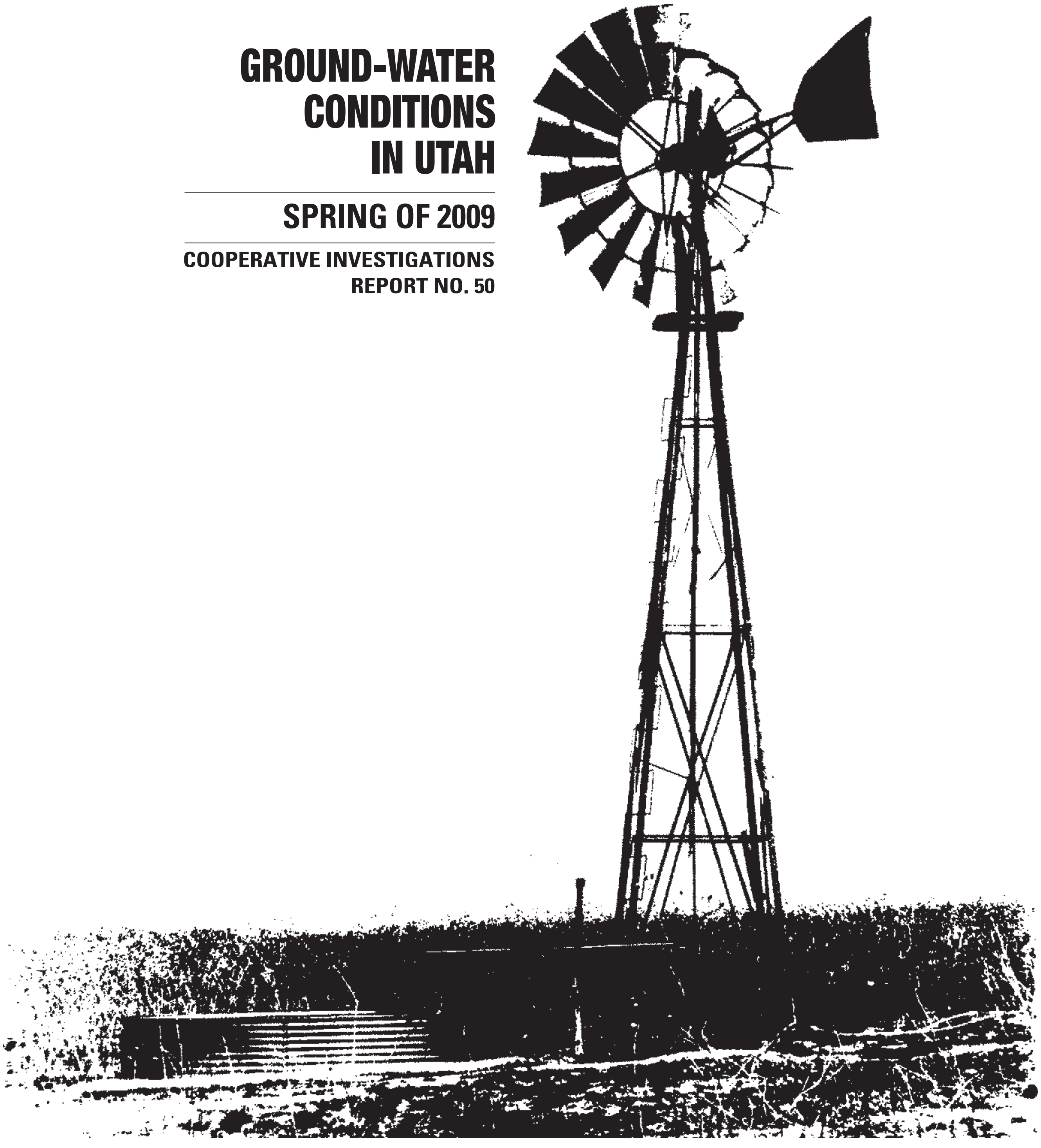
GROUND-WATER CONDITIONS IN UTAH

SPRING OF 2009

COOPERATIVE INVESTIGATIONS
REPORT NO. 50



UTAH DEPARTMENT OF NATURAL RESOURCES and
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

U.S. GEOLOGICAL SURVEY

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 2009

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 Resources and Division of Water Rights; and
Utah Department of Environmental Quality, Division of Water Quality

Published by the
Utah Department of Natural Resources
Division of Water Resources
Cooperative Investigations Report No. 50
2009

Contents

Introduction 1
Utah's Ground-Water Reservoir 1
Summary of Conditions 2
Major Areas of Ground-Water Development 7
  Curlew Valley 7
  Cache Valley 12
  East Shore Area 17
  Salt Lake Valley 22
  Tooele Valley 29
  Utah and Goshen Valleys 34
  Juab Valley 41
  Sevier Desert 46
  Central Sevier Valley 53
  Pahvant Valley 58
  Cedar Valley, Iron County 64
  Parowan Valley 69
  Escalante Valley 74
    Milford Area 74
    Beryl-Enterprise Area 79
  Central Virgin River Area 84
  Other Areas 89
Quality of Water from Selected Wells in Utah, Summer of 2008 107
References Cited 119

Illustrations

Figure 1. Areas of ground-water development in Utah specifically referred to in this report 3
Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2009 8
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 9
Figure 4. Location of wells in Cache Valley in which the water level was measured during March 2009 13
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 14
Figure 6. Location of wells in the East Shore area in which the water level was measured during March 2009 18
Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 19
Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 2009 23
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) 24

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 25
Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 2009 30
Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1 31
Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2009 35
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 Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells 36
Figure 15. Location of wells in Juab Valley in which the water level was measured during March 2009 42
Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1 43
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 2009 47
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 2009 48
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 49
Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 2009 54
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 55
Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 2009 59
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 60
Figure 24. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2009 65
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 66
Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 2009 70
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 71
Figure 28. Location of wells in the Milford area in which the water level was measured during March 2009 75
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 76
Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2009 80
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 81

Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 2009 85
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 86
Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2009 91
Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield 92
Figure 36. Location of wells in Sanpete Valley in which the water level was measured during March 2009 93
Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti 94
Figure 38. Location of wells in Snake Valley and the West Desert in which the water level was measured during March 2009........ 95
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 96
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 97
Figure 41. Location of ground-water sites sampled during the summer of 2008 108
Figure 42. Location of ground-water sites sampled in inset from figure 41 during the summer of 2008 109

Tables

Table 1. Areas of ground-water development in Utah specifically referred to in this report........ 4
Table 2. Number of wells constructed and estimated withdrawal of water from wells in Utah........ 5
Table 3. Total annual withdrawal of water from wells in significant areas of ground-water development in Utah, 1998–2007....... 6
Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2008 110
Table 5. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2008........ 116

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	2.590	square kilometer

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

Chemical concentration is reported only in metric units. 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.

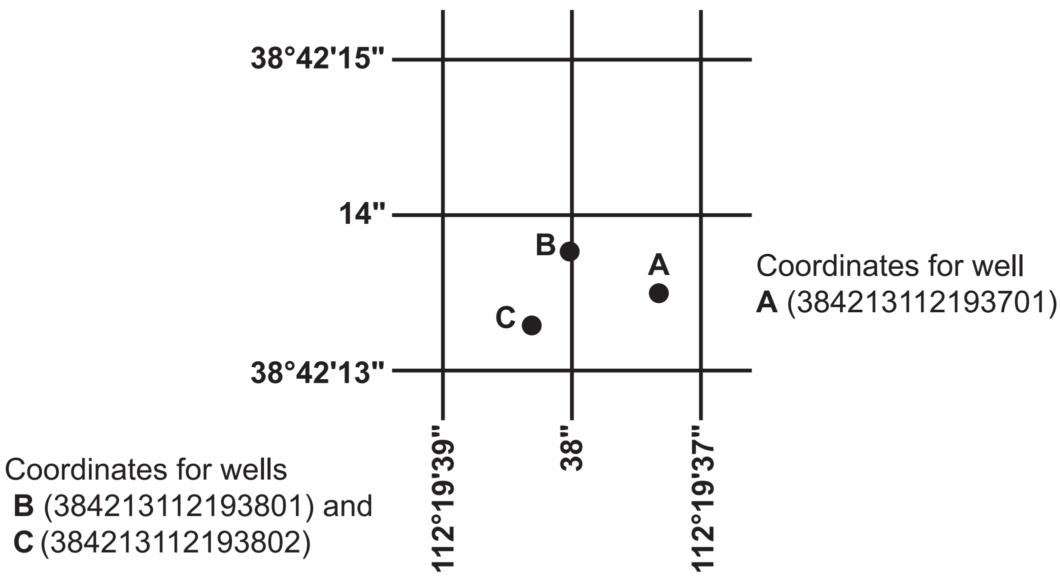
Definition of Terms

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

Numbering System for Wells and Surface-Water Sites

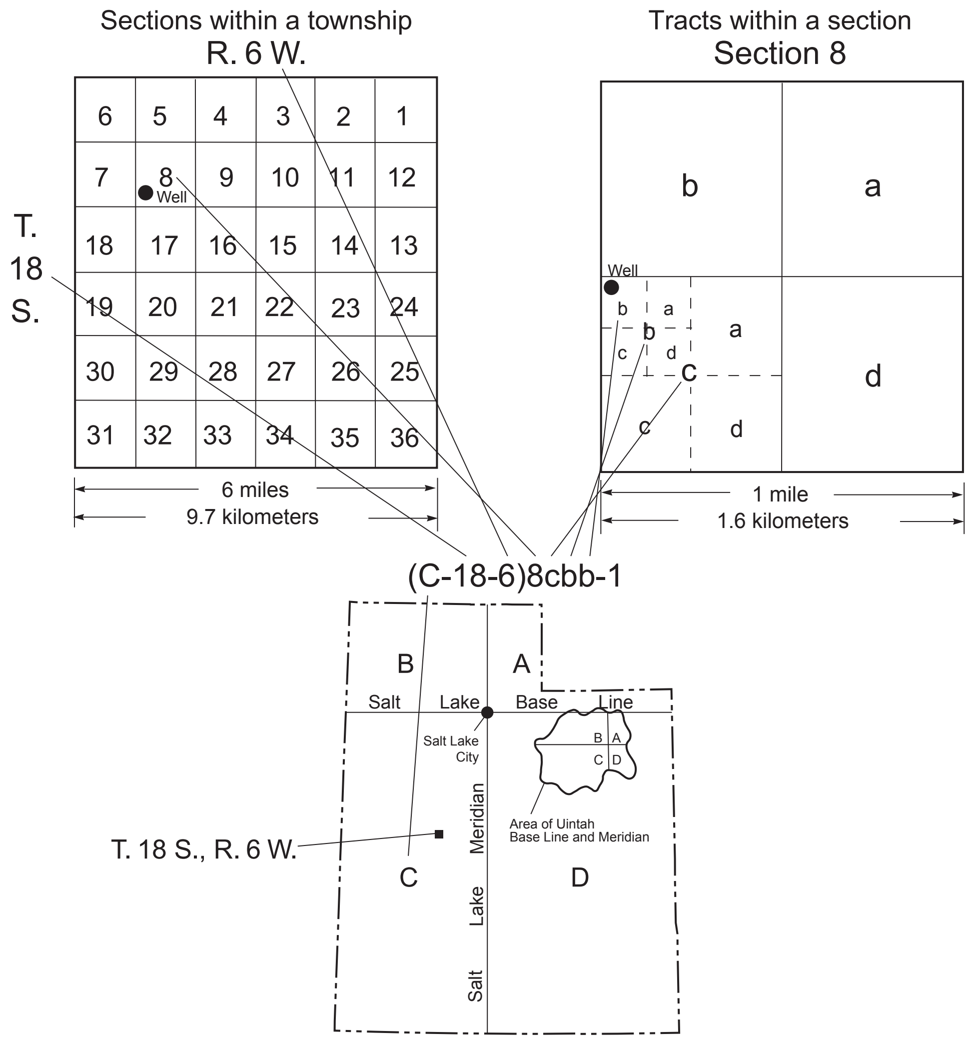
Wells by Latitude and Longitude

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



Wells by the Cadastral System of Land Subdivision

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



Surface-Water Sites— Downstream Order and Station Number

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

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

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 2009

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

INTRODUCTION

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

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

This report includes individual discussions of selected significant areas of ground-water development in the State for calendar year 2008. Most of the reported data were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Resources and Division of Water Rights, and the Utah Department of Environmental Quality, Division of Water Quality. This report is available online at *http://www.waterrights.utah.gov/techinfo/* and *http://ut.water.usgs.gov/publications/GW2009.pdf*.

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

The following reports deal with ground water in the State and were published by the U.S. Geological Survey or by cooperating agencies from May 2008 through April 2009:

Assessment of managed aquifer recharge at Sand Hollow Reservoir, Washington County, Utah, updated to conditions through 2007: U.S. Geological Survey Scientific Investigations Report 2009-5050, by Victor M. Heilweil, Gema Ortiz, and David D. Susong.

Evaluation of the effects of precipitation on ground-water levels from wells in selected alluvial aquifers in Utah and Arizona, 1936-2005: U.S. Geological Survey Scientific Investigations Report 2008-5242, by Philip M. Gardner and Victor M. Heilweil.

Ground-water conditions in Utah, spring of 2008: Utah Division of Water Resources Cooperative Investigations Report No. 49, by Carole B. Burden and others.

Hydrology of northern Utah Valley, Utah County, Utah, 1975-2005: U.S. Geological Survey Scientific Investigations Report 2008-5197, by Jay R. Cederberg, Philip M. Gardner, and Susan A. Thiros.

Southwest principal aquifers regional ground-water quality assessment: U.S. Geological Survey Fact Sheet 2009-3015, by David W. Anning, Susan A. Thiros, Laura M. Bexfield, Tim S. McKinney, and Jenna M. Green.

Three-dimensional numerical model of ground-water flow in northern Utah Valley, Utah County, Utah: U.S. Geological Survey Scientific Investigations Report 2008-5049, by Philip M. Gardner.

UTAH'S GROUND-WATER RESERVOIR

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

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

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

SUMMARY OF CONDITIONS

The total estimated withdrawal of water from wells in Utah during 2008 was about 1,003,000 acre-feet (table 2), which is about 2,000 acre-feet more than the revised total for 2007 and 135,000 acre-feet more than the 1998–2007 average annual withdrawal (table 3). The increase in withdrawal resulted mostly from increased irrigation and industrial use. The total estimated withdrawal for irrigation was about 555,000 acre-feet, which is 13,000 acre-feet more than the revised value for 2007. Withdrawal for industrial use increased about 16,000 acre-feet to about 95,000 acre-feet. Withdrawal for public supply was about 289,000 acre-feet, which is about 27,000 acre-feet less than the value for 2007. Withdrawal for domestic and stock use was about 63,000 acre-feet, which is 1,000 acre-feet less than in 2007.

From 2007 to 2008, ground-water withdrawal increased in 9 of the 16 areas of ground-water development discussed in this report (table 2). Withdrawal in the Sevier Desert increased about 10,000 acre-feet, the largest increase of any of the ground-water development areas shown in figure 1. The 2008 withdrawal was more than the average annual withdrawal for 1998–2007 in all 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 2008 at 23 of 28 weather stations included in this report (National Oceanic and Atmospheric Administration, 2008), was less than the long-term average. The greatest decrease in precipitation from average was 6.4 inches at Ogden Pioneer Powerhouse. The greatest increase in precipitation from average was 2.9 inches at Hatch.

About 650 water-level measurements were made during February and March 2009 in wells for areas included in this report. Water-level data included in the hydrographs in this report are from measurements made during the spring months, generally February-March, but may include water-level measurements made in April and May. Many of the wells in this report have additional water-level measurements made throughout the year which are not included in this report. All water-level data are available online at *http://waterdata.usgs.gov/ut/nwis/gwlevels*. Water-quality data are available online at *http://waterdata.usgs.gov/ut/nwis/qw*.

In 2008, 487 wells were constructed for new appropriations of ground water, as determined by the Utah Division of Water Rights (table 2), which is 71 fewer wells than the total reported for 2007. In 2008, 19 large-diameter wells (12 inches or more) were constructed for new appropriations of ground water (table 2), which is two more wells than the total reported for 2007. These are principally for withdrawal of water for public supply, irrigation, and industrial use.

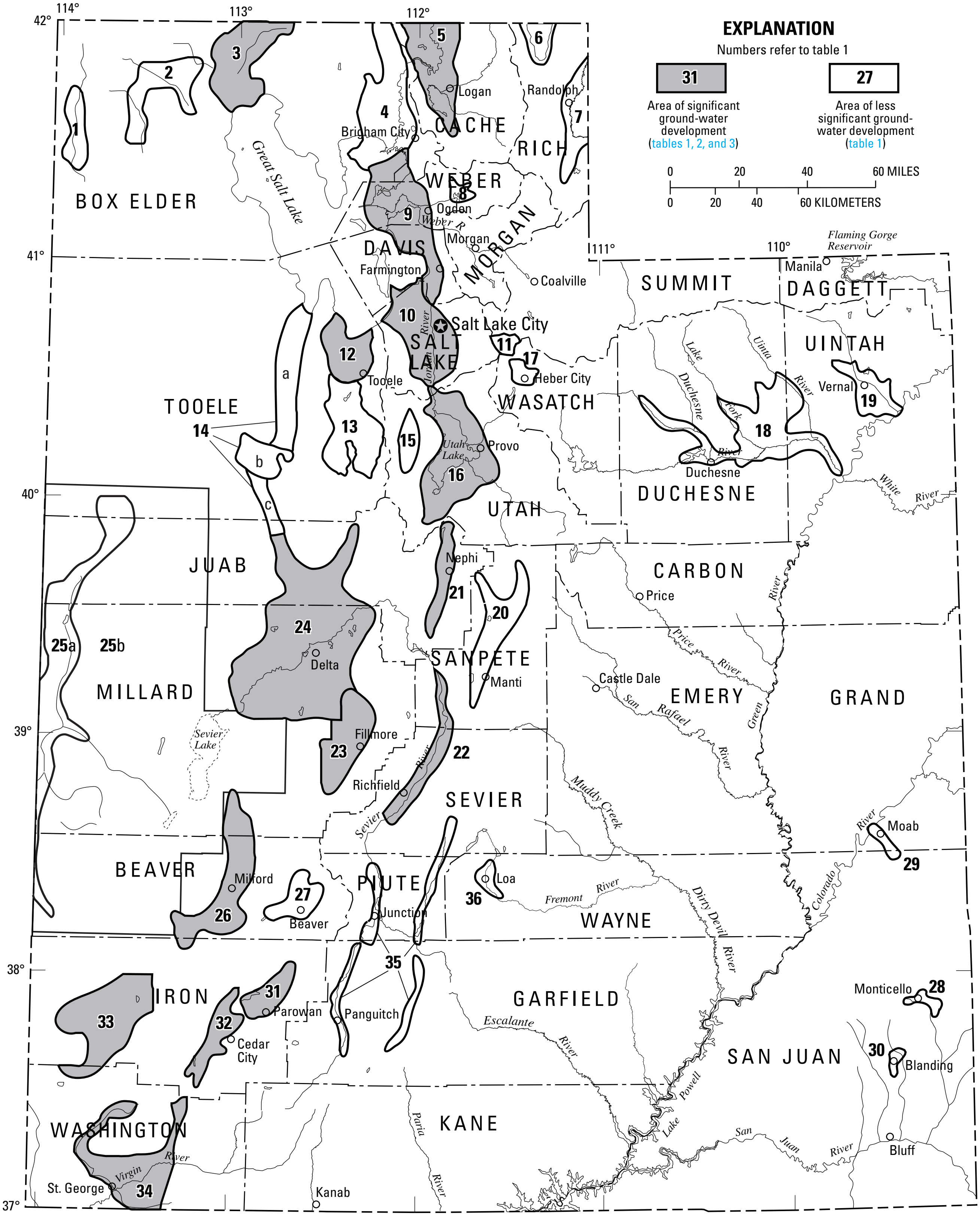


Figure 1. Areas of ground-water development in Utah specifically referred to in this report.

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

[Do., ditto]

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

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

Area	Number in figure 1	Number of wells[1] constructed in 2008		Estimated withdrawal from wells (acre-feet)					
				2008					2007 total[2] (rounded)
		Total	Diameter of 12 inches or more	Irrigation	Industrial[1]	Public supply[1]	Domestic and stock	Total (rounded)	
Curlew Valley	3	1	1	43,500	0	200	100	44,000	38,000
Cache Valley	5	24	0	13,700	5,900	12,900	2,000	34,000	36,000
East Shore area	9	2	1	7,200	4,000	37,700	5,000	54,000	52,000
Salt Lake Valley	10	2	0	970	[3] 31,900	80,000	22,000	135,000	151,000
Tooele Valley	12	24	6	[4,5] 16,500	1,500	9,800	1,200	29,000	[6] 27,000
Utah and Goshen Valleys	16	34	3	31,700	8,900	66,700	16,700	124,000	126,000
Juab Valley	21	2	1	24,500	80	[7]650	400	26,000	26,000
Sevier Desert	24	11	0	36,600	4,700	1,600	1,200	44,000	34,000
Central Sevier Valley	22	13	0	19,000	60	3,500	1,300	24,000	19,000
Pahvant Valley	23	8	1	92,900	0	950	320	94,000	89,000
Cedar Valley, Iron County	32	4	0	29,900	100	8,000	2,200	40,000	40,000
Parowan Valley	31	6	0	[8] 37,300	100	350	330	38,000	34,000
Escalante Valley									
Milford area	26	7	2	40,300	[9] 9,700	720	140	51,000	49,000
Beryl-Enterprise area	33	6	1	89,900	[10] 1,600	590	650	93,000	92,000
Central Virgin River area	34	12	0	5,900	560	20,000	2,400	29,000	33,000
Other areas[11,12]		331	3	65,200	26,300	45,700	7,300	144,000	155,000
Total (rounded)		487	19	555,000	95,000	289,000	63,000	1,003,000	[6] 1,001,000

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

[2] From Burden and others (2008, table 2).

[3] Includes some use for air conditioning, about 2,500 acre-feet. About 92 percent was injected back into the aquifer.

[4] Includes some domestic and stock use.

[5] Includes some flowing well discharge.

[6] Revised.

[7] Previously included some springs.

[8] Includes some stock use.

[9] Includes 7,240 acre-feet for geothermal power generation. About 99 percent was injected back into the aquifer.

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

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

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

Table 3. Total annual withdrawal of water from wells in significant areas of ground-water development in Utah, 1998–2007.

Area	Number in figure 1	Thousands of acre-feet[1] (rounded)										1998–2007 average (rounded)
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
Curlew Valley	3	29	29	41	36	[2]38	42	38	29	31	38	35
Cache Valley	5	26	24	30	32	33	27	27	29	31	36	30
East Shore area	9	56	61	60	57	49	49	46	41	46	52	52
Salt Lake Valley	10	122	126	145	151	[2]140	130	125	110	131	151	131
Tooele Valley	12	[2]19	21	24	21	21	22	21	[2]18	[2]21	[2]27	22
Utah and Goshen Valleys	16	[2]77	[2]103	[2]120	[2]111	[2]111	[2]108	[2]105	[2]87	100	126	105
Juab Valley	21	12	14	27	29	29	27	26	14	21	26	22
Sevier Desert	24	12	12	15	19	36	28	41	24	20	34	24
Central Sevier Valley	22	20	20	13	12	11	15	15	17	16	19	16
Pahvant Valley	23	66	76	80	80	89	86	85	80	86	89	82
Cedar Valley, Iron County	32	36	32	[2]35	32	42	39	40	30	35	40	36
Parowan Valley	31	28	[2]26	30	[2]33	39	31	37	27	33	34	32
Escalante Valley												
Milford area	26	41	41	49	42	52	50	44	40	45	49	45
Beryl-Enterprise area	33	74	79	84	81	99	92	98	68	79	92	85
Central Virgin River area	34	20	[2]18	[2]26	27	27	28	26	29	32	33	27
Other areas		99	106	[2]135	114	131	128	129	111	130	155	124
Total (rounded)		[2]737	[2]788	[2]914	[2]877	[2]947	[2]902	[2]903	[2]754	[2]857	[2]1,001	868

[1] From previous reports of this series.

[2] Revised.

MAJOR AREAS OF GROUND-WATER 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, north, and east by mountains that range in altitude from about 6,500 to nearly 10,000 feet and is open to the south, where water draining from the valley enters Great Salt Lake.

The Utah part of Curlew Valley (Utah subbasin) covers about 550 square miles 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 ground water. The ground-water 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 2008 was about 44,000 acre-feet, which is 6,000 acre-feet more than the value for 2007 and 9,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2009 is shown in figure 2. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3.

Water levels in Curlew Valley generally declined from March 2008 to March 2009. Since about 1980, water levels have generally declined, probably the result of continued large withdrawals for irrigation.

Precipitation at Grouse Creek in 2008 was about 7.0 inches, which is about 0.9 inch more than in 2007 and about 4.1 inches less than the average annual precipitation for 1959–2008.

Physical properties and records of chemical analyses for water from three wells in Curlew Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 41. The concentration of dissolved solids and dissolved chloride in water samples from wells (B-14-8)11bca-1 and (B-14-9)5bbb-1 exceeded the secondary drinking-water standards for these constituents (500 and 250 mg/L, respectively). The concentration of dissolved sulfate in water from well (B-14-8)11bca-1 also exceeded the secondary drinking-water standard for this constituent (250 mg/L).

The concentration of dissolved solids in water samples collected from well (B-12-11)4bcc-1, north of Kelton, and well (B-14-9)5bbb-1, 10 miles west of Snowville, from 1972–2007 and 1971–2008, respectively, is shown in figure 3. The dissolved-solids concentration in water samples from well (B-14-9)5bbb-1 has generally increased since 1972. The sample collected in August 2008 had a dissolved-solids concentration of 1,150 mg/L, which is 3.3 times greater than the concentration in the water sample collected in May 1971 (349 mg/L). The dissolved-solids concentration in water from well (B-12-11)4bcc-1 has gradually increased from 1972 to 2007. This irrigation well was not sampled in 2008.

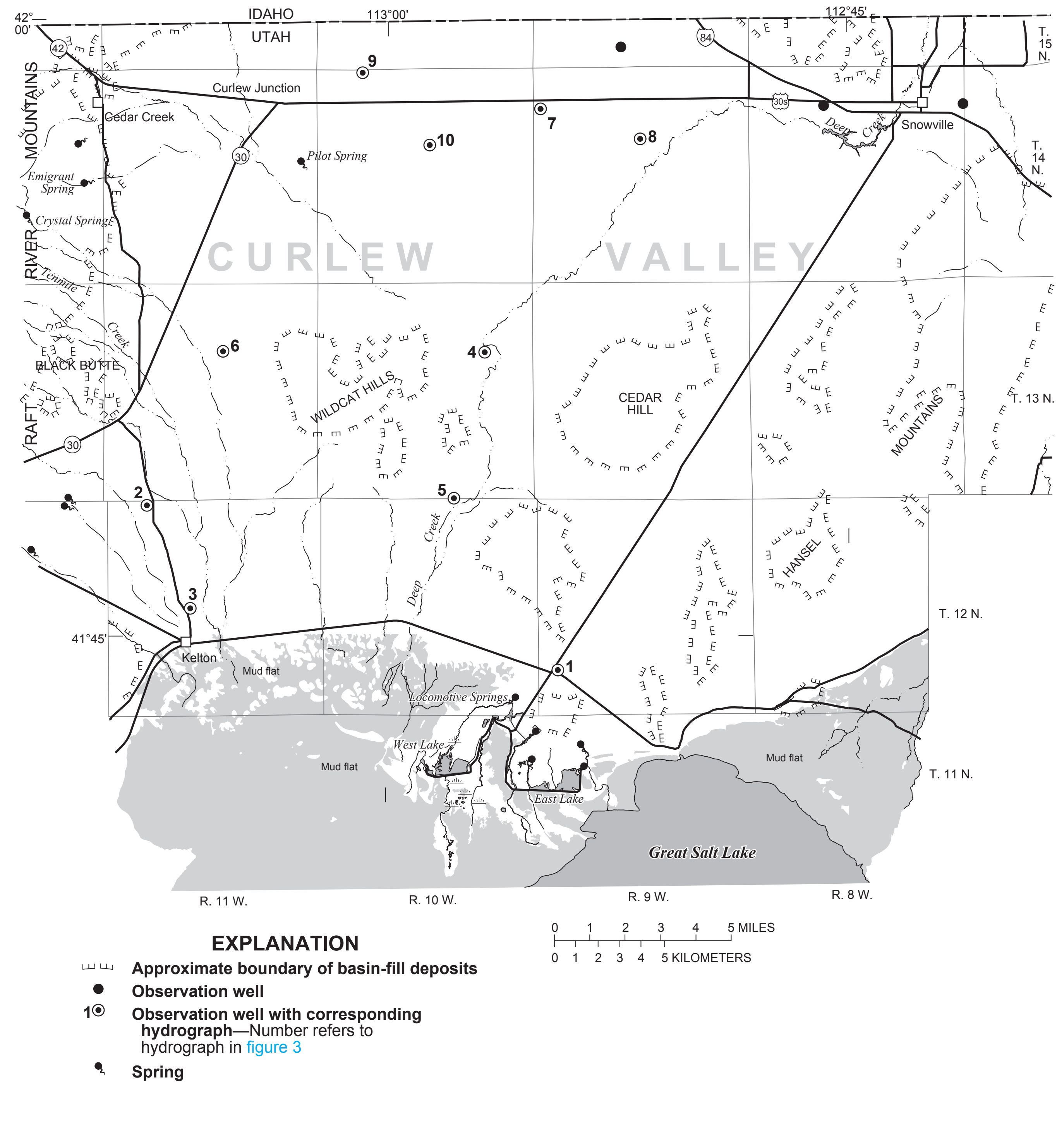


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2009.

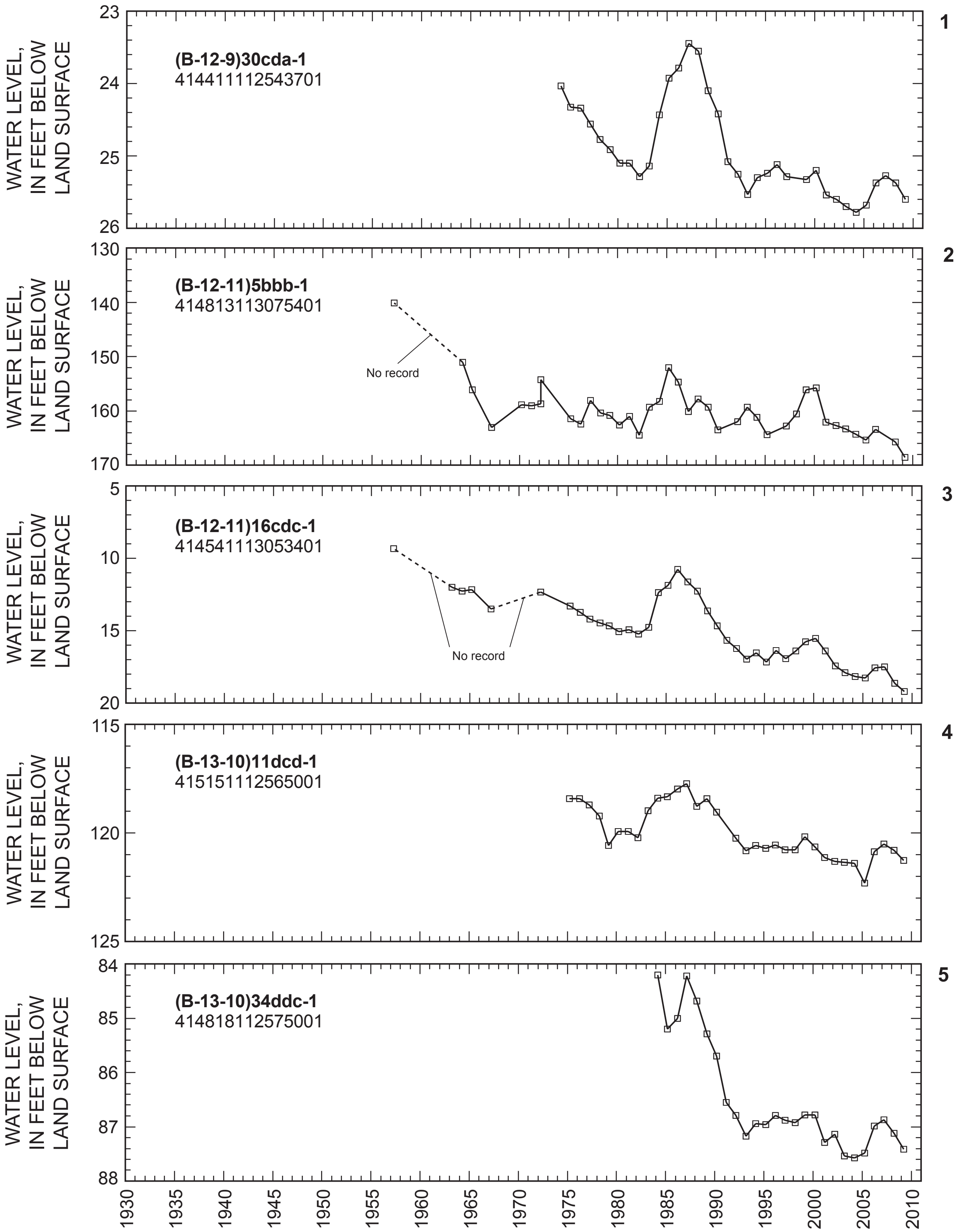


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

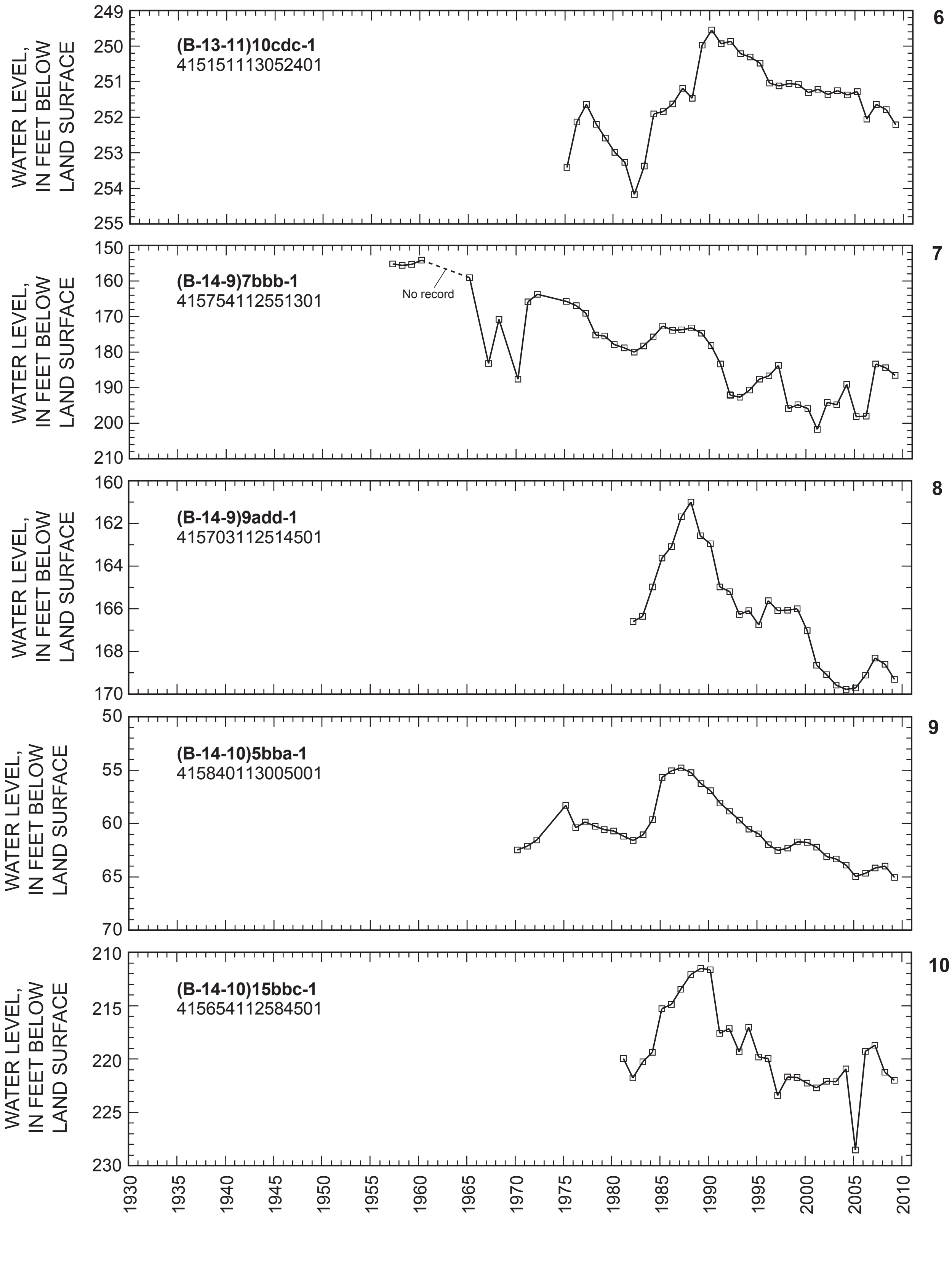


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

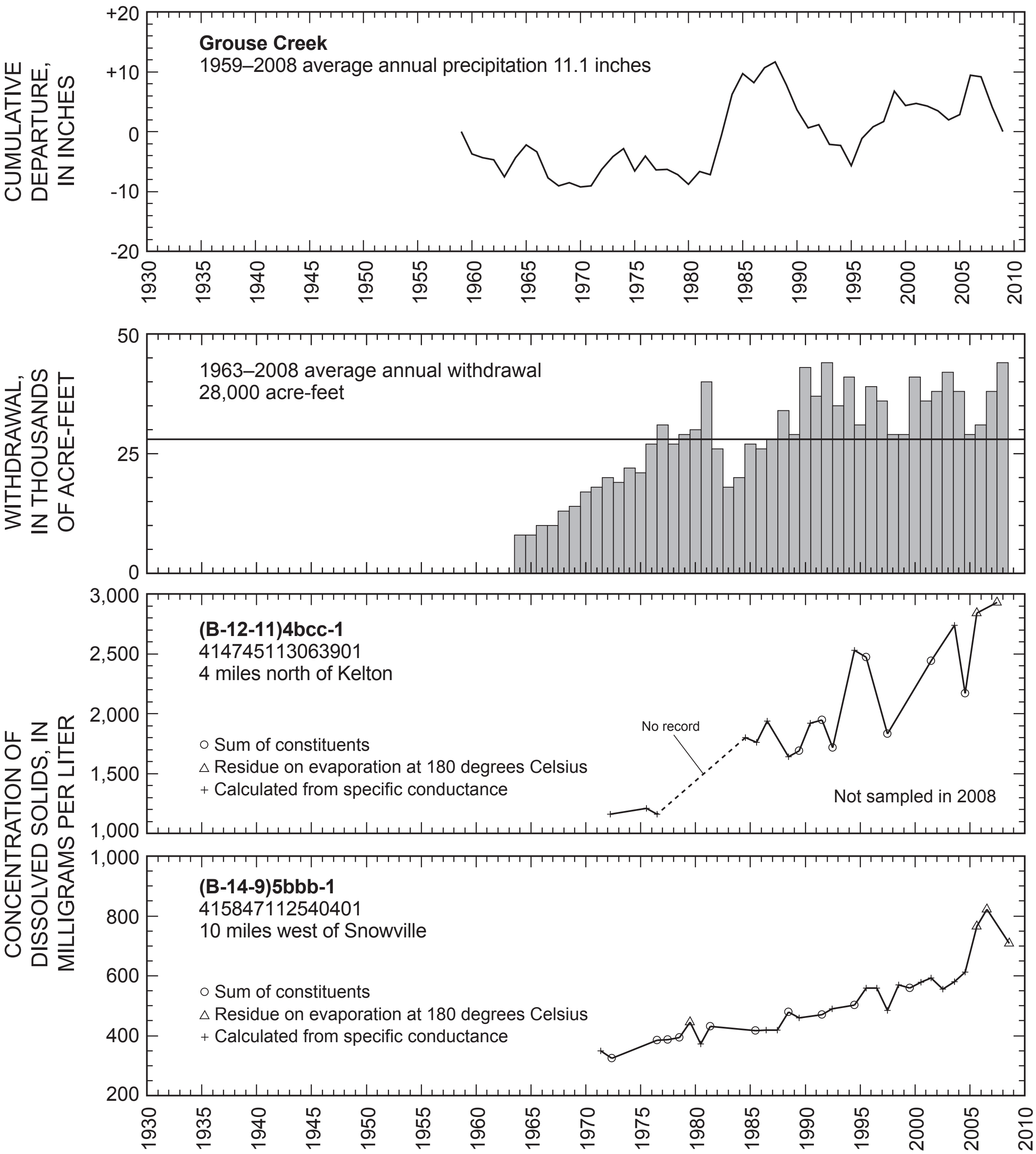


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

CACHE VALLEY

By Ryan C. Rowland

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). Ground water occurs in unconsolidated basin-fill deposits in the valley, under both water-table and artesian conditions. Recharge to the ground-water system occurs principally along the margins of the valley, and ground water moves toward the center of the valley and west toward Cache Junction.

Total estimated withdrawal of water from wells in Cache Valley in 2008 was about 34,000 acre-feet, which is 2,000 acre-feet less than in 2007 and 4,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). Withdrawal for irrigation was 13,700 acre-feet (largely from flowing wells), which is 2,300 acre-feet less than in 2007. Withdrawal for public supply was 12,900 acre-feet, 800 acre-feet more than in 2007.

The location of wells in Cache Valley in which the water level was measured during March 2009 is shown in figure 4. The relation of the water level in selected observation wells to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1 is shown in figure 5.

Water levels throughout the valley generally rose from March 2008 to March 2009. This is consistent with increased precipitation in 2008 compared to 2007. Water levels fluctuated between 1935 and 1983; since 1985, water levels have fluctuated depending on the amount and timing of precipitation and recharge to the unconsolidated deposits from snowmelt runoff.

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 2008 was about 149,800 acre-feet, which is 23,600 acre-feet more than the revised 2007 total of 126,200 acre-feet and 30,200 acre-feet less than the 1941–2008 average annual discharge.

Precipitation at Logan, Utah State University, was about 17.0 inches in 2008. This is about 2.8 inches more than for 2007 and about 1.2 inches less than the average annual precipitation for 1930–2008.

Physical properties and records of chemical analyses for water from five wells in Cache Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 41. The concentration of dissolved manganese in the water sample from well (A-13-1)29bcd-1 exceeded the secondary standard for this constituent (0.05 mg/L). Analytical results for the remaining wells did not exceed secondary standards or MCLs for major ions, trace elements, and nutrients.

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 2008, is shown in figure 5. The concentration has ranged from 223 to 278 mg/L, with a median value of 258 mg/L. The maximum value was measured in the sample collected in July 2008 and is about 8 percent greater than the median value. There is little variability in the data and no apparent trends. This is consistent with the relatively small range (55 mg/L) and standard deviation (11.0 mg/L) associated with the data.

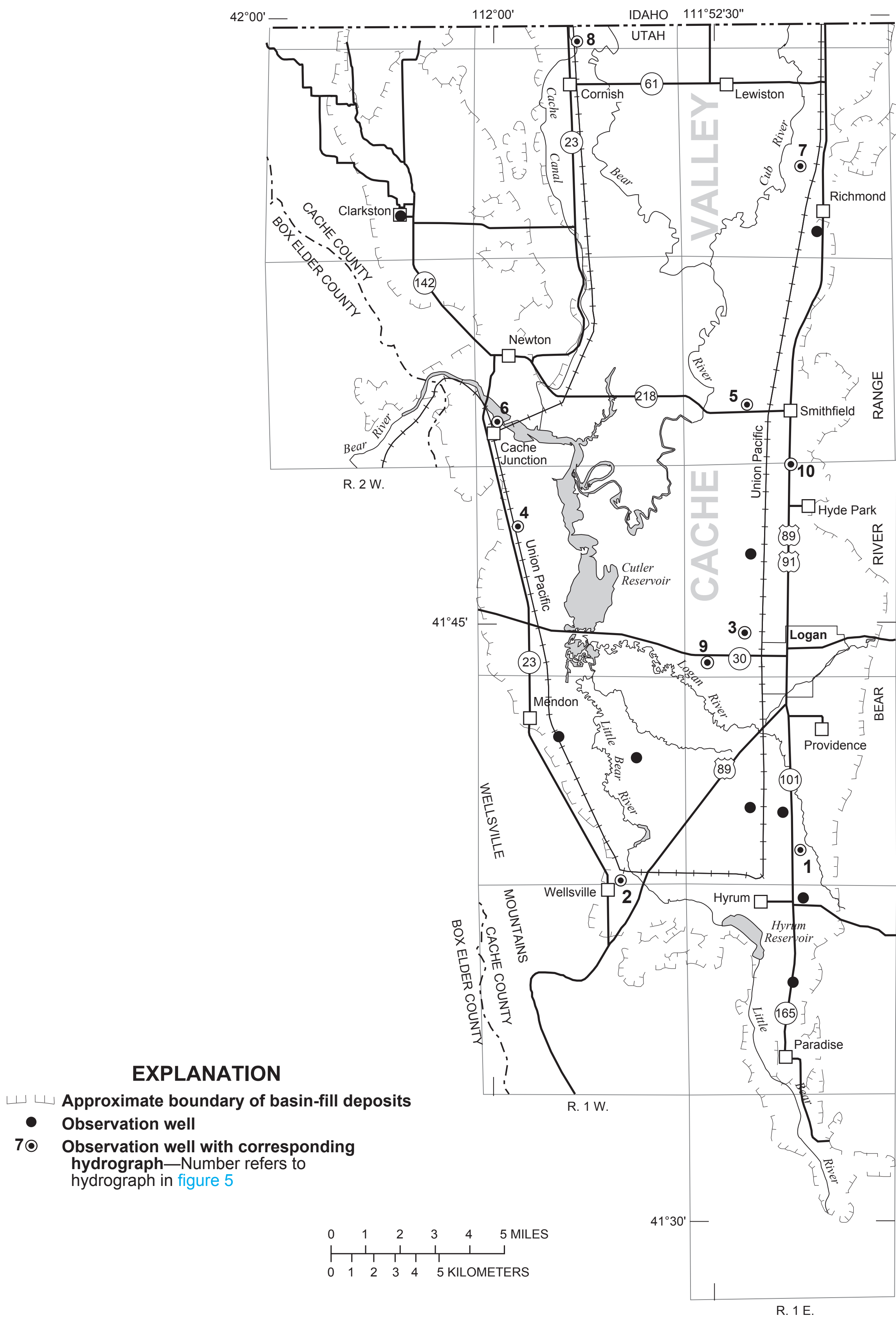


Figure 4. Location of wells in Cache Valley in which the water level was measured during March 2009.

