State of Utah

GARY R. HERBERT
*Governor*

SPENCER J. COX
*Lieutenant Governor*

Department of
Environmental Quality

Alan Matheson
*Executive Director*

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
*Director*

**Water Quality Board**
Myron E. Bateman, Chair
Shane E. Pace, Vice-Chair
Clyde L. Bunker
Steven K. Earley
Gregg A. Galecki
Jennifer Grant
Michael D. Luers
Alan Matheson
Walter L. Baker
*Executive Secretary*

***Utah Water Quality Board Meeting***
**DEQ Building Board Room 1015**
**195 N 1950 W**
**Salt Lake City, UT 84116**
**January 27, 2016**

***Work Meeting Begins @ 8:30 a.m.***
Monitoring & Reporting Section ……..……..…. Jim Harris

***Board Meeting Begins @ 9:30 a.m.***
**AGENDA**

A. **Water Quality Board Meeting – Roll Call**

B. (Tab 1) **Minutes:**
Approval of Minutes for December 7, 2015 WQ Board Meeting ……..... Myron Bateman

C. **Executive Secretary's Report** ……... Walt Baker

D. (Tab 2) **Funding Requests:**
1. Financial Report …….……..….…. Emily Cantón

2. Coalville: *Hardship Grant Request* …….……..…. Lisa Nelson

E. (Tab 3) **Other Business:**
1. Long term Ground Water Monitoring in Utah ……..…..… Cory Angeroth (USGS)

2. Salt Lake County MS4 Consent Decree: *Request to proceed* ……..…… Jeff Studenka

3. Appointments to Wastewater Operator Certification Council …….. Judy Etherington

**Next Meeting February 24, 2016**
**DEQ Building Board Room 1015**
**195 North 1950 West**
**Salt Lake City, Utah 84116**

**Revised 01/22/2016**

In compliance with the American Disabilities Act, individuals with special needs (including auxiliary communicative aids and services) should contact Ashley Nelsen, Office of Human Resources, at (801) 903-3978, TDD (801) 903-3978, at least five working prior to the scheduled meeting

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***MINUTES***
***UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY***
UTAH WATER QUALITY BOARD
DEQ Building Board Room – 1015
195 North 1950 West
Salt Lake City, UT 84116
December 7, 2015

## UTAH WATER QUALITY BOARD MEMBERS PRESENT

Brad Johnson
Steven Earley
Gregg Galecki
Myron Bateman
Jennifer Grant
Michael Luers
Shane Pace

Excused: Clyde Bunker

## DIVISION OF WATER QUALITY STAFF MEMBERS PRESENT

Jenny Potter, Erica Gaddis, Leah Ann Lamb, Scott Baird, Amanda Allred, Ken Hoffman, Jodi Gardberg, Jeff Ostermiller, Chris Bittner, Jake Vander Laan, Kim Shelley, Jennifer Robinson, Jeff Studenka, Lisa Nelson, Emily Cantón, Lonnie Shull, Ben Holcomb, Svetlana Kopytkovskiy, Marsha Case, Mark Stanger, Sandy Wingert, Judy Etherington.

## OTHERS PRESENT

| Name | Organization Representing |
|---|---|
| Steven Zohner | BYU |
| Jeremy Scott | BYU |
| Emma Penrod | Salt Lake Tribune |
| Gary Vance | J-U-B |
| Trevor Lindley | J-U-B |
| Craig Ashcroft | Carollo |
| Jill Jones | Central Davis Sewer |
| Pamela Gill | Kearns Improvement |

| | |
|---|---|
| Don Leonard | GSLBSCI |
| Theron Miller | JR/FBWQC |
| Joro Walker | WRA |
| Sam Rushforth | UVU |
| Phil Heck | Central Valley |
| Ron Roberts | Central Valley |
| Jay Olsen | UDAF |
| Jesse Stewart | SLC |

Myron Bateman called the Board meeting to order at 10:08 AM and took roll call for the members of the Board and audience.

## APPROVAL OF MINUTES OF THE SEPTEMBER 23, 2015 MEETINGS

**Motion:** **It was moved by Mr. Pace to approve the minutes for the September 2015 Board meeting. Mr. Galecki seconded the motion. The motion was unanimously passed.**

## RECOGNITION AWARDS

**Recognition of the 2015 Sudweeks Award:** Mr. Bateman invited Sam Rushforth to come before the Board and the audience to recognize him for his over 45 years of service to Utah and his commitment to protecting Utah's waters.

## EXECUTIVE SECRETARY REPORT

- Mr. Baker brought to the Board's attention the recent spill on the Provo River. A rollover of a tractor trailer on icy roads caused around 1,000 gallons of oil to be spilled. Emergency response people were onsite and established booms to contain the spill. Due to their fast efforts none of the contaminant levels were above the levels that would pose a risk to the public. Communication was done well, and all were impressed at how quick the response was.

## FUNDING REQUESTS

**Financial Reports:** Ms. Cantón updated the Board on the Loan Funds, and Hardship Grant Funds, as seen in the Board Packet on pages 5-6.

**Ammonia Hardship Grant Authorization:** Mr. Bittner requested the Board approve a hardship grant for $75,000 to conduct studies in support of the 2013 USEPA ammonia criteria for Utah Waters.

**Motion:** **Following a discussion, Mr. Luers made the motion to approve the hardship grant. Ms. Grant seconded the motion. The motion was unanimously passed.**

**Eagle Mountain White Hills Funding Clarification:** Ms. Nelson requested the Board amend the minutes from the June 25, 2014 Water Quality Board meeting for the funding request made by Eagle Mountain City for the White Hills project. The correct amounts of loan and grant

authorized should have shown the following: Design Advance of $54,000, a hardship grant for $598,000 and a loan in the amount of $490,000 at 1% with all other conditions remaining in effect.

**Motion:** **Following a discussion, Mr. Galecki made the motion to fund as changed. Mr. Pace seconded the motion. The motion unanimously passed.**

## RULEMAKING

**R317-1-3.3 Technology Based Limits for Controlling Phosphorus Pollution (Amendment):** Mr. Mackey requested to initiate rulemaking to amend rule R317-1-3.3, as detailed in the board packet pages, 11-27.

**Motion:** **Following a discussion, Mr. Luers made the motion to initiate rulemaking. Ms. Grant seconded the motion. The motion unanimously passed.**

**R317-4 Onsite Wastewater Systems Request to Adopt Rule:** Mr. Kennington requested to adopt rule R317-4 changes, during comment period no comments were made, as detailed in the board packet pages, 28-30.

**Motion:** **Following a discussion, Mr. Pace made the motion to adopt rule R317-4 changes. Mr. Early seconded the motion. The motion unanimously passed.**

## OTHER BUSINESS

**Budget Update FY2016-FY2017:** Ms. Cantón presented the Division's FY2016-FY2017 Budget to the Board. In December, the Governor will make a final budget recommendation to the Legislature and during the FY2016 legislative session the appropriation will be determined.

**FY2017 Funding Needs:** Ms. Gaddis identified three important financial needs for FY2017 to support new or expanded initiatives outlined in the Board packets on pages 33-43.

**Nine Mile Creek Temperature TMDL:** Ms. Wingert, Mr. Holcomb, and Mr. Adams presented to the board the development of the Temperature Total Maximum Daily Load (TMDL) study for Nine Mile Creek. Details can be found in the Board packet pages 44-46.

**Next Meeting January 27, 2016**
**DEQ Building Board Room 1015**
**195 North 1950 West**
**Salt Lake City, UT 84116**

_____
Myron Bateman, Chair
Utah Water Quality Board

# LOAN FUNDS
# FINANCIAL PROJECTIONS

| STATE REVOLVING FUND (SRF) | 3rd Qtr FY 2016 Jan - Mar 2016 | 4th Qtr FY 2016 Apr - June 2016 | 1st Qtr FY 2017 July - Sept 2016 | 2nd Qtr FY 2017 Oct - Dec 2016 | 3rd Qtr FY 2017 Jan - Mar 2017 | 4th Qtr FY 2017 Apr - June 2017 | 1st Qtr FY 2018 July - Sept 2017 | 2nd Qtr FY 2018 Oct - Dec 2017 | 3rd Qtr FY 2018 Jan - Mar 2018 | 4th Qtr FY 2018 Apr - June 2018 | 1st Qtr FY 2019 July - Sept 2018 | 2nd Qtr FY 2019 Oct-Dec 2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Funds Available** | | | | | | | | | | | | |
| SRF - 1st Round (LOC) 2014 Cap Grant | 2,549,381 | - | - | - | - | - | - | - | - | - | - | - |
| Less: 2014 Principal Forgiveness Amount | (600,934) | - | - | - | - | - | - | - | - | - | - | - |
| SRF - 1st Round (LOC) 2015 Cap Grant | 6,924,000 | - | - | - | - | - | - | - | - | - | - | - |
| State Match | 1,465,154 | - | - | - | - | - | - | - | - | - | - | - |
| SRF - 2nd Round | 85,757,433 | 98,075,720 | 71,372,827 | 61,416,419 | 53,115,592 | 47,867,843 | 41,655,898 | 33,685,222 | 23,972,661 | 18,713,815 | 22,554,250 | 24,583,408 |
| Interest Earnings at 0.6% | 128,636 | 122,595 | 89,216 | 76,771 | 66,394 | 59,835 | 52,070 | 42,107 | 29,966 | 23,392 | 28,193 | 30,729 |
| Loan Repayments | 3,390,049 | 3,571,513 | 1,954,376 | 1,622,402 | 4,685,856 | 3,728,221 | 1,977,254 | 1,195,332 | 4,711,189 | 3,817,043 | 2,000,965 | 1,455,512 |
| Total Funds Available | 99,613,720 | 101,769,827 | 73,416,419 | 63,115,592 | 57,867,843 | 51,655,898 | 43,685,222 | 34,922,661 | 28,713,815 | 22,554,250 | 24,583,408 | 26,069,650 |
| **Project Obligations** | | | | | | | | | | | | |
| Eureka City | (400,000) | - | - | - | - | - | - | - | - | - | - | - |
| Francis City | (1,138,000) | - | - | - | - | - | - | - | - | - | - | - |
| **Loan Authorizations** | | | | | | | | | | | | |
| Logan City | - | - | (10,000,000) | (10,000,000) | (10,000,000) | (10,000,000) | (10,000,000) | (10,000,000) | (10,000,000) | - | - | - |
| **Anticipated Projects** | | | | | | | | | | | | |
| Ammonia Projects | - | - | - | - | - | - | - | - | - | - | - | (13,647,000) |
| Phosphorus Projects | - | - | - | - | - | - | - | - | - | - | - | (23,377,500) |
| Bear Lake SSD | - | - | (2,000,000) | - | - | - | - | - | - | - | - | - |
| Moab City | - | (10,497,000) | - | - | - | - | - | - | - | - | - | - |
| Payson City | - | (6,900,000) | - | - | - | - | - | - | - | - | - | - |
| Salem City | - | (13,000,000) | - | - | - | - | - | - | - | - | - | - |
| Wellington City | - | - | - | - | - | - | - | (950,000) | - | - | - | - |
| Total Obligations | (1,538,000) | (30,397,000) | (12,000,000) | (10,000,000) | (10,000,000) | (10,000,000) | (10,000,000) | (10,950,000) | (10,000,000) | - | - | (37,024,500) |
| **SRF Unobligated Funds** | $ 98,075,720 | $ 71,372,827 | $ 61,416,419 | $ 53,115,592 | $ 47,867,843 | $ 41,655,898 | $ 33,685,222 | $ 23,972,661 | $ 18,713,815 | $ 22,554,250 | $ 24,583,408 | $ (10,954,850) |

| UTAH WASTEWATER LOAN FUND (UWLF) | 3rd Qtr FY 2016 Jan - Mar 2016 | 4th Qtr FY 2016 Apr - June 2016 | 1st Qtr FY 2017 July - Sept 2016 | 2nd Qtr FY 2017 Oct - Dec 2016 | 3rd Qtr FY 2017 Jan - Mar 2017 | 4th Qtr FY 2017 Apr - June 2017 | 1st Qtr FY 2018 July - Sept 2017 | 2nd Qtr FY 2018 Oct - Dec 2017 | 3rd Qtr FY 2018 Jan - Mar 2018 | 4th Qtr FY 2018 Apr - June 2018 | 1st Qtr FY 2019 July - Sept 2018 | 2nd Qtr FY 2019 Oct-Dec 2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Funds Available** | | | | | | | | | | | | |
| UWLF | $ 16,520,771 | $ 13,662,341 | $ 14,132,829 | $ 15,159,512 | $ 16,142,862 | $ 17,436,292 | $ 19,449,046 | $ 20,512,829 | $ 21,577,179 | $ 22,838,609 | $ 24,900,616 | $ 25,932,499 |
| Sales Tax Revenue | 467,114 | - | 896,875 | 896,875 | 896,875 | 896,875 | 896,875 | 896,875 | 896,875 | 896,875 | 896,875 | 896,875 |
| Loan Repayments | 746,135 | 1,300,012 | 469,333 | 426,000 | 736,080 | 1,455,404 | 506,433 | 507,000 | 704,080 | 1,504,657 | 474,533 | 514,000 |
| Total Funds Available | 17,734,020 | 14,962,354 | 15,499,037 | 16,482,387 | 17,775,817 | 19,788,571 | 20,852,354 | 21,916,704 | 23,178,134 | 25,240,141 | 26,272,024 | 27,343,374 |
| **General Obligations** | | | | | | | | | | | | |
| State Match Transfer | (1,465,154) | - | - | - | - | - | - | - | - | - | - | - |
| DWQ Administrative Expenses | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) |
| **Project Obligations** | | | | | | | | | | | | |
| Murray City | (1,110,000) | - | - | - | - | - | - | - | - | - | - | - |
| **Loan Authorizations** | | | | | | | | | | | | |
| Helper City | (1,157,000) | | | | | | | | | | | |
| Eagle Mountain City - White Hills | - | (490,000) | - | - | - | - | - | - | - | - | - | - |
| **Planned Projects** | | | | | | | | | | | | |
| None at this time | - | - | - | - | - | - | - | - | - | - | - | - |
| Total Obligations | (4,071,679) | (829,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) | (339,525) |
| **UWLF Unobligated Funds** | $ 13,662,341 | $ 14,132,829 | $ 15,159,512 | $ 16,142,862 | $ 17,436,292 | $ 19,449,046 | $ 20,512,829 | $ 21,577,179 | $ 22,838,609 | $ 24,900,616 | $ 25,932,499 | $ 27,003,849 |

