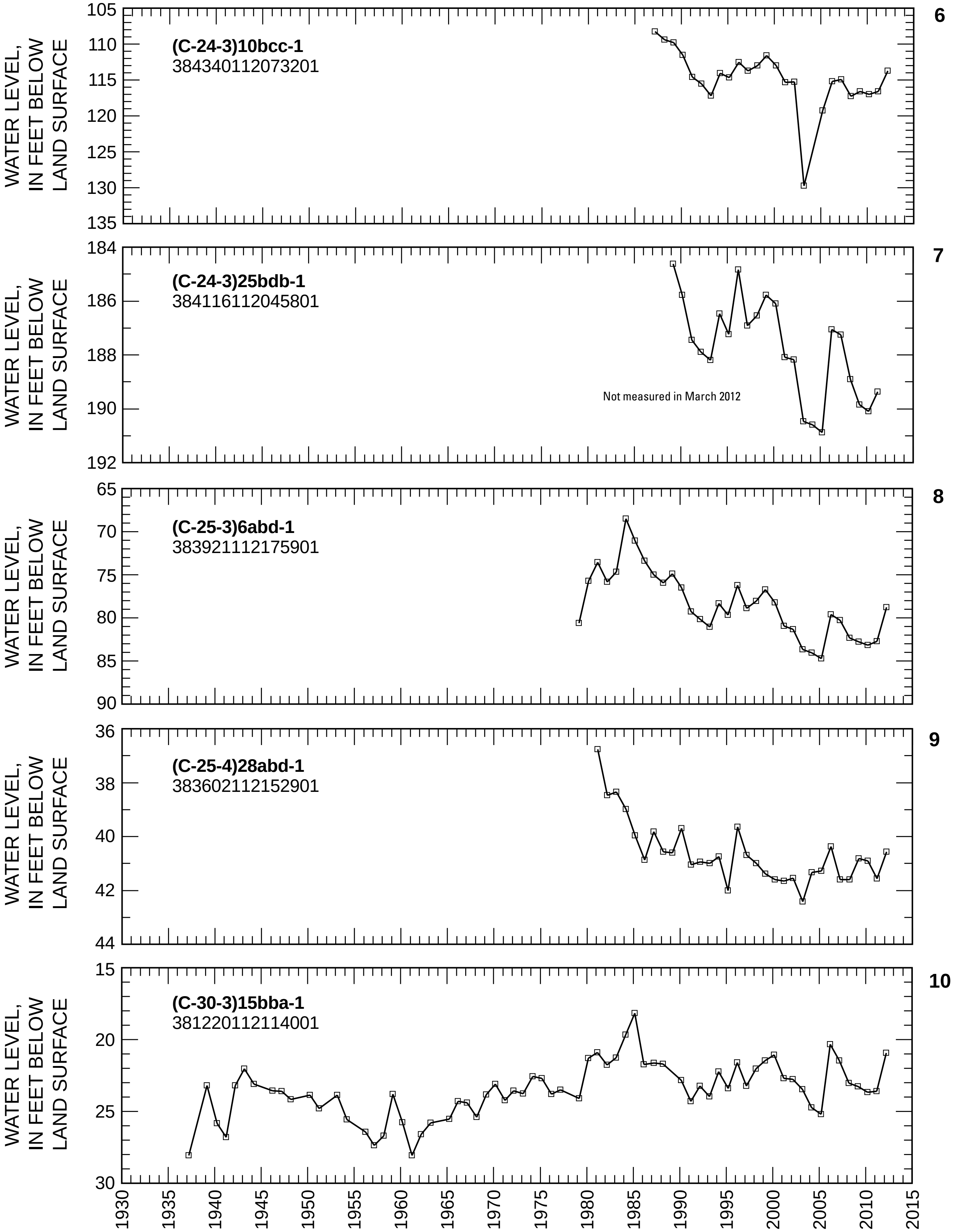


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.—Continued

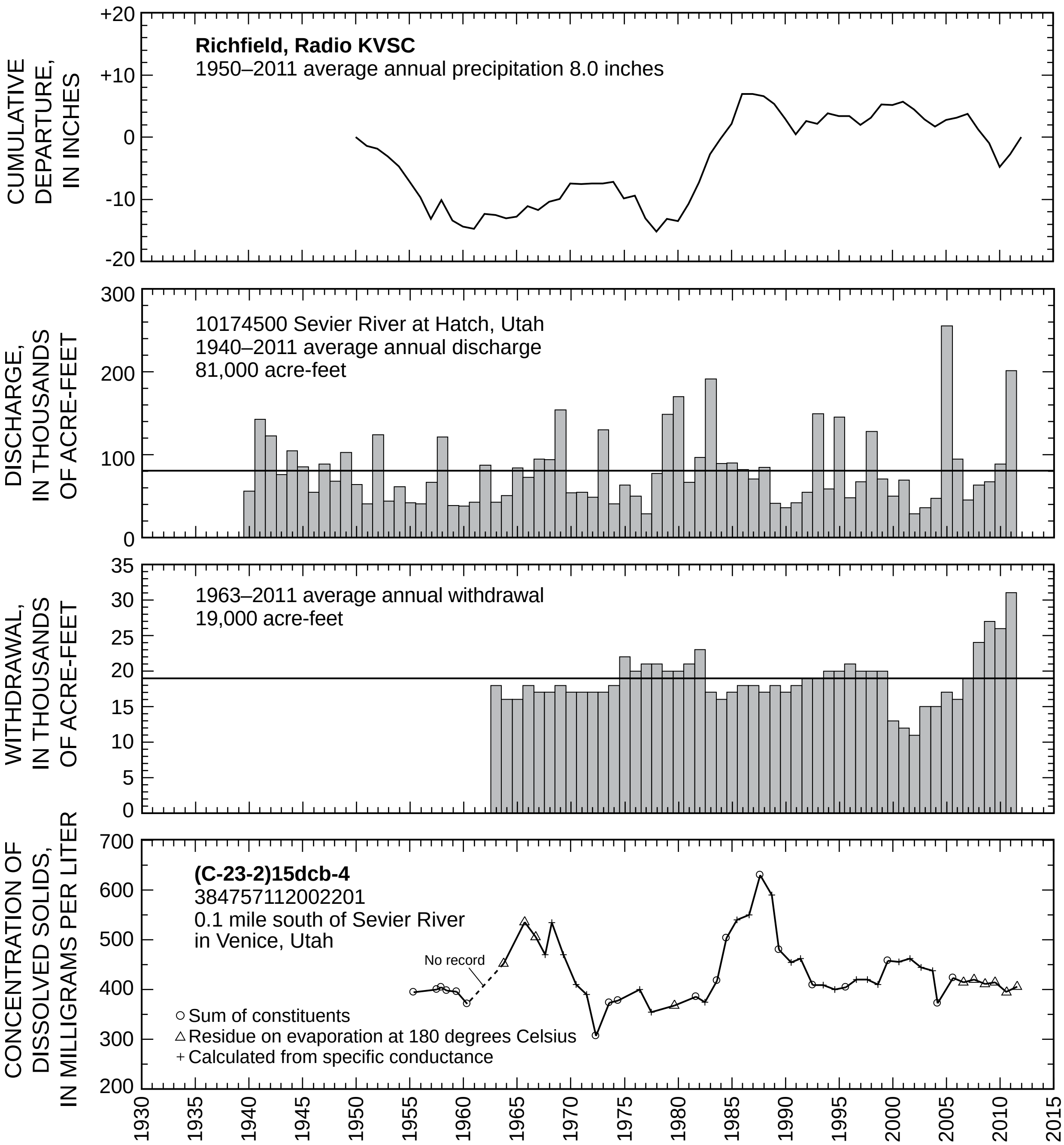


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.—Continued

Pahvant Valley

By Nickolas R. Whittier

Pahvant Valley, in southeastern Millard County, extends from the vicinity of McCornick in the north to Kanosh in the south, and from the Pahvant Range and Canyon Mountains on the east and northeast to a low basalt ridge known as The Cinders on the west (fig. 22). The area of the valley is about 300 square miles. Groundwater drains west to the valley from the mountainous terrain to the east. Groundwater occurs in basin-fill deposits in the valley under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Pahvant Valley in 2011 was about 89,000 acre-feet, which is about 17,000 acre-feet less than was reported in 2010 and 1,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3). Withdrawal for irrigation in 2011 was about 88,400 acre-feet, which is 16,700 acre-feet less than was reported in 2010.

The location of wells in Pahvant Valley in which water levels were measured during March 2012 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 2011 was about 19.5 inches, which is about 4.2 inches more than the average annual precipitation for 1930–2011 and about 4.0 inches less than in 2010.

Water levels rose from March 2011 to March 2012 in the central and southeastern parts of Pahvant Valley. Rises of up to 20 feet were measured in wells around Flowell and Meadow. Rises are probably due to greater-than average-precipitation and decreased withdrawals for irrigation. Water levels declined in wells measured in the northern and southwestern parts of the valley. Declines of up to about 2 feet were measured near McCornick. 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 generally rose from 1982 to 1985 and were generally higher than in the early 1950s. The 1982–85 rises were the result of greater-than-average precipitation and decreased withdrawals for irrigation. Water levels generally have declined throughout the valley since 1985.

The concentration of dissolved solids in water samples collected from wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3, located in the Flowell area, from 1954 to 2011, and from well (C-23-6)8abd-1, located in the Kanosh area, from 1957 to 2010, is shown in figure 23. Wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3 are located near each other and are finished in the same aquifer. The dissolved-solids concentrations in water samples from these wells were combined to give an extended temporal record for this constituent. Dissolved-solids concentrations in water samples from wells in the Flowell area have ranged from 707 to 1,080 mg/L, with a median value of 868 mg/L. The concentration of dissolved solids in water samples from well (C-23-6)8abd-1 has ranged from 2,350 to 5,990 mg/L, with a median value of 4,268 mg/L. This well was not sampled in 2011.

Physical properties and results of chemical analyses for water from five wells in Pahvant Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentrations of dissolved solids in water from all wells exceeded the secondary drinking-water standard for this constituent (500 mg/L). Water from wells (C-23-6)15bda-1 and (C-23-6)16bad-1 exceeded the MCL for dissolved solids (2,000 mg/L) and the secondary standard for chloride (250 mg/L). Water from two wells, (C-20-4)6bdb-1 and (C-23-6)15bda-1, exceeded the secondary standard for sulfate (250 mg/L), and water from well (C-23-6)16bad-1 exceeded the MCL for sulfate (1,000 mg/L).

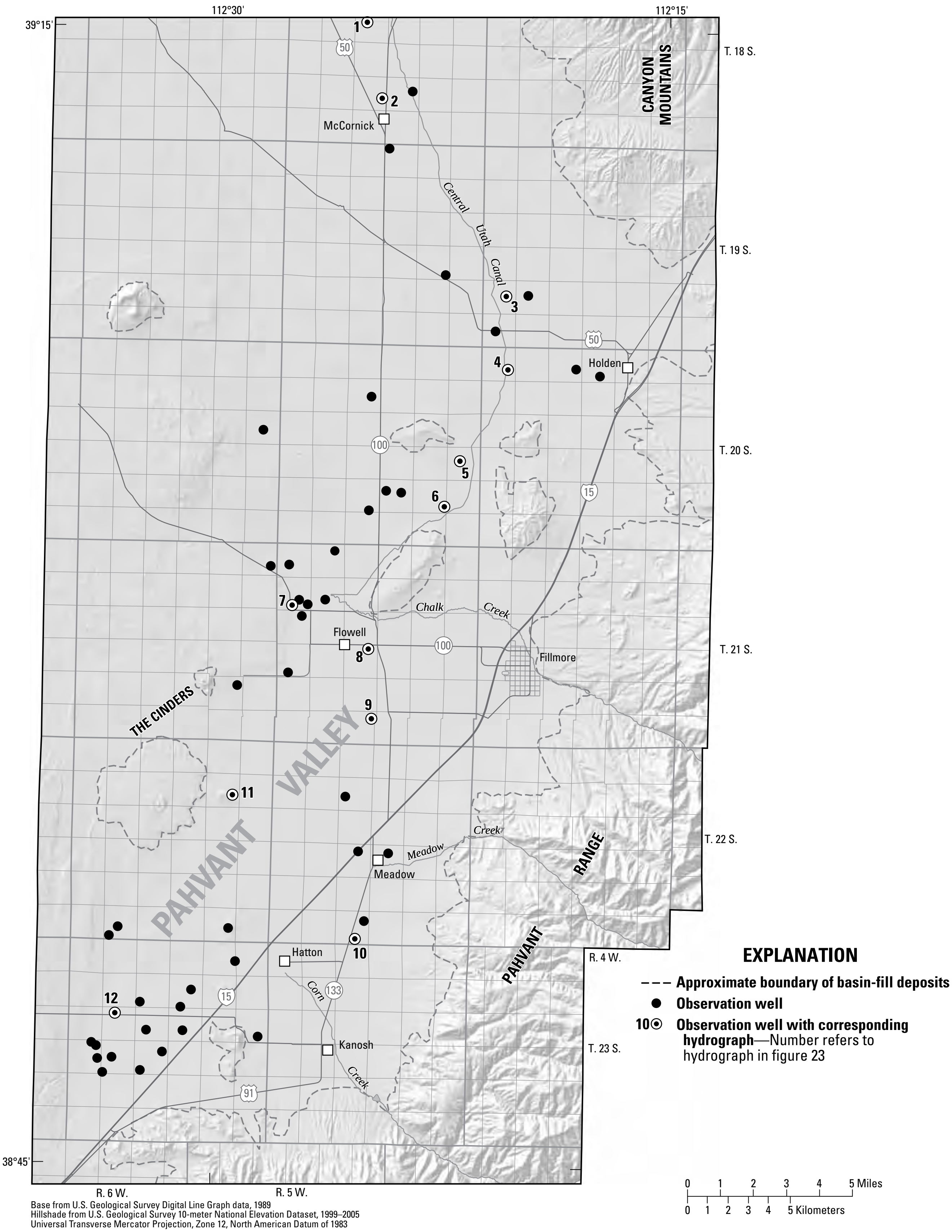


Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 2012.

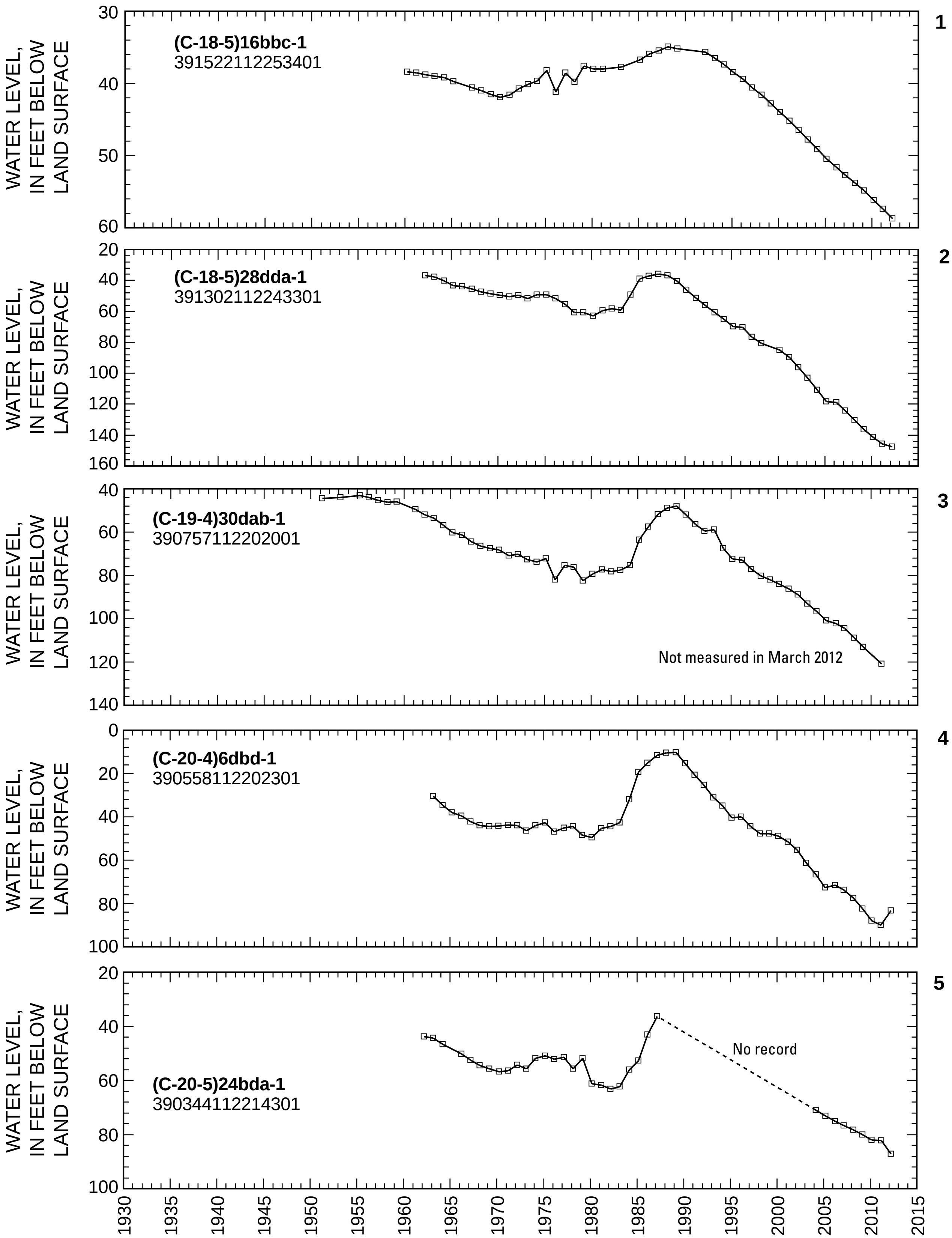


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

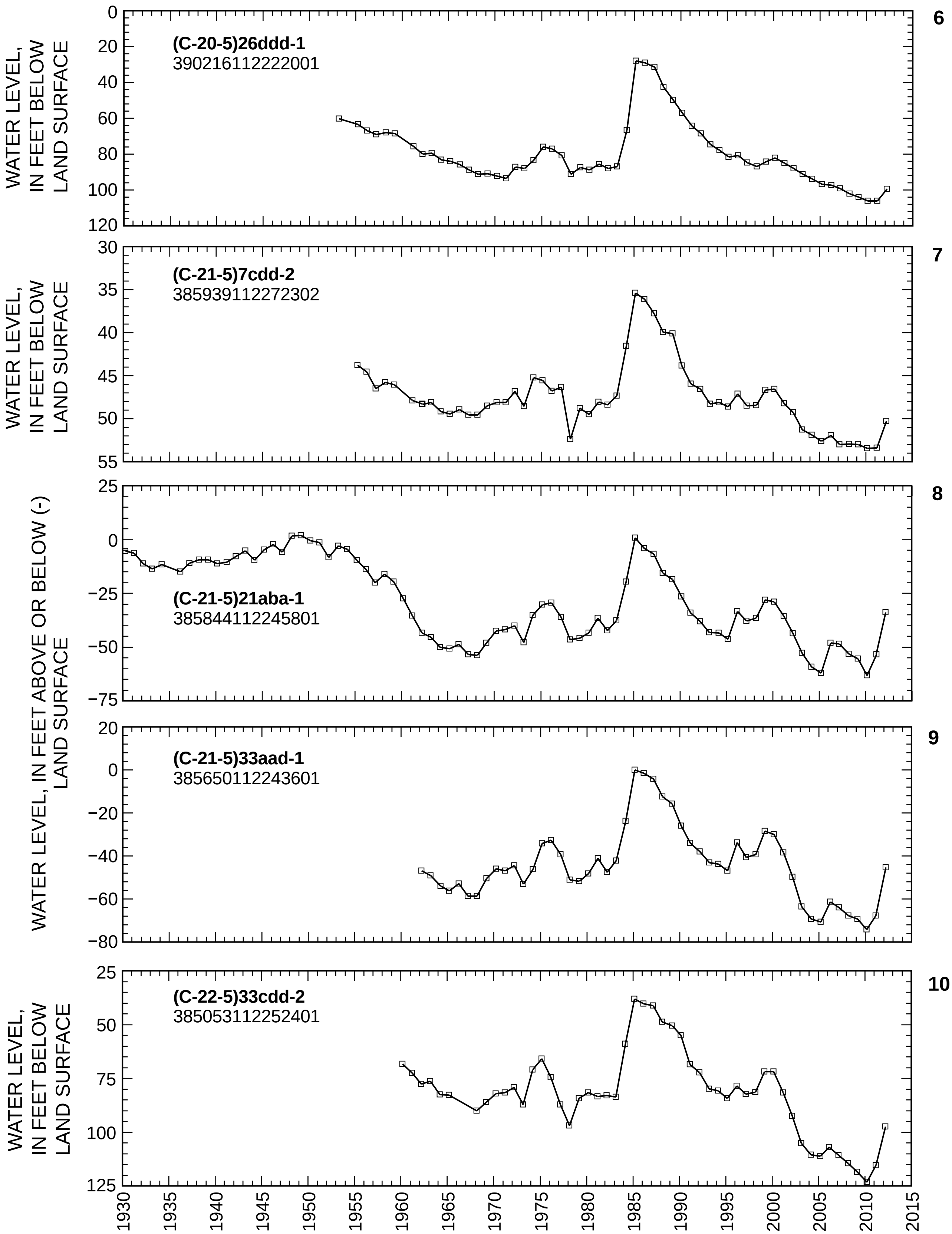


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

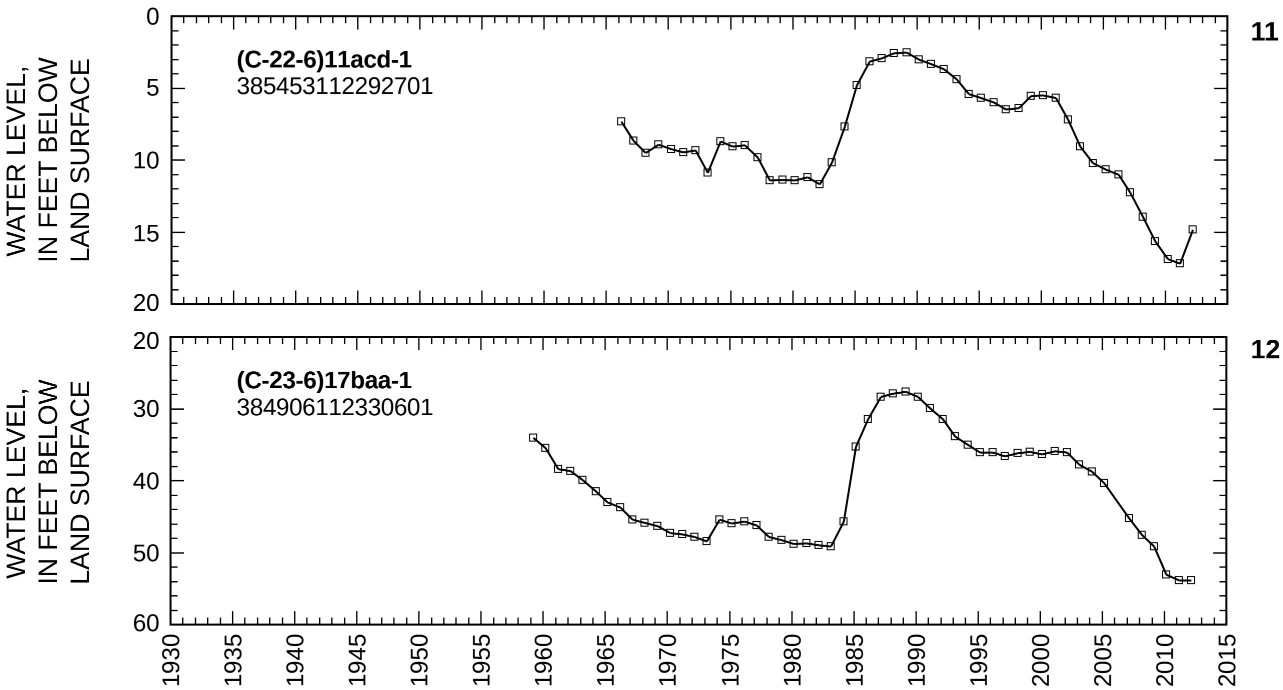


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

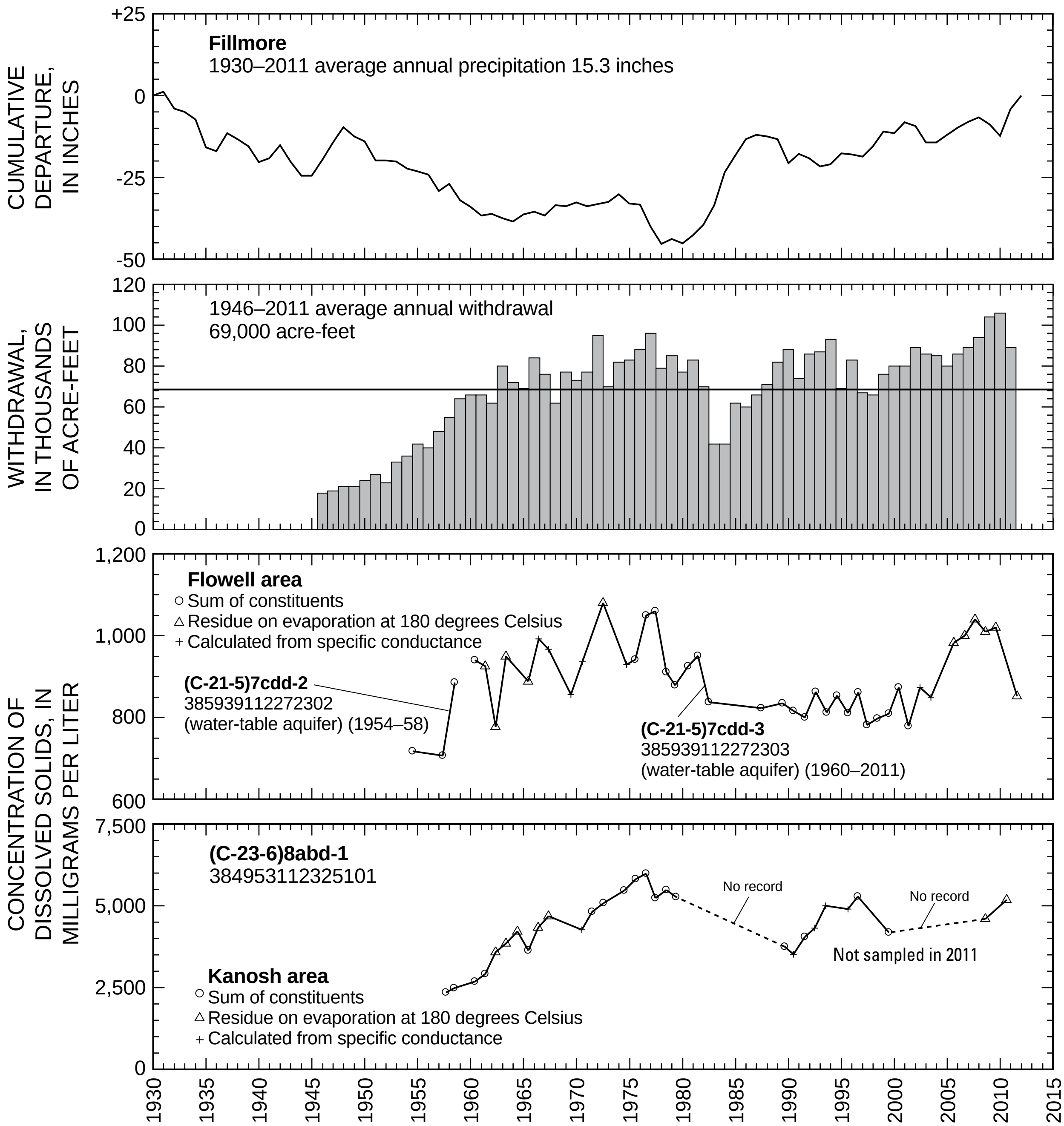


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cedar Valley, Iron County

By James H. Howells

Cedar Valley is in eastern Iron County, southwestern Utah. The valley covers about 220 square miles from the vicinity of Rush Lake in the north to the community of Kanarraville in the south and includes Cedar City on its eastern edge (fig. 24). Groundwater in Cedar Valley occurs in unconsolidated basin-fill deposits, mostly under water-table conditions. The principal source of recharge to the basin-fill aquifer is water from Coal Creek, some of which seeps directly from the stream channel into the groundwater system.