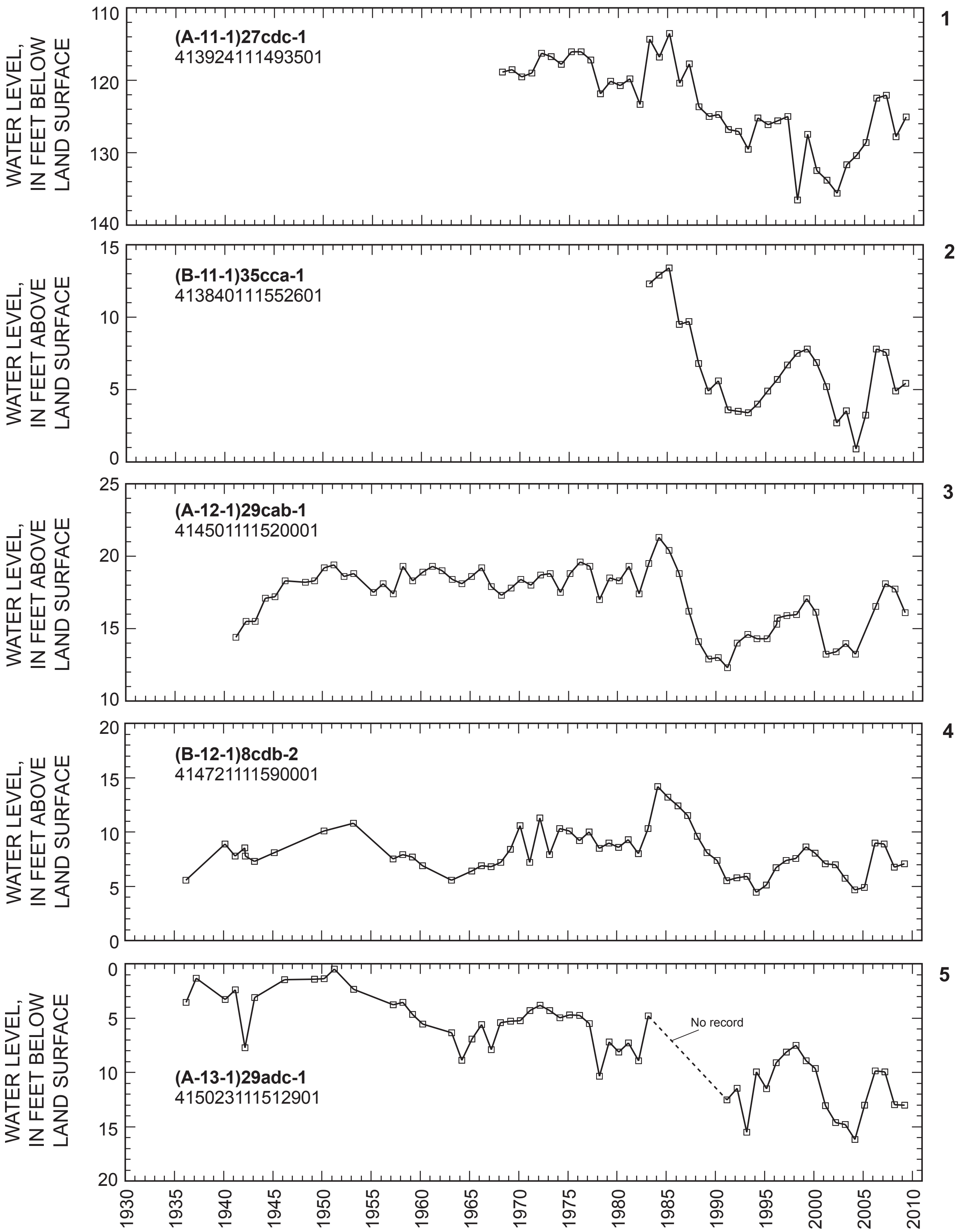


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

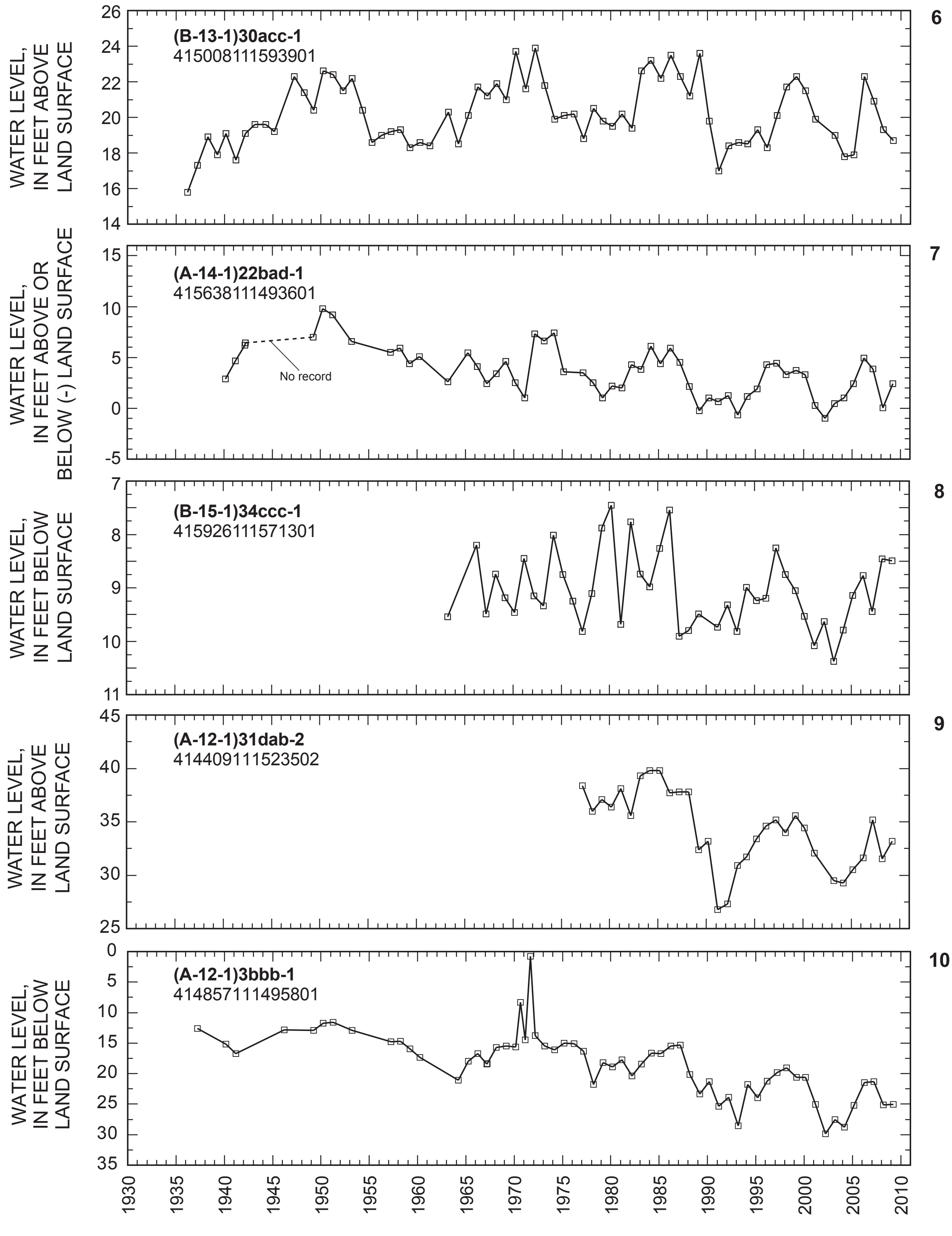


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

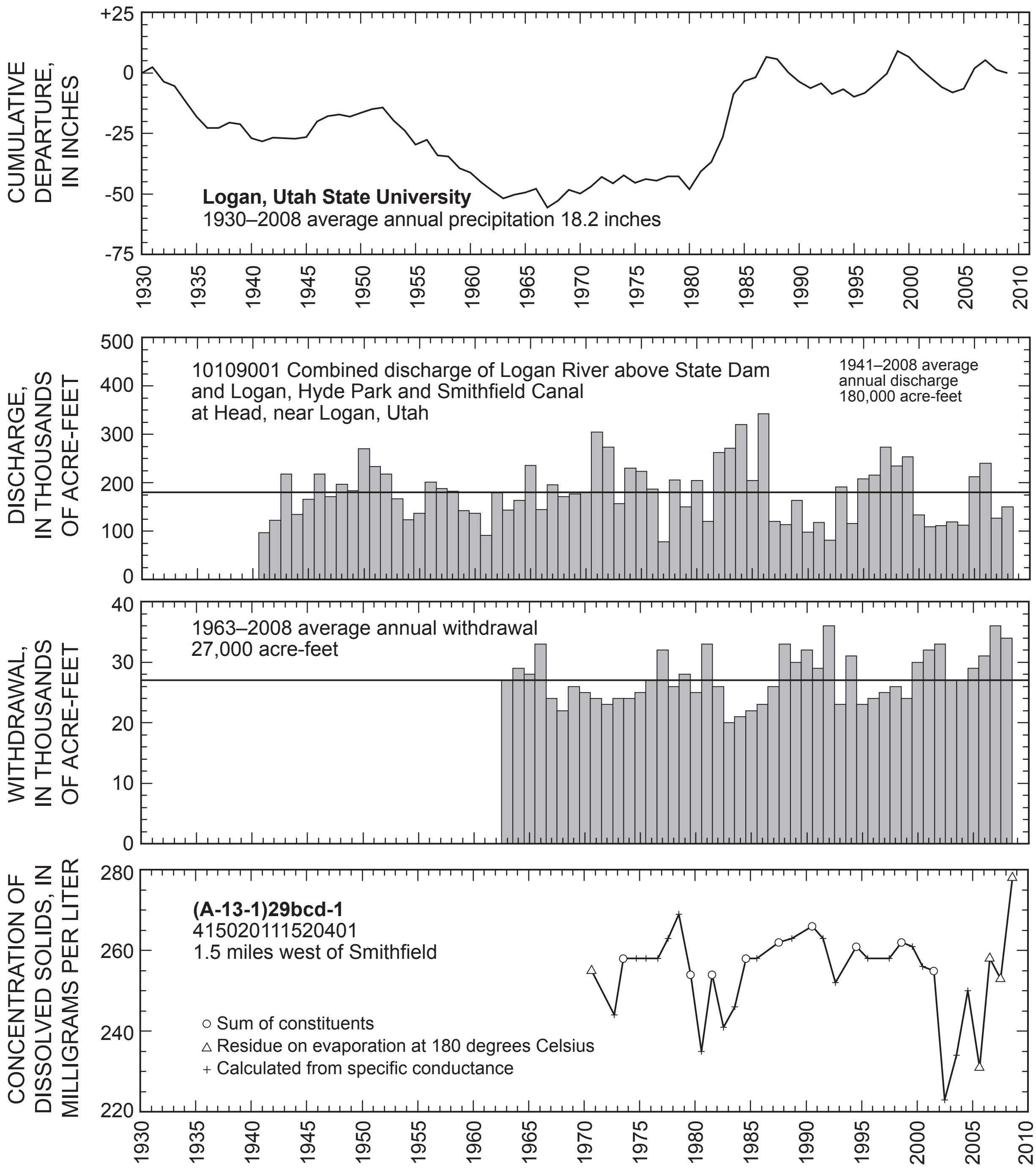


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from 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). Ground water 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 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 2008 was about 54,000 acre-feet, which is 2,000 acre-feet more than was reported for 2007 and 2,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). Withdrawal for public supply was about 2,700 acre-feet more than in 2007. Withdrawal for irrigation was about 7,200 acre-feet, which is about 600 acre-feet less than in 2007. Withdrawal for industrial use was about 4,000 acre-feet, which is about 200 acre-feet more than in 2007.

The location of wells in the East Shore area in which the water level was measured during March 2008 is shown in figure 6. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 7.

Water levels declined from March 2008 to March 2009 in most of the wells measured in the East Shore area. Declines probably resulted from less recharge due to less-than-average precipitation and continued large withdrawals for public supply (table 2). Water levels have generally declined in most of the East Shore area from the mid-1950s to 2009.

Precipitation at Ogden Pioneer Powerhouse in 2008 was about 14.8 inches, which is about 6.4 inches less than the average annual precipitation for 1930–2008 and about 3.0 inches less than in 2007.

Physical properties and records of chemical analyses for water from five wells in the East Shore area are listed in tables 4 and 5, and the location of the wells is plotted in figure 41. The concentrations of dissolved iron and manganese in water samples from wells (B-4-2)27aba-1 and (B-5-1)30ada-2 (Davis County), and well (B-5-2)6bdd-5 (Weber County) exceeded the secondary standards for these constituents (0.3 and 0.05 mg/L, respectively). Water from well (B-5-2)6bdd-5 also exceeded secondary standards for dissolved solids and dissolved chloride (500 and 250 mg/L, respectively). The water sample from well (B-6-2)8abd-2 in Weber County exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from well (B-4-2)27aba-1, 2.3 miles south-southeast of Syracuse, from 1969 to 2008, is shown in figure 7. The concentration has ranged from 287 to 633 mg/L with a median value of 400 mg/L. From 1969 to 1993, dissolved-solids concentrations in water samples varied by as much as 346 mg/L; however, recent data collected from 1995 to 2008 vary by less than 30 mg/L. The dissolved-solids concentration in the water sample collected in August 2008 (373 mg/L) compares well to the median value.

Figure 6. Location of wells in the East Shore area in which the water level was measured during March 2009.

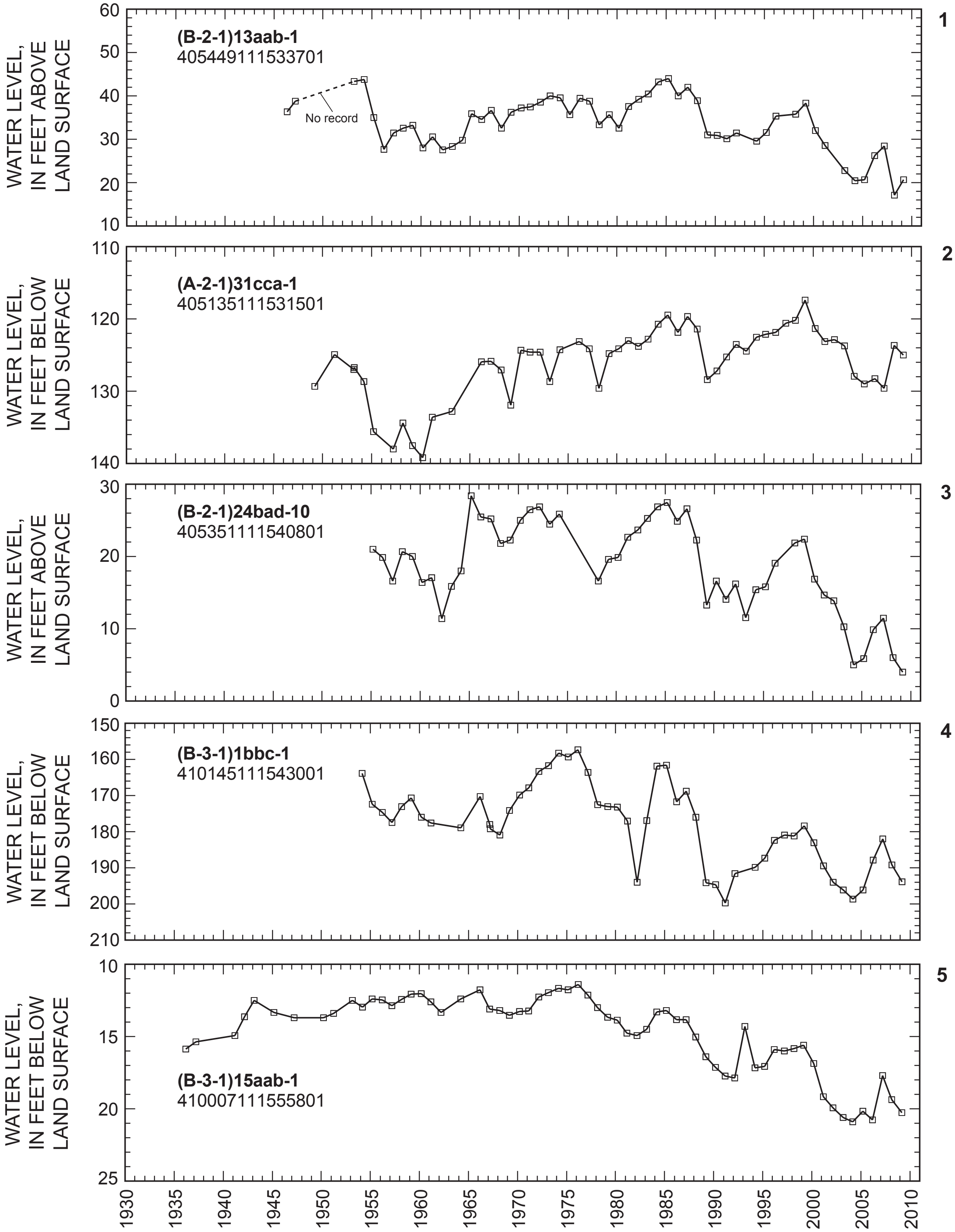


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

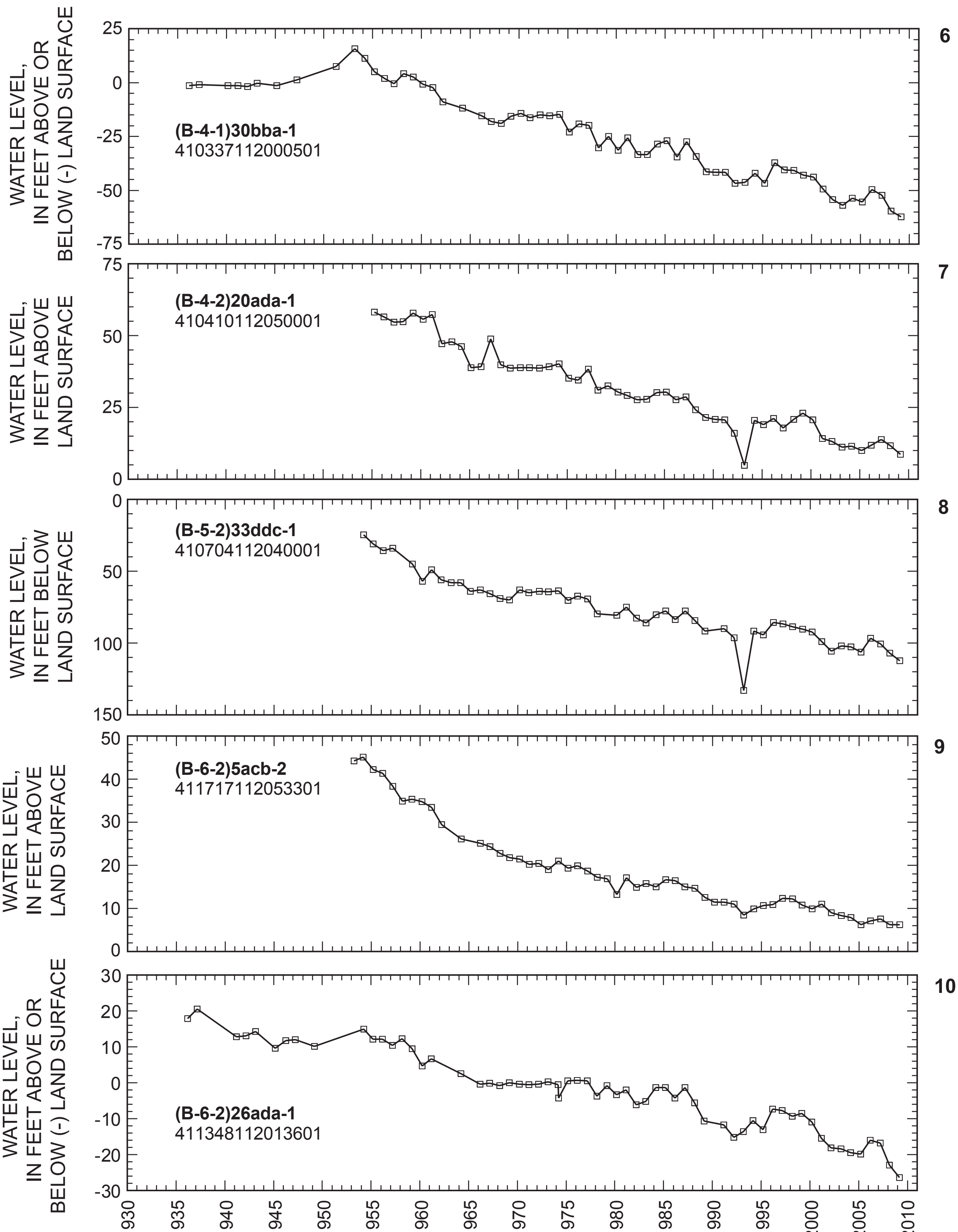


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

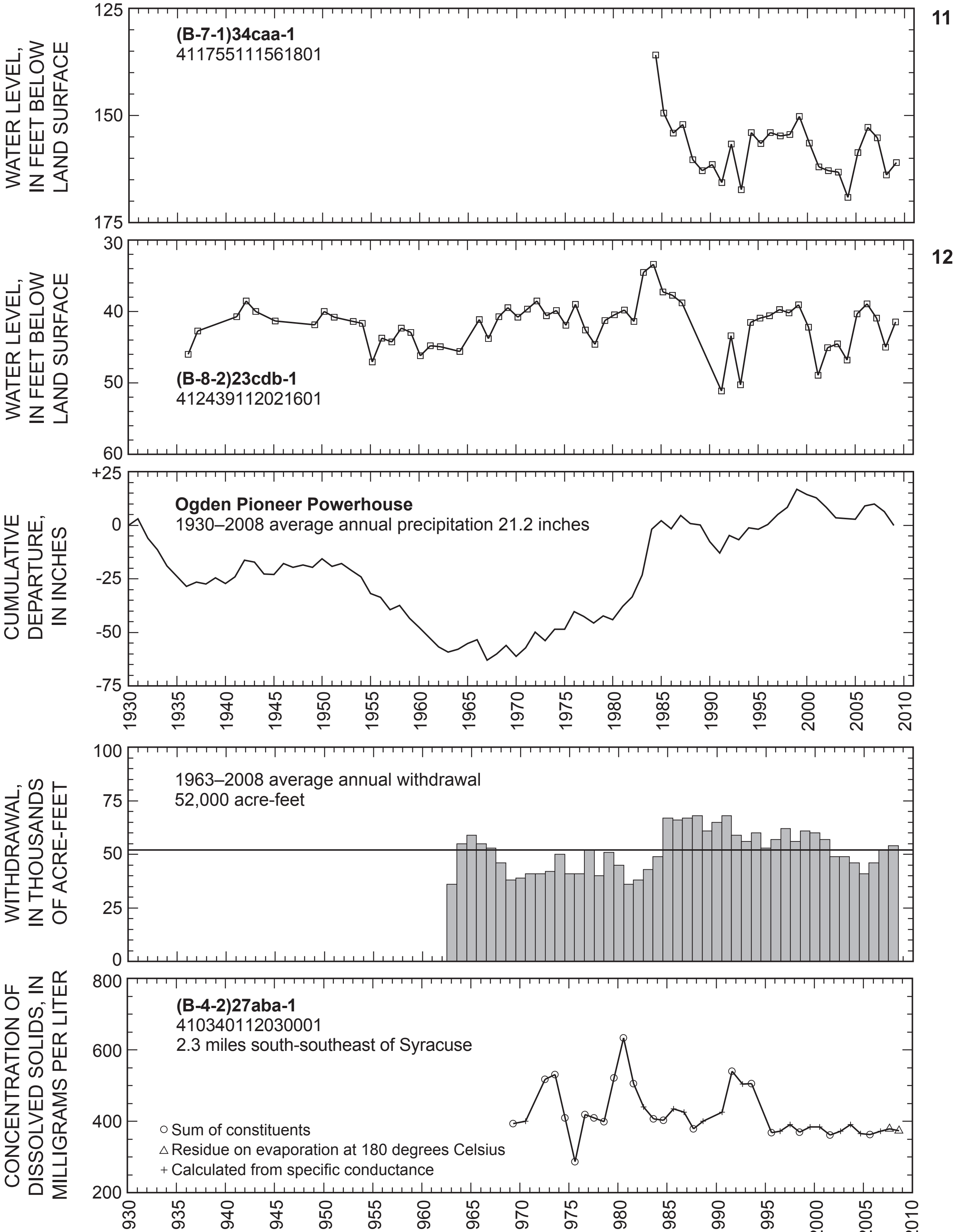


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

SALT LAKE VALLEY

By Michael L. Freeman

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

Total estimated withdrawal of water from wells in Salt Lake Valley in 2008 was about 135,000 acre-feet, which is 16,000 acre-feet less than in 2007 and 4,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). Withdrawal for public supply was about 80,000 acre-feet, which is 25,000 acre-feet less than the total for 2007. Withdrawal for industrial use was about 31,900 acre-feet, which is 9,300 acre-feet more than the total for 2007.

The location of wells in Salt Lake Valley in which the water level was measured during February 2009 is shown in figure 8. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (WSO) (International Airport) are shown in figure 9. Precipitation at Salt Lake City WSO during 2008 was about 11.7 inches, about 1.9 inches less than 2007 and about 3.5 inches less than the average annual precipitation for 1931–2008.

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 40.8 inches in 2008, which is about 7.7 inches more than in 2007 and about 1.5 inches less than the average annual precipitation for 1931–2008.

Water levels rose slightly from February 2008 to February 2009 in most of the wells measured in Salt Lake Valley. The water level in most of the observation wells was highest during 1985–87, which corresponds to a period of much-greater-than-average precipitation. Levels have generally declined since 1987, although substantial rises occurred in the northeastern part of the valley from 1994 to 1999.

Physical properties and records of chemical analyses for water from six wells in Salt Lake Valley are listed in tables 4 and 5, and the location of the wells is plotted in figures 41 and 42. The dissolved-solids concentration in water samples from all wells exceeded the secondary standard for this constituent (500 mg/L). Dissolved-chloride concentrations in water from wells (B-1-2)19aca-1 and (C-3-1)12ccb-3 exceeded the secondary standard for this constituent (250 mg/L). Water from well (B-1-1)27cac-1 exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from well (D-1-1)7abd-6, a flowing well at 800 South 500 East in Salt Lake City, from 1931 to 2008, is shown in figure 10. The concentration has ranged from 554 to 838 mg/L with a median value of 681 mg/L. The concentration of dissolved solids increased from 576 mg/L in December 1931 to 838 mg/L in July 2008.

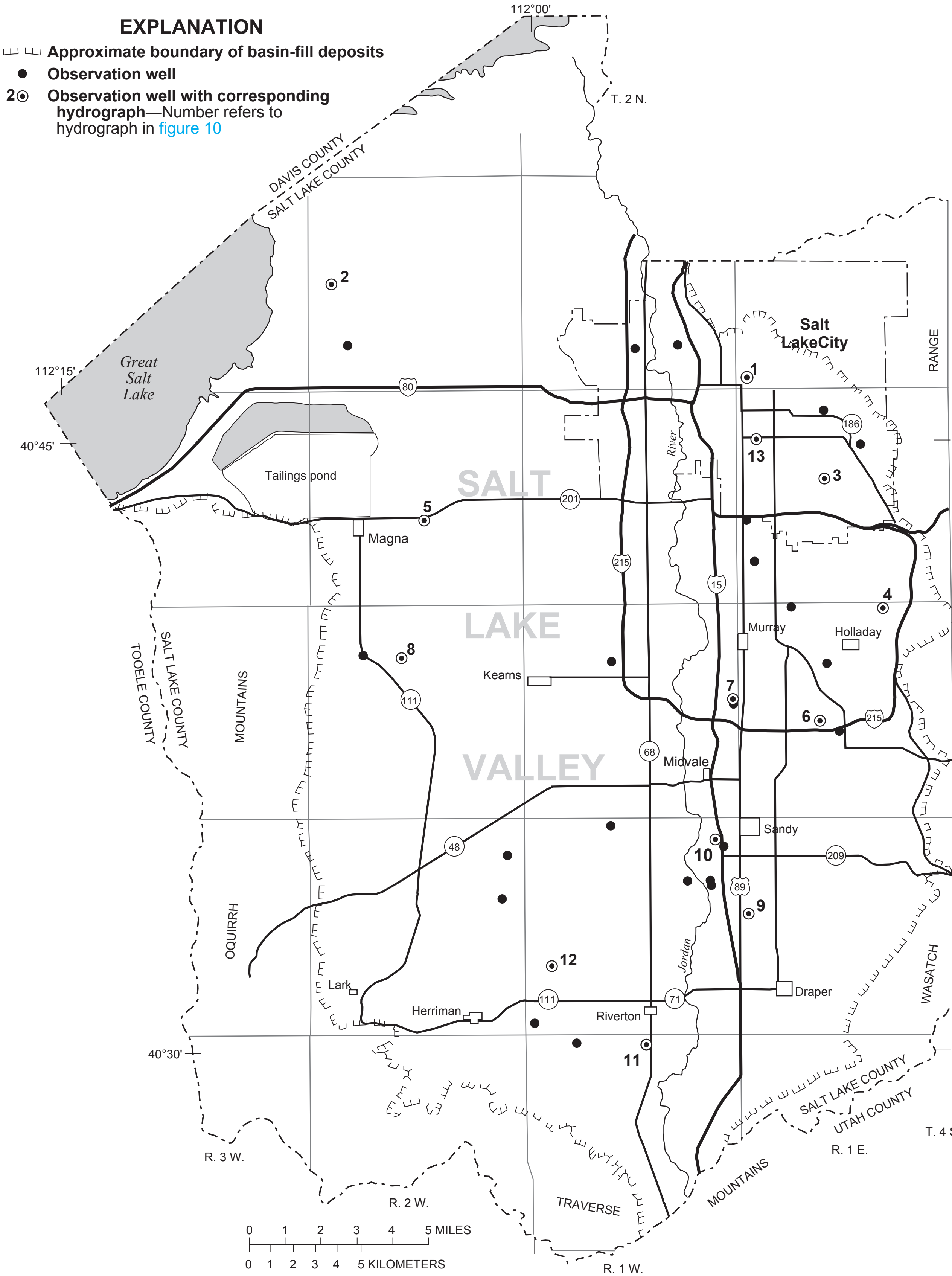


Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 2009.

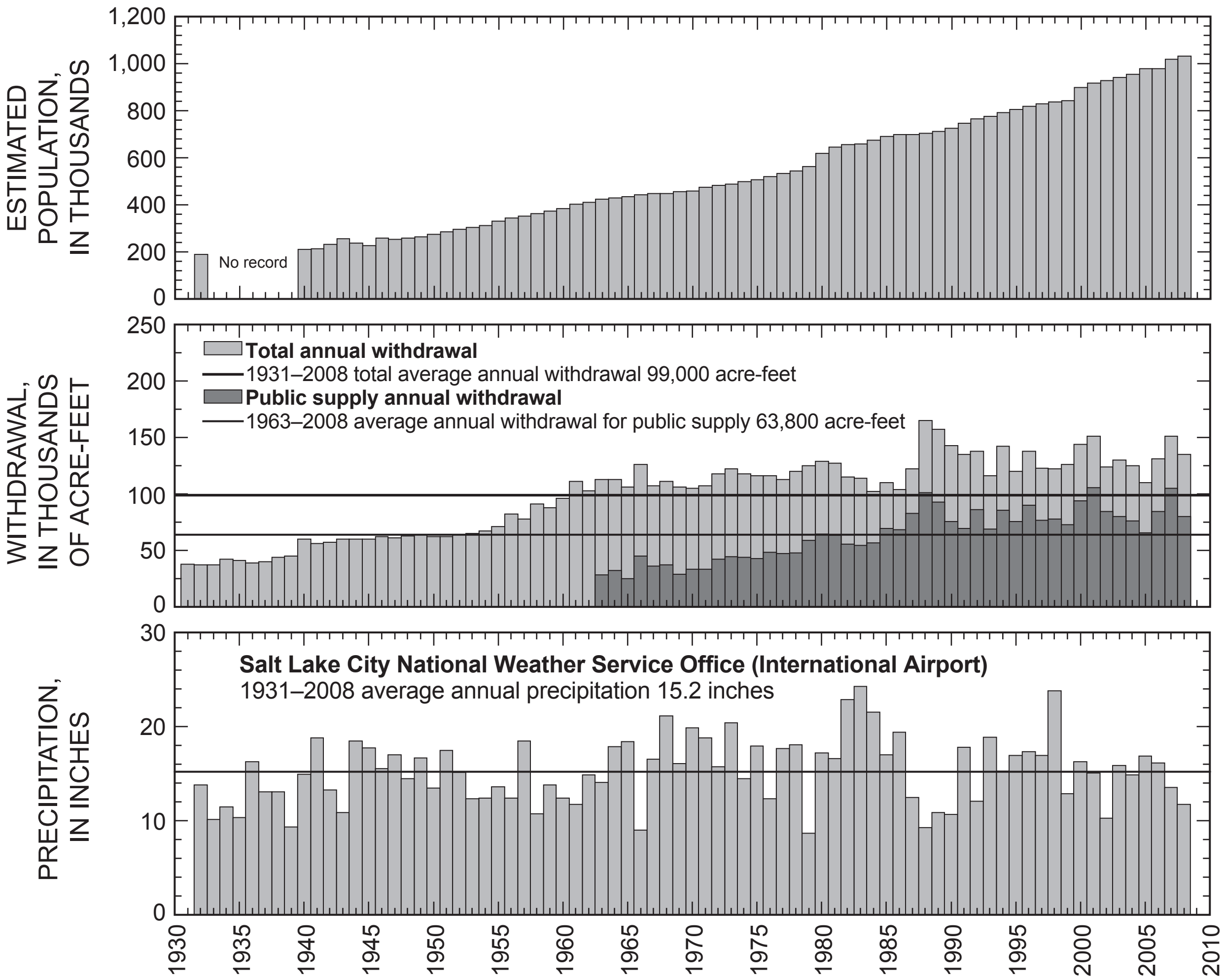


Figure 9. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

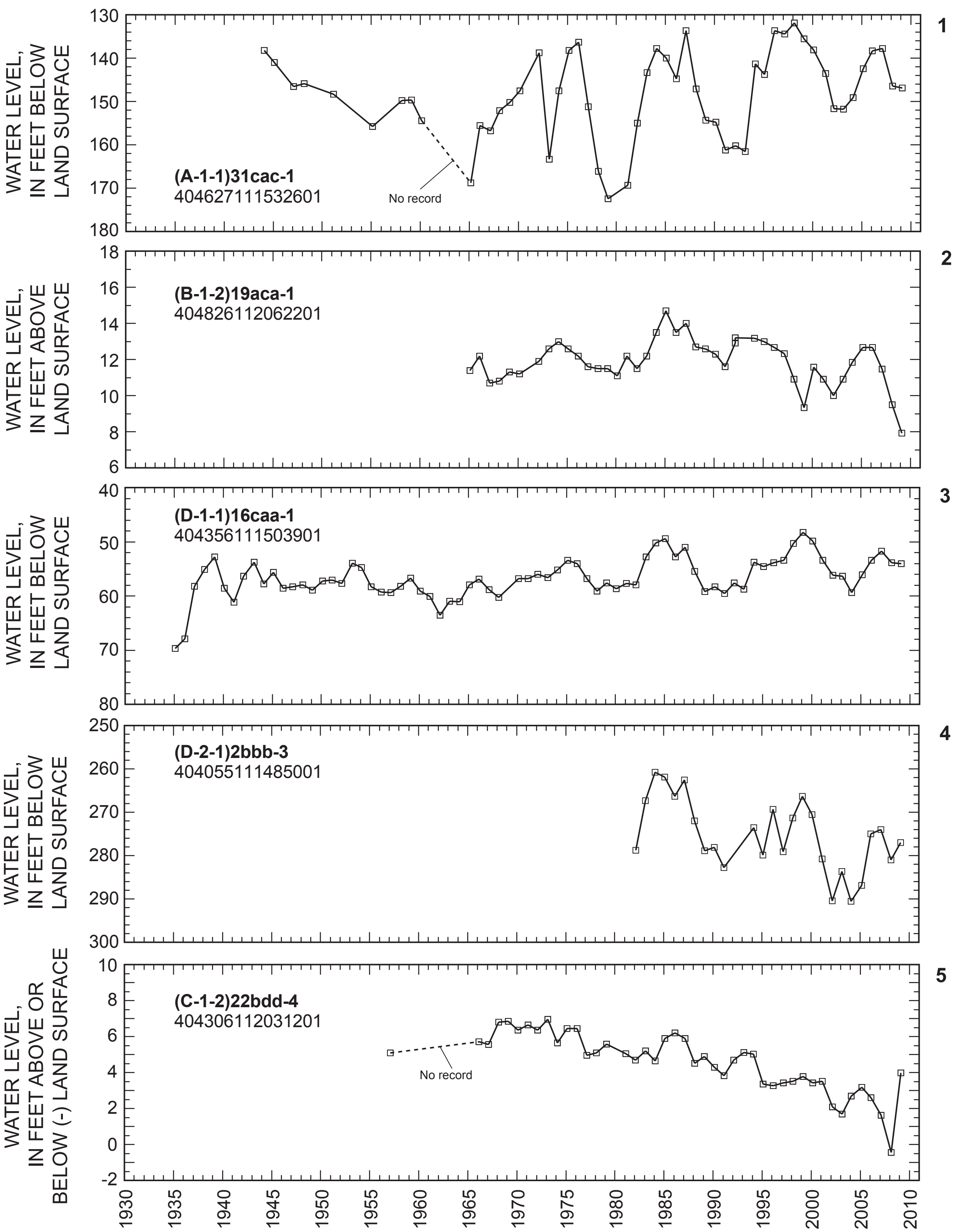


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

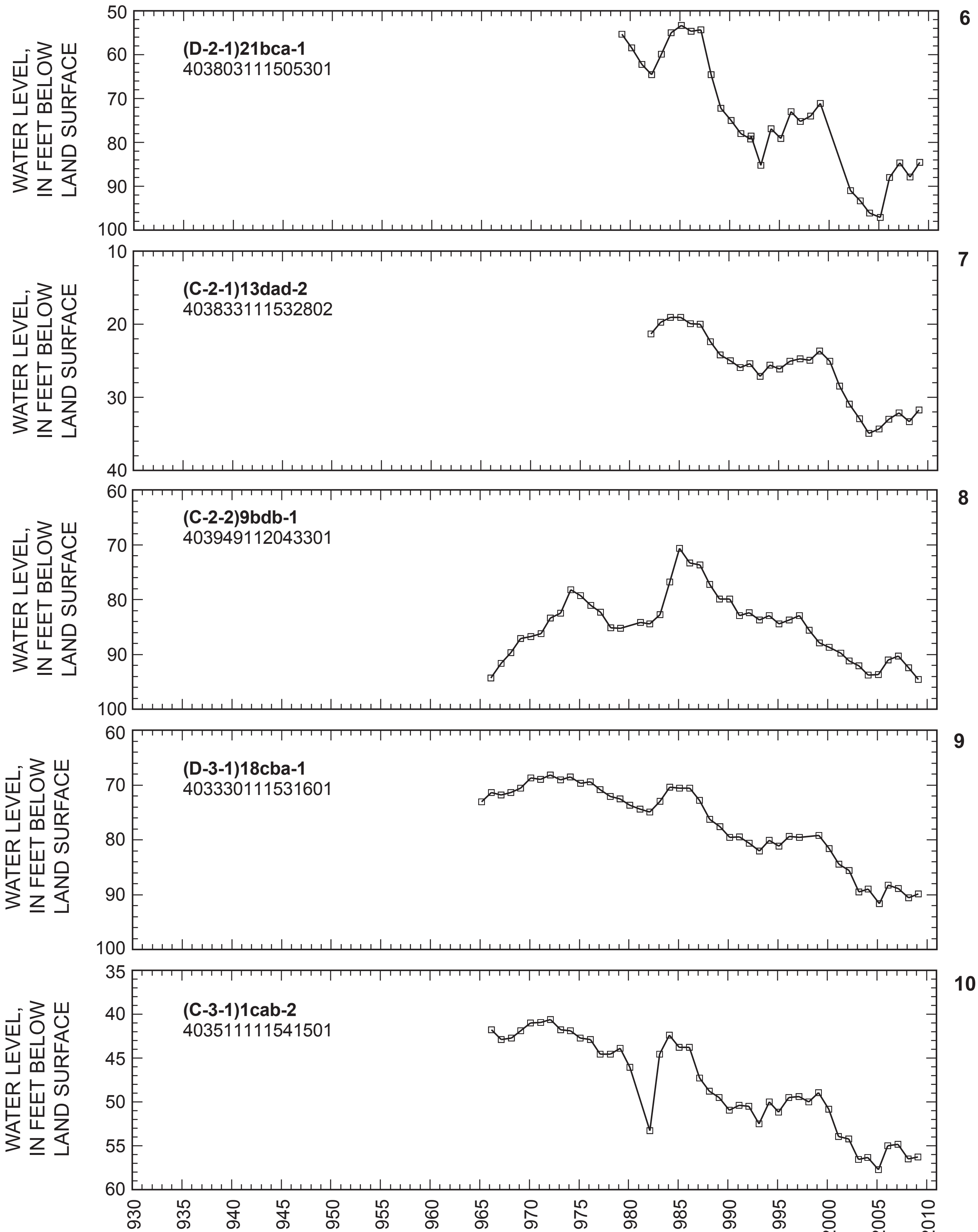


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

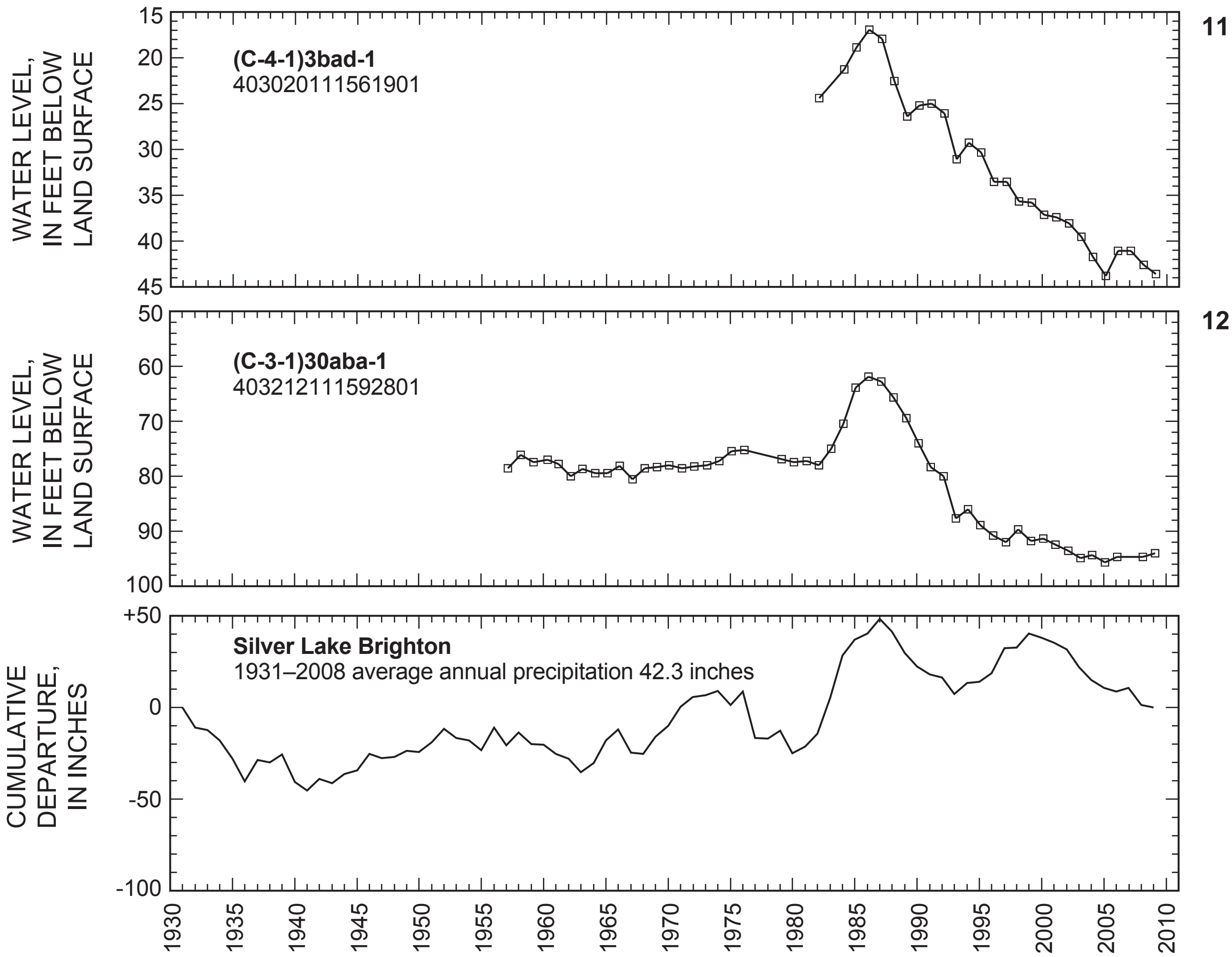


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

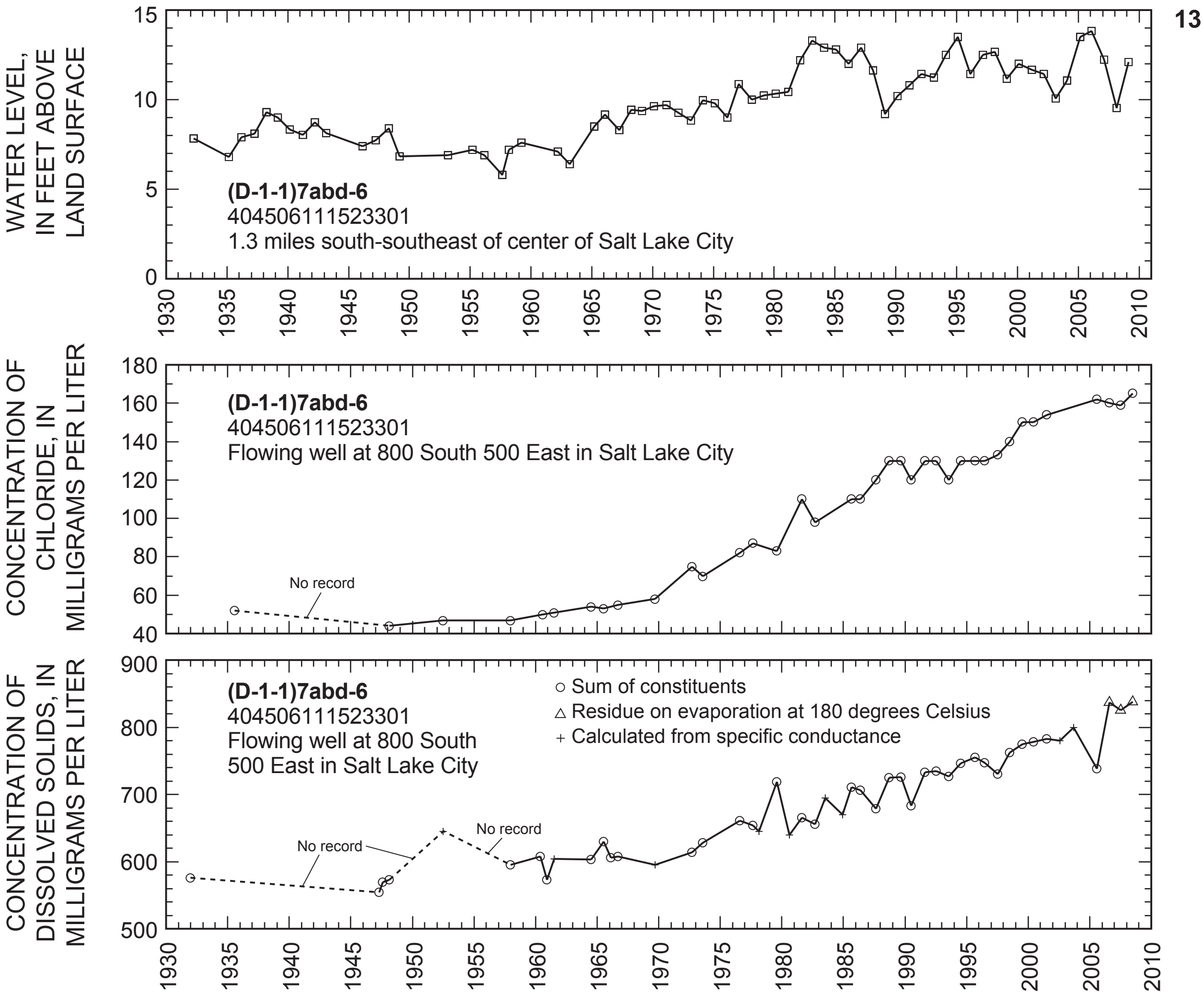


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

TOOELE VALLEY

By Paul Downhour

Tooele Valley is between the Stansbury and Oquirrh Mountains and extends south from Great Salt Lake to South Mountain. The total area of the valley is about 250 square miles within Tooele County (fig. 11). Ground water 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 2008 was about 29,000 acre-feet, which is about 2,000 acre-feet more than the revised total for 2007 and 7,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). Withdrawal for irrigation was about 16,500 acre-feet, which is 2,700 acre-feet more than the revised total for 2007. Withdrawal for public supply was about 9,800 acre-feet, which is 200 acre-feet less than in 2007. Withdrawal for industrial use was about 1,500 acre-feet, which is the same as in 2007.

The location of wells in Tooele Valley in which the water level was measured during March 2009 is shown in figure 11. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1 is shown in figure 12. Precipitation at Tooele during 2008 was about 17.8 inches, which is about 0.5 inch more than in 2007 and about the same as the average annual precipitation for 1936–2008.

Water levels declined in most of the wells measured in Tooele Valley from March 2008 to March 2009. Declines probably are the result of increased withdrawals for irrigation.

Physical properties and records of chemical analyses for water from five wells in Tooele Valley are listed in tables 4 and 5, and the location of the wells is plotted in figures 41 and 42. The dissolved-solids concentration in water samples from all five wells exceeded the secondary standard for this constituent (500 mg/L), and water from one of the wells ((C-2-5)35cab-1) exceeded the MCL (2,000 mg/L). The concentration of dissolved chloride in water samples from three wells ((C-2-5)35cab-1, (C-2-5)36cba-1, and (C-2-6)23cbb-1) and the concentration of dissolved sulfate in water from one well ((C-2-4)28daa-1) equaled or exceeded the secondary standard for these constituents (250 mg/L).

The concentration of dissolved solids in water samples collected from well (C-2-6)23cbb-1, located 3 miles northwest of Grantsville, from 1961 to 2008, is shown in figure 12. The concentration has ranged from 553 to 848 mg/L with a median value of 701 mg/L. The maximum value was measured in the water sample collected in August 2008. The dissolved-solids concentration has increased since 2001.

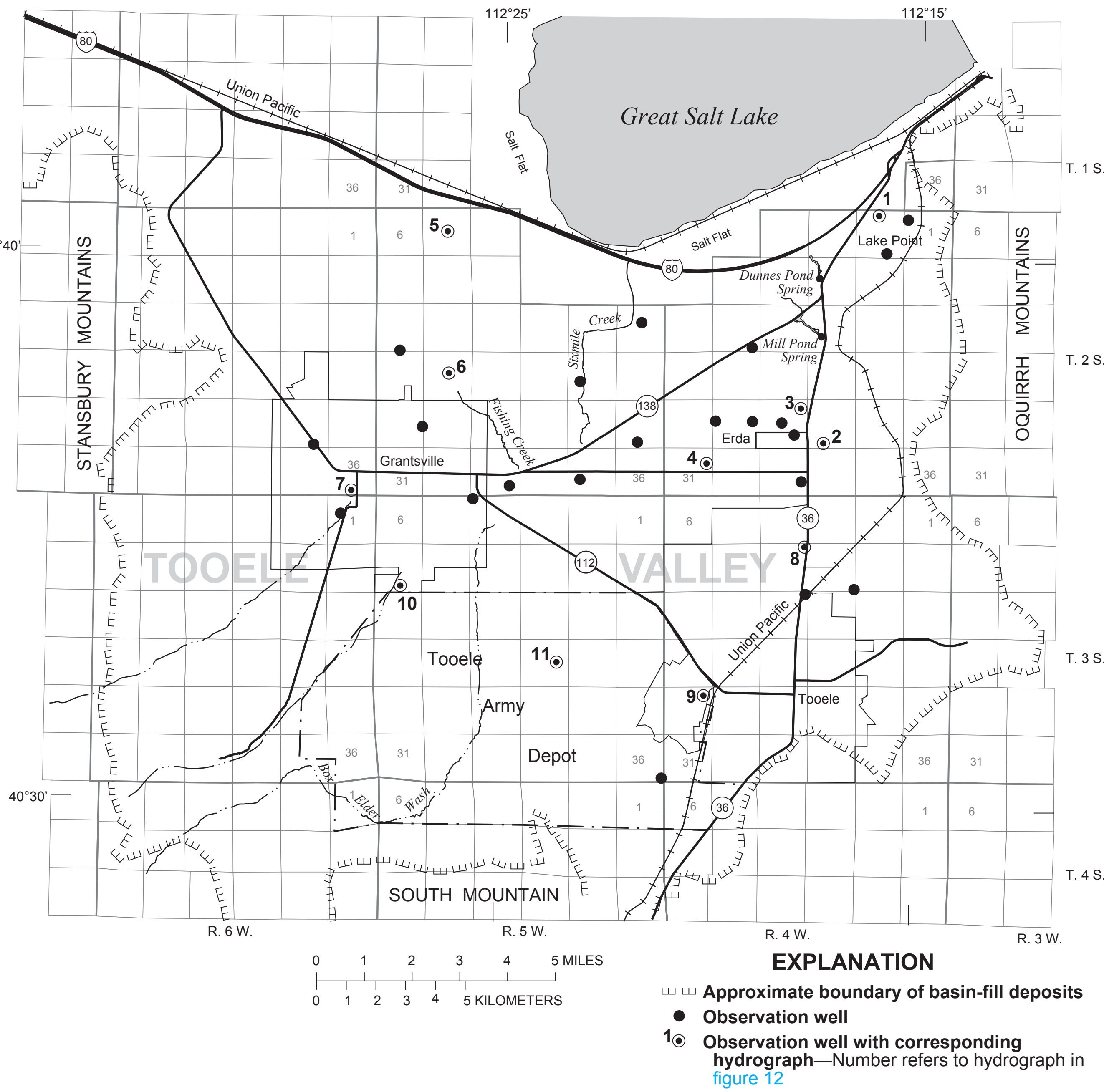


Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 2009.