*Projects being presented to the WQB
Date Printed: 1/19/2016

# HARDSHIP GRANT FUNDS
# FINANCIAL PROJECTIONS

| HARDSHIP GRANT FUNDS (HGF) | 3rd Qtr FY 2016 Jan - Mar 2016 | 4th Qtr FY 2016 Apr - June 2016 | 1st Qtr FY 2017 July - Sept 2016 | 2nd Qtr FY 2017 Oct - Dec 2016 | 3rd Qtr FY 2017 Jan - Mar 2017 | 4th Qtr FY 2017 Apr - June 2017 | 1st Qtr FY 2018 July - Sept 2017 | 2nd Qtr FY 2018 Oct - Dec 2017 | 3rd Qtr FY 2018 Jan - Mar 2018 | 4th Qtr FY 2018 Apr - June 2018 | 1st Qtr FY 2019 July - Sept 2018 | 2nd Qtr FY 2019 Oct-Dec 2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Funds Available** | | | | | | | | | | | | |
| Beginning Balance | $ - | $ 4,661,836 | $ 4,611,359 | $ 2,215,325 | $ 2,345,363 | $ 2,613,427 | $ 3,702,548 | $ 3,159,608 | $ 3,292,696 | $ 3,537,261 | $ 4,401,595 | $ 3,838,307 |
| Federal HGF Beginning Balance | 5,947,957 | - | - | - | - | - | - | - | - | - | - | - |
| State HGF Beginning Balance | 605,571 | - | - | - | - | - | - | - | - | - | - | - |
| 2014 Principal Forgiveness Amount | 600,934 | - | - | - | - | - | - | - | - | - | - | - |
| Interest Earnings at 0.6% | 9,830 | 5,827 | 5,764 | 2,769 | 2,932 | 3,267 | 4,628 | 3,950 | 4,116 | 4,422 | 5,502 | 4,798 |
| UWLF Interest Earnings at 0.6% | 24,781 | 17,078 | 17,666 | 18,949 | 20,179 | 21,795 | 24,311 | 25,641 | 26,971 | 28,548 | 31,126 | 32,416 |
| Hardship Grant Assessments | 104,451 | 930,197 | 402,201 | - | 201,698 | 860,685 | 379,454 | - | 180,346 | 787,051 | 356,178 | - |
| Interest Payments | 53,057 | 222,420 | 53,335 | 108,319 | 43,257 | 203,374 | 48,667 | 103,497 | 33,132 | 44,313 | 43,906 | 98,569 |
| Advance Repayments | 1,094,000 | - | - | - | - | - | - | - | - | - | - | - |
| **Total Funds Available** | 8,440,581 | 5,837,359 | 5,090,325 | 2,345,363 | 2,613,427 | 3,702,548 | 4,159,608 | 3,292,696 | 3,537,261 | 4,401,595 | 4,838,307 | 3,974,089 |
| **Project Obligations** | | | | | | | | | | | | |
| DWQ-Central Utah Pulic Health Dept - Planning Grant | (50,000) | | | | | | | | | | | |
| Eagle Mountain City - White Hills - Construction Grant | - | (580,000) | - | - | - | - | - | - | - | - | - | - |
| Eureka City - Construction Grant | - | (646,000) | - | - | - | - | - | - | - | - | - | - |
| Emigration Sewer Imp Dist - Planning Grant | (60,000) | - | - | - | - | - | - | - | - | - | - | - |
| Francis City - Construction Grant | - | - | (1,875,000) | - | - | - | - | - | - | - | - | - |
| TriCounty Health Dept. - Planning Grant | (45,000) | | | | | | | | | | | |
| Wellington - Planning Advance | (32,000) | - | - | - | - | - | - | - | - | - | - | - |
| **Planned Projects** | | | | | | | | | | | | |
| *Coalville - Hardship Grant | (100,000) | | | | | | | | | | | |
| **Non-Point Source Project Obligations** | | | | | | | | | | | | |
| (FY11) Gunnison Irrigation Company | (48,587) | - | - | - | - | - | - | - | - | - | - | - |
| (FY11) DEQ - Willard Spur Study | (210,559) | - | - | - | - | - | - | - | - | - | - | - |
| (FY12) UDAF | (798,519) | - | - | - | - | - | - | - | - | - | - | - |
| (FY13) DEQ - Great Salt Lake Advisory Council | (339,418) | - | - | - | - | - | - | - | - | - | - | - |
| (FY14) UACD | (47,394) | - | - | - | - | - | - | - | - | - | - | - |
| (FY15) DEQ - Ammonia Criteria Study | (75,000) | | | | | | | | | | | |
| (FY15) DEQ - Nitrogen Transformation Study | (150,000) | | | | | | | | | | | |
| FY 2011 - Remaining Payments | (3,800) | - | - | - | - | - | - | - | - | - | - | - |
| FY 2012 - Remaining Payments | (59,540) | - | - | - | - | - | - | - | - | - | - | - |
| FY 2013 - Remaining Payments | (83,385) | - | - | - | - | - | - | - | - | - | - | - |
| FY 2014 - Remaining Payments | (262,166) | - | - | - | - | - | - | - | - | - | - | - |
| FY 2015 - Remaining Payments | (548,477) | - | - | - | - | - | - | - | - | - | - | - |
| FY 2016 Allocation | (864,900) | - | - | - | - | - | - | - | - | - | - | - |
| FY 2017 Allocation | - | - | (1,000,000) | - | - | - | - | - | - | - | - | - |
| FY 2018 Allocation | - | - | - | - | - | - | (1,000,000) | - | - | - | - | - |
| FY 2019 Allocation | - | - | - | - | - | - | - | - | - | - | (1,000,000) | - |
| **Non-Point Source Projects in Planning** | | | | | | | | | | | | |
| None at this time | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total Obligations** | (3,778,745) | (1,226,000) | (2,875,000) | - | - | - | (1,000,000) | - | - | - | (1,000,000) | - |
| **HGF Unobligated Funds** | $ 4,661,836 | $ 4,611,359 | $ 2,215,325 | $ 2,345,363 | $ 2,613,427 | $ 3,702,548 | $ 3,159,608 | $ 3,292,696 | $ 3,537,261 | $ 4,401,595 | $ 3,838,307 | $ 3,974,089 |

*Projects being presented to the WQB
Date Printed: 1/19/2016

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Project Number:_____
Date Received: January 12, 2016
Date to be presented to the WQB: January 27, 2016

WATER QUALITY BOARD
REQUEST FOR HARDSHIP GRANT FUND RESERVE
**AUTHORIZATION**

| | |
|---|---|
| APPLICANT: | Coalville City<br>10 North Main PO Box 188<br>Coalville, Utah 84017<br>Telephone: 435-336-5981 |
| PRESIDING OFFICIAL/CONTACT: | Mayor Trever Johnson<br>10 North Main PO Box 188<br>Coalville, Utah 84017<br>Telephone: 435-336-5981 |
| TREASURER: | Niki Sargent, City Recorder<br>PO Box 188<br>Coalville, Utah 84017<br>Telephone: 435-336-5981 |
| CONSULTING ENGINEER: | James Goodley, P.E., Project Manager<br>J-U-B Engineers Inc.<br>2875 S Decker Lake Dr., Ste. 575<br>Salt Lake City, Utah 84119<br>Telephone: 801-886-9052 |
| CITY ATTORNEY: | Sheldon Smith, Sheldon Smith & Associates<br>PO Box 972<br>Coalville, Utah 84017<br>Telephone: 435-336-1200 |

BOND COUNSEL:

Eric Todd Johnson
Blaisdell and Church P.C.
5995 S. Redwood Rd.
Taylorsville, UT 84123
Telephone: 801-521-7620

## APPLICANT'S REQUEST:

Coalville City is requesting a hardship grant in the amount of **$100,000** to fund repairs to their South Lift Station and the purchase of a dedicated Biosolids Dump Truck.

## APPLICANT'S LOCATION

Coalville City is located in Summit County approximately thirty miles north of Park City.

## BACKGROUND

On August 28, 2013 the Water Quality Board authorized funding to Coalville City for the construction of a new wastewater treatment plant. Coalville City's existing wastewater treatment plant was nearly fifty years old and in need of significant repairs and upgrades. During the planning process the City discovered their treatment plant was actually located on property owned by the federal Bureau of Reclamation (BOR) and had been leased to the City on a fifty year lease. The BOR was unable to extend the lease or sell the City the land, so the City was left with no choice but to construct a new wastewater treatment plant. This new plant has now reached substantial completion and on September 23, 2015 the Water Quality Board and attended the ribbon cutting ceremony for the new treatment plant.

The United States Department of Agriculture's Office of Rural Development (USDA-RD) also invested in this project, partnering with the Water Quality Board to fully fund the project. The funding breakdown was as follows:

| Funding Agency | Amount |
|---|---|
| WQB Grant | $ 4,121,000 |
| WQB Loan | $ 1,144,000 |
| USDA Loan | $ 2,856,000 |
| USDA Grant | $ 3,665,000 |
| **Total:** | **$ 11,786,000** |

The bids for construction of the treatment plant were opened in July, 2013, and the low bid was $2 million over the City's budgeted amount. To reduce the overall project cost, the City decided to reduce their construction contingency from $975,000 to less than $350,000 (16% of construction costs to 4%).

Shortly after construction began, the City began experiencing catastrophic failures in their South Lift Station and the force main it services. The City didn't originally include upgrades to this lift station as part of the original project in an effort to contain costs and they thought they would still have sufficient service life left in it. However, over the next few months there were more failures and the City realized the lift station and force main would have to be upgraded.

The City immediately coordinated with USDA-RD and Water Quality to discuss these additional project needs. Both agencies recognized the importance and the need of repairing the lift station, particularly with the large investment already made, but with such a small contingency both USDA-RD and Water Quality staff were reluctant to include it at that time. It was decided the City would begin the necessary work (planning, design and environmental) to include the lift station and force main repairs into the project scope, but would wait until the project reached significant completion and see if there were sufficient funds remaining. The City has shrewdly managed their contingency budget ($131,000 remaining) and has also held off on the purchase of a dedicated biosolids dump truck (which was part of the original project scope) to help offset the costs of these repairs. USDA-RD has completed the environmental review and is able to fund most of cost of repairing the lift station and force main, but additional funds are needed. Coalville is asking the Water Quality Board to assist them with this funding requirement.

## PROJECT NEED

The City is seeking additional funds for improvements to their South Lift Station and to purchase a dump truck to haul dewatered biosolids. The needs for the South Lift Station arose during construction of the new treatment plant and were not contemplated earlier. The City has been working with both funding agencies ever since the problems with the South Lift Station became apparent. The City has already completed the design, environmental work, and has revised its application with USDA-RD to incorporate this work into the project scope.

In late 2013 and early 2014, during the construction of the new treatment facility, the South Lift Station experienced a series of failures. First, one of the two pumps failed and was subsequently replaced. Shortly after this, the force main, which conveys sewage under I-80, experienced four failures in the

span of three months. The failures all occurred in the section between the lift station and the main highway, three of which occurred between the westbound off-ramp and the main highway. The City hired a contractor on an emergency basis to make repairs on the first two force main breaks. The next two breaks were repaired by the City's Public Works staff. During each repair it was found that the force main was badly corroded and the thickness of the pipe wall was compromised. It is believed that the higher head of the new pump may have triggered the breaks. There are no records available as to the design or construction of the lift station but it is estimated the station was installed in the early 1970's after development occurred on the west side of the highway. This would place the age of the lift station at about 45 years old. The City is very concerned that another break in the force main could occur at any time. In a worst case scenario, a break would occur under the highway or on/off-ramps or near the lift station where the spill could reach the nearby Weber River.

The piping and valves in the lift station wet well are also badly corroded and in disrepair. Since the pump replacement, the station now includes two different types of pumps. The City has spent in excess of $35,000 for these repairs and replacements and still does not have any confidence in the reliability of the station or force main. For the above reasons, the City needs to replace both the force main and the lift station. The force main would be replaced by a combination open cut and pipe bursting methods. The pipe bursting would be used for the area under the highway and on/off-ramps. The lift station replacement would convert the station from a submersible to a suction lift type station and reuse the existing concrete wet well.

The City is also in need of a dedicated truck for hauling biosolids. The scope of the original project included purchase of this truck, but the City elected to exclude it when the bids exceeded the budget. However, since the plant's startup in the July 2015, the City has been experiencing difficulty in trying to handle the dewatered biosolids with their existing equipment which consists of a flatbed truck and a dump trailer. The flatbed truck can only accommodate a relatively small amount of biosolids which requires frequent trips to the landfill and the low sides are a safety and transportation risk, as it is difficult to prevent spillage off the sides and back. The dump trailer has been problematic since the biosolids tend to freeze and then it is very difficult to remove. The City has been using a concrete blanket over the trailer to try and prevent freezing but with limited success. The City also needs the dump trailer for plowing snow and salting, so during winter it's impractical to try and accommodate both needs. It is a significant operational hardship to try and meet the needs of the treatment plant and the City's other Public Works projects without a dedicated vehicle.

**PROJECT DESCRIPTION:**

The City is looking to purchase a dedicated Biosolids Dump Truck and to make necessary improvements to the South Lift Station and force main.

**IMPLEMENTATION SCHEDULE:**

| | |
|---|---|
| Advertise for Bids: | February 2016 |
| Bid Opening: | March 2016 |
| Commence Construction: | April 2016 |
| Complete Construction: | **August 2016** |

**COST ESTIMATE:**

| | | |
|---|---|---|
| Force Main | $ | 251,000 |
| Lift Station Improvements | $ | 162,000 |
| Biosolids Dump Truck | $ | 75,000 |
| Engineering - Design | $ | Done |
| Engineering - CMS | $ | 20,000 |
| Contingency | $ | 27,000 |
| Total | $ | 535,000 |

**COST SHARING:**

| | | |
|---|---|---|
| Balance left in Contingency | $ | 131,000 |
| USDA-Rural Development | $ | 304,000 |
| WQB | $ | 100,000 |
| | $ | 535,000 |

**STAFF COMMENTS AND RECOMMENDATION:**

Staff recommends that the Board authorize $100,000 in grant to Coalville City.

**SUPPORTING PHOTOS:**

Repair of South Lift Station Force Main – note I-80 and overpass in background.

Break in force main. Preparing for repair.

Force Main Repair Completed, Preparing for Backfill

Images showing the equipment trailer used to hold and transport biosolids
(Note concrete blanket used to prevent freezing)

Dump truck used in warmer months for holding and transporting biosolids. Used in winters for plowing and salting. (Note the short walls on the bed not suitable for hauling biosolids)

State of Utah

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# MEMORANDUM

**TO:** Water Quality Board

**THROUGH:** Walter L. Baker, P.E.

**FROM:** Bill Damery, Environmental Scientist III
Standards and Technical Services Section

**DATE:** January 27, 2016

**SUBJECT:** "Long-term ground water monitoring in Utah: water quality, water levels, and withdrawals" Cory E. Angeroth, US Geological Survey.

The U.S. Geological Survey, in cooperation with the State of Utah, Department of Environmental Quality and Department of Natural Resources, operates a state-wide ground-water level and water quality monitoring program. This program collects water level information from a network of nearly 1,000 wells located across the state. Operated since 1964, this program provides a valuable long-term record of water level for managing the State's ground-water resources. Estimates of annual ground water withdrawal are also made as part of this program. During the summer irrigation season, water quality samples from approximately 100 wells are also collected. In 2014, 104 wells were sampled for major ions and select trace elements in the major aquifers across the state. Results from these monitoring programs are published in the annual ground-water conditions report, the 2015 publication enclosed for your library and available on the internet at http://ut.water.usgs.gov/publications/GW2015.pdf and http://www.waterrights.utah.gov/techinfo/ .

At our Board meeting Cory E. Angeroth of the U.S Geological Survey will give a short, informal presentation on the ground water monitoring program and be available to answer your questions.