Total estimated withdrawal of water from wells in Cedar Valley in 2011 was about 34,000 acre-feet, which is 4,000 acre-feet less than in 2010 and 3,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3).

The location of wells in Cedar Valley in which the water level was measured during March 2012 is shown in figure 24. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 25.

Precipitation at Cedar City Federal Aviation Administration Airport in 2011 was about 15.2 inches, which is about 1.2 inches less than in 2010 and about 4.4 inches more than the average annual precipitation for 1949–2011. Discharge of Coal Creek was about 47,400 acre-feet in 2011, which is 15,700 acre-feet more than in 2010, and 22,700 acre-feet more than the average annual discharge for 1936 and 1939–2011.

Groundwater levels rose from March 2011 to March 2012 in most parts of Cedar Valley. The largest rises, greater than 11 feet, were measured in four wells north and west of Cedar City. Water-level rises probably resulted from locally decreased withdrawals, greater-than-average precipitation, and increased recharge. Water-level declines were measured in several wells near Quichapa Lake. Water-level declines probably resulted from continued localized large withdrawals for irrigation.

The concentration of dissolved solids in water samples collected from well (C-37-12)23acb-1, located 2.3 miles northeast of Kanarraville, from 1966 to 2011, and well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, from 1977 to 2011, is shown in figure 25. The dissolved-solids concentration in water from well (C-37-12)23acb-1 has ranged from 347 to 996 mg/L, with a median value of 506 mg/L; the concentration of dissolved solids from 1966 to 2011 has generally increased. For well (C-35-11)31dbd-1, the concentration of dissolved solids in water samples has ranged from 364 to 1,020 mg/L, with a median value of 538 mg/L. From 1987 to 2011, the concentration has generally increased.

Physical properties and results of chemical analyses for water from four wells in Cedar Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentrations of dissolved solids in water from all wells exceeded the secondary drinking-water standard for this constituent (500 mg/L) and the secondary standard for sulfate (250 mg/L). Also, water from well (C-36-11)11bac-1 exceeded the MCL for sulfate (1,000 mg/L).

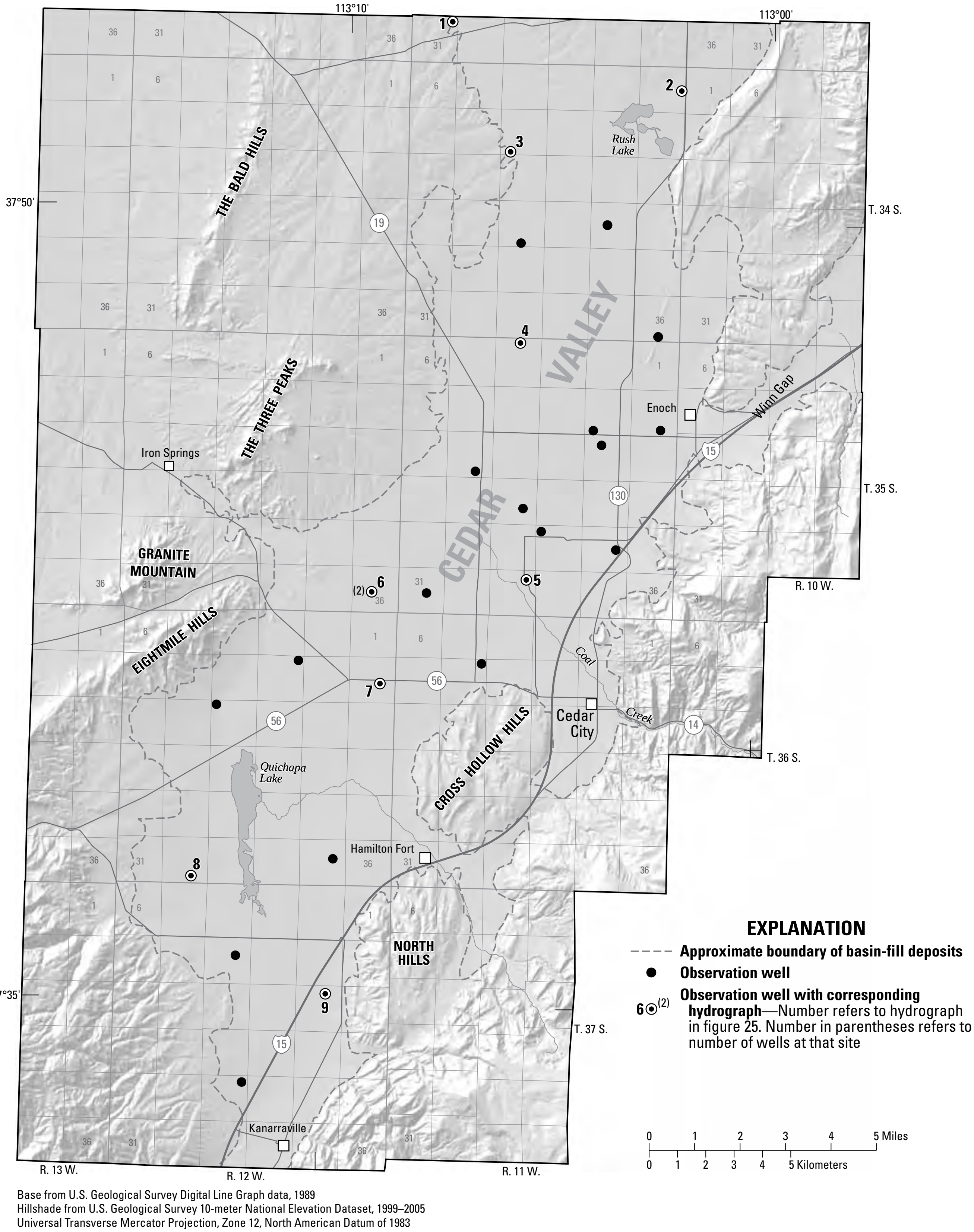


Figure 24. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2012.

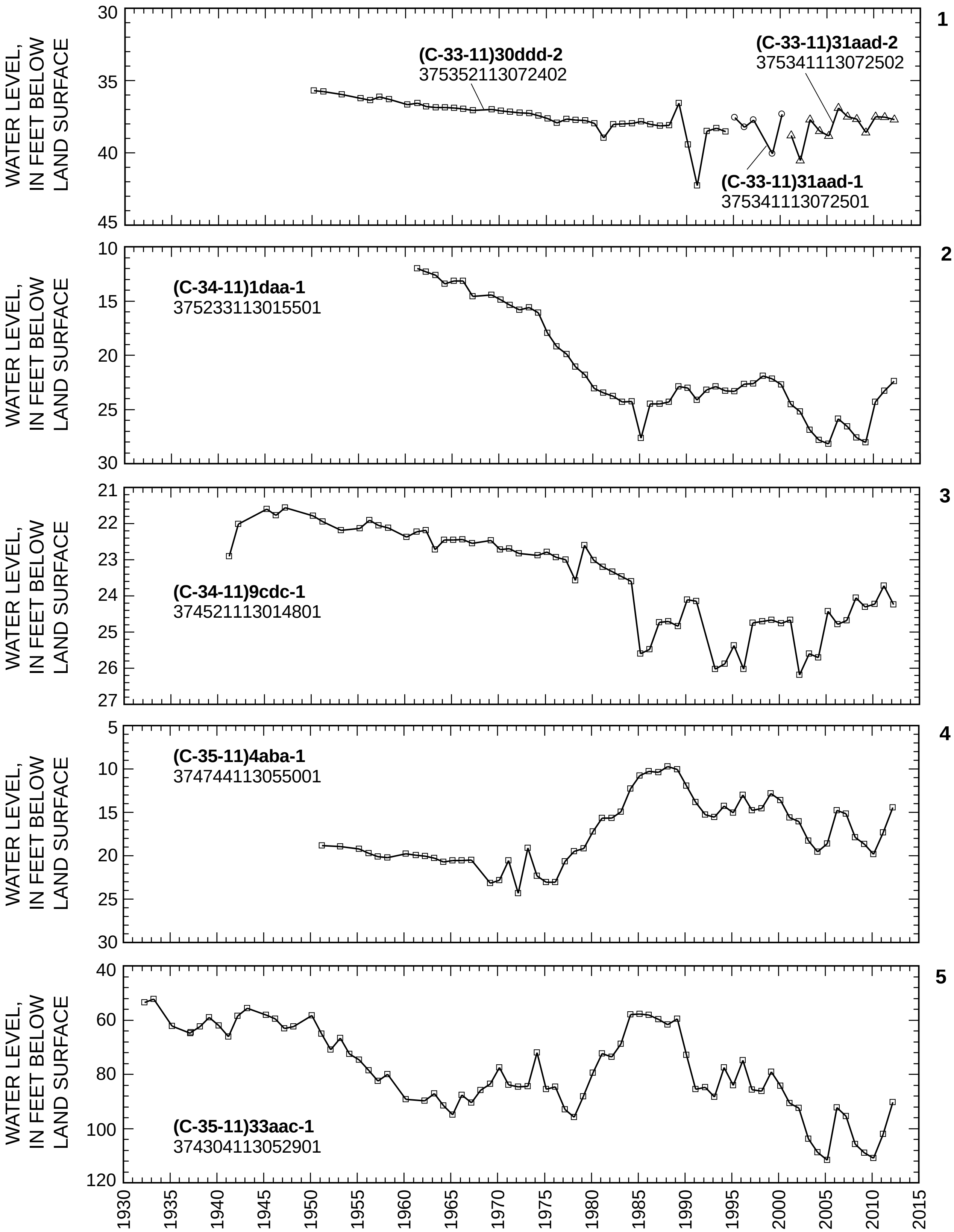


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration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

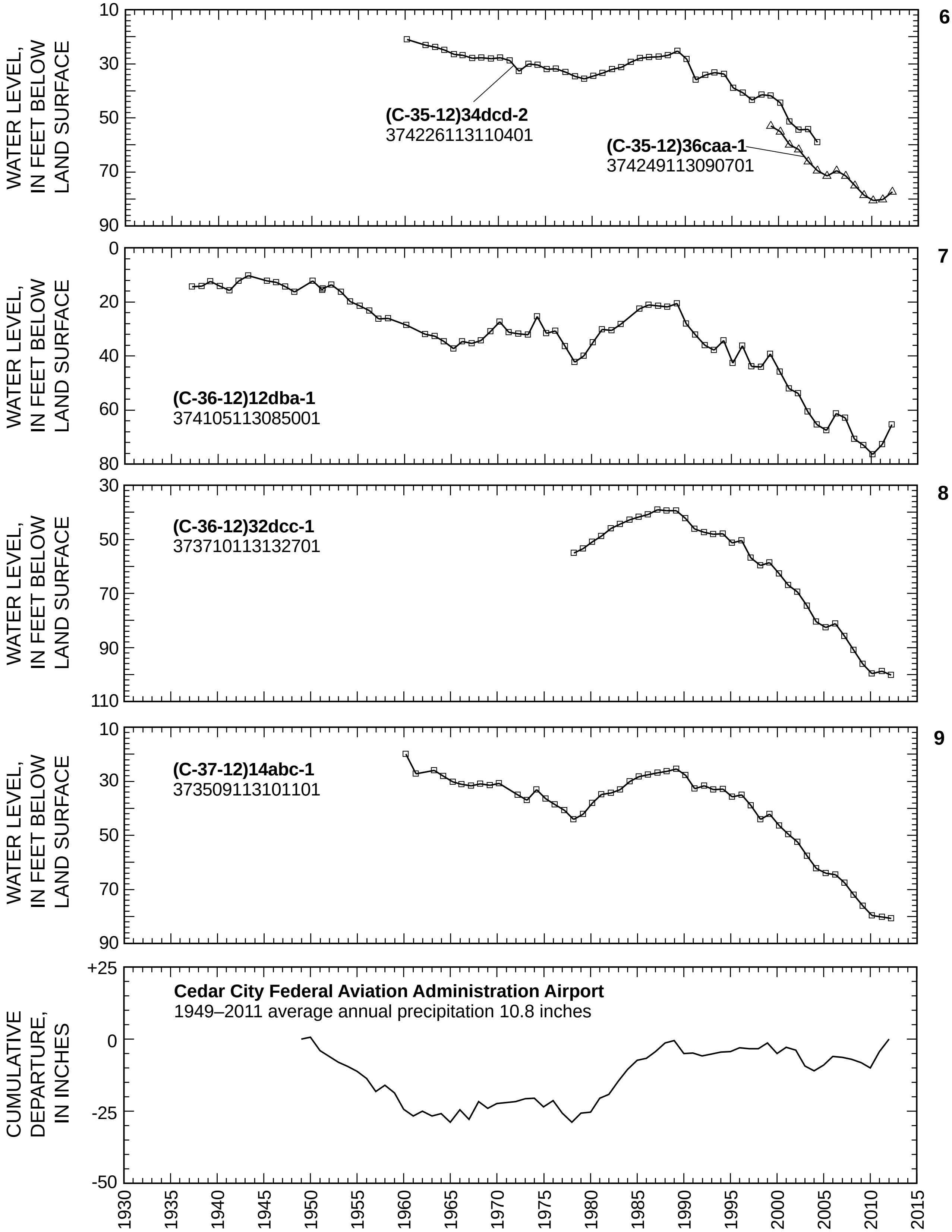


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration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

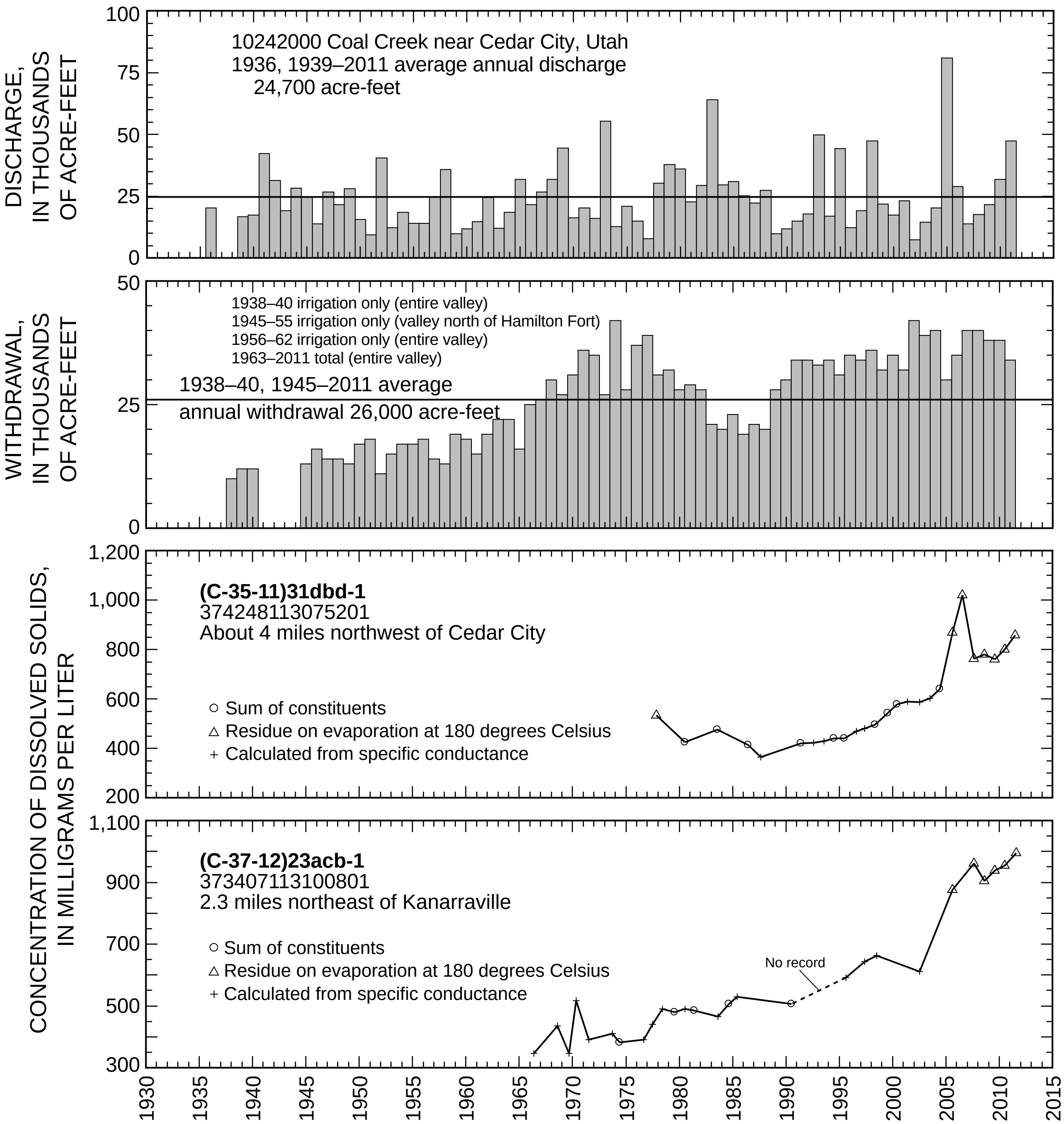


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration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

Parowan Valley

By James H. Howells

Parowan Valley is in northern Iron County, southwestern Utah. The valley covers about 160 square miles west of the Hurricane Cliffs and includes the towns of Paragonah and Parowan (fig. 26). Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Parowan Valley in 2011was about 32,000 acre-feet, which is about 2,000 acre-feet less than was reported for 2010 and 2,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3). The decrease is mainly due to decreased withdrawals for irrigation.

The location of wells in Parowan Valley in which the water level was measured during March 2012 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 2011 was about 15.2 inches, which is about 1.2 inches less than the value for 2010 and 4.4 inches more than the average annual precipitation for 1949–2011.

Water levels generally rose from March 2011 to March 2012 in most parts of Parowan Valley for which data are available. The largest rise, about 10.6 feet, was measured in a well north and east of Parowan. Water levels generally declined in wells in the southwest part of Parowan Valley for which data are available. The largest decline, about 1.9 feet, was measured in a well south and west of Parowan. Water levels in Parowan Valley generally have declined since 1950. Some rises occurred during 1973–74, 1983–85, 1996–99, 2006, and 2012. Declines in water levels are probably the result of continued large local withdrawals for irrigation. Rises are probably the result of less withdrawal for irrigation and several years 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 2011, is shown in figure 27. The concentration has ranged from 257 to 885 mg/L, with a median value of 290 mg/L. The water sampled collected in August 2011 had a dissolved-solids concentration of 267 mg/L. With the exception of relatively high dissolved-solids concentrations in water samples collected in 1970, 1973, and 1974, concentrations have varied little.

Physical properties and results of chemical analyses for water from four wells in Parowan Valley are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. No water from the four wells sampled in Parowan Valley exceeded any secondary drinking-water standards or MCLs.

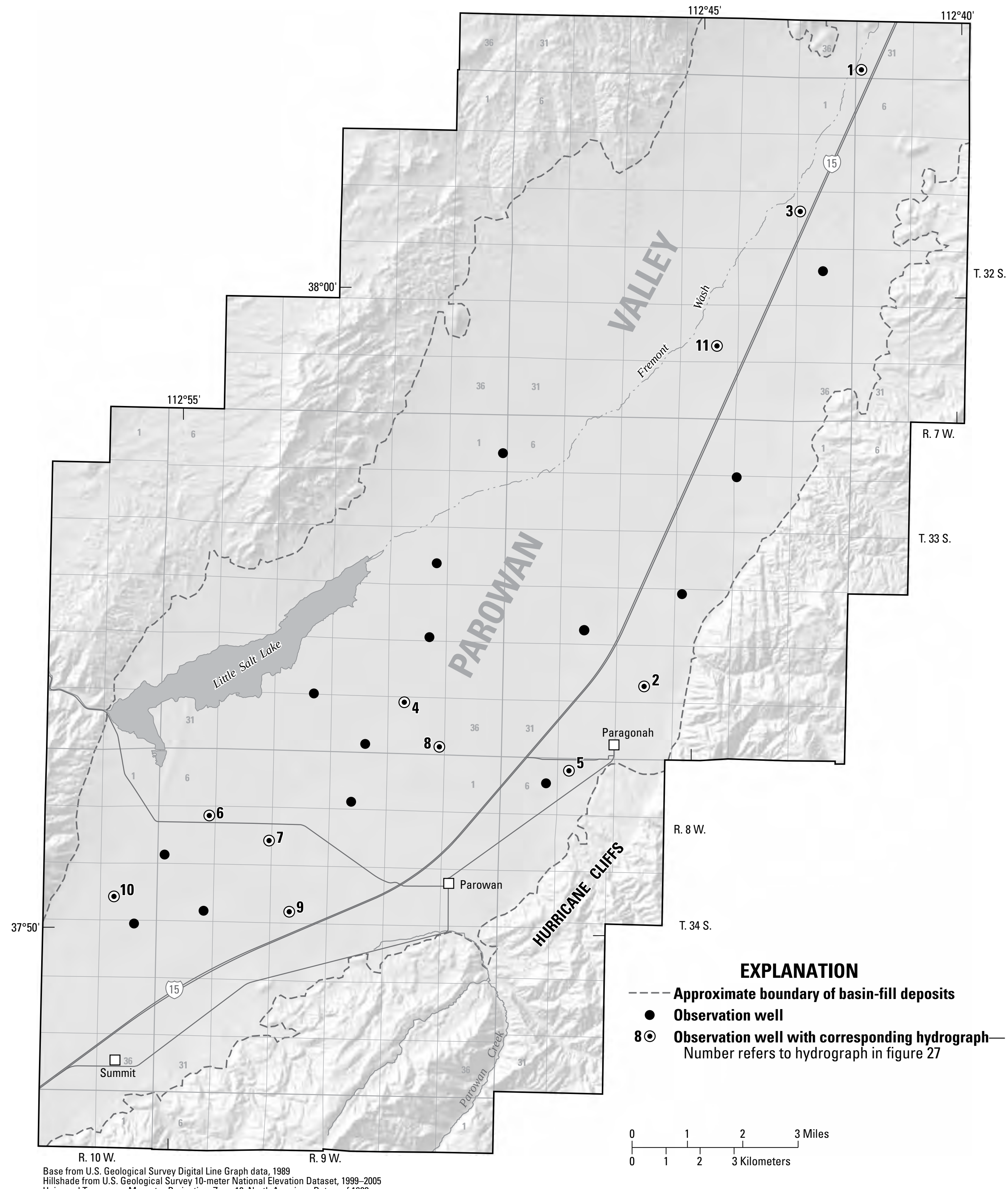


Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 2012.