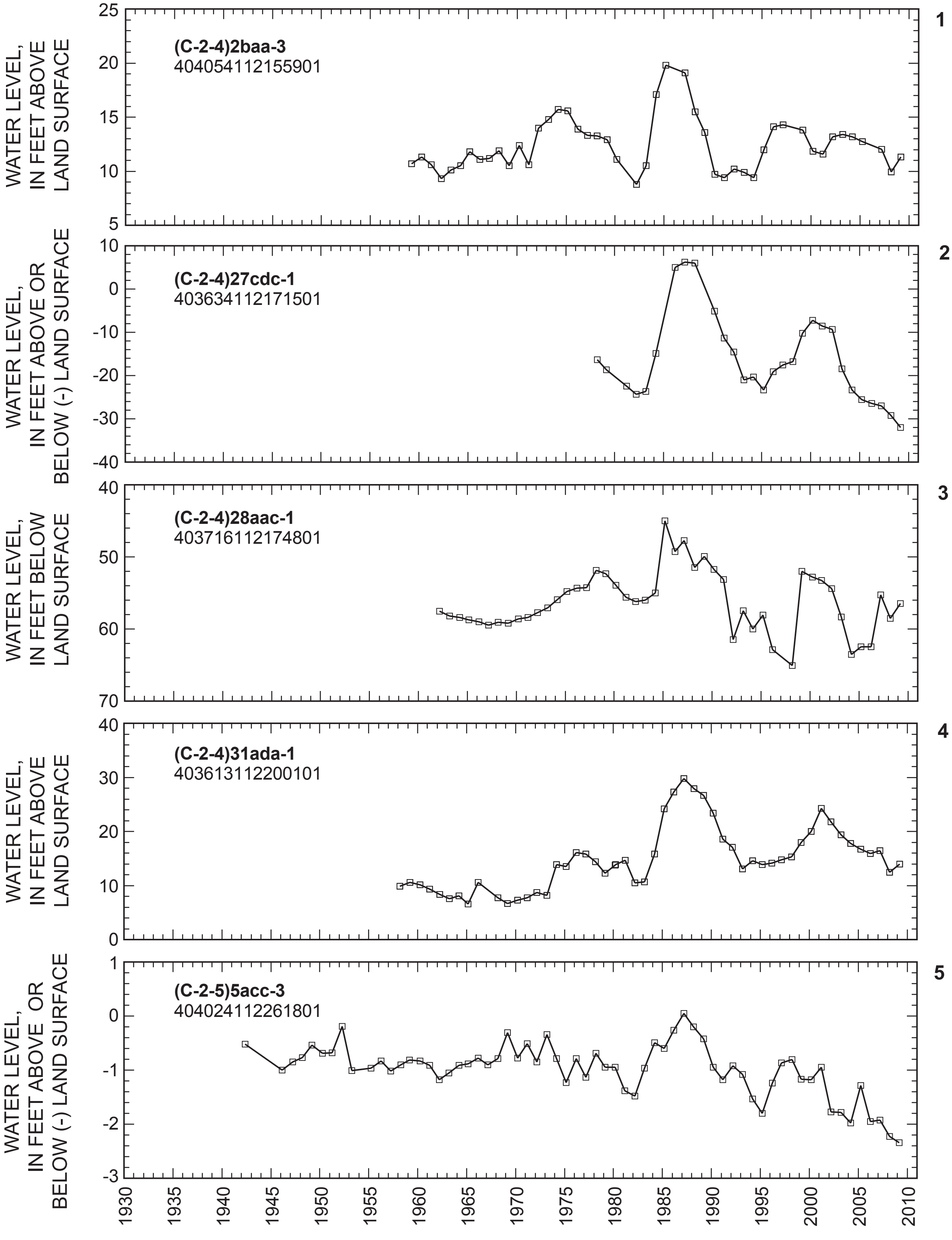


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.

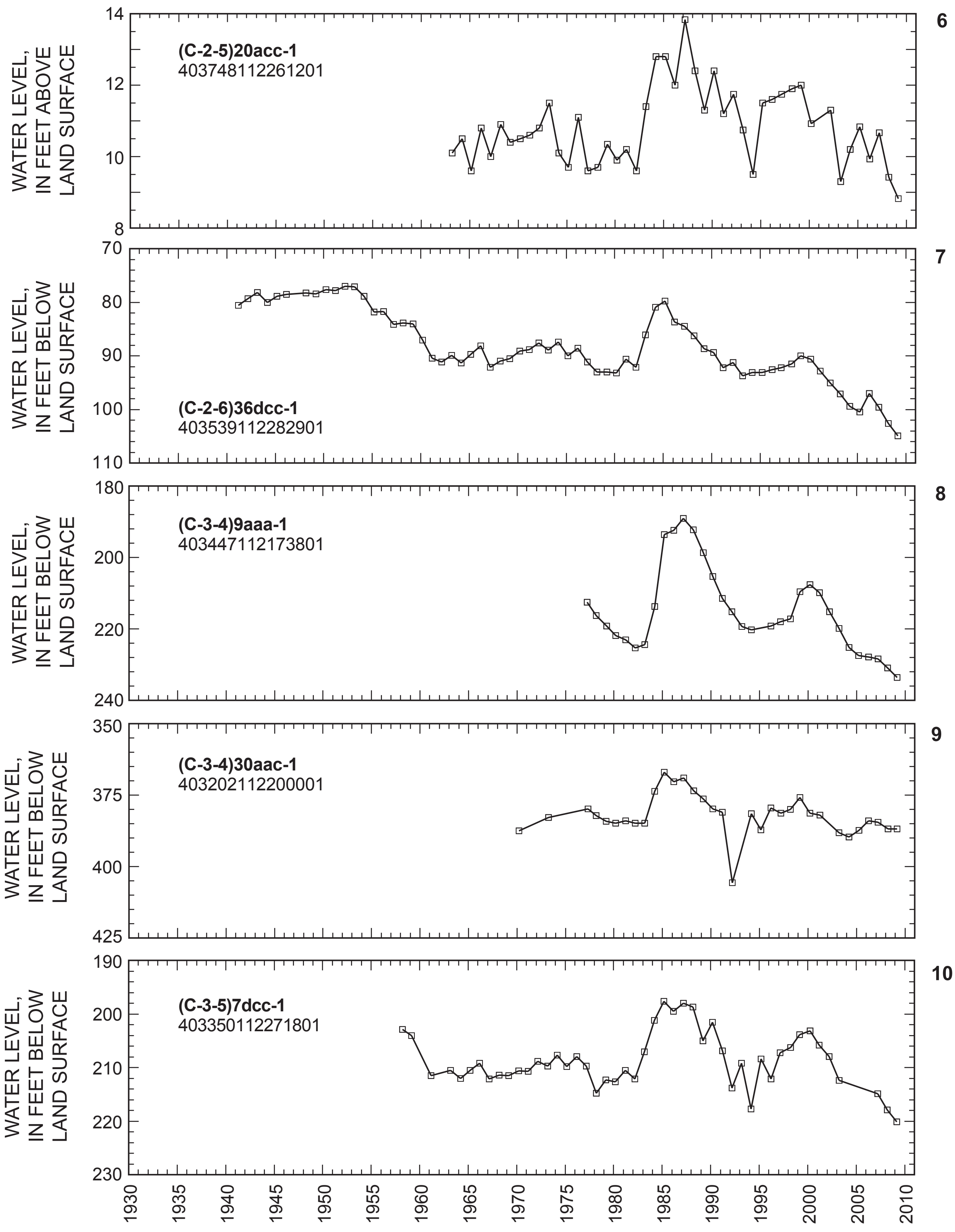


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1—Continued.

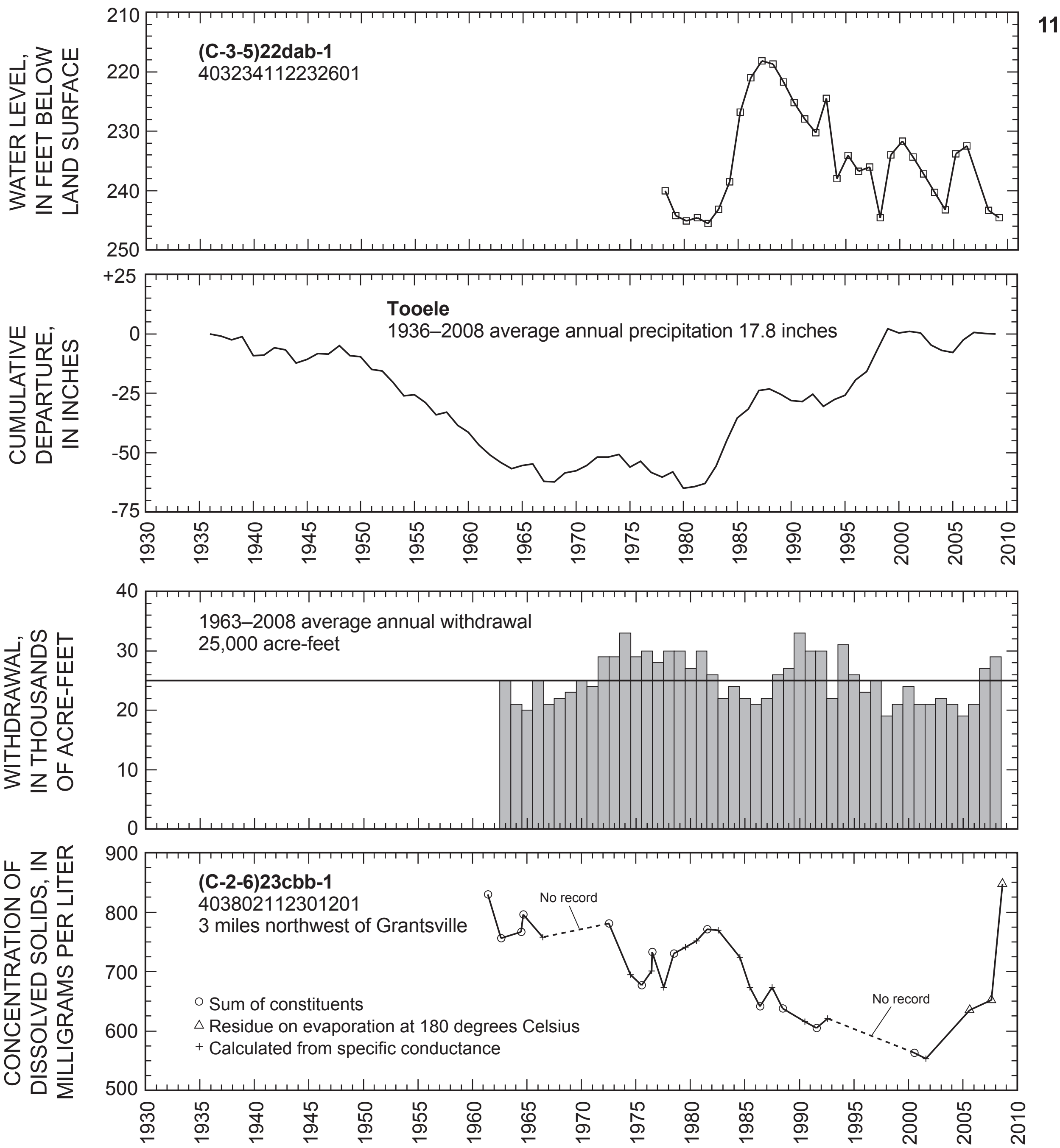


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1—Continued.

UTAH AND GOSHEN VALLEYS

By Ashley Nielson

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

Southern Utah Valley is bounded by the Wasatch Range, West Mountain, and the northern extension of Long Ridge. Goshen Valley is bounded by West Mountain, Long Ridge, the Lake Mountains, and the East Tintic Mountains (fig. 13). Ground water 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 2008 was about 124,000 acre-feet, which is 2,000 acre-feet less than in 2007, and 19,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). Withdrawal in southern Utah Valley was about 33,900 acre-feet, which is 3,900 acre-feet less than in 2007. Withdrawal in Goshen Valley was about 19,400 acre-feet, which is 3,800 acre-feet more than in 2007. Withdrawal in northern Utah Valley was about 70,700 acre-feet, which is 1,400 acre-feet less than in 2007. The overall decrease in withdrawals was mainly due to decreased withdrawal for irrigation in both northern and southern Utah Valley.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2009 is shown in figure 13. Water levels generally declined slightly in most of the wells measured in Utah and Goshen Valleys from March 2008 to March 2009. Water levels in Goshen Valley and in the northern and southern parts of Utah Valley generally rose in the early 1980s. The rise corresponds to a period of greater-than-average precipitation and recharge from surface water. Water levels generally declined from 1985 to 1993 in Utah Valley and generally rose from 1993 to 1998. This rise is the result of greater-than-average precipitation during this period. Water levels generally declined throughout Utah Valley from March 1999 to March 2005. Water levels in some wells reached their lowest level for their period of record, many dating back to 1935. From March 2005 to March 2007, most water levels in Utah and Goshen Valleys rose as a result of average to greater-than-average precipitation in 2005 and 2006 following 6 years of less-than-average precipitation.

The relation of the water level in selected observation wells to cumulative departure from average precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells, is shown in figure 14. Discharge of Spanish Fork at Castilla in 2008 was about 180,700 acre-feet, which is 11,900 acre-feet more than the 1933–2008 annual average. Precipitation at Silver Lake Brighton in 2008 was about 40.8 inches, which is about 1.5 inches less than the long-term average (1931–2008) and about 7.7 inches more than in 2007. Precipitation at Spanish Fork Powerhouse in 2008 was about 16.9 inches, which is about 2.3 inches less than the long-term average (1930–2008) and about the same as in 2007.

Physical properties and records of chemical analyses for water from ten wells in Utah Valley (includes northern and southern Utah Valleys) and Goshen Valley are listed in tables 4 and 5, and the location of the wells is plotted in figures 41 and 42. For Goshen Valley, the dissolved-solids concentration in water samples from all five wells sampled and the dissolved-chloride concentration in water samples from three wells ((C-9-1)4ccc-1, (C-9-1)28ccb-1, and (C-9-1)29acc-1) exceeded the secondary standards for these constituents (500 and 250 mg/L, respectively). The concentration of dissolved nitrite plus nitrate in water from all five wells sampled exceeded the MCL for this constituent (10 mg/L). For southern Utah Valley, water samples from wells (D-7-2)4cbb-2 and (D-7-2)11caa-1 exceeded the secondary standards for dissolved iron and manganese (0.3 and 0.05 mg/L, respectively). Water samples from the two wells sampled in northern Utah Valley ((D-5-1)20cbc-1 and (D-5-1)21dda-2) did not exceed secondary standards or MCLs.

The concentration of dissolved solids in water samples collected from wells (C-10-1)4cbb-1, located 1.5 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 for well (C-10-1)4cbb-1 has ranged from 603 to 2,140 mg/L with a median value of 896 mg/L. The maximum value for dissolved solids, 2,140 mg/L, is associated with the sample collected in August 2007 and is nearly 50 percent greater than the previous maximum value for the sample collected in June 1986. This well was not sampled in 2008. The dissolved-solids concentration for well (D-7-2)4cbb-2 has ranged from 278 to 539 mg/L with a median value of 319 mg/L. Water collected in 2008 had a dissolved-solids concentration (308 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. The dissolved-solids concentration in the water sample collected in July 2008 (299 mg/L) was also near the median value.

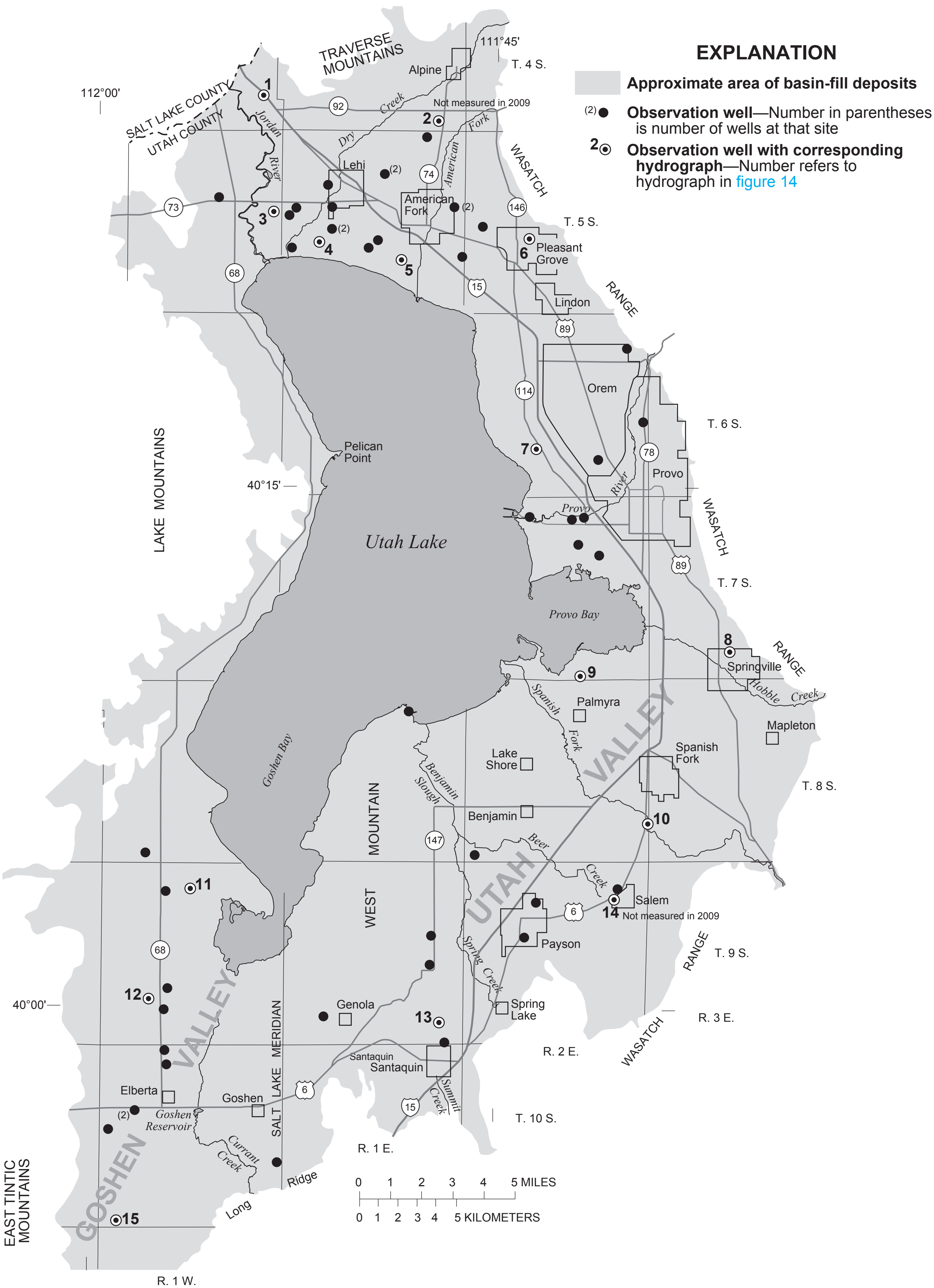


Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2009.

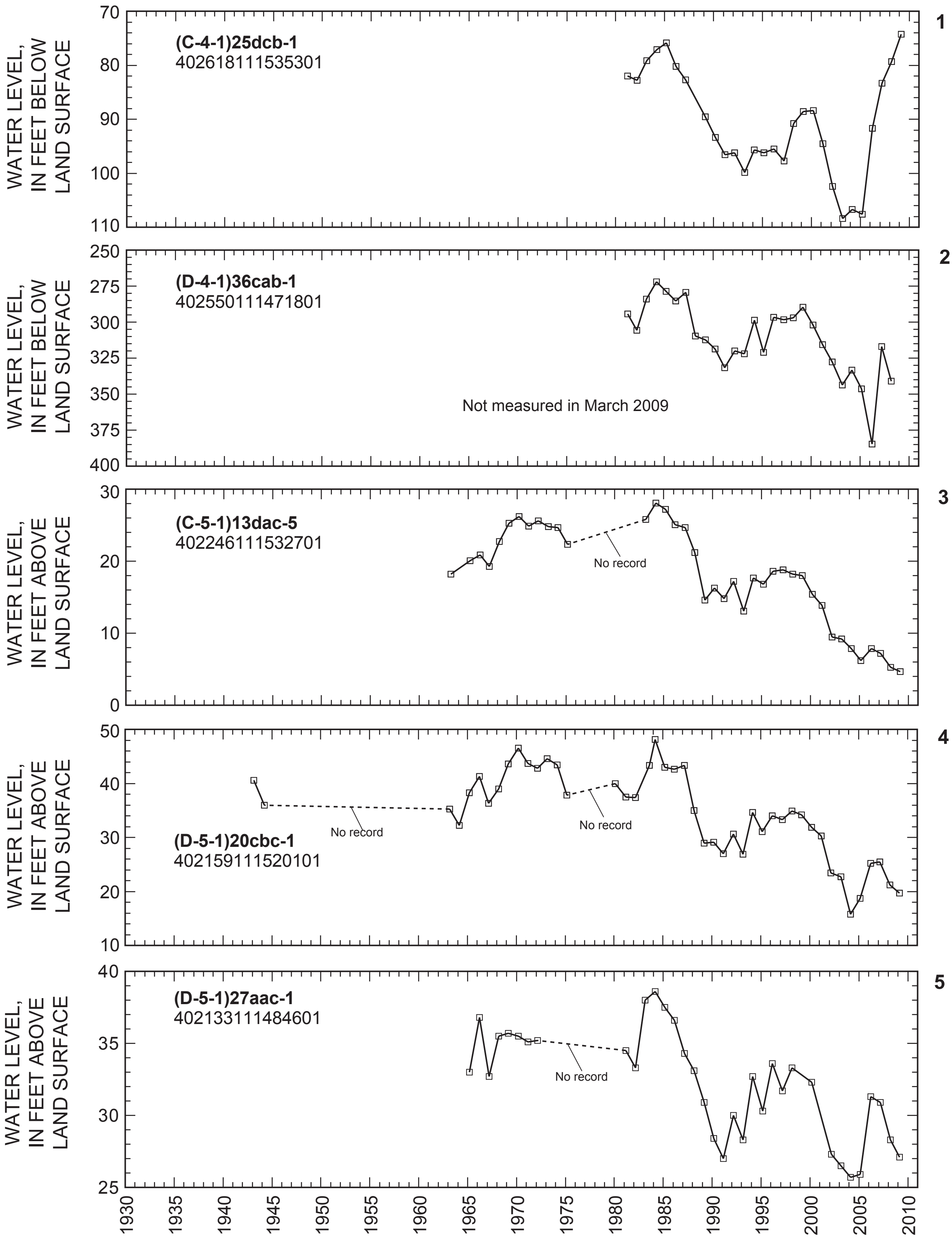


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

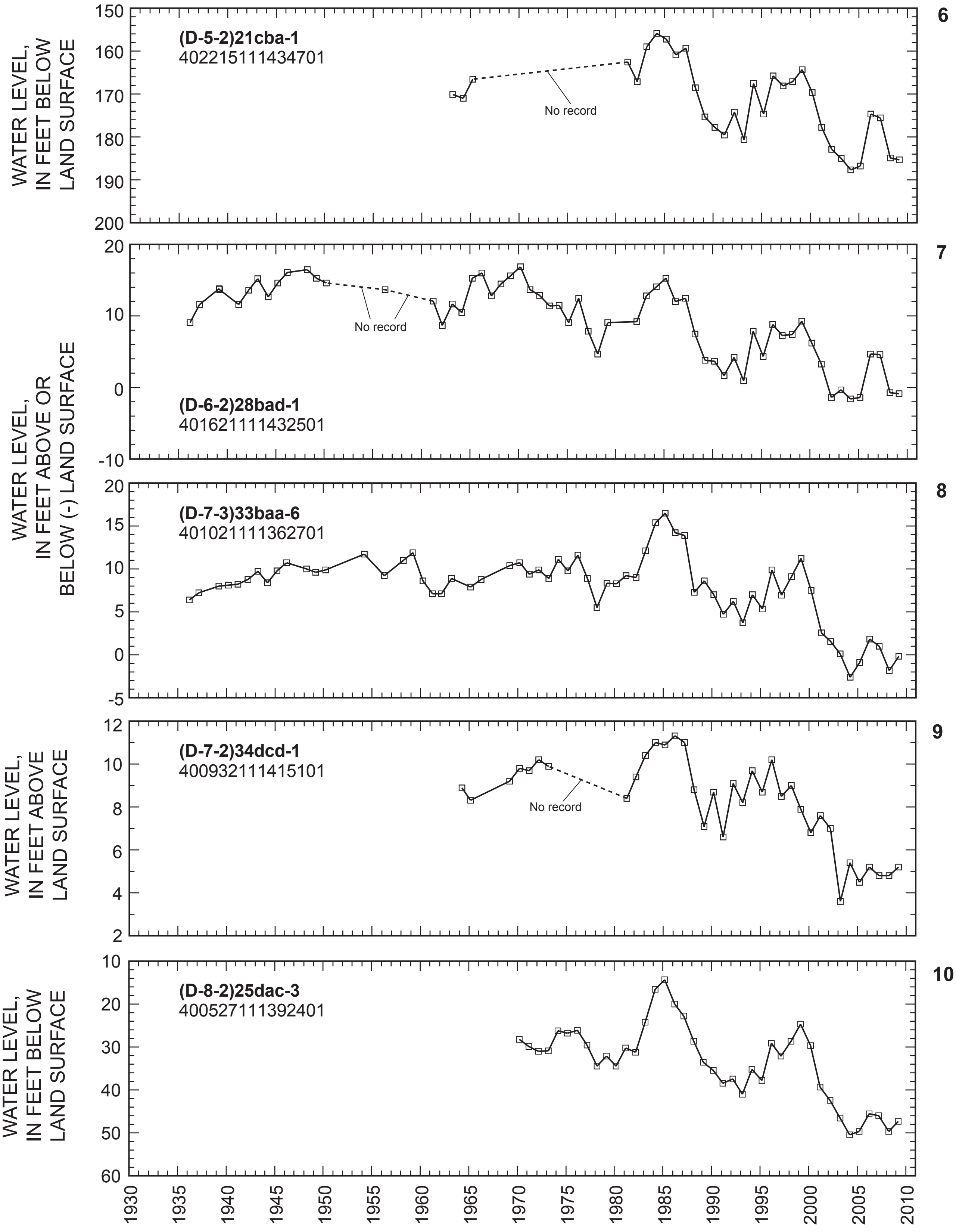


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

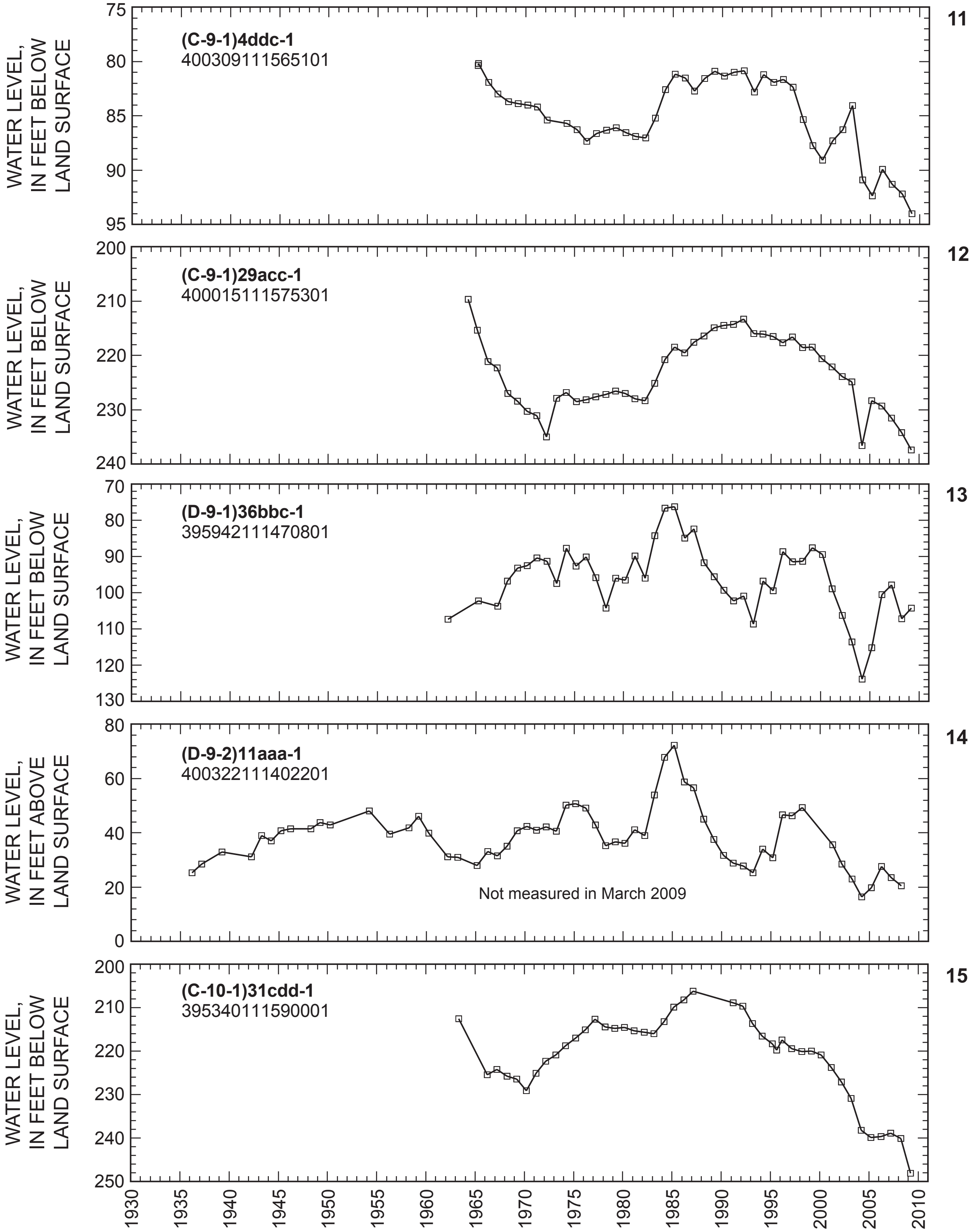


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

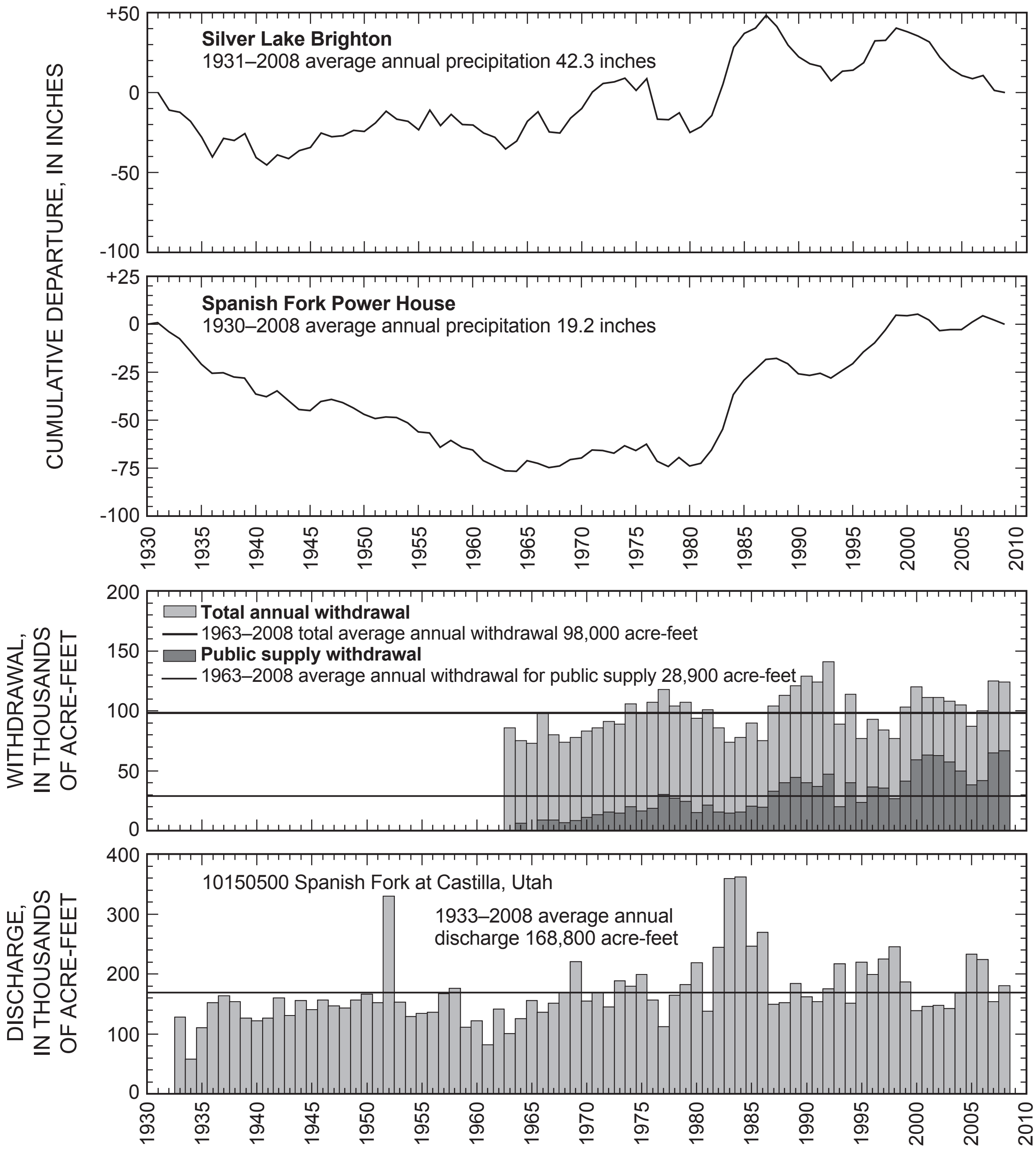


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

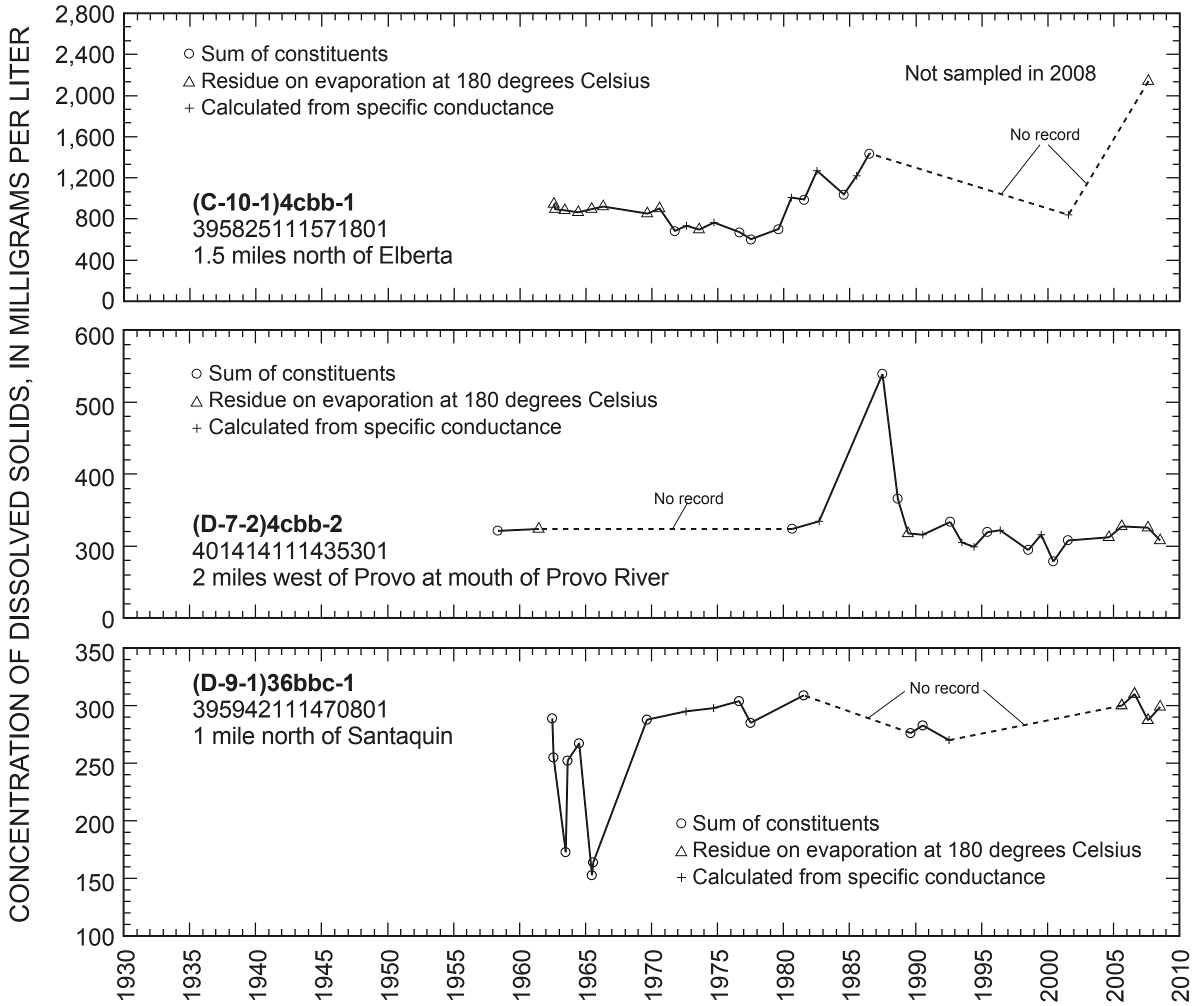


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

JUAB VALLEY

By Robert J. Eacret

Juab Valley, which is about 30 miles long and averages about 4 miles wide, is in central Utah in Juab County. 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). Ground water 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.

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

Total estimated withdrawal of water from wells in Juab Valley in 2008 was about 26,000 acre-feet, which is the same as the amount reported for 2007 and 4,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3).

The location of wells in Juab Valley in which the water level was measured during March 2009 is shown in figure 15. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1 is shown in figure 16.

Water levels declined in most of the wells measured in Juab Valley from March 2008 to March 2009. Water levels generally rose from 1978 to their highest level in 1985. This rise corresponds to a period of greater-than-average precipitation during 1978–86. Water levels generally declined from 1986 to 2009, although there was a substantial rise from 1993 to 1999.

Precipitation at Nephi during 2008 was about 11.2 inches, which is about 3.2 inches less than the average annual precipitation for 1935–2008, and about the same as in 2007.

Physical properties and records of chemical analyses for water from three wells in Juab Valley are listed in tables 4 and 5, and the location of the wells is plotted in figures 41 and 42. The dissolved-solids concentration in water samples from wells (D-13-1)5ddb-1 and (D-14-1)31ada-1 and the dissolved-sulfate concentration in water from well (D-14-1)31ada-1 exceeded the secondary drinking-water standards for these constituents (500 and 250 mg/L, respectively).

The concentration of dissolved solids in water samples collected from well (C-12-1)24baa-1, located 4.5 miles north-northwest of Nephi, from 1964 to 2007, is shown in figure 16. The concentration has ranged from 650 to 755 mg/L with a median value of 714 mg/L. Concentrations have varied little during the period of record. The well was not sampled in 2008.

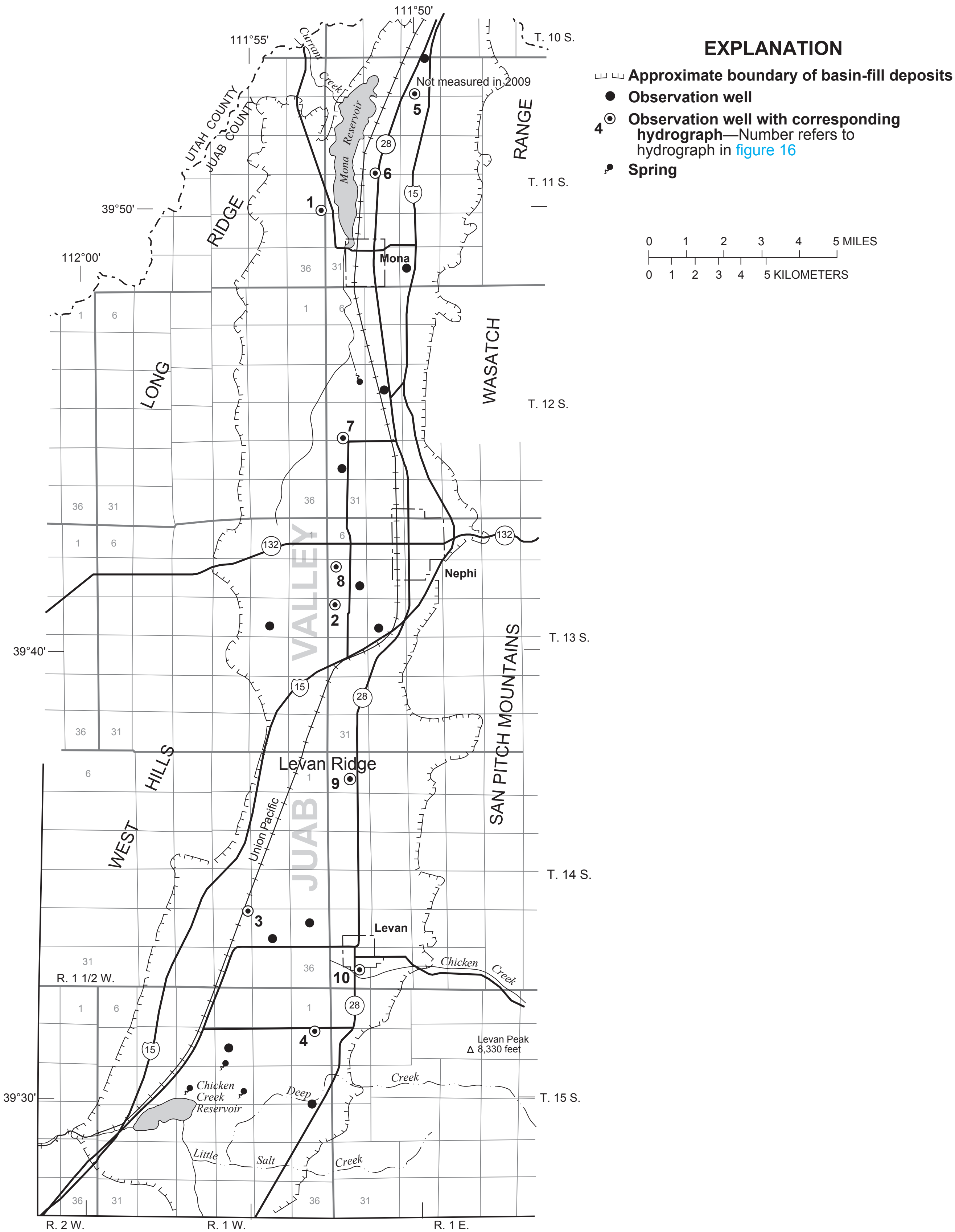


Figure 15. Location of wells in Juab Valley in which the water level was measured during March 2009.

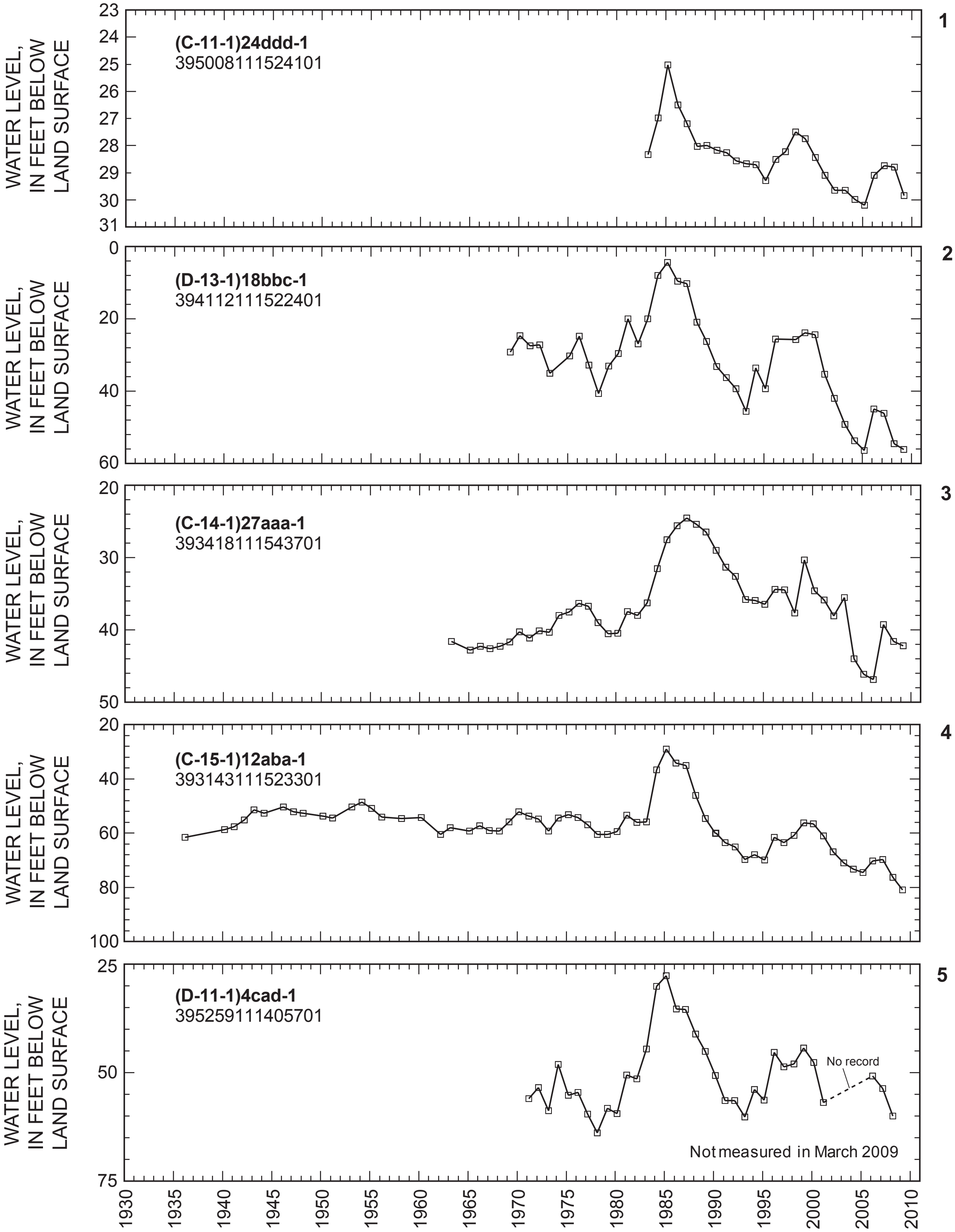


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1.

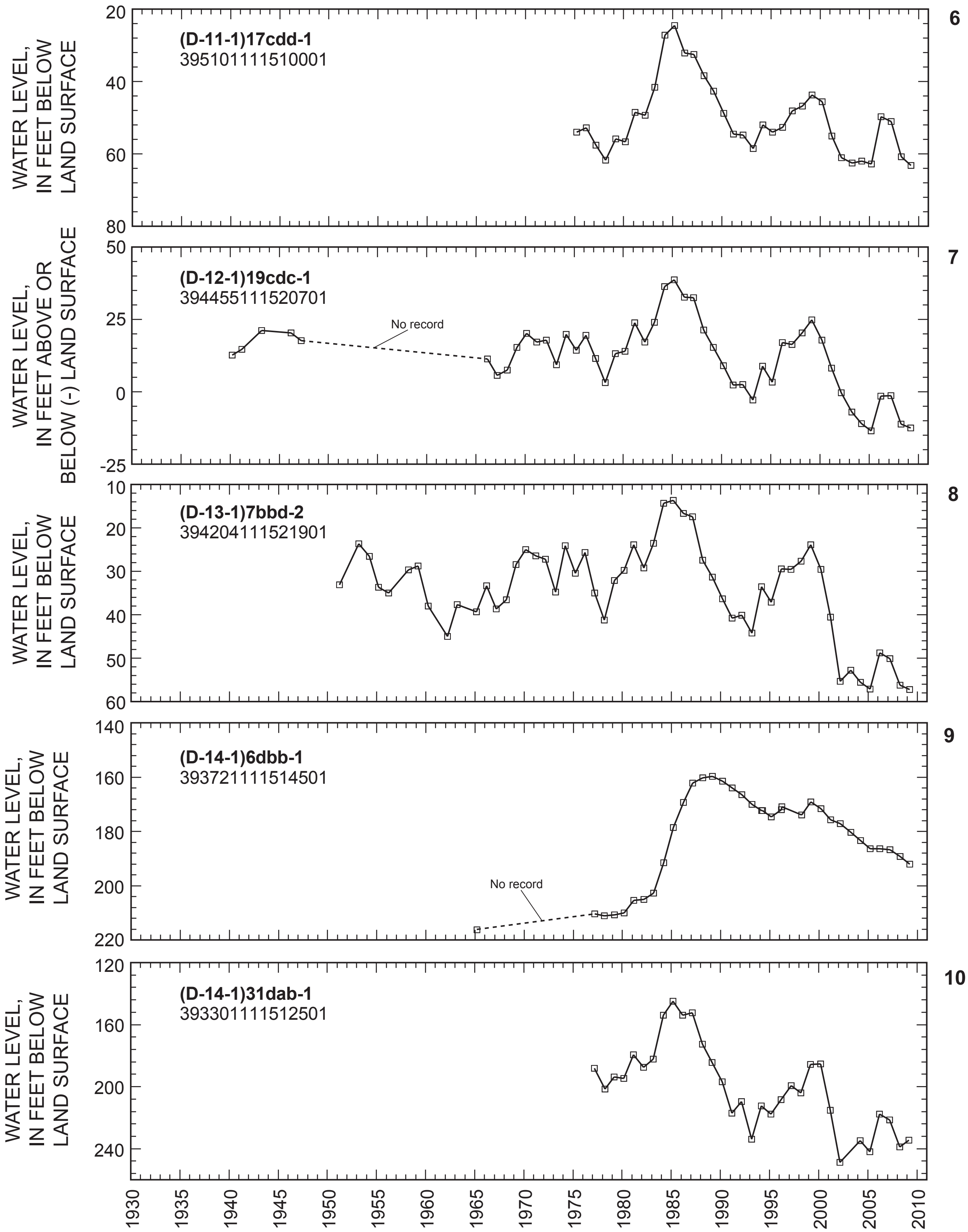


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1—Continued.

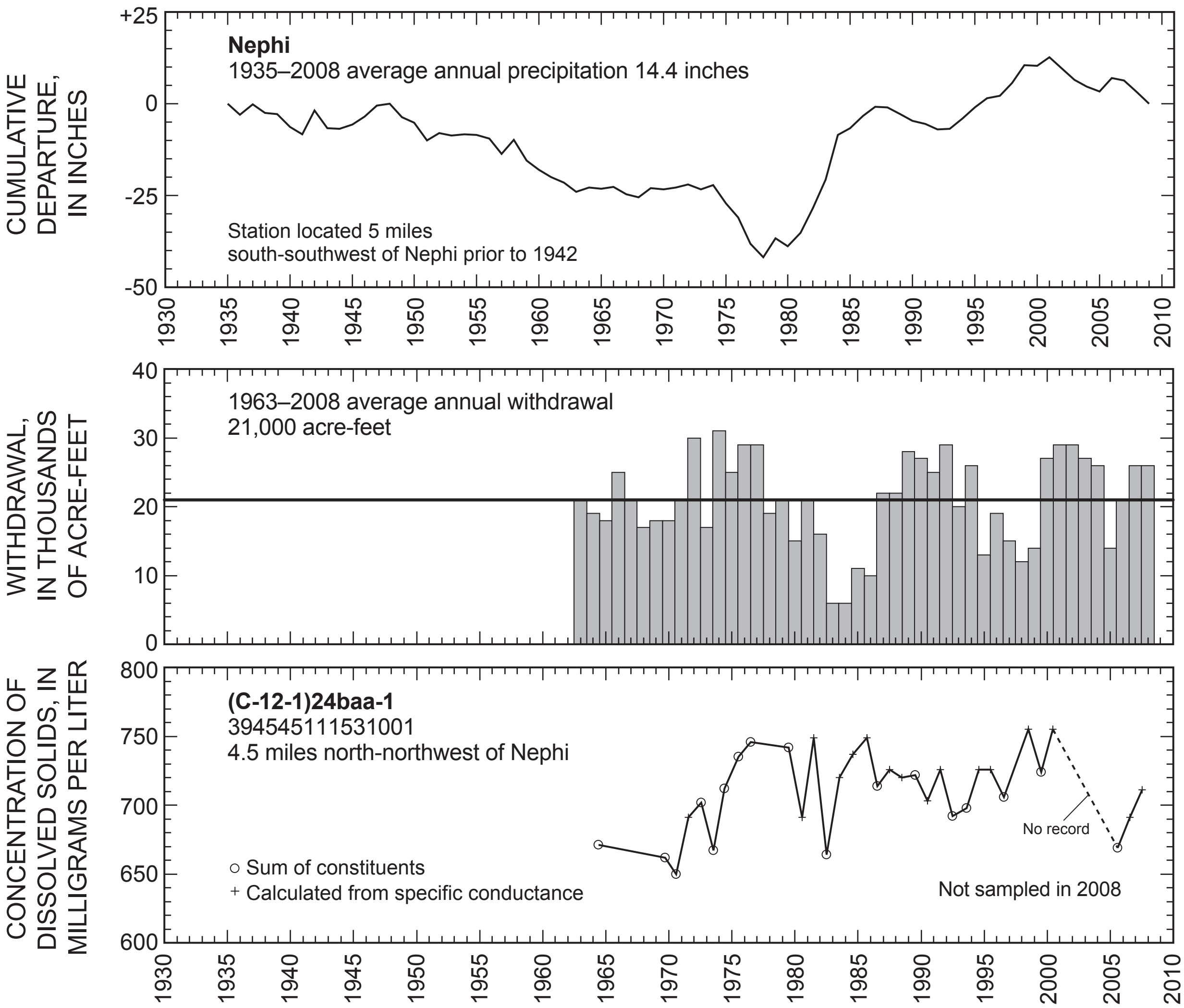


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1—Continued.