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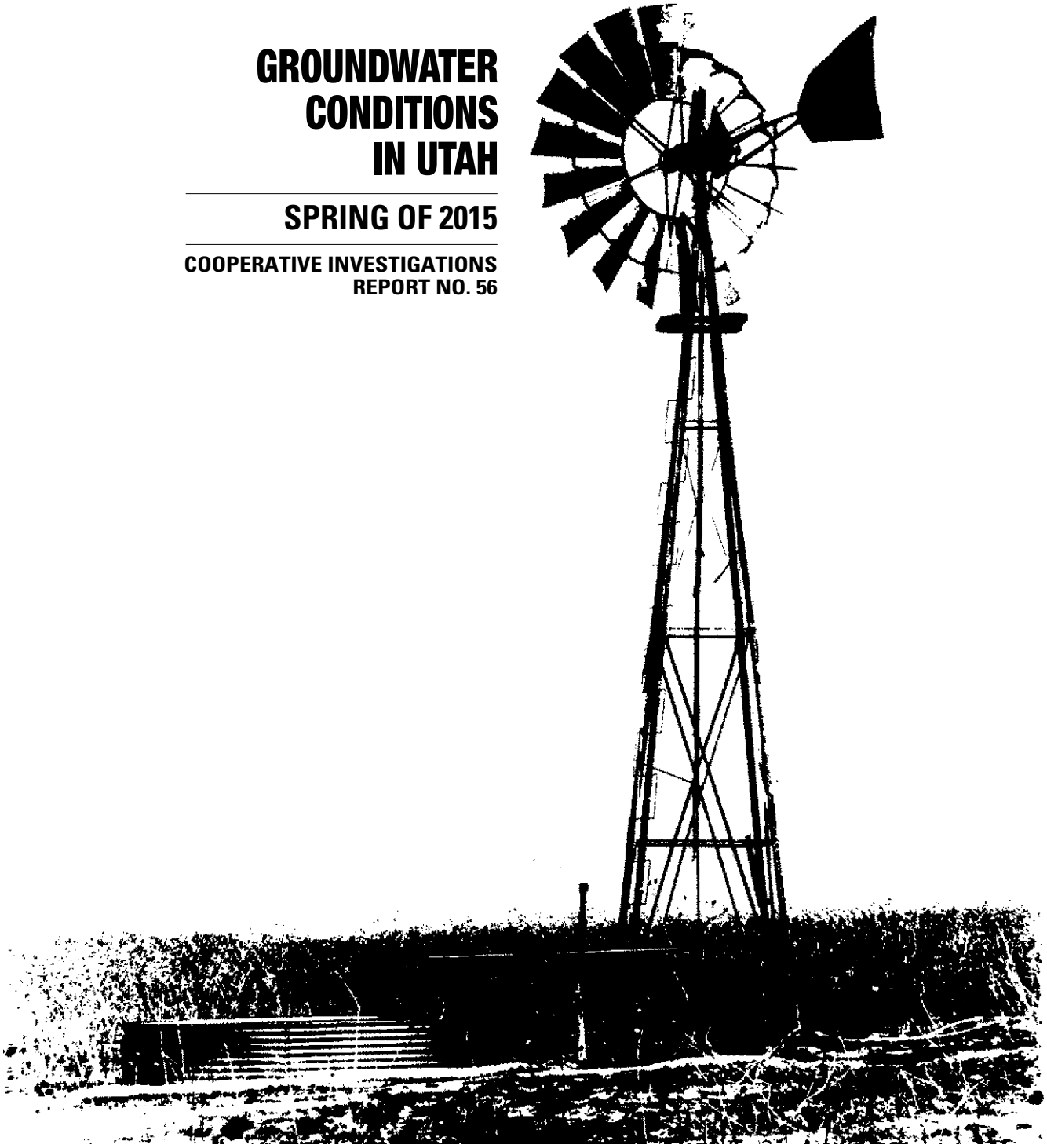
# GROUNDWATER CONDITIONS IN UTAH

## SPRING OF 2015

**COOPERATIVE INVESTIGATIONS REPORT NO. 56**



**UTAH DEPARTMENT OF NATURAL RESOURCES and UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY**

**U.S. GEOLOGICAL SURVEY**

# GROUNDWATER CONDITIONS IN UTAH, SPRING OF 2015

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

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

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2015

# Contents

Introduction ..... 1
Utah's Groundwater Reservoir ..... 1
Summary of Conditions ..... 2
Major Areas of Groundwater Development ..... 7
Curlew Valley ..... 7
Cache Valley ..... 13
East Shore Area ..... 19
Salt Lake Valley ..... 25
Tooele Valley ..... 32
Utah and Goshen Valleys ..... 38
Juab Valley ..... 46
Sevier Desert ..... 52
Central Sevier Valley ..... 61
Pahvant Valley ..... 67
Cedar Valley, Iron County ..... 74
Parowan Valley ..... 80
Escalante Valley ..... 86
Milford Area ..... 86
Beryl-Enterprise Area ..... 92
Central Virgin River Area ..... 98
Other Areas ..... 104
Quality of Water from Selected Wells in Utah, Summer of 2014 ..... 122
References Cited ..... 136

# Figures

1. Map showing areas of groundwater development in Utah specifically referred to in this report ..... 3
2. Map showing location of wells in Curlew Valley in which the water level was measured during March 2015 ..... 8
3. Graphs showing relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells ..... 9
4. Map showing water-level change in Curlew Valley from March 1985 to March 2015 ..... 12
5. Map showing location of wells in Cache Valley in which the water level was measured during March 2015 ..... 14
6. Graph showing 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 ..... 15
7. Map showing water-level change in Cache Valley from March 1985 to March 2015 ..... 18
8. Map showing location of wells in the East Shore area in which the water level was measured during March 2015 ..... 20
9. Graphs showing relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 ..... 21

10. Map showing water-level change in the East Shore area from March 1985 to March 2015 ... 24
11. Map showing location of wells in Salt Lake Valley in which the water level was measured during February 2015 ... 26
12. Graphs showing 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 ... 27
13. Graphs showing 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 ... 28
14. Map showing water-level change in Salt Lake Valley from February 1985 to February 2015 ... 31
15. Map showing location of wells in Tooele Valley in which the water level was measured during March 2015 ... 33
16. Graphs showing relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1 ... 34
17. Map showing water-level change in Tooele Valley from March 1985 to March 2015. ... 37
18. Map showing location of wells in Utah and Goshen Valleys in which the water level was measured during March 2015 ... 39
19. Graphs showing relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, Utah, and to concentration of dissolved solids in water from three wells ... 40
20. Map showing water-level change in Utah and Goshen Valleys from March 1985 to March 2015 ... 45
21. Map showing location of wells in Juab Valley in which the water level was measured during March 2015 ... 47
22. Graphs showing relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1 ... 48
23. Map showing water-level change in Juab Valley from March 1985 to March 2015 ... 51
24. Map showing location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2015 ... 53
25. Map showing location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2015 ... 54
26. Graphs showing 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 ... 55
27. Map showing water-level change in the shallow artesian aquifer in part of the Sevier Desert from March 1985 to March 2015 ... 59
28. Map showing water-level change in the deep artesian aquifer in part of the Sevier Desert from March 1985 to March 2015 ... 60
29. Map showing location of wells in central Sevier Valley in which the water level was measured during March 2015 ... 62
30. Graphs showing relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 ... 63
31. Map showing water-level change in central Sevier Valley from March 1985 to March 2015 ... 66
32. Map showing location of wells in Pahvant Valley in which the water level was measured during March 2015 ... 68
33. Graphs showing 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 ... 69
34. Map showing water-level change in Pahvant Valley from March 1985 to March 2015 ... 73

35. Map showing location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2015 ..... 75
36. Graphs showing relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells ..... 76
37. Map showing water-level change in Cedar Valley, Iron County, from March 1985 to March 2015 ..... 79
38. Map showing location of wells in Parowan Valley in which the water level was measured during March 2015 ..... 81
39. Graphs showing 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 ..... 82
40. Map showing water-level change in Parowan Valley from March 1985 to March 2015 ..... 85
41. Map showing location of wells in the Milford area in which the water level was measured during March 2015 ..... 87
42. Graphs showing 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 ..... 88
43. Map showing water-level change in the Milford area from March 1985 to March 2015 ..... 91
44. Map showing location of wells in the Beryl-Enterprise area in which the water level was measured during March 2015 ..... 93
45. Graphs showing relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3 ..... 94
46. Map showing water-level change in the Beryl-Enterprise area from March 1985 to March 2015 ..... 97
47. Map showing location of wells in the central Virgin River area in which the water level was measured during February 2015 ..... 99
48. Graphs showing relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2 ..... 100
49. Map showing water-level change in the central Virgin River area from February 1985 to February 2015 ..... 103
50. Map showing location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2015 ..... 105
51. Graphs showing relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Provo BYU ..... 106
52. Map showing water-level change in Cedar Valley, Utah County, from March 1985 to March 2015 ..... 107
53. Map showing location of wells in Sanpete Valley in which the water level was measured during March 2015 ..... 108
54. Graphs showing relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti ..... 109
55. Map showing water-level change in Sanpete Valley from March 1985 to March 2015 ..... 110
56. Map showing location of wells in Snake Valley in which the water level was measured during March 2015 ..... 111
57. Graphs showing relation of water level in selected wells in Snake Valley to cumulative departure from average annual precipitation at Callao ..... 112
58. Map showing water-level change in Snake Valley from March 1985 to March 2015 ..... 113
59. Graphs showing 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 ..... 114
60. Map showing location of groundwater sites sampled during the summer of 2014 ..... 123

# Tables

1. Areas of groundwater development in Utah specifically referred to in this report ..... 4
2. Number of wells constructed and estimated withdrawal of water from wells in Utah, 2014 ..... 5
3. Total annual withdrawal of water from wells in significant areas of groundwater development in Utah, 2004–2013 ..... 6
4. Estimated withdrawal of water from wells in other areas of Utah, 2014 ..... 104
5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2014 ..... 124
6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2014 ..... 132

# Conversion Factors, Datums, and Water-Quality Units

| Multiply | By | To obtain |
|---|---|---|
| acre-foot | 1,233 | cubic meter |
| foot | 0.3048 | meter |
| gallon per minute | 0.06301 | liter per second |
| inch | 2.54 | centimeter |
| mile | 1.609 | kilometer |
| square mile | 2.59 | square kilometer |

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

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

Specific conductance is a measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25 degrees Celsius. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids concentration in the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in microsiemens). This relation is not constant in water from one well or stream to another, and it may vary for the same source with changes in the composition of the water.

# Definition of Terms

**Acre-foot—**The quantity of water required to cover 1 acre to a depth of 1 foot—equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

**Aquifer—**A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield substantial amounts of water to wells and springs.

**Artesian—**Describes a well in which the water level stands above the top of the aquifer tapped by the well (confined). A flowing artesian well is one in which the water level is above the land surface.

**Average annual withdrawal—**Calculated average from estimated withdrawals, rounded to the nearest thousand acre-feet.

**Cumulative departure from average annual precipitation—**A graph of the departure or difference between the average annual precipitation and the value of precipitation for each year, plotted cumulatively. A cumulative plot is generated by adding the departure from average precipitation for the current year to the sum of departure values for all previous years in the period of record. A positive departure, or greater-than-average precipitation, for a year results in a graph segment trending upward; a negative departure results in a graph segment trending downward. A generally downward-trending graph for a period of years represents a period of generally less-than-average precipitation, which commonly causes and corresponds with declining water levels in wells. Likewise, a generally upward-trending graph for a period of years represents a period of greater-than-average precipitation, which commonly causes and corresponds with rising water levels in wells. However, increases or decreases in withdrawals of groundwater from wells also affect water levels and can change or eliminate the correlation between water levels in wells and the graph of cumulative departure from average precipitation.

**Dissolved—**Material in a representative water sample that passes through a 0.45–micron membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

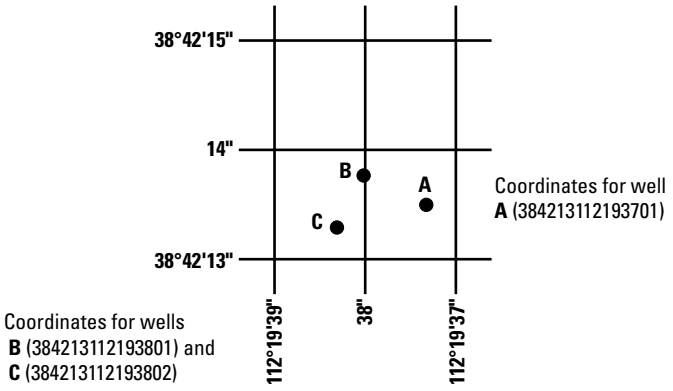
**Land-surface datum (lsd)—**A datum plane that is approximately at land surface at each groundwater observation well.

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

# Numbering System for Wells and Surface-Water Sites

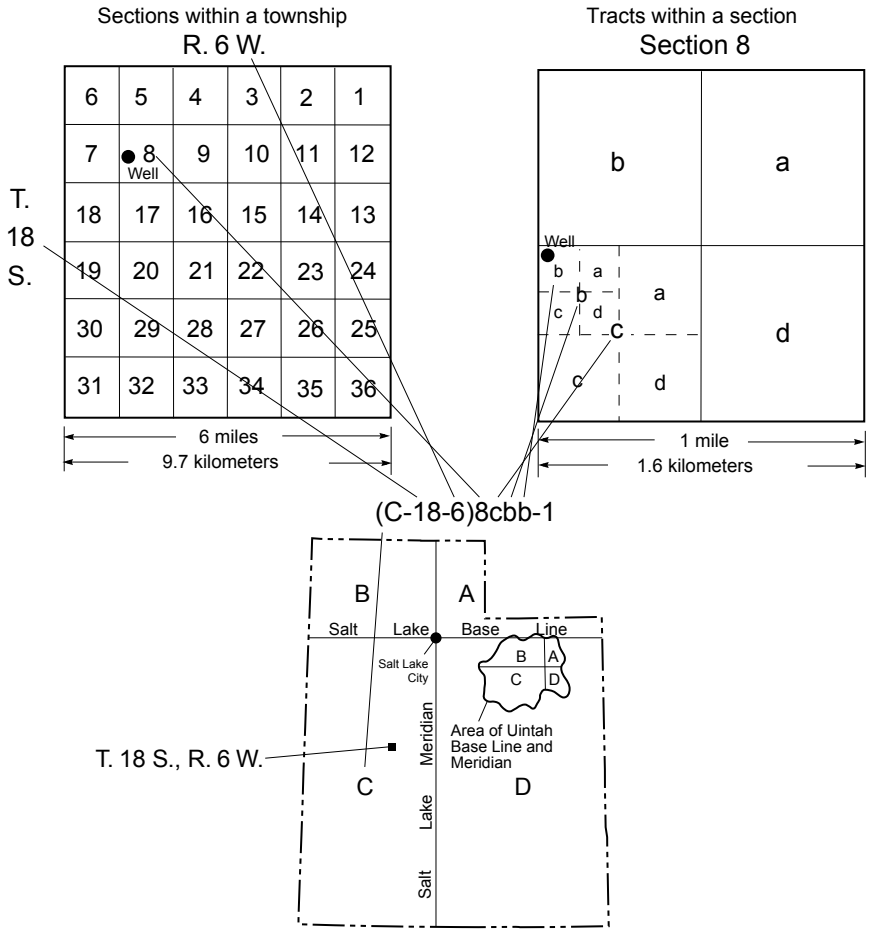
## Wells by Latitude and Longitude

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



## Wells by the Cadastral System of Land Subdivision

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




## Surface-Water Sites— Downstream Order and Station Number

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

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

# Groundwater Conditions in Utah, Spring of 2015

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

## Introduction

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

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

This report includes individual discussions of selected significant areas of groundwater development in the State for calendar year 2014. Most of the reported data were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights, and the Utah Department of Environmental Quality, Division of Water Quality. This report is also available online at *http://www.waterrights.utah.gov/techinfo/* and *http://ut.water.usgs.gov/publications/GW2015.pdf*. Groundwater conditions in Utah for calendar year 2013 are reported in Burden and others (2014) and are available online at *http://ut.water.usgs.gov/publications/GW2014.pdf*.

The water-level change maps in this report show the difference between water levels measured in the same well at two distinct times: in the spring of 1985 and the spring of 2015. Throughout the state, many groundwater levels were near their peak in or around 1985 following a multiple-year period of above average precipitation in the early 1980s. Conversely, consecutive years of significant drought have contributed to low groundwater levels in 2015. For these reasons, the difference between 1985 and 2015 groundwater levels may not accurately portray long-term changes in an aquifer. An evaluation of water-level trends should also include consideration of the annual water-level measurement plots provided for each of the major areas of groundwater development in this report.

## Utah's Groundwater Reservoir

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

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

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

# Summary of Conditions

The total estimated withdrawal of water from wells in Utah during 2014 was about 1,048,000 acre-feet (table 2), which is about 18,000 acre-feet more than the revised total for 2013 and 109,000 acre-feet more than the 2004–2013 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 597,000 acre-feet, which is about 39,000 acre-feet more than the revised total for 2013 (Burden and others, 2014). Withdrawal for industrial use was about 129,000 acre-feet, which is 12,000 acre-feet more than in 2013. Withdrawal for public-supply use was about 268,000 acre-feet, which is 25,000 acre-feet less than the value for 2013. Withdrawal for domestic and stock use was about 55,000 acre-feet, which is 5,000 acre-feet less than the total for 2013.