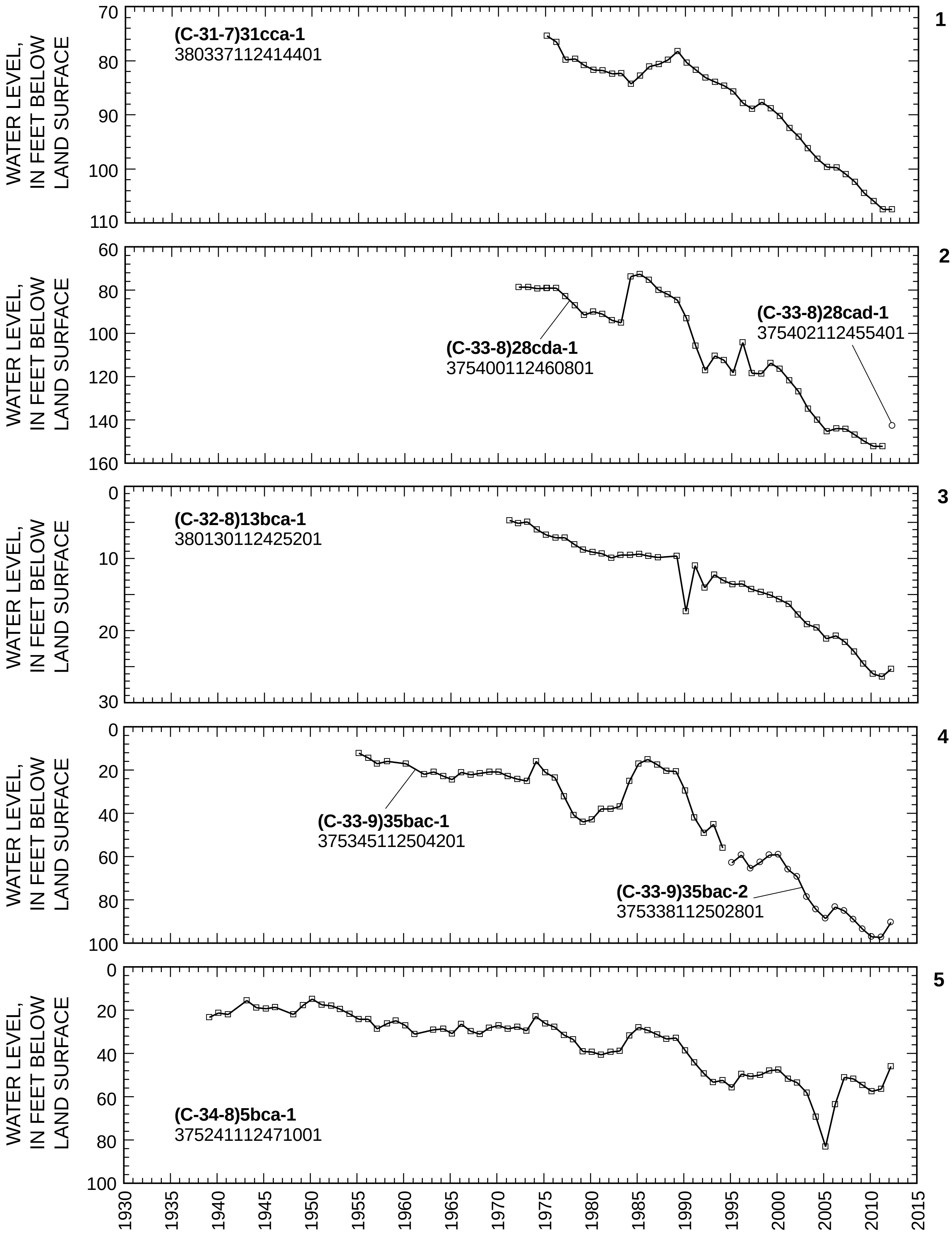


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

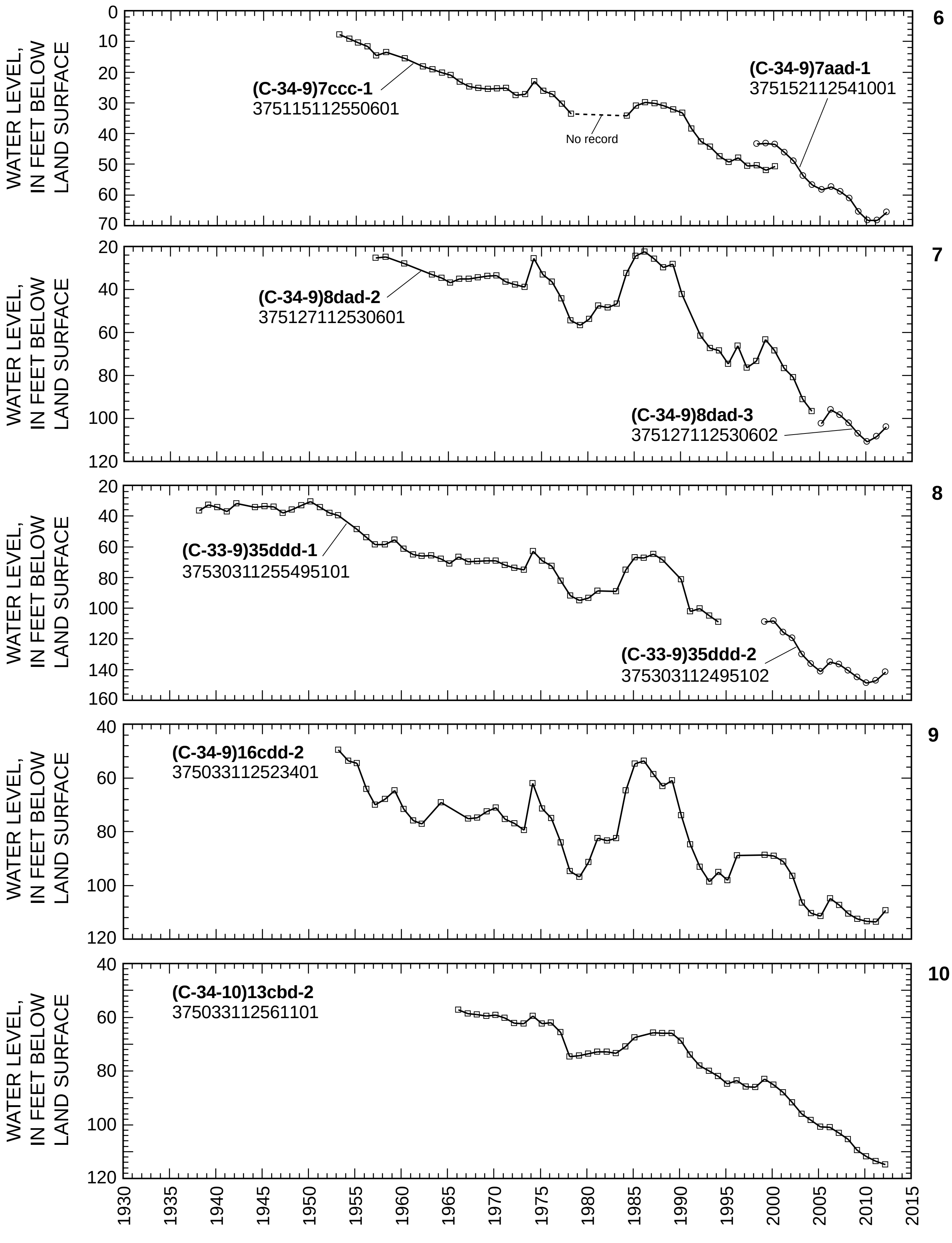


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

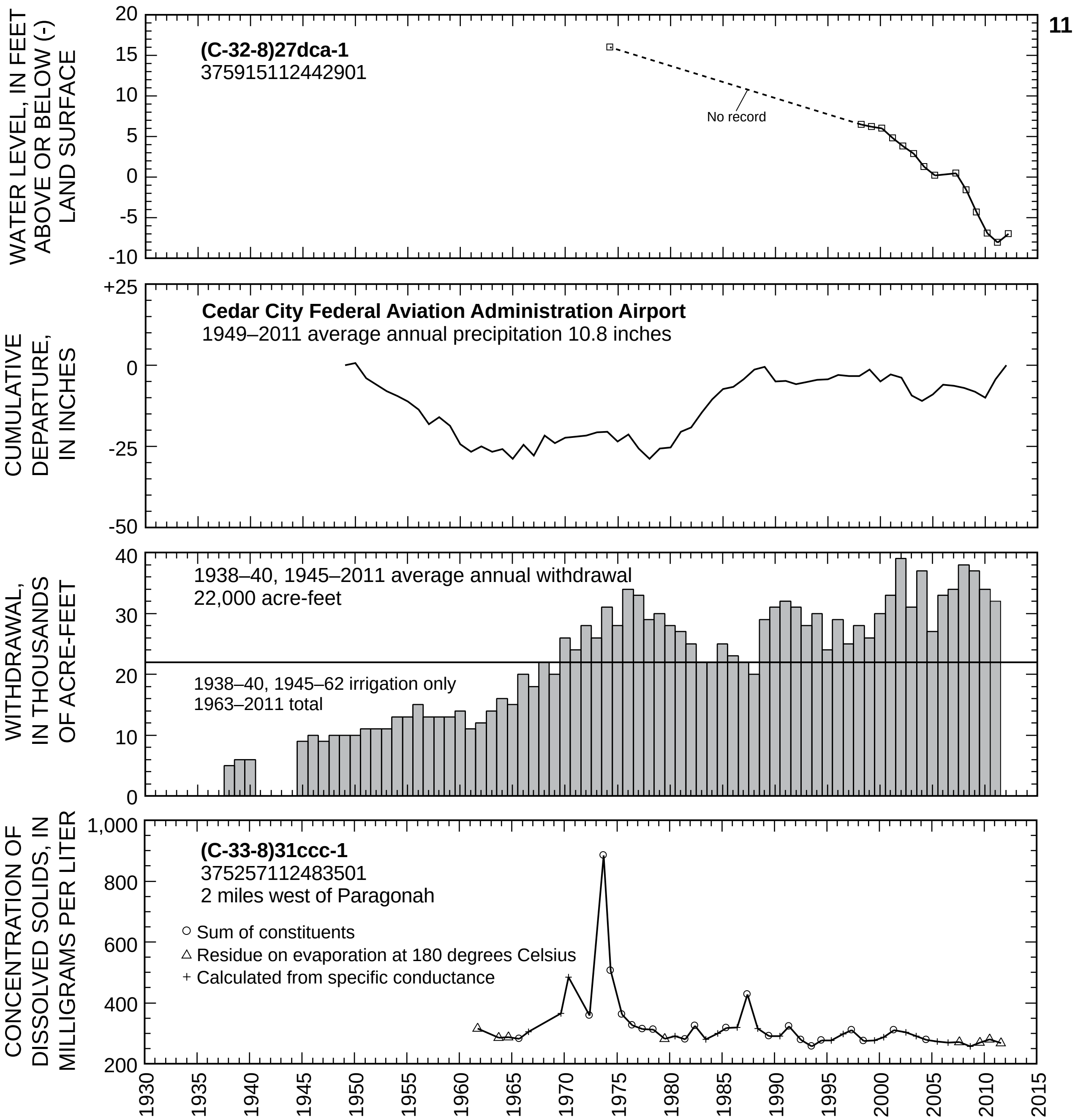


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

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, the southern part of Millard County, and a small area in the northern part of Iron County (fig. 28). Groundwater occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Milford area of Escalante Valley in 2011 was about 53,000 acre-feet, which is 9,000 acre-feet less than was reported for 2010 and 4,000 acre-feet more than the average annual withdrawal for 2001–2010 (tables 2 and 3). This decrease was most likely the result of decreased pumpage due to increased availability of surface water.

The location of wells in the Milford area in which the water level was measured during March 2012 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 2011 was about 13.7 inches, about 0.6 inch more than in 2010 and about 4.7 inches more than the 1952–2011 average annual precipitation.

Water levels generally increased slightly from March 2011 to March 2012 in the northern part of the Milford area and decreased slightly in the southern part of the 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 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 2011, is shown in figure 29. The concentration has ranged from 486 to 909 mg/L with a median value of 572 mg/L. The dissolved-solids concentration in the August 2011 sample was 503 mg/L. With the exception of a relatively high dissolved-solids concentration in the water sample collected in 2001 (909 mg/L), concentrations have varied little.

Physical properties and results of chemical analyses for water from five wells in the Milford area are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentrations of dissolved solids in the water samples from three wells, (C-29-10)5cdd-2, (C-29-11)13dcc-1, and (C-29-11)14cdb-1, exceeded the secondary drinking-water standard (500 mg/L). Water from well (C-29-11)13dcc-1 also exceeded the MCL for nitrate plus nitrite (10 mg/L).

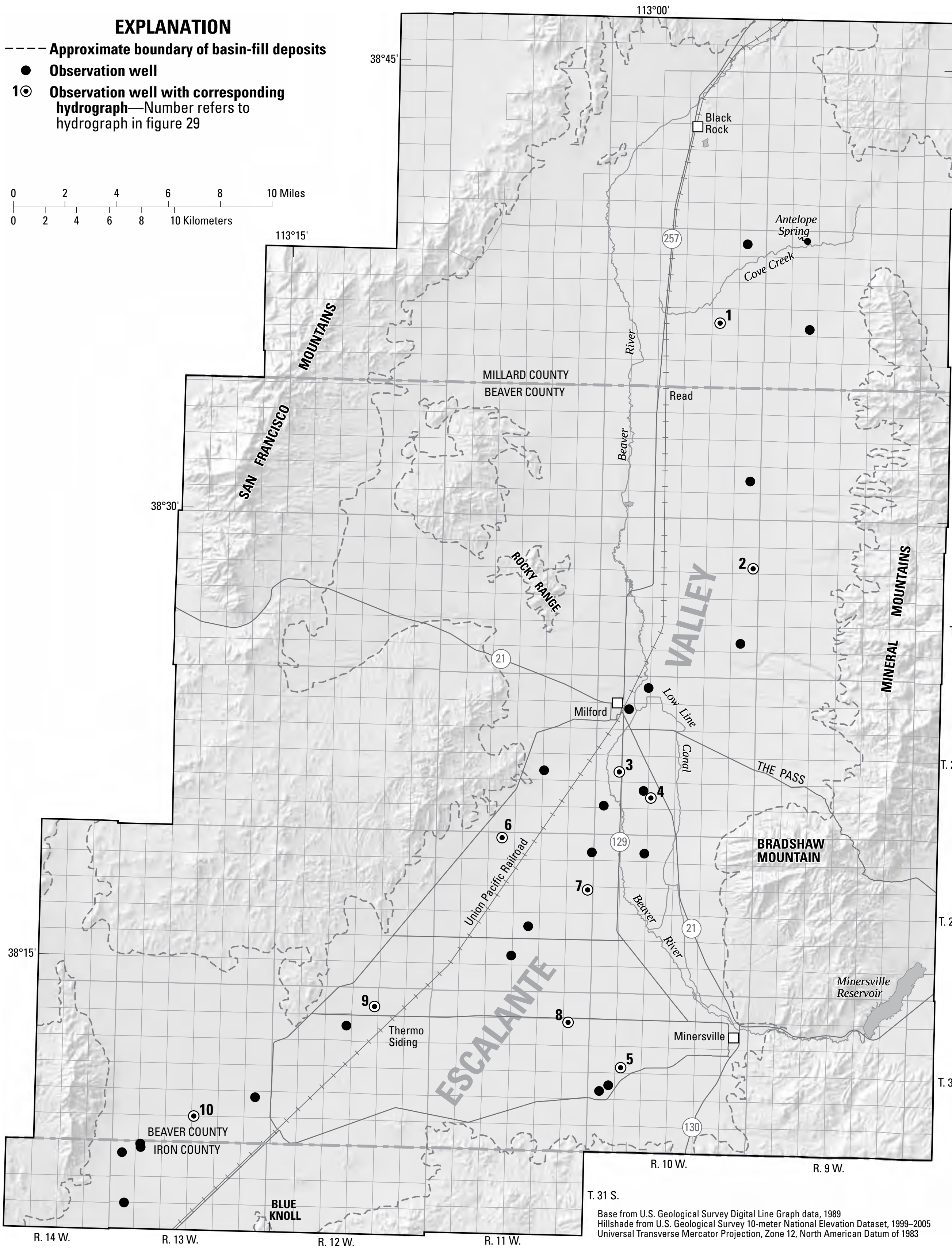


Figure 28. Location of wells in the Milford area in which the water level was measured during March 2012.

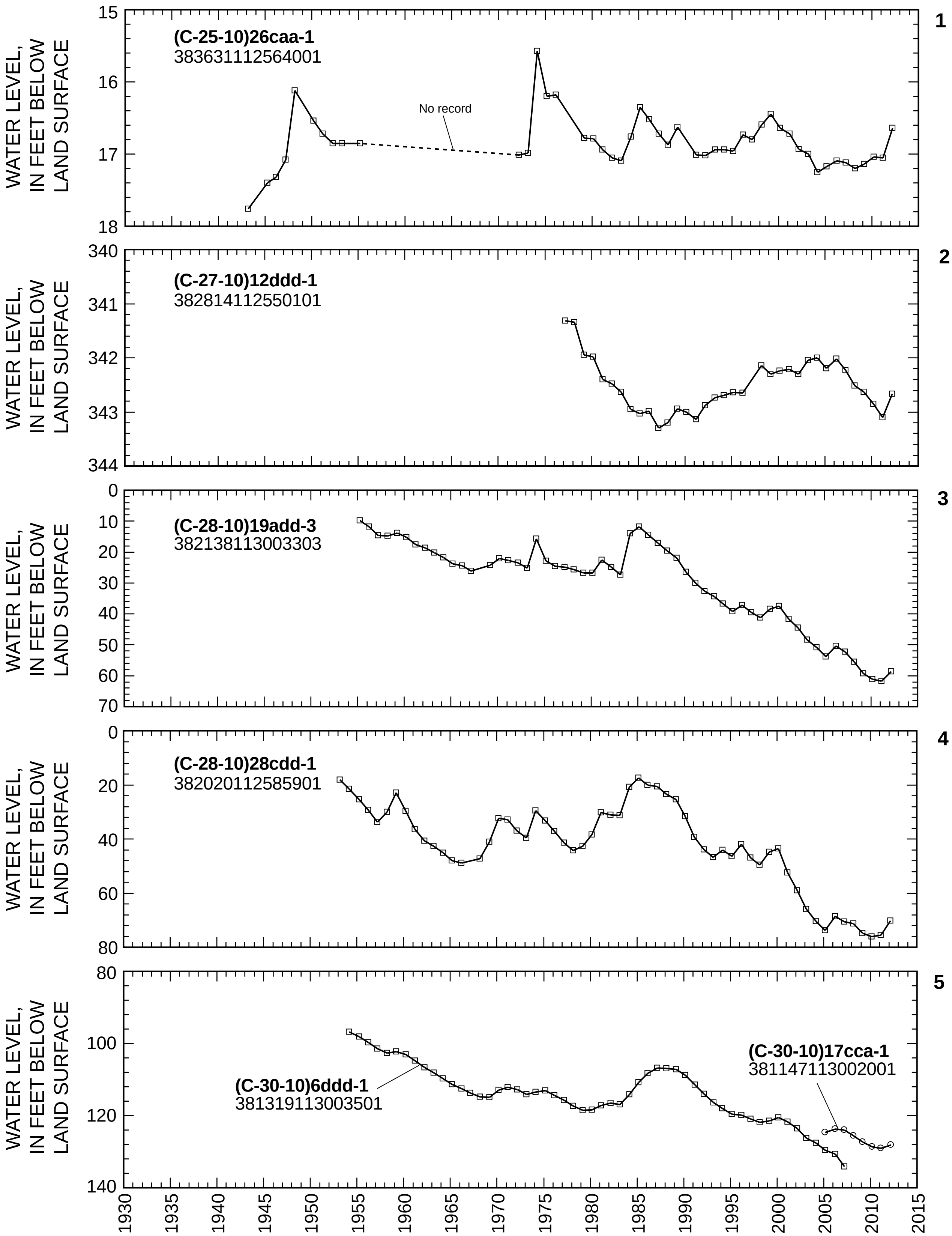


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.

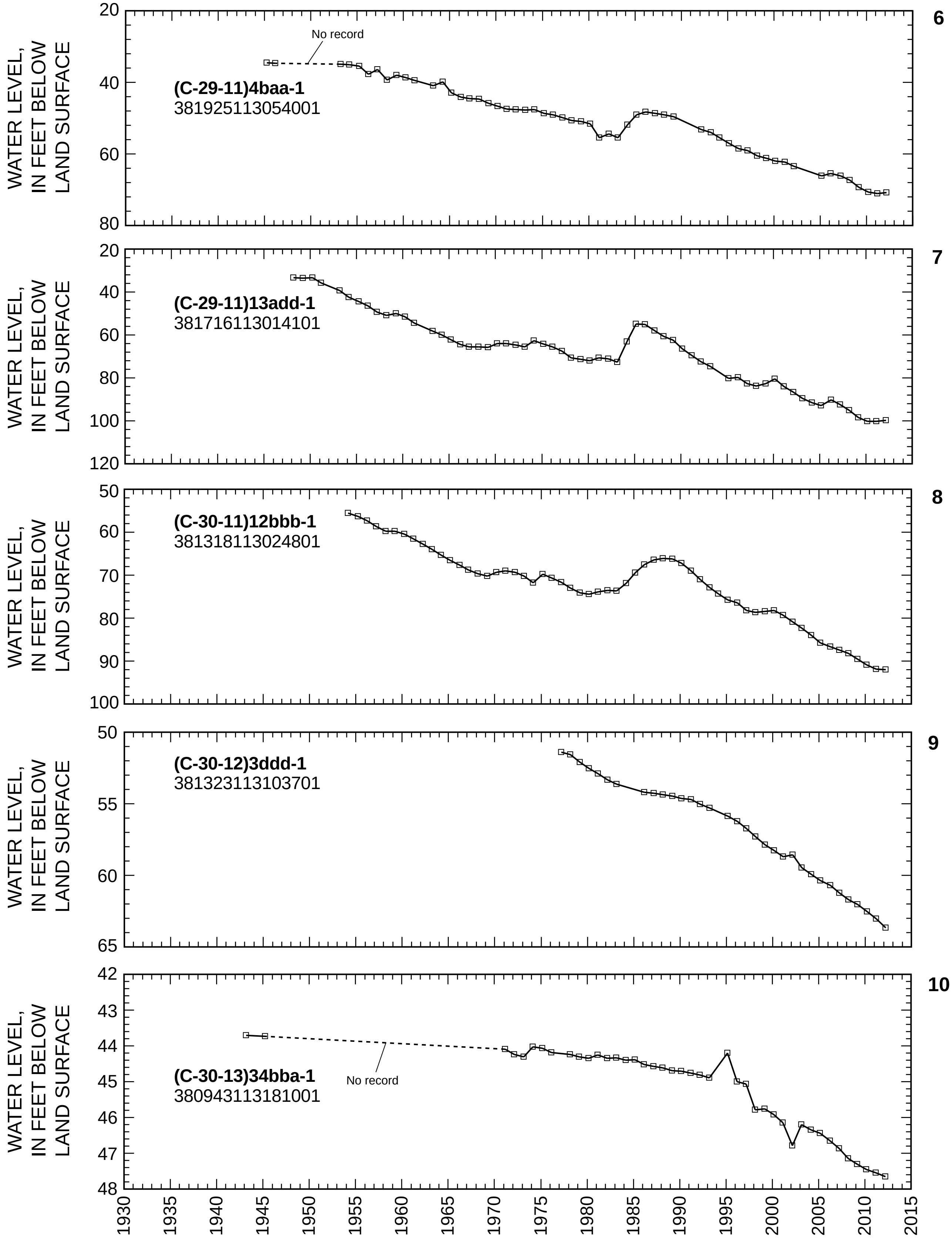


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

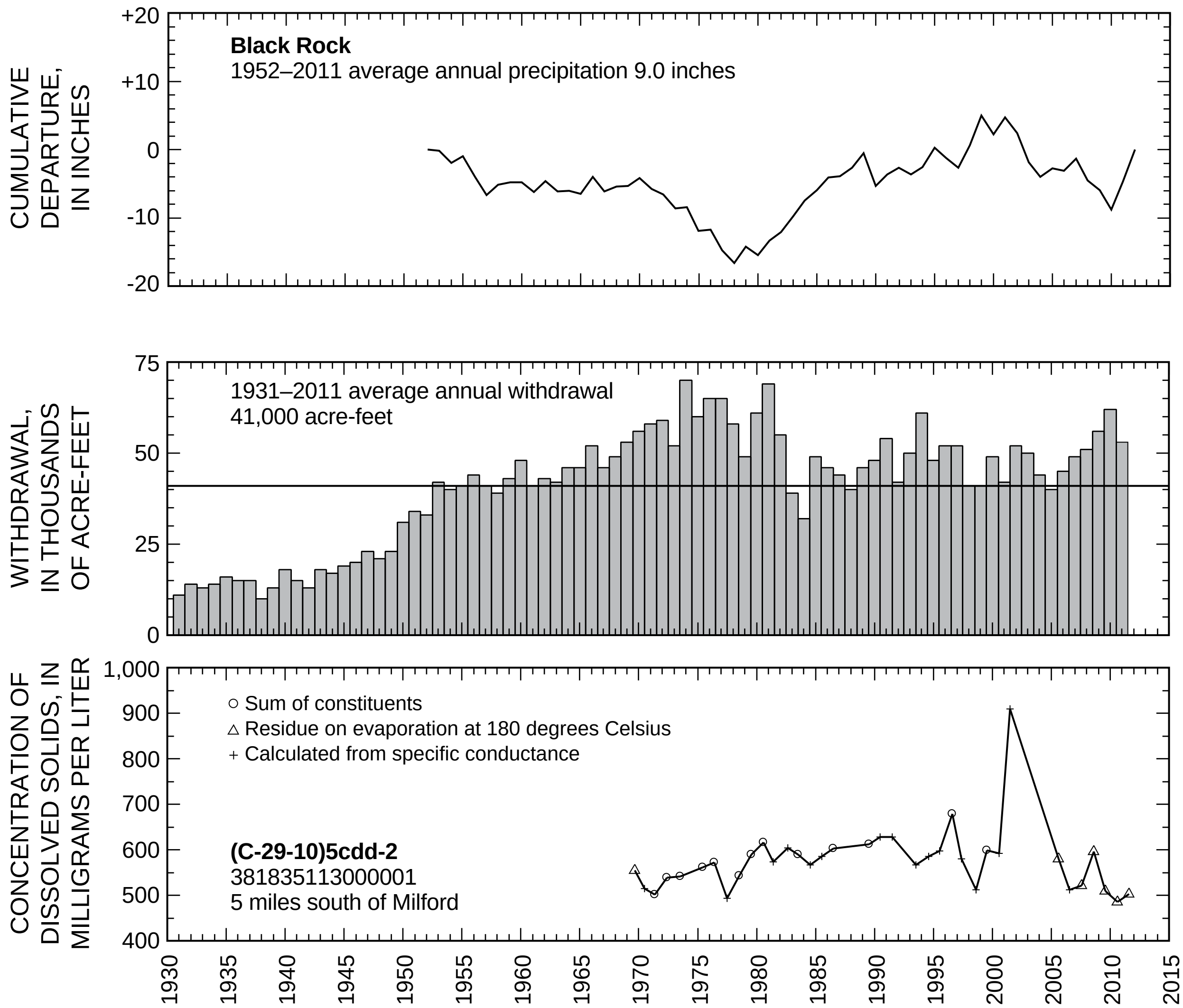


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

Escalante Valley

Beryl-Enterprise Area

By Howard K. Christiansen

The Beryl-Enterprise area covers about 800 square miles at the southern end of Escalante Valley, southeast of the Wah Wah Mountains in Iron County, and a small area in Washington County in the vicinity of the community of Enterprise (fig. 30). Groundwater occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 2011 was about 84,000 acre-feet, which is 6,000 acre-feet less than in 2010 and 5,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3).

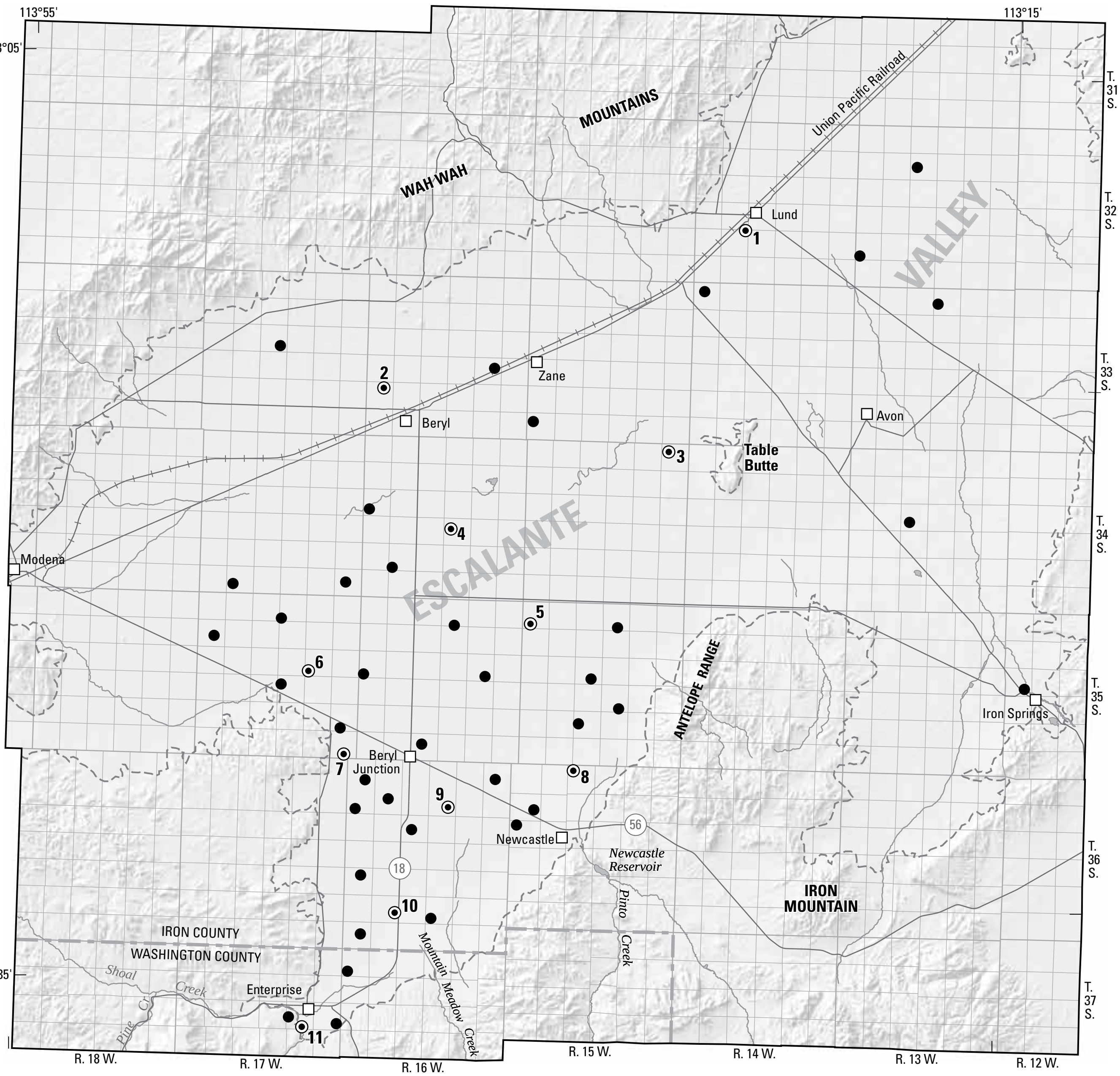
The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2012 is shown in figure 30. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 31.