SEVIER DESERT

By Andrew Myers

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

Total estimated withdrawal of water from wells in the Sevier Desert in 2008 was about 44,000 acre-feet, which is 10,000 acre-feet more than in 2007 and about 20,000 acre-feet more than the 1998–2007 average annual withdrawal (tables 2 and 3). The increase in withdrawals was mainly due to increased withdrawal for irrigation.

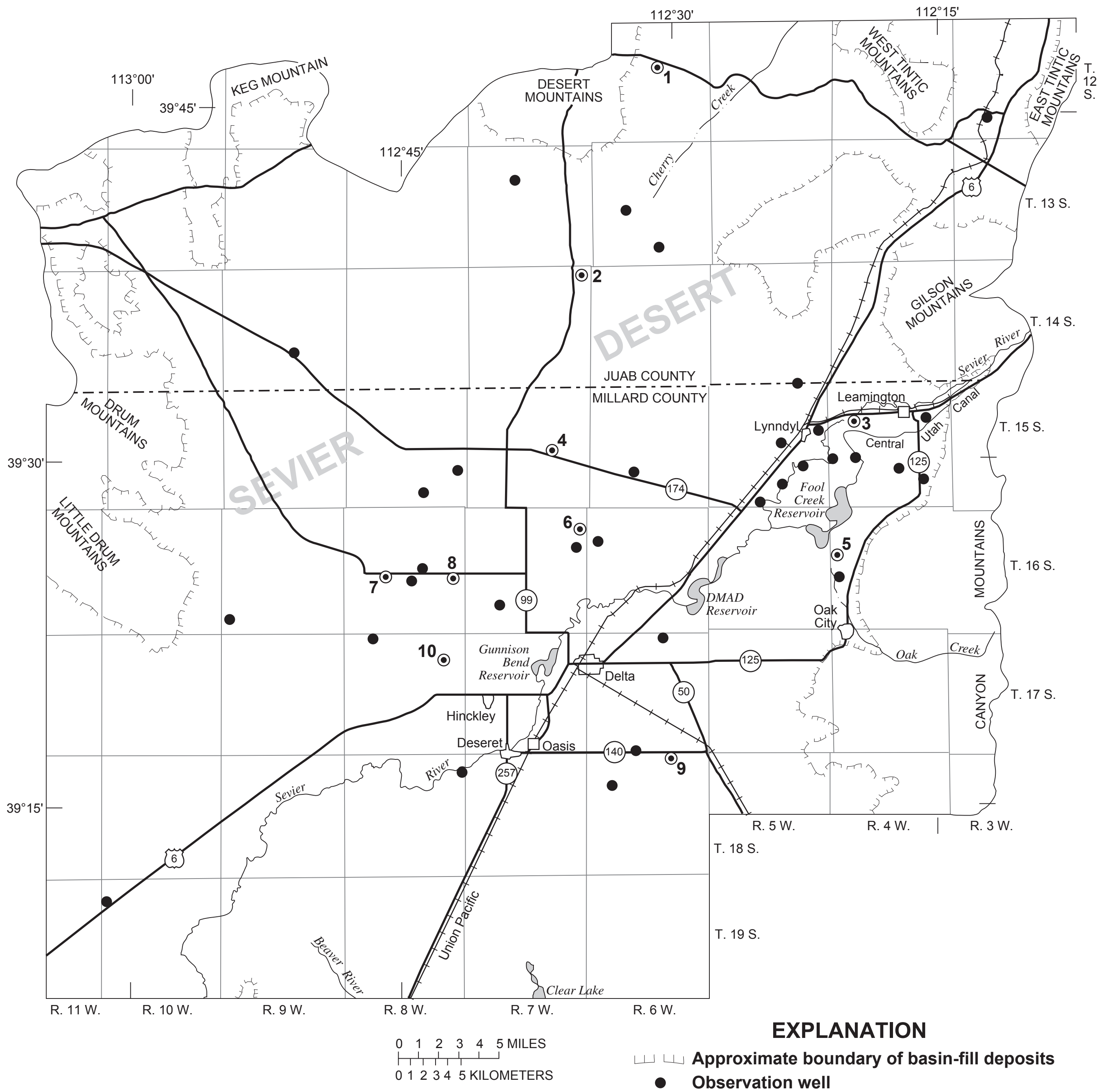
The location of wells in the Sevier Desert in which the water level was measured during March 2009 is shown in figures 17 and 18. The relation of the water level in selected observation wells to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation 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.

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

Discharge of the Sevier River near Juab in 2008 was 134,500 acre-feet, 7,500 acre-feet more than in 2007 and 44,700 acre-feet less than the long-term average (1935–2008). Precipitation at Oak City was about 11.3 inches in 2008, about 1.6 inches less than the 1930–2008 average annual precipitation and about 2.7 inches less than in 2007.

Physical properties and records of chemical analyses for water from four wells in the Sevier Desert are listed in tables 4 and 5, and the location of the wells is plotted in figures 41 and 42. The concentrations of dissolved solids, dissolved sulfate, and dissolved chloride in water samples from wells (C-15-4)8cba-1, (C-15-4)18daa-1, and (C-15-5)13bbc-1 exceeded the secondary drinking-water standards for these constituents (500 mg/L for dissolved solids and 250 mg/L for both sulfate and chloride). Dissolved-solids concentration in water from wells (C-15-4)8cba-1 and (C-15-4)18daa-1 also exceeded the MCL for this constituent (2,000 mg/L). The concentration of dissolved manganese in water samples from wells (C-15-4)8cba-1 and (C-15-5)13bbc-1 and the concentration of dissolved iron in well (C-15-5)13bbc-1 exceeded the secondary standards for these constituents (0.05 and 0.3 mg/L, respectively). Water from well (C-17-6)26daa-3 had a dissolved-arsenic concentration that exceeded the MCL for this constituent (10 µg/L).

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 2008, is shown in figure 19. The concentration has ranged from 1,490 to 2,270 mg/L, with a median value of 2,030 mg/L. The concentration of dissolved solids has increased from 1,490 mg/L in 1958 to 2,250 mg/L in 2008.



EXPLANATION

Approximate boundary of basin-fill deposits

Observation well

9 Observation well with corresponding hydrograph—Number refers to hydrograph in figure 19

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 2009.

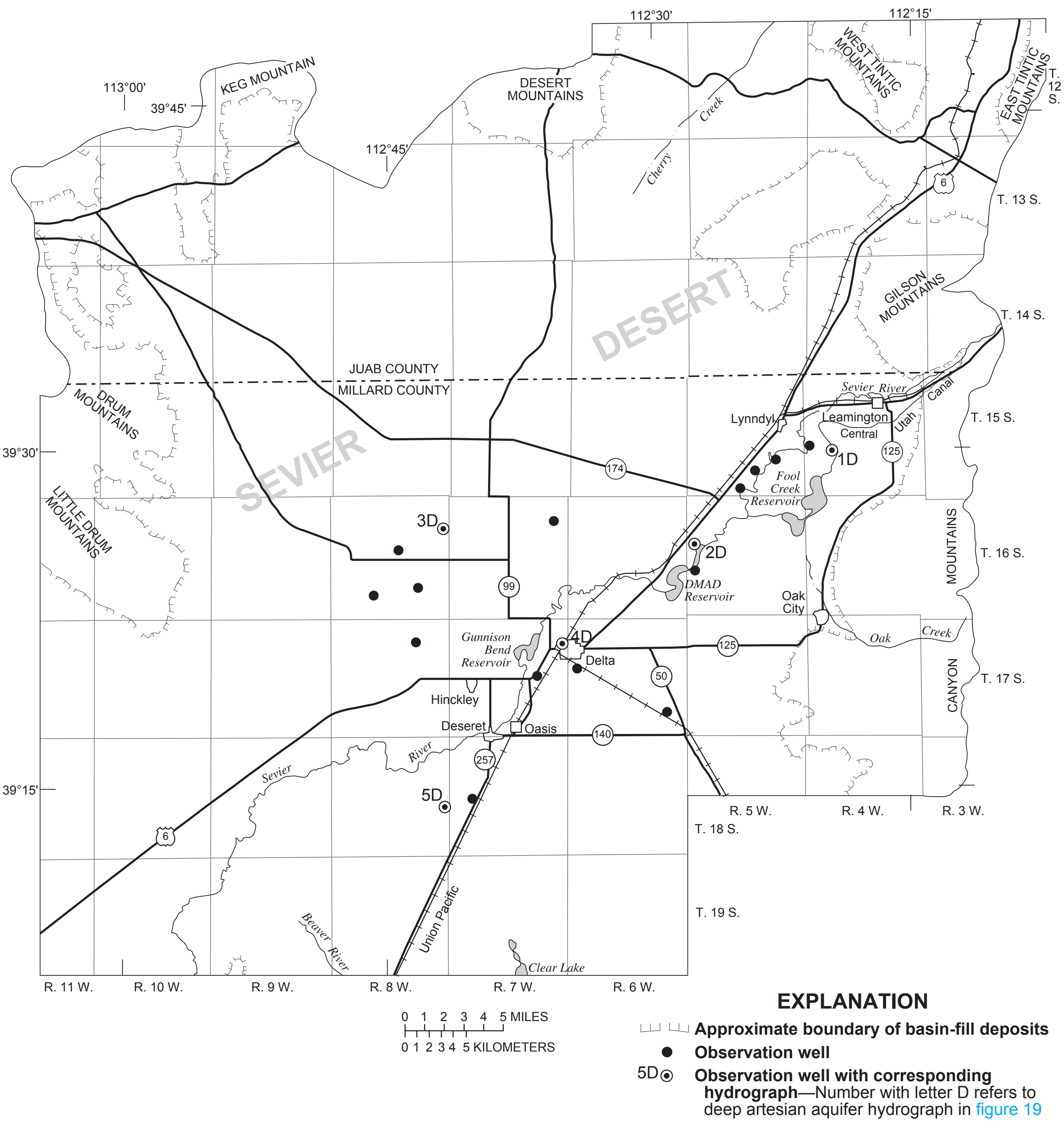


Figure 18. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2009.

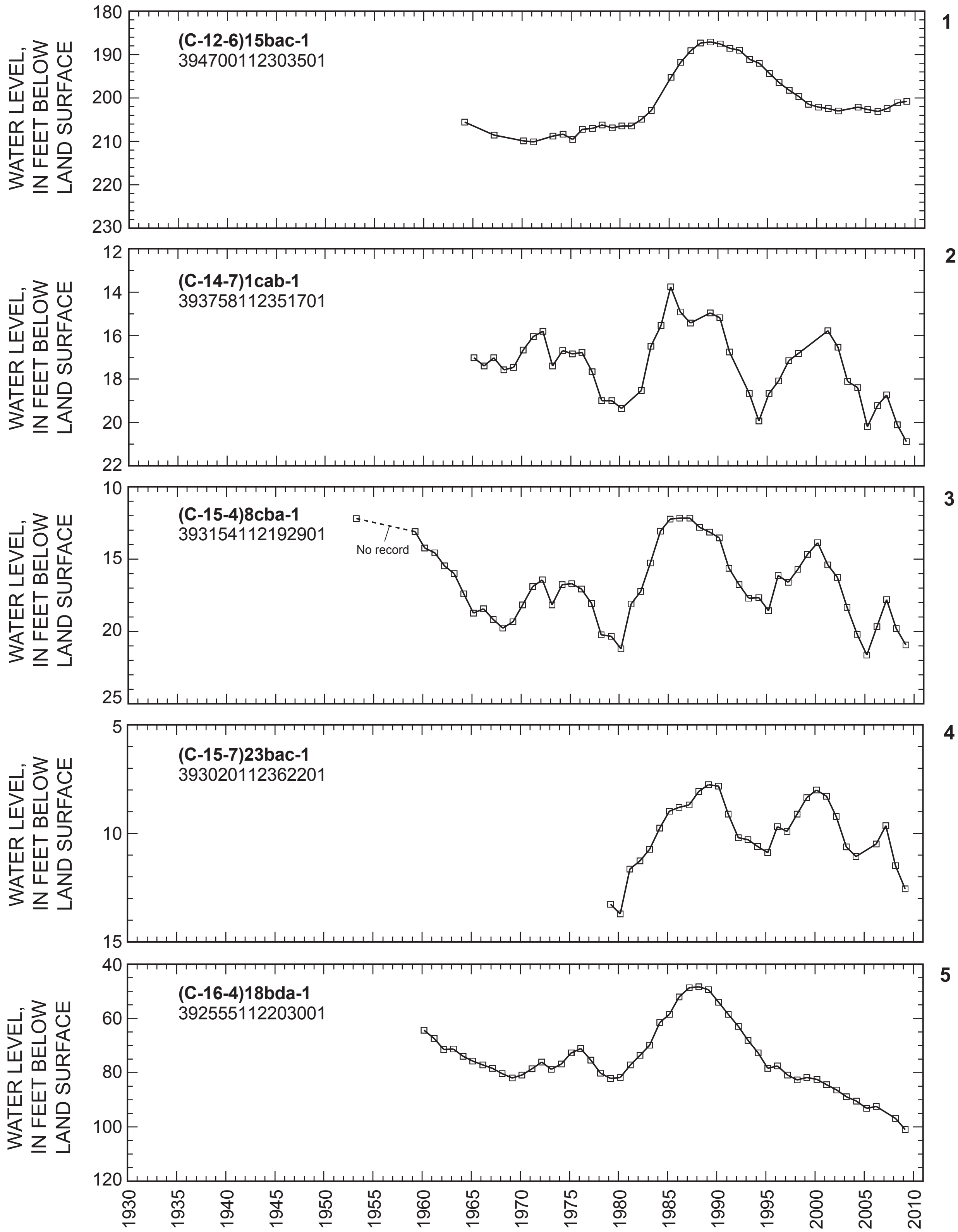


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.

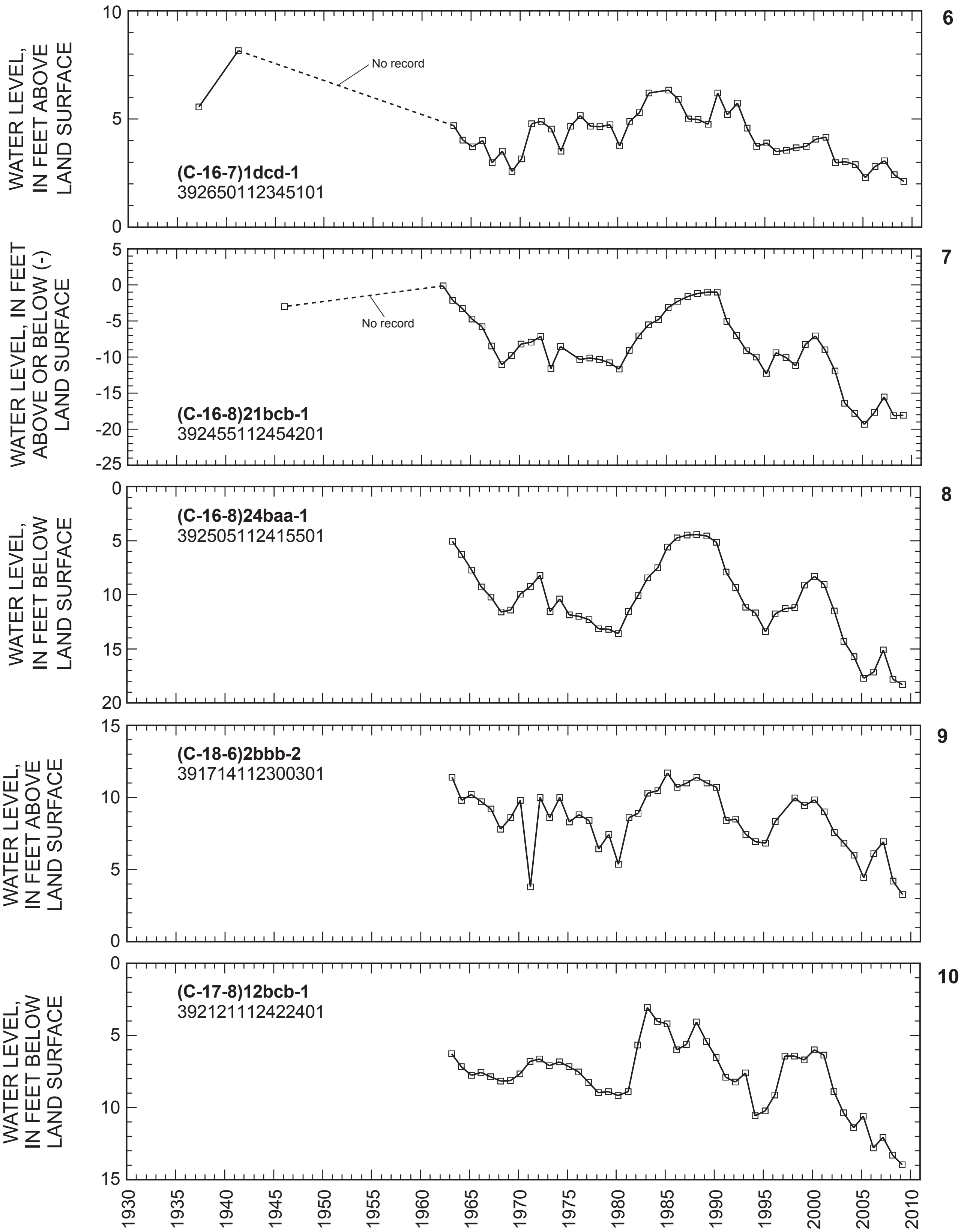


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1—Continued.

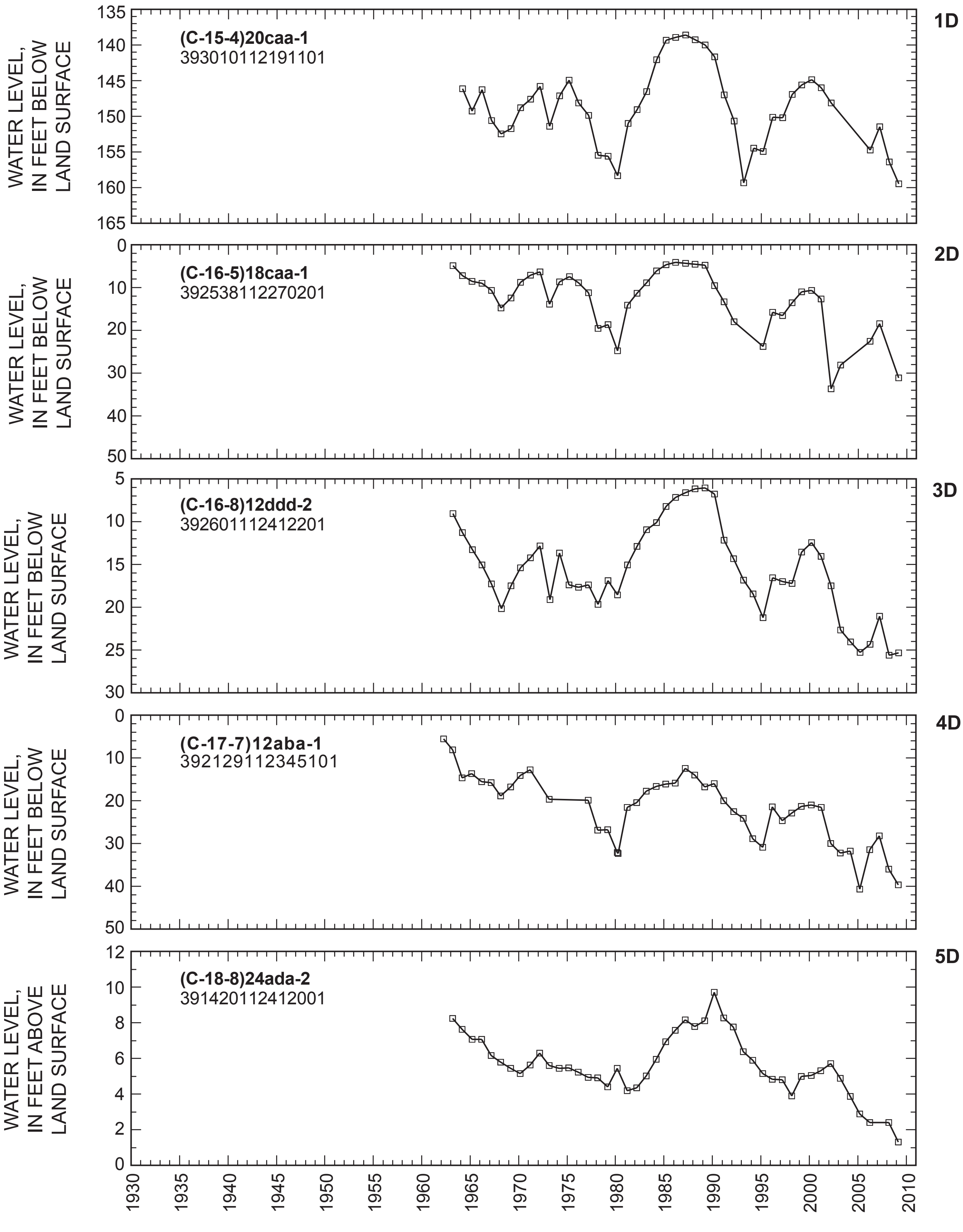


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1—Continued.

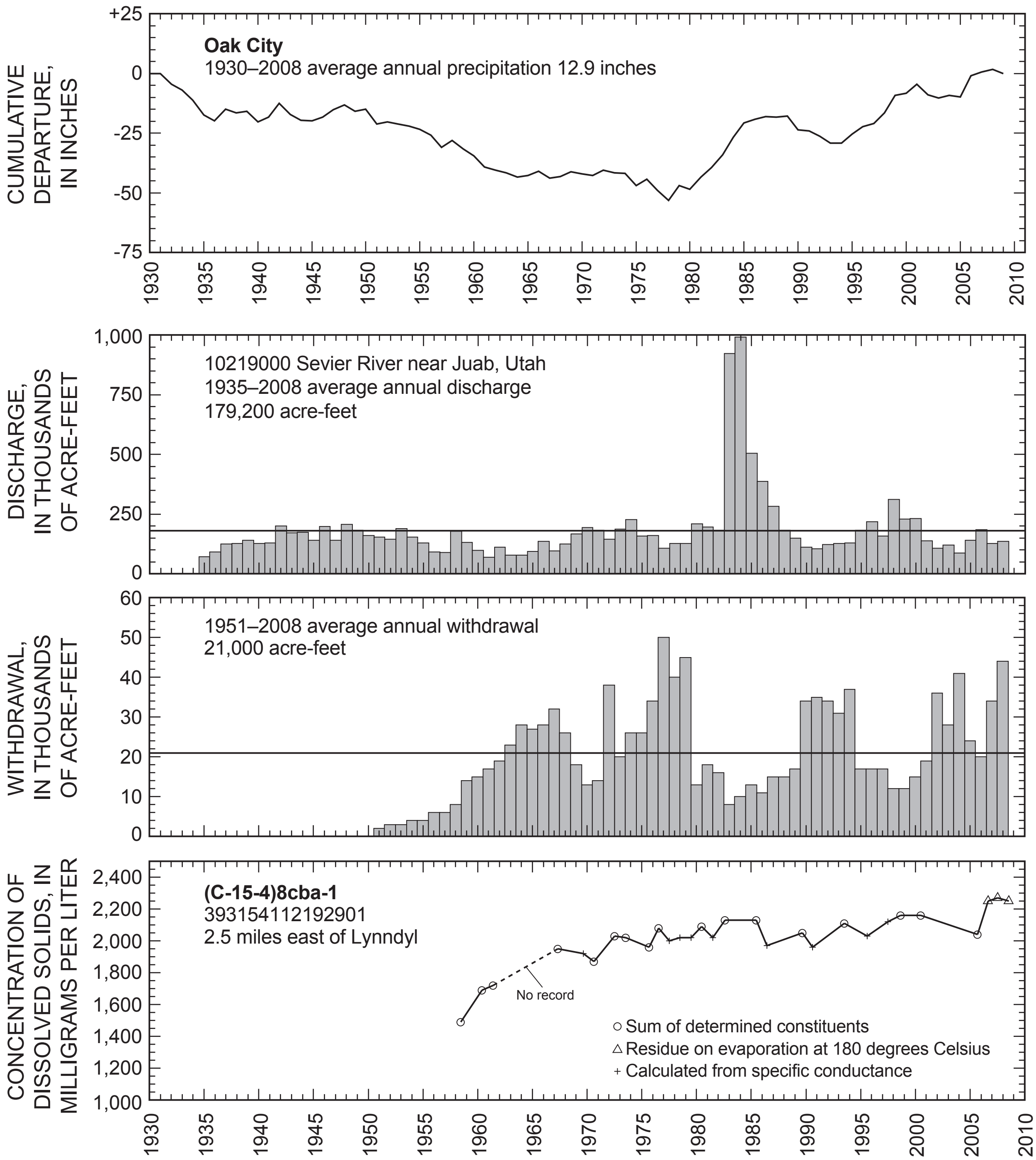


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1—Continued.

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. Ground water occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in the central Sevier Valley in 2008 was about 24,000 acre-feet, which is 5,000 acre-feet more than reported for 2007 and 8,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3).

The location of 24 wells in central Sevier Valley in which the water level was measured during March 2009 is shown in figure 20. The relation of the water level in selected observation wells to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 21.

Water levels generally declined from March 2008 to March 2009 in central Sevier Valley. Hydrographs for selected wells show that March water levels generally rose from about 1978 to 1985 and declined from 1985 to about 1993. Since 1993, water levels have fluctuated depending upon the amount and timing of precipitation and recharge to the basin-fill aquifer from snowmelt runoff.

Discharge of the Sevier River at Hatch in 2008 was about 63,300 acre-feet. This is about 191,900 acre-feet less than the record high 255,200 acre-feet reported for 2005 (revised value) and about 16,000 acre-feet less than the 1940–2008 average annual discharge.

Precipitation at Richfield was about 5.8 inches in 2008, which is about 2.2 inches less than the 1950–2008 average annual precipitation and about 0.2 inch more than in 2007.

Physical properties and records of chemical analyses for water from four wells in central Sevier Valley are listed in tables 4 and 5, and the location of the wells is shown in figure 41. The concentration of dissolved solids in water from well (C-23-2)30baa-2 exceeded the secondary standard for this constituent (500 mg/L). Water from well (C-21-1)13abd-1 exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from well (C-23-2)15dcb-4, located 0.1 miles south of Sevier River in Venice, from 1955 to 2008, is shown in figure 21. The concentration has ranged from 307 to 630 mg/L, with a median value of 416 mg/L. Relative to the median value, there were modest (less than 225 mg/L) increases in dissolved-solids concentrations during the mid- to late 1960s and 1980s. Samples collected from 1990 through 2008 show little variation and are in close agreement with the median value.

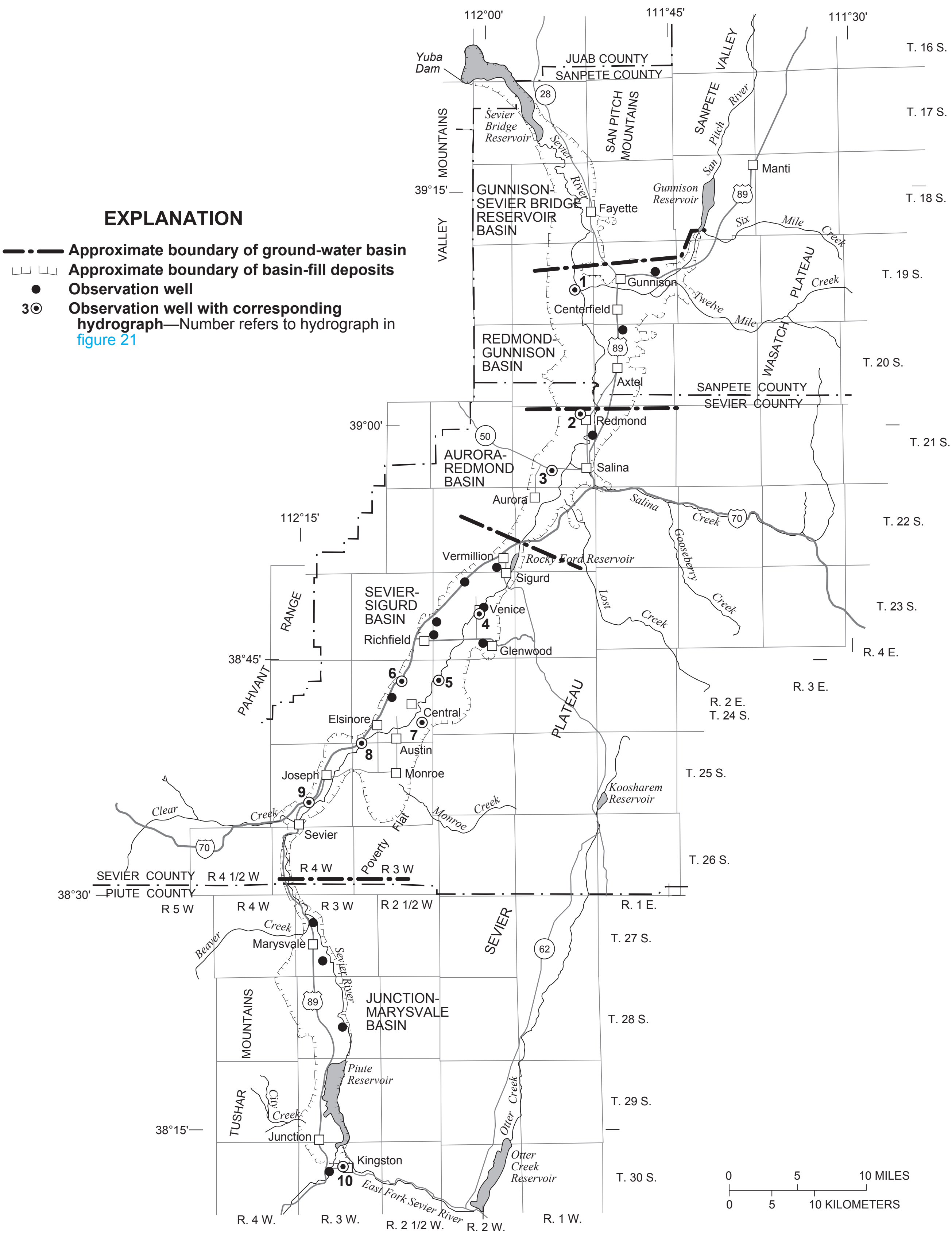


Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 2009.

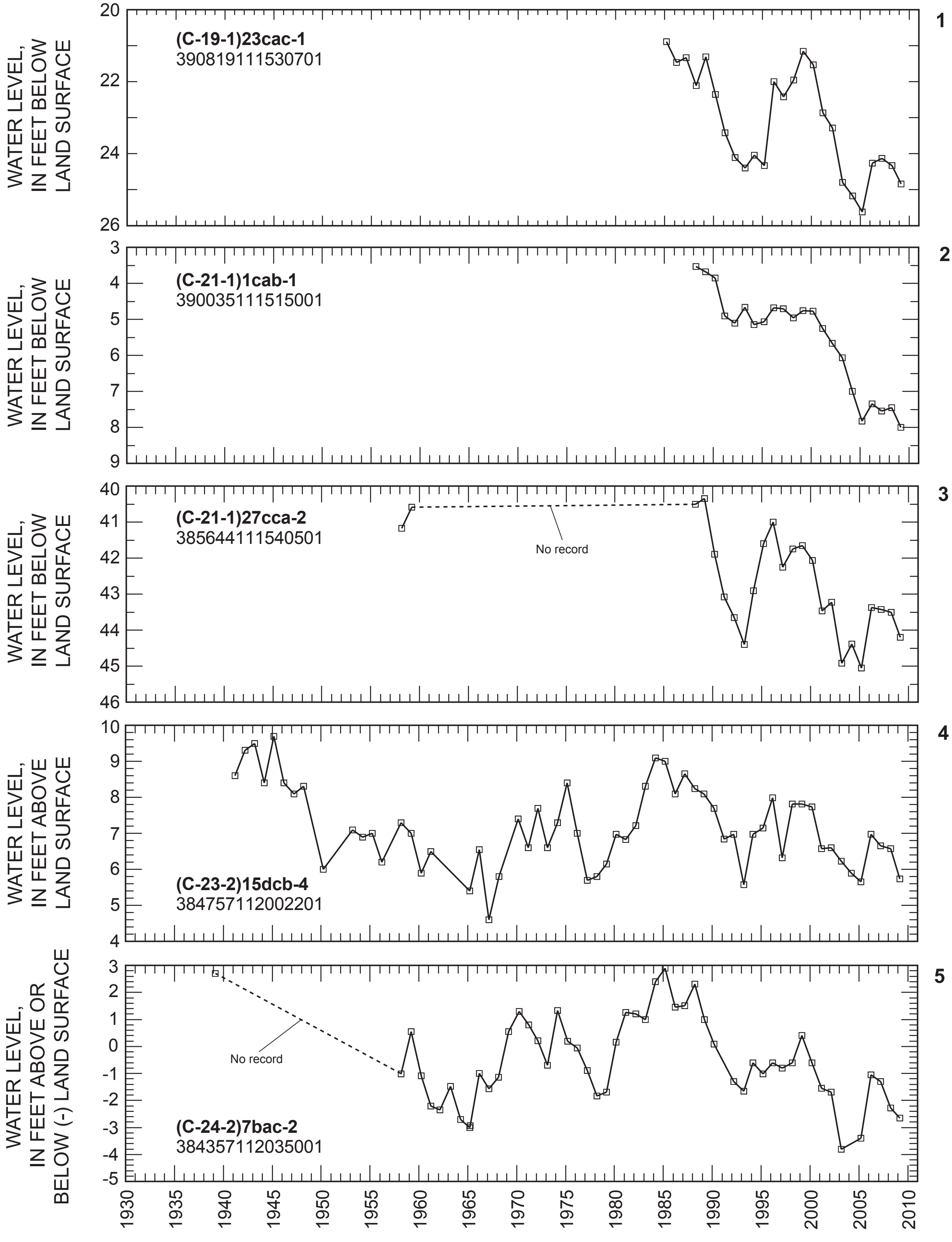


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

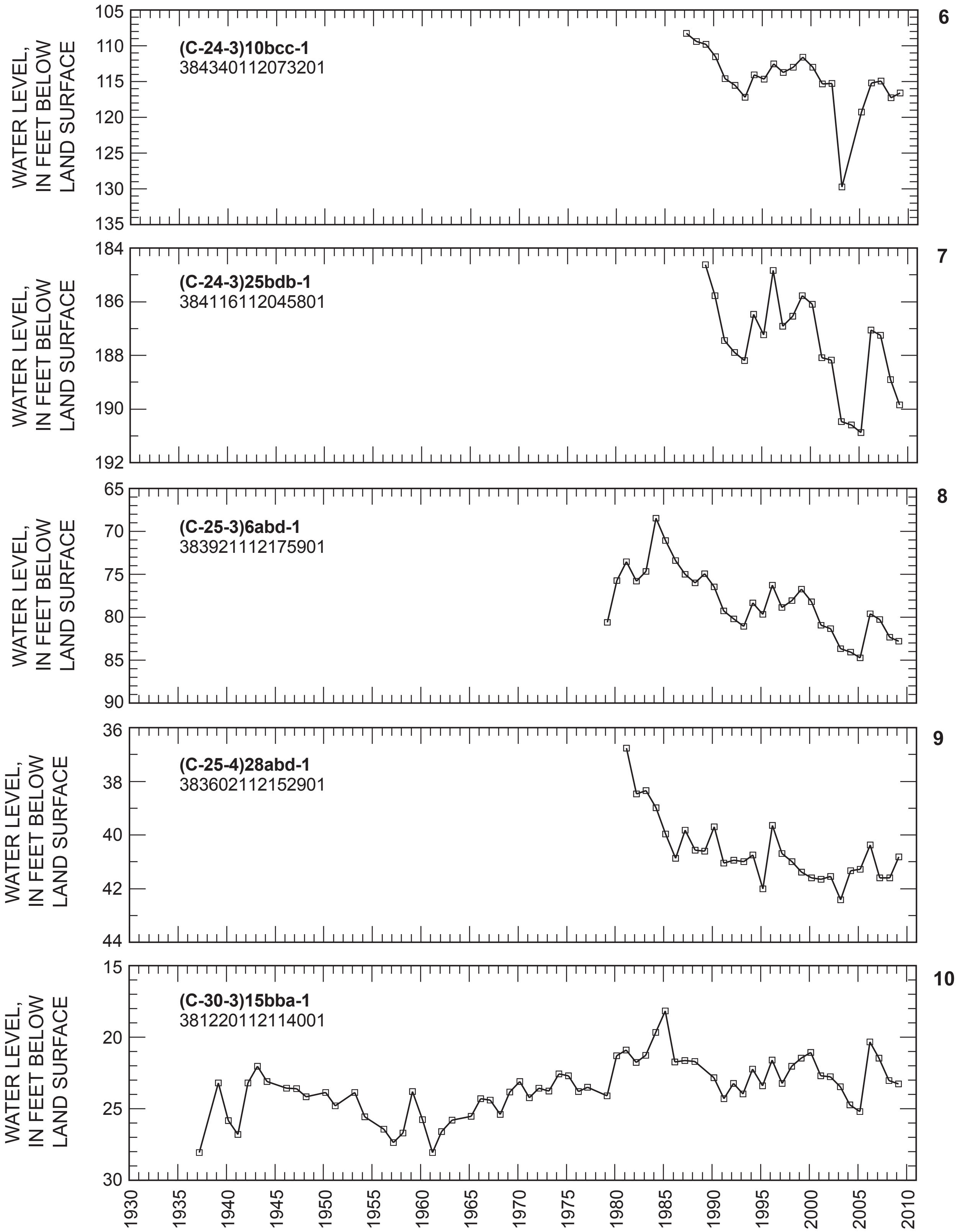


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

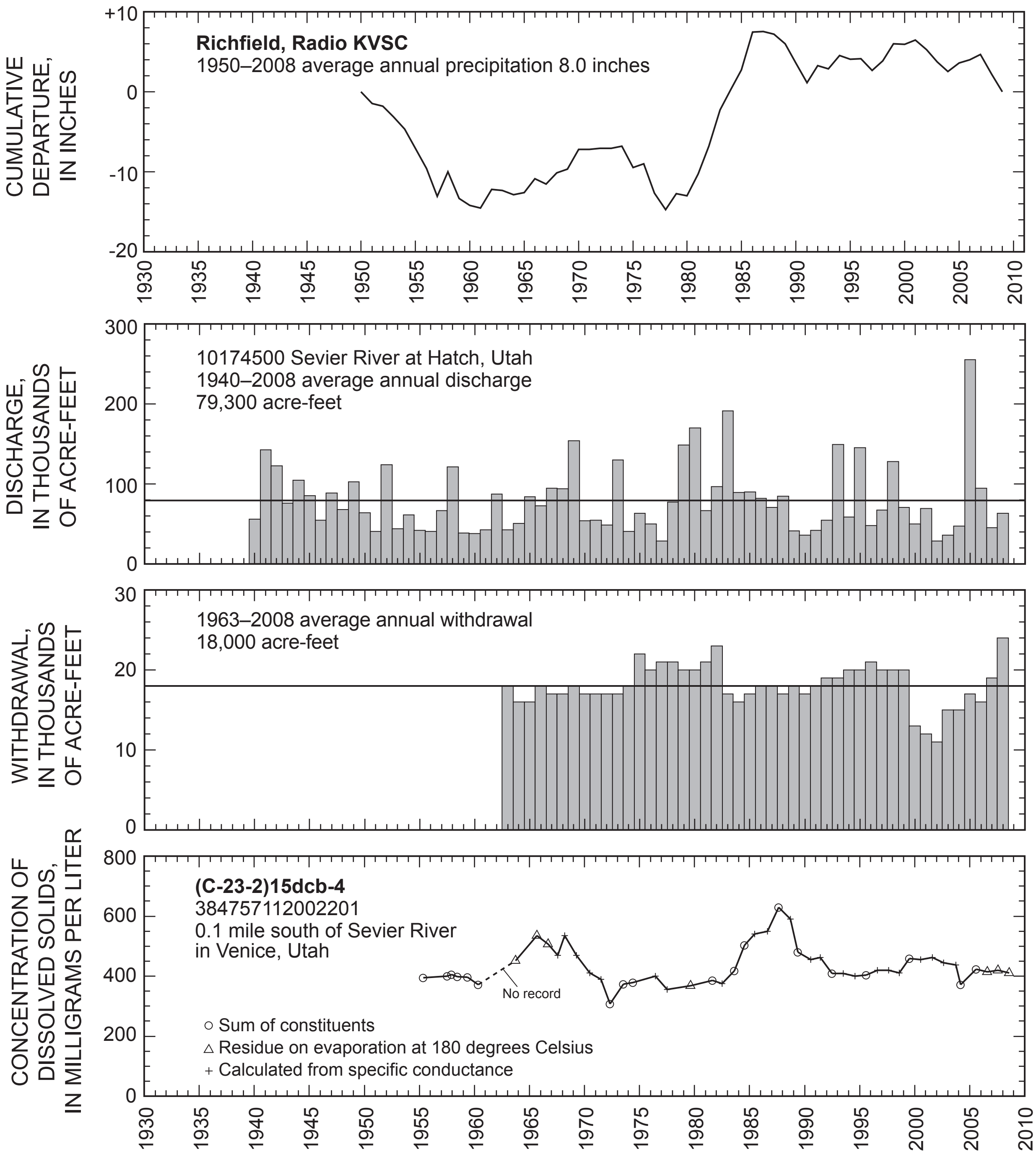


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

PAHVANT VALLEY

By Robert L. Swenson

Pahvant Valley, in southeastern Millard County, extends from the vicinity of McCornick in the north to Kanosh in the south, and from the Pahvant Range and Canyon Mountains on the east and northeast to a low basalt ridge known as The Cinders on the west (fig. 22). The area of the valley covers about 300 square miles. Ground water drains west to the valley from the mountainous terrain to the east. Ground water 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 2008 was about 94,000 acre-feet, which is about 5,000 acre-feet more than was reported in 2007 and 12,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). Withdrawal for irrigation in 2008 was about 92,900 acre-feet, which is 5,300 acre-feet more than was reported in 2007.

The location of wells in Pahvant Valley in which water levels were measured during March 2009 is shown in figure 22. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 23.

Water levels declined slightly in most of the wells measured in Pahvant Valley from March 2008 to March 2009. Declines in wells west of Flowell were generally less than 0.5 foot. Water levels rose slightly in some wells near Meadow. The declines probably are a result of continued large withdrawals for irrigation. Water levels generally declined from the early 1950s until 1982 as a result of generally less-than-average precipitation and increased withdrawals. Water levels generally rose from 1982 to 1985, and were generally higher than in the early 1950s. The 1982–85 rises were the result of greater-than-average precipitation and decreased withdrawals for irrigation. Levels generally have declined since 1985.

Precipitation at Fillmore during 2008 was about 13.1 inches, which is about 2.1 inches less than the average annual precipitation for 1930–2008 and about 3.5 inches less than in 2007.

Physical properties and records of chemical analyses for water from four wells in Pahvant Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 41. The dissolved-solids concentration in water samples from all four wells and the dissolved-sulfate and dissolved-chloride concentrations in water samples from two wells ((C-23-6)8abd-1 and (C-23-6)9ccd-1) exceeded the secondary standards for these constituents (500 mg/L for dissolved solids and 250 mg/L for both sulfate and chloride). Dissolved-solids concentrations in water from wells (C-23-6)8abd-1 and (C-23-6)9ccd-1 and the concentration of dissolved sulfate in water from well (C-23-6)8abd-1 exceeded the MCLs for these constituents (2,000 and 1,000 mg/L, respectively).

The concentration of dissolved solids in water samples collected from wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3, located in the Flowell area, from 1957 to 2008, and from well (C-23-6)8abd-1, located in the Kanosh area, from 1957 to 2008, is shown in figure 23. Wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3 are located near each other and are finished in the same aquifer. The dissolved-solids concentrations in water samples from these wells were combined to give an extended temporal record for this constituent. Dissolved-solids concentrations in water samples from these wells have ranged from 707 to 1,080 mg/L, with a median value of 868 mg/L. Since 2003, dissolved solids generally have increased. The concentration of dissolved solids in water samples from well (C-23-6)8abd-1 has ranged from 2,350 to 5,990 mg/L, with a median value of 4,230 mg/L. The most recent value (4,600 mg/L) for the water sample collected in August 2008 compares well with the median value.

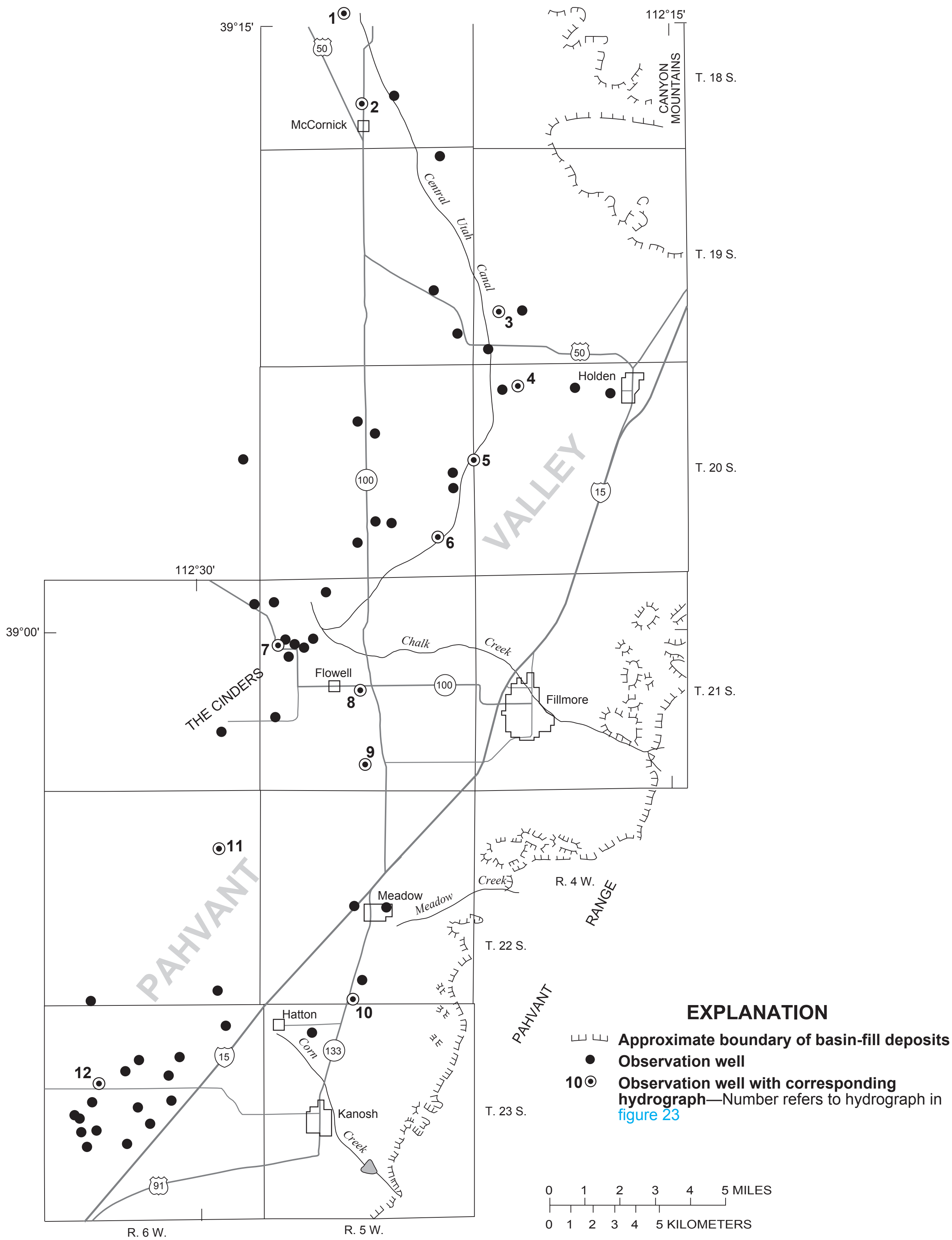


Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 2009.