From 2013 to 2014, groundwater withdrawals increased in 9 of the 16 areas of groundwater development discussed in this report (table 2). Withdrawal in Pahvant Valley increased about 15,000 acre-feet, the largest increase in any of the groundwater development areas shown on figure 1. Withdrawal in Cache Valley decreased about 11,000 acre-feet, the largest decrease in any of the areas. The 2014 total withdrawal was more than the average annual withdrawal for 2004–2013 in 12 of the 16 areas (table 3).

The amount of water withdrawn from wells is related to demand and availability of water from other sources, which, in turn, are partly related to local climatic conditions. Precipitation during calendar year 2014 at 16 of 28 weather stations included in this report (Western Regional Climate Center, accessed July 1, 2015, at *http://www.wrcc.dri.edu*), was more than the long-term average. The greatest increase in precipitation from average was 6.8 inches at Laketown. The greatest decrease in precipitation from average was 3.4 inches at Blanding.

During February and March 2015, about 630 water-level measurements were made in wells for areas included in this report. Most water-level data included in the hydrographs for these wells are from measurements made during February and March, but may include some water-level measurements made in April and May. Many of the wells have additional water-level measurements made throughout the year which are not included in this report. All water-level data are available online at *http://nwis.waterdata.usgs.gov/ut/nwis/gwlevels*.

In 2014, 348 new wells were constructed, as determined by the Utah Division of Water Rights (table 2); this is 7 more wells than the total reported for 2013 (Burden and others, 2014). In 2014, 32 large-diameter wells (12 inches or more) were constructed (table 2), which is 2 more than the total reported for 2013. These new wells are used principally for withdrawal of water for public supply, irrigation, and industrial purposes.

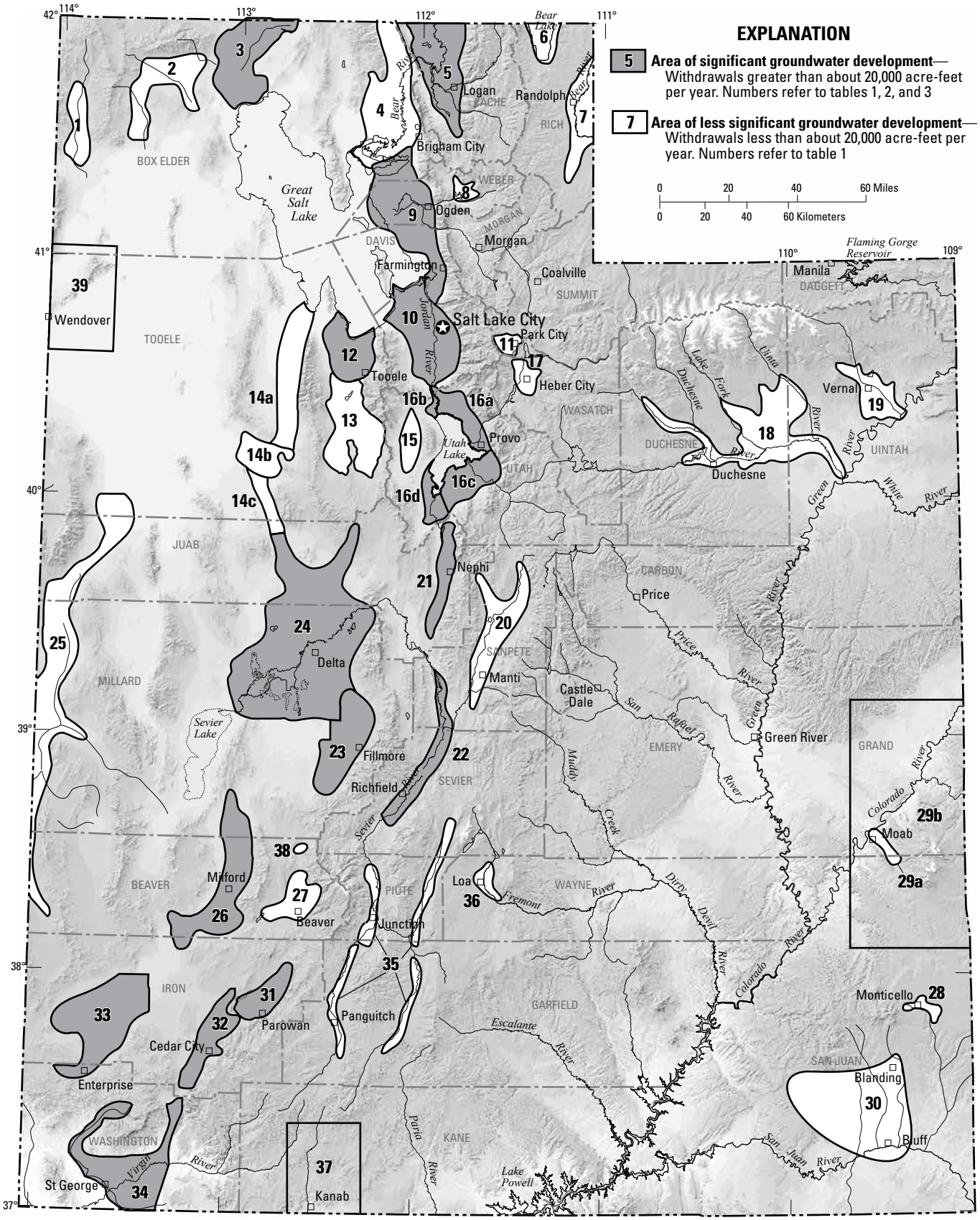



**Figure 1.** Areas of groundwater development in Utah specifically referred to in this report.

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

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

**Table 2.** Number of wells constructed and estimated withdrawal of water from wells in Utah, 2014.

| Area | Number in figure 1 | Number of wells[1] constructed in 2014 | | Estimated withdrawal from wells, in acre-feet (rounded) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2014 | | | | | 2013 total[2] |
| | | Total | Diameter of 12 inches or more | Irrigation | Industrial[1] | Public supply[1] | Domestic and stock | Total | |
| Curlew Valley | 3 | 1 | 0 | 35,000 | 0 | 200 | 100 | 35,000 | 40,000 |
| Cache Valley | 5 | 27 | 1 | 11,000 | 5,500 | 8,900 | 2,000 | 27,000 | 38,000 |
| East Shore area | 9 | 3 | 0 | 4,000 | 4,000 | 29,400 | 3,000 | 40,000 | 49,000 |
| Salt Lake Valley | 10 | 6 | 4 | 600 | [3] 41,200 | 80,800 | 22,000 | 145,000 | 153,000 |
| Tooele Valley | 12 | 18 | 0 | [4, 5] 10,000 | 400 | 11,000 | 1,100 | 22,000 | 25,000 |
| Utah and Goshen Valleys | 16 | 28 | 2 | 31,200 | 10,300 | 53,000 | 12,400 | 107,000 | [6] 115,000 |
| Northern Utah Valley-east[7] | 16a | (7) | (2) | (2,000) | (7,000) | (36,400) | (4,000) | (49,400) | (56,200) |
| Northern Utah Valley-west[7] | 16b | (0) | (0) | (0) | (0) | (2,400) | (2,000) | (4,400) | (3,900) |
| Southern Utah Valley[7] | 16c | (21) | (0) | (7,000) | (3,300) | (14,000) | (6,300) | (30,600) | (35,200) |
| Goshen Valley[7] | 16d | (0) | (0) | (22,200) | (0) | (200) | (60) | (22,500) | [6] (19,500) |
| Juab Valley | 21 | 6 | 0 | 28,000 | 100 | [8] 720 | 470 | 29,000 | 27,000 |
| Sevier Desert | 24 | 9 | 1 | 43,900 | 7,100 | 1,500 | 890 | 53,000 | [6] 46,000 |
| Central Sevier Valley | 22 | 9 | 0 | 26,600 | 60 | 3,200 | 840 | 31,000 | 28,000 |
| Pahvant Valley | 23 | 3 | 1 | 117,000 | 0 | 800 | 320 | 118,000 | 103,000 |
| Cedar Valley, Iron County | 32 | 8 | 1 | 32,600 | 100 | 7,700 | 2,400 | 43,000 | 39,000 |
| Parowan Valley | 31 | 4 | 3 | [9] 35,600 | 1,400 | 440 | 350 | 38,000 | 32,000 |
| Escalante Valley | | | | | | | | | |
| Milford area | 26 | 5 | 3 | 45,700 | [10] 20,700 | 730 | 130 | 67,000 | 68,000 |
| Beryl-Enterprise area | 33 | 21 | 7 | 97,500 | [11] 4,100 | 570 | 650 | 103,000 | 93,000 |
| Central Virgin River area | 34 | 2 | 0 | 6,800 | 570 | 21,000 | 2,400 | 31,000 | 29,000 |
| Other areas[12, 13] | | 198 | 9 | 71,400 | 33,300 | 47,600 | 6,500 | 159,000 | 145,000 |
| Total (rounded) | | 348 | 32 | 596,900 | 128,800 | 267,600 | 55,600 | 1,048,000 | [6] 1,030,000 |

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

[2] From Burden and others (2014, table 2).

[3] Includes some use for air conditioning, about 2,700 acre-feet, of which 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] Numbers for Northern Utah Valley-east, Northern Utah Valley-west, Southern Utah Valley, and Goshen Valley, presented within parentheses, are a subtotal of withdrawal.

[8] Previously included some springs.

[9] Includes some stock use.

[10] Includes 18,000 acre-feet for geothermal power generation, of which about 99 percent was injected back into the aquifer.

[11] Includes 2,810 acre-feet for heating greenhouses, of which about 95 percent was injected back into the aquifer.

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

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

**Table 3.** Total annual withdrawal of water from wells in significant areas of groundwater development in Utah, 2004–2013.

| Area | Number in figure 1 | Thousands of acre-feet[1] (rounded) | | | | | | | | | | 2004–2013 average (rounded) | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | | |
| Curlew Valley | 3 | 38 | 29 | 31 | 38 | 44 | 34 | 39 | 32 | 42 | 40 | 37 | 35 |
| Cache Valley | 5 | 27 | 29 | 31 | 36 | 34 | 31 | 33 | 30 | 38 | 38 | 33 | 27 |
| East Shore area | 9 | 46 | 41 | 46 | 52 | 54 | 46 | 43 | 37 | 46 | 49 | 46 | 40 |
| Salt Lake Valley | 10 | 125 | 110 | 131 | 151 | 135 | 137 | 140 | 126 | 167 | 153 | 138 | 145 |
| Tooele Valley | 12 | 21 | [2] 18 | [2] 21 | [2] 27 | [2] 28 | 25 | 24 | 21 | 30 | 25 | 24 | 22 |
| Utah and Goshen Valleys | 16 | [2] 105 | [2] 87 | [2] 99 | 126 | [2] 120 | [2] 105 | [2] 106 | [2] 90 | [2] 113 | [2] 115 | 107 | 107 |
| Northern Utah Valley[3] | 16a,b | [2] (66) | [2] (46) | (58) | (72) | [2] (67) | [2] (60) | [2] (58) | [2] (45) | [2] (62) | (60) | (59) | (54) |
| Southern Utah Valley[3] | 16c | (30) | (31) | (29) | (38) | (34) | (30) | (31) | (28) | [2] (35) | (35) | (32) | (31) |
| Goshen Valley[3] | 16d | (9) | (10) | (12) | (16) | (19) | (15) | (17) | (17) | [2] (16) | [2] (20) | (15) | (22) |
| Juab Valley | 21 | 26 | 14 | 21 | 26 | 26 | 21 | 22 | 15 | 28 | 27 | 23 | 29 |
| Sevier Desert | 24 | 41 | 24 | 20 | 34 | 44 | 48 | 46 | 20 | 24 | [2] 46 | 35 | 53 |
| Central Sevier Valley | 22 | 15 | 17 | 16 | 19 | 24 | 27 | 26 | 31 | 28 | 28 | 23 | 31 |
| Pahvant Valley | 23 | 85 | 80 | 86 | 89 | 94 | 104 | 106 | 89 | 114 | 103 | 95 | 118 |
| Cedar Valley, Iron County | 32 | 40 | 30 | 35 | 40 | 40 | 38 | 38 | 34 | 40 | 39 | 37 | 43 |
| Parowan Valley | 31 | 37 | 27 | 33 | 34 | 38 | 37 | 34 | 32 | 38 | 32 | 34 | 38 |
| Escalante Valley | | | | | | | | | | | | | |
| Milford area | 26 | 44 | 40 | 45 | 49 | 51 | 56 | 62 | 53 | 67 | 68 | 54 | 67 |
| Beryl-Enterprise area | 33 | 98 | 68 | 79 | 92 | 93 | 93 | 90 | 84 | 91 | 93 | 88 | 103 |
| Central Virgin River area | 34 | 26 | 29 | 32 | 33 | 29 | 33 | 29 | 28 | 29 | 29 | 30 | 31 |
| Other areas | | 129 | 111 | 130 | 155 | 144 | 130 | 134 | 123 | 156 | 145 | 136 | 159 |
| Total (rounded) | | [2] 903 | [2] 754 | [2] 856 | [2] 1,001 | [2] 998 | [2] 965 | [2] 972 | [2] 845 | [2] 1,051 | [2] 1,030 | 940 | 1,048 |

[1] From previous reports in this series.
[2] Revised.
[3] Numbers for Northern Utah Valley, Southern Utah Valley, and Goshen Valley, presented within parentheses, are a subtotal of withdrawal.

# Major Areas of Groundwater Development

## Curlew Valley

By Adam S. Birken

The Curlew Valley drainage basin extends across the Utah-Idaho state line and includes the communities of Cedar Creek, Kelton, and Snowville (fig. 2). The valley is bounded on the west and east by the Raft River and Hansel Mountains, which range in altitude from about 6,500 to nearly 10,000 feet. The valley is open to the south, where water draining from it enters Great Salt Lake. The Utah part of Curlew Valley (Utah subbasin) covers about 550 square miles in Box Elder County. It is an arid to semiarid, largely uninhabited area, with a community center at Snowville.

The principal source of water in Curlew Valley is groundwater. The groundwater reservoir consists primarily of confined 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 2014 was about 35,000 acre-feet, which is 5,000 acre-feet less than the value for 2013 and 2,000 acre-feet less than the average annual withdrawal for 2004–2013 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2015 is shown in figure 2. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Oakley, Idaho (62 miles northwest of Snowville), to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3.

Precipitation at Oakley, Idaho (62 miles northwest of Snowville) in 2014 was about 16.0 inches, which is 7.2 inches more than in 2013 and 5.0 inches more than the average annual precipitation for 1930–2014.

Water levels in Curlew Valley generally declined from March 2014 to March 2015. The largest decline, about 1.7 feet, occurred in a well about 4 miles west of Snowville. These declines are most likely the result of large localized withdrawals for irrigation.

Water levels declined from March 1985 to March 2015 in all areas of Curlew Valley for which data are available (fig. 4). The largest decline, more than 87 feet, occurred in a well about 4 miles west of Snowville. Declines are probably the result of continued large withdrawals for irrigation.

The concentration of dissolved solids in water samples collected from well (B-12-11)8abb-1, located 3 miles north of Kelton, and well (B-14-9)5bbb-1, located 10 miles west of Snowville, from 1972–2014 and 1971–2014, respectively, is shown in figure 3. The dissolved-solids concentration in water from well (B-12-11)8abb-1 increased substantially from July 2013 to June 2014; the 2014 concentration is the maximum on record (4,790 mg/L). Dissolved-solids concentrations in water from both wells have generally increased since the early 1970s.