Precipitation at Enterprise in 2011 was about 11.5 inches, which is about 2.6 inches less than the average annual precipitation for 1955–2011 and about 13.8 inches less than in 2010.

Water levels declined slightly from March 2011 to March 2012 in most of the wells measured in the Beryl-Enterprise area. Water levels have declined steadily since 1950 and show little or no recovery during periods of greater-than-average precipitation. The declines are a result of continued large withdrawals for irrigation since 1950. A decline of about 130 feet from March 1946 to March 2012 was measured in well (C-36-16)29daa-1, about 5 miles northeast of Enterprise (fig. 31).

The concentration of dissolved solids in water samples collected from well (C-34-16)28dcc-2, located 6 miles south-southeast of Beryl, from 1950 to 2011, is shown in figure 31. Based on the chemistry of the water from this well, the sum of the constituents has been determined to be the best method to estimate the concentration of dissolved solids. The concentration has ranged from 460 to 699 mg/L with a median value of 649 mg/L. The concentration of dissolved solids in the water sample collected in August 2011 was 681 mg/L.

Physical properties and results of chemical analyses for water from four wells in the Beryl-Enterprise area are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentration of dissolved solids in the water sample from well (C-34-16)28dcc-2 exceeded the secondary drinking-water standard (500 mg/L).



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

0 2 4 6 8 Miles
0 2 4 6 8 Kilometers

EXPLANATION

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

● **Observation well**

9 ⊙ **Observation well with corresponding hydrograph**—Number refers to hydrograph in figure 31

Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2012.

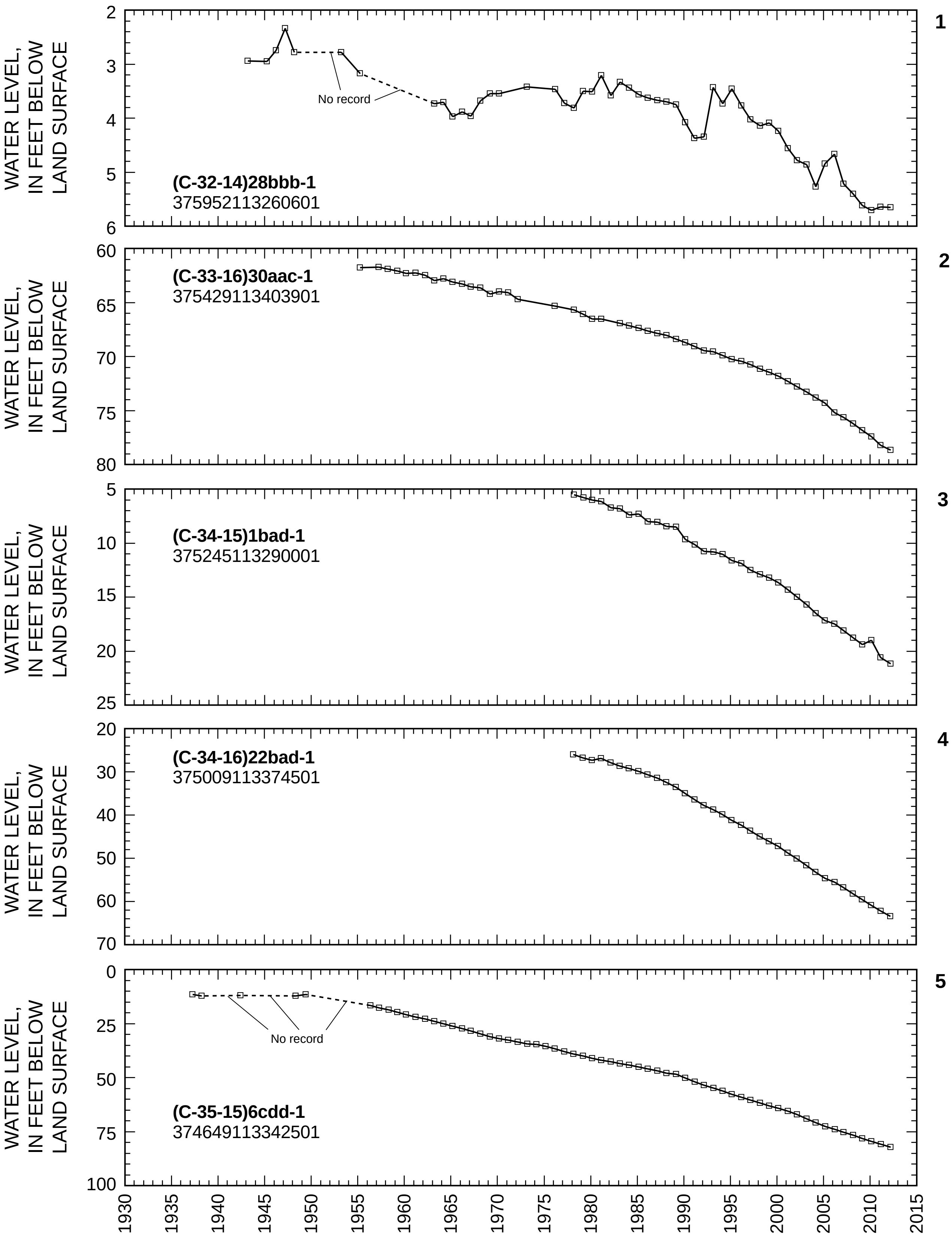


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

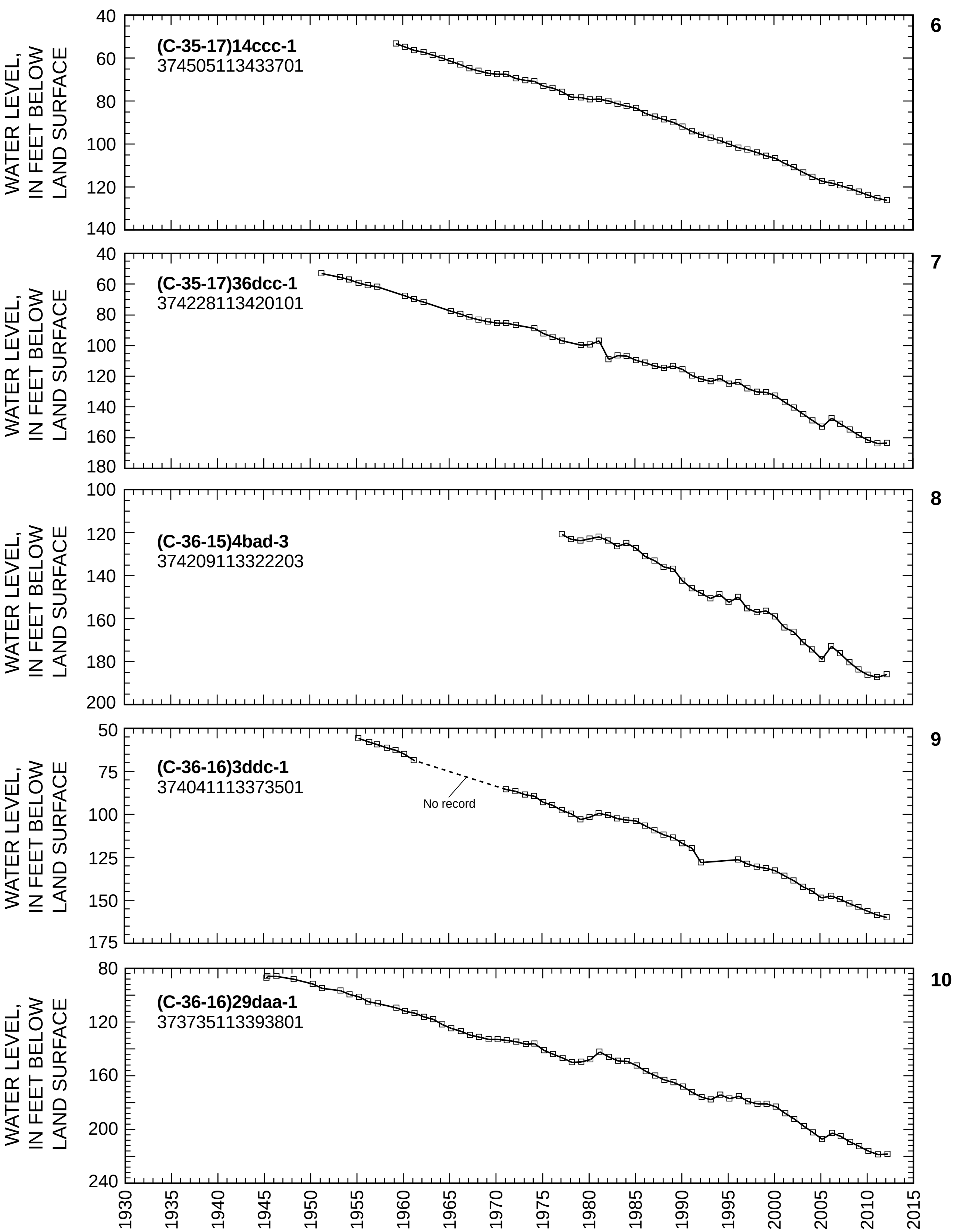


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.—Continued

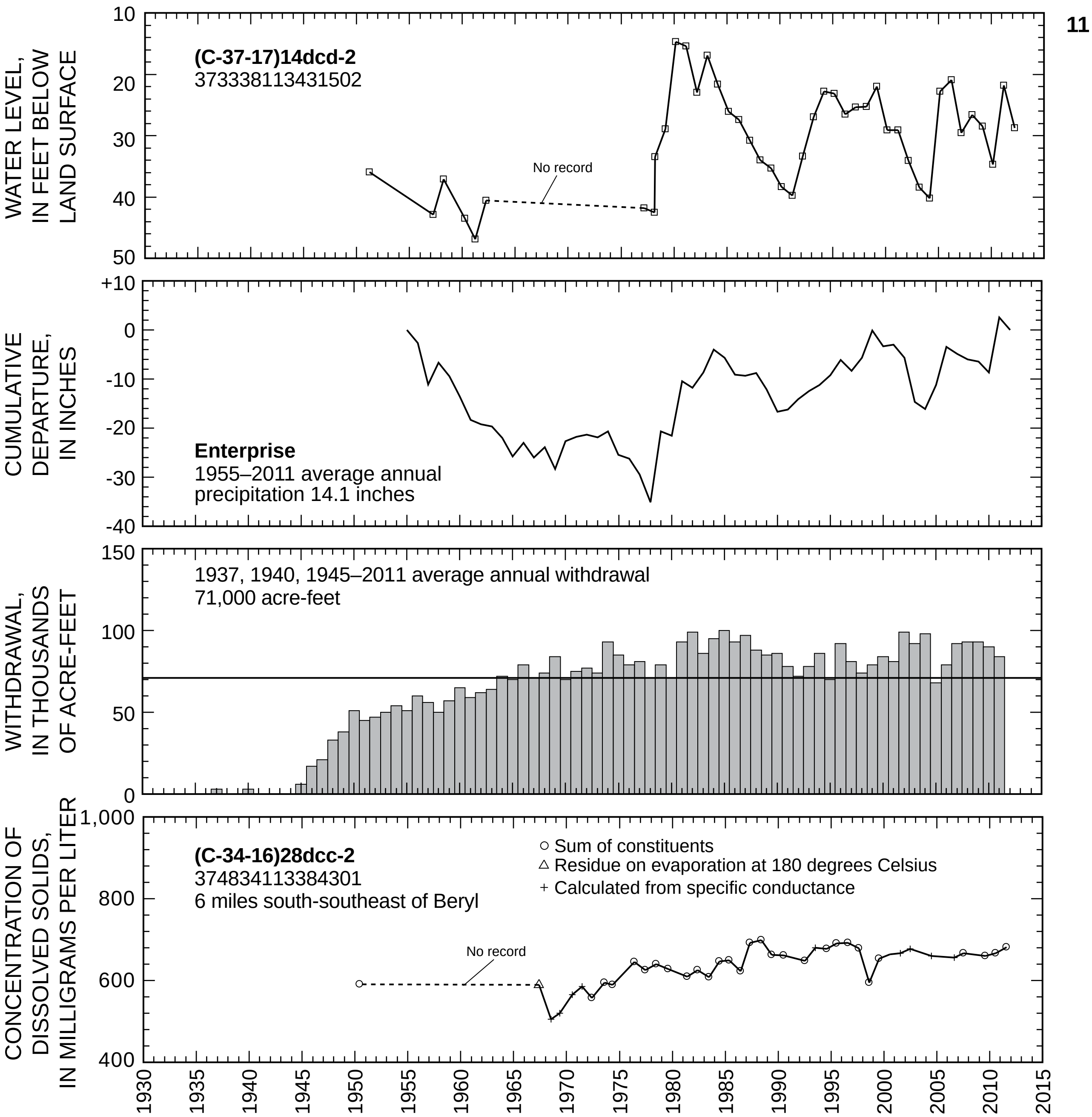


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.—Continued

Central Virgin River Area

By Howard K. Christiansen

The central Virgin River area is between the Pine Valley Mountains and the Hurricane Cliffs, and is bounded by the Beaver Dam Mountains to the southwest, in Washington County (fig. 32). Major groundwater development includes water from valley-fill aquifers that is used primarily for irrigation, and water from consolidated rock and valley fill that is used primarily for public supply. Most of the wells are located near the Virgin and Santa Clara Rivers.

Total estimated withdrawal of water from wells in the central Virgin River area in 2011 was about 28,000 acre-feet, which is about 1,000 acre-feet less than in 2010 and 1,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3), mainly due to decreased withdrawal for irrigation. Withdrawal for industrial use decreased slightly, and withdrawals for public supply and for domestic and stock use were about the same as in 2010.

The location of wells in the central Virgin River area in which the water level was measured during February 2012 is shown in figure 32. The relation of the water level in selected observation wells to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2 is shown in figure 33.

Discharge of the Virgin River at Virgin in 2011 was about 234,100 acre-feet, which is 50,600 acre-feet more than the revised value for 2010 and about 99,500 acre-feet more than the long-term average for 1931–70 and 1979–2011. Precipitation at St. George in 2011 was about 2.4 inches, which is about 5.7 inches less than the average annual precipitation for 1930–2011 and 12.6 inches less than in 2010.

Water levels from February 2011 to February 2012 generally rose in most of the central Virgin River area. The largest rise, about 7.5 feet, was observed in a well in the northern part of the area near Kanarraville. Rises are probably the result of decreased withdrawal for irrigation. Some declines were observed, probably due to continued localized pumpage and less-than-average precipitation. The largest decline, almost 6 feet, was observed in a well southeast of New Harmony.

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 2011, 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 to give an extended temporal record for this constituent. The concentration has ranged from 255 to 313 mg/L with a median value of 290 mg/L. The dissolved-solids concentration in the water sample collected in August 2011 (296 mg/L) is very close to the median value.

Physical properties and results of chemical analyses for water from four wells in the central Virgin River area are shown in tables 5 and 6, and the locations of the wells are plotted in figure 41. Water from well (C-42-16)26bcc-1 exceeded the MCLs for dissolved solids (2,000 mg/L), sulfate (1,000 mg/L), nitrate plus nitrite (10 mg/L) and the secondary drinking-water standards for chloride (250 mg/L) and manganese (50 µg/L). Water from well (C-41-17)8cbd-2 exceeded the MCL for arsenic (10 µg/L).

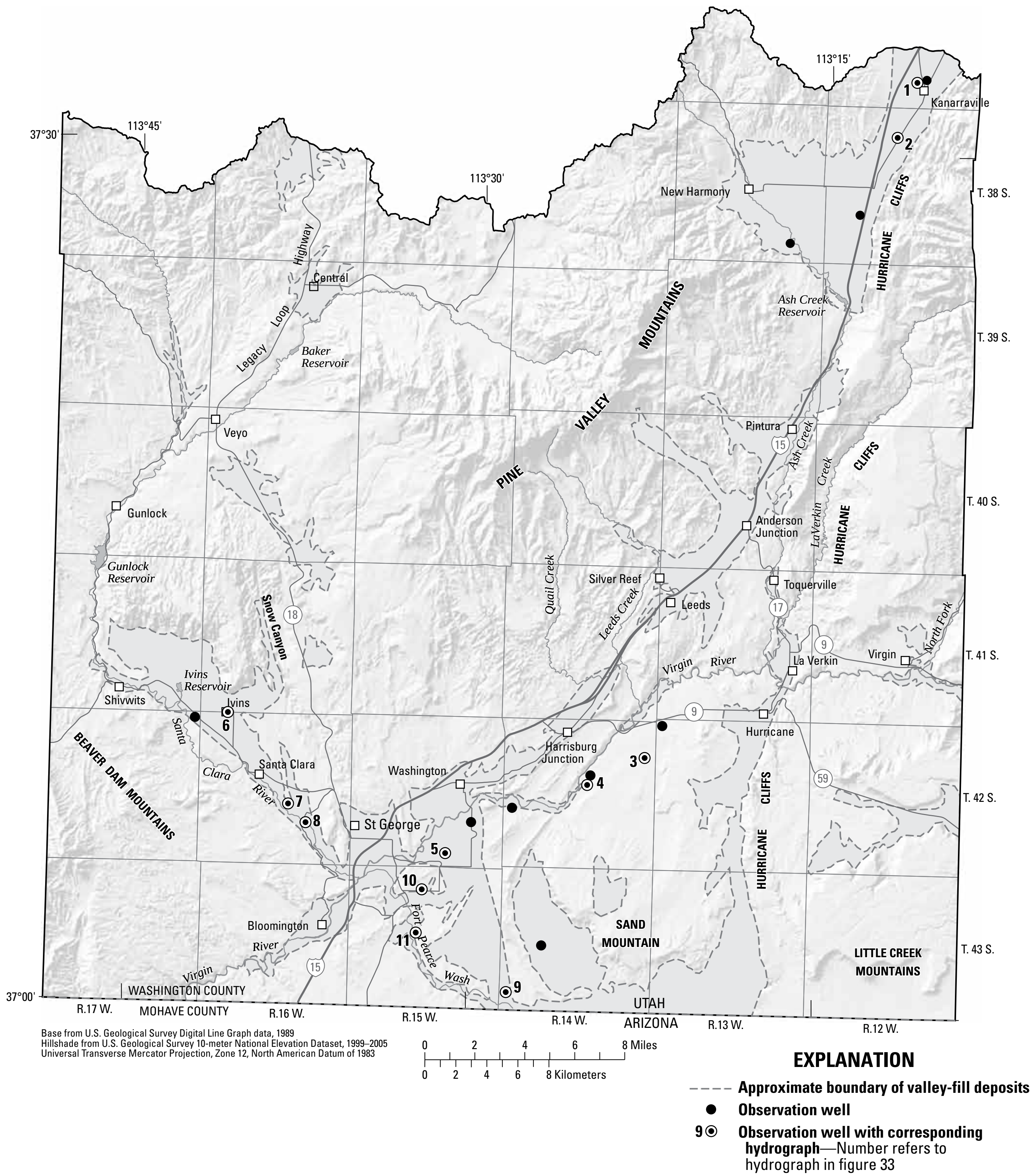


Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 2012.