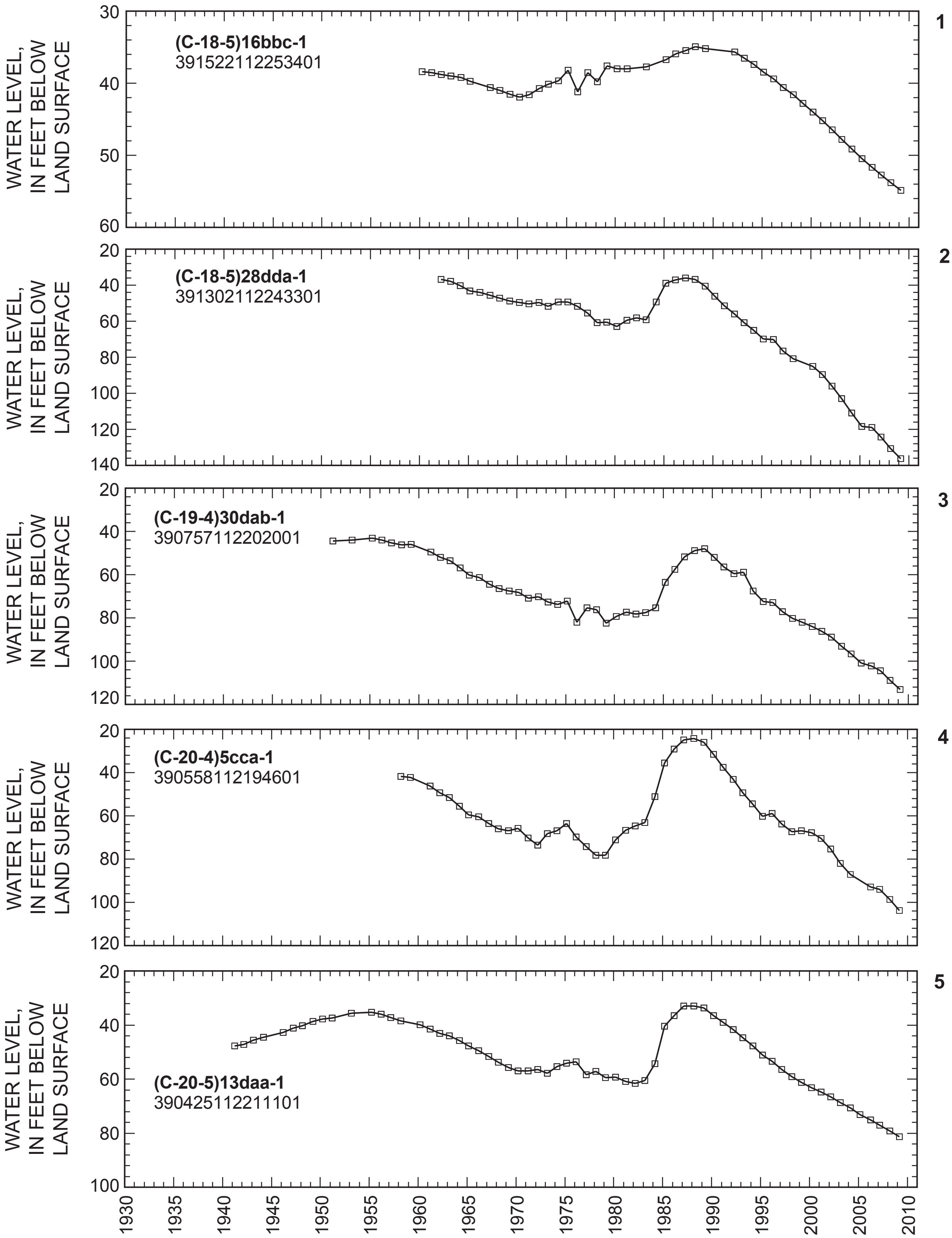


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

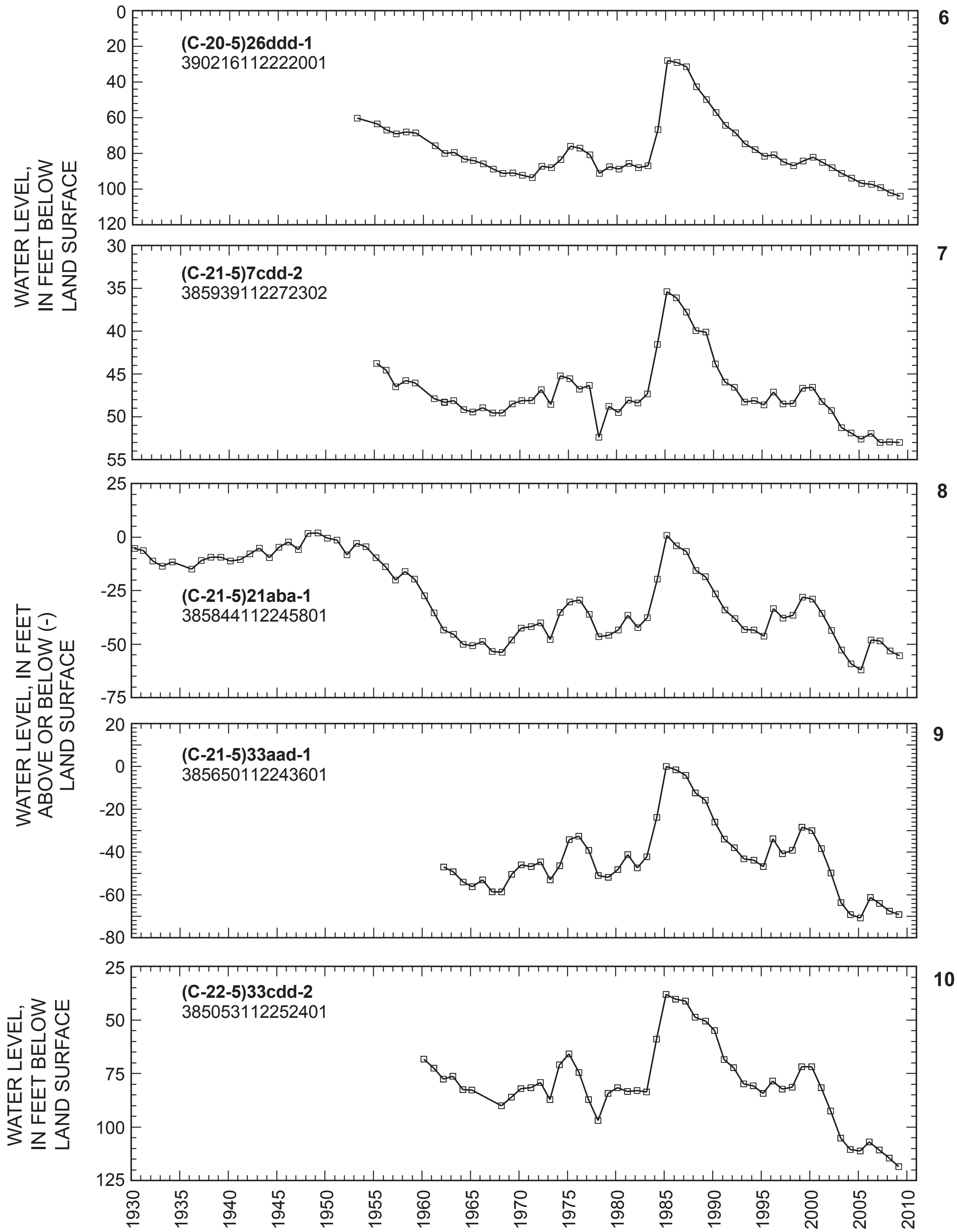


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

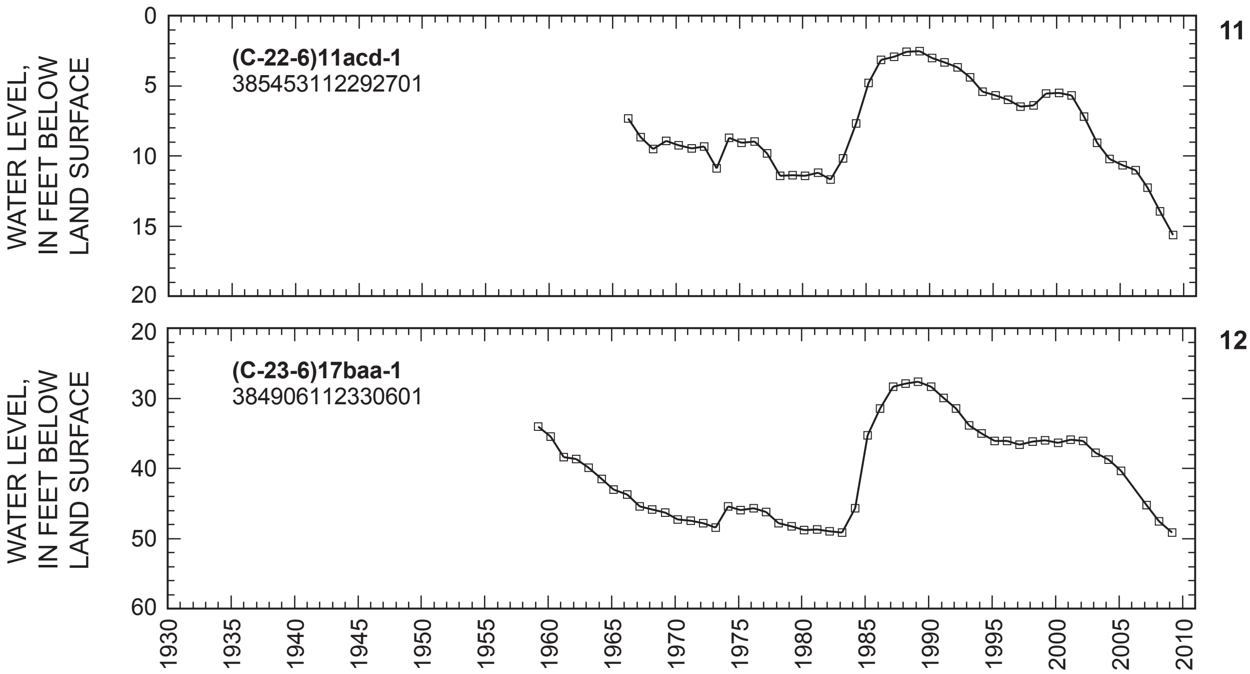


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

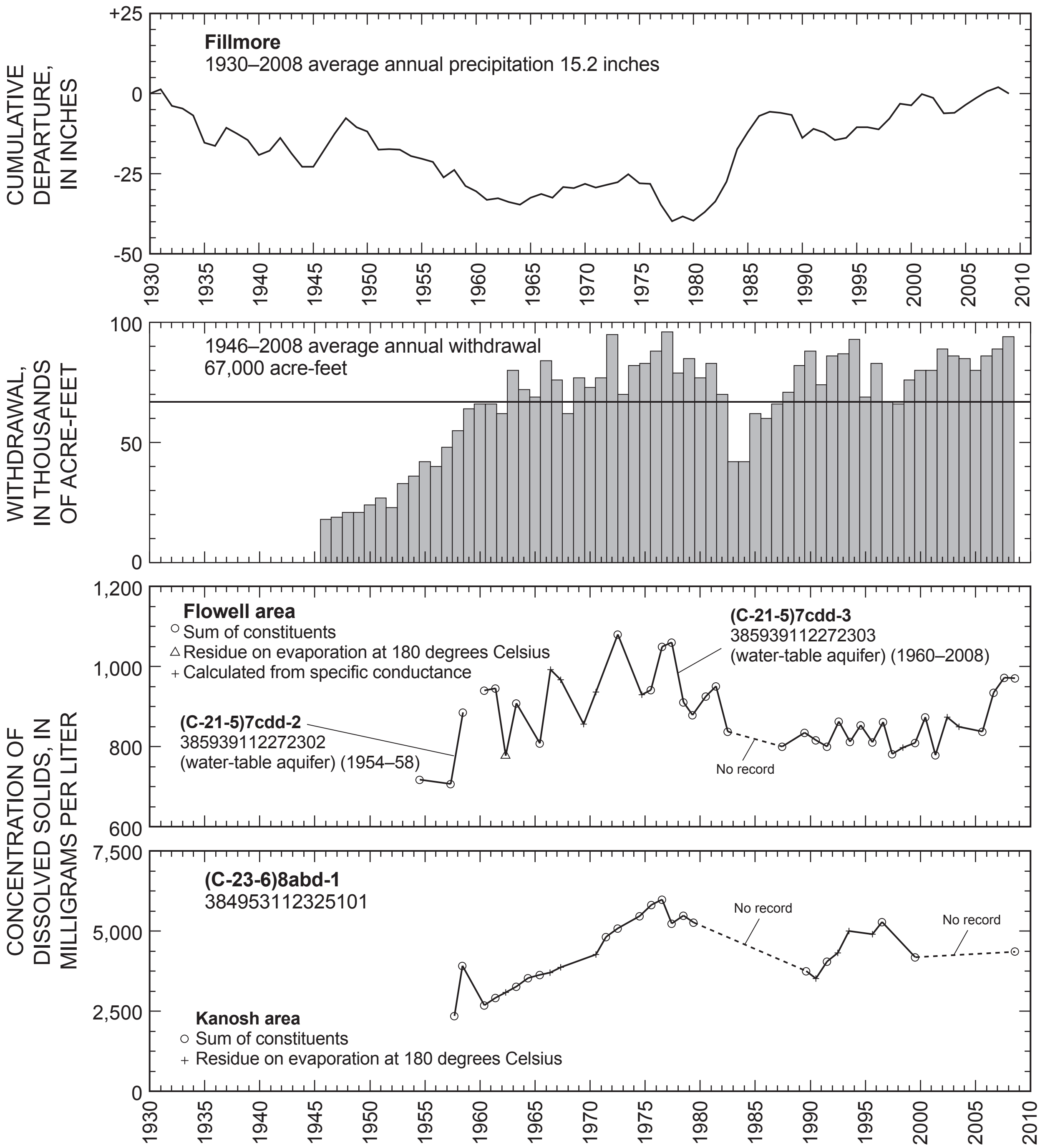


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

CEDAR VALLEY, IRON COUNTY

By James H. Howells

Cedar Valley is in eastern Iron County, southwestern Utah. The valley covers about 170 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). Ground water 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 ground-water system.

Total estimated withdrawal of water from wells in Cedar Valley in 2008 was about 40,000 acre-feet, which is the same as in 2007 and 4,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3).

The location of wells in Cedar Valley in which the water level was measured during March 2009 is shown in figure 24. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 25.

Ground-water levels generally declined from March 2008 to March 2009 in most parts of Cedar Valley. The largest declines, about 5 feet, were measured in two wells north and west of Cedar City and in one well west of Quichapa Lake. A water-level rise was measured in one well south of Rush Lake. Water-level declines probably result from continued localized large withdrawals for irrigation and municipal use. Water-level rises probably result from locally decreased withdrawals.

Precipitation at Cedar City Federal Aviation Administration Airport in 2008 was about 9.6 inches, which is about 0.6 inch less than in 2007 and about 1.0 inch less than the average annual precipitation for 1949–2008. Discharge of Coal Creek was about 17,600 acre-feet in 2008, which is 3,900 acre-feet more than in 2007, and 6,800 acre-feet less than the average annual discharge for 1936 and 1939–2008.

Physical properties and records of chemical analyses for water from three wells in Cedar Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 41. Water samples from all three wells exceeded the secondary standard for dissolved solids (500 mg/L), and the concentration of dissolved sulfate in water samples from wells (C-35-11)31dbd-1 and (C-37-12)23acb-1 exceeded the secondary standard for this constituent (250 mg/L).

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 2008, and well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, from 1977 to 2008, is shown in figure 25. Dissolved-solids concentration in water from well (C-37-12)23acb-1 has ranged from 347 to 961 mg/L, with a median value of 491 mg/L. The concentration of dissolved solids in water from this well has increased from 347 mg/L in 1966 to 904 mg/L in 2008. 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 495 mg/L. From 1987 to 2008, the concentration has generally increased.

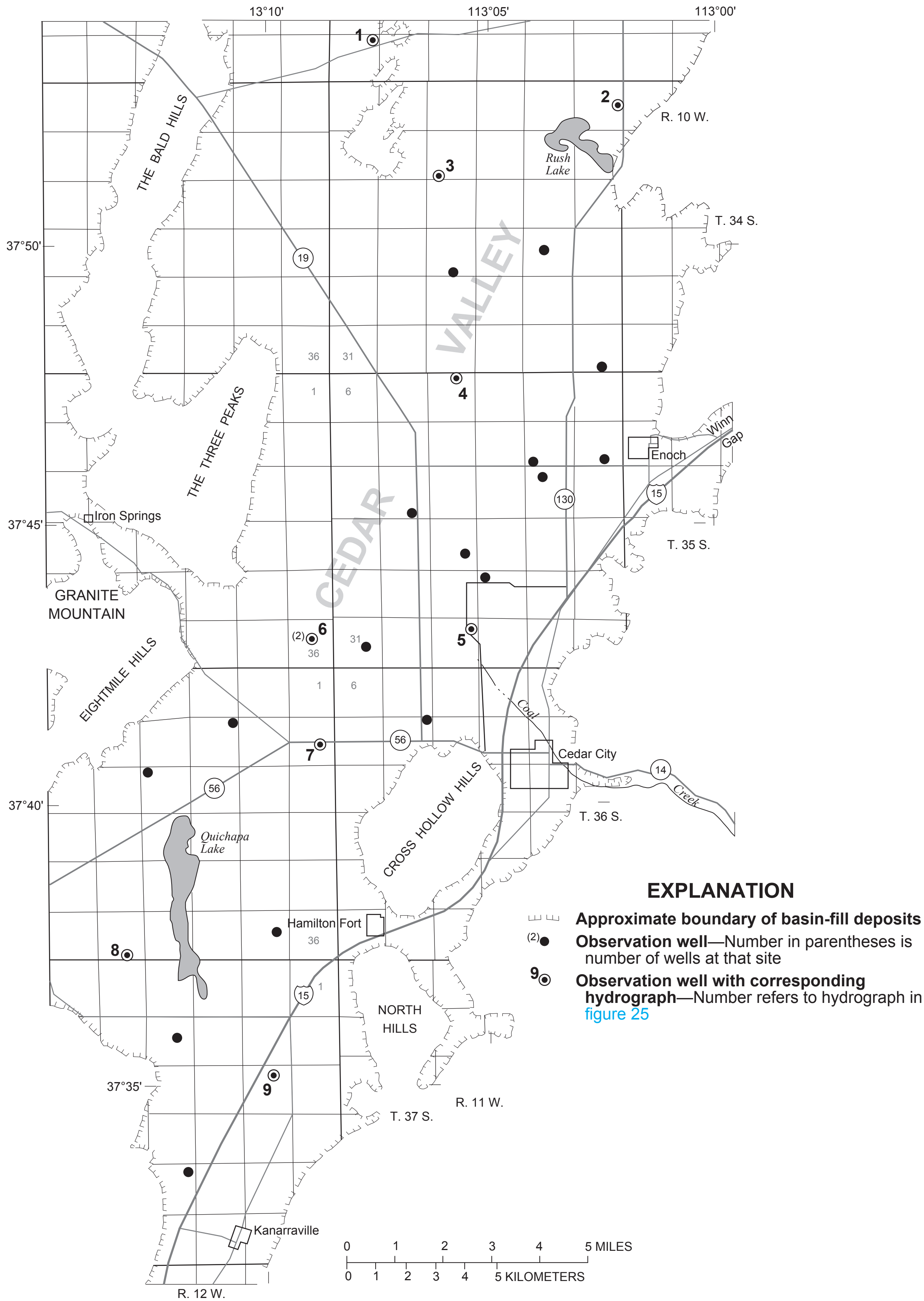


Figure 24. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2009.

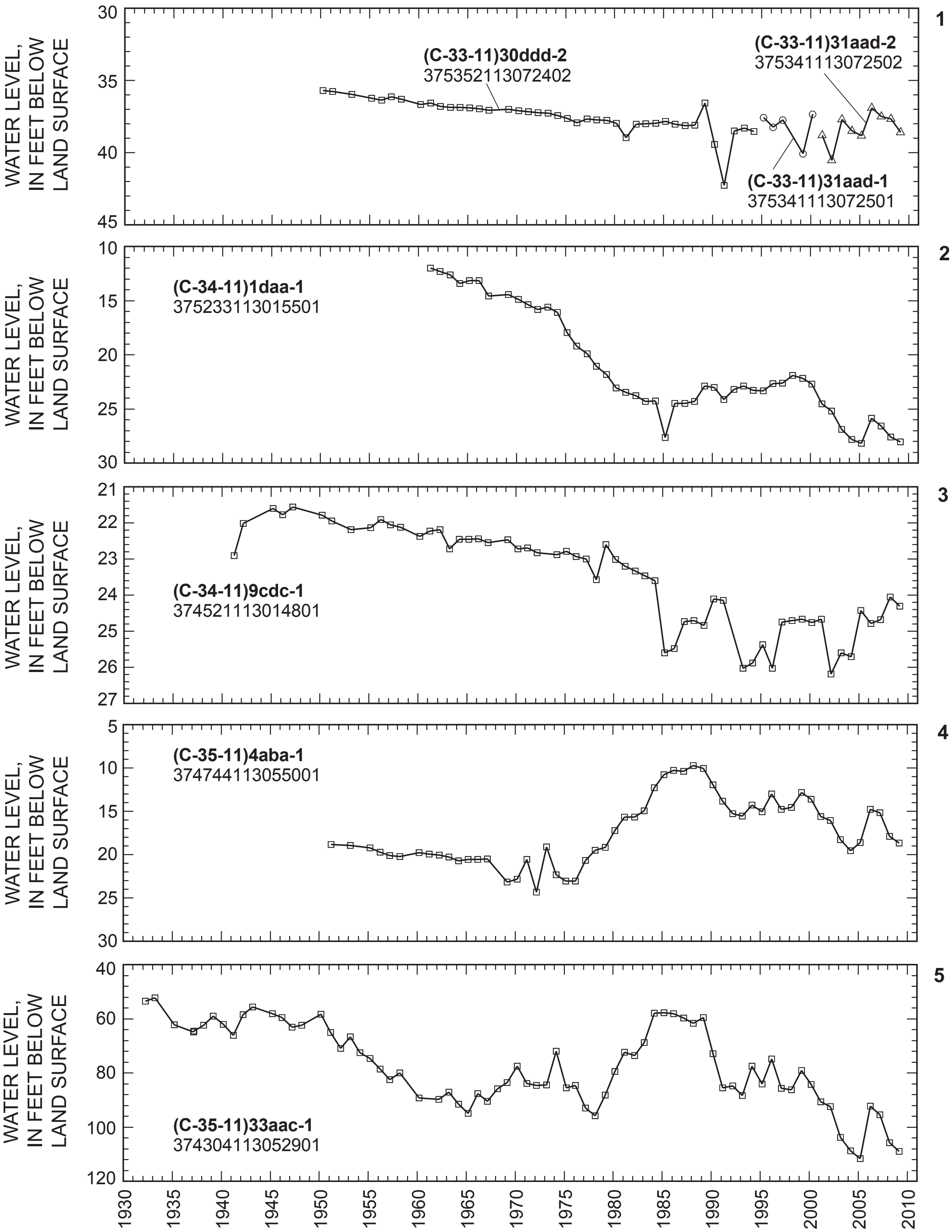


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration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

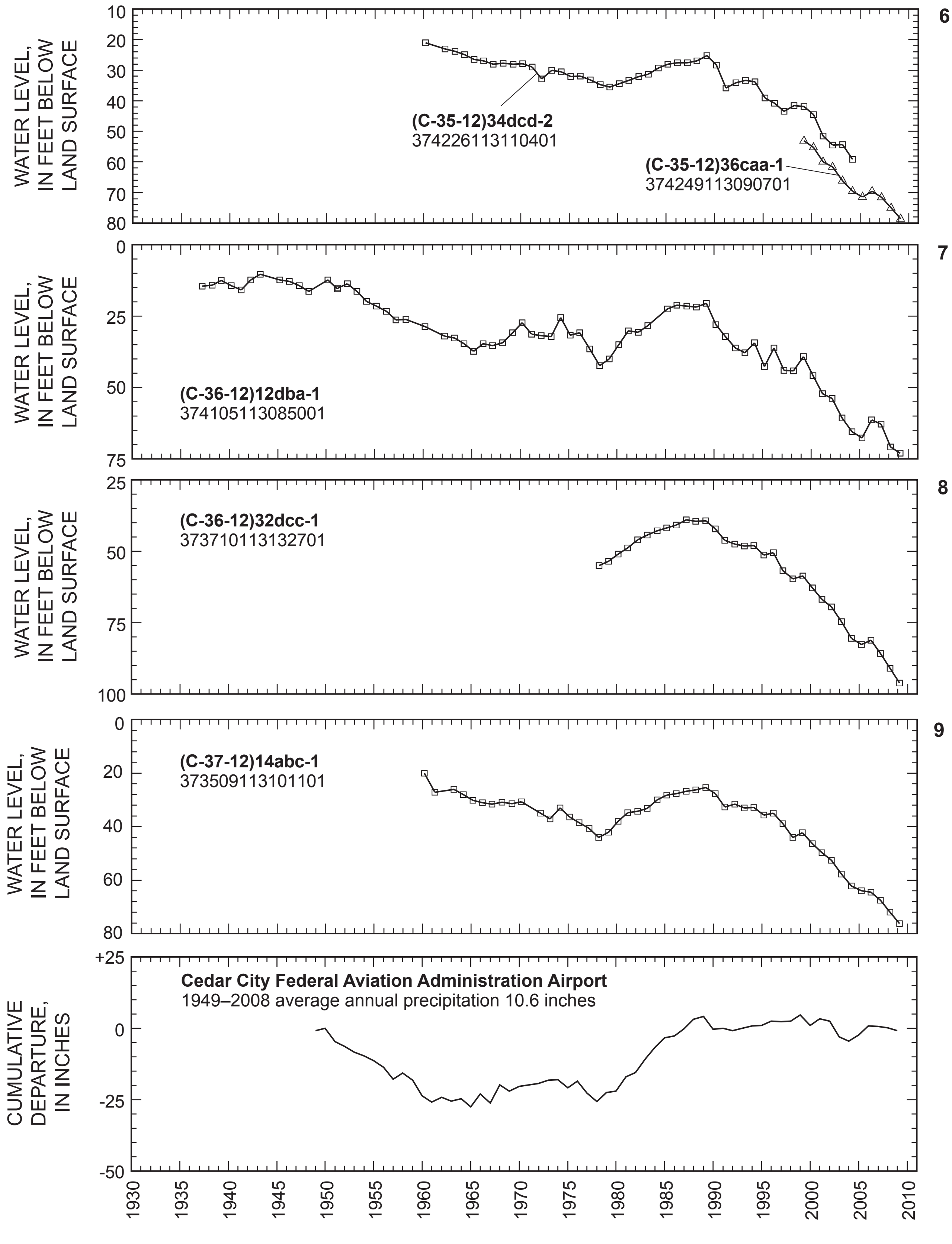


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration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

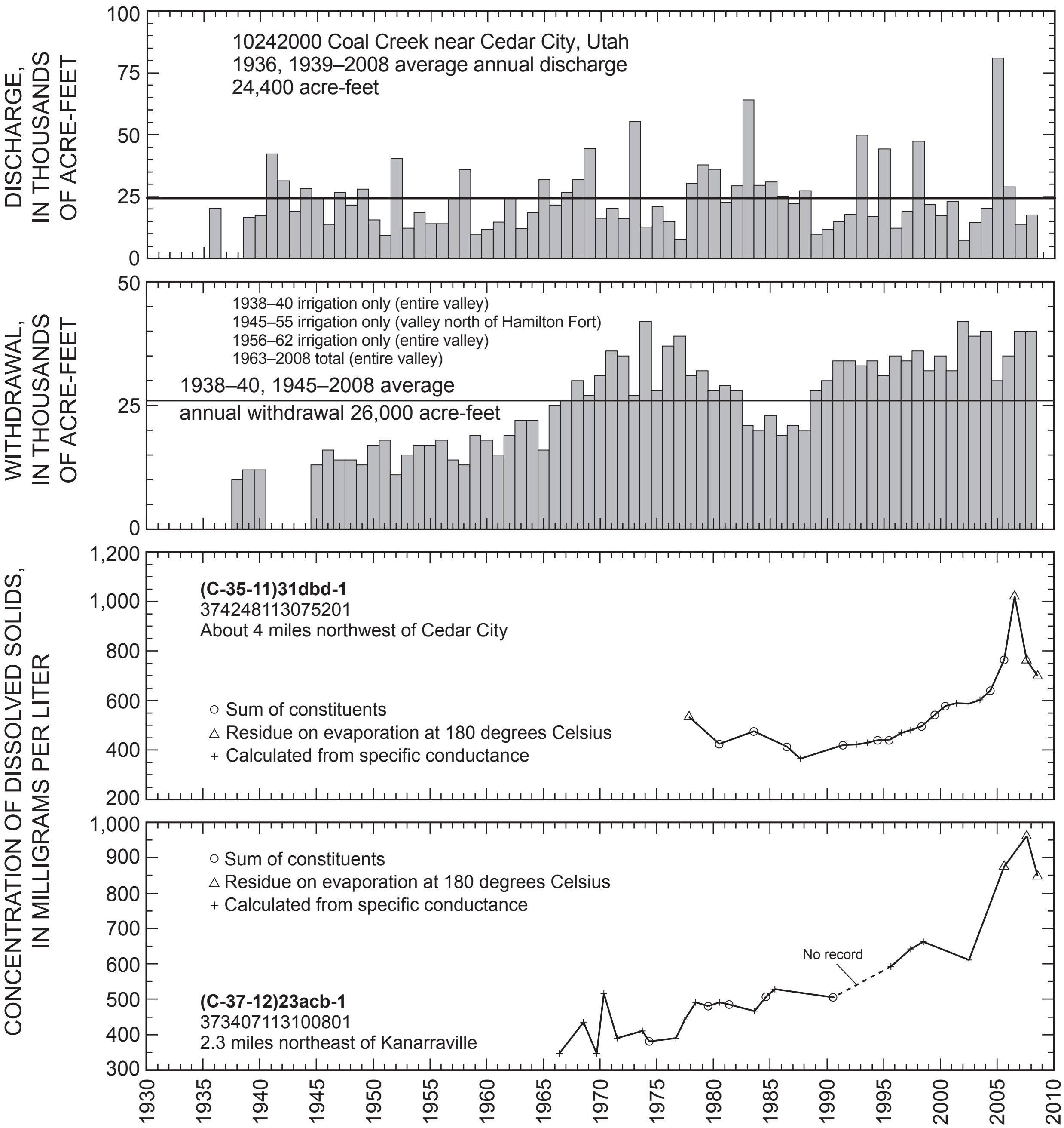


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration 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). Ground water occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Parowan Valley in 2008 was about 38,000 acre-feet, which is about 4,000 acre-feet more than was reported for 2007 and 6,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). This increase is attributed to increased withdrawals for irrigation.

The location of wells in Parowan Valley in which the water level was measured during March 2009 is shown in figure 26. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 27.

Water levels declined from March 2008 to March 2009 in most parts of Parowan Valley for which data are available. The largest decline, greater than 6 feet, was measured in a well north of Parowan. Water levels in Parowan Valley generally have declined since 1950. Some rises occurred during 1973–74, 1983–85, 1996–99, and 2006. Declines are probably the result of continued large withdrawals for irrigation. Rises are probably the result of less withdrawal for irrigation and several years of greater-than-average precipitation.

Precipitation at Cedar City Federal Aviation Administration Airport in 2008 was about 9.6 inches, which is about 0.6 inch less than the value for 2007 and 1.0 inch less than the average annual precipitation for 1949–2008.

Physical properties and records of chemical analyses for water from four wells in Parowan Valley are listed in tables 4 and 5, and the location of the wells is plotted in figure 41. The concentration of dissolved solids in water from well (C-34-9)18bdc-1 slightly exceeded the secondary standard for this constituent (500 mg/L). Analytical values available for major ions, selected trace elements, and nutrients in water samples from the wells did not exceed secondary standards or MCLs.

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 2007, is shown in figure 27. The concentration has ranged from 257 to 885 mg/L, with a median value of 297 mg/L. With the exception of relatively high dissolved-solids concentrations in water samples collected in 1970, 1973, and 1974, concentrations have varied little. This well was not sampled in 2008.

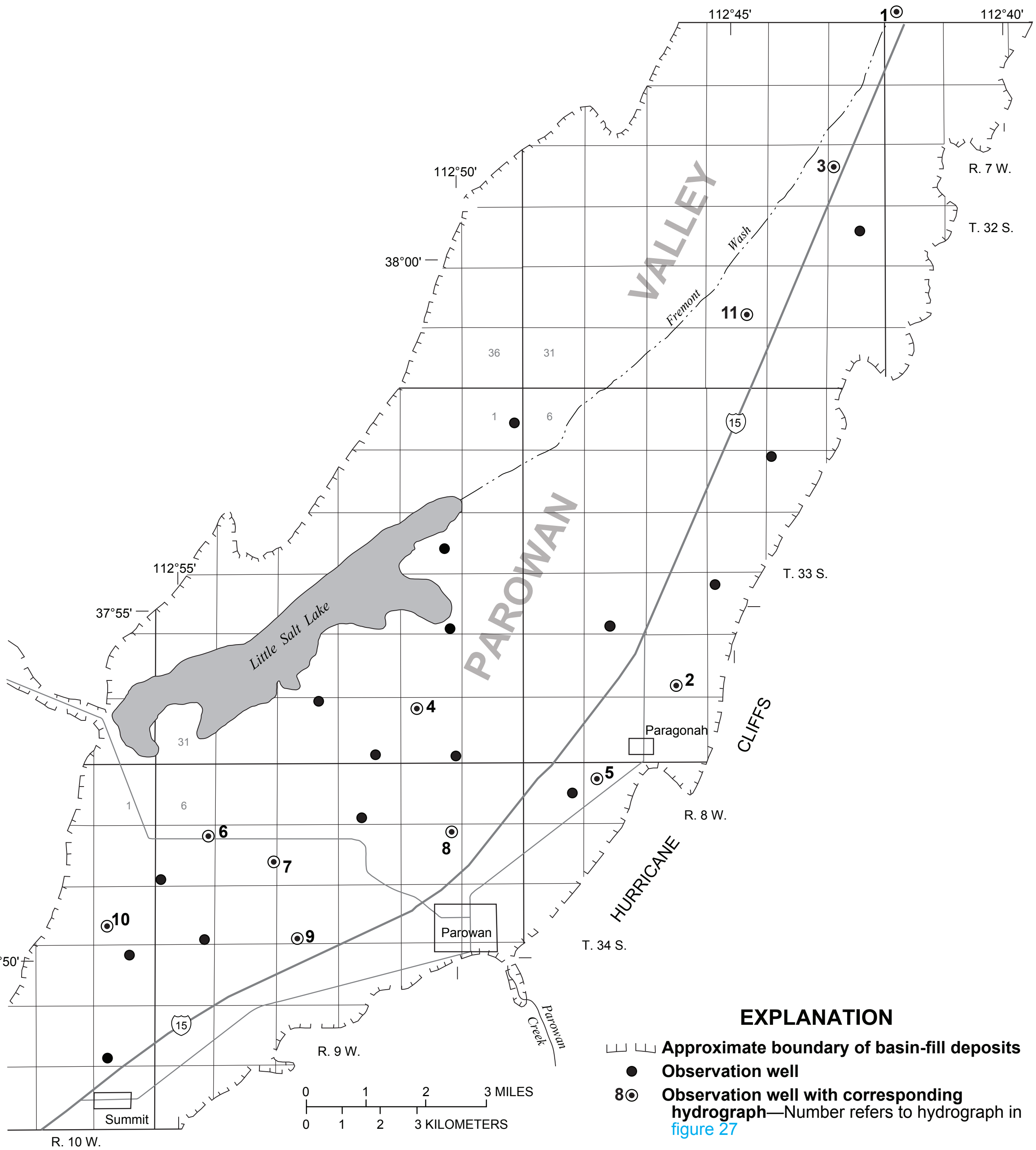


Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 2009.

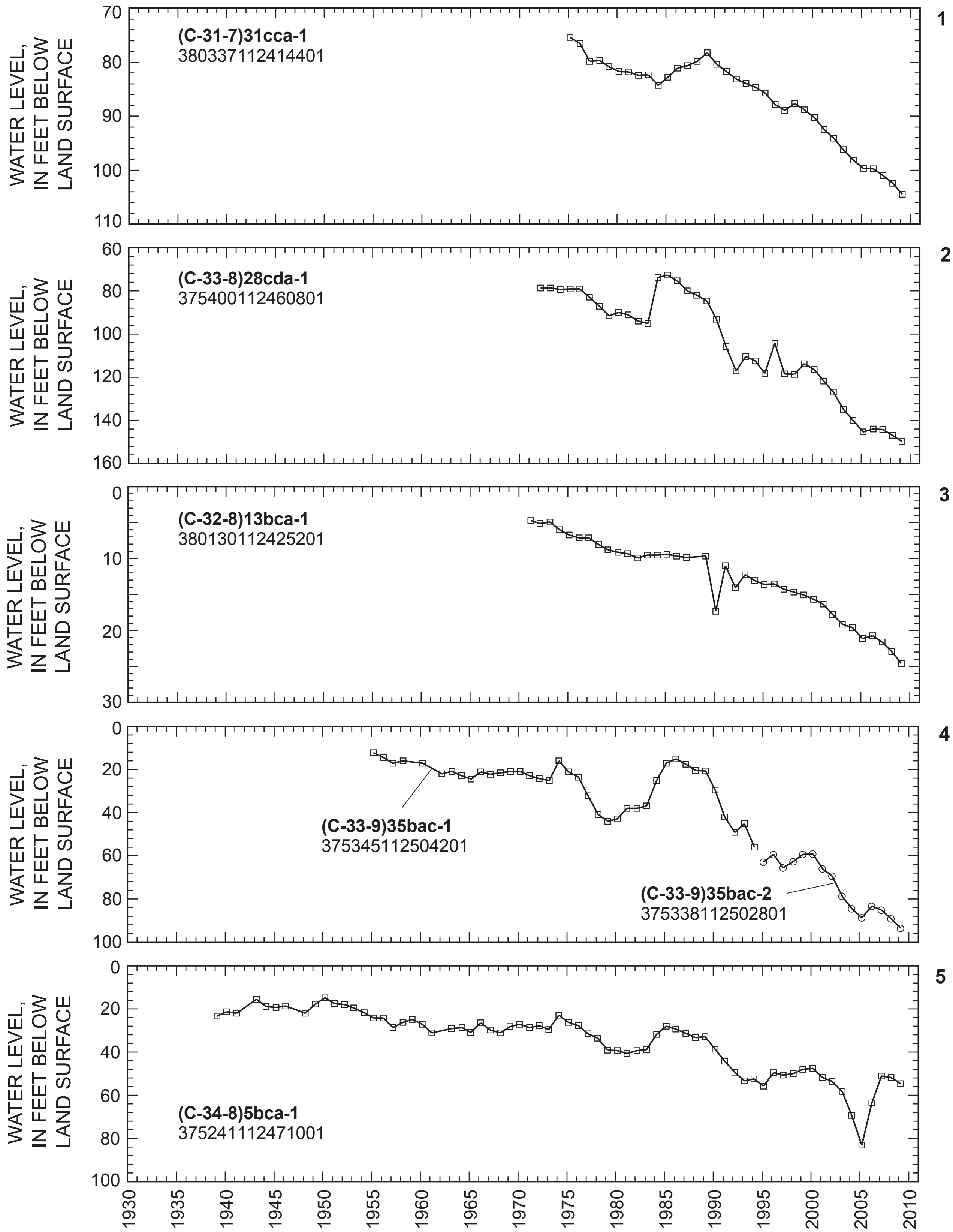


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

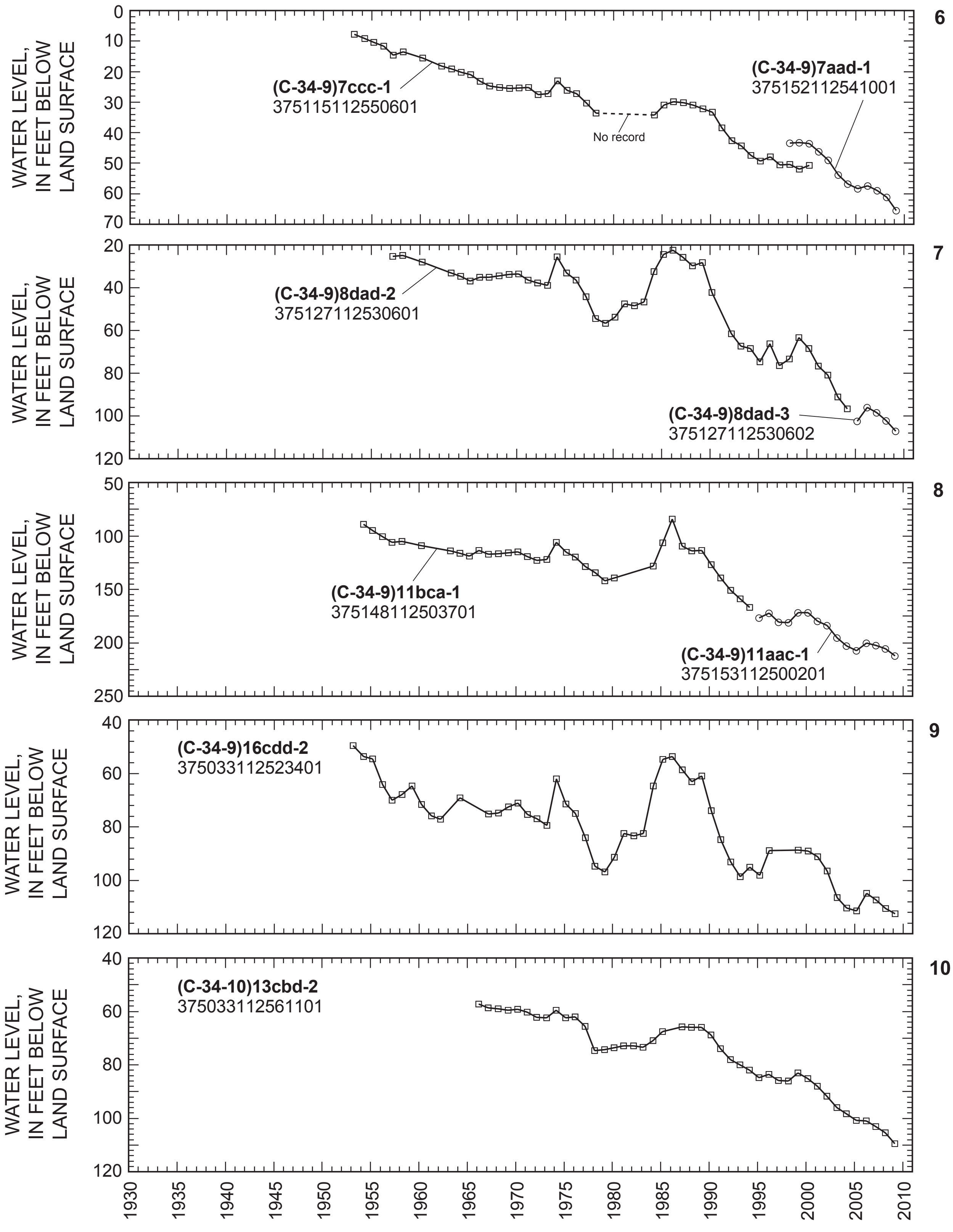


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

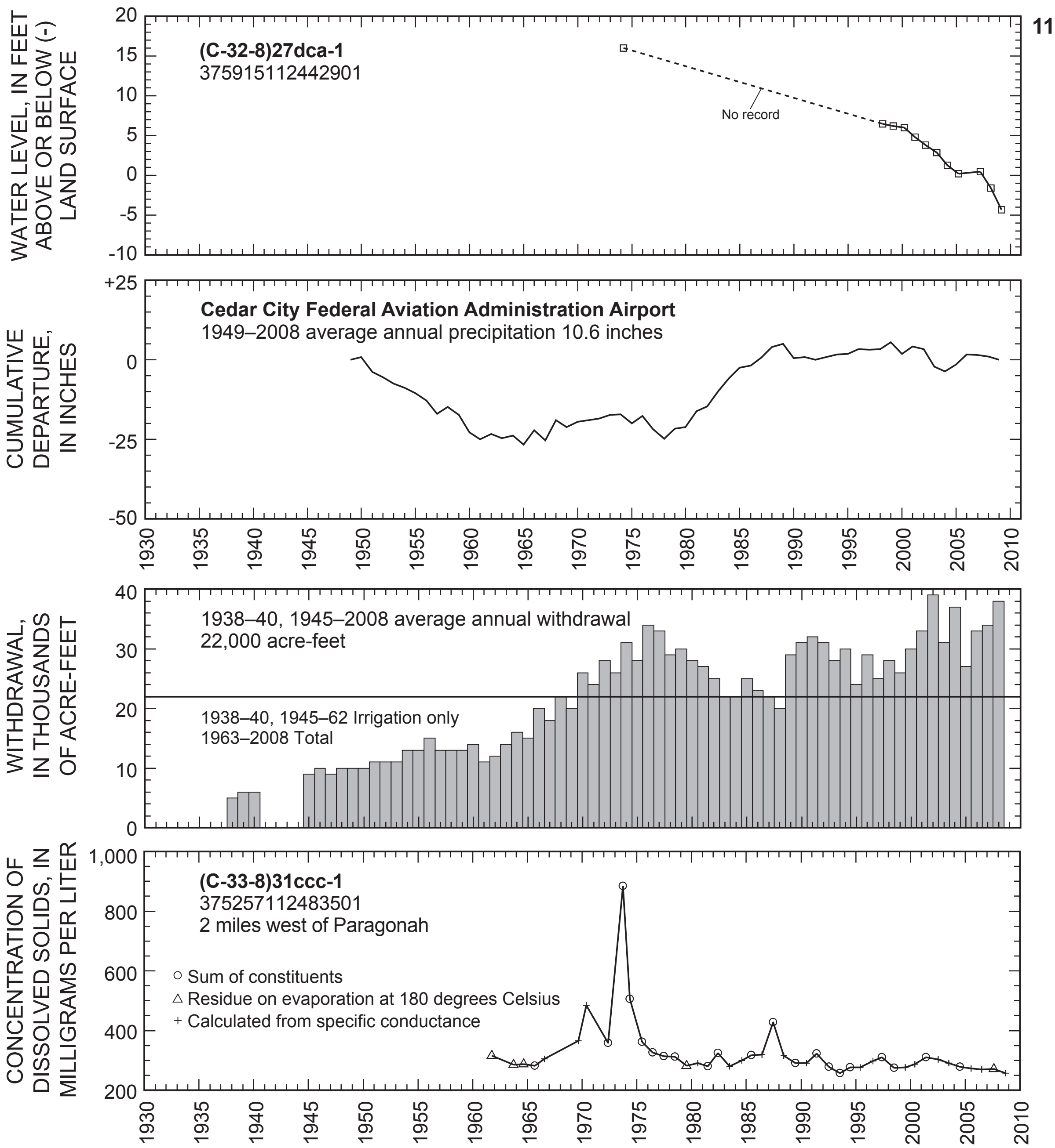


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

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). Ground water occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Milford area of Escalante Valley in 2008 was about 51,000 acre-feet, which is 2,000 acre-feet more than was reported for 2007 and 6,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). This increase was mostly the result of increased withdrawal for industrial use.

The location of 31 wells in the Milford area in which the water level was measured during March 2009 is shown in figure 28. The relation of the water level in selected observation wells to cumulative departure from the average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2 is shown in figure 29.

Water levels generally declined slightly from March 2008 to March 2009 in the Milford area. The amount of water-level rise or decline depends largely on ground-water withdrawals, the amount and timing of precipitation, and recharge to the basin-fill aquifer from the Beaver River. Since the early1950s water levels generally have declined in the south-central Milford area in response to the long-term effects of ground-water 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.

Precipitation at Black Rock in 2008 was about 7.6 inches, about 1.8 inches more than in 2007 and about 1.3 inches less than the 1952–2008 average annual precipitation.

Physical properties and records of chemical analyses for water from five wells in the Milford area are listed in tables 4 and 5, and the location of the wells is plotted in figure 41. Dissolved-solids concentrations in water samples from four wells ((C-28-10)5add-1, (C-29-10)5cdd-2, (C-29-11)1add-1, and (C-29-11)27aad-1) exceeded the secondary standard for this constituent (500 mg/L). Analytical values for major ions, selected trace elements, and nutrients did not exceed secondary standards or MCLs.

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 2008, is shown in figure 29. The concentration has ranged from 494 to 909 mg/L with a median value of 580 mg/L. Dissolved-solids concentrations in the August 2008 sample (543 mg/L) compare well with the median value. With the exception of a relatively high dissolved-solids concentration in the water sample collected in 2001 (909 mg/L), concentrations have varied little.

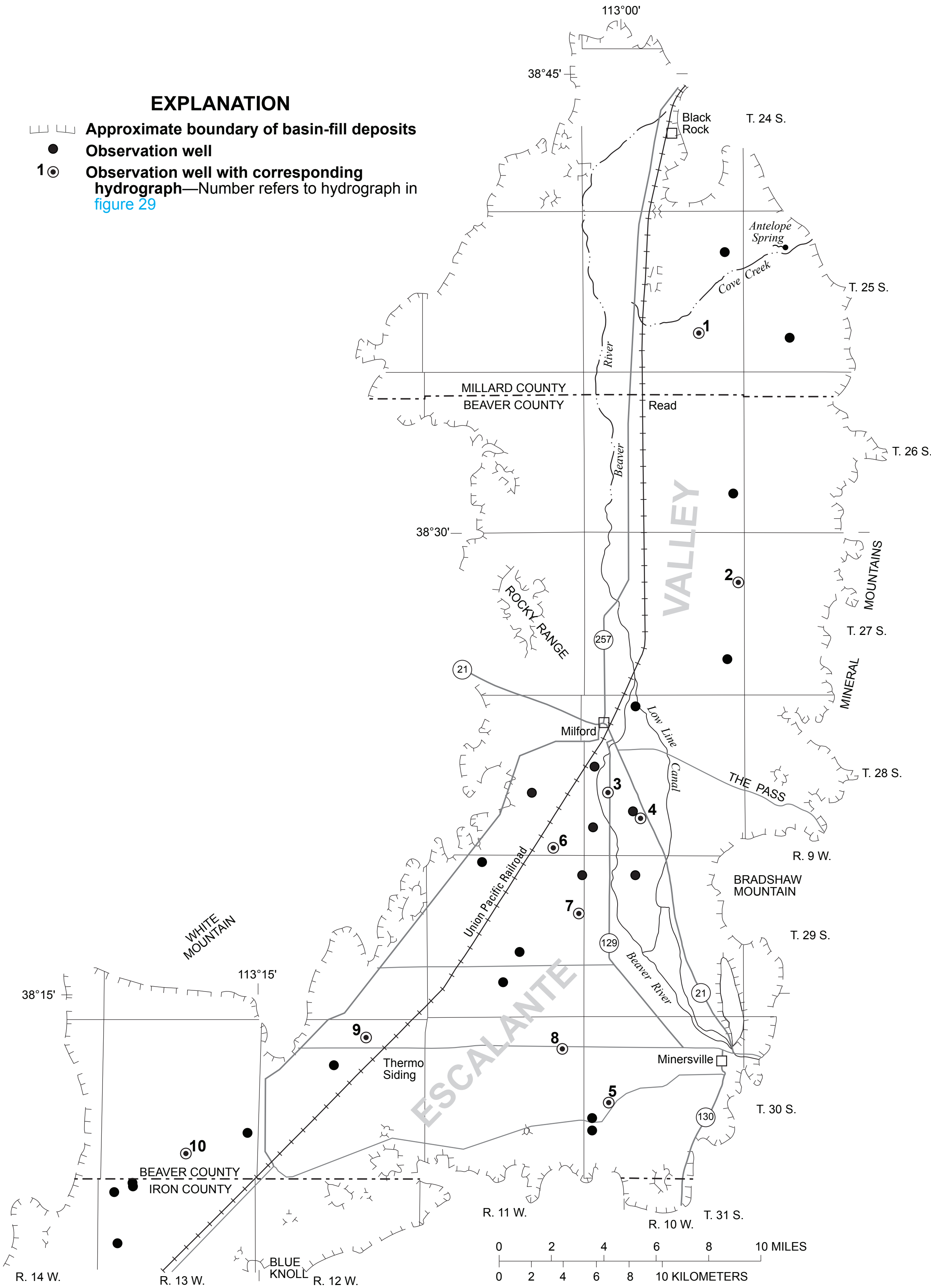


Figure 28. Location of wells in the Milford area in which the water level was measured during March 2009.