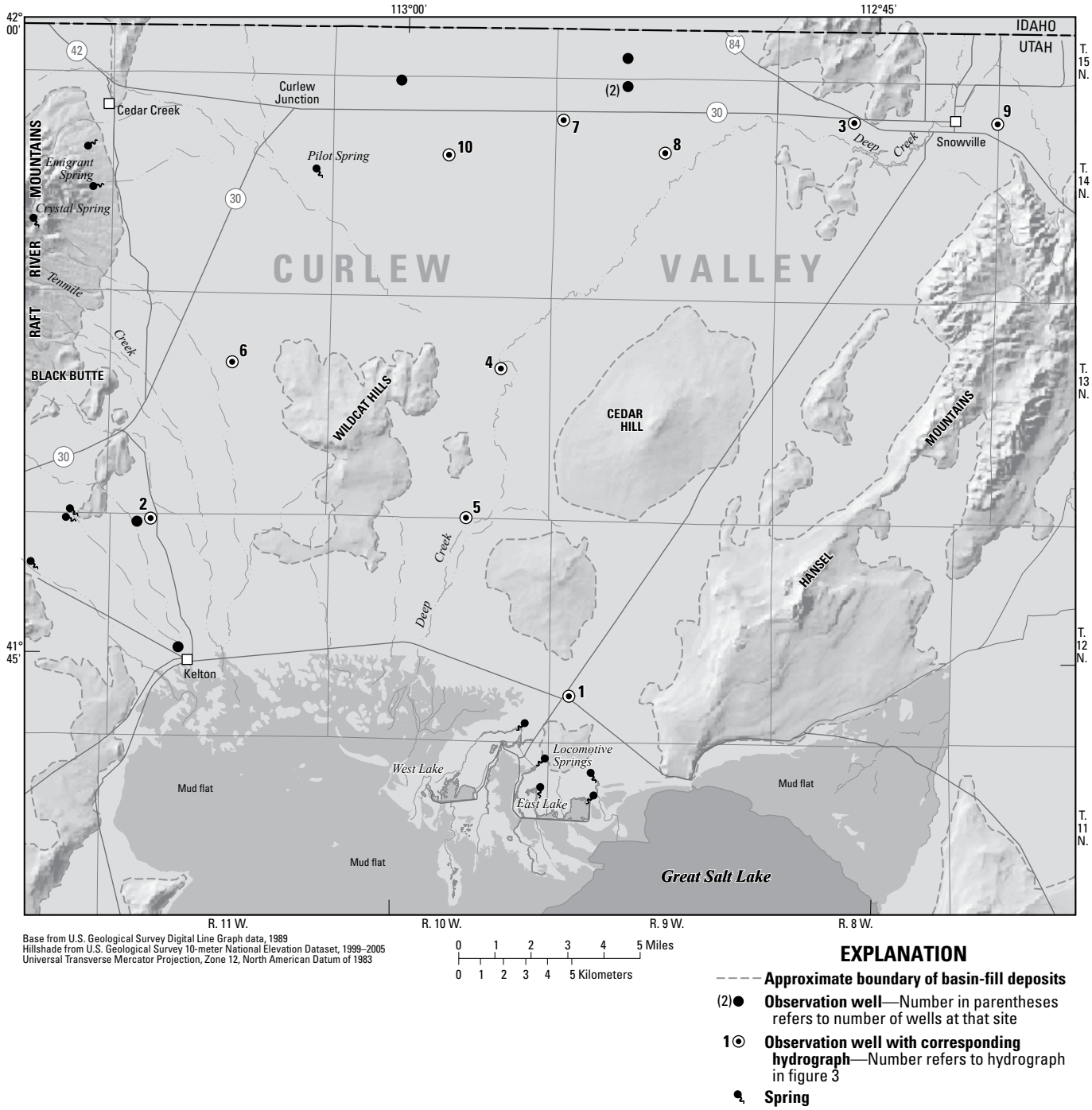



**Figure 2.** Location of wells in Curlew Valley in which the water level was measured during March 2015.

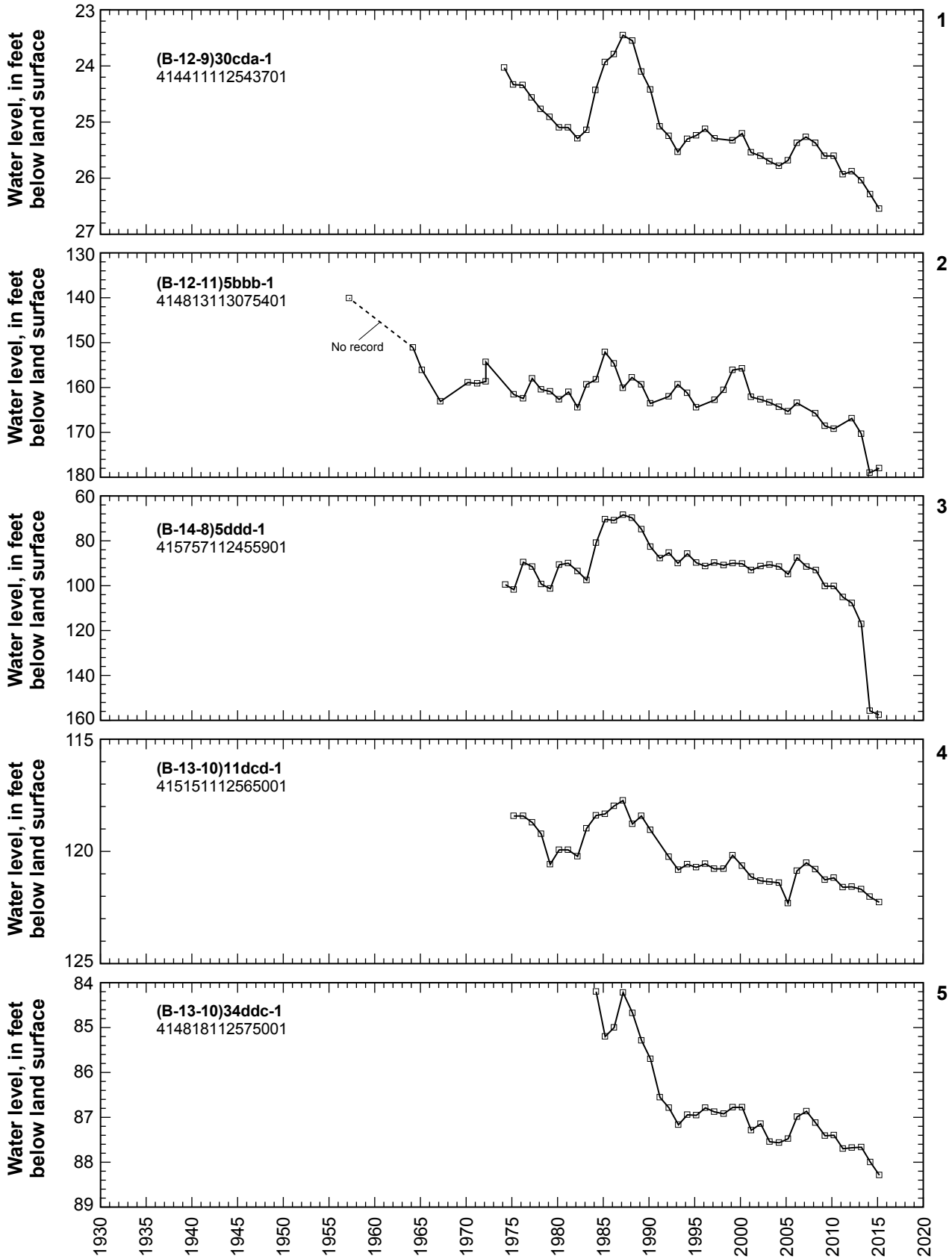



**Figure 3.** Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

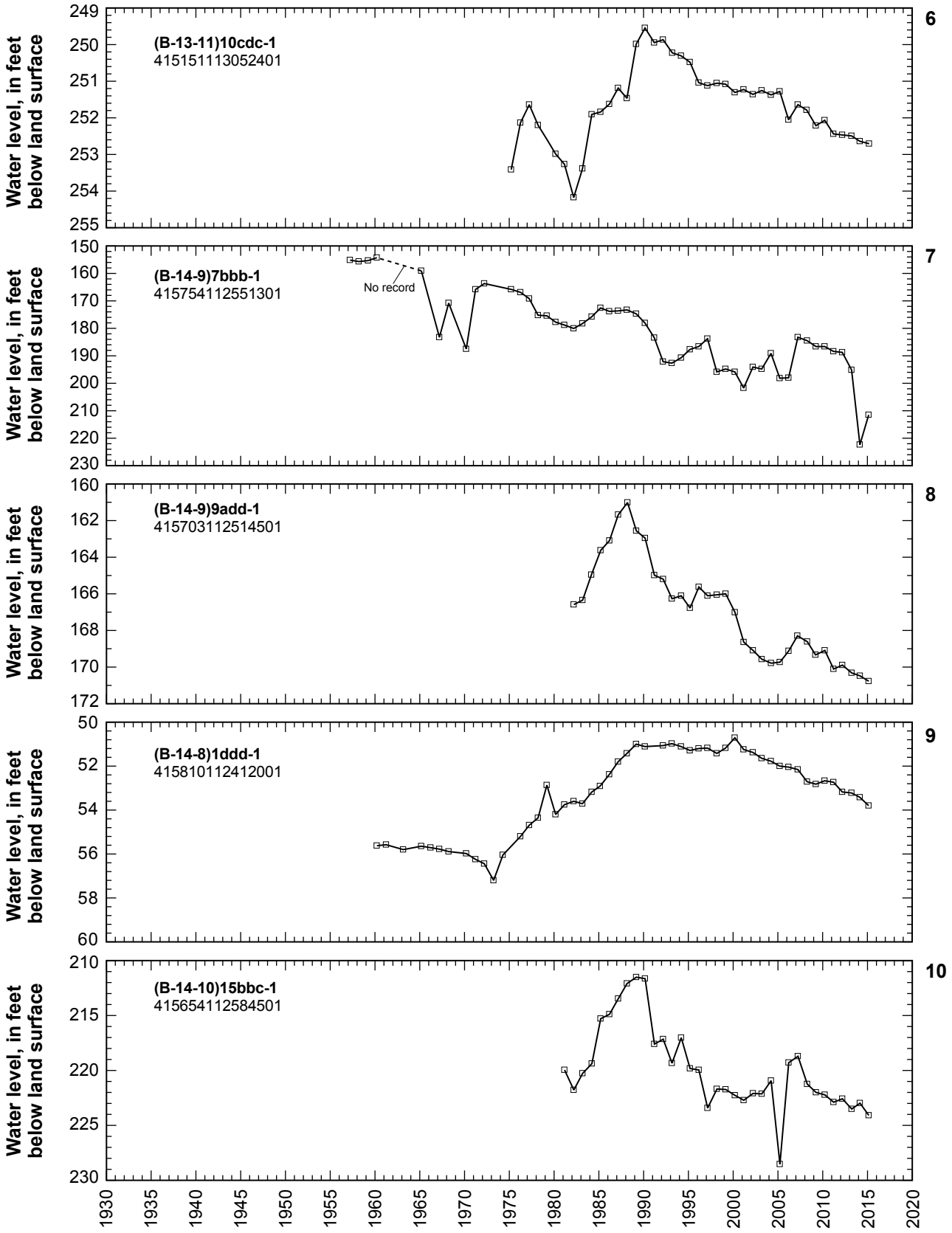



**Figure 3.** Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

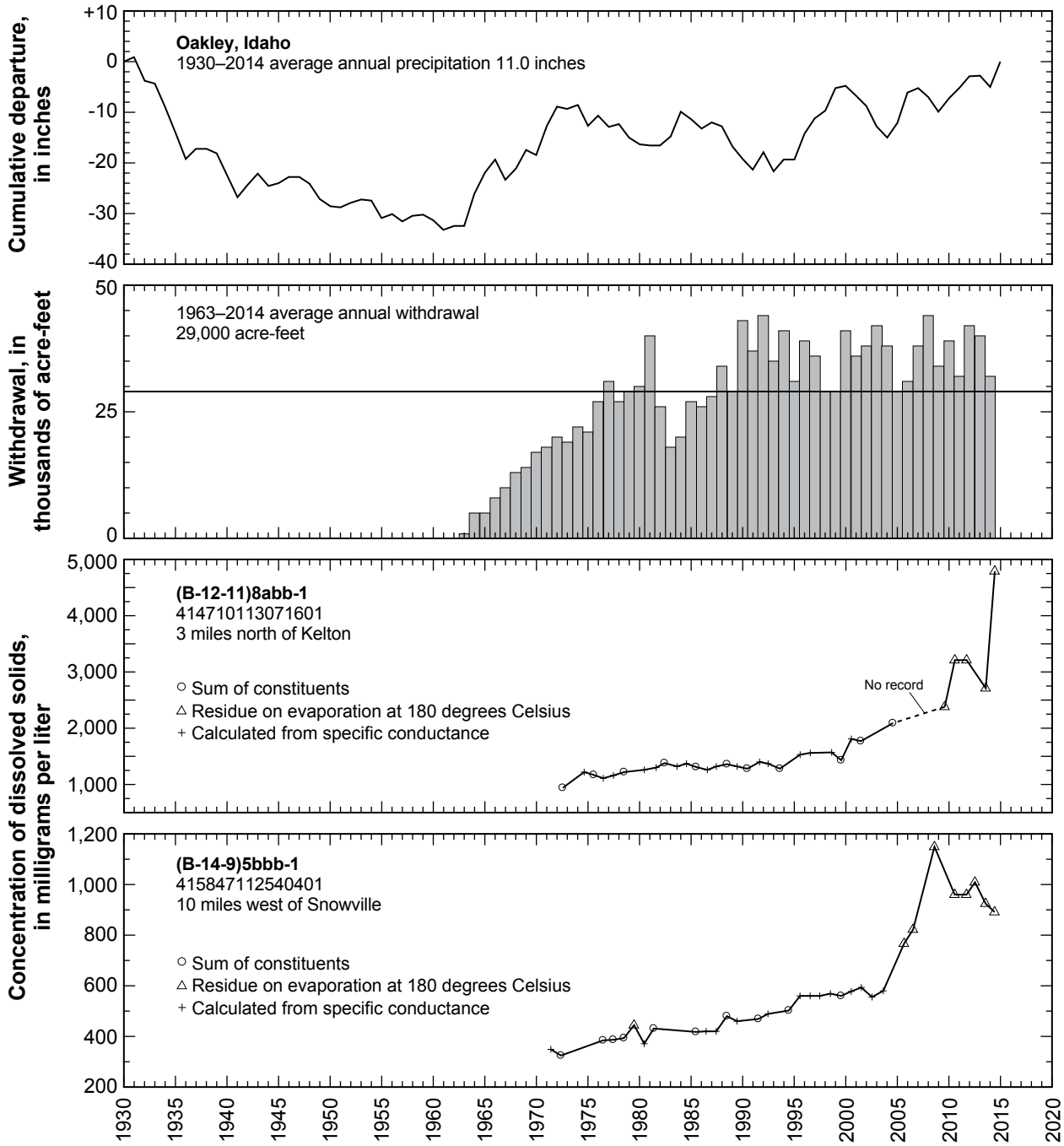



**Figure 3.** Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

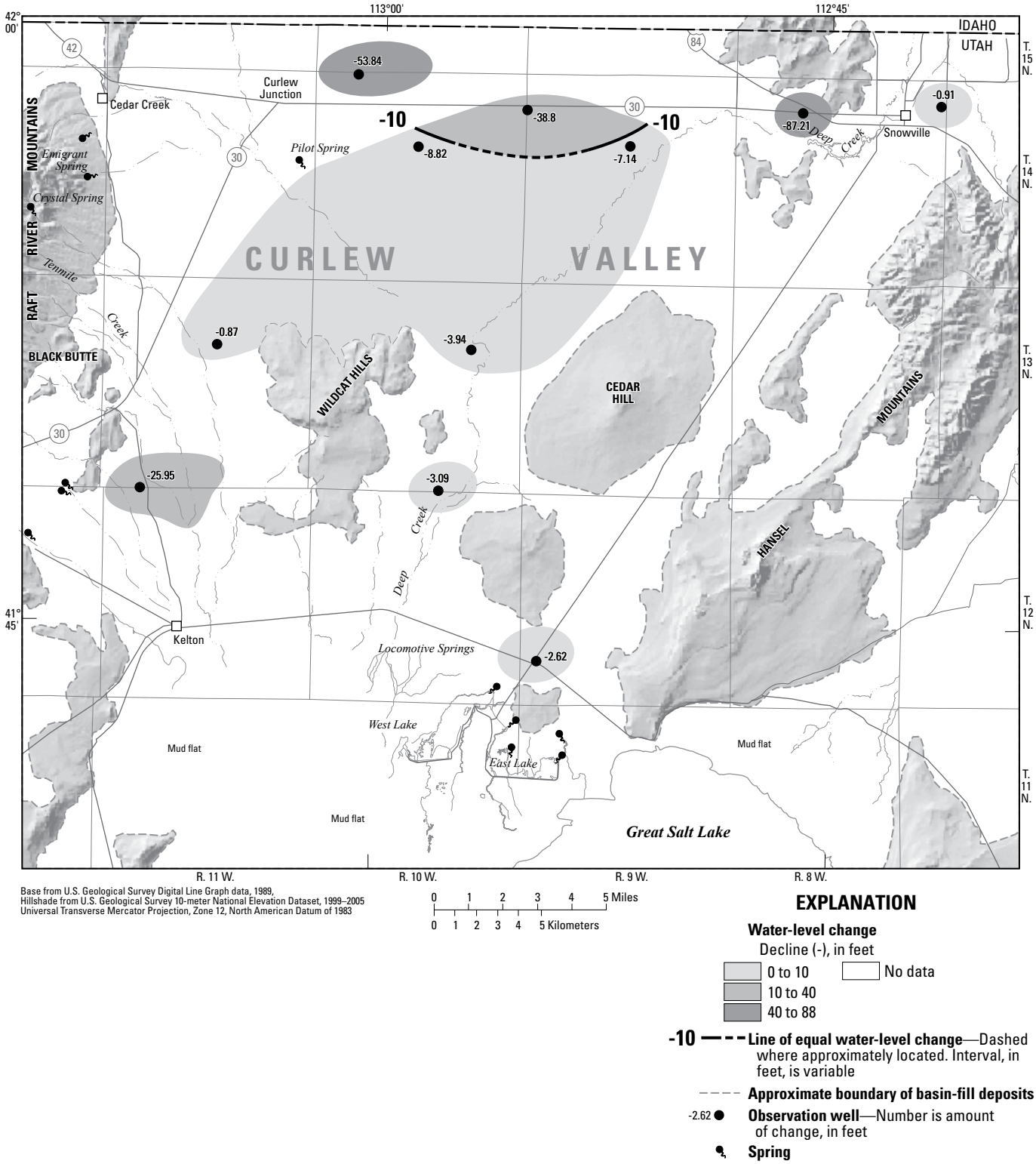



**Figure 4.** Water-level change in Curlew Valley from March 1985 to March 2015.

## Cache Valley

By John P. Carricaburu

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

Total estimated withdrawal of water from wells in Cache Valley in 2014 was about 27,000 acre-feet, which is 11,000 acre-feet less than in 2013 and 6,000 acre-feet less than the average annual withdrawal for 2004–2013 (tables 2 and 3). Withdrawal for irrigation was 11,000 acre-feet, of which an estimated 9,000 acre-feet was from flowing wells. Irrigation withdrawals were 6,500 acre-feet less than in 2013. Withdrawal for public supply was 8,900 acre-feet, which is 4,200 acre-feet less than in 2013.

The location of wells in Cache Valley in which the water level was measured during March 2015 is shown in figure 5. The relation of the water level in selected observation wells to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1 is shown in figure 6.

Total discharge of the Logan River (combined flow from the Logan River above State Dam and Cache Highline Canal, near Logan) during 2014 was about 144,200 acre-feet, which is 42,200 acre-feet more than the 2013 total and 34,800 acre-feet less than the 1941–2014 average annual discharge. Precipitation at Logan, Utah State University, was about 19.2 inches in 2014. This is about 7.4 inches more than for 2013 and about 1.0 inch more than the average annual precipitation for 1930–2014.