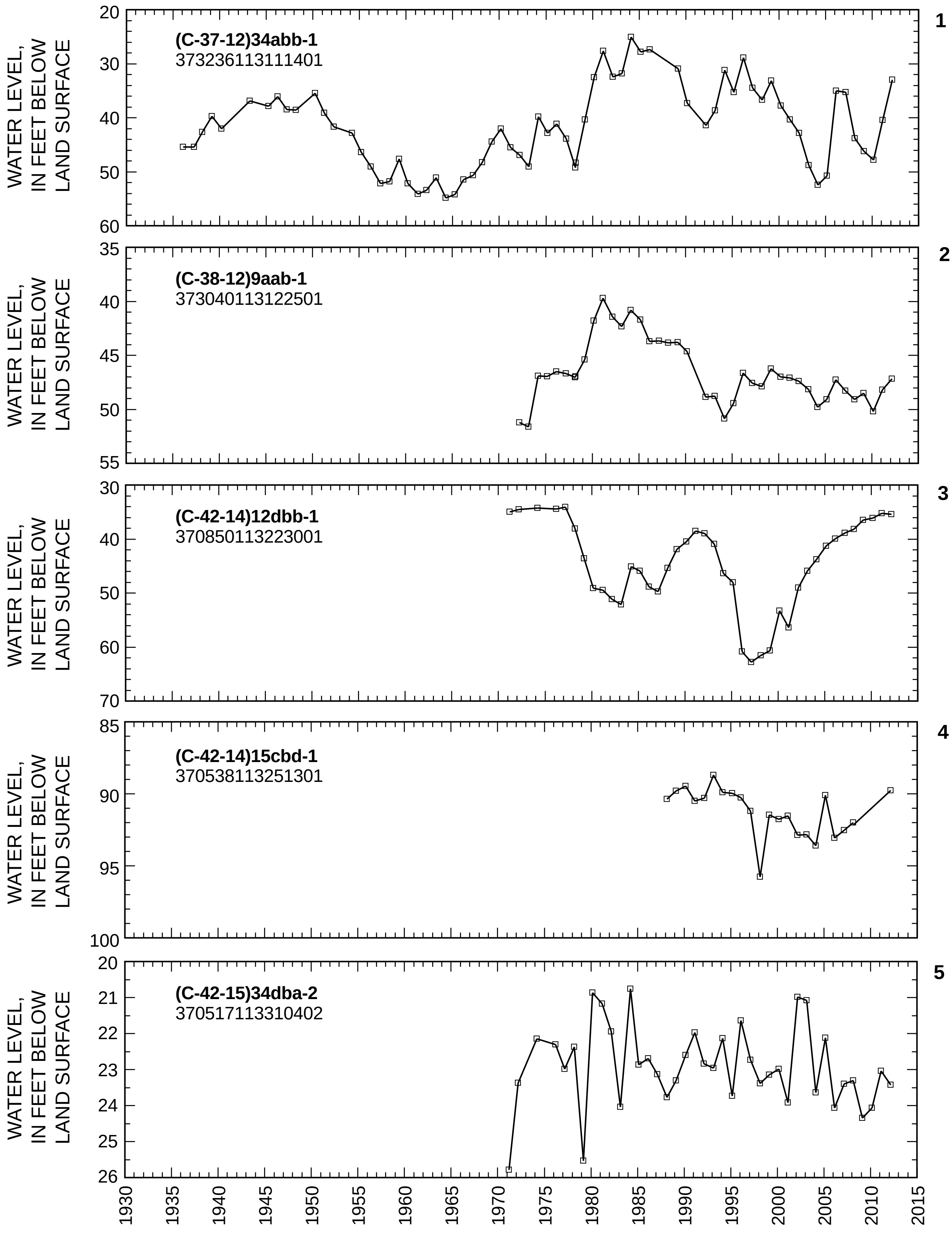


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

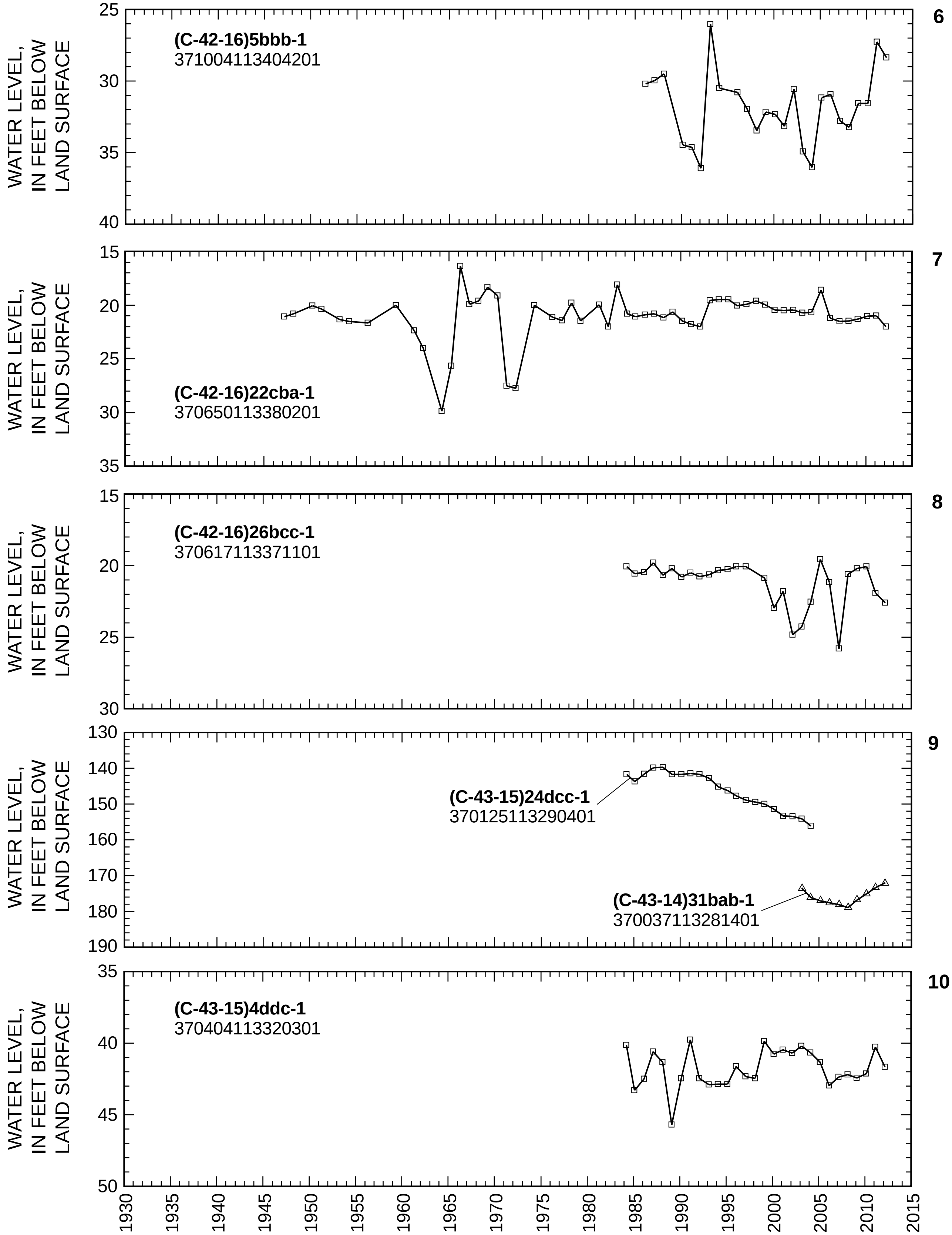


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

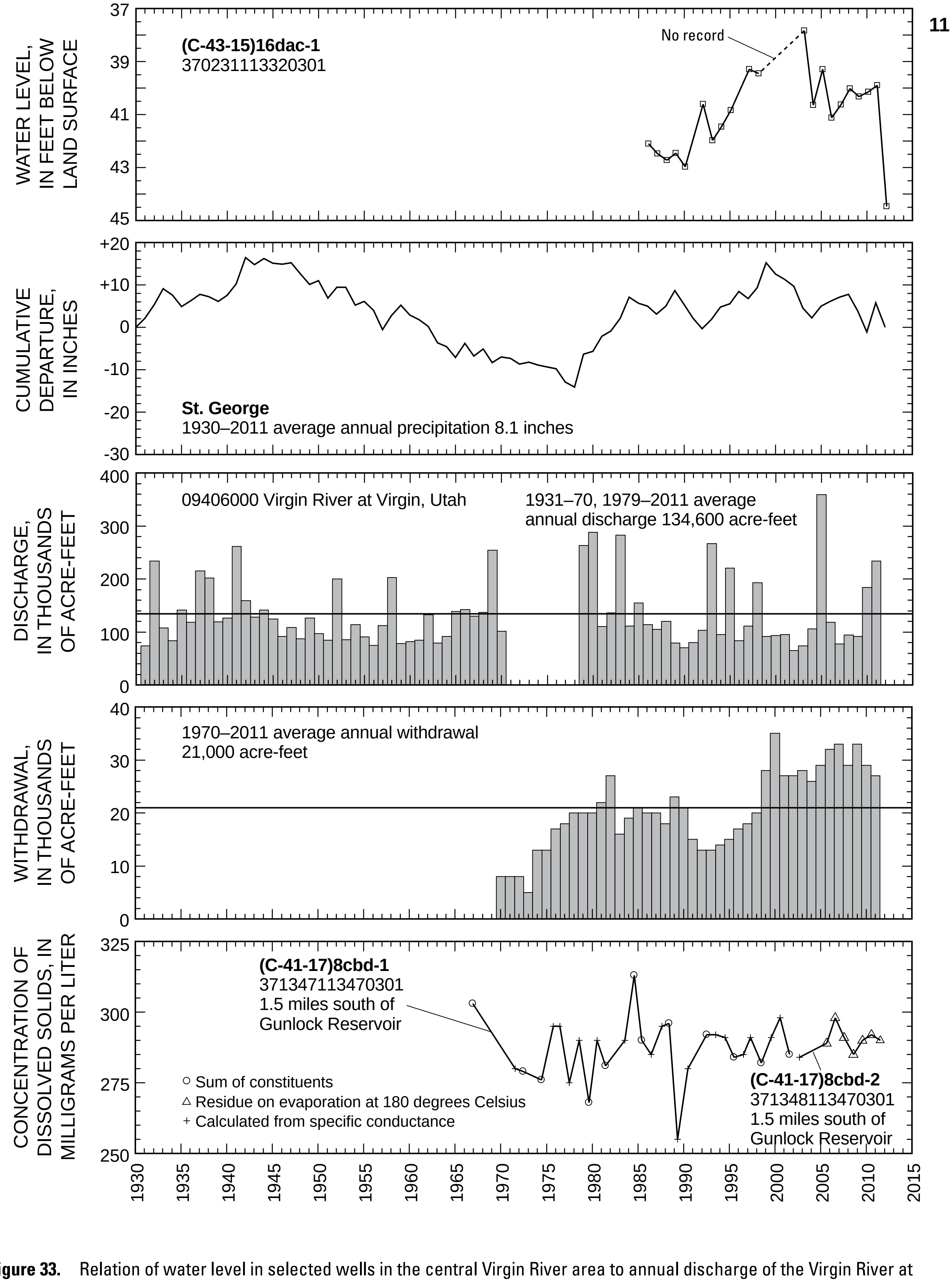


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

Other Areas

By Martel J. Fisher

Total estimated withdrawal of water from wells in other areas of Utah (table 4) in 2011 was about 123,000 acre-feet, which is 11,000 acre-feet less than the estimate for 2010 and 8,000 acre-feet less than the average annual withdrawal for 2001–2010 (tables 2 and 3). The largest decreases were due to decreased withdrawals for irrigation use. In most of the areas listed in table 4, withdrawals in 2011 were less than in 2010, except in Skull Valley, Dugway area, and Old River Bed, and Ogden Valley, where public-supply use increased slightly or stayed the same; and in Cedar Valley, Utah County, where irrigation withdrawals increased slightly.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2012, is shown in figure 34. The relation of the water level in 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, but generally have declined since the mid-1980s. Water levels rose in most of the wells from March 2011 to March 2012.

The location of wells in Sanpete Valley in which the water level was measured during March 2012 is shown in figure 36. The relation of the water level in selected observation wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti is shown in figure 37.

Water levels in many of the selected wells in Sanpete Valley rose from the late-1970s to the mid-1980s as a result of greater-than-average precipitation and have varied since the mid-1980s, but overall have declined. Water levels rose in most of the selected observation wells from March 2011 to March 2012.

The location of wells in Snake Valley and the West Desert in which the water level was measured during March 2012 is shown in figure 38. The relation of the water level in selected observation wells in the area to cumulative departure from average annual precipitation at Callao is shown in figure 39.

Water levels in many of the selected wells in Snake Valley and the West Desert rose, or declined only slightly, from March 2011 to March 2012. 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 wells in the remaining selected areas of Utah (table 4) to cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 40. Water levels rose or decreased only slightly in most of the selected observation wells from March 2011 to March 2012.

Table 4. Estimated withdrawal of water from wells in other areas of Utah, 2011.

Number in figure 1	Area	Estimated withdrawal from wells (acre-feet)					
		2011					2010 total (rounded)
		Irrigation	Industrial	Public supply	Domestic and stock	Total (rounded)	
1	Grouse Creek Valley	1,600	0	0	20	1,600	1,800
2	Park Valley area	1,500	0	0	10	1,500	1,800
4	Lower Bear River area	3,000	380	5,500	200	9,100	11,100
8	Ogden Valley	0	0	12,100	20	12,100	12,100
13	Rush Valley	4,000	300	340	30	4,700	4,800
14	Skull Valley, Dugway area, and Old River Bed	2,400	3,800	1,300	10	7,500	6,600
15	Cedar Valley, Utah County	1,900	0	4,300	40	6,200	5,700
20	Sanpete Valley	1,700	790	980	4,000	7,500	10,400
25a	Snake Valley	14,800	0	90	50	14,900	17,500
27	Beaver Valley	5,900	20	330	470	6,700	10,300
	Remainder of State	11,700	14,700	21,900	2,600	50,900	51,400
Total (rounded)		48,500	20,000	46,800	7,500	123,000	134,000

Water Quality

Physical properties and results of chemical analyses for water from wells in the areas indicated below are shown in tables 5 and 6, and the location of the wells is shown in figure 41.

Beaver Valley

The water sample from well (C-29-8)31add-1, the only well sampled in Beaver Valley, exceeded the secondary standard for dissolved solids (500 mg/L).

Lower Bear River area

Concentrations of dissolved solids and chloride in water from three wells sampled in the lower Bear River area exceeded the secondary standards for these constituents (500 mg/L and 250 mg/L, respectively). Also, water from well (B-12-4)35aab-1 exceeded the secondary standard for sulfate (250 mg/L), and the MCL for selenium (50 µg/L).

Duchesne River area

Concentrations of dissolved solids and sulfate in the water sample from well U(C-2-1)3cbd-1, one of five wells sampled in the Duchesne River area, exceeded the secondary standard for these constituents (500 mg/L and 250 mg/L, respectively). Also, water from wells U(C-1-2)22ccc-1 and U(C-2-1)3cbd-1 exceeded the secondary standard for iron (300 µg/L). Water from wells U(C-2-5)34abc-1 and U(C-2-5)35bab-1, exceeded the secondary standard for pH (6.5 to 8.5 units).

Curlew Valley (Kelton area)

Concentrations of dissolved solids in water from the two wells sampled in the Kelton area exceeded the MCL for this constituent (2,000 mg/L) and exceeded the secondary standard for chloride (250 mg/L).

Snake Valley

Concentrations of dissolved solids in water samples from wells (C-23-19)20bac-2 and (C-23-19)20bcd-1, two of five wells sampled in Snake Valley, exceeded the secondary standard for this constituent (500 mg/L) and exceeded the MCL for arsenic (10 µg/L).

Sanpete Valley

Concentrations of dissolved solids in water samples from wells (D-16-2)13dda-1 and (D-16-3)21cdb-2, two of three wells sampled in Sanpete Valley, exceeded the secondary standard for this constituent (500 mg/L). Also, water from well (D-16-2)13dda-1 exceeded the secondary standard for manganese (50 µg/L).

Upper Sevier River area

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

Rush Valley

Water from two of the three wells sampled in Rush Valley, (C-5-5)32dbb-2 and (C-4-5)30aac-2, exceeded the secondary standard for dissolved solids (500 mg/L). Also, water from one well, (C-8-5)7ddd-2, exceeded the MCL for arsenic (10 µg/L).

Skull Valley

Concentrations of dissolved solids in water from the two wells sampled in Skull Valley exceeded the secondary standard for this constituent (500 mg/L). Also, water from well (C-4-8)3bca-1 exceeded the secondary standard for chloride (250 mg/L).

Cedar Valley, Utah County

Water from one of the two wells sampled in Cedar Valley, Utah County, (C-6-2)26cbb-1, exceeded the secondary standard for dissolved solids (500 mg/L).

Heber Valley

Concentrations of iron in water from two of the eight wells sampled in Heber Valley, (D-4-4)13bdd-1 and (D-4-5)16ccd-1, exceeded the secondary standard for this constituent (300 µg/L). Analytical results for major ions, trace elements (arsenic, molybdenum, selenium, and uranium were not analyzed), and nutrients in water from the remaining wells sampled did not exceed secondary standards or MCLs.

Upper Fremont River Valley

Concentrations of dissolved solids and sulfate in water from the two wells sampled in the upper Fremont River Valley exceeded the secondary standards for these constituents (500 and 250 mg/L, respectively).

Blanding-Bluff area

Concentrations of dissolved solids, iron, and manganese in water from one of the two wells sampled in the Blanding-Bluff area, (D-37-18)35dab-1, exceeded the secondary standards for these constituents (500 mg/L, 300 µg/L, and 50 µg/L, respectively). Also, water from well (D-40-21)33dbc-2 exceeded the secondary standard for pH (6.5-8.5 units).

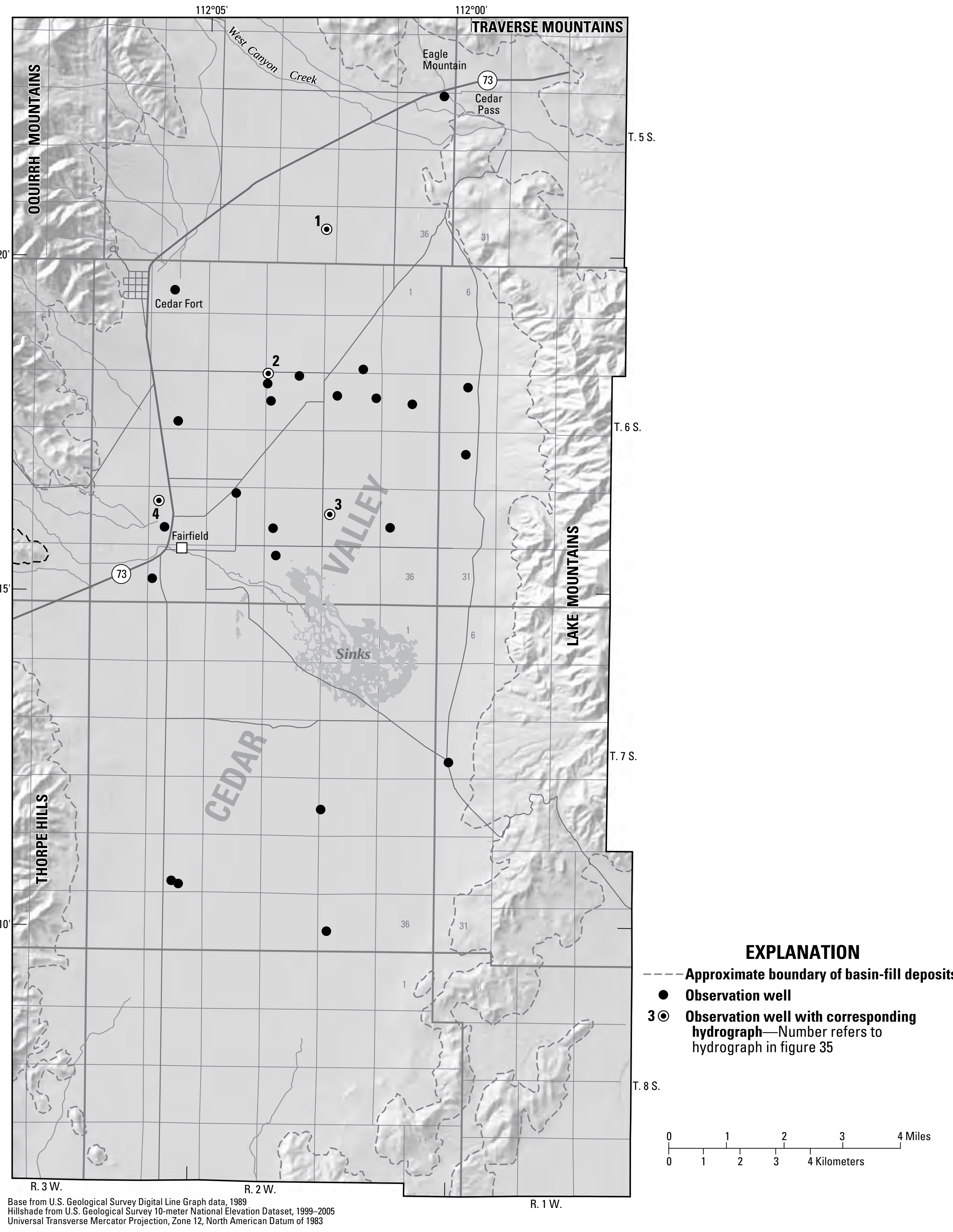


Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2012.

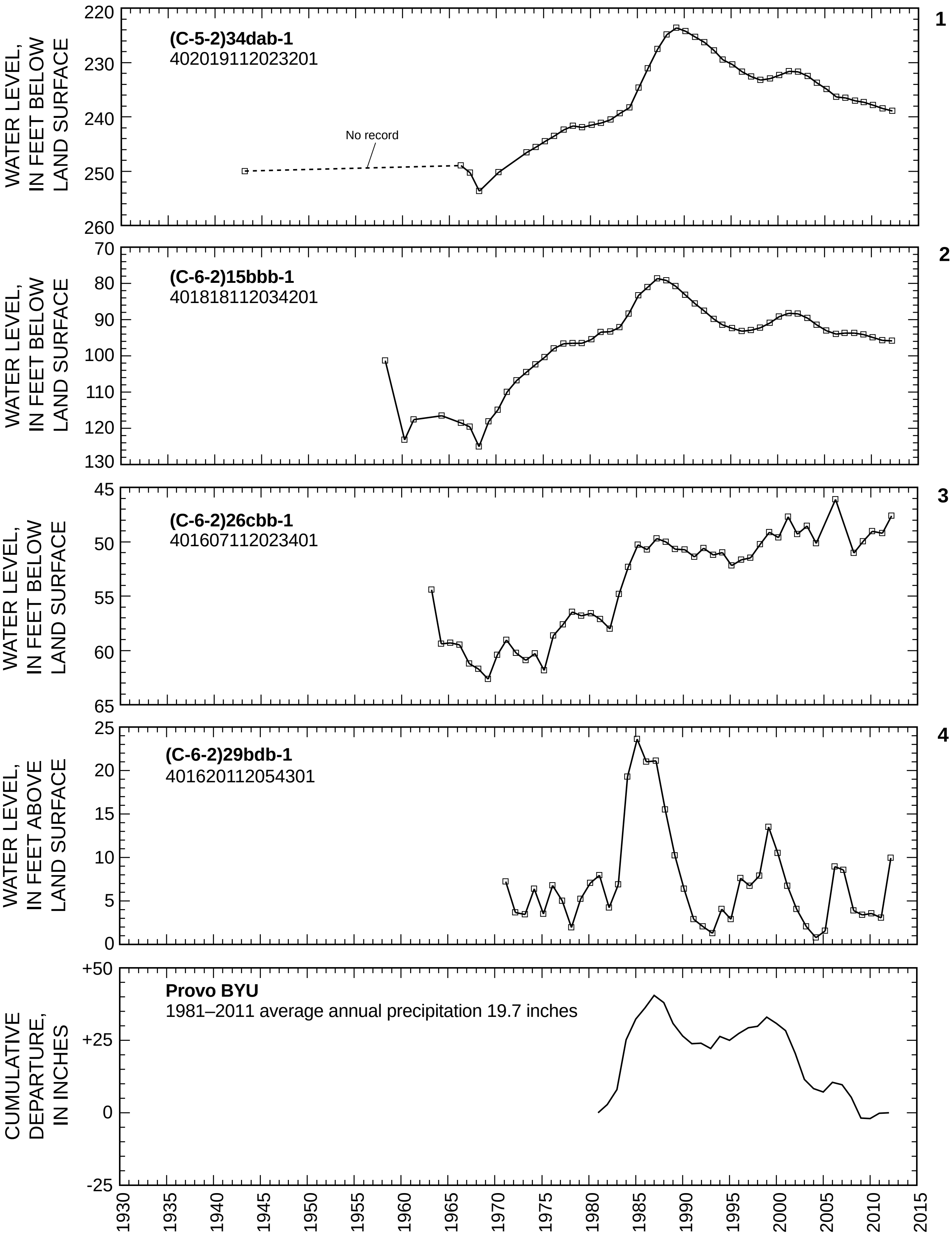


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Provo BYU.

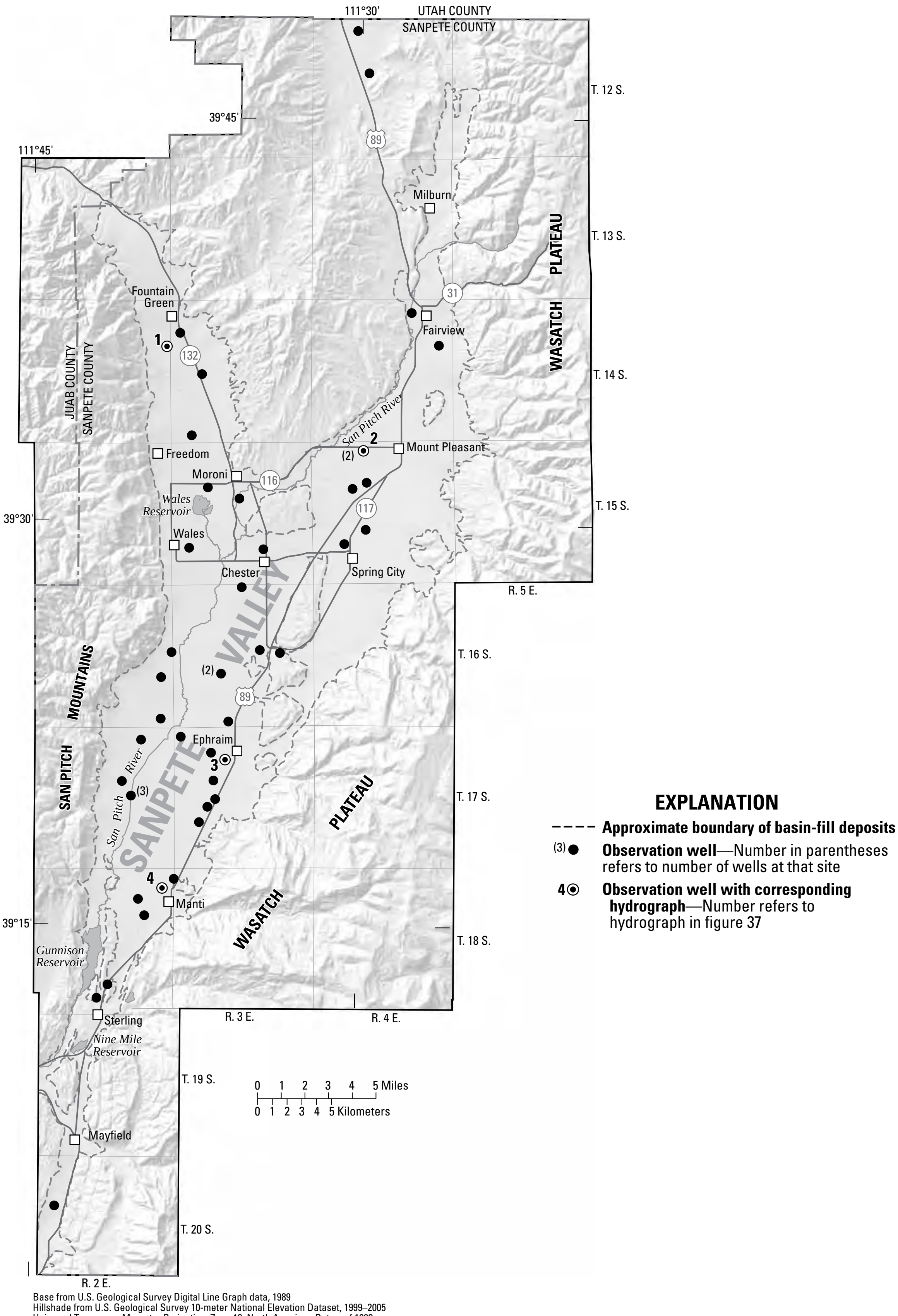


Figure 36. Location of wells in Sanpete Valley in which the water level was measured during March 2012.

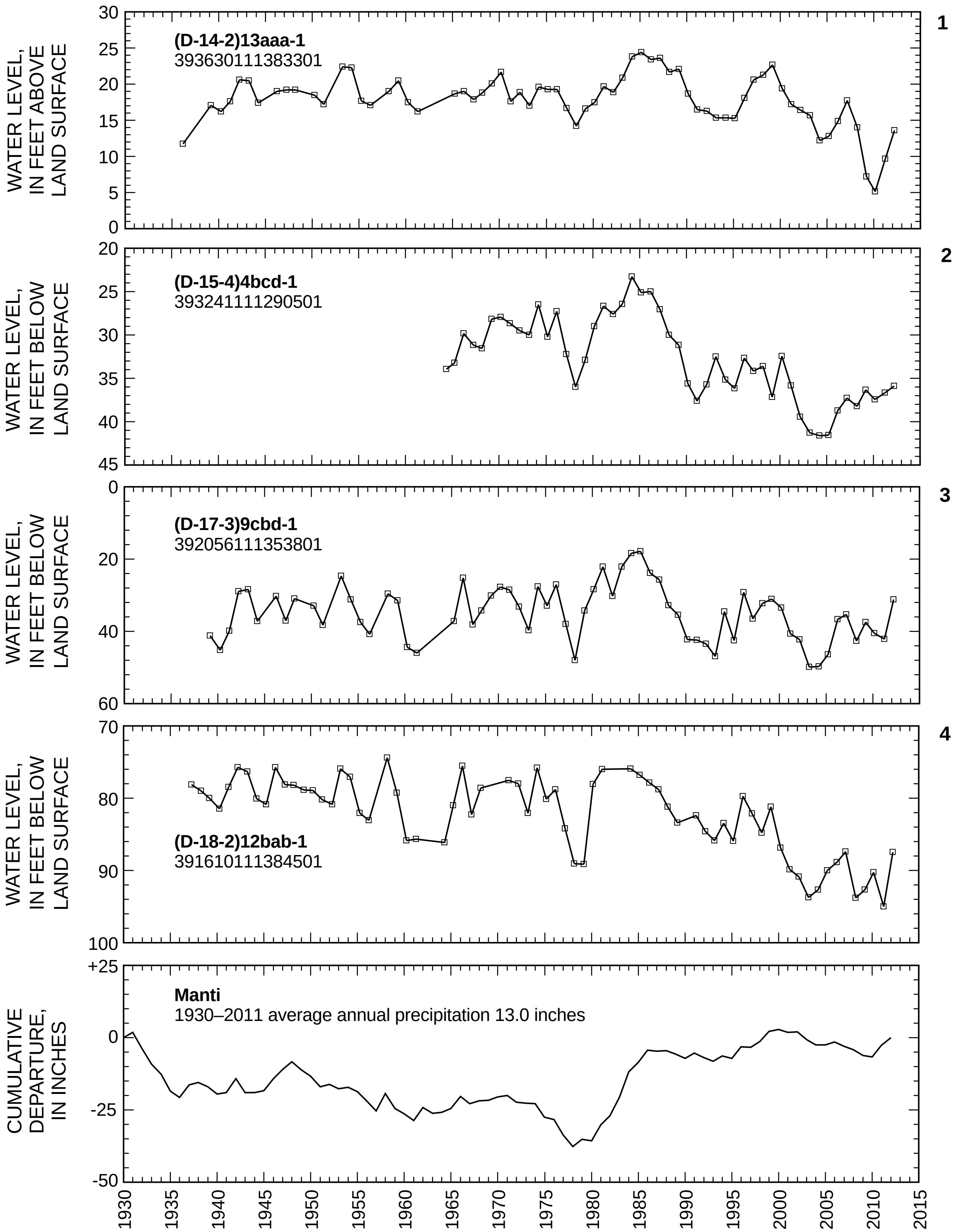


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

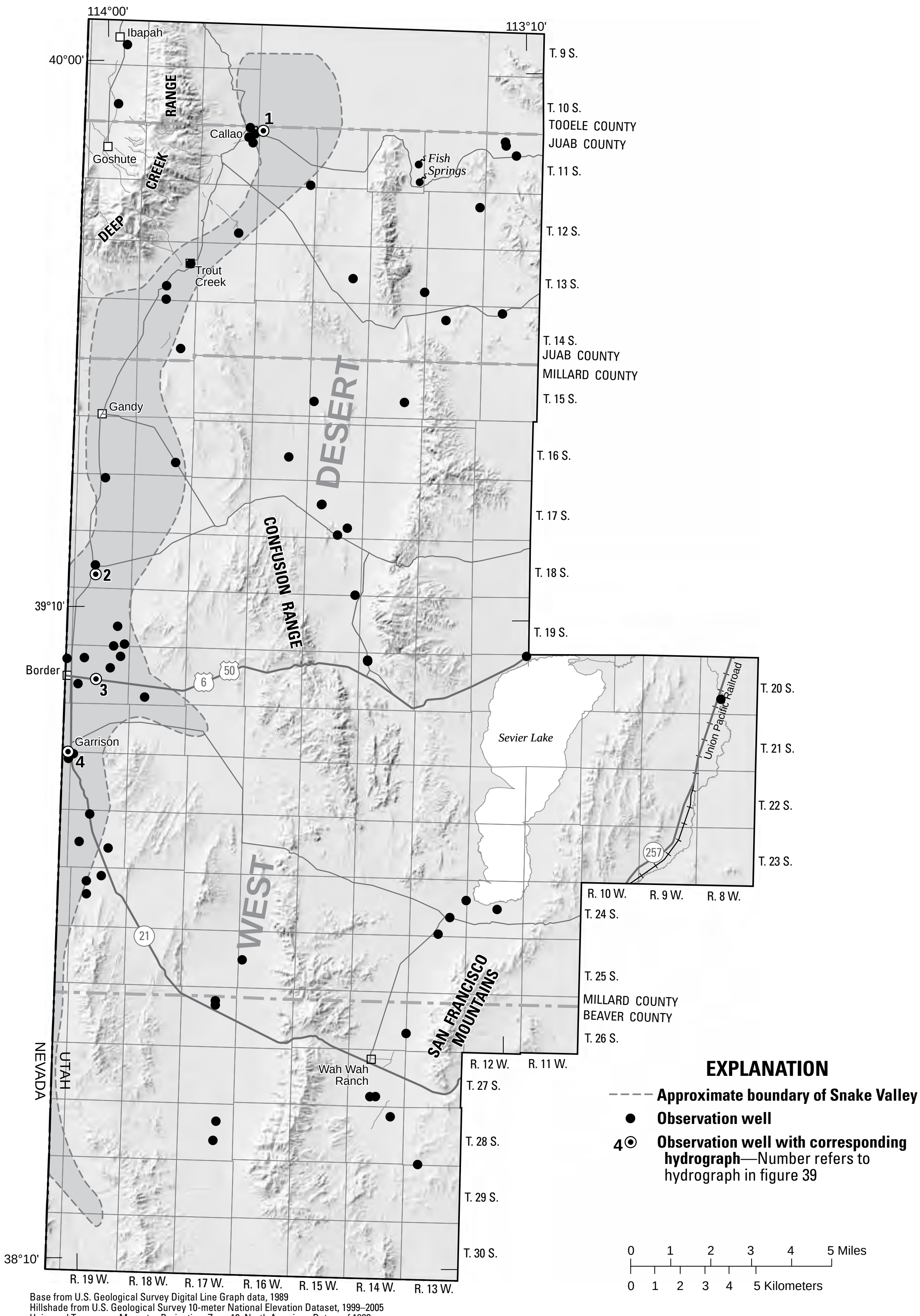


Figure 38. Location of wells in Snake Valley and the West Desert in which the water level was measured during March 2012.