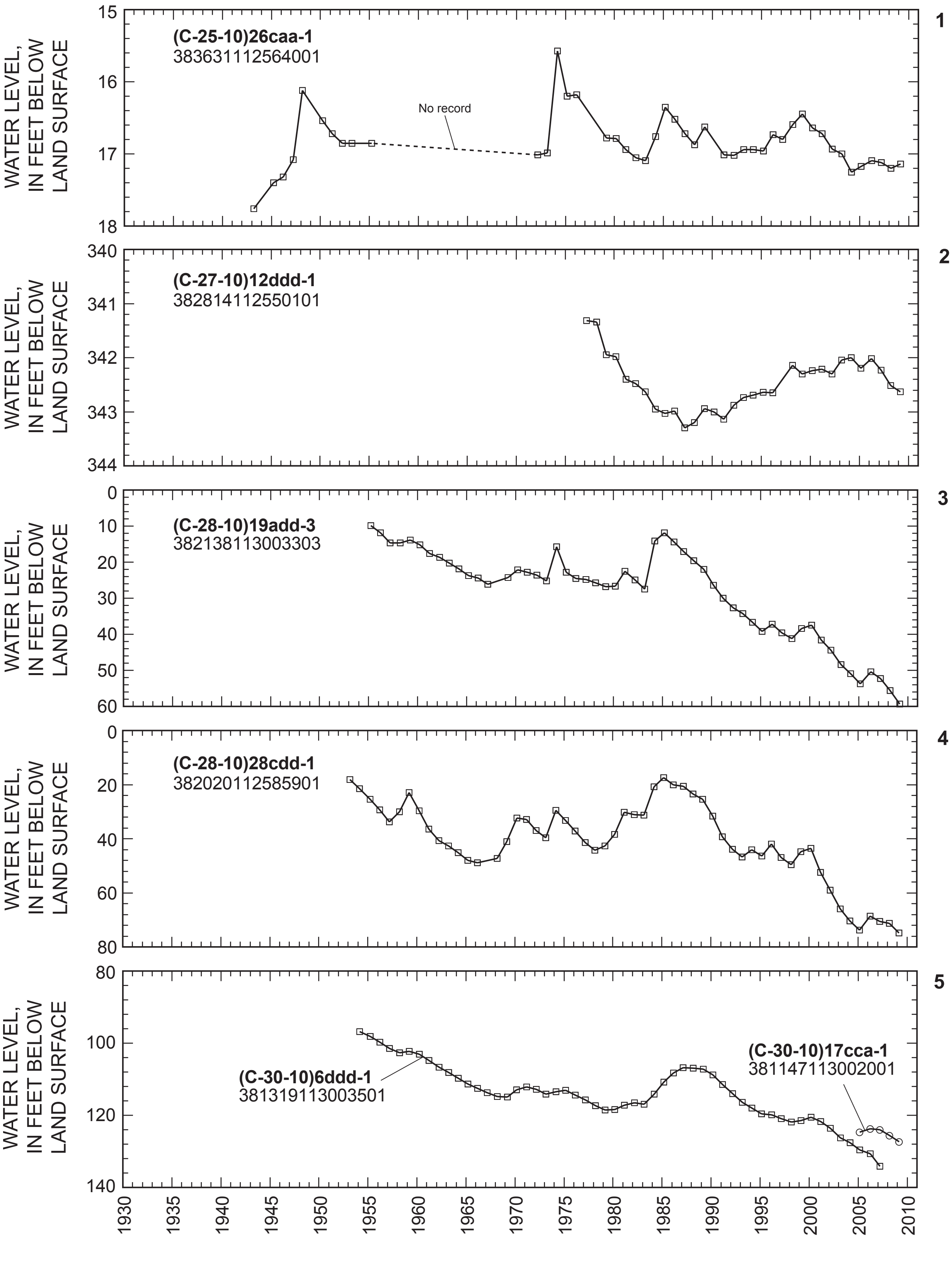


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.

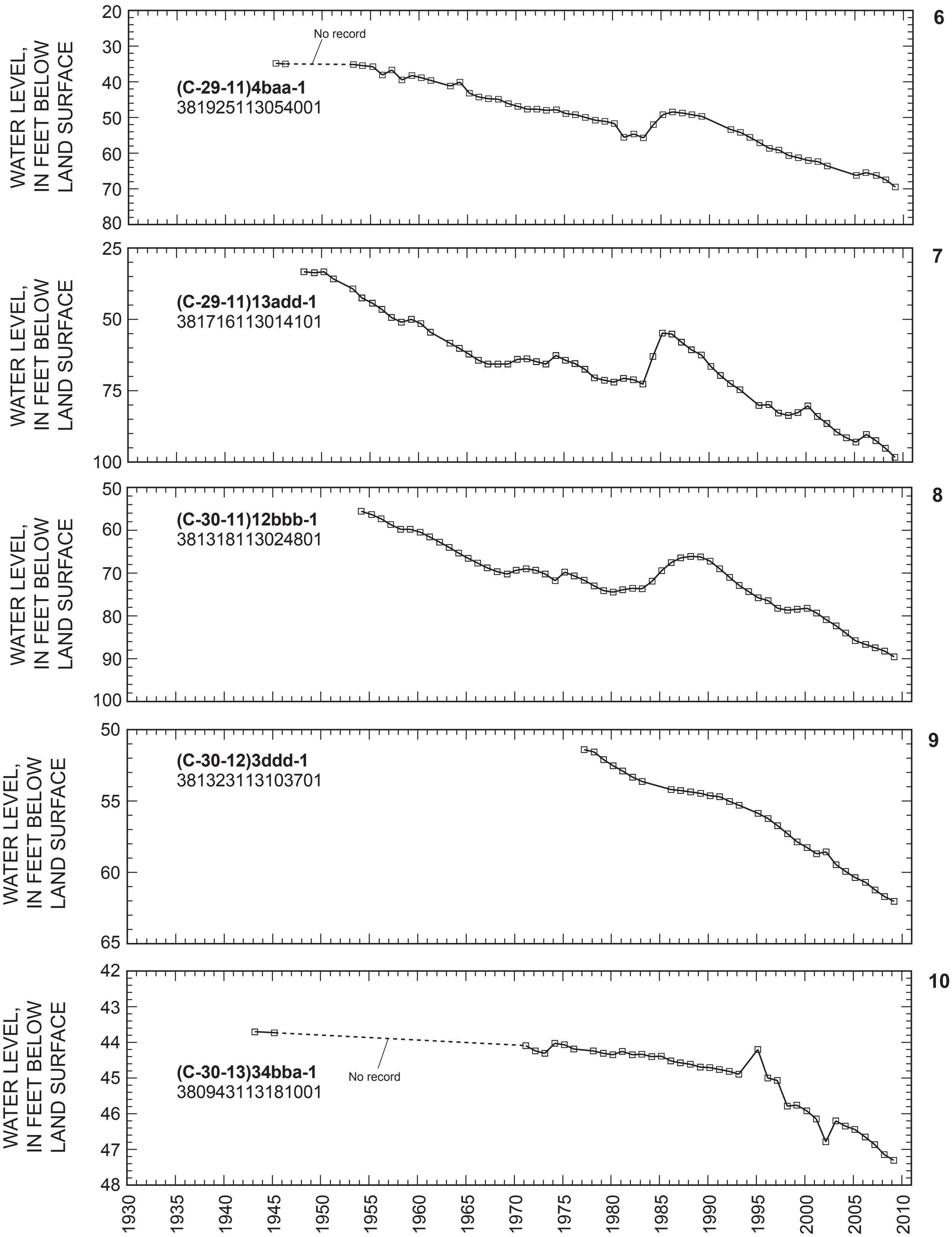


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2—Continued.

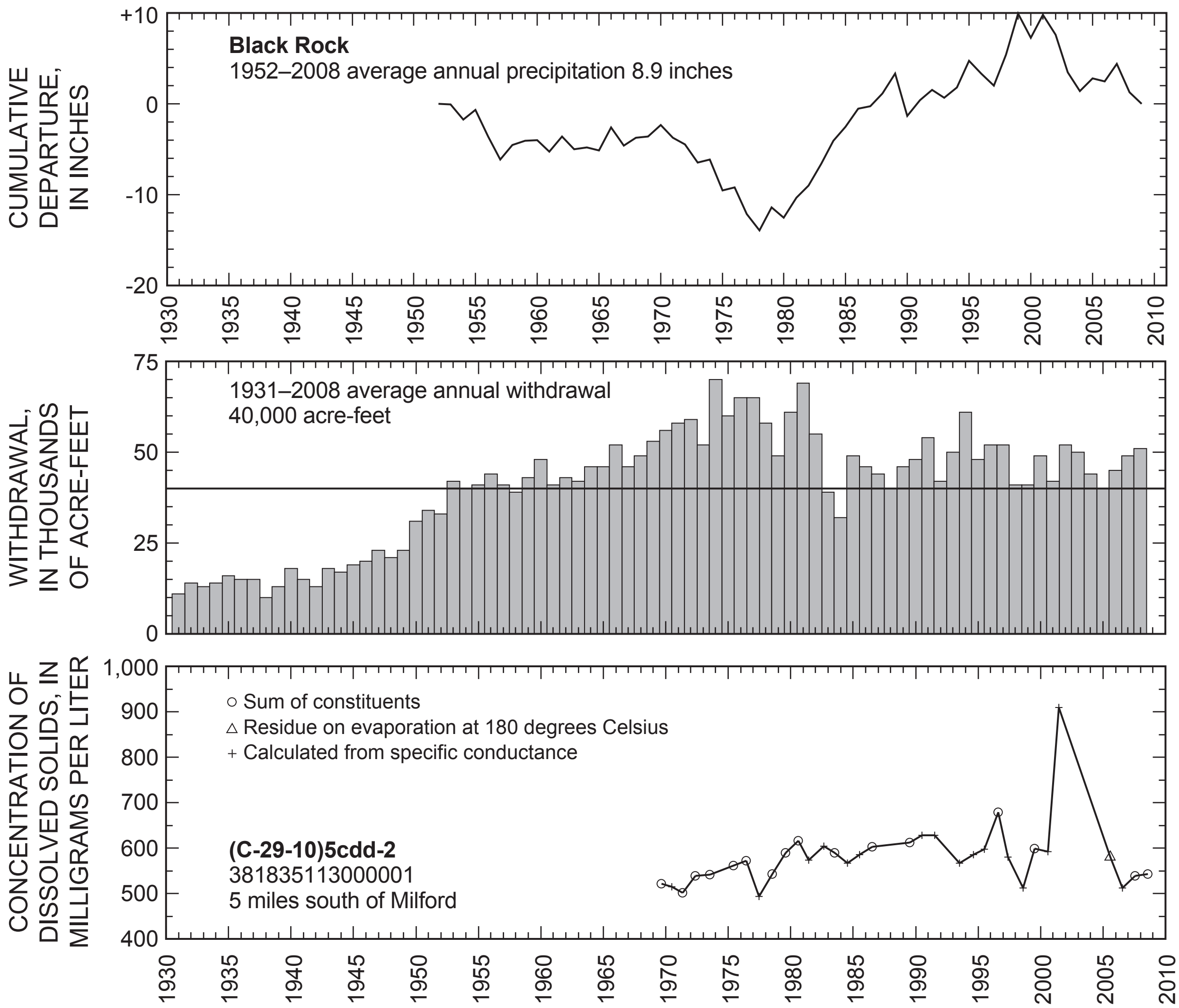


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2—Continued.

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, in Iron County southeast of the Wah Wah Mountains, and a small area in Washington County in the vicinity of the community of Enterprise (fig. 30). Ground water occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 2008 was about 93,000 acre-feet, which is 1,000 acre-feet more than in 2007 and 8,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). This increase was mostly the result of increased withdrawals for irrigation.

The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2009 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.

Water levels in the Beryl-Enterprise area declined from March 2008 to March 2009. 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 125 feet from March 1948 to March 2009 is shown in well (C-36-16)29daa-1 (fig. 31), about 5 miles northeast of Enterprise.

Precipitation at Enterprise in 2008 was about 13.6 inches, which is about 0.4 inch less than the average annual precipitation for 1955–2008 and about 0.6 inch more than in 2007.

Physical properties and records of chemical analyses for water from six wells in the Beryl-Enterprise area are listed in tables 4 and 5, and the location of the wells is shown in figure 41. Dissolved-solids concentrations in water samples from four wells ((C-34-16)28dcc-2, (C-34-17)32cca-1, (C-36-15)4bad-3, and (C-36-15)7cdd-2) and the dissolved-sulfate concentration in water samples from two wells ((C-34-16)28dcc-2 and (C-36-15)7cdd-2) exceeded the secondary standards for these constituents (500 and 250 mg/L, respectively). The concentration of dissolved chloride in the water sample from well (C-14-16)28dcc-2 exceeded the secondary standard for this constituent (250 mg/L). Water samples from wells (C-36-15)4bad-3 and (C-36-15)7cdd-2 exceeded the MCL for arsenic (10 µg/L). The concentration of dissolved solids in water from well (C-34-16)28dcc-2 exceeded the MCL for this constituent (2,000 mg/L).

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 2008, is shown in figure 31. The concentration has ranged from 460 to 2,170 mg/L with a median value of 648 mg/L. The concentration of dissolved solids in the water sample collected in August 2008 is the maximum value for this site and is more than three times greater than the median value.

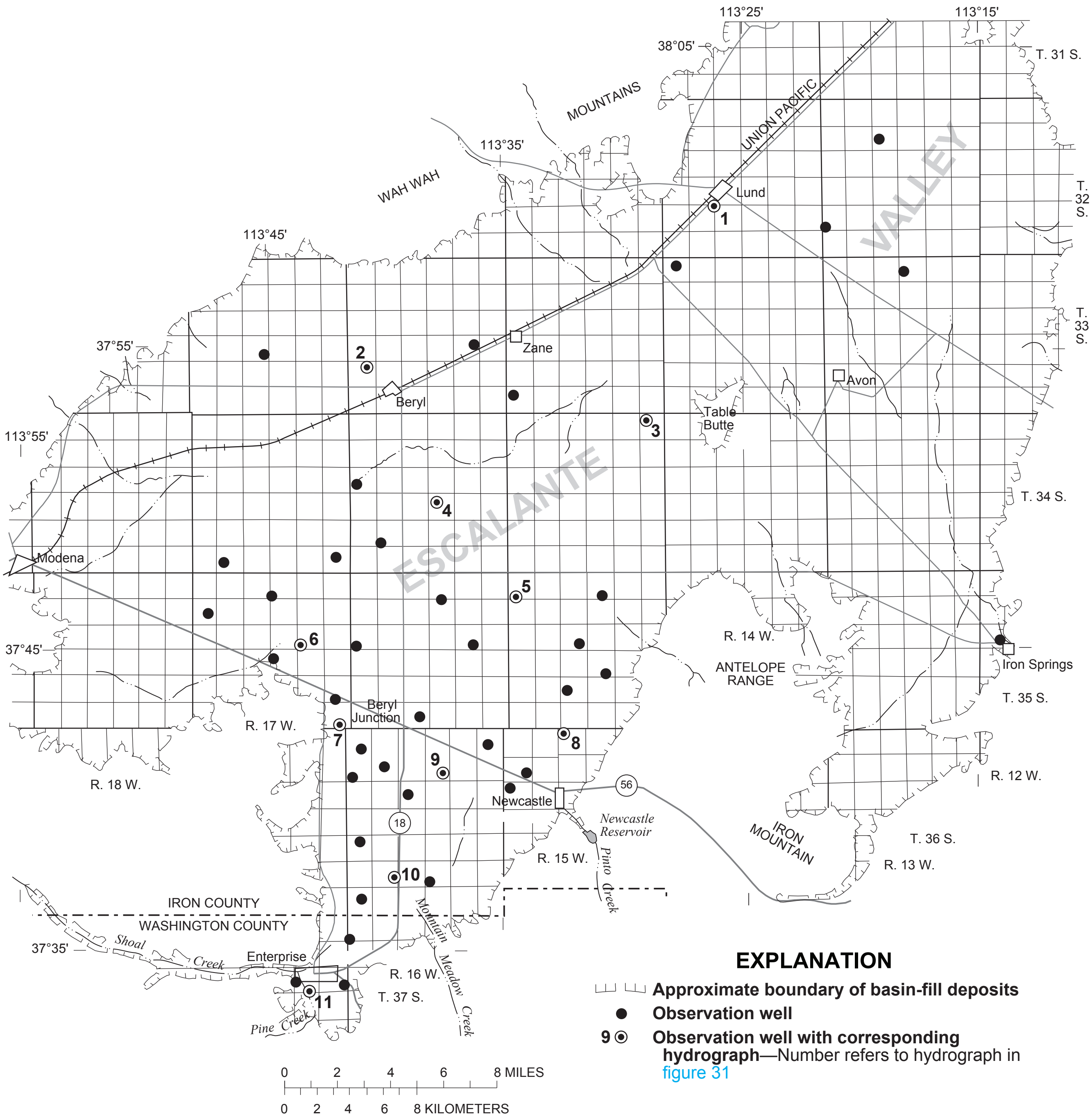


Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2009.

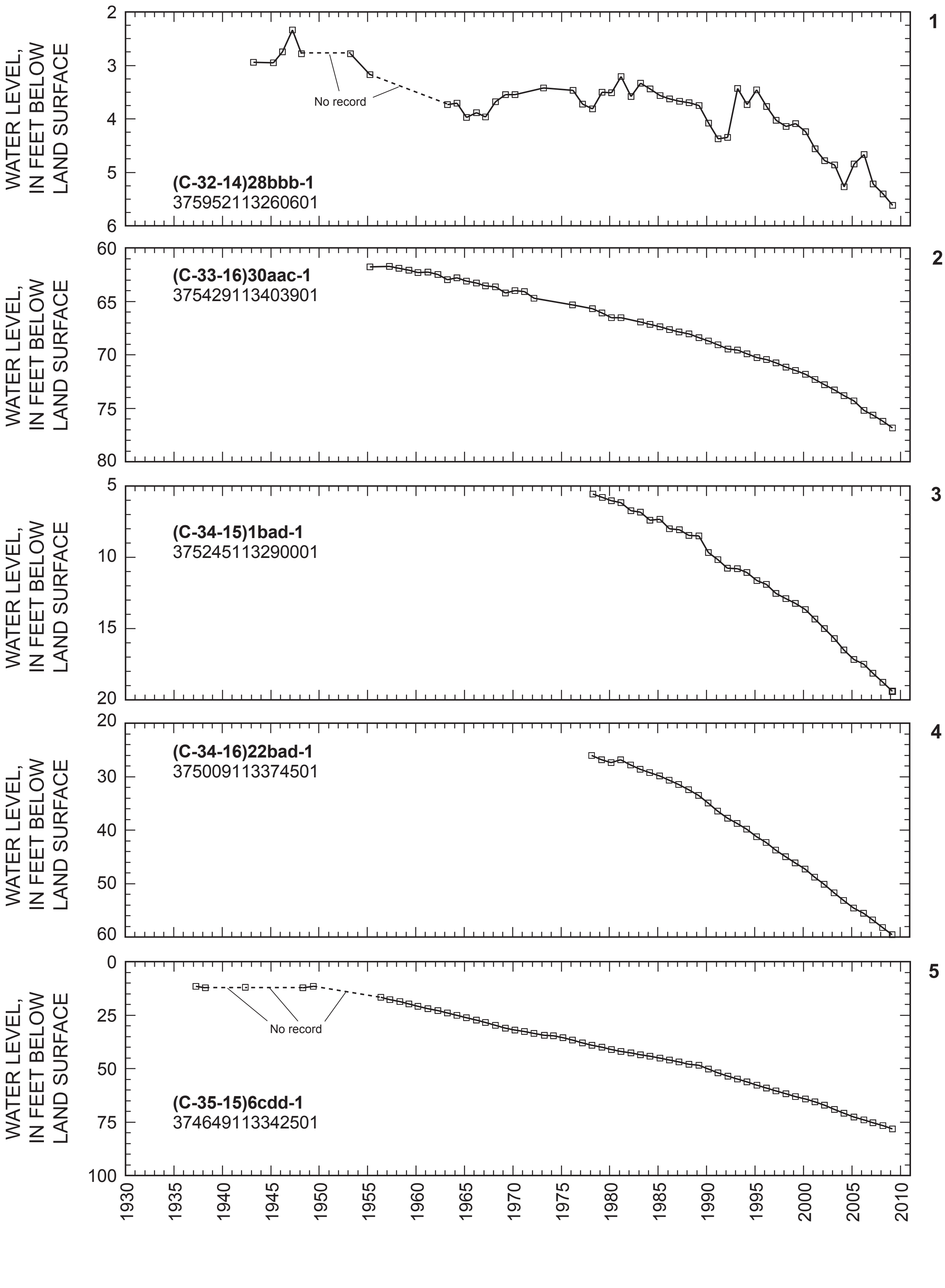


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

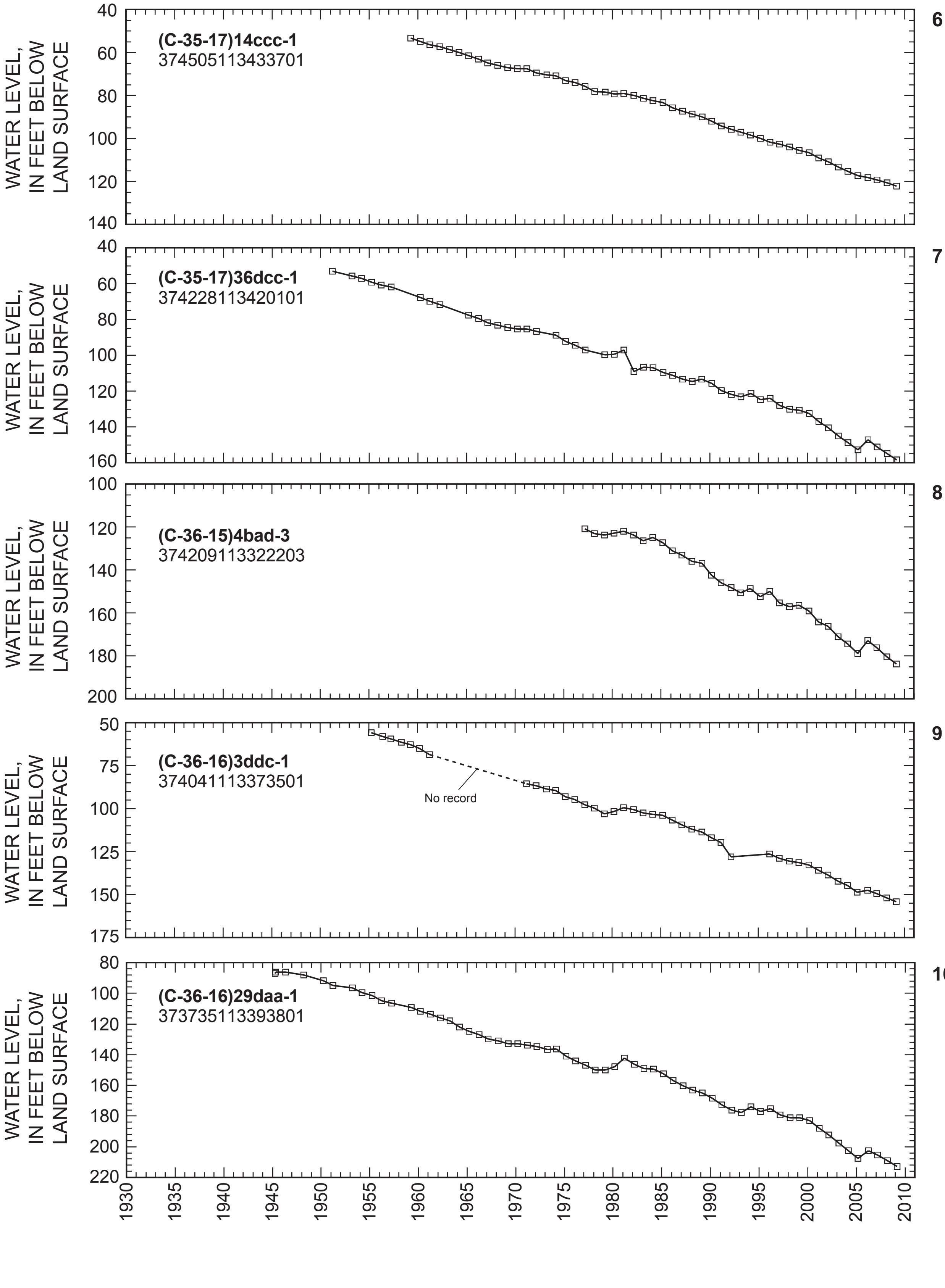


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2—Continued.

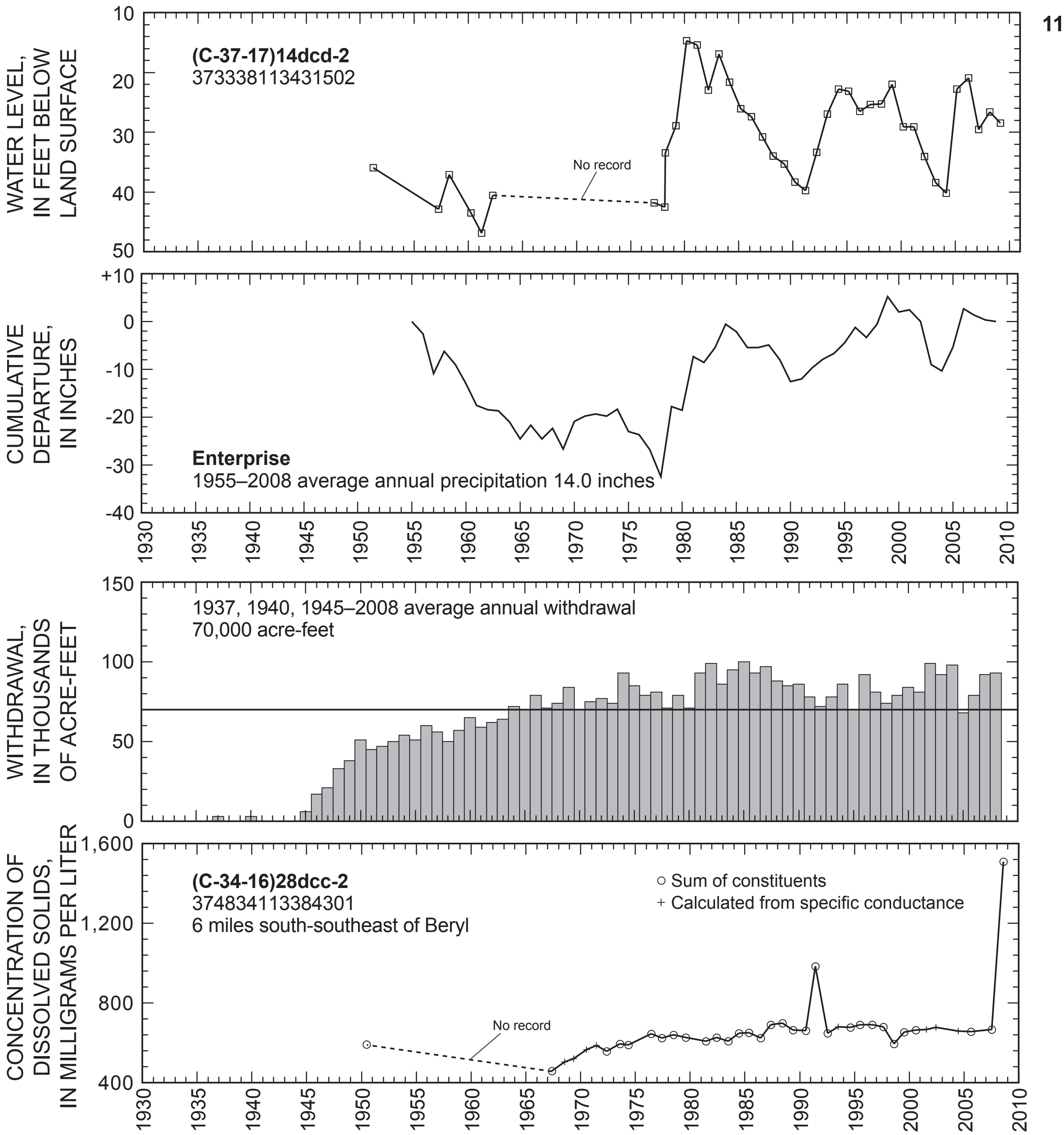


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 —Continued.

CENTRAL VIRGIN RIVER AREA

By Howard K. Christiansen

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

Total estimated withdrawal of water from wells in the central Virgin River area in 2008 was about 29,000 acre-feet, which is about 4,000 acre-feet less than in 2007 and 2,000 acre-feet more than the average annual withdrawal for 1998-2007 (tables 2 and 3). Withdrawal for irrigation decreased by about 1,000 acre-feet from 2007 to 2008. Withdrawals for public supply decreased by about 3,000 acre-feet. Withdrawals for domestic and stock use were about the same as in 2007.

The location of wells in the central Virgin River area in which the water level was measured during February 2009 is shown in figure 32. The relation of the water level in selected observation wells to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2 is shown in figure 33.

Water levels from February 2008 to February 2009 in the central Virgin River area show little change in the Santa Clara River drainage, the Fort Pearce Wash area, and most of the Virgin River drainage.

Discharge of the Virgin River at Virgin in 2008 was about 93,900 acre-feet, which is 16,500 acre-feet more than in 2007 and about 39,200 acre-feet less than the long-term average for 1931–70 and 1979–2008. Precipitation at St. George in 2008 was about 4.2 inches, which is about 4.0 inches less than the average annual precipitation for 1930–2008 and 4.6 inches less than in 2007.

Physical properties and records of chemical analyses for water from two wells in the Central Virgin River area are listed in tables 4 and 5, and the location of the wells is shown in figure 41. The concentration of dissolved chloride in the water sample from well (C-42-14)15cbd-1 exceeded the secondary standard for this constituent (250 mg/L). For the same well, the concentration of dissolved solids and dissolved sulfate exceeded the MCLs for these constituents (2,000 and 1,000 mg/L, respectively). The water sample from well (C-41-17)8cbd-2 exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from wells (C-41-17)8cbd-1 and (C-41-17)8cbd-2, located 1.5 miles south of Gunlock Reservoir, from 1966 to 2008, 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 2008 (292 mg/L) compares well with the median value.

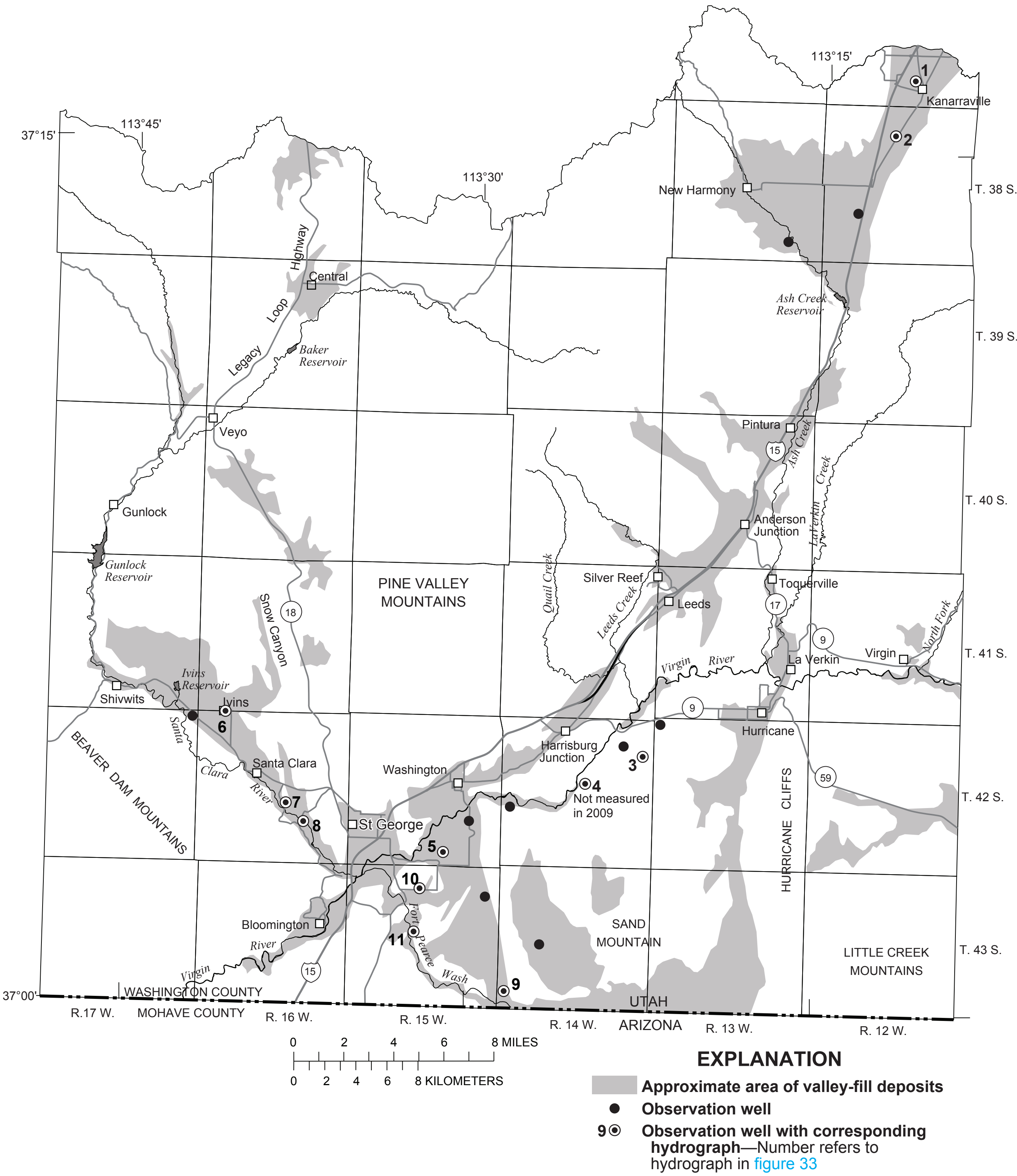


Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 2009.

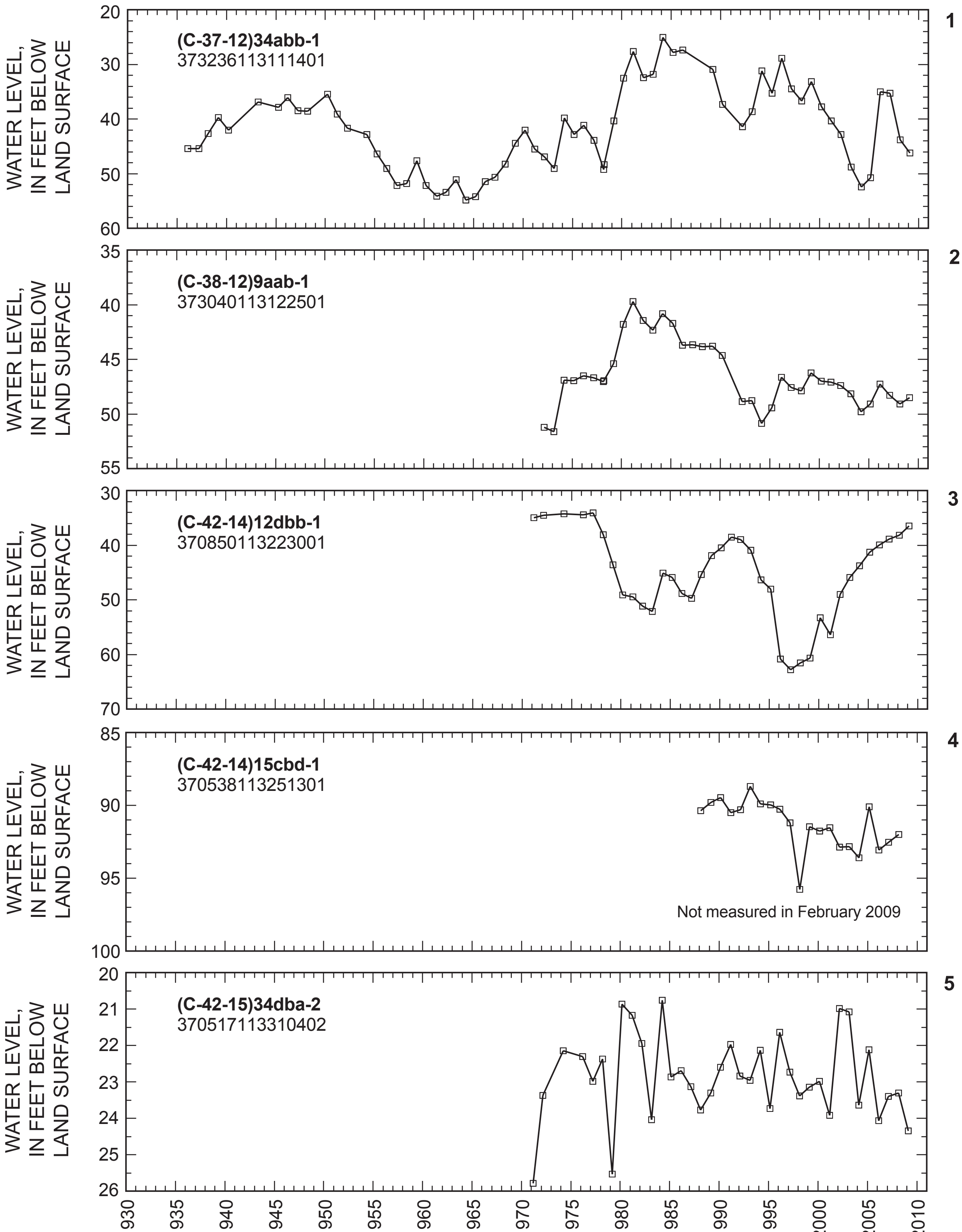


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

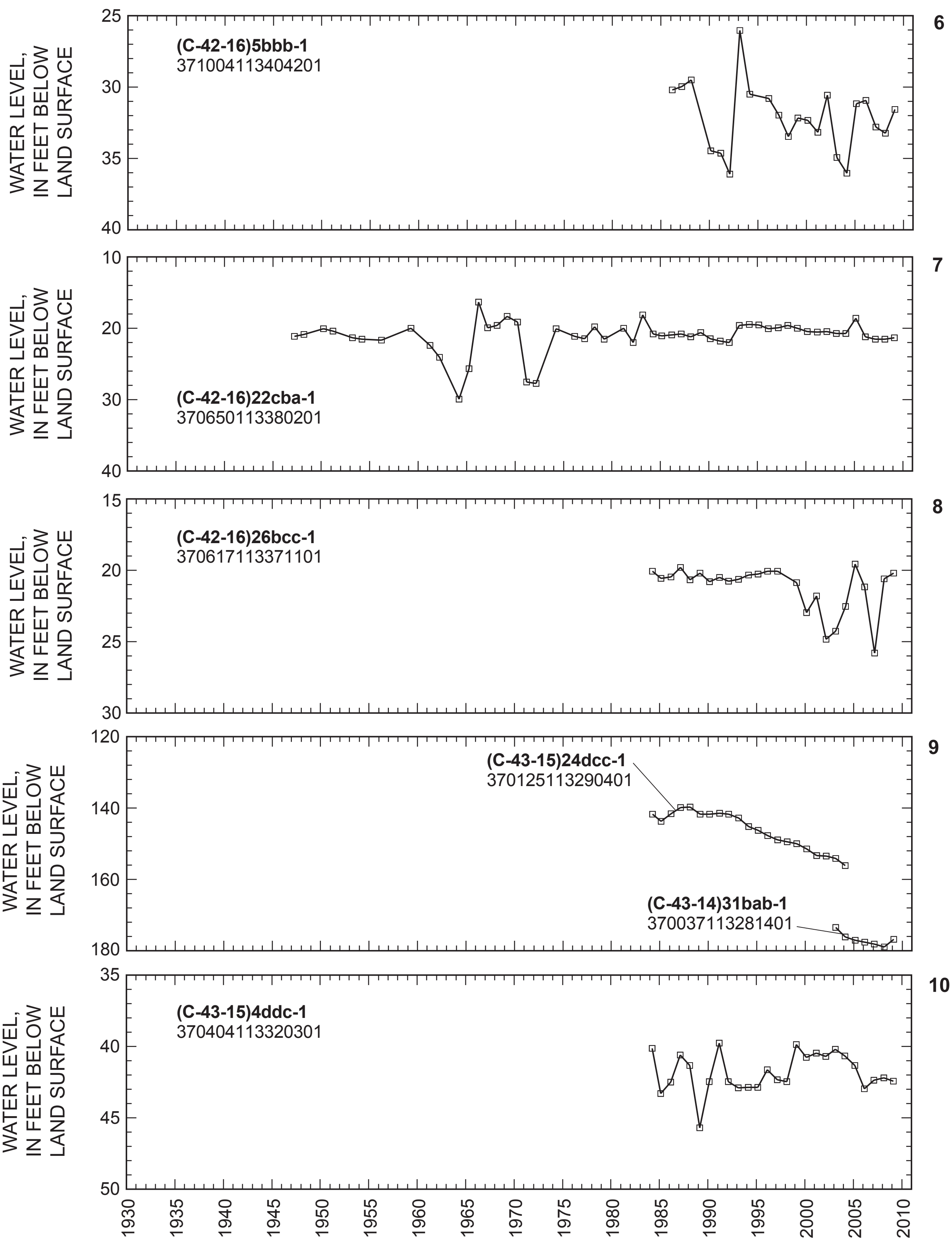


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

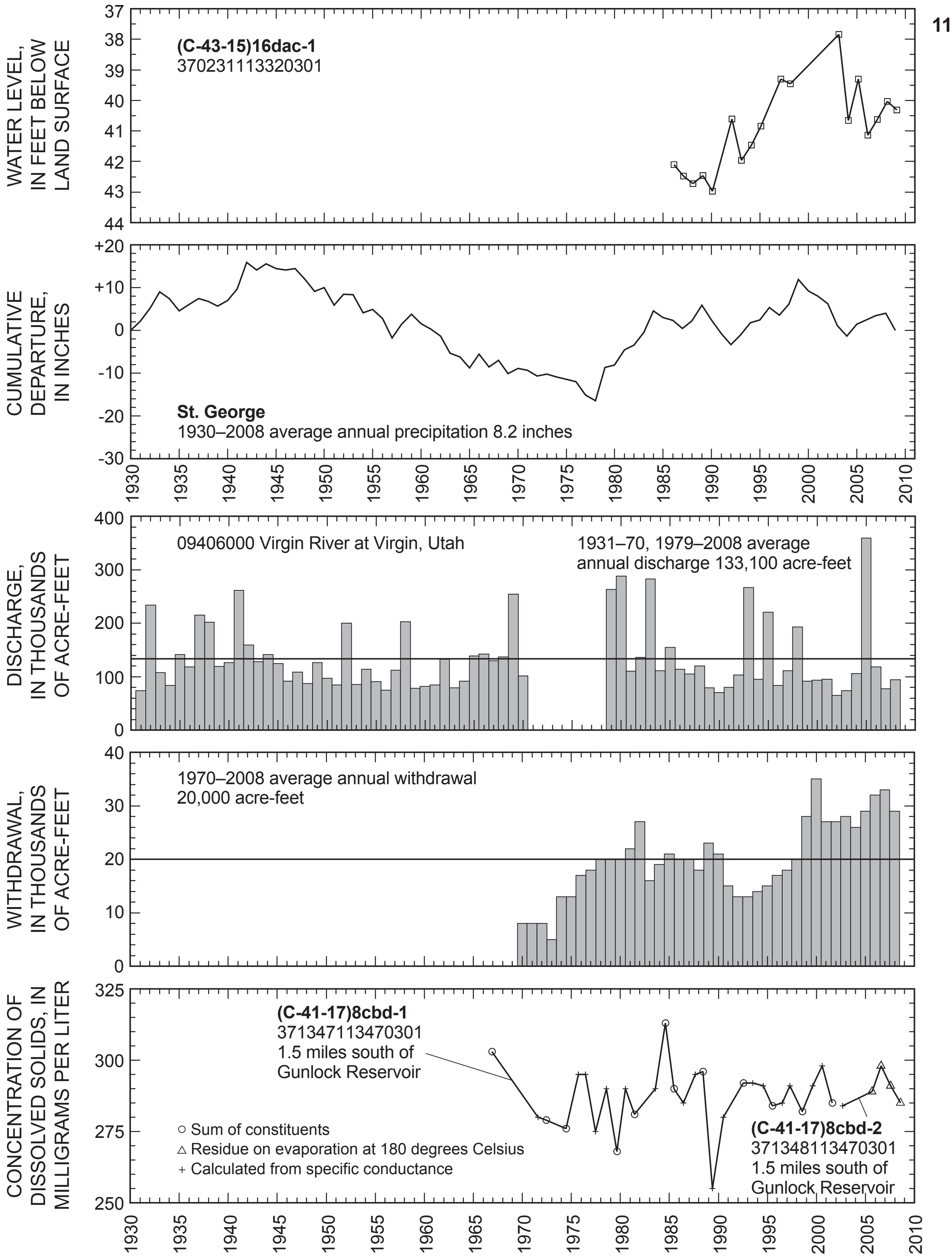


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

OTHER AREAS

By Martel J. Fisher

Total estimated withdrawal of water from wells in the areas of Utah listed below in 2008 was about 144,000 acre-feet, which is 11,000 acre-feet less than the estimate for 2007 and 20,000 acre-feet more than the average annual withdrawal for 1998–2007 (tables 2 and 3). The largest increases were due to increased withdrawals for irrigation and public supply use. In most of the areas listed below, withdrawals in 2008 were less than in 2007, except in Grouse Creek Valley and Snake Valley, where irrigation withdrawals increased slightly; the Dugway area, Skull Valley, and Old River Bed, where industrial withdrawals increased; and in Cedar Valley, Utah County, where public supply withdrawals increased.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2009 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 Fairfield is shown in figure 35.

Water levels in selected wells in Cedar Valley generally rose during the 1970s. Water levels rose sharply from the early to mid-1980s as a result of greater-than-average precipitation, but generally have declined since the mid-1980s. Water levels declined slightly in most of the wells from March 2008 to March 2009.

The location of wells in Sanpete Valley in which the water level was measured during March 2009 is shown in figure 36. The relation of the water level in selected observation wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti is shown in figure 37.

Water levels in many of the selected wells in Sanpete County rose from the late 1970s to the mid-1980s as a result of greater-than-average precipitation and have varied since the mid-1980s, but overall have declined. Water levels rose or decreased only slightly in most of the selected observation wells from March 2008 to March 2009.

The location of wells in Snake Valley and the West Desert in which the water level was measured during March 2009 is shown in figure 38. The relation of 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 declined from March 2008 to March 2009. 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 (see accompanying table) 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 2008 to March 2009.

Water Quality

Physical properties and records of chemical analyses for water from wells in the areas indicated below are listed in tables 4 and 5, and the location of the wells is shown in figures 41 and 42.

Beaver Valley

Analytical results for major ions, trace elements, and nutrients in water from well (C-29-7)19bcd-1 did not exceed secondary standards or MCLs.

Lower Bear River area

The dissolved-solids and dissolved-chloride concentrations in water from all four wells sampled in the Lower Bear River area exceeded secondary standards for these constituents (500 and 250 mg/L, respectively). The concentration of dis-

Number in figure 1	Area	Estimated withdrawal (acre-feet)					
		2008					2007 total (rounded)
		Irrigation	Industrial	Public supply	Domestic and stock	2008 total (rounded)	
1	Grouse Creek Valley	2,200	0	0	20	2,200	1,900
2	Park Valley	2,000	0	0	10	2,000	2,800
4	Malad-lower Bear River Valley	3,800	440	6,500	200	10,900	11,200
8	Ogden Valley	0	0	11,100	20	11,100	11,700
13	Rush Valley	5,200	250	290	30	5,800	6,500
14	Dugway area, Skull Valley, and Old River Bed	2,500	4,100	1,800	10	8,400	8,200
15	Cedar Valley, Utah County	2,300	0	7,500	40	9,800	9,700
20	Sanpete Valley	5,100	840	590	4,000	10,500	13,500
25	Snake Valley	20,100	0	90	50	20,200	19,800
27	Beaver Valley	10,300	20	1,200	460	12,000	13,800
	Remainder of State	11,700	20,600	16,600	2,500	51,400	55,800
Total (rounded)		65,200	26,300	45,700	7,300	144,000	155,000

solved sulfate in water from well (B-12-4)26bbb-1 exceeded the secondary standard (250 mg/L). The concentrations of dissolved solids and dissolved nitrite plus nitrate in water from the same well exceeded MCLs for these constituents (2,000 and 10 mg/L, respectively).

Altamont-Bluebell area

Analytical results for major ions, trace elements, and nutrients in water from well U(C-2-2)14ddb-1 did not exceed secondary standards or MCLs.

Uinta Basin

Analytical results for major ions, trace elements, and nutrients in water from well U(B-1-1)31ddb-1 did not exceed secondary standards or MCLs.

Starvation Duchesne area

The dissolved-solids concentration and pH measured in the water sample from well U(C-3-5)31dcd-2 exceeded the secondary standards for these constituents (500 mg/L and 8.5 standard units, respectively). Analytical results for major ions, trace elements, and nutrients in water from this well did not exceed secondary standards or MCLs.

Kelton area

The concentrations of dissolved solids and dissolved chloride in well (B-12-11)8baa-1 exceeded secondary standards for these constituents (500 and 250 mg/L, respectively). The dissolved-solids concentration also exceeded the MCL for this constituent (2,000 mg/L).

Snake Valley

The concentration of dissolved solids in one of the three wells sampled ((C-19-19)26bac-1) exceeded the secondary standard for this constituent (500 mg/L). Analytical results for major ions, trace elements, and nutrients in water from the wells did not exceed secondary standards or MCLs.

Bluff area

The pH measured in water from well (D-40-22)30bbb-1 exceeded the secondary standard for this constituent (8.5 standard units). The concentration of dissolved arsenic in water from this well exceeded the MCL for this constituent (10 µg/L).

Sanpete Valley

The concentration of dissolved solids in water from one of two wells sampled in Sanpete Valley ((D-17-2)14ccb-1) exceeded the secondary standard for this constituent (500 mg/L). Analytical results for major ions, trace elements, and nutrients in water from the wells did not exceed secondary standards or MCLs.

Upper Sevier Valley

Analytical results for major ions, trace elements, and nutrients in water from well (C-30-2)28bdc-1 did not exceed secondary standards or MCLs.

Rush Valley

Analytical results for major ions, trace elements, and nutrients in water from the three wells sampled in Rush Valley did not exceed secondary standards or MCLs.

Skull Valley

The concentration of dissolved solids in water samples from two wells sampled in Skull Valley ((C-2-7)7dda-1 and (C-3-8)28adc-1) exceeded the secondary standard for this constituent (500 mg/L). Water from well (C-2-7)7dda-1 also exceeded the MCL for dissolved solids (2,000 mg/L) and the secondary standard for dissolved chloride (250 mg/L).

Cedar Valley, Utah County

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

Heber Valley

The concentration of dissolved iron in water from one of the nine wells sampled ((D-3-5)18cba-1) exceeded the secondary standard for this constituent (0.03 mg/L). Analytical results for major ions, trace elements (arsenic, molybdenum, selenium, and uranium were not analyzed for), and nutrients in water from the remaining wells sampled did not exceed secondary standards or MCLs.

Upper Fremont Valley

The concentrations of dissolved solids and sulfate in the water sample from well (D-27-3)19aaa-1 exceeded the secondary standards for these constituents (500 and 250 mg/L, respectively). Analytical results for major ions, trace elements, and nutrients did not exceed MCLs.