Water levels throughout the valley generally rose from March 2014 to March 2015. Rises are probably the result of greater-than-average precipitation and less-than-average withdrawals. Water levels have fluctuated over the entire period of record, as far back as 1935 in many cases, depending on the amount and timing of precipitation, and recharge to the unconsolidated deposits from snowmelt runoff.

Water levels declined from March 1985 to March 2015 in most parts of Cache Valley for which data are available (fig. 7). The largest decline, about 12.4 feet, occurred in a well northeast of Hyrum. Declines are probably the result of continued large withdrawals.

The concentration of dissolved solids in water samples collected during 1970 to 2014 from well (A-13-1)29bcd-1, located 1.5 miles west of Smithfield, is shown in figure 6. The concentration has ranged from 215 to 278 mg/L, with a median value of 258 mg/L. The dissolved-solids concentration from the August 2014 sample was the lowest on record.

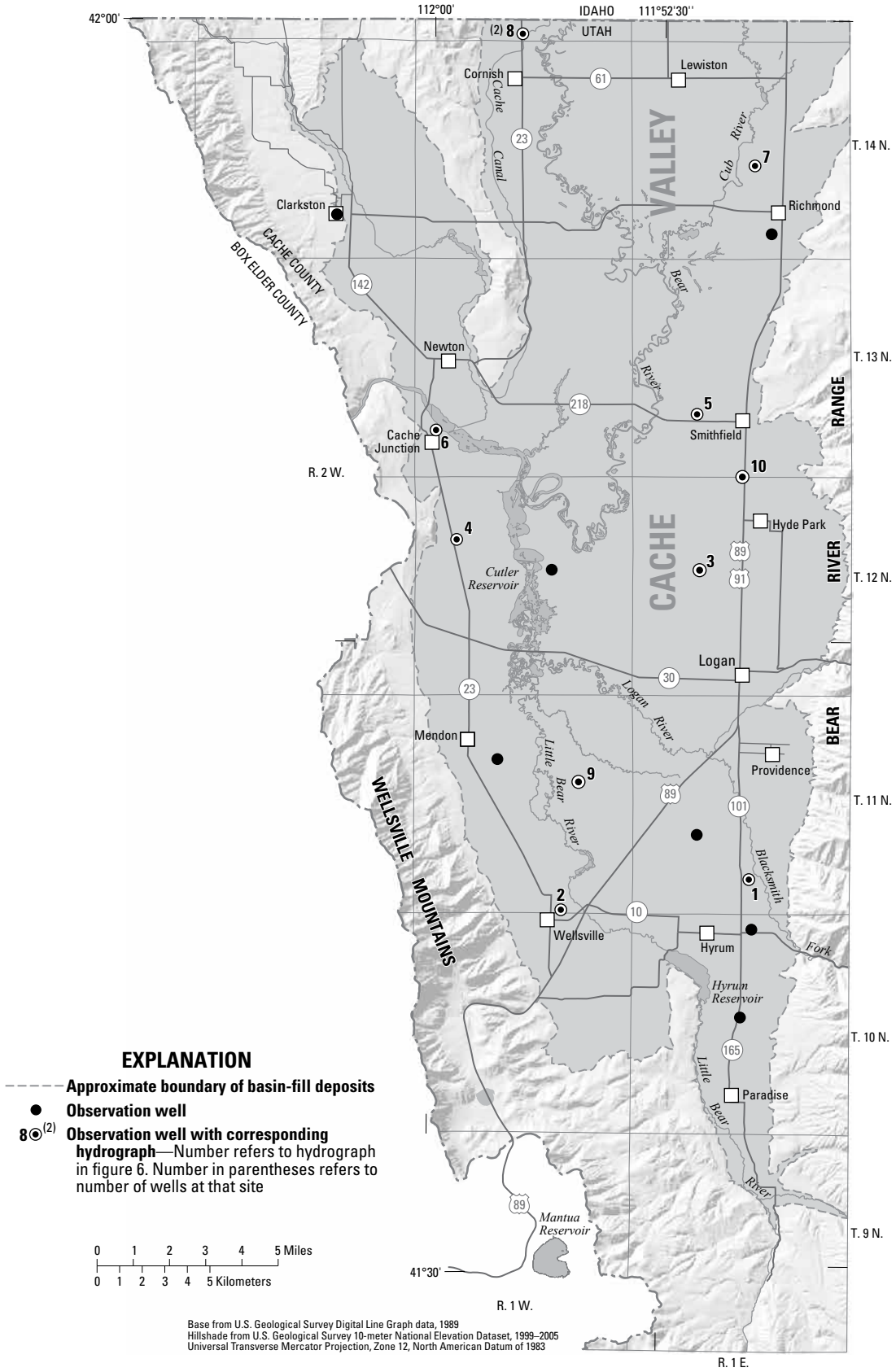



**Figure 5.** Location of wells in Cache Valley in which the water level was measured during March 2015.

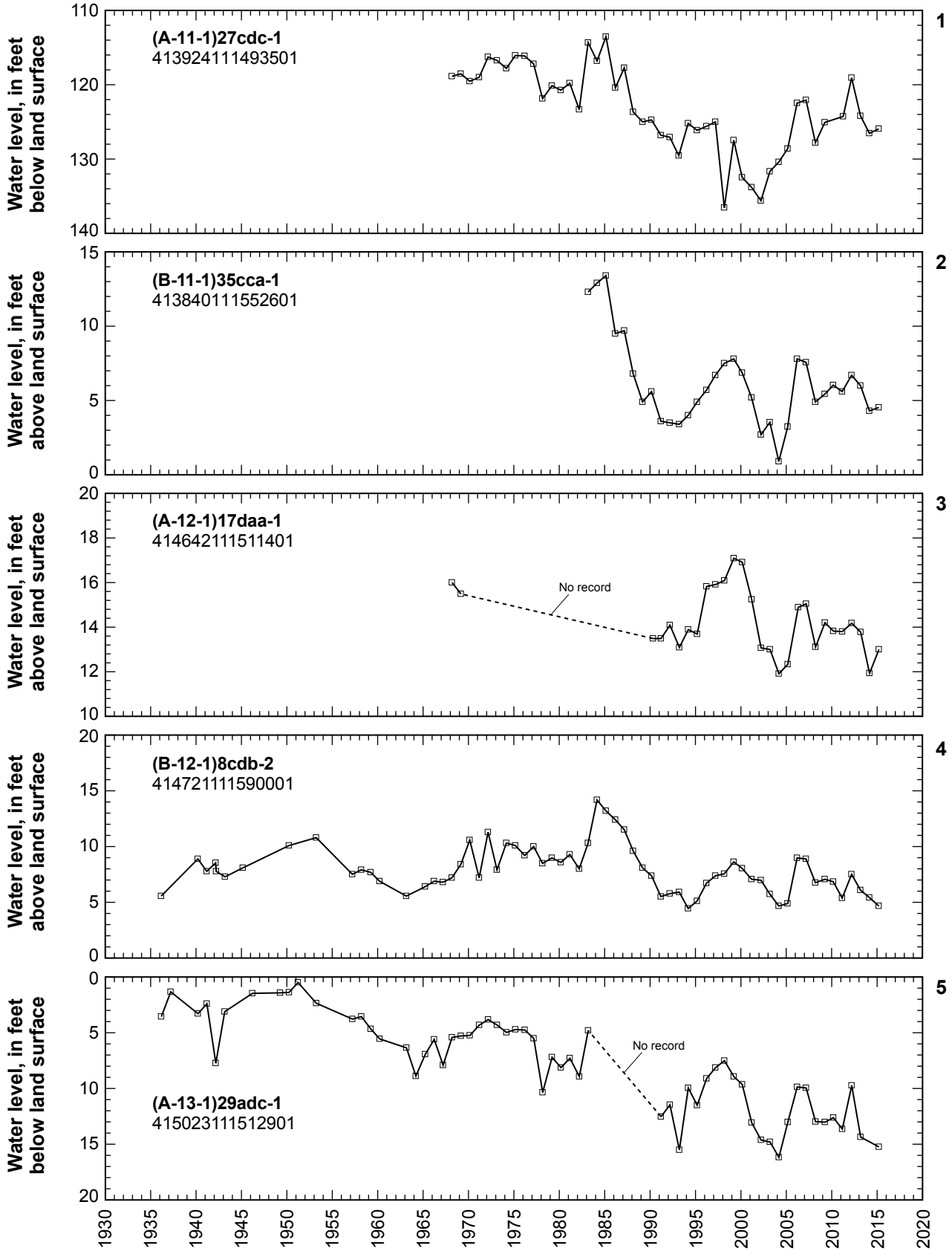



**Figure 6.** Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water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

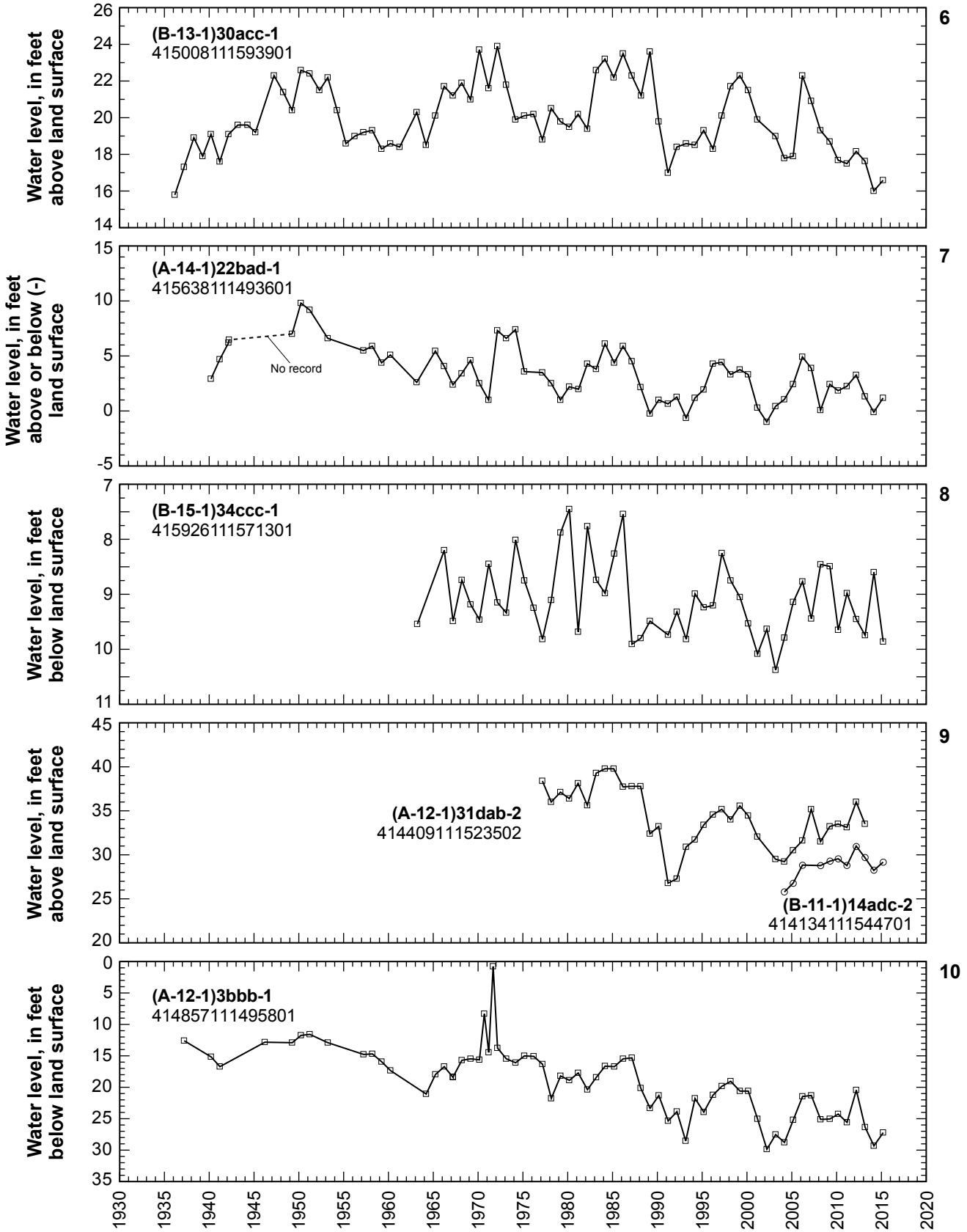



**Figure 6.** Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water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