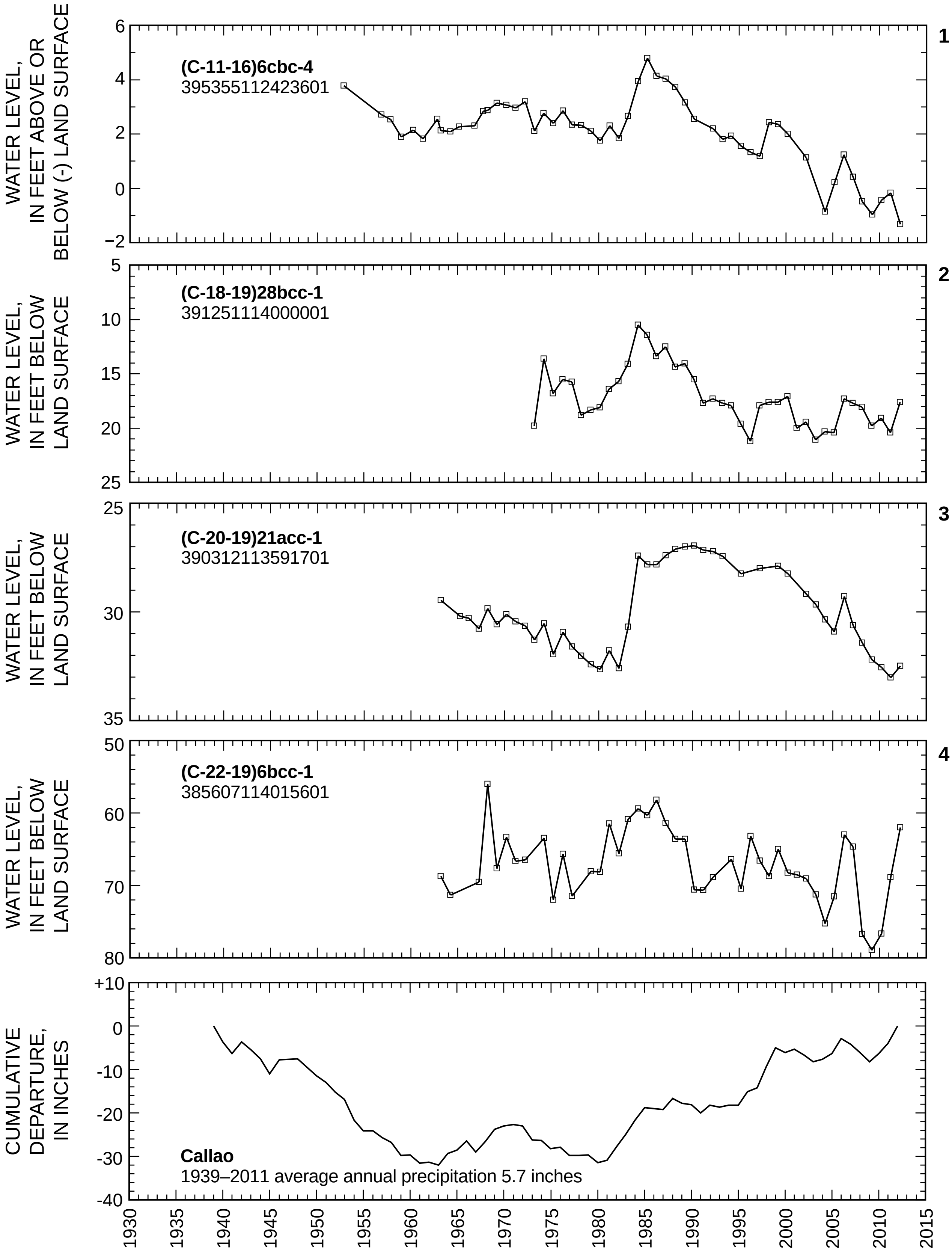


Figure 39. Relation of water level in selected wells in Snake Valley and the West Desert to cumulative departure from average annual precipitation at Callao.