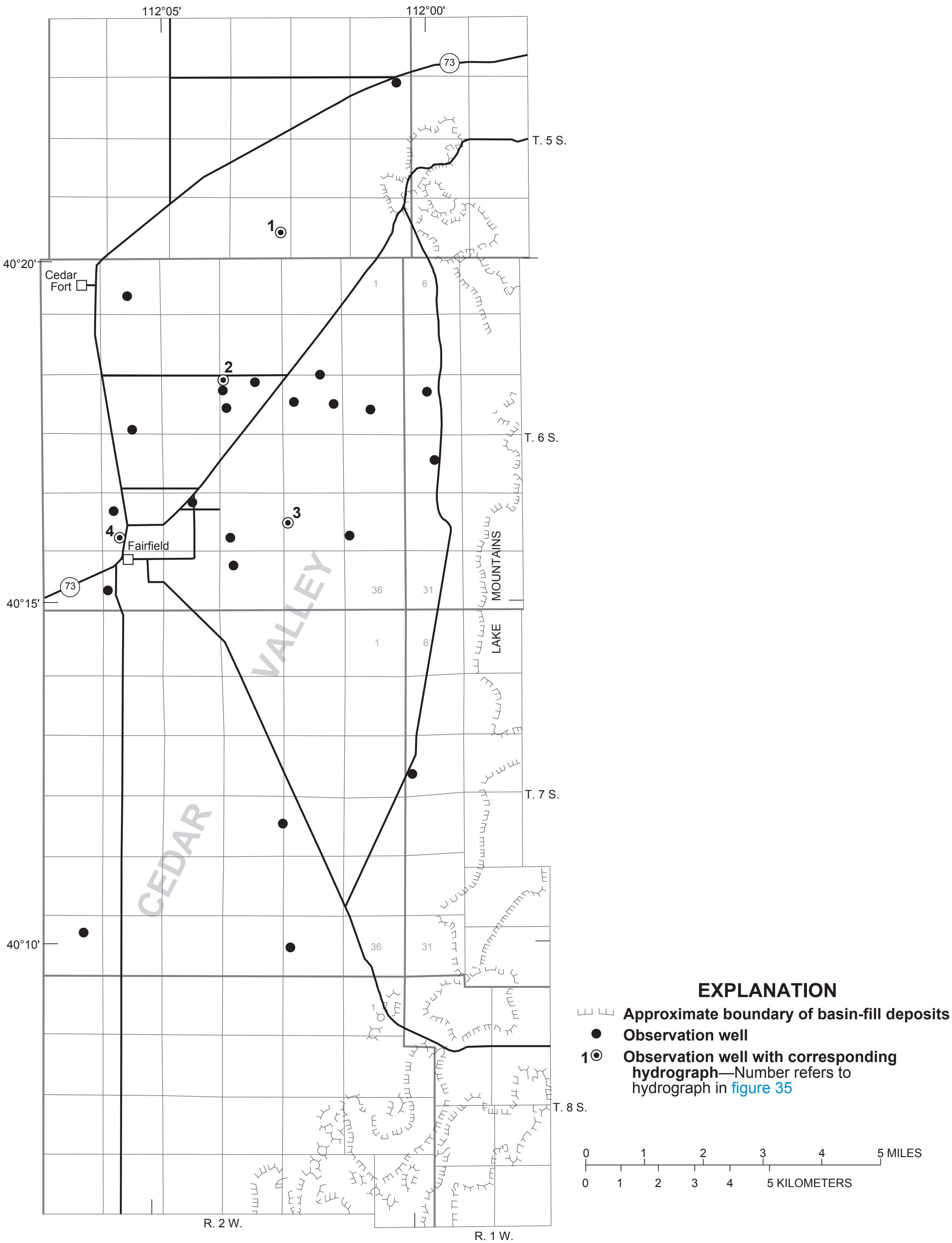


Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2009.

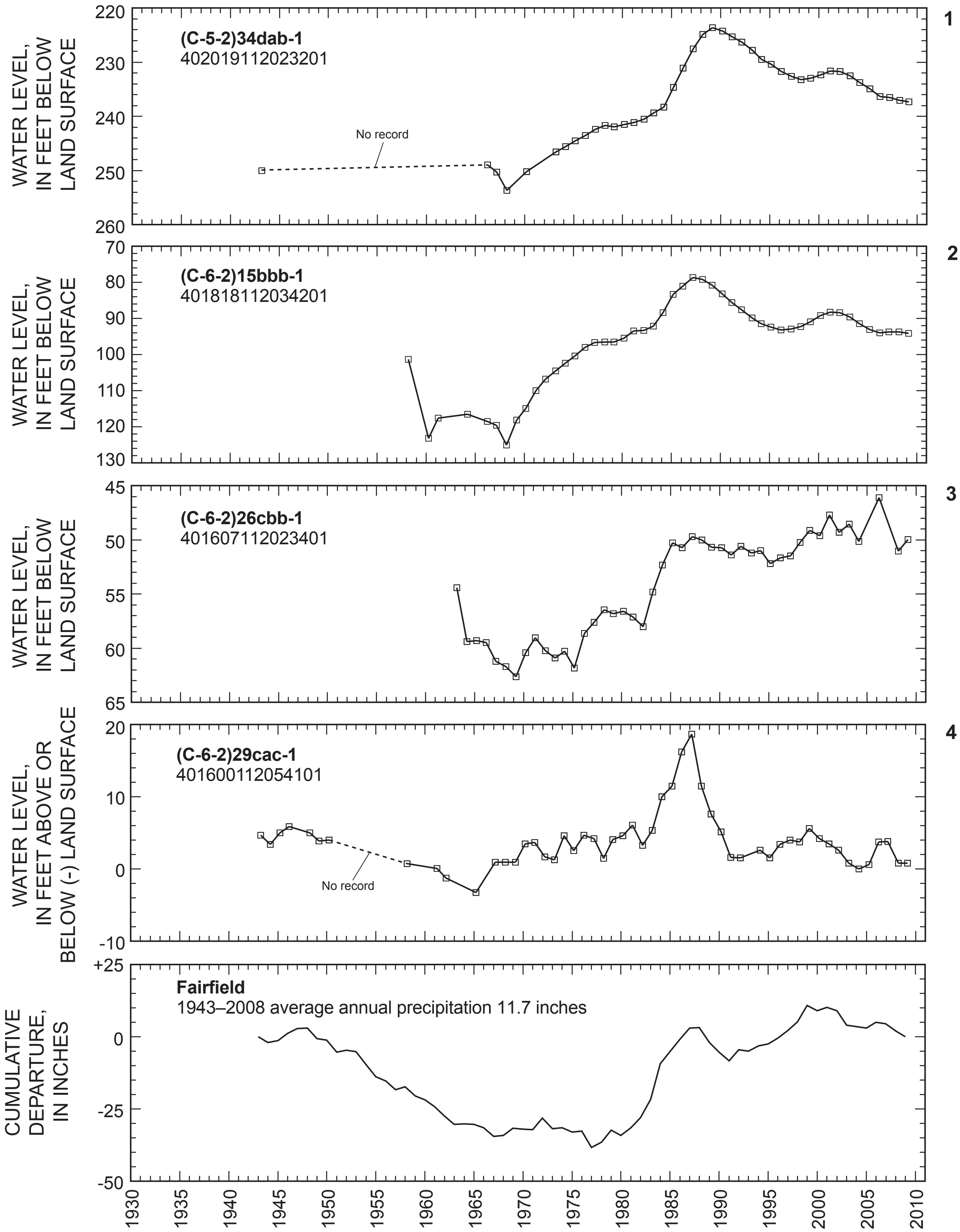


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield.

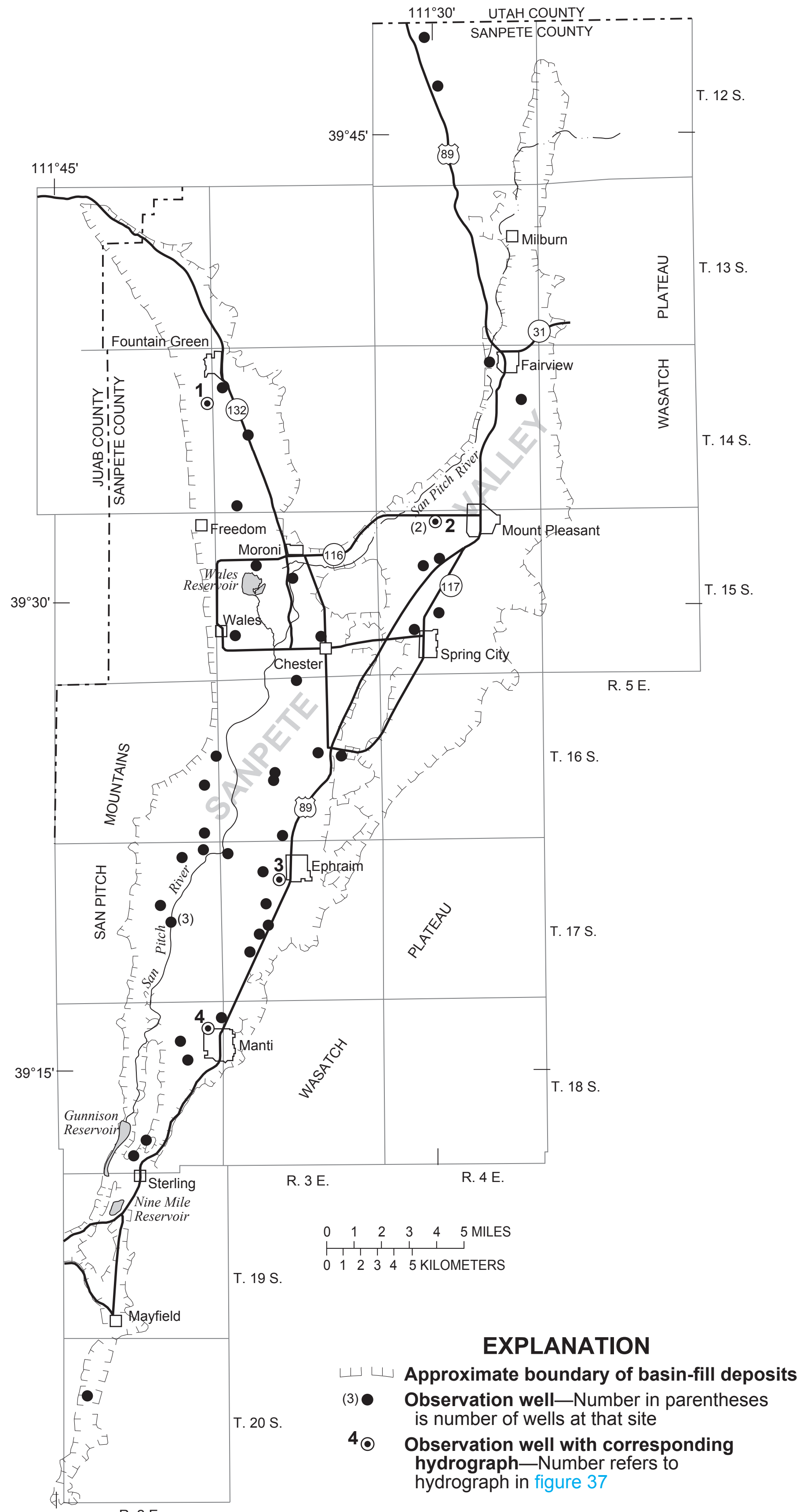


Figure 36. Location of wells in Sanpete Valley in which the water level was measured during March 2009.

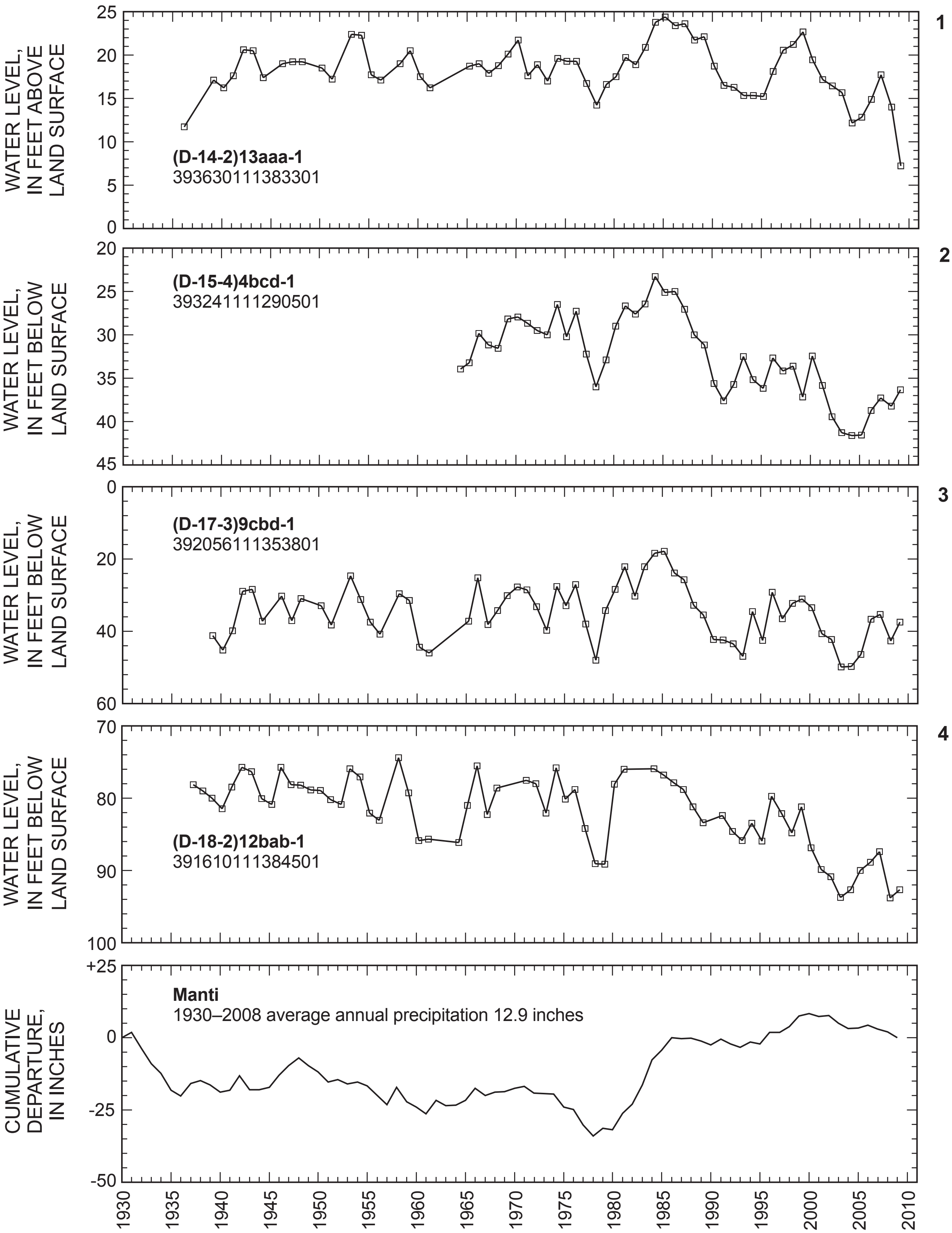


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

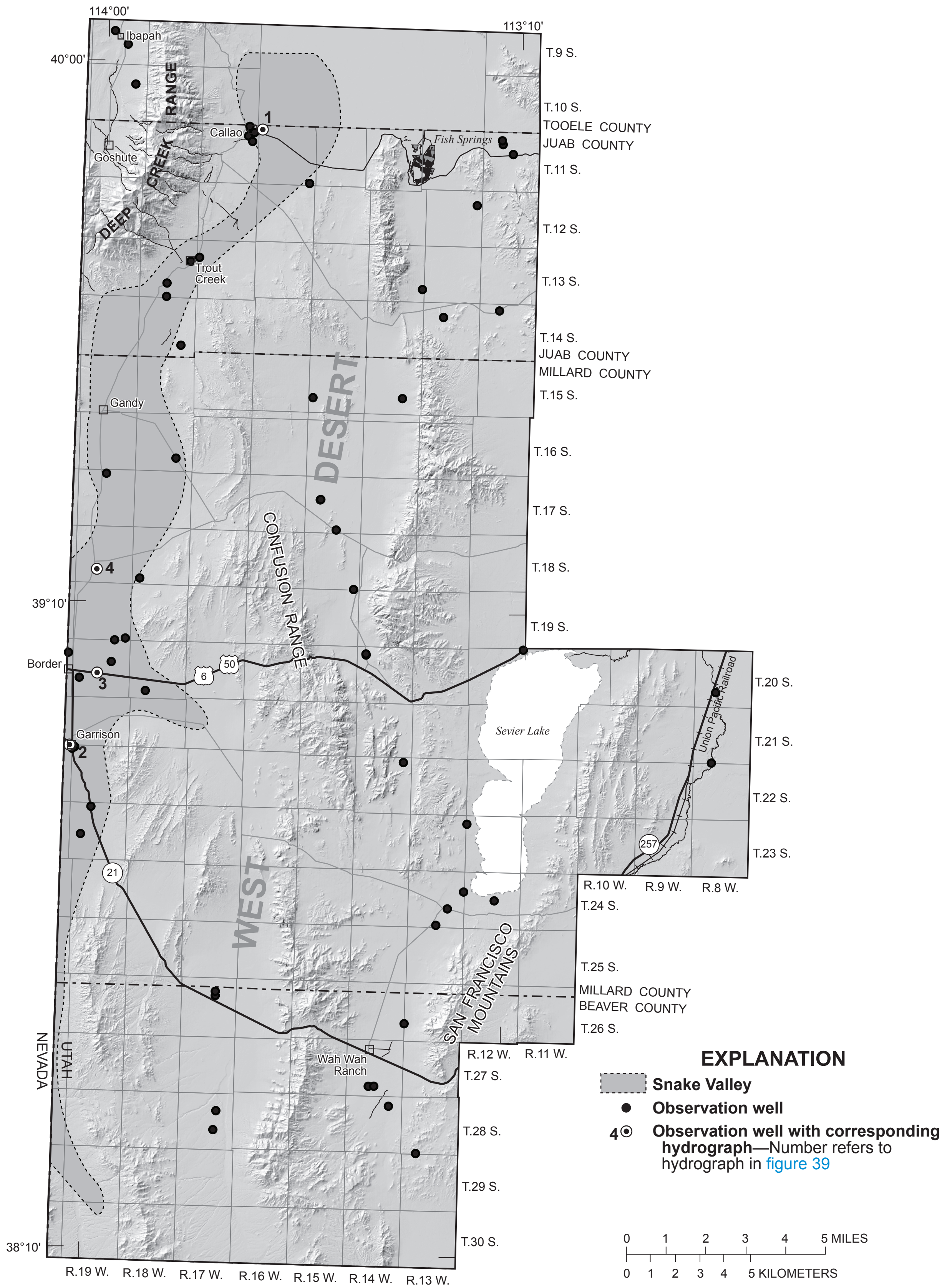


Figure 38. Location of wells in Snake Valley and the West Desert in which the water level was measured during March 2009.

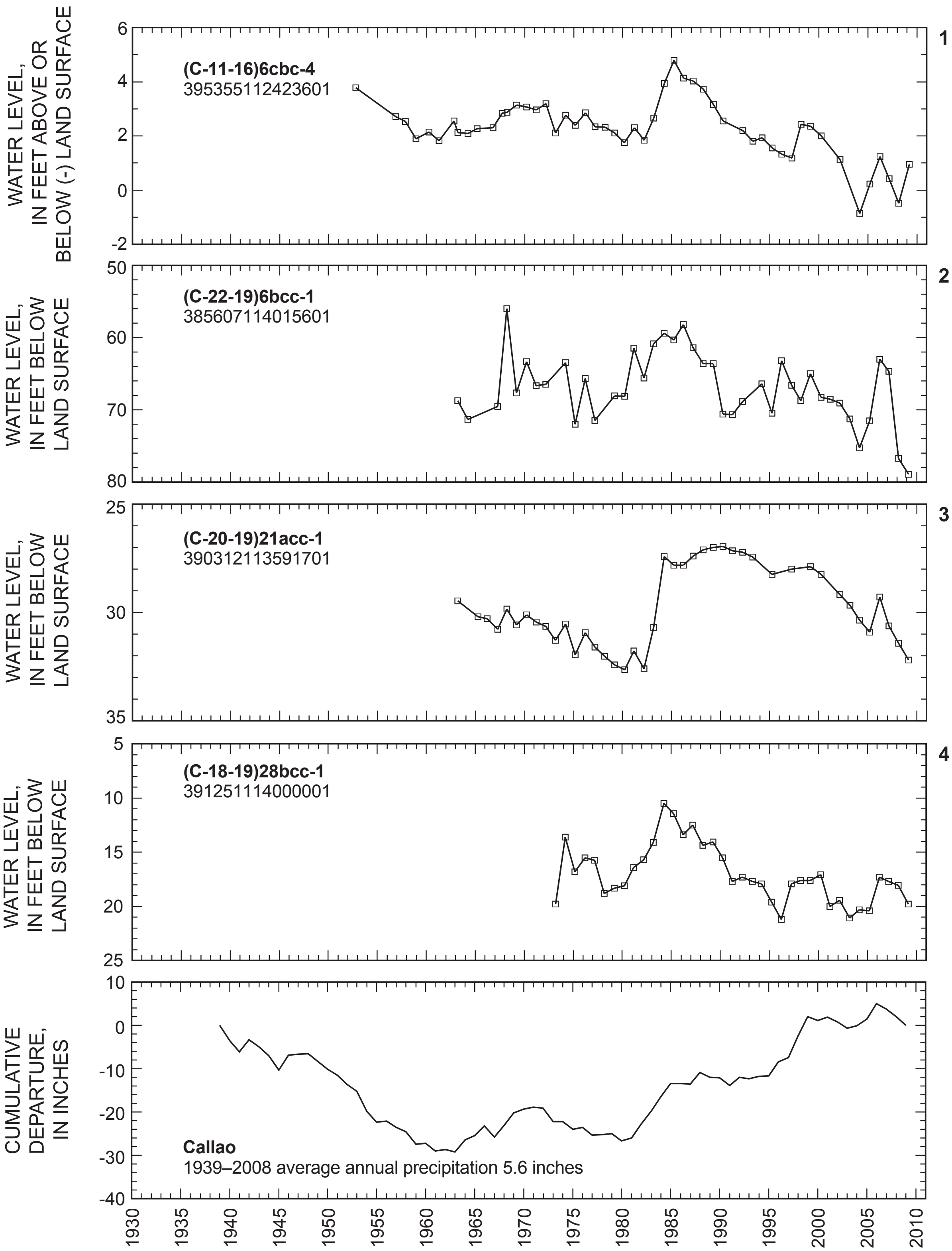


Figure 39. Relation of water level in selected wells in Snake Valley and the West Desert to cumulative departure from average annual precipitation at Callao.

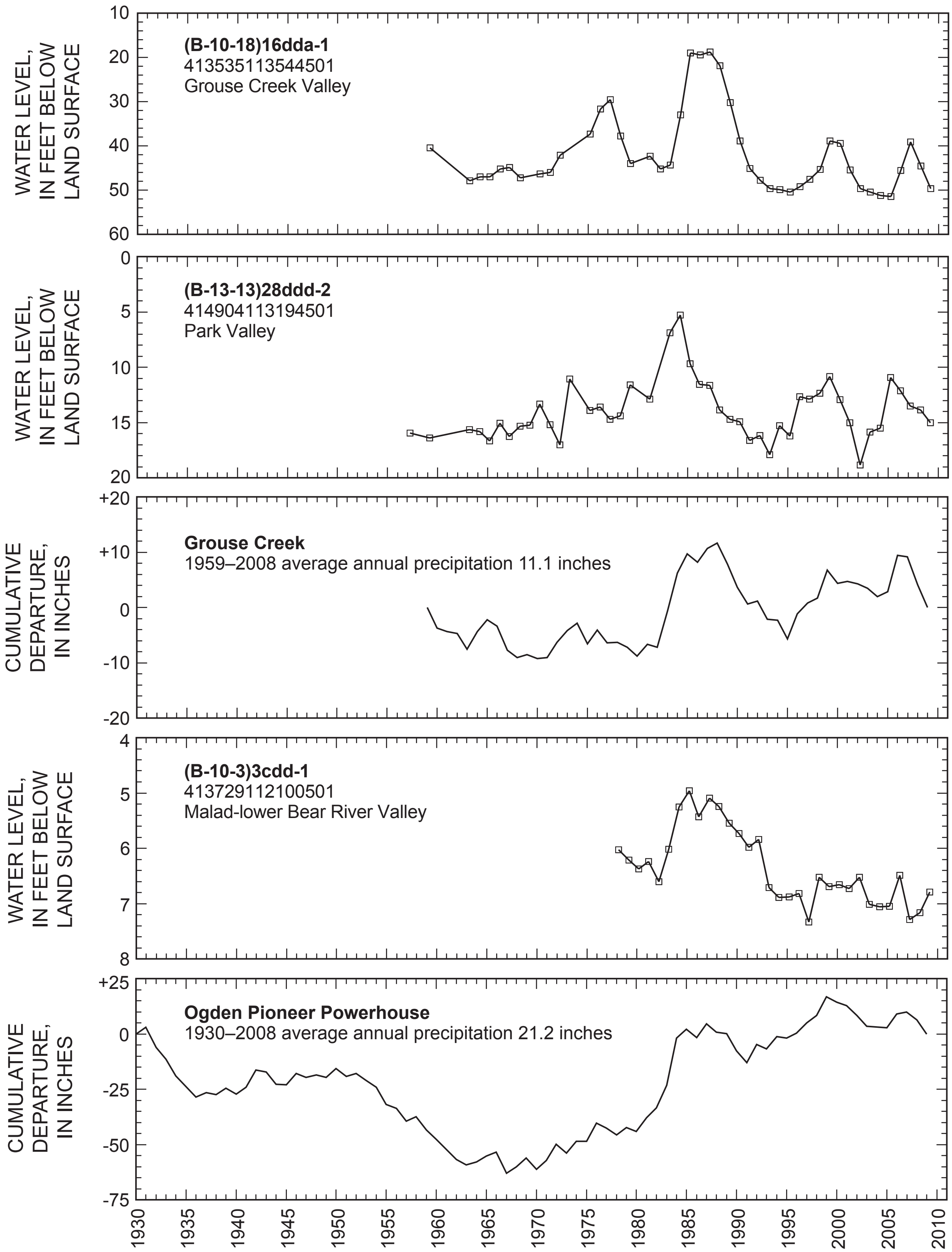


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

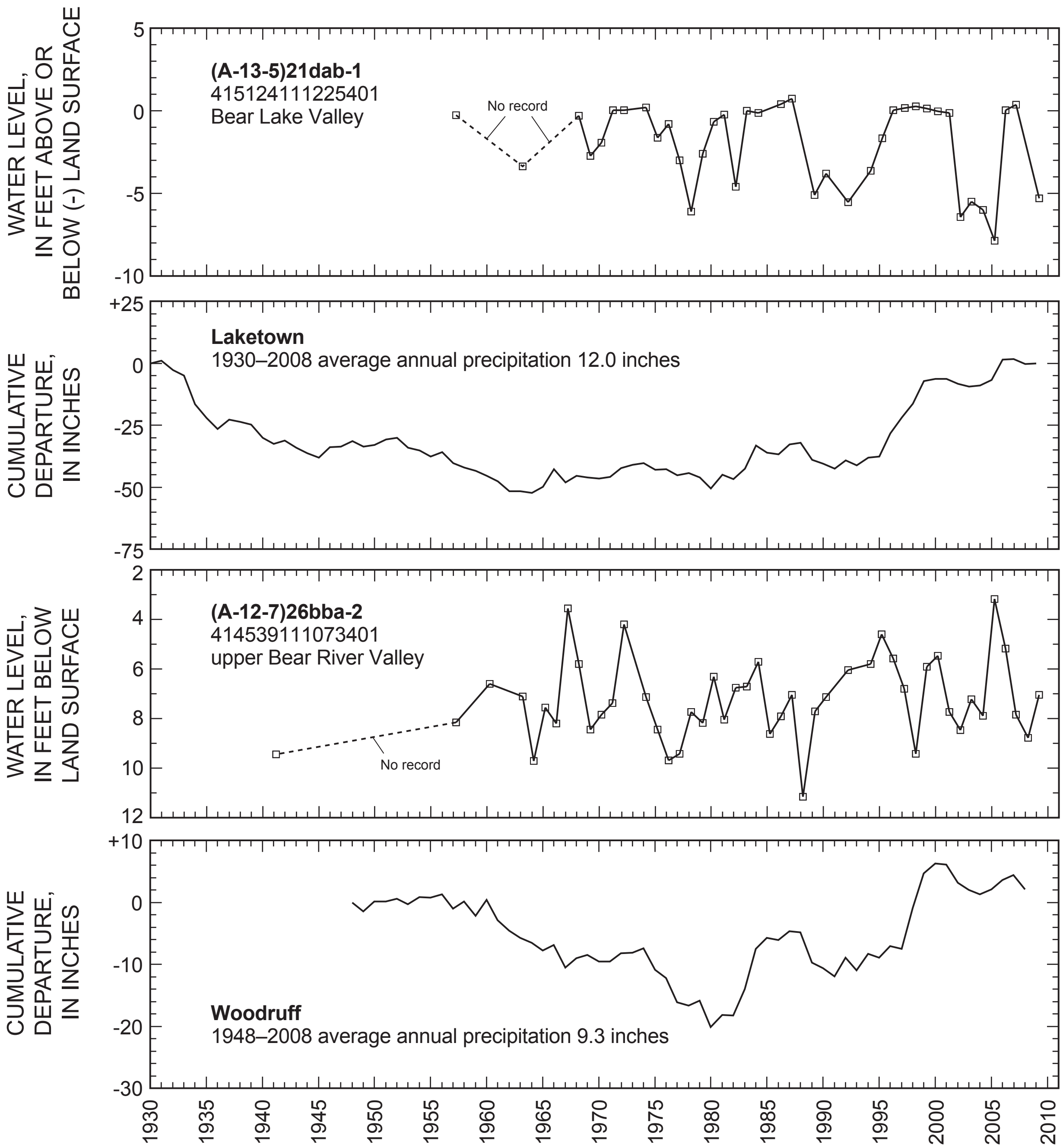


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

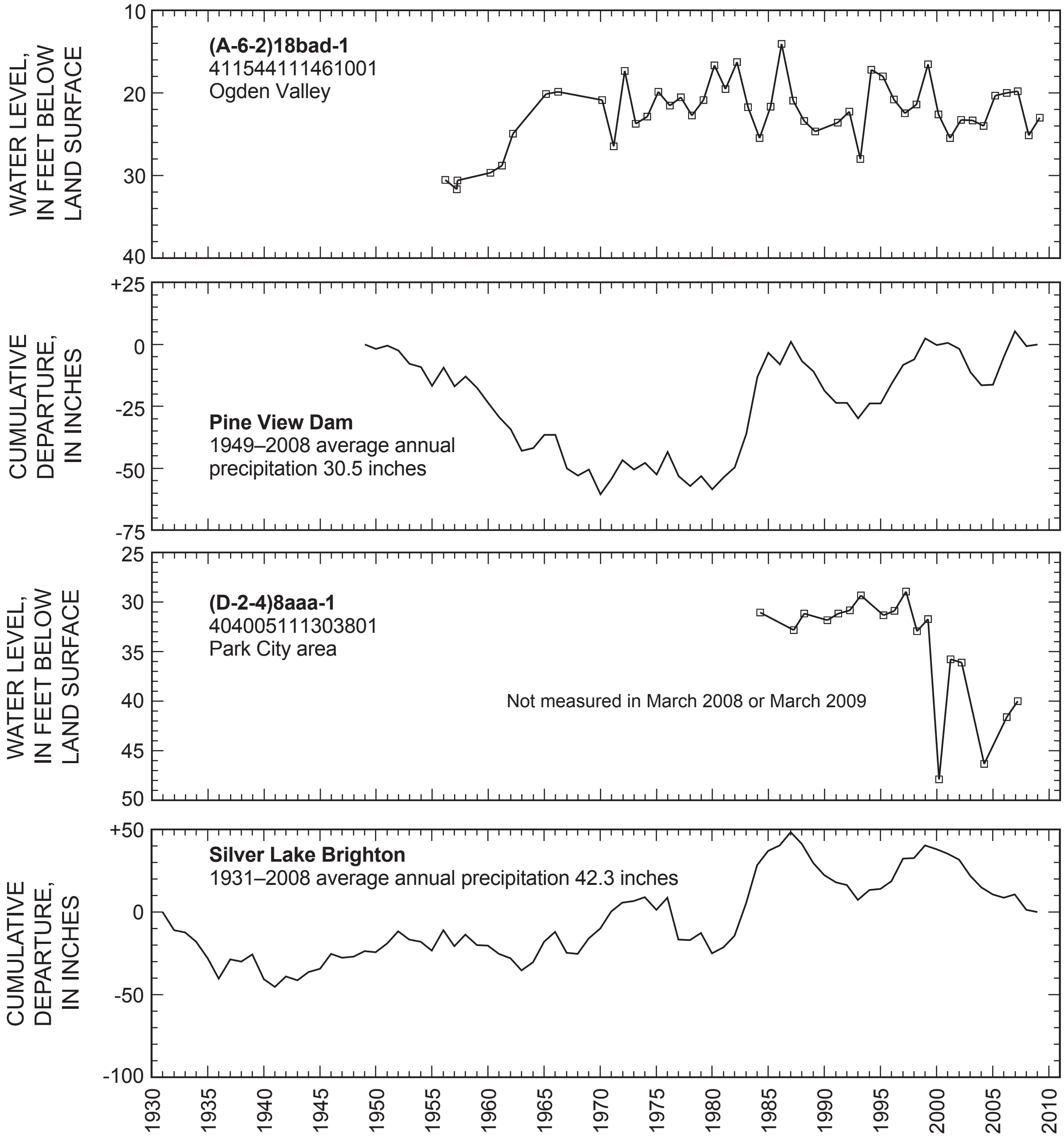


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

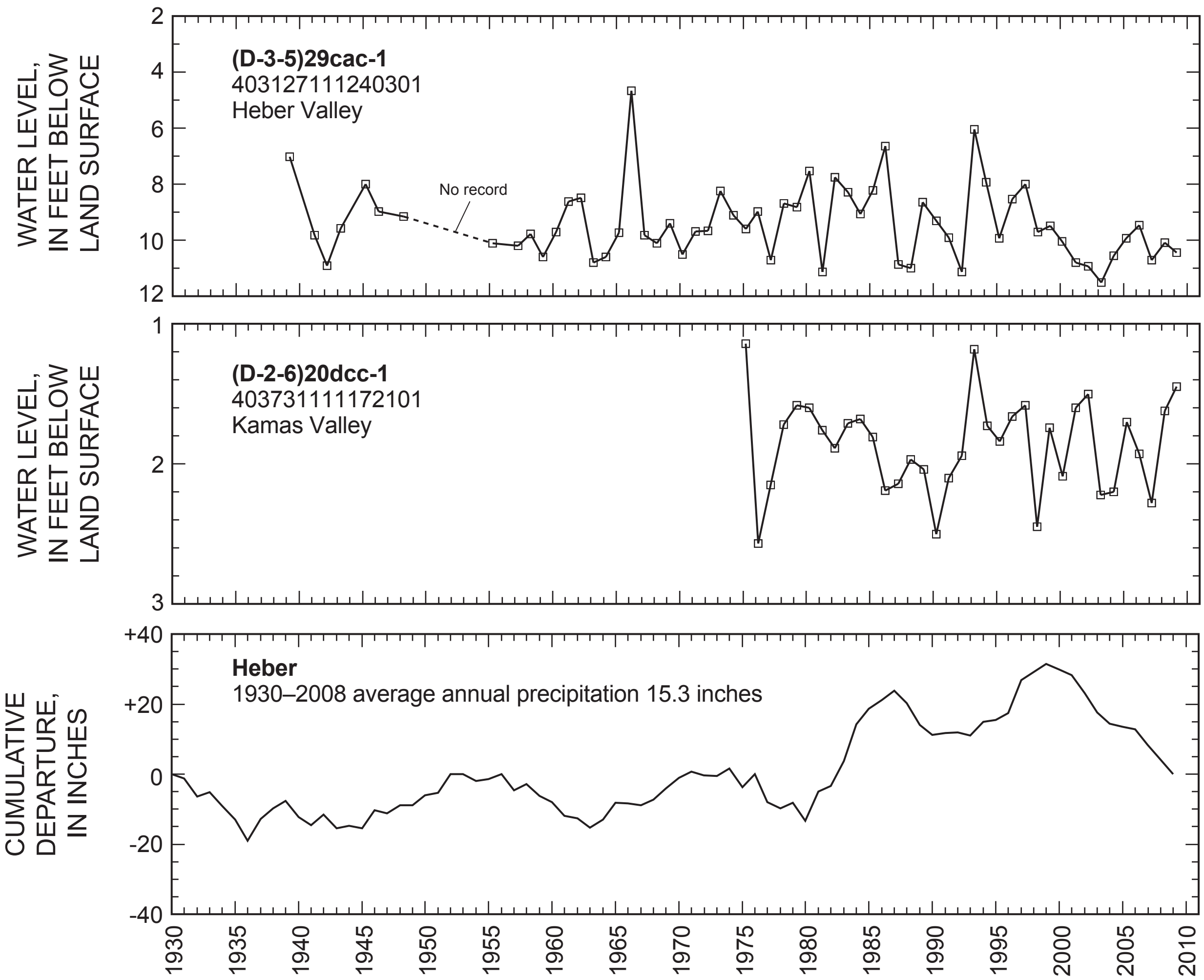


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

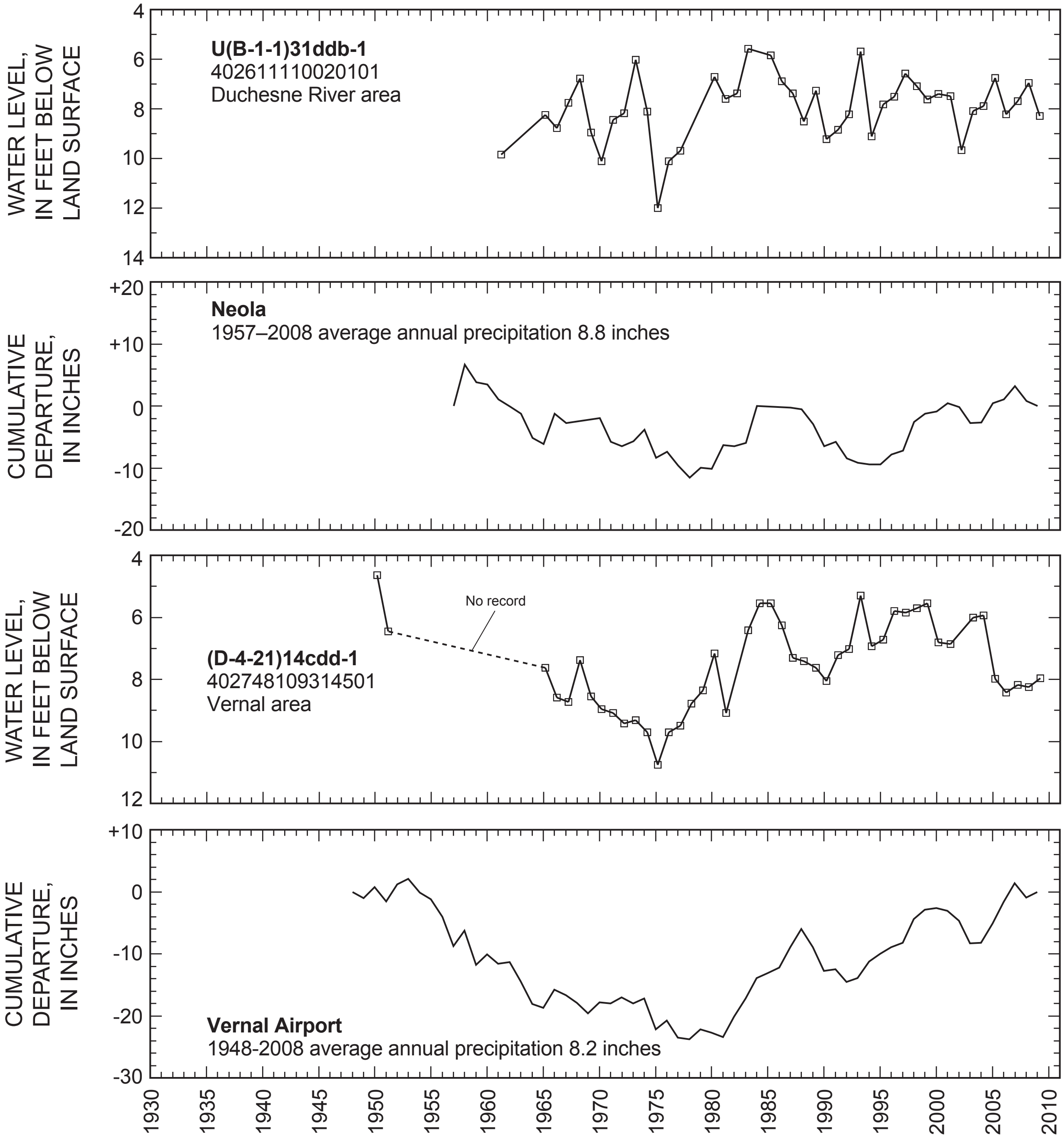


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

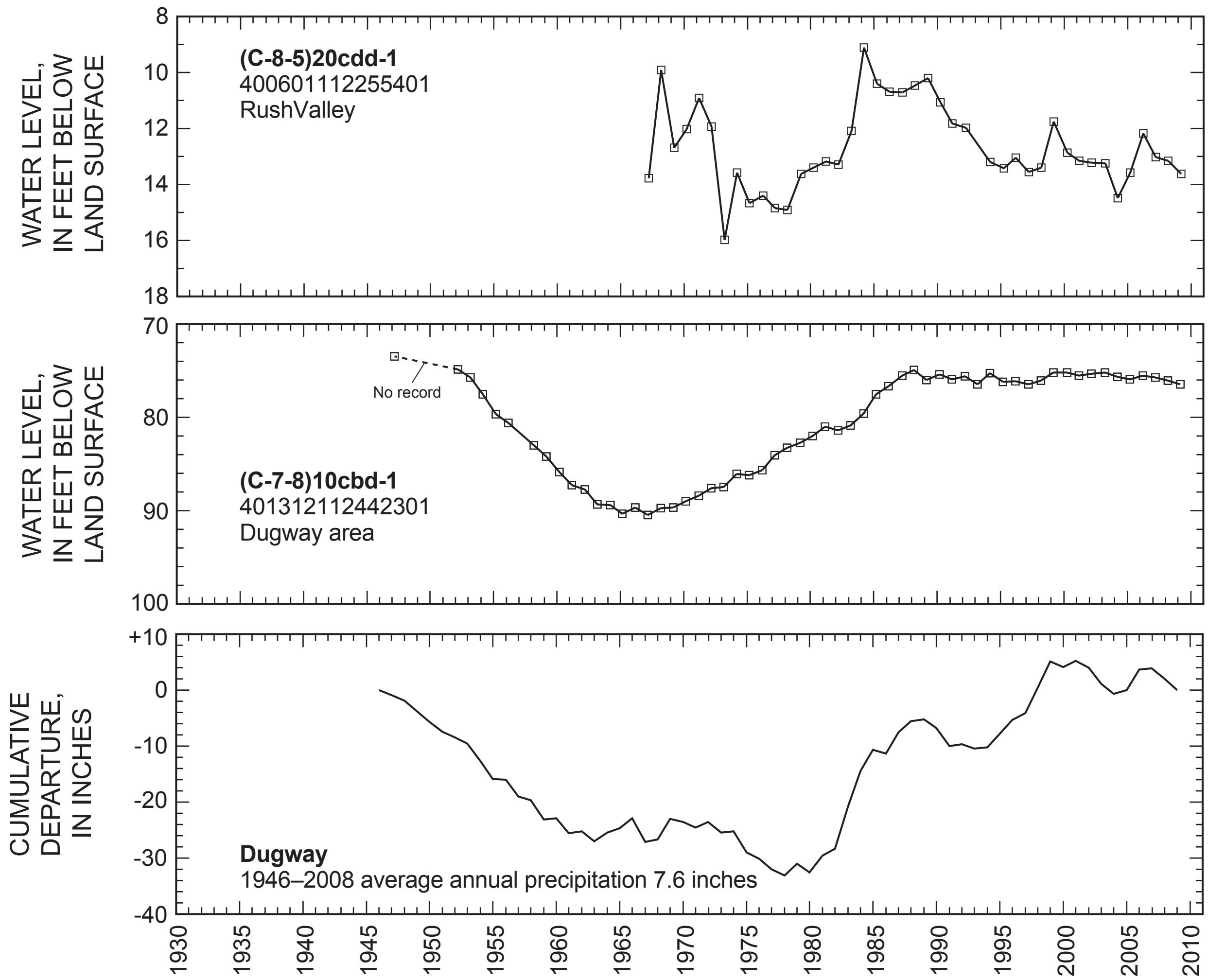


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

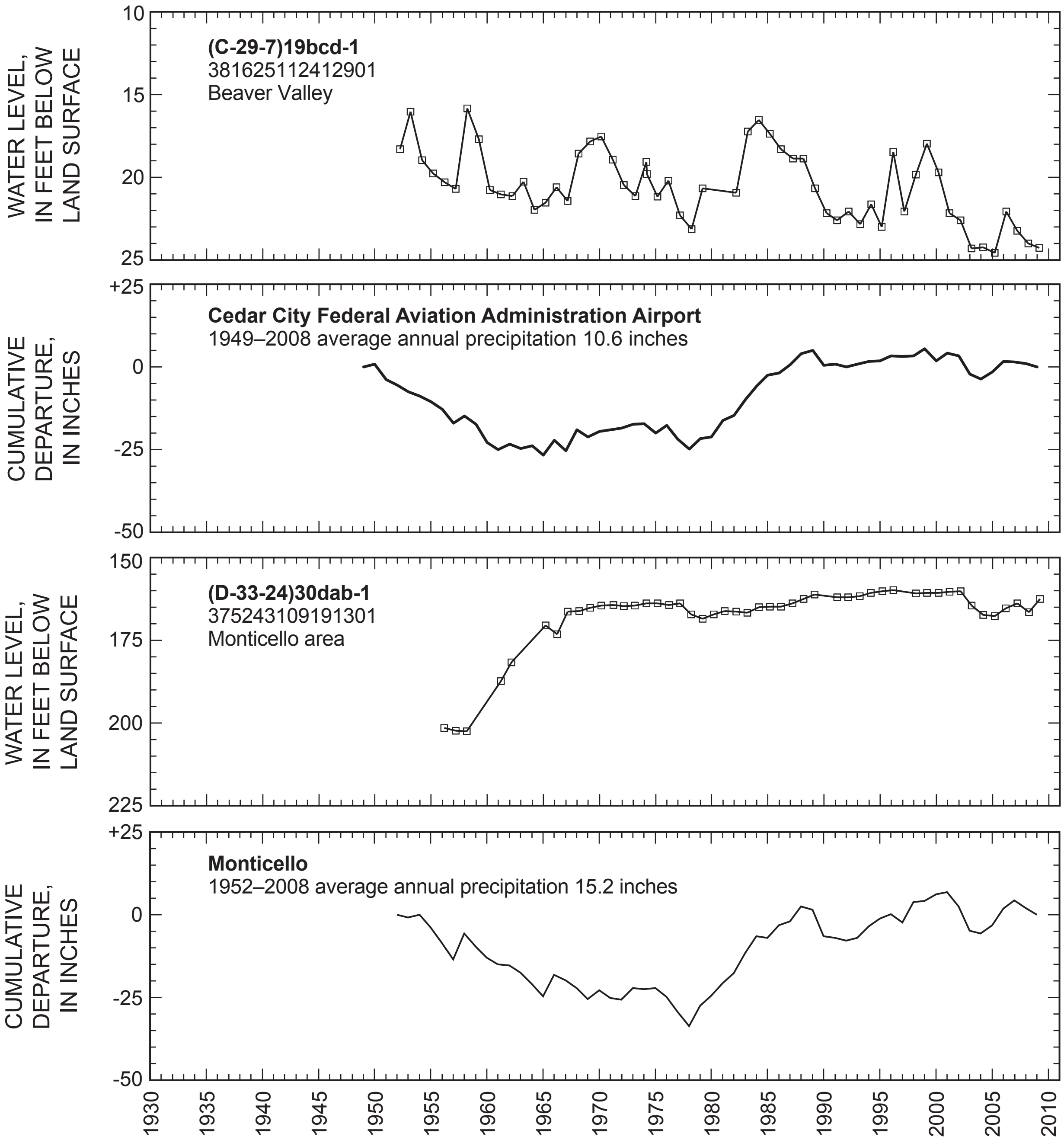


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

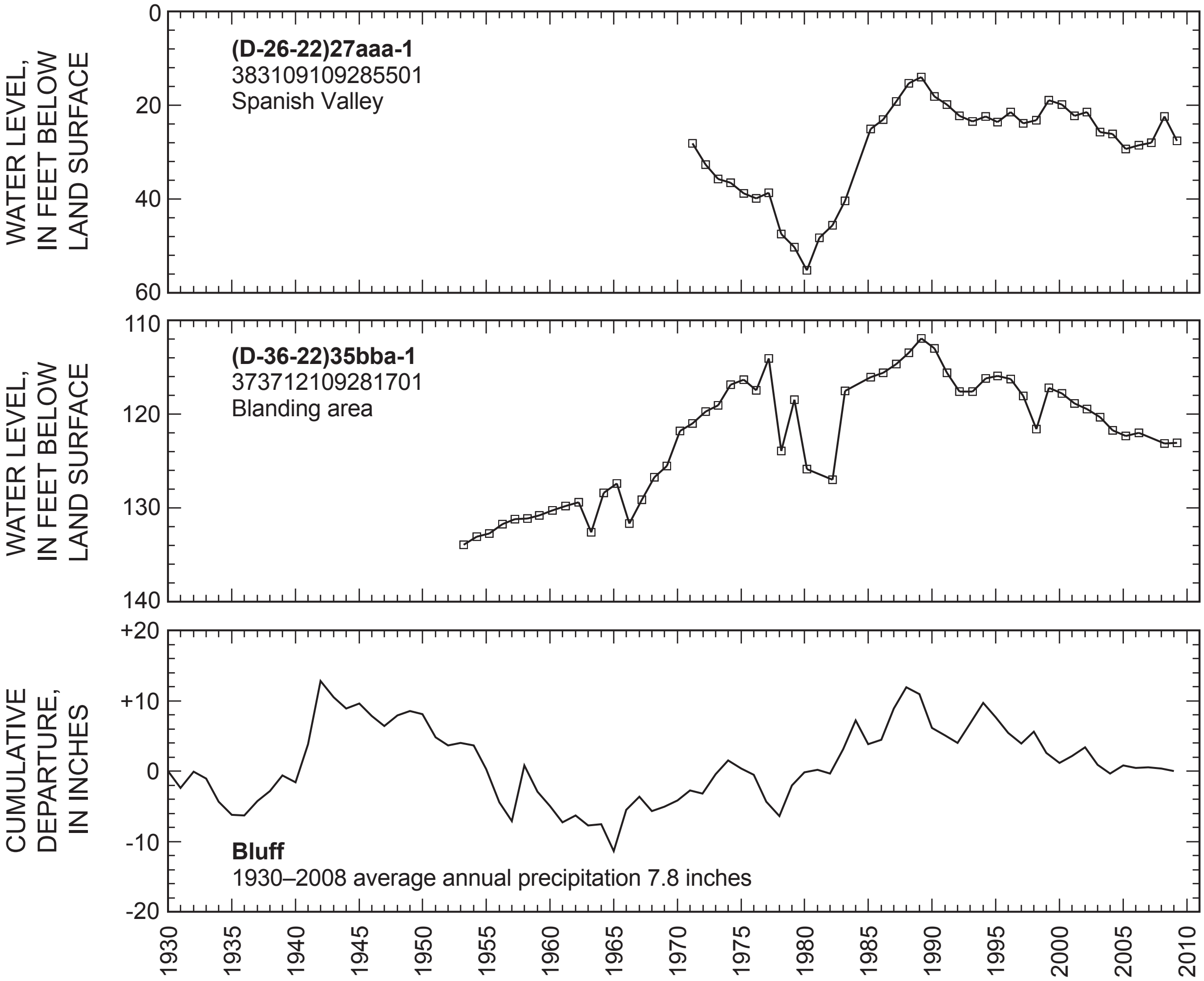


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

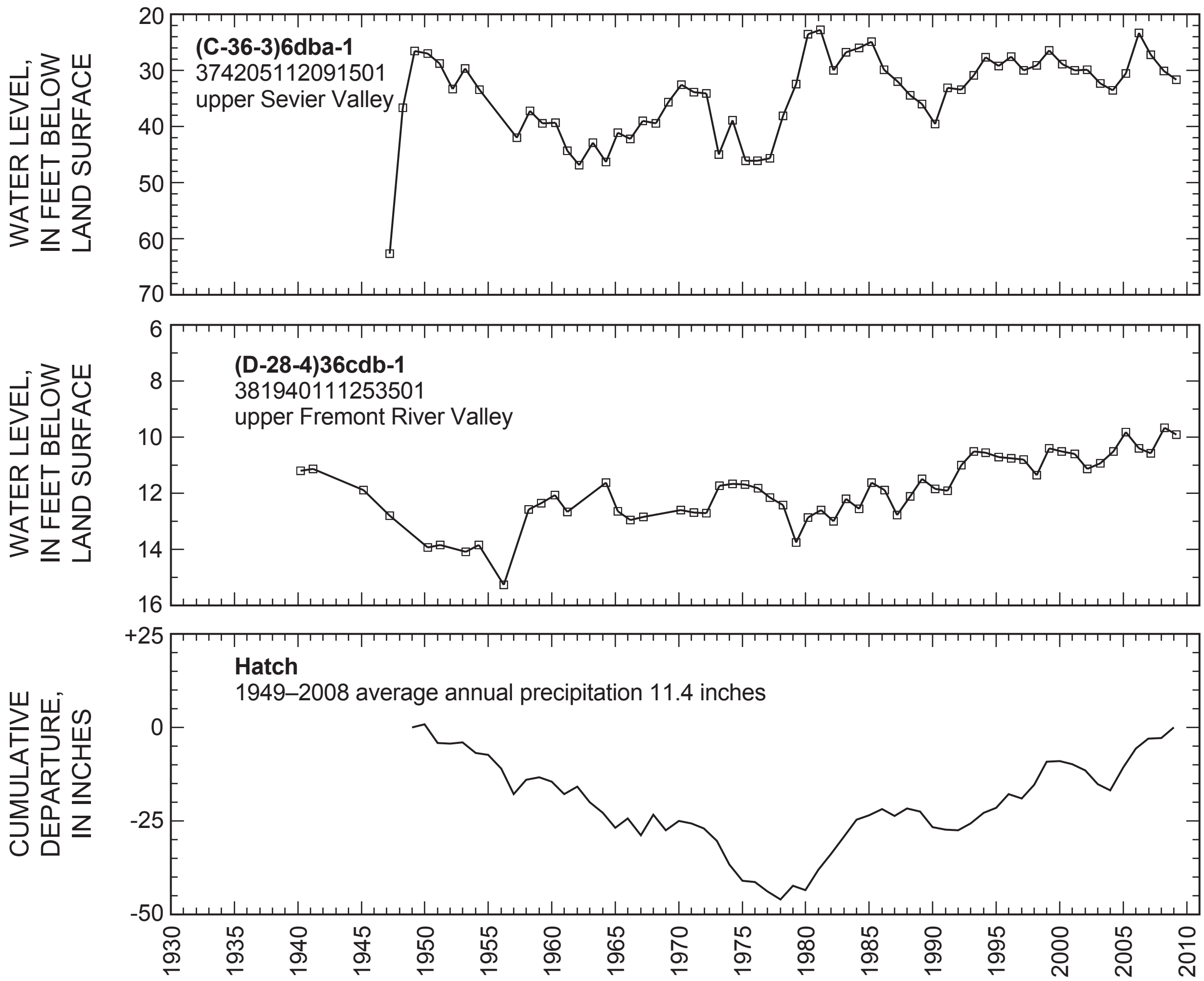


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

QUALITY OF WATER FROM SELECTED WELLS IN UTAH, SUMMER OF 2008

From July through September 2008, 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 105 wells located in 20 counties (figs. 41 and 42). Samples were collected during this time period to limit seasonal variability, if any, in the data. The majority of water samples were collected from irrigation wells. Field parameters that were measured at time the water samples were collected include pH, specific conductance, and water temperature. Chemical constituents that were analyzed in the water samples include major ions, dissolved solids, nutrients (nitrite plus nitrate, and orthophosphate), and selected trace elements. The USGS National Water Quality Laboratory in Lakewood, Colorado, analyzed the water samples. Field parameter values and analytical results for all constituents except trace elements are listed in table 4. Analytical results for trace elements are listed in table 5.