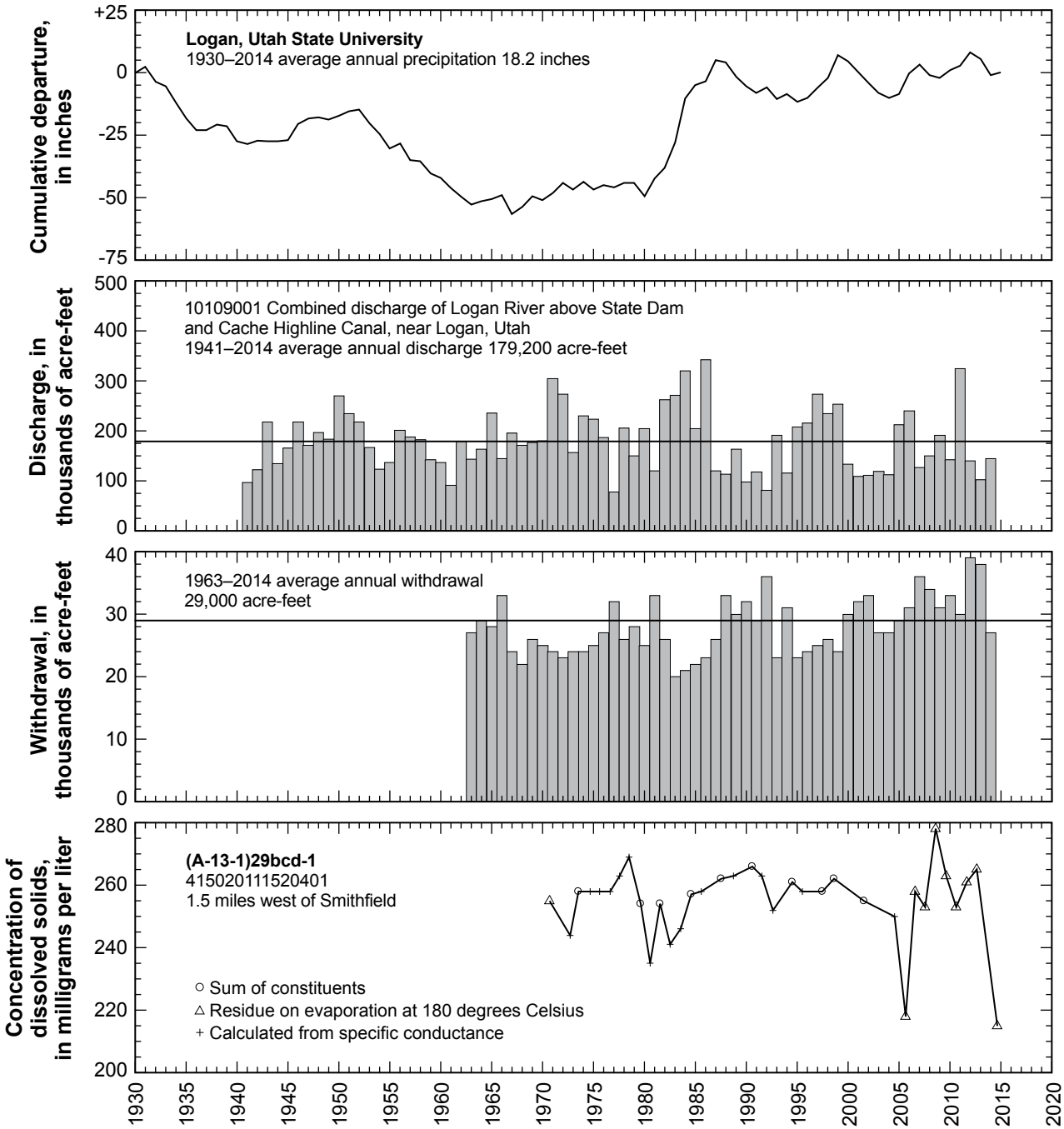



**Figure 6.** Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water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

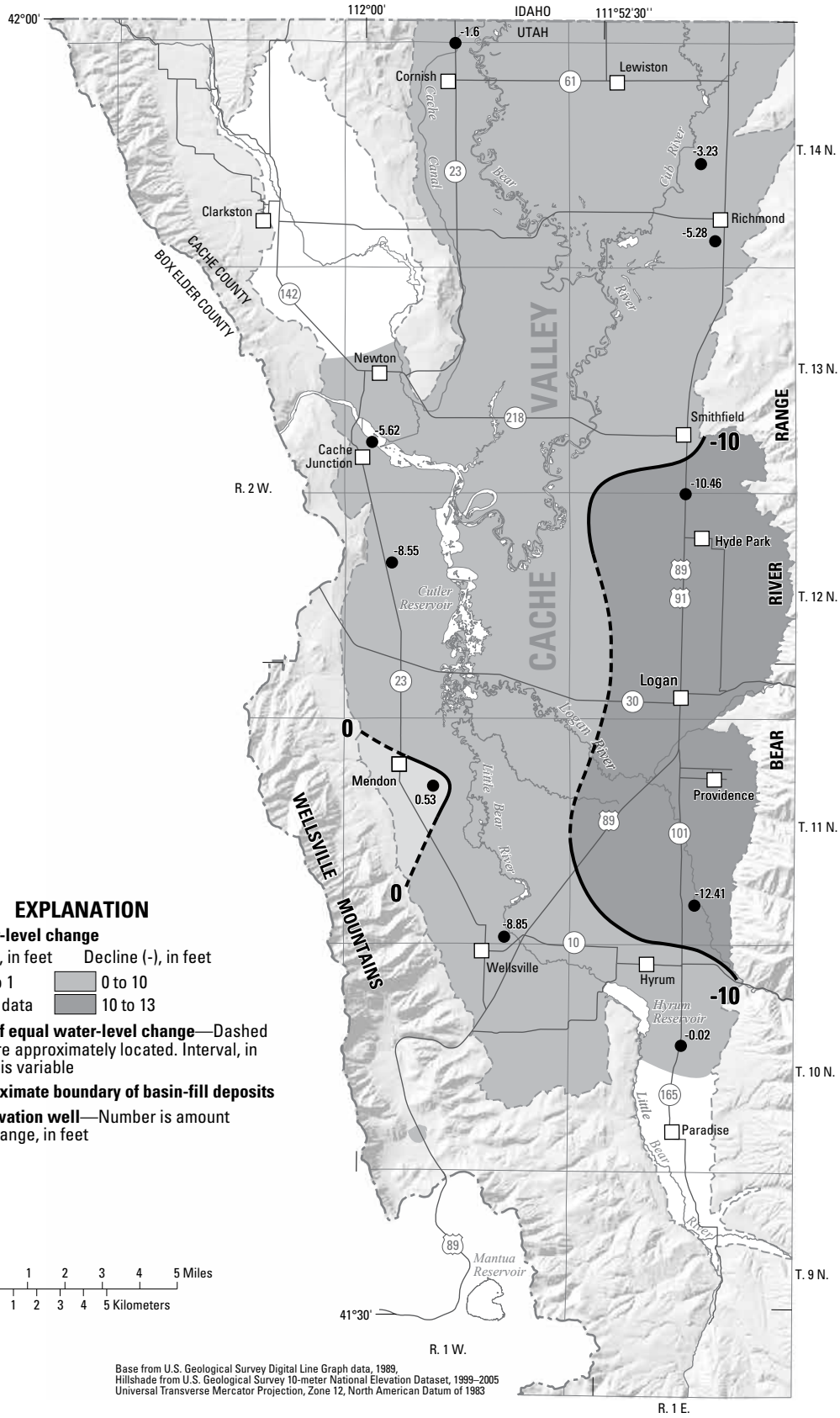



**Figure 7.** Water-level change in Cache Valley from March 1985 to March 2015.

## East Shore Area

By Martel J. Fisher

The East Shore area is in north-central Utah between the Wasatch Range and Great Salt Lake within Davis, Weber, and Box Elder Counties (fig. 8). Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions, but most of the water withdrawn by wells is from the artesian aquifers. Water enters the artesian aquifers along the contact between the Wasatch Range and the eastern edge of the basin-fill deposits, and generally moves westward toward Great Salt Lake.

Total estimated withdrawal of water from wells in the East Shore area in 2014 was about 40,000 acre-feet, which is 9,000 acre-feet less than was reported for 2013 and 6,000 acre-feet less than the average annual withdrawal for 2004–2013 (tables 2 and 3). Withdrawal for public supply was 29,400 acre-feet in 2014, about 4,300 acre-feet less than in 2013. Withdrawal for irrigation was about 4,000 acre-feet, which is 2,800 acre-feet less than was reported for 2013. Withdrawal for industrial use was also about 4,000 acre-feet, which is 700 acre-feet more than in 2013.

The location of wells in the East Shore area in which the water level was measured during March 2015 is shown in figure 8. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 9.

Precipitation at Pineview Dam in 2014 was about 31.2 inches, which is about 0.7 inch more than the average annual precipitation for 1949–2014 and about 12.5 inches more than in 2013.

Water levels declined from March 2014 to March 2015 in most of the wells measured in the East Shore area. Declines are probably due to continued large withdrawals for public-supply use. Water levels have generally declined since the mid-1980s in wells south of Kaysville and have generally declined since the mid-1950s in wells north of Kaysville.

Water levels declined from March 1985 to March 2015 in all areas of the East Shore area for which data are available (fig. 10). The largest decline, more than 36 feet, occurred in a well in the Bountiful area. Declines are probably the result of continued large withdrawals.

The concentration of dissolved solids in water samples collected from well (B-4-2)27aba-1, located 2.3 miles south-southeast of Syracuse, from 1969 to 2014, is shown in figure 9. The median concentration during this period was 393 mg/L. From 1969 to 1993, dissolved-solids concentrations in water samples ranged from 287 to 633 mg/L. Dissolved-solid concentrations in water samples collected from 1995 to 2014 were much less variable, ranging from 362 to 399 mg/L. The dissolved-solids concentration in the water sample collected in June 2014 (388 mg/L) was similar to the median concentration.