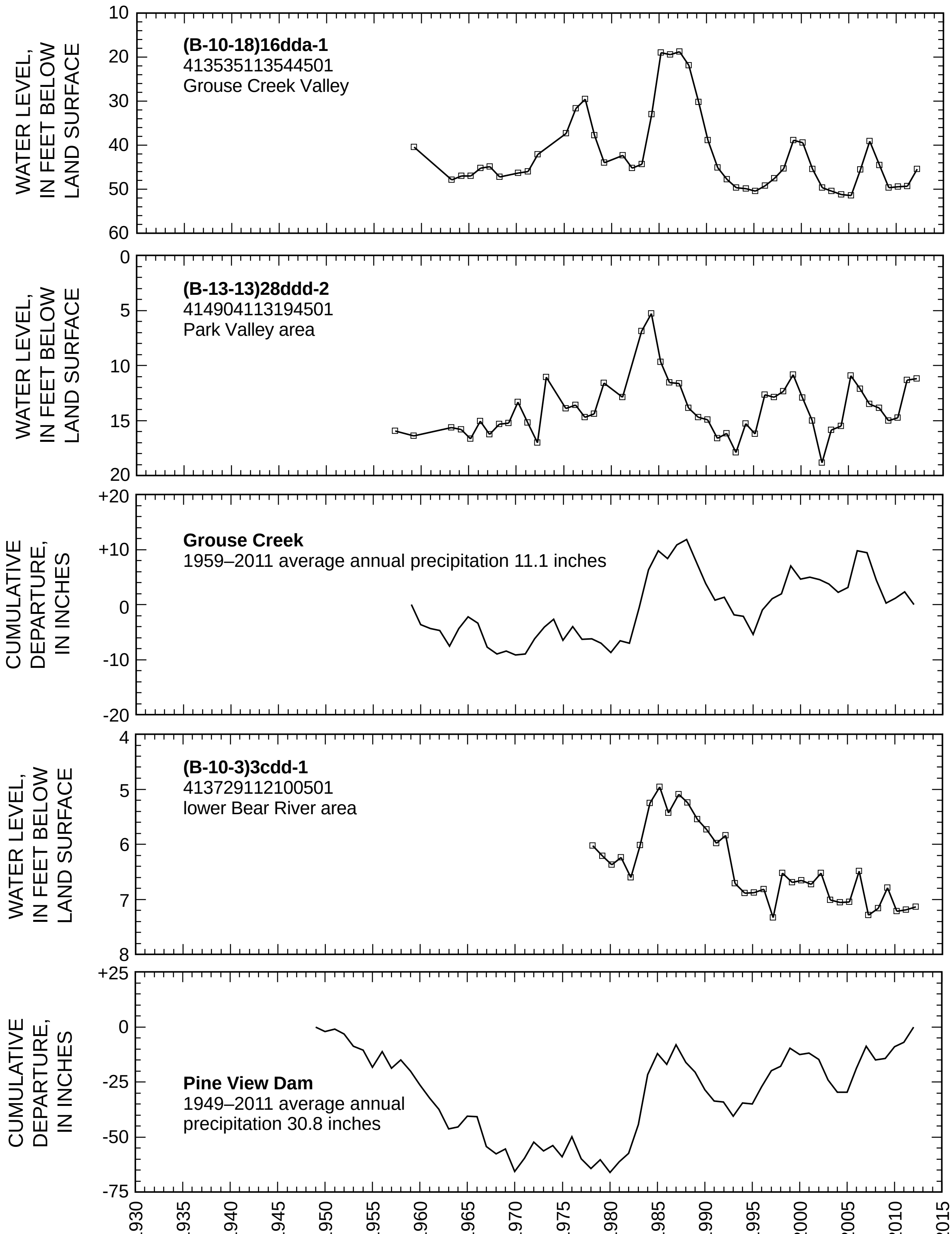


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

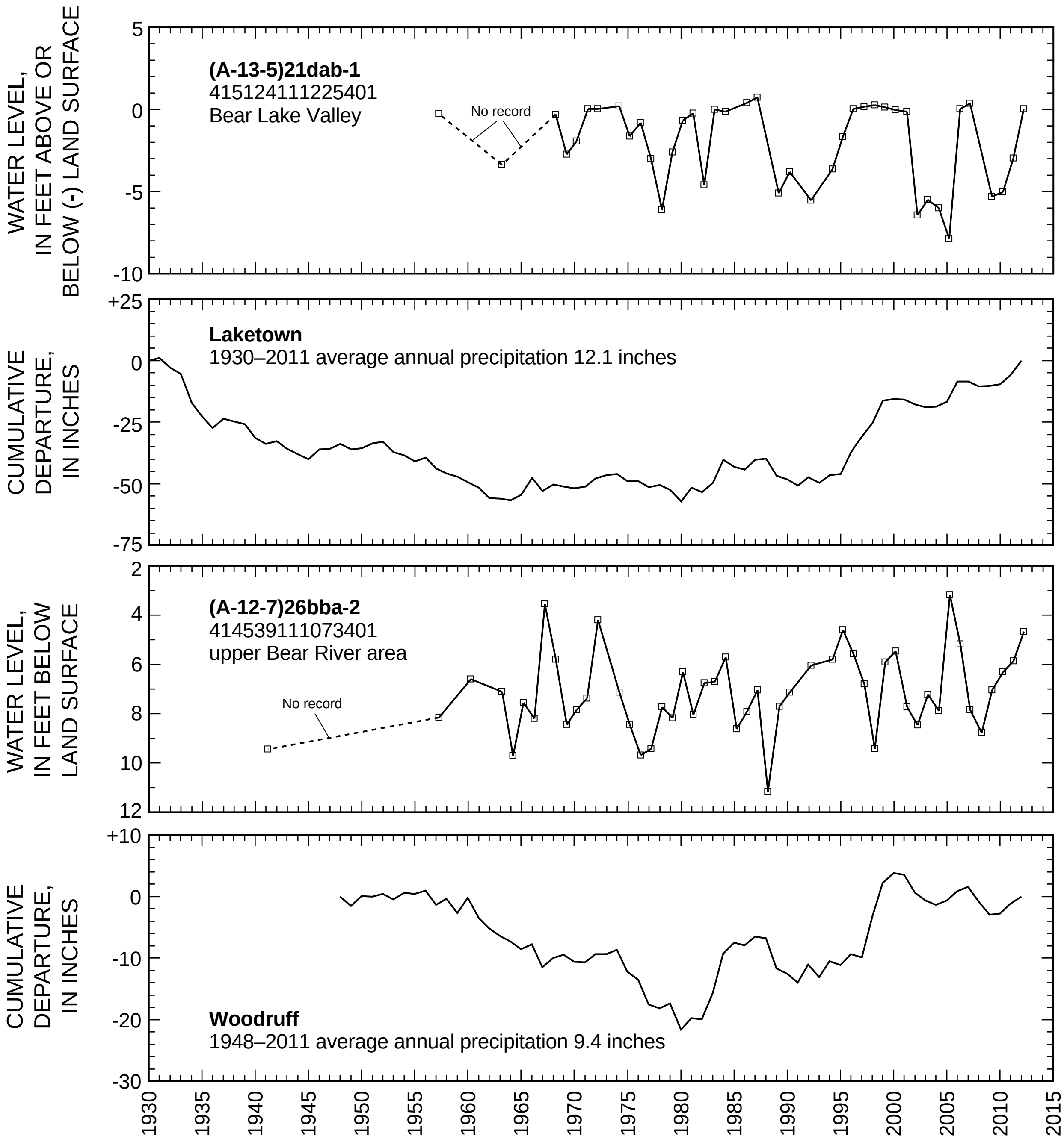


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

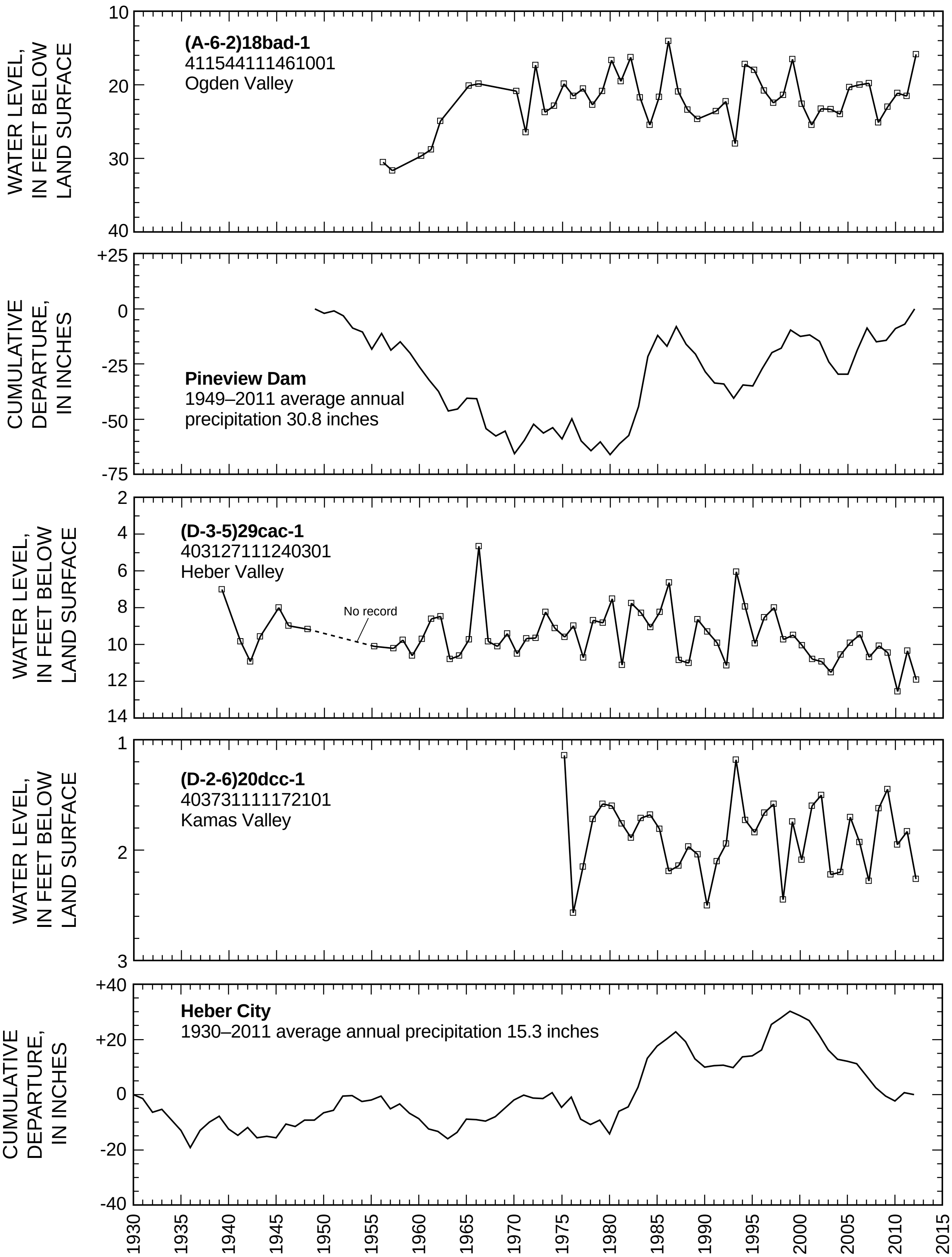


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

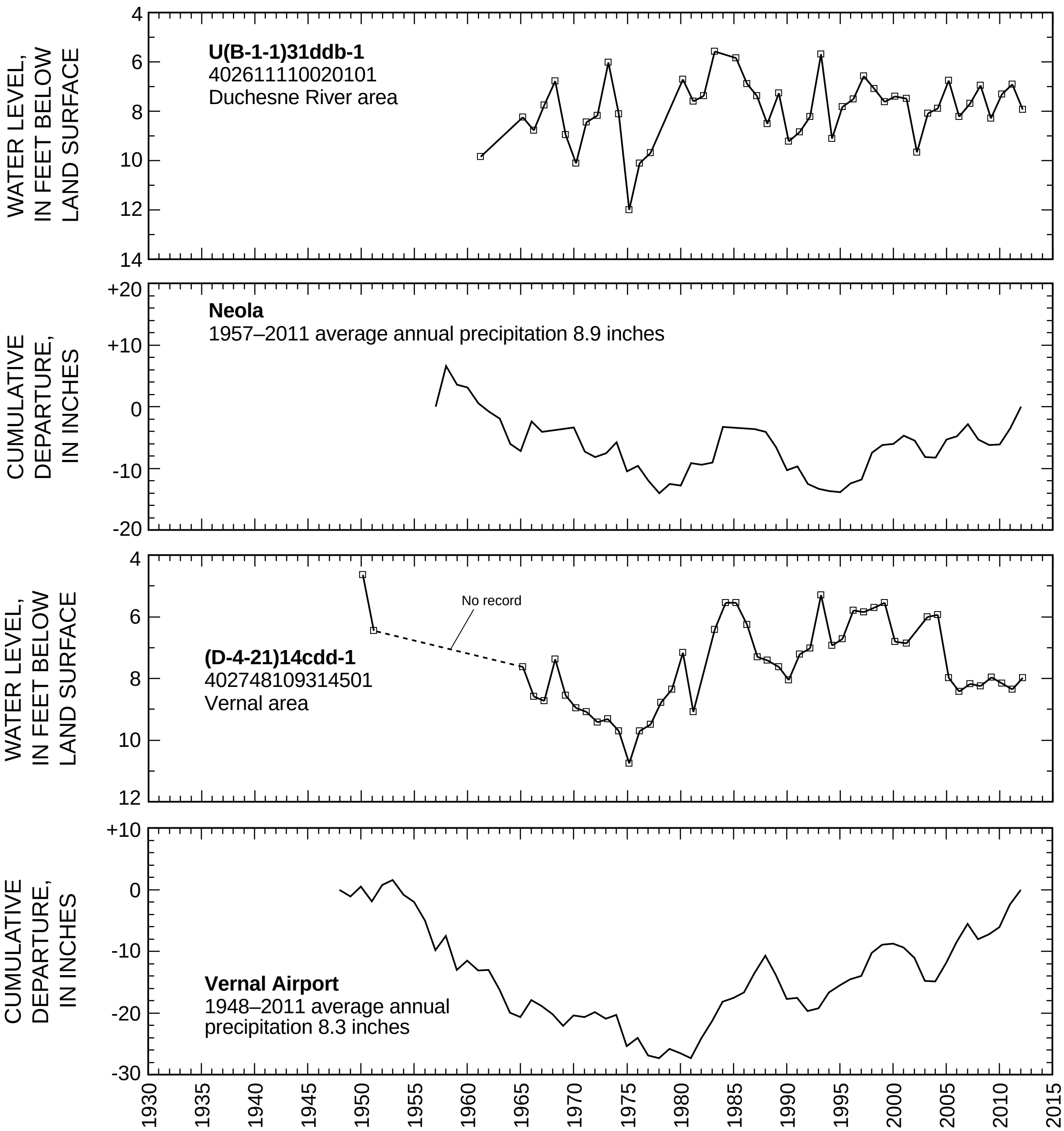


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

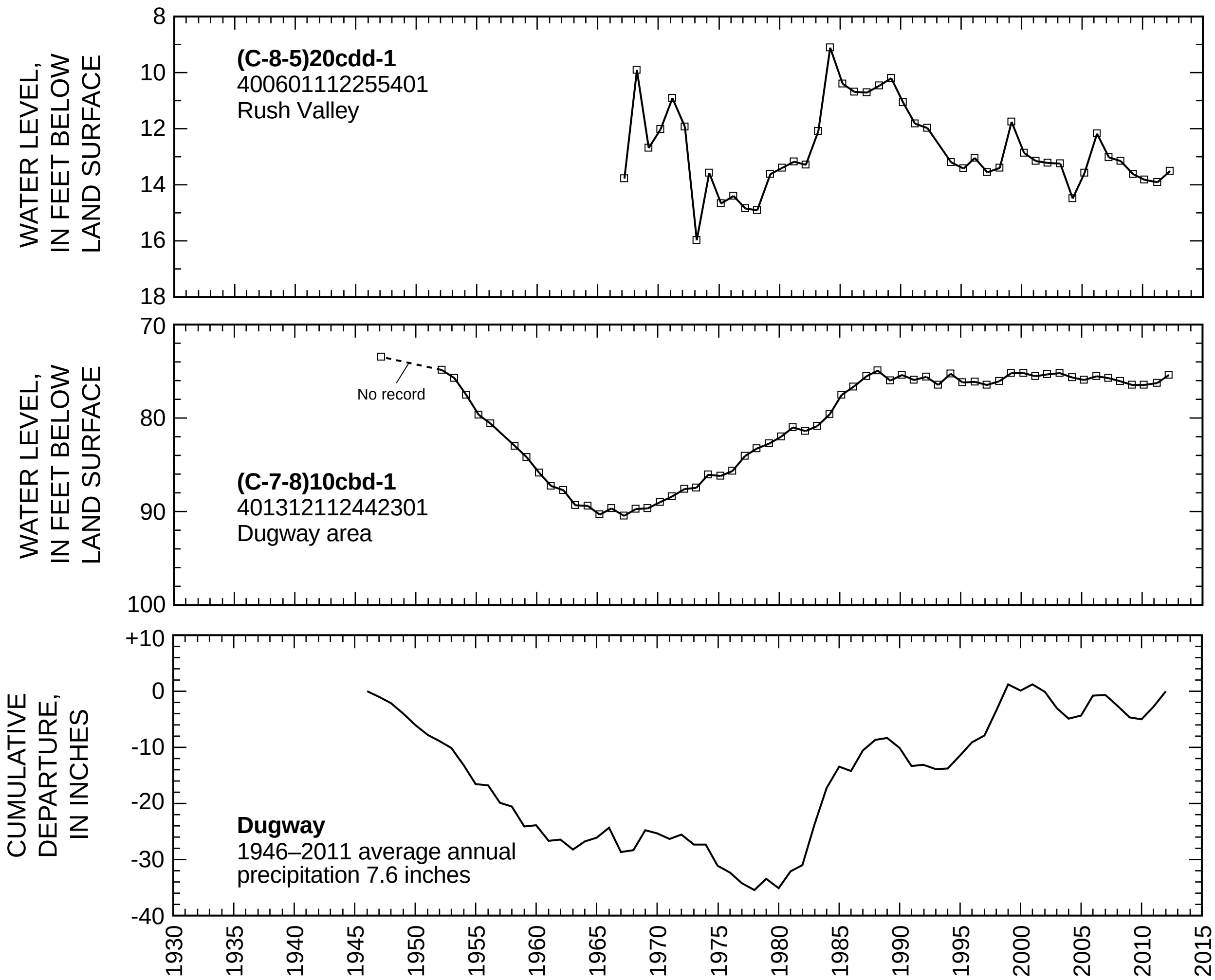


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

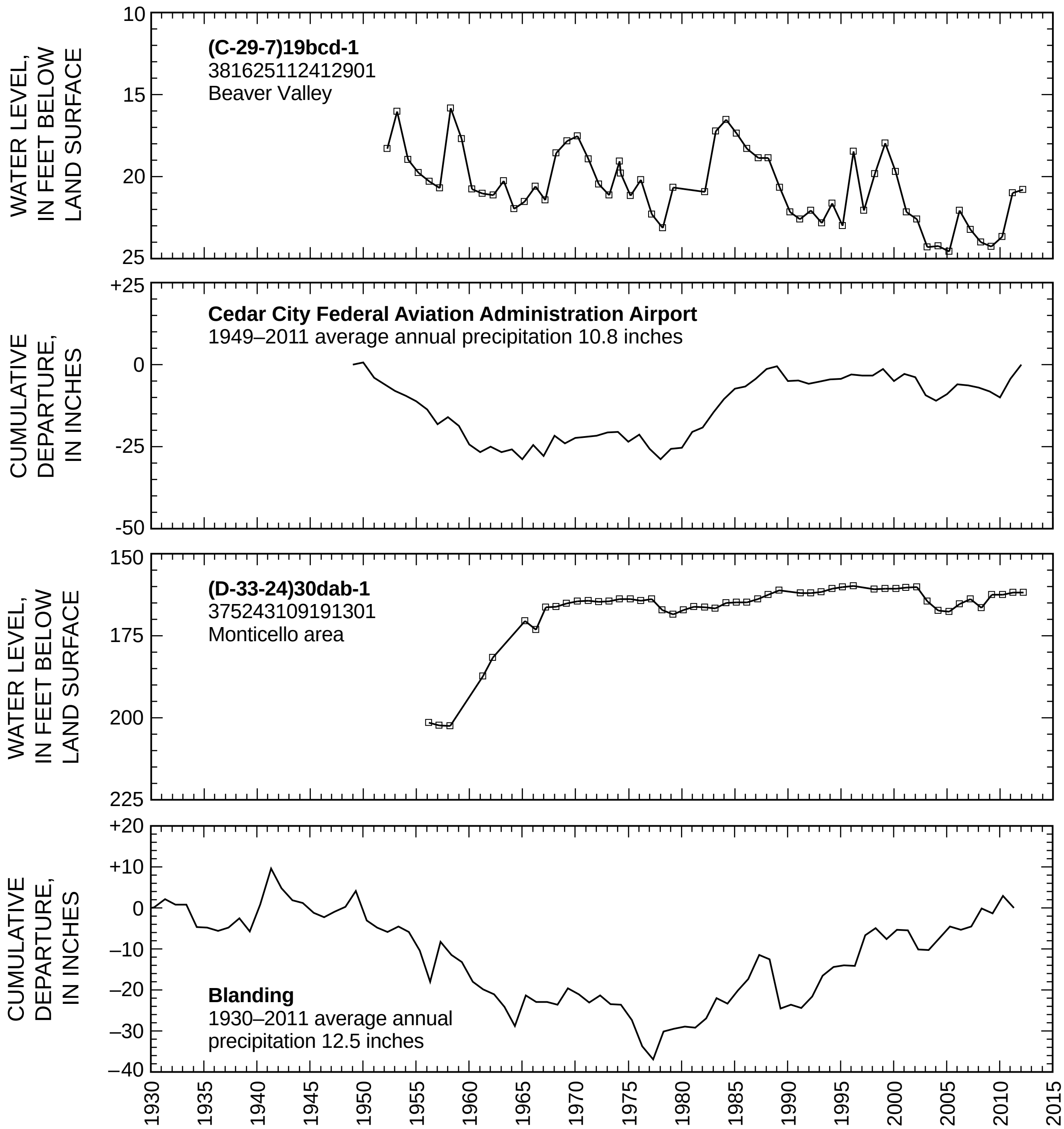


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

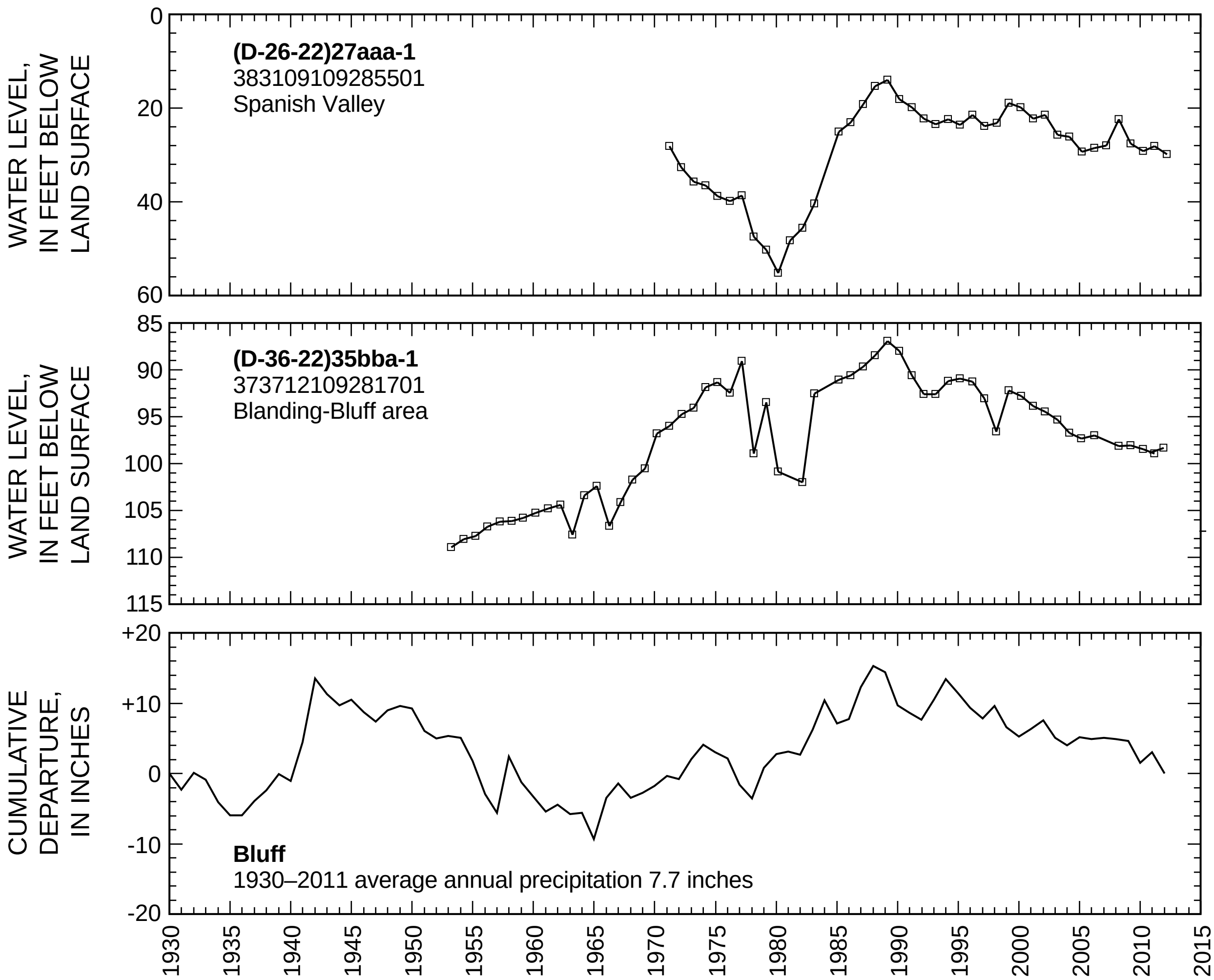


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

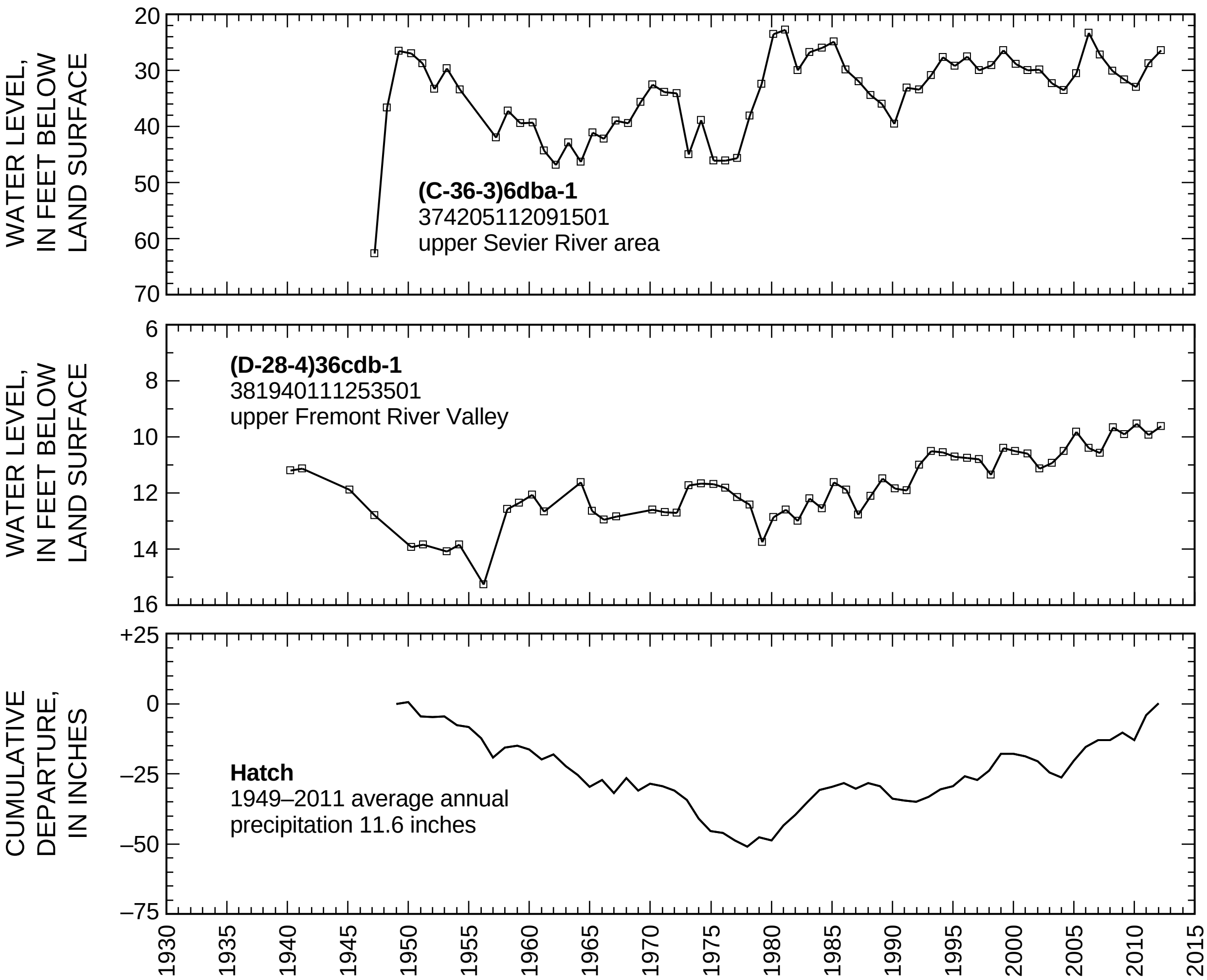


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

Quality of Water from Selected Wells in Utah, Summer of 2011

From June through September 2011, 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 112 wells located in 21 counties (fig. 41). Samples were collected during this time period to limit seasonal variability in the data. The majority of water samples were collected from irrigation wells. Field parameters that were measured at the time the water samples were collected included pH, specific conductance, and water temperature. Chemical constituents that were analyzed in the water samples included major ions, dissolved solids, nutrients (nitrate plus nitrite and orthophosphate), and selected trace elements. The USGS National Water Quality Laboratory in Denver, Colorado, analyzed the water samples. Field parameter values and analytical results for major ions, dissolved solids, and nutrients are shown in table 5. Analytical results for trace elements are shown in table 6.

The water samples were collected using protocols in the USGS National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated). Analytical methods used by the laboratory are described in Fishman and Friedman (1989). Water-quality data in this report are stored in the USGS National Water Information System (NWIS) database and are available on line 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. Twelve field blank water samples were processed during the 2011 sampling period. Analytical results associated with the samples were at or less than the detection limit for all constituents.

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

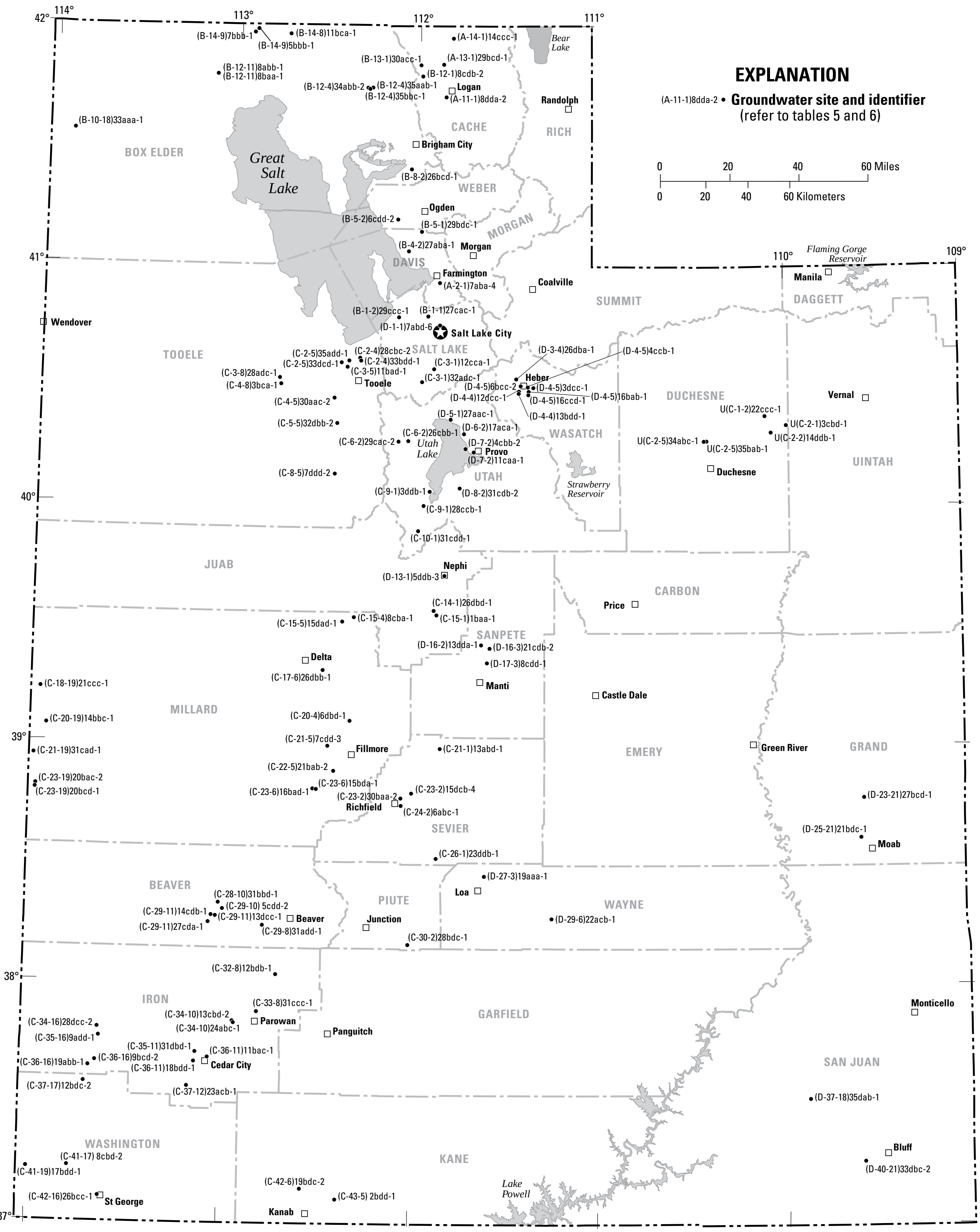


Figure 41. Location of groundwater sites sampled during the summer of 2011.

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2011.

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

Local identifier (refer to figure 41)	Station number	Date	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	6/28/2011	7.7	1,030	13.7	344	94.8	26.1
Escalante Valley, Milford area								
(C-28-10)31bbd-1	382008113012301	8/1/2011	7.3	743	19.9	283	76.9	22.0
(C-29-10)5cdd-2	381835113000001	8/1/2011	7.4	815	14.8	344	102	22.0
(C-29-11)13dcc-1	381649113021301	8/1/2011	7.3	1,100	22.9	446	134	27.3
(C-29-11)14cdb-1	381700113033401	8/9/2011	8.3	957	17.8	369	107	24.8
(C-29-11)27cda-1	381513113042801	8/1/2011	8.5	634	17.9	232	68.0	15.1
Box Elder County								
Curlew Valley								
(B-12-11)8abb-1	414710113071601	9/8/2011	7.1	4,430	14.0	1,760	501	123
(B-12-11)8baa-1	414721113072601	9/8/2011	7.0	3,640	17.0	1,050	302	72.1
(B-14-8)11bca-1	415737112431601	9/8/2011	6.9	3,030	11.5	801	182	83.8
(B-14-9)5bbb-1	415847112540401	9/8/2011	7.2	1,370	17.3	486	139	33.9
(B-14-9)7bbb-1	415754112551301	9/8/2011	7.0	1,620	18.6	547	151	41.3
East Shore area								
(B-8-2)26bcd-1	412405112022501	7/28/2011	7.4	426	12.5	195	52.0	15.8
Grouse Creek Valley								
(B-10-18)33aaa-1	413300113543001	9/8/2011	6.9	1,060	12.1	380	109	26.4
Lower Bear River area								
(B-12-4)34abb-2	414417112170701	8/12/2011	7.0	1,680	17.1	396	89.8	41.8
(B-12-4)35aab-1	414418112154801	8/12/2011	6.9	2,820	15.2	1,020	238	103
(B-12-4)35bbc-1	414406112163601	8/12/2011	7.0	1,570	16.8	343	75.3	37.7
Cache County								
Cache Valley								
(A-11-1)8dda-2	414211111510902	8/24/2011	7.3	527	11.1	278	66.5	27.1
(A-13-1)29bcd-1	415020111520401	8/24/2011	7.4	437	13.4	188	38.3	22.4
(A-14-1)14ccc-1	415653111485401	8/24/2011	7.2	487	11.0	265	65.1	24.9
(B-12-1)8cdb-2	414721111590001	8/24/2011	7.5	732	13.0	132	28.1	15.0
(B-13-1)30acc-1	415008111593901	8/24/2011	7.3	640	14.5	220	54.2	20.5
Davis County								
East Shore area								
(A-2-1)7aba-4	405535111525101	7/29/2011	7.1	307	15.8	84	18.2	9.39
(B-4-2)27aba-1	410340112030001	7/28/2011	7.8	607	16.3	45	11.3	4.12
(B-5-1)29bdc-1	410830111585101	7/28/2011	7.3	532	11.5	233	65.6	16.9
Duchesne County								
Duchesne River area								
U(C-1-2)22ccc-1	402227110061401	7/13/2011	7.7	394	12.5	188	45.9	17.8
U(C-2-1)3cbd-1	402009109591701	7/13/2011	8.1	1,370	17.5	337	72.4	38.1
U(C-2-2)14ddb-1	401819110041601	7/13/2011	8.0	407	13.5	128	31.9	11.7
U(C-2-5)34abc-1	401609110261101	7/12/2011	9.6	660	11.5	4	0.93	0.32
U(C-2-5)35bab-1	401611110251502	7/12/2011	9.7	582	12.4	6	0.98	0.91
Grand County								
Spanish Valley								
(D-23-21)27bcd-1	384654109353601	8/11/2011	8.0	512	22.4	183	26.3	28.4
(D-25-21)21bdc-1	383655109364001	8/11/2011	7.4	1,340	19.7	365	86.0	36.6

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
Beaver County										
Beaver Valley										
5.57	69.9	342	0.22	72.0	0.64	45.5	99.5	680	3.07	0.048
Escalante Valley, Milford area										
4.83	33.1	136	0.22	96.6	0.46	36.2	90.2	480	2.19	0.017
4.88	27.0	215	0.17	56.1	0.29	35.0	70.4	503	6.13	0.063
6.64	33.0	132	0.60	181	0.39	35.5	107	824	13.7	0.030
6.51	35.0	97	0.38	171	0.35	43.2	99.3	661	3.65	0.025
6.26	39.4	107	0.13	55.0	0.42	45.5	138	445	0.77	0.026
Box Elder County										
Curlew Valley										
13.3	184	128	0.89	1,420	0.10	23.4	43.6	3,210	1.82	0.013
8.47	267	221	0.84	1,020	0.07	21.7	101	2,480	3.48	0.008
17.4	326	255	0.55	703	0.75	49.3	318	1,880	1.28	0.049
13.5	51.1	120	0.27	331	0.18	55.5	24.8	960	1.93	0.031
15.9	70.3	120	0.25	414	0.22	61.1	26.7	1,250	0.60	0.025
East Shore area										
4.26	10.5	177	0.02	19.1	0.12	12.1	28.0	256	0.08	0.133
Grouse Creek Valley										
8.82	59.1	228	0.26	158	0.30	49.4	85.0	670	0.68	0.047
Lower Bear River area										
3.47	170	184	0.29	392	0.22	18.9	42.0	932	1.59	0.015
6.06	179	169	1.07	534	0.13	25.9	516	1,780	9.63	0.029
4.04	164	187	0.30	352	0.24	19.9	48.2	850	1.88	0.018
Cache County										
Cache Valley										
1.56	8.14	258	0.02	14.8	0.11	9.83	23.5	324	0.88	0.016
1.61	25.4	230	0.01	8.82	0.11	10.7	10.9	261	0.15	0.013
0.79	4.53	253	0.01	10.7	0.08	11.9	4.47	292	3.01	0.011
7.54	116	289	0.07	51.8	2.36	63.4	32.7	483	<0.02	0.069
9.21	54.7	310	0.06	34.3	0.57	65.3	1.10	413	<0.02	0.173
Davis County										
East Shore area										
1.39	29.0	111	0.02	16.4	0.09	20.2	17.6	177	1.19	0.031
5.38	115	267	0.06	41.6	0.39	31.4	0.15	381	<0.02	0.614
2.12	26.3	270	0.03	20.5	0.12	12.0	7.17	301	<0.02	0.047
Duchesne County										
Duchesne River area										
3.49	9.23	180	0.02	1.26	0.48	9.21	30.6	228	<0.02	0.006
3.11	181	170	0.01	2.36	1.97	2.46	550	976	<0.02	<0.004
2.74	37.0	160	<0.01	2.75	0.60	9.73	46.9	246	<0.02	0.010
0.23	149	270	0.02	2.15	0.25	8.45	68.2	401	<0.02	0.066
0.4	133	294	<0.01	1.11	0.26	9.41	16.1	355	<0.02	0.051
Grand County										
Spanish Valley										
5.81	31.2	174	0.17	35.5	0.37	9.77	35.5	284	0.77	<0.004
8.82	137	199	0.29	167	0.39	12.1	239	846	5.69	0.005

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2011.—Continued

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

Local identifier (refer to figure 41)	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Water temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Iron County								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	6/29/2011	8.0	1,080	13.6	612	119	76.6
(C-36-11)11bac-1	374122113034801	6/29/2011	7.5	2,160	14.4	1,380	304	152
(C-36-11)18bdd-1	374017113080401	8/9/2011	7.6	1,360	16.3	641	130	76.5
(C-37-12)23acb-1	373407113100801	8/9/2011	7.3	1,330	13.9	638	140	70.1
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-2	374834113384301	8/9/2011	7.2	1,170	18.8	445	134	26.6
(C-35-16)9add-1	374623113381301	8/9/2011	7.9	453	22.3	175	52.9	10.5
(C-36-16)9bcd-2	374014113391101	8/9/2011	6.8	551	14.9	216	67.0	11.9
(C-36-16)19abb-1	373854113411501	8/9/2011	8.5	476	21.7	185	55.9	11.0
Parowan Valley								
(C-32-8)12bdb-1	380218112424401	8/16/2011	7.8	488	18.7	181	53.0	11.7
(C-33-8)31ccc-1	375257112483501	8/16/2011	7.5	466	14.8	199	40.9	23.6
(C-34-10)13cbd-2	375033112561101	8/9/2011	8.0	477	12.2	208	39.2	26.7
(C-34-10)24abc-1	375006112554801	6/28/2011	7.1	461	14.0	201	39.0	25.2
Juab County								
Juab Valley								
(C-14-1)26dbd-1	393342111534501	8/8/2011	7.0	1,100	13.6	509	105	60.0
(C-15-1)1baa-1	393236111525300	8/8/2011	6.6	1,210	12.8	617	154	56.3
(D-13-1)5ddb-3	394226111502101	8/8/2011	6.8	1,630	—	499	134	39.9
Kane County								
Kanab area								
(C-42-6)19bdc-2	370843112340602	8/15/2011	8.0	258	21.0	124	22.1	16.6
(C-43-5)2bdd-1	370608112230001	8/15/2011	7.1	720	15.2	342	76.1	36.9
Millard County								
Pahvant Valley								
(C-20-4)6dbd-1	390558112202301	8/8/2011	7.2	L 1,870	18.4	962	258	77.3
(C-21-5)7cdd-3	385939112272303	8/16/2011	7.2	1,370	12.4	505	110	56.3
(C-22-5)21bab-2	385324112252301	8/8/2011	7.2	1,060	14.1	307	84.7	23.2
(C-23-6)15bda-1	384848112305101	8/16/2011	7.3	3,180	15.1	878	212	84.4
(C-23-6)16bad-1	384856112315701	8/16/2011	7.1	6,740	15.8	1,670	439	139
Sevier Desert								
(C-15- 4) 8cba- 1	393154112192901	8/16/2011	6.7	3,370	13.6	975	210	110
(C-15- 5)15dad- 1	393046112231301	8/18/2011	7.2	1,030	15.2	335	64.6	42.2
(C-17- 6)26dbb-1	391834112292001	8/18/2011	7.6	538	21.2	114	20.7	15.2
Snake Valley								
(C-18-19)21ccc- 1	391319113595501	8/17/2011	7.6	323	21.1	112	26.4	11.3
(C-20-19)14bbc- 1	390416113573801	8/17/2011	7.4	385	13.9	157	35.2	16.9
(C-21-19)31cad- 1	385640114012401	8/17/2011	7.2	485	12.1	239	55.3	24.5
(C-23-19)20bac- 2	384900114003001	8/17/2011	7.4	968	14.0	330	45.4	52.7
(C-23-19)20bcd- 1	384815114003701	8/17/2011	7.6	947	11.9	345	50.9	52.9
Piute County								
Upper Sevier River area								
(C-30- 2)28bdc- 1	381003112010301	8/17/2011	7.9	377	18.4	153	36.3	15.1

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
Iron County										
Cedar Valley										
2.4	11.5	129	0.06	15.9	0.26	21.6	460	857	2.34	0.016
4.28	36.2	214	0.10	39.6	0.27	22.7	1,120	1,970	5.82	0.018
3.77	60.0	160	0.23	74.2	0.28	33.1	506	1,060	3.15	0.017
2.07	49.7	144	0.71	126	0.05	17.8	425	996	1.86	0.026
Escalante Valley, Beryl-Enterprise area										
9.0	37.1	112	0.94	237	0.57	61.4	99.1	892	1.65	0.028
4.74	14.6	149	0.17	40.5	0.22	51.6	16.9	311	1.53	0.038
4.21	17.2	154	0.27	62.1	0.26	38.8	20.4	370	2.55	0.044
4.46	17.7	172	0.15	33.0	0.31	36.7	17.7	279	2.22	0.048
Parowan Valley										
6.17	17.5	103	0.25	53.7	0.21	53.6	32.9	329	1.87	0.027
2.66	21.7	183	0.07	20.3	0.18	28.2	18.8	267	1.51	0.029
4.69	15.6	206	0.07	17.5	0.27	43.0	23.7	308	1.78	0.028
4.2	18.4	186	0.08	21.1	0.35	44.2	25.1	291	1.35	0.030
Juab County										
Juab Valley										
3.27	55.8	252	0.06	55.8	0.23	18.9	297	772	1.92	0.020
2.12	44.4	284	0.05	58.0	0.20	13.8	332	875	2.00	0.010
3.84	149	348	0.08	253	0.17	25.1	119	959	5.02	0.029
Kane County										
Kanab area										
2.20	3.61	120	0.05	4.40	0.06	14.9	4.45	147	2.20	0.017
2.73	18.4	187	0.09	7.85	0.14	11.7	181	479	4.87	0.029
Millard County										
Pahvant Valley										
5.57	53.0	222	0.29	165	0.64	17.4	620	1,420	2.56	0.012
4.83	105	337	0.21	137	0.16	26.2	167	852	4.74	0.026
10.8	88.3	246	0.20	150	0.84	15.4	59.0	627	1.62	0.013
26.1	319	237	0.92	705	0.32	31.3	374	2,040	3.56	0.029
86.9	859	331	1.99	1,700	1.17	39.8	1,090	4,680	1.85	0.050
Sevier Desert										
8.62	364	399	0.57	621	0.21	29.3	553	2,250	0.47	0.029
3.9	70.3	164	0.20	192	0.35	28.6	60.7	570	0.14	<0.004
17.5	62.4	192	0.04	26.6	1.31	56.7	30.7	368	0.21	0.027
Snake Valley										
1.98	23.2	120	0.05	20.1	0.11	13.7	11.5	195	0.25	0.008
1.4	19.0	150	0.08	25.2	0.33	21.4	11.2	219	0.11	0.013
1.45	14.1	219	0.06	15.8	0.08	16.9	13.1	299	1.47	0.011
4.2	88.8	342	0.17	65.9	0.99	50.9	77.1	603	1.10	0.062
8.61	81.0	338	0.15	68.5	0.89	52.5	71.0	604	0.23	0.072
Piute County										
Upper Sevier River area										
4.51	14.8	168	0.05	9.68	0.27	31.8	14.1	221	0.30	0.039