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

Analytical results associated with water samples collected from each area of ground-water 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 on the internet at *http://www.rules.utah.gov/publicat/code/r309/r309-200.htm#T5*. 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. A comparison MCLs and secondary drinking-water standards with results of analyses is included in the text associated with each area of ground-water development.

Water-quality field blanks were collected to determine if samples were being contaminated during equipment decontamination and/or sample collection procedures. A field blank is an inorganic blank water sample that is prepared by and obtained from the USGS National Water Quality Laboratory and carried in the field. Each field blank water sample is processed using the same methods and equipment as are used for environmental water samples, including processing in the field, preservation, shipment, laboratory handling procedures, and analytical protocols. Replicate water samples also were collected at selected wells. A replicate sample is collected concurrent with an environmental sample and is used to assess the repeatability of the laboratory analytical results.

Ten field blank water samples were processed during the sampling period. Only one constituent (dissolved solids) in one field blank sample was detected at a concentration greater than the reporting limit. The reporting limit for this constituent is 10 mg/L and the measured value was 11 mg/L. This is not significant because values for this constituent in water samples collected during this study ranged from 169 to 4,600 mg/L (see table 4), well above the value detected in the field blank. The analytical results for the replicate water samples were in good agreement with the environmental samples, confirming the repeatability of the laboratory analytical results.

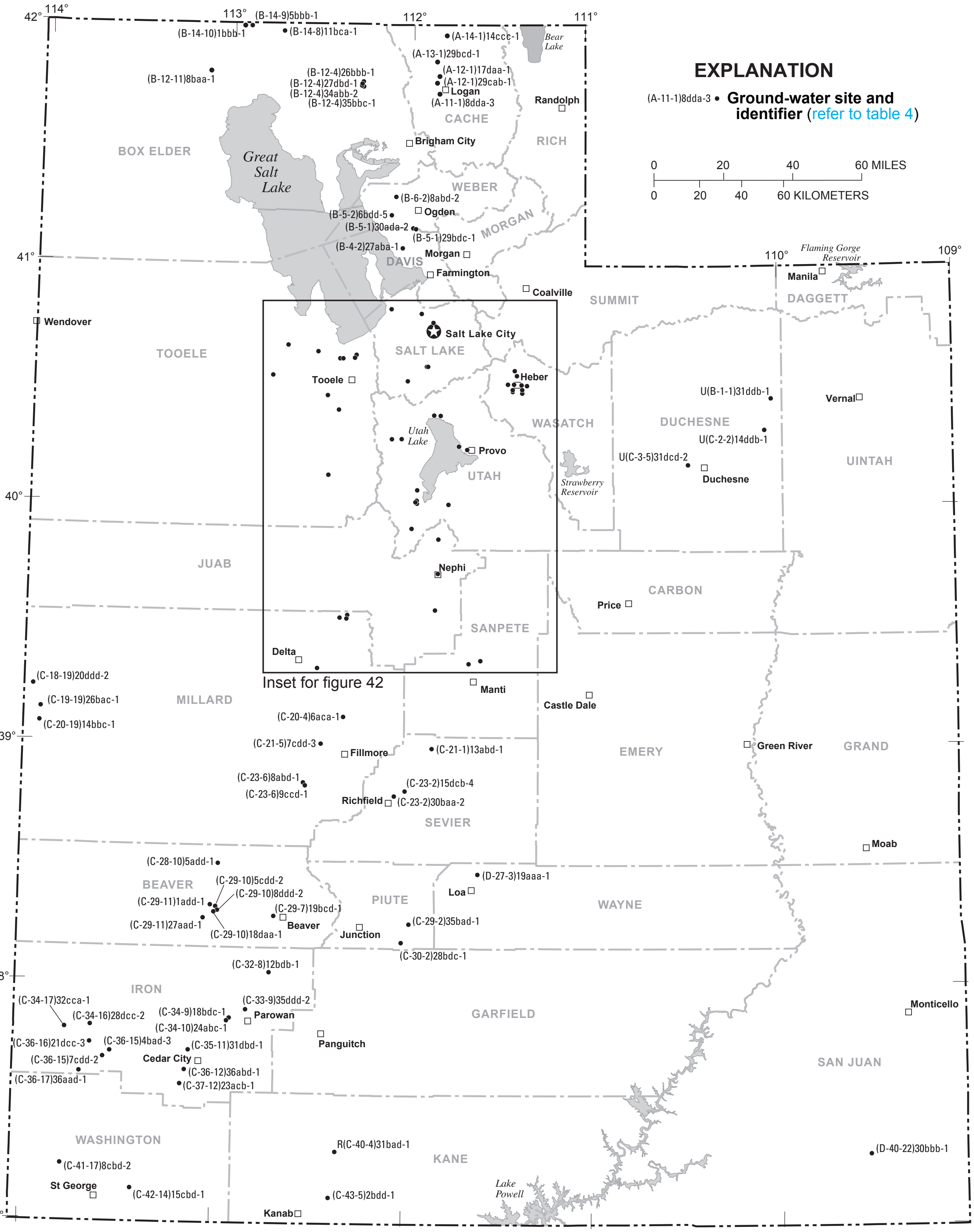


Figure 41. Location of ground-water sites sampled during the summer of 2008.

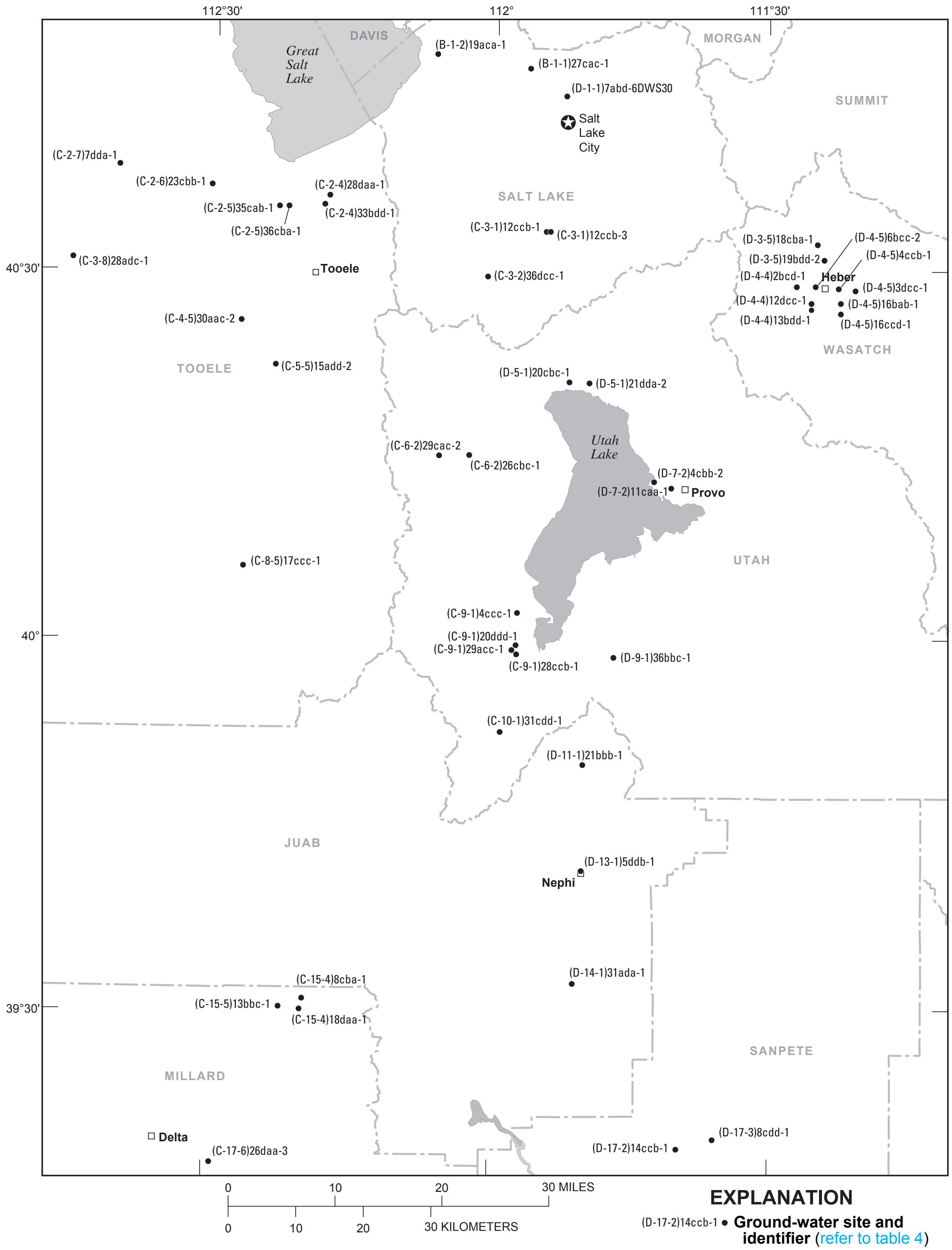


Figure 42. Location of ground-water sites sampled in inset from figure 41 during the summer of 2008.

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2008.

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

Local identifier	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
BEAVER COUNTY								
Beaver Valley								
(C-29-7)19bcd-1	381625112412901	8/4/2008	—	452	12.5	160	49.9	9.24
Escalante Valley, Milford area								
(C-28-10)5add-1	382924112592901	8/4/2008	7.4	885	21.5	260	64.4	25
(C-29-10)5cdd-2	381835113000001	8/4/2008	7.5	905	21.4	390	118	24.6
(C-29-10)8ddd-2	381741112592702	8/4/2008	7.7	756	15.6	300	76.9	25.4
(C-29-11)1add-1	381901113014101	8/4/2008	7.4	950	16.4	400	116	26.2
(C-29-11)27aad-1	381543113035501	8/4/2008	7.3	726	20.9	250	73.5	15.2
BOX ELDER COUNTY								
Curlew Valley								
(B-14-8)11bca-1	415737112431601	8/7/2008	6.8	3,090	11.3	730	160	79.7
(B-14-9)5bbb-1	415847112540401	8/7/2008	7.3	1,340	17.3	480	139	32.4
(B-14-10)1bbb-1	415845112562201	8/7/2008	7.2	583	16.1	210	59.8	15.7
Kelton area								
(B-12-11)8baa-1	414721113072601	8/7/2008	7.1	4,100	13.9	1,300	354	105
Lower Bear River area								
(B-12-4)26bbb-1	414510112163501	8/8/2008	7.3	2,950	13.8	1,100	243	115
(B-12-4)27dbd-1	414454112173101	8/8/2008	7.3	2,430	15.1	760	171	82
(B-12-4)34abb-2	414417112170701	8/8/2008	7.4	1,720	16.9	400	92.3	41.7
(B-12-4)35bbc-1	414406112163601	8/8/2008	7.3	1,570	16.7	330	74.7	34.9
CACHE COUNTY								
Cache Valley								
(A-11-1)8dda-3	414216111511001	7/31/2008	7.5	508	10.8	260	63.2	23.9
(A-12-1)17daa-1	414642111511401	7/31/2008	7.4	514	20.7	230	55.3	21.9
(A-12-1)29cab-1	414501111520001	7/31/2008	7.5	496	20.8	210	51.7	20.7
(A-13-1)29bcd-1	415020111520401	7/31/2008	7.8	456	13.5	190	39.5	22.3
(A-14-1)14ccc-1	415653111485401	7/31/2008	7.6	510	10.9	270	65.7	24.7
DAVIS COUNTY								
East Shore area								
(B-4-2)27aba-1	410340112030001	8/26/2008	7.9	588	20.1	45	11.4	3.92
(B-5-1)29bdc-1	410830111585101	8/27/2008	7.5	531	10.9	230	64.8	16.4
(B-5-1)30ada-2	410835111591502	8/27/2008	7.5	540	11.7	250	69.7	17.6
DUCHESNE COUNTY								
Altamont-Bluebell area								
U(C-2-2)14ddb-1	401819110041601	9/3/2008	7.8	353	19.2	160	38.7	14.8
Starvation-Duchesne area								
U(C-3-5)31dcd-2	401012110291901	9/3/2008	9.3	1,810	13.0	17	1.93	2.91
Uinta Basin								
U(B-1-1)31ddb-1	402611110020101	9/3/2008	8.2	417	14.2	81	22.3	6.12
IRON COUNTY								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	8/5/2008	7.5	906	13.5	520	103	64.2
(C-36-12)36adb-1	373743113084201	8/5/2008	7.7	762	13.5	440	107	41.7
(C-37-12)23acb-1	373407113100801	8/5/2008	7.7	1,160	14.5	580	131	61.6
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-2	374834113384301	8/7/2008	7.8	2,580	14.0	1,100	338	66.1
(C-34-17)32cca-1	374753113464601	8/5/2008	7.3	861	23.5	330	106	15.3
(C-36-15)4bad-3	374209113322203	8/5/2008	7.7	745	22.0	130	42.3	6.72
(C-35-16)21dcc-3	374412113384503	8/5/2008	8.2	376	14.2	170	51.4	9.27
(C-36-15)7cdd-2	374040113343102	8/7/2008	7.5	964	24.6	200	51	16.4
(C-36-17)36aad-1	373656113415201	8/5/2008	7.3	403	16.0	180	54.6	9.66
Parowan Valley								
(C-32-8)12bdb-1	380218112424401	8/4/2008	—	436	19.0	160	48	10.4
(C-33-9)35ddd-2	375303112495102	8/4/2008	—	530	13.0	270	57.9	29.6
(C-34-9)18bdc-1	375046112545901	8/4/2008	—	846	13.0	400	72.9	52.5
(C-34-10)24abc-1	375006112554801	8/5/2008	7.5	457	14.0	200	38.8	24.4

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2008—Continued.

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrite plus nitrate, dissolved, in mg/L as N	Orthophos-phate, dissolved, in mg/L as P
BEAVER COUNTY										
Beaver Valley										
6.47	27.9	160	0.06	22.6	0.75	41	32.4	308	1.94	0.041
Escalante Valley, Milford area										
2.9	61.8	121	0.2	127	0.26	24.6	113	537	0.73	0.017
5.45	29.9	292	0.2	62.1	0.24	33.6	81.8	596	2.73	0.05
3.83	33.2	182	0.2	63.5	0.35	26.2	93	484	3.83	0.021
6.1	27.9	191	0.3	134	0.26	37.3	82.9	713	4.16	0.032
6.27	37.7	128	0.2	94.9	0.4	42.2	67.7	521	2.64	0.037
BOX ELDER COUNTY										
Curlew Valley										
19	327	268	0.54	682	0.71	43.3	319	1,910	1.32	0.053
14	48.9	125	0.25	312	0.2	54	24.3	1,150	1.91	0.036
7.72	28.4	154	0.07	76.4	0.28	59.1	24.7	378	0.34	0.037
Kelton area										
15.1	272	200	0.89	1,240	0.14	25.6	57.7	3,010	2.83	0.02
Lower Bear River area										
7.05	167	183	0.78	631	0.19	32.4	396	2,100	14.5	0.035
4.22	171	172	0.77	613	0.22	22.1	146	1,710	4.93	0.021
3.62	170	197	0.3	402	0.24	19.6	39.9	1,060	1.57	0.018
3.9	164	203	0.28	328	0.26	20.6	40.5	867	1.59	0.021
CACHE COUNTY										
Cache Valley										
1.56	6.63	242	e.01	10.5	0.15	9.03	25.2	322	0.43	0.012
6.84	17.6	253	e.01	8.4	0.29	25.5	10.6	338	2.04	0.022
5.34	17.4	222	e.02	14.6	0.28	21.5	21.1	318	1.25	0.027
1.65	24.1	232	e.01	8.59	0.13	10.6	11.1	278	0.13	0.015
0.82	4.41	258	<.02	7.96	e.10	11.7	5.04	340	3.54	0.013
DAVIS COUNTY										
East Shore area										
5.47	126	265	0.05	41.2	0.41	29.2	<.18	373	<.04	0.612
2.24	30.5	268	0.03	20.8	0.13	11	6.96	312	<.04	0.051
2.28	28.3	268	0.03	20.1	0.15	10.7	12.4	317	<.04	0.019
DUCHESNE COUNTY										
Altamont-Bluebell area										
3.36	9.61	144	e.01	1.19	0.53	9.47	45.8	217	<.04	<.006
Starvation-Duchesne area										
1.13	406	548	0.07	158	1.37	14.4	156	1,110	<.04	0.057
Uinta Basin										
2.61	65.5	184	<.02	2.41	1.15	9	43.5	255	e.02	e.006
IRON COUNTY										
Cedar Valley										
2.35	10.8	135	0.06	14.9	0.27	20.3	390	779	2.13	0.016
2.04	15.5	286	0.05	7.67	0.14	18.9	166	577	1.78	0.016
1.99	48.8	145	0.58	109	e.07	17	382	904	1.91	0.023
Escalante Valley, Beryl-Enterprise area										
15.8	65.8	126	2.32	582	0.35	58.3	291	2,170	3.84	0.041
10.9	45.7	137	0.42	137	0.53	65.6	92.9	677	4.47	0.035
4.73	113	158	0.13	38.4	1.52	52.6	164	528	0.87	0.035
4.6	14.7	154	0.11	25.6	0.24	48.1	13.2	281	1.32	0.039
4.44	127	122	0.13	42.8	1.56	41.4	279	661	0.5	0.028
6.73	22.2	180	0.11	23.5	0.28	49.9	13.9	304	1.93	0.075
Parowan Valley										
6.16	16.9	110	0.21	46.9	0.21	55.3	29	315	1.77	0.036
2.76	14	235	0.06	21.7	0.14	25	30.5	358	3.23	0.024
3.91	19.6	186	0.51	107	0.23	33.3	113	540	1.85	0.028
4.35	18.8	190	0.11	20.6	0.34	41.8	26.1	305	1.49	0.031

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2008—Continued.

Local identifier	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
JUAB COUNTY								
Juab Valley								
(D-11- 1)21bbb-1	395059111501901	8/20/2008	7.6	515	13.0	260	61.9	25
(D-13- 1) 5ddb-1	394225111502201	8/20/2008	7.3	1,580	11.3	490	132	39.1
(D-14- 1)31ada-1	393315111511601	8/20/2008	7.2	1,320	13.3	690	184	55.9
KANE COUNTY								
Kanab area								
(C-43- 5) 2bdd-1	370608112230001	8/6/2008	7.1	749	13.5	350	80.3	37.2
R(C-40- 4)31bad-1	371740112210601	8/6/2008	7.1	1,890	18.0	950	126	154
MILLARD COUNTY								
Pahvant Valley								
(C-20-4)6aca-1	390628112201401	8/13/2008	7.3	1,690	20.0	730	173	72.4
(C-21-5)7cdd-3	385939112272303	8/13/2008	7.2	1,520	11.9	530	114	58.7
(C-23-6)8abd-1	384953112325101	8/13/2008	7.1	6,760	21.1	1,800	433	165
(C-23-6)9ccd-1	384910112321401	8/13/2008	7.3	5,490	17.2	1,300	342	115
Sevier Desert								
(C-15-4)8cba-1	393154112192901	7/16/2008	7.1	3,390	13.6	970	212	106
(C-15-4)18daa-1	393102112194401	7/16/2008	7.0	3,100	15.8	1,100	236	121
(C-15-5)13bbc-1	393113112215701	7/16/2008	7.3	2,560	14.0	1,000	198	129
(C-17-6)26daa-3	391832112285601	7/16/2008	7.9	666	20.0	130	25.1	16.9
Snake Valley								
(C-18-19)20ddd-2	391324114000001	7/17/2008	7.8	324	21.9	110	27.5	10.7
(C-19-19)26bac-1	390748113572201	7/17/2008	7.3	792	12.3	320	77.1	31.8
(C-20-19)14bbc-1	390416113573801	7/17/2008	7.7	409	13.6	160	37.6	16.5
PIUTE COUNTY								
Central Sevier Valley								
(C-29-2)35bad-1	381440111584001	8/13/2008	8.3	451	13.9	180	51.4	13.7
Upper Sevier Valley								
(C-30-2)28bdc-1	381003112010301	8/14/2008	7.8	387	14.4	200	48.3	18.1
SALT LAKE COUNTY								
Salt Lake Valley								
(B-1-1)27cac-1	404720111562701	7/8/2008	7.8	877	13.2	150	30.4	18.2
(B-1-2)19aca-1	404826112062201	7/8/2008	8.5	2,290	16.8	52	8.28	7.65
(C-3-1)12ccb-1	403408111543201	7/8/2008	7.6	928	19.8	280	61.3	31.5
(C-3-1)12ccb-3	403409111542401	7/8/2008	7.6	2,540	19.0	610	153	55.5
(C-3-2)36dcc-1	403029112004601	7/8/2008	7.5	1,140	15.3	440	126	30
(D-1-1)7abd-6	404506111523301	7/9/2008	7.2	1,340	14.3	590	142	56.5
SAN JUAN COUNTY								
Bluff area								
(D-40-22)30bbb-1	371716109325501	9/4/2008	8.9	800	19.5	5	1.29	0.412
SANPETE COUNTY								
Sanpete Valley								
(D-17-2)14ccb-1	391955111401301	8/20/2008	7.3	895	11.9	370	55.8	56.1
(D-17-3)8cdd-1	392042111362501	8/19/2008	7.6	755	11.5	330	56.4	45.9
SEVIER COUNTY								
Central Sevier Valley								
(C-21-1)13abd-1	385910111512101	8/13/2008	8	736	18.3	140	29.6	17
(C-23-2)15dcb-4	384757112002201	8/13/2008	7.6	665	14.3	290	60.1	34.7
(C-23-2)30baa-2	384641112034601	8/13/2008	7.2	825	14.9	420	84.7	51.2
TOOELE COUNTY								
Rush Valley								
(C-4-5)30aac-2	402645112265101	7/29/2008	7.4	823	21.9	280	62.5	30.5
(C-5-5)15add-2	402310112231002	7/29/2008	7.3	549	11.5	250	53.7	27.2
(C-8-5)17ccc-1	400652112261801	7/29/2008	8	578	16.1	210	41.8	25.3
Skull Valley								
(C-2-7)7dda-1	403914112400301	7/22/2008	7.5	5,300	17.7	450	95.6	51.1
(C-3-8)28adc-1	403140112445001	7/22/2008	7.7	870	14.6	180	54.8	11.3

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2008—Continued.

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrite plus nitrate, dissolved, in mg/L as N	Orthophos-phate, dissolved, in mg/L as P
JUAB COUNTY										
Juab Valley										
1.05	12.1	209	0.05	20	e.11	8.64	37	304	1.79	0.009
3.96	150	364	0.08	226	0.18	22.9	122	965	4.6	0.029
2.13	44.8	244	0.05	53.4	0.23	12.2	411	993	1.58	0.01
KANE COUNTY										
Kanab area										
2.92	19.1	188	0.09	7.74	0.18	11.1	176	480	4.84	0.029
10.6	101	370	0.08	20.7	0.63	12.6	735	1,450	e.02	0.011
MILLARD COUNTY										
Pahvant Valley										
3.56	68.3	278	0.48	245	0.3	19.8	232	1,110	6.97	0.018
5.21	133	318	0.27	176	0.16	25.1	246	1,010	5.06	0.029
68.1	785	328	2.08	1,640	1.07	38.9	1,030	4,600	1.99	0.055
63.6	618	328	1.5	1,230	1.31	37	841	3,760	2.42	0.057
Sevier Desert										
8.56	351	407	0.57	609	0.17	26	538	2,250	0.58	0.031
7.53	224	288	0.58	585	0.25	25.6	524	2,080	2.2	0.029
6.45	113	203	0.54	552	0.22	27.3	328	1,590	0.36	0.024
14.6	78.8	243	0.05	39	1.79	62.1	35.4	407	0.36	0.034
Snake Valley										
1.91	23.3	134	0.04	17.9	0.15	13.6	9.98	196	0.2	0.011
3.8	45.5	254	0.14	72.6	0.24	23.3	74.4	518	1.24	0.024
1.48	19.6	157	0.08	29.1	0.35	20.1	11.8	239	0.09	0.015
PIUTE COUNTY										
Central Sevier Valley										
5.79	13.5	184	0.16	24.8	0.21	45.7	18.1	300	1	0.078
Upper Sevier Valley										
5.12	18.4	197	0.06	10.6	0.28	30.9	21.1	261	0.49	0.038
SALT LAKE COUNTY										
Salt Lake Valley										
10.2	156	851	0.11	57.8	0.5	27.6	<.18	594	<.04	0.324
2.66	452	382	0.32	432	2.92	20.2	115	1,300	<.04	0.181
8.9	81	185	0.12	123	0.26	31.8	108	573	0.26	0.025
26.6	250	202	0.35	595	0.39	29.1	183	1,560	0.5	0.022
7.33	47.3	220	0.19	203	0.12	42.4	47.1	733	1.03	0.046
3.09	54.6	287	0.1	165	0.21	17.9	174	838	5.11	0.046
SAN JUAN COUNTY										
Bluff area										
1.08	185	356	0.03	15	0.46	9.74	48.7	485	<.04	0.007
SANPETE COUNTY										
Sanpete Valley										
1.27	47.2	305	0.1	54.6	0.3	15.9	103	542	—	—
1.45	38.8	347	0.04	13.5	0.21	12	49.8	441	—	—
SEVIER COUNTY										
Central Sevier Valley										
4.58	95.8	115	0.08	105	0.56	38.7	86.4	459	0.28	0.028
3.08	18.2	273	0.07	29.3	0.38	32.5	48	411	0.91	0.043
1.99	35.1	430	0.07	14.5	0.18	14.4	31.7	504	2.86	0.026
TOOELE COUNTY										
Rush Valley										
3.16	44.4	162	0.11	134	0.26	21.8	36.5	453	0.49	0.02
1.18	14	200	0.04	41.4	0.18	10.7	21.7	303	1.32	0.013
2.23	31	158	0.05	68.2	0.42	16.1	24.3	321	0.16	0.014
Skull Valley										
36.4	846	152	0.94	1,610	0.27	21.8	127	3,110	2.61	0.025
6.55	101	123	0.12	203	0.15	16	21.9	551	0.55	0.026

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2008—Continued.

Local identifier	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
TOOELE COUNTY—CONTINUED								
Tooele Valley								
(C-2-4)28daa-1	403657112173901	8/28/2008	7.7	971	13.0	410	100	37.6
(C-2-4)33bdd-1	403629112174801	8/28/2008	7.5	962	14.1	270	67.7	23.7
(C-2-5)35cab-1	403602112230101	8/28/2008	7.3	4,450	20.2	490	119	46.4
(C-2-5)36cba-1	403603112215801	8/28/2008	7.4	2,130	19.6	380	94.7	34.8
(C-2-6)23cbb-1	403802112301201	8/28/2008	7.8	1,330	19.0	260	59.3	27.1
UTAH COUNTY								
Cedar Valley								
(C-6-2)26cbc-1	401600112023401	7/10/2008	7.6	765	11.2	330	55.3	47.7
(C-6-2)29cac-2	401557112053701	7/10/2008	7.7	415	11.1	200	51.7	17.1
Goshen Valley								
(C-9-1)4ccc-1	400315111572001	7/14/2008	7.6	1,720	14.3	410	101	37.6
(C-9-1)20ddd-1	400040111572701	7/14/2008	7.8	1,330	16.1	320	79.2	30.4
(C-9-1)28ccb-1	395956111572101	9/5/2008	7.5	2,060	17.9	600	158	50.9
(C-9-1)29acc-1	400015111575301	7/14/2008	7.7	1,450	16.2	370	90	36
(C-10-1)31cdd-1	395340111590001	9/5/2008	7.3	912	18.9	370	92.3	33.6
Northern Utah Valley								
(D-5-1)20cbc-1	402159111520101	7/14/2008	7.9	353	11.5	160	36.9	15.5
(D-5-1)21dda-2	402154111495101	7/10/2008	7.8	394	11.9	190	43.9	19.2
Southern Utah Valley								
(D-7-2)4cbb-2	401414111435301	7/17/2008	6.7	543	13.4	250	62.1	22.4
(D-7-2)11caa-1	401325111410901	7/17/2008	6.7	642	15.9	300	71.1	29.1
(D-9-1)36bbc-1	395942111470801	7/17/2008	7.1	516	10.7	260	66.3	22.5
WASATCH COUNTY								
Heber Valley								
(D-3-5)18cba-1	403325111254601	8/5/2008	7.6	322	10.0	140	41.9	8.83
(D-3-5)19bdd-2	403243111252701	8/15/2008	6.6	278	11.0	130	36.7	8.88
(D-4-4)2bcd-1	403004111280301	8/5/2008	7.5	485	19.7	270	68.8	23.7
(D-4- 4)12dcc-1	402842111263101	8/5/2008	7.3	634	12.1	300	83.8	21.5
(D-4-4)13bdd-1	402810111263601	8/15/2008	7.5	465	20.8	230	54.2	23.2
(D-4-5)3dcc-1	402937111214901	8/15/2008	6.7	532	13.4	260	85.1	10.8
(D-4-5)4ccb-1	402946111233901	8/5/2008	7.1	394	11.4	190	60.2	8.98
(D-4-5)6bcc-2	403003111255801	8/5/2008	7.5	383	14.2	180	55.6	10.8
(D-4-5)16bab-1	402840111232201	8/5/2008	7.2	541	13.9	270	72.6	20.4
(D-4-5)16ccd-1	402750111232701	8/5/2008	7.4	451	12.1	230	57.2	21
WASHINGTON COUNTY								
Central Virgin River area								
(C-41-17)8cbd-2	371348113470301	8/6/2008	7.2	491	19.0	220	63.9	15.9
(C-42-14)15cbd-1	370538113251301	8/6/2008	7.2	2,850	27.7	2,000	424	216
WAYNE COUNTY								
Upper Fremont Valley								
(D-27-3)19aaa-1	382717111365601	8/13/2008	7.5	1,360	11.1	710	213	43.4
WEBER COUNTY								
East Shore area								
(B-5-2)6bdd-5	411153112064605	8/27/2008	8.3	2,150	15.2	240	67.4	17.1
(B-6-2)8abd-2	411633112051701	8/26/2008	7.8	618	17.5	62	17.4	4.6

Table 4. Physical properties and concentration of major ions in water samples collected from selected wells in Utah, summer of 2008—Continued.

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrite plus nitrate, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
TOOELE COUNTY—CONTINUED										
Tooele Valley										
1.78	61.9	204	0.13	51	e.10	12.4	250	652	3.35	0.028
2.15	106	216	0.1	116	0.16	11.5	110	589	1.9	0.023
10.6	718	206	0.79	1,250	0.49	22.1	146	2,600	3.4	0.019
4.07	278	206	0.33	536	0.2	17.5	36.1	1,300	2.46	0.015
23.4	146	122	0.2	314	0.36	48.8	29.8	848	0.91	0.027
UTAH COUNTY										
Cedar Valley										
3.62	22.4	229	0.11	97.7	0.35	54	31.1	453	0.15	0.045
0.87	8.32	186	e.02	15	0.14	9.74	14.9	169	0.8	0.014
Goshen Valley										
11.5	148	126	0.56	329	0.29	55.7	126	1,060	11.3	0.037
12	119	127	0.49	231	0.22	55.6	53.1	882	32.5	0.039
17.7	134	112	0.67	451	0.21	59.5	119	1,420	17.4	0.015
12.2	127	117	0.47	277	0.21	56.7	122	958	16.6	0.038
7.84	31.4	150	0.22	127	0.2	52.4	76.3	642	12.2	0.019
Northern Utah Valley										
1.15	9.59	132	e.02	8.58	0.24	11.4	34.9	215	1.88	0.013
1	6.63	158	<.02	6.42	0.25	11.4	40.4	234	0.71	0.012
Southern Utah Valley										
2.81	16.2	230	0.03	12.4	0.29	18.6	45.4	308	e.02	0.031
2.34	21.8	266	0.04	19.3	0.22	17.4	65.5	403	e.02	0.02
1.48	7.29	230	0.03	18	0.26	15.9	20.2	299	1.92	0.015
WASATCH COUNTY										
Heber Valley										
2.3	9.45	136	—	9.62	0.13	28.7	20.7	—	e.03	—
1.08	5.87	87	—	15.1	e.11	17.6	28.8	—	0.7	—
1.26	7.18	225	—	7.2	0.28	9.9	33.5	—	0.41	—
1.44	16.4	244	—	37	0.12	21.9	31.2	—	2.89	—
1.83	10	205	—	19.3	0.33	13.1	19	—	0.33	—
3.77	7.71	194	—	29.9	e.10	38.4	7.47	—	9.48	—
2.45	5.26	164	—	11	e.09	41.6	14.3	—	4.09	—
2.07	7.66	166	—	10	e.09	28.6	21.3	—	1.6	—
1.52	12.3	244	—	15.8	0.23	29.3	22.2	—	2.3	—
1.09	13.9	203	—	17.8	0.16	13.7	26.2	—	3.78	—
WASHINGTON COUNTY										
Central Virgin River area										
2.29	13.5	197	0.07	13.5	0.35	16.9	39	292	0.45	0.018
8.48	131	144	1.37	371	0.49	20.5	1,490	3,020	6.8	0.019
WAYNE COUNTY										
Upper Fremont Valley										
3.9	33.7	205	0.07	12.8	e.08	28	526	1,030	2.73	0.043
WEBER COUNTY										
East Shore area										
10.3	324	91	0.38	626	0.37	16.6	3.76	1,170	<.04	0.006
3.24	124	232	0.08	70.7	0.96	28.6	<.18	380	<.04	0.063

Table 5. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2008.

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

Local identifier	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
BEAVER COUNTY								
Beaver Valley								
(C-29-7)19bcd-1	381625112412901	8/4/2008	3.9	<8	2.3	2.2	0.69	18.4
Escalante Valley, Milford area								
(C-28-10)5add-1	382924112592901	8/4/2008	1.4	28	0.8	0.8	2	11
(C-29-10)5cdd-2	381835113000001	8/4/2008	2.3	11	<.4	0.5	0.59	39.5
(C-29-10)8ddd-2	381741112592702	8/4/2008	5	<8	<.4	2	1.1	9.35
(C-29-11)1add-1	381901113014101	8/4/2008	2.5	<8	<.4	0.6	0.57	21.6
(C-29-11)27aad-1	381543113035501	8/4/2008	3.6	<8	<.4	1.5	0.87	11.2
BOX ELDER COUNTY								
Curlew Valley								
(B-14-8)11bca-1	415737112431601	8/7/2008	9.1	<16	2.7	2.9	6.4	6.03
(B-14-9)5bbb-1	415847112540401	8/7/2008	2	<8	<.4	0.8	1.8	1.46
(B-14-10)1bbb-1	415845112562201	8/7/2008	4.5	<8	<.4	1.3	1.2	2.2
Kelton area								
(B-12-11)8baa-1	414721113072601	8/7/2008	1.3	<24	<1.2	0.7	1.8	4.79
Lower Bear River area								
(B-12-4)26bbb-1	414510112163501	8/8/2008	2.4	<16	<.8	0.6	31.5	3.74
(B-12-4)27dbd-1	414454112173101	8/8/2008	0.86	<16	<.8	0.7	15.4	1.74
(B-12-4)34abb-2	414417112170701	8/8/2008	0.66	e7	0.6	0.9	1.4	1.17
(B-12-4)35bbc-1	414406112163601	8/8/2008	0.91	<8	<.4	0.8	3.1	1.44
CACHE COUNTY								
Cache Valley								
(A-11-1)8dda-3	414216111511001	7/31/2008	0.1	e5	0.8	0.5	1.1	1.29
(A-12-1)17daa-1	414642111511401	7/31/2008	1.3	<8	<.4	0.8	0.23	0.69
(A-12-1)29cab-1	414501111520001	7/31/2008	1.3	<8	<.4	0.7	0.17	0.61
(A-13-1)29bcd-1	415020111520401	7/31/2008	6.7	190	63.6	0.7	0.05	0.3
(A-14-1)14ccc-1	415653111485401	7/31/2008	0.23	<8	<.4	e.1	0.06	0.49
DAVIS COUNTY								
East Shore area								
(B-4-2)27aba-1	410340112030001	8/26/2008	24.5	603	52.4	0.4	e.03	<.02
(B-5-1)29bdc-1	410830111585101	8/27/2008	0.78	12	6.1	0.3	<.04	2.61
(B-5-1)30ada-2	410835111591502	8/27/2008	1.7	352	285	0.5	<.04	4.6
DUCHESNE COUNTY								
Altamont-Bluebell area								
U(C-2-2)14ddb-1	401819110041601	9/3/2008	0.07	148	10.3	0.4	<.04	0.14
Starvation-Duchesne area								
U(C-3-5)31dcd-2	401012110291901	9/3/2008	0.06	<8	e.3	<.2	<.04	0.03
Uinta Basin								
U(B-1-1)31ddb-1	402611110020101	9/3/2008	0.3	156	6	1.8	<.04	0.05
IRON COUNTY								
Cedar Valley								
(C-35-11)31dbd-1	374248113075201	8/5/2008	0.94	<8	<.4	0.6	1.5	2.83
(C-36-12)36adb-1	373743113084201	8/5/2008	0.84	<8	<.4	0.3	1.3	2.68
(C-37-12)23acb-1	373407113100801	8/5/2008	0.71	e4	0.7	0.5	10.3	2.04
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-2	374834113384301	8/7/2008	5.1	<16	<.8	e.3	7.7	6.73
(C-34-17)32cca-1	374753113464601	8/5/2008	3.6	<8	<.4	0.8	1.4	4.02
(C-35-16)21dcc-3	374412113384503	8/5/2008	3.7	<8	<.4	0.4	0.47	3.11
(C-36-15)4bad-3	374209113322203	8/5/2008	22.2	<8	<.4	8.8	0.35	1.37
(C-36-15)7cdd-2	374040113343102	8/7/2008	25	<8	0.8	16.5	0.31	2.98
(C-36-17)36aad-1	373656113415201	8/5/2008	3.8	<8	<.4	0.9	0.48	3.27

Table 5. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2008—Continued.

Local identifier	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
IRON COUNTY—CONTINUED								
Parowan Valley								
(C-32-8)12bdb-1	380218112424401	8/4/2008	2.4	<8	<.4	0.7	1.3	2
(C-33-9)35ddd-2	375303112495102	8/4/2008	1.5	<8	<.4	e.2	1	2.29
(C-34-9)18bdc-1	375046112545901	8/4/2008	2.8	e5	<.4	0.5	5.4	3.33
(C-34-10)24abc-1	375006112554801	8/5/2008	5.8	<8	<.4	1	0.88	3.29
JUAB COUNTY								
Juab Valley								
(D-11-1)21bbb-1	395059111501901	8/20/2008	0.19	<8	<.4	0.5	4.4	1.12
(D-13-1)5ddb-1	394225111502201	8/20/2008	0.62	<8	e.3	0.5	1.9	2.13
(D-14-1)31ada-1	393315111511601	8/20/2008	0.27	17	0.6	0.2	0.88	0.6
KANE COUNTY								
Kanab area								
(C-43-5)2bdd-1	370608112230001	8/6/2008	0.65	10	e.4	e.1	2.7	3.41
R(C-40-4)31bad-1	371740112210601	8/6/2008	0.25	263	138	1.1	0.04	8.14
MILLARD COUNTY								
Pahvant Valley								
(C-20-4)6aca-1	390628112201401	8/13/2008	1.6	e5	<.4	0.5	2.6	0.95
(C-21-5)7cdd-3	385939112272303	8/13/2008	2.1	<8	<.4	1.6	2.3	3.62
(C-23-6)8abd-1	384953112325101	8/13/2008	8.1	<32	e1.4	1.7	8.2	8.04
(C-23-6)9ccd-1	384910112321401	8/13/2008	8.2	<24	<1.2	1.9	4	6.68
Sevier Desert								
(C-15-4)8cba-1	393154112192901	7/16/2008	3.2	161	370	2.3	0.17	5.36
(C-15-4)18daa-1	393102112194401	7/16/2008	3	26	3.7	0.5	3.7	5.97
(C-15-5)13bbc-1	393113112215701	7/16/2008	5.4	572	316	0.9	0.09	2.57
(C-17-6)26daa-3	391832112285601	7/16/2008	12.6	<8	e.3	4	0.86	1.14
Snake Valley								
(C-18-19)20ddd-2	391324114000001	7/17/2008	0.89	<8	e.2	0.4	0.32	1.32
(C-19-19)26bac-1	390748113572201	7/17/2008	3.7	<8	<.4	1.7	3.7	7.3
(C-20-19)14bbc-1	390416113573801	7/17/2008	4.3	<8	<.4	2.6	0.29	2.29
PIUTE COUNTY								
Central Sevier Valley								
(C-29-2)35bad-1	381440111584001	8/13/2008	1.6	<8	1.2	0.5	0.29	6.5
Upper Sevier Valley								
(C-30-2)28bdc-1	381003112010301	8/14/2008	6.4	<8	<.4	1.2	0.42	3.35
SALT LAKE COUNTY								
Salt Lake Valley								
(B-1-1)27cac-1	404720111562701	7/8/2008	21.3	72	40.7	0.4	0.07	e.01
(B-1-2)19aca-1	404826112062201	7/8/2008	1.5	118	13.6	13.5	0.1	e.01
(C-3-1)12ccb-1	403408111543201	7/8/2008	4	<8	<.4	1.5	1.2	4.68
(C-3-1)12ccb-3	403409111542401	7/8/2008	0.55	259	9.6	1.9	1.1	6.76
(C-3-2)36dcc-1	403029112004601	7/8/2008	2	<8	0.6	0.7	2.1	5.03
(D-1-1)7abd-6	404506111523301	7/9/2008	1.1	e7	5.1	1.1	1.7	1.8
SAN JUAN COUNTY								
Bluff area								
(D-40-22)30bbb-1	371716109325501	9/4/2008	63.5	<8	1.6	1.6	<.04	0.37
SANPETE COUNTY								
Sanpete Valley								
(D-17-2)14ccb-1	391955111401301	8/20/2008	1.2	<8	e.3	0.7	6.2	2.38
(D-17-3)8cdd-1	392042111362501	8/19/2008	0.29	<8	<.4	1	1.7	2.08
SEVIER COUNTY								
Central Sevier Valley								
(C-21-1)13abd-1	385910111512101	8/13/2008	10.4	<8	<.4	3.5	0.45	4.79
(C-23-2)15dcb-4	384757112002201	8/13/2008	3.8	<8	<.4	3.5	1.2	5.82
(C-23-2)30baa-2	384641112034601	8/13/2008	2.1	<8	e.2	0.3	0.37	2.74

Table 5. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2008—Continued.

Local identifier	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
TOOELE COUNTY								
Rush Valley								
(C-4-5)30aac-2	402645112265101	7/29/2008	1.2	20	0.8	1	0.57	1.43
(C-5-5)15add-2	402310112231002	7/29/2008	1.5	<8	<.4	0.8	1.5	1.82
(C-8-5)17ccc-1	400652112261801	7/29/2008	9.5	14	1.2	2.3	0.23	2.22
Skull Valley								
(C-2-7)7dda-1	403914112400301	7/22/2008	1.9	58	e.7	e.6	1	1.21
(C-3-8)28adc-1	403140112445001	7/22/2008	0.69	e7	<.4	0.3	0.3	0.46
Tooele Valley								
(C-2-4)28daa-1	403657112173901	8/28/2008	1.4	<8	0.6	0.3	10	1.97
(C-2-4)33bdd-1	403629112174801	8/28/2008	1.4	<8	<.4	0.5	2.2	2.09
(C-2-5)35cab-1	403602112230101	8/28/2008	4.1	<24	e.9	3.1	5.6	2.35
(C-2-5)36cba-1	403603112215801	8/28/2008	1.6	<16	e.6	0.7	0.97	1.73
(C-2-6)23cbb-1	403802112301201	8/28/2008	4.4	<8	<.4	0.6	0.71	1.03
UTAH COUNTY								
Cedar Valley								
(C-6-2)26cbc-1	401600112023401	7/10/2008	5.8	e6	24	3.2	0.44	4.17
(C-6-2)29cac-2	401557112053701	7/10/2008	0.65	<8	<.4	0.6	1	1.43
Goshen Valley								
(C-9-1)4ccc-1	400315111572001	7/14/2008	7.7	<8	<.4	2.2	4.1	5.03
(C-9-1)20ddd-1	400040111572701	7/14/2008	8.3	<8	<.4	0.9	4	4.48
(C-9-1)28ccb-1	395956111572101	9/5/2008	4	<16	<.8	1.7	6	5.82
(C-9-1)29acc-1	400015111575301	7/14/2008	6.1	<8	<.4	0.8	4.9	5.58
(C-10-1)31cdd-1	395340111590001	9/5/2008	3.5	<8	<.4	0.8	3.3	2.57
Northern Utah Valley								
(D-5-1)20cbc-1	402159111520101	7/14/2008	1	e4	<.4	2.3	1.7	2.32
(D-5-1)21dda-2	402154111495101	7/10/2008	0.83	<8	<.4	1.9	1.4	1.7
Southern Utah Valley								
(D-7-2)4cbb-2	401414111435301	7/17/2008	2.1	802	67.3	1	<.04	0.02
(D-7-2)11caa-1	401325111410901	7/17/2008	4.2	2,190	405	0.6	<.04	0.35
(D-9-1)36bbc-1	395942111470801	7/17/2008	0.41	<8	<.4	0.6	1.3	1.54
WASATCH COUNTY								
Heber Valley								
(D-3-5)18cba-1	403325111254601	8/5/2008	—	1,120	30.8	—	—	—
(D-3-5)19bdd-2	403243111252701	8/15/2008	—	58	0.5	—	—	—
(D-4-4)2bcd-1	403004111280301	8/5/2008	—	<8	<.4	—	—	—
(D-4-4)12dcc-1	402842111263101	8/5/2008	—	<8	e.3	—	—	—
(D-4-4)13bdd-1	402810111263601	8/15/2008	—	<8	<.4	—	—	—
(D-4-5)3dcc-1	402937111214901	8/15/2008	—	<8	1.2	—	—	—
(D-4-5)4ccb-1	402946111233901	8/5/2008	—	<8	e.4	—	—	—
(D-4-5)6bcc-2	403003111255801	8/5/2008	—	e5	1.5	—	—	—
(D-4-5)16bab-1	402840111232201	8/5/2008	—	e7	0.5	—	—	—
(D-4-5)16ccd-1	402750111232701	8/5/2008	—	<8	0.6	—	—	—
WASHINGTON COUNTY								
Central Virgin River area								
(C-41-17)8cbd-2	371348113470301	8/6/2008	28.9	<8	e.3	5.9	0.41	1.51
(C-42-14)15cbd-1	370538113251301	8/6/2008	5.9	17	3.6	3.8	16.7	23.6
WAYNE COUNTY								
Upper Fremont Valley								
(D-27-3)19aaa-1	382717111365601	8/13/2008	1.2	<8	<.4	e.2	0.69	19.7
WEBER COUNTY								
East Shore area								
(B-5-2)6bdd-5	411153112064605	8/27/2008	1.7	1,260	67.3	2.5	e.04	0.02
(B-6-2)8abd-2	411633112051701	8/26/2008	42.5	239	53.9	7.4	<.04	<.02

REFERENCES CITED

Burden, C.B., and others, 2008, Ground-water conditions in Utah, spring of 2008: Utah Division of Water Resources Cooperative Investigations Report No. 49, 118 p.

National Oceanic and Atmospheric Administration, 2008, Climatological data, Utah: Asheville, North Carolina, National Climatic Data Center, v. 110, no. 1–12 [variously paged].

Fishman, M.J., and Friedman, L.C., 1989, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A1, 545 p.

U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1–A9, available online at *http://pubs.water.usgs.gov/twri9A*. [Chapters were published from 1997–1999; updates and revisions are ongoing and can be viewed at *http://water.usgs.gov/owq/FieldManual/mastererrata.html*]

UTAH
DEPARTMENT OF
NATURAL
RESOURCES