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2011.—Continued

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

Local identifier (refer to figure 41)	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Water temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Salt Lake County								
Salt Lake Valley								
(B-1-1)27cac-1	404720111562701	8/4/2011	7.4	931	14.1	157	31.0	19.3
(B-1-2)29ccc-1	404704112060401	8/30/2011	7.6	9,060	15.7	262	37.9	40.7
(C-3-1)12cca-1	403410111542501	8/4/2011	7.1	892	20.0	280	59.4	32.0
(C-3-1)32adc-1	403054111581601	8/4/2011	7.4	1,530	14.9	626	177	44.8
(D-1-1)7abd-6	404506111523301	8/4/2011	6.7	1,320	14.5	598	141	59.5
San Juan County								
Blanding-Bluff area								
(D-37-18)35dab-1	373130109534501	9/15/2011	7.5	1,050	12.2	491	87.7	66.0
(D-40-21)33dbc-2	371545109364402	9/15/2011	9.2	457	17.3	6	1.62	0.43
Sanpete County								
Sanpete Valley								
(D-16-2)13dda-1	392511111382001	8/25/2011	7.5	1,030	14.2	354	60.0	49.5
(D-16-3)21cdb-2	392421111353601	8/25/2011	7.2	1,100	11.6	484	76.5	71.1
(D-17-3)8cdd-1	392042111362501	8/25/2011	7.3	614	10.0	310	52.6	43.4
Sevier County								
Central Sevier Valley								
(C-21-1)13abd-1	385910111512101	8/8/2011	7.7	745	22.6	144	29.3	17.2
(C-23-2)15dcb-4	384757112002201	8/8/2011	7.3	656	19.1	308	61.1	37.8
(C-23-2)30baa-2	384641112034601	8/8/2011	7.4	875	14.8	429	85.2	52.5
(C-24-2)6abc-1	384450112034001	8/8/2011	7.3	814	18.3	408	103	36.6
Upper Sevier River area								
(C-26-1)23ddb-1	383140111522001	8/17/2011	7.4	217	14.0	78	24.8	3.87
Tooele County								
Rush Valley								
(C-4-5)30aac-2	402645112265101	7/21/2011	7.3	787	—	284	61.7	31.6
(C-5-5)32dbb-2	402024112254601	7/21/2011	6.9	1,010	9.8	366	104	25.6
(C-8-5)7ddd-2	400745112263101	7/21/2011	7.4	529	17.0	191	34.6	25.4
Skull Valley								
(C-3-8)28adc-1	403140112445001	7/26/2011	7.5	840	15.4	189	54.5	12.7
(C-4-8)3bca-1	403006112442201	7/26/2011	7.2	1,280	14.1	429	130	25.3
Tooele Valley								
(C-2-4)28cbc-2	403649112183902	8/1/2011	7.2	2,240	14.6	329	82.1	30.1
(C-2-4)33bdd-1	403629112174801	8/1/2011	7.1	993	14.3	275	69.8	24.5
(C-2-5)33dcd-1	403547112244401	8/1/2011	7.4	2,780	19.8	736	168	76.4
(C-2-5)35add-1	403606112221201	8/1/2011	7.0	2,190	20.0	415	102	38.5
(C-3-5)11bad-1	403419112222001	8/1/2011	7.1	9,300	25.3	830	204	77.8

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
Salt Lake County										
Salt Lake Valley										
10.3	165	468	0.10	57.1	0.50	29.0	<0.09	582	<0.02	0.336
21.5	1,840	300	1.73	2,950	1.60	19.9	256	5,250	<0.02	0.133
9.05	82.8	189	0.12	122	0.23	32.7	107	572	0.25	0.019
3.85	102	310	0.20	213	0.09	26.8	225	991	2.10	0.035
3.19	58.7	290	0.12	185	0.19	19.1	168	831	5.31	0.043
San Juan County										
Blanding-Bluff area										
7.54	39.4	317	0.18	22.6	0.33	7.29	240	726	<0.02	<0.012
1.02	102	206	0.03	3.08	0.13	10.6	28.0	278	<0.02	0.007
Sanpete County										
Sanpete Valley										
3.3	93.4	235	0.11	140	0.51	25.5	142	660	0.02	0.016
2.63	62.6	320	0.22	73.1	0.32	21.1	192	731	4.06	0.020
1.3	18.6	302	0.03	12.1	0.15	10.6	33.6	341	2.74	0.011
Sevier County										
Central Sevier Valley										
4.42	90.8	106	0.08	106	0.55	42.1	87.6	452	0.29	0.021
3.13	19.5	252	0.07	26.8	0.38	33.8	46.1	404	1.00	0.045
1.83	32.6	416	0.09	15.0	0.18	15.7	30.7	518	3.16	0.022
3.06	24.9	247	0.08	18.5	0.16	31.5	169	566	2.71	0.034
Upper Sevier River area										
2.86	9.28	81	0.06	13.9	0.19	42.5	4.97	158	0.45	0.022
Tooele County										
Rush Valley										
3.09	44.4	164	0.11	138	0.25	25.2	37.1	516	0.49	0.019
1.26	75.2	298	0.13	130	0.27	18.1	47.1	614	1.66	0.019
2.44	32.8	157	0.06	65.5	0.68	14.1	24.0	305	0.04	0.011
Skull Valley										
5.71	91.3	129	0.12	180	0.09	19.2	20.5	513	0.81	0.025
3.94	68.6	92	0.28	310	0.10	10.3	49.6	822	5.30	0.172
Tooele Valley										
3.15	317	219	0.34	567	0.14	13.0	48.3	1,250	2.06	0.015
2.17	104	219	0.12	132	0.14	12.7	110	604	1.82	0.023
9.13	254	158	0.52	764	0.32	26.9	117	1,930	1.91	0.014
3.95	266	211	0.35	560	0.18	20.6	35.8	1,230	2.02	0.014
21.4	1,540	194	1.75	3,060	0.43	24.9	118	5,410	0.63	0.005

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2011.—Continued

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

Local identifier (refer to figure 41)	Station number	Date	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
Utah County								
Cedar Valley								
(C-6-2)26cbb-1	401607112023401	7/26/2011	7.3	843	11.8	374	58.6	55.4
(C-6-2)29cac-2	401557112053701	7/26/2011	7.1	400	10.7	200	51.4	17.5
Goshen Valley								
(C-9-1)3ddb-1	400325111552501	8/8/2011	7.2	1,490	14.8	301	74.5	27.9
(C-9-1)28ccb-1	395956111572101	8/8/2011	7.2	2,210	18.0	703	184	58.9
(C-10-1)31cdd-1	395340111590001	8/8/2011	7.2	882	19.2	373	93.8	33.6
Northern Utah Valley								
(D-5-1)27aac-1	402133111484601	8/30/2011	7.1	673	11.3	308	71.4	31.5
(D-6-2)17aca-1	401801111442501	8/9/2011	7.2	500	14.8	255	62.9	23.9
Southern Utah Valley								
(D-7-2)4cbb-2	401414111435301	8/9/2011	7.1	475	—	250	61.8	23.3
(D-7-2)11caa-1	401325111410901	8/9/2011	7.4	616	14.0	307	72.4	30.6
(D-8-2)31cdb-2	400423111454001	8/30/2011	6.8	3,460	30.9	318	79.2	29.1
Wasatch County								
Heber Valley								
(D-3-4)26dba-1	403146111272701	8/22/2011	7.4	797	13.2	377	115	22.0
(D-4-4)12dcc-1	402842111263101	8/22/2011	6.8	706	11.1	314	86.3	23.9
(D-4-4)13bdd-1	402810111263601	8/22/2011	7.0	579	10.9	236	59.4	21.2
(D-4-5)3dcc-1	402937111214901	8/23/2011	6.8	561	10.9	264	86.3	11.9
(D-4-5)4ccb-1	402946111233901	8/23/2011	6.8	409	11.3	201	63.4	10.3
(D-4-5)6bcc-2	403003111255801	8/22/2011	7.0	369	13.1	171	50.6	10.8
(D-4-5)16bab-1	402840111232201	8/23/2011	7.1	615	11.4	307	83.6	23.9
(D-4-5)16ccd-1	402750111232701	8/22/2011	7.0	581	12.0	259	63.8	24.2
Washington County								
Central Virgin River area								
(C-37-17)12bdc-2	373456113423501	8/9/2011	6.8	466	18.8	175	53.5	10.0
(C-41-17)8cbd-2	371348113470301	8/16/2011	7.7	485	19.0	219	61.4	15.9
(C-41-19)17bdd-1	371315113594901	8/15/2011	7.2	515	20.7	218	61.8	15.5
(C-42-16)26bcc-1	370617113371101	8/15/2011	7.0	6,130	22.3	2,440	548	260
Wayne County								
Upper Fremont River Valley								
(D-27-3)19aaa-1	382717111365601	8/17/2011	7.2	1,410	12.8	719	214	45.2
(D-29-6)22acb-1	381644111152501	8/18/2011	7.2	974	13.0	497	144	33.6
Weber County								
East Shore area								
(B-5-2)6cdd-2	411130112064502	7/28/2011	7.8	324	19.5	124	33.1	10.1

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
Utah County										
Cedar Valley										
3.72	23.2	214	0.16	138	0.34	59.8	29.4	514	0.17	0.041
0.81	8.47	173	0.03	15.7	0.08	10.5	14.8	226	0.80	0.013
Goshen Valley										
13.1	180	159	0.27	332	0.44	63.5	93.6	903	0.89	0.028
18.4	137	109	0.82	559	0.20	64.9	120	1,460	20.2	0.030
7.56	30.0	152	0.23	130	0.20	58.3	76.1	573	11.5	0.034
Northern Utah Valley										
1.52	24.4	237	0.04	19.6	0.28	15.3	105	428	2.27	0.012
4.26	14.6	212	0.04	18.2	0.20	21.2	53.2	353	1.30	0.035
Southern Utah Valley										
2.8	15.8	233	0.04	12.9	0.24	19.6	44.8	313	<0.02	0.027
2.2	21.8	266	0.05	20.2	0.21	19.4	71.5	404	<0.02	0.015
37.6	556	467	0.42	757	1.67	48.7	178	2,000	0.02	0.033
Wasatch County										
Heber Valley										
8.06	23.3	280	—	29.2	0.52	20.9	72.8	[1]482	5.08	[2]<0.02
1.47	24.5	260	—	51.0	0.07	23.6	32.9	[1]415	3.44	[2]0.04
1.34	14.5	216	—	39.6	0.13	11.4	12.2	[1]302	2.66	[2]<0.02
3.54	7.75	187	—	36.0	0.08	38.1	6.84	[1]341	8.69	[2]0.08
2.56	5.53	158	—	13.8	0.06	41.7	14.1	[1]265	4.15	[2]0.09
2.10	8.06	162	—	10.2	0.06	30.8	17.7	[1]233	1.33	[2]0.029
1.65	14.0	259	—	21.5	0.20	31.3	19.7	[1]366	3.41	[2]0.021
1.18	20.0	214	—	37.6	0.13	16.7	23.1	[1]339	5.38	[2]<0.02
Washington County										
Central Virgin River area										
4.33	23.8	192	0.11	20.3	0.22	41.6	14.1	303	2.12	0.085
2.26	13.7	202	0.06	14.5	0.30	17.7	39.3	296	0.34	0.009
2.9	20.9	192	0.07	14.0	0.51	34.7	62.9	345	0.97	0.038
14.8	775	339	1.33	375	0.62	22.4	3,270	5,910	18.3	0.031
Wayne County										
Upper Fremont River Valley										
4.06	40.8	207	0.06	13.4	0.06	29.3	588	1,150	3.06	0.040
5	22.0	234	0.06	16.3	0.31	24.5	291	720	0.09	0.011
Weber County										
East Shore area										
1.71	18.6	156	0.01	15.4	0.16	15.1	<0.09	183	<0.02	0.004

[1] Dissolved solids determined by sum of constituents.
[2] Phosphorus, dissolved, in mg/L as P.

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2011.

[µg/L, micrograms per liter; < , less than; —, no data]

Local identifier (refer to figure 41)	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Beaver County								
Beaver Valley								
(C-29-8)31add-1	381435112471401	6/28/2011	3.4	22	8.3	2.4	0.87	25.0
Escalante Valley, Milford area								
(C-28-10)31bbd-1	382008113012301	8/1/2011	6.5	10	0.5	1.7	3.0	12.0
(C-29-10)5cdd-2	381835113000001	8/1/2011	2.2	22	1.2	0.5	0.61	33.2
(C-29-11)13dcc-1	381649113021301	8/1/2011	2.8	<3.2	<0.16	1.2	1.3	22.5
(C-29-11)14cdb-1	381700113033401	8/9/2011	3.1	<3.2	0.2	1.3	1.2	15.8
(C-29-11)27cda-1	381513113042801	8/1/2011	3.8	<3.2	<0.16	1.5	0.52	4.35
Box Elder County								
Curlew Valley								
(B-12-11)8abb-1	414710113071601	9/8/2011	0.81	<9.6	<0.48	0.6	1.1	3.89
(B-12-11)8baa-1	414721113072601	9/8/2011	0.76	18	3.6	0.4	2.3	5.13
(B-14-8)11bca-1	415737112431601	9/8/2011	9.3	8	3.0	3.1	6.4	5.82
(B-14-9)5bbb-1	415847112540401	9/8/2011	2.0	4	<0.16	0.9	1.9	1.46
(B-14-9)7bbb-1	415754112551301	9/8/2011	2.0	4	<0.16	0.8	1.1	2.08
East Shore area								
(B-8-2)26bcd-1	412405112022501	7/28/2011	7.3	609	584	1.5	7.3	0.03
Grouse Creek Valley								
(B-10-18)33aaa-1	413300113543001	9/8/2011	6.5	10	0.3	4.0	3.7	11.0
Lower Bear River area								
(B-12-4)34abb-2	414417112170701	8/12/2011	0.70	<3.2	0.3	0.9	1.5	1.19
(B-12-4)35aab-1	414418112154801	8/12/2011	1.3	<6.4	0.3	0.5	61.5	2.76
(B-12-4)35bbc-1	414406112163601	8/12/2011	0.92	<3.2	<0.16	0.9	5.0	1.53
Cache County								
Cache Valley								
(A-11-1)8dda-2	414211111510902	8/24/2011	0.25	<3.2	<0.16	0.4	0.69	0.88
(A-13-1)29bcd-1	415020111520401	8/24/2011	5.7	142	67.4	0.7	0.05	0.27
(A-14-1)14ccc-1	415653111485401	8/24/2011	0.26	5	<0.16	0.1	0.07	0.44
(B-12-1)8cdb-2	414721111590001	8/24/2011	16	17	63.5	5.1	<0.03	1.60
(B-13-1)30acc-1	415008111593901	8/24/2011	<0.02	417	72.4	0.3	<0.03	0.01
Davis County								
East Shore area								
(A- 2- 1) 7aba- 4	405535111525101	7/29/2011	0.10	<3.2	0.7	1.0	0.91	4.15
(B- 4- 2)27aba- 1	410340112030001	7/28/2011	24.6	311	49.9	0.4	0.04	0.01
(B- 5- 1)29bdc- 1	410830111585101	7/28/2011	0.82	8	10.5	0.4	<0.03	2.97
Duchesne County								
Duchesne River area								
U(C- 1- 2)22ccc- 1	402227110061401	7/13/2011	1.5	645	9.7	0.9	<0.03	0.26
U(C- 2- 1) 3cbd- 1	402009109591701	7/13/2011	4.3	912	20.4	2.9	<0.03	0.10
U(C- 2- 2)14ddb- 1	401819110041601	7/13/2011	0.30	195	8.8	0.6	<0.03	0.09
U(C- 2- 5)34abc- 1	401609110261101	7/12/2011	0.60	<3.2	1.6	1.2	<0.03	0.28
U(C- 2- 5)35bab- 1	401611110251502	7/12/2011	0.56	4	0.3	0.4	<0.03	0.41

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2011.—Continued

[µg/L, micrograms per liter; < , less than; —, no data]

Local identifier (refer to figure 41)	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Grand County								
Spanish Valley								
(D-23-21)27bcd- 1	384654109353601	8/11/2011	0.20	<3.2	<0.16	1.8	3.3	2.33
(D-25-21)21bdc- 1	383655109364001	8/11/2011	0.12	162	0.8	2.5	9.0	7.71
Iron County								
Cedar Valley								
(C-35-11)31dbd- 1	374248113075201	6/29/2011	0.87	<3.2	0.3	0.5	1.7	2.96
(C-36-11)11bac- 1	374122113034801	6/29/2011	0.39	12	<0.32	0.2	3.8	6.52
(C-36-11)18bdd- 1	374017113080401	8/9/2011	3.8	5	<0.16	1.6	5.3	4.61
(C-37-12)23acb- 1	373407113100801	8/9/2011	0.79	12	15.0	0.5	12.0	2.11
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-2	374834113384301	8/9/2011	0.05	<3.2	<0.16	0.2	<0.03	0.03
(C-35-16)9add-1	374623113381301	8/9/2011	3.3	<3.2	<0.16	0.3	0.89	2.34
(C-36-16)9bcd-2	374014113391101	8/9/2011	2.8	<3.2	<0.16	0.5	1.4	3.93
(C-36-16)19abb-1	373854113411501	8/9/2011	2.0	<3.2	<0.16	0.8	0.82	7.11
Parowan Valley								
(C-32-8)12bdb-1	380218112424401	8/16/2011	2.5	<3.2	<0.16	0.7	1.5	2.10
(C-33-8)31ccc-1	375257112483501	8/16/2011	4.5	<3.2	<0.16	0.5	0.81	1.94
(C-34-10)13cbd-2	375033112561101	8/9/2011	6.0	<3.2	<0.16	0.7	1.1	3.54
(C-34-10)24abc-1	375006112554801	6/28/2011	5.9	<3.2	<0.16	1.1	0.87	3.09
Juab County								
Juab Valley								
(C-14-1)26dbd-1	393342111534501	8/8/2011	1.1	<3.2	<0.16	1.1	1.0	1.98
(C-15-1)1baa-1	393236111525300	8/8/2011	0.43	<3.2	<0.16	0.4	0.98	1.05
(D-13-1)5ddb-3	394226111502101	8/8/2011	0.75	5	<0.16	0.5	1.9	2.00
Kane County								
Kanab area								
(C-42-6)19bdc-2	370843112340602	8/15/2011	1.0	<3.2	<0.16	0.0	0.38	0.44
(C-43-5)2bdd-1	370608112230001	8/15/2011	0.70	15	0.7	0.1	2.7	3.43
Millard County								
Pahvant Valley								
(C-20-4)6dbd-1	390558112202301	8/8/2011	2.3	5	<0.16	9.8	33.4	11.2
(C-21-5)7cdd-3	385939112272303	8/16/2011	2.3	4	<0.16	0.9	2.7	3.17
(C-22-5)21bab-2	385324112252301	8/8/2011	0.78	8	1.4	2.0	0.64	0.54
(C-23-6)15bda-1	384848112305101	8/16/2011	3.6	18	<0.32	0.5	2.3	2.49
(C-23-6)16bad-1	384856112315701	8/16/2011	9.4	24	<0.64	0.7	5.2	3.74
Sevier Desert								
(C-15-4)8cba-1	393154112192901	8/16/2011	3.6	176	405	2.8	0.14	5.77
(C-15-5)15dad-1	393046112231301	8/18/2011	5.5	8	10.0	2.3	0.22	1.77
(C-17-6)26dbb-1	391834112292001	8/18/2011	13.6	6	1.6	2.1	0.55	0.93
Snake Valley								
(C-18-19)21ccc-1	391319113595501	8/17/2011	0.81	<3.2	<0.16	0.4	0.38	1.43
(C-20-19)14bbc-1	390416113573801	8/17/2011	4.5	<3.2	<0.16	2.6	0.33	2.38
(C-21-19)31cad-1	385640114012401	8/17/2011	1.0	<3.2	<0.16	0.3	0.30	2.22
(C-23-19)20bac-2	384900114003001	8/17/2011	24	4	<0.16	14.8	10.8	13.7
(C-23-19)20bcd-1	384815114003701	8/17/2011	21.1	6	0.4	7.6	5.2	8.63

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2011.—Continued

[µg/L, micrograms per liter; < , less than; —, no data]

Local identifier (refer to figure 41)	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Piute County								
Upper Sevier River area								
(C-30-2)28bdc-1	381003112010301	8/17/2011	7.9	4	<0.16	1.2	0.31	2.60
Salt Lake County								
Salt Lake Valley								
(B-1-1)27cac-1	404720111562701	8/4/2011	25	642	46.0	0.5	0.05	<0.004
(B-1-2)29ccc-1	404704112060401	8/30/2011	200	536	85.6	18.4	0.17	0.15
(C-3-1)12cca-1	403410111542501	8/4/2011	3.9	8	<0.16	1.5	1.3	4.88
(C-3-1)32adc-1	403054111581601	8/4/2011	3.4	11	<0.16	0.3	2.2	8.72
(D-1-1)7abd-6	404506111523301	8/4/2011	1.2	<3.2	0.3	1.2	1.8	1.83
San Juan County								
Blanding-Bluff area								
(D-37-18)35dab-1	373130109534501	9/15/2011	0.17	9,710	70.5	0.04	0.13	<0.004
(D-40-21)33dbc-2	371545109364402	9/15/2011	0.46	5	4.4	16.2	0.04	0.84
Sanpete County								
Sanpete Valley								
(D-16-2)13dda-1	392511111382001	8/25/2011	0.69	10	54.2	9.6	<0.03	2.61
(D-16-3)21cdb-2	392421111353601	8/25/2011	2.8	4	<0.16	2.6	6.2	3.80
(D-17-3)8cdd-1	392042111362501	8/25/2011	0.43	<3.2	<0.16	0.8	1.1	1.80
Sevier County								
Central Sevier Valley								
(C-21-1)13abd-1	385910111512101	8/8/2011	10.7	4	<0.16	3.5	0.47	4.54
(C-23-2)15dcb-4	384757112002201	8/8/2011	4.0	<3.2	<0.16	3.5	1.2	5.35
(C-23-2)30baa-2	384641112034601	8/8/2011	1.7	6	1.0	0.3	0.40	2.72
(C-24-2)6abc-1	384450112034001	8/8/2011	1.7	<3.2	7.2	0.3	0.66	13.1
Upper Sevier River area								
(C-26-1)23ddb-1	383140111522001	8/17/2011	3.7	<3.2	<0.16	0.4	0.29	2.61
Tooele County								
Rush Valley								
(C-4-5)30aac-2	402645112265101	7/21/2011	1.2	4	0.2	1.0	0.59	1.33
(C-5-5)32dbb-2	402024112254601	7/21/2011	2.0	78	16.9	0.9	2.1	3.48
(C-8-5)7ddd-2	400745112263101	7/21/2011	20.2	<3.2	<0.16	3.0	0.08	1.67
Skull Valley								
(C- 3- 8)28adc- 1	403140112445001	7/26/2011	0.75	<3.2	0.2	0.3	0.42	0.52
(C- 4- 8) 3bca- 1	403006112442201	7/26/2011	1.0	<3.2	<0.16	0.1	1.7	2.09
Tooele Valley								
(C- 2- 4)28cbc- 2	403649112183902	8/1/2011	1.2	123	18.9	0.3	1.1	1.69
(C- 2- 4)33bdd- 1	403629112174801	8/1/2011	1.4	<3.2	<0.16	0.5	2.3	1.97
(C- 2- 5)33dcd- 1	403547112244401	8/1/2011	2.7	10	1.0	1.0	3.2	2.44
(C- 2- 5)35add- 1	403606112221201	8/1/2011	1.3	14	1.2	0.6	0.91	1.64
(C- 3- 5)11bad- 1	403419112222001	8/1/2011	1.4	2,180	20.8	1.9	1.0	2.61

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2011.—Continued

[µg/L, micrograms per liter; < , less than; —, no data]

Local identifier (refer to figure 41)	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Utah County								
Cedar Valley								
(C-6-2)26cbb-1	401607112023401	7/26/2011	6.3	<3.2	27.8	3.1	0.55	4.12
(C-6-2)29cac-2	401557112053701	7/26/2011	0.70	<3.2	<0.16	0.6	1.1	1.44
Goshen Valley								
(C-9-1)3ddb-1	400325111552501	8/8/2011	8.0	8	<0.16	3.1	2.7	5.59
(C-9-1)28ccb-1	395956111572101	8/8/2011	4.3	<6.4	<0.32	1.6	6.8	5.71
(C-10-1)31cdd-1	395340111590001	8/8/2011	3.8	<3.2	<0.16	0.9	3.3	2.43
Northern Utah Valley								
(D-5-1)27aac-1	402133111484601	8/30/2011	1.7	10	0.6	1.3	4.5	3.15
(D-6-2)17aca-1	401801111442501	8/9/2011	1.8	4	1.1	1.7	1.4	1.84
Southern Utah Valley								
(D-7-2) 4cbb-2	401414111435301	8/9/2011	2.1	732	73.5	1.0	<0.03	0.02
(D-7-2)11caa-1	401325111410901	8/9/2011	5.5	1,860	427	0.6	<0.03	0.52
(D-8-2)31cdb-2	400423111454001	8/30/2011	2.5	29	54.8	2.2	0.13	2.24
Wasatch County								
Heber Valley								
(D-3-4)26dba-1	403146111272701	8/22/2011	—	4	<0.16	—	—	—
(D-4-4)12dcc-1	402842111263101	8/22/2011	—	4	<0.16	—	—	—
(D-4-4)13bdd-1	402810111263601	8/22/2011	—	1,030	45.5	—	—	—
(D-4-5)3dcc-1	402937111214901	8/23/2011	—	<3.2	<0.16	—	—	—
(D-4-5)4ccb-1	402946111233901	8/23/2011	—	<3.2	0.4	—	—	—
(D-4-5)6bcc-2	403003111255801	8/22/2011	—	4	1.0	—	—	—
(D-4-5)16bab-1	402840111232201	8/23/2011	—	6	0.3	—	—	—
(D-4-5)16ccd-1	402750111232701	8/22/2011	—	352	19.9	—	—	—
Washington County								
Central Virgin River area								
(C-37-17)12bdc-2	373456113423501	8/9/2011	3.7	<3.2	<0.16	0.5	0.40	3.25
(C-41-17)8cbd-2	371348113470301	8/16/2011	18.3	114	17.4	4.9	0.41	1.47
(C-41-19)17bdd-1	371315113594901	8/15/2011	3.1	16	7.6	1.3	0.44	2.04
(C-42-16)26bcc-1	370617113371101	8/15/2011	0.12	71	1,820	6.2	<0.09	<0.012
Wayne County								
Upper Fremont River Valley								
(D-27-3)19aaa-1	382717111365601	8/17/2011	1.3	10	<0.16	0.2	0.69	22.2
(D-29-6)22acb-1	381644111152501	8/18/2011	0.53	10	0.3	0.7	0.26	3.32
Weber County								
East Shore area								
(B-5-2)6cdd-2	411130112064502	7/28/2011	4.8	81	79.3	1.0	<0.03	0.11

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