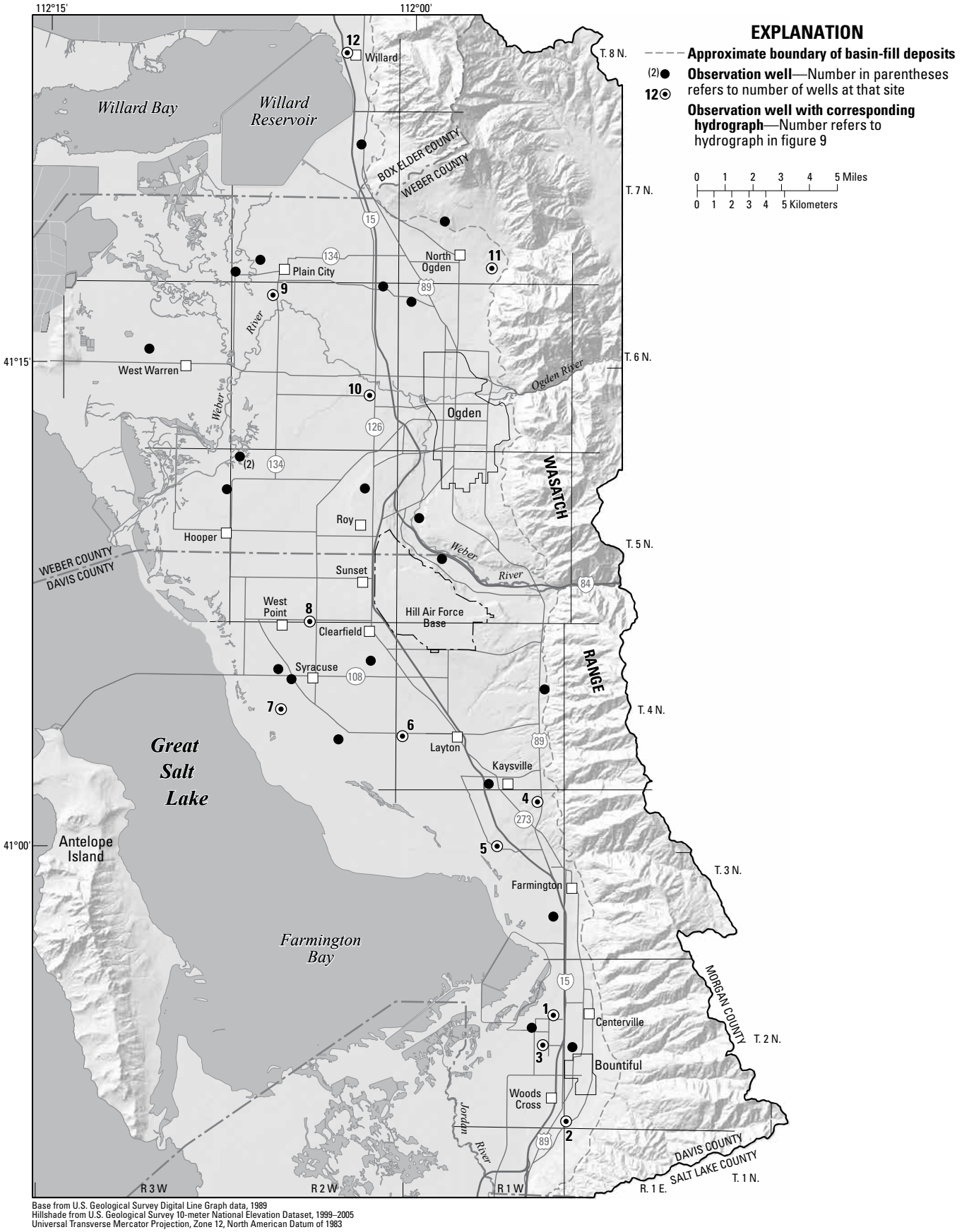



**Figure 8.** Location of wells in the East Shore area in which the water level was measured during March 2015.

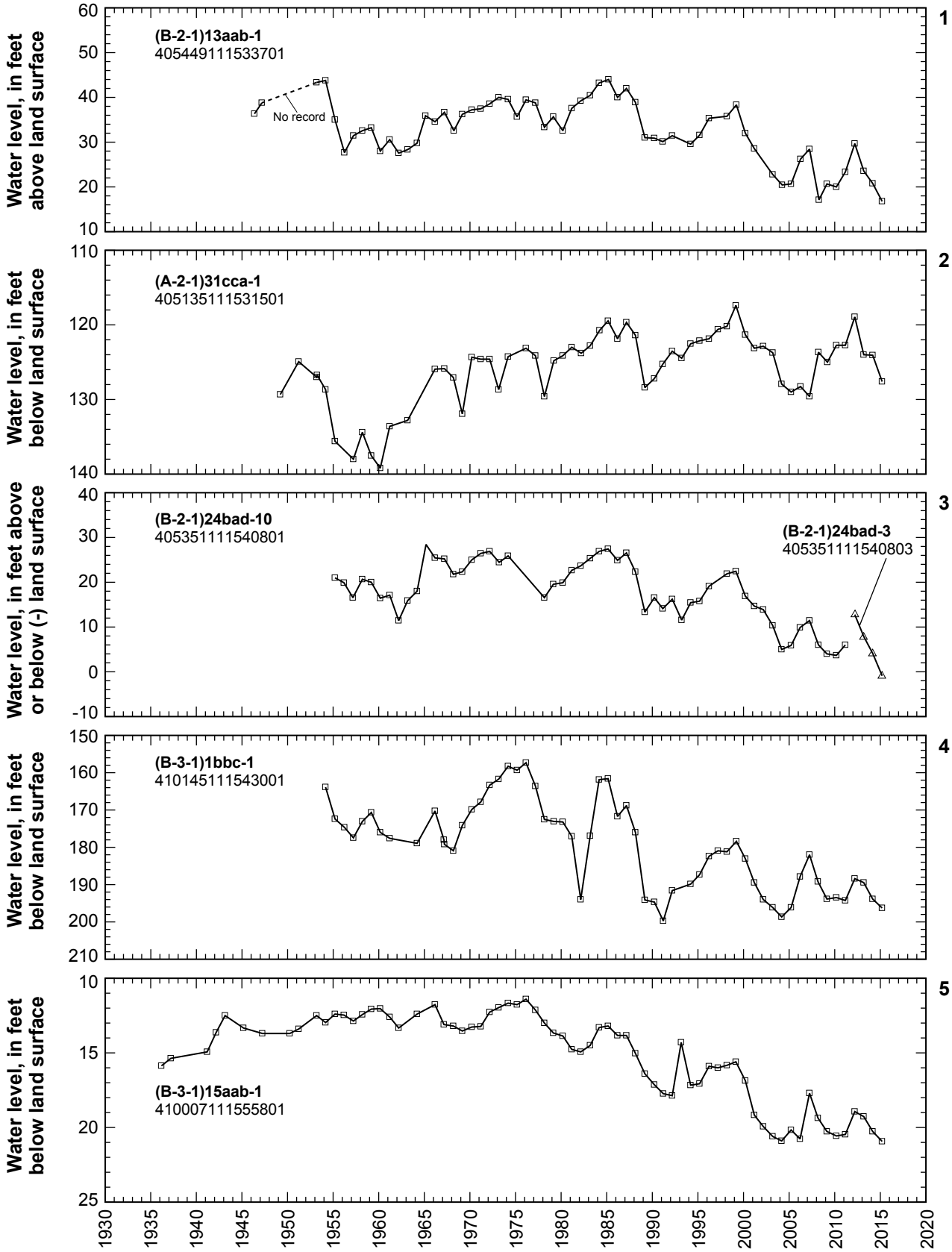



**Figure 9.** Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

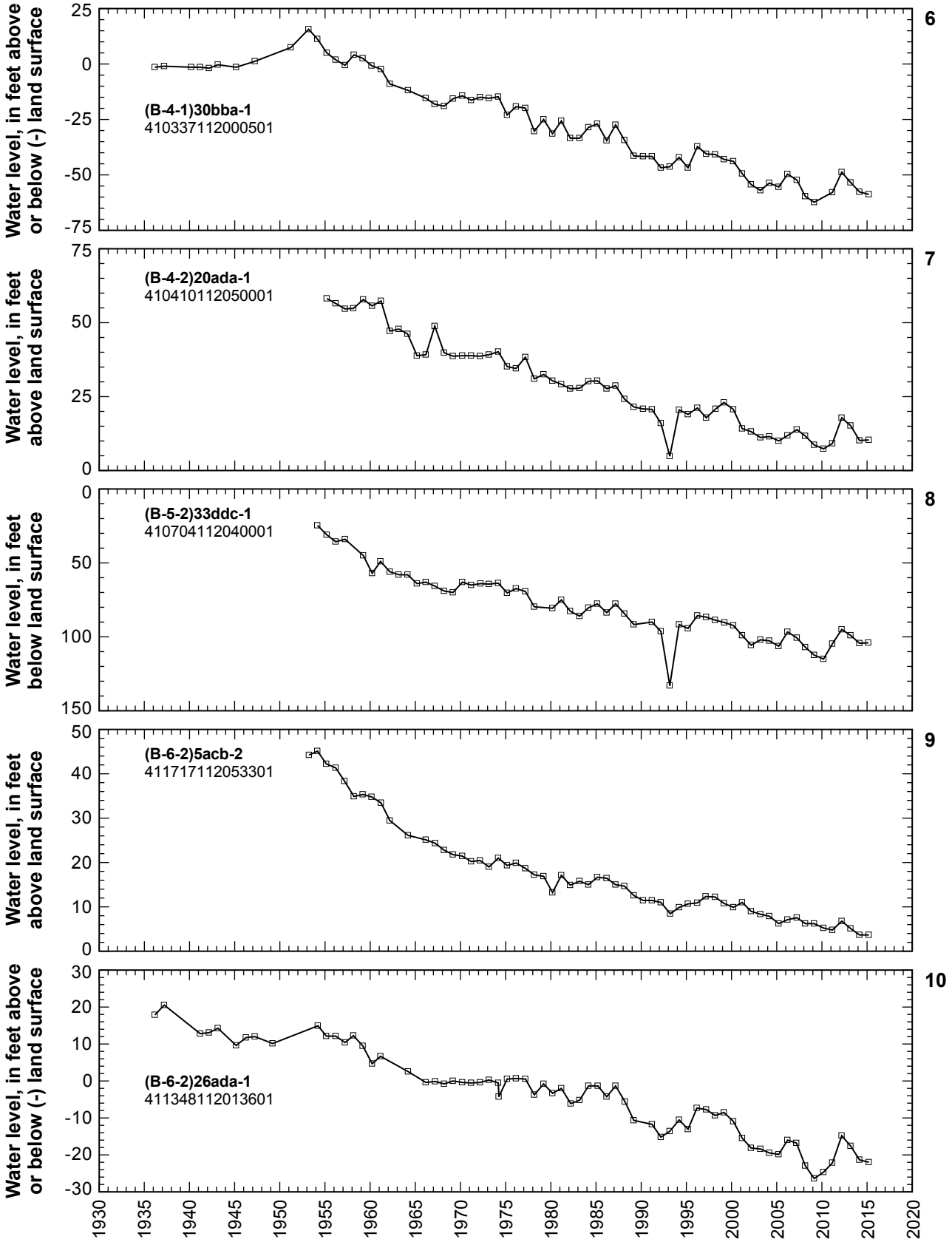



**Figure 9.** Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

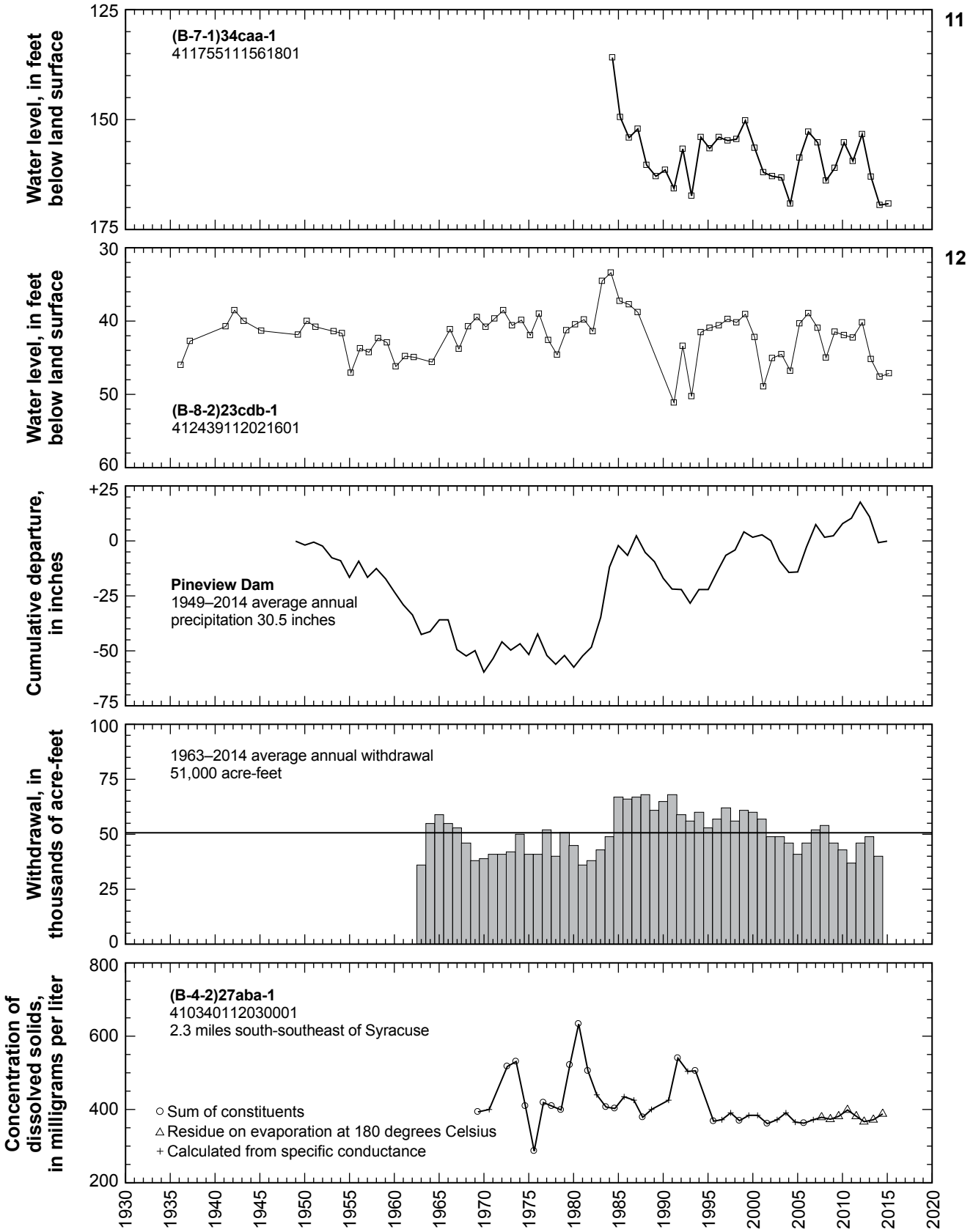
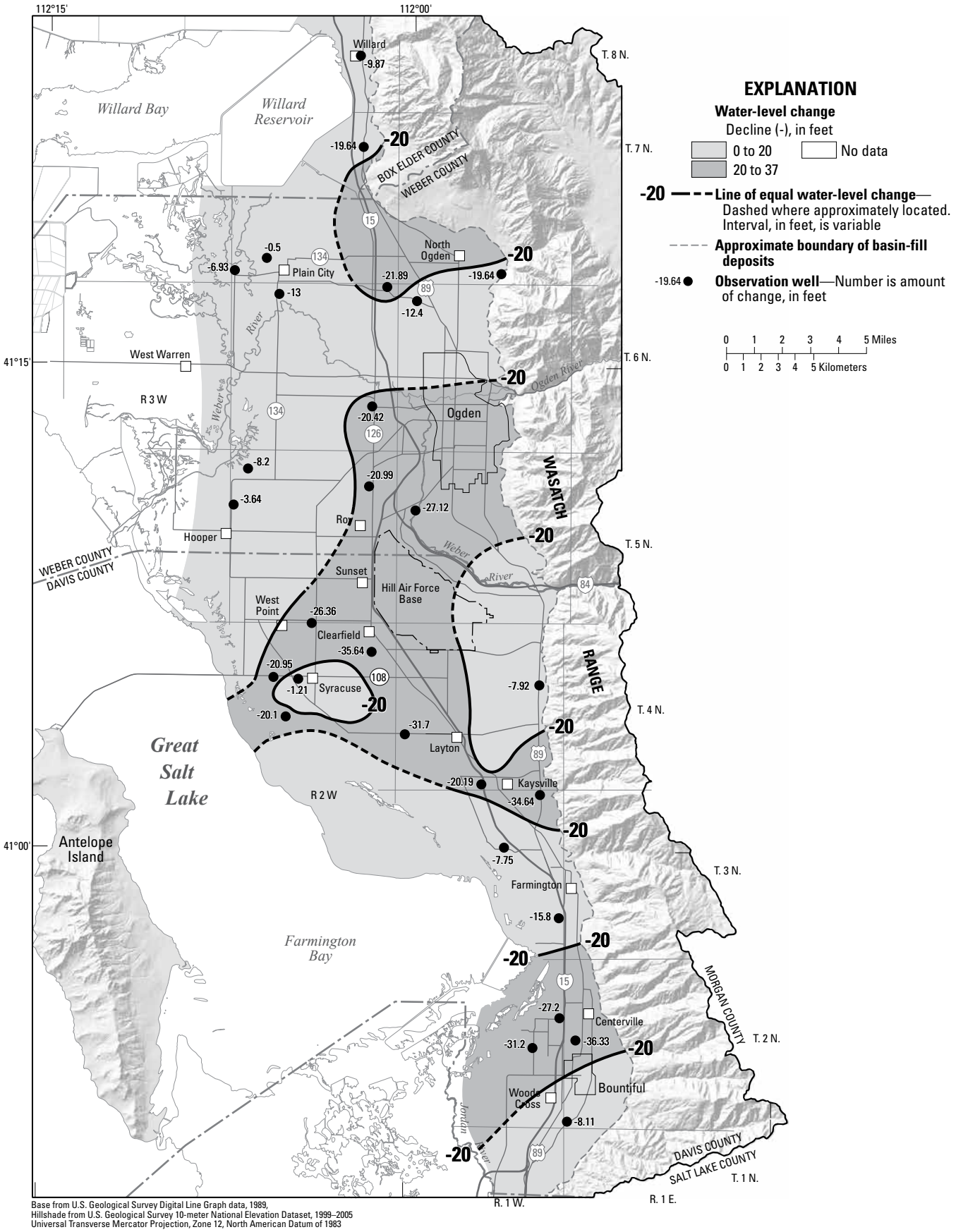



**Figure 9.** Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued




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

**Figure 10.** Water-level change in the East Shore area from March 1985 to March 2015.

## Salt Lake Valley

By V. Noah Derrick

Salt Lake Valley covers about 400 square miles between the Wasatch Range and the Oquirrh and Traverse Mountains in Salt Lake County (fig. 11). Groundwater occurs in unconsolidated deposits in the valley under water-table and artesian conditions. Recharge to the aquifers occurs mainly along the area where the mountains border the valley. In the southwestern part of the valley, groundwater moves from the base of the Oquirrh Mountains eastward toward the Jordan River. In the northwestern part of the valley, the direction of movement is mostly toward Great Salt Lake. In the eastern half of the valley, groundwater moves westward from the base of the Wasatch Range toward the Jordan River. The Jordan River drains both surface water and groundwater from the valley.

Total estimated withdrawal of water from wells in Salt Lake Valley in 2014 was about 145,000 acre-feet, which is 8,000 acre-feet less than in 2013 and 7,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3). Withdrawal for public supply was about 80,800 acre-feet, which is 10,800 acre-feet less than the total for 2013. Withdrawal for industrial use was about 41,200 acre-feet, which is 2,300 acre-feet more than the total for 2013.

The location of wells in Salt Lake Valley in which the water level was measured during February 2015 is shown in figure 11. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport) are shown in figure 12. Precipitation at Salt Lake City during 2014 was about 14.5 inches, about 2.8 inches more than in 2013 and about 0.7 inch less than the average annual precipitation for 1931–2014.

The relation of the water level in selected observation wells completed in the principal aquifer to cumulative departure from average annual precipitation at Silver Lake Brighton, and the relation of the water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well are shown in figure 13. Precipitation at Silver Lake Brighton was about 44.0 inches in 2014, which is about 12.7 inches more than in 2013 and about 1.7 inches more than the average annual precipitation for 1931–2014.

Water levels declined from February 2014 to February 2015 in most of the wells measured in Salt Lake Valley. Declines are probably the result of continued large withdrawals for public supply and industrial use. 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.

Water levels in the principal aquifer declined from February 1985 to February 2015 in all areas where data are available (fig. 14). The largest decline, more than 38 feet, occurred in a well southwest of Holladay. Declines are probably the result of continued large withdrawals for public supply and industrial use.

The concentrations of dissolved solids and dissolved chloride (from 1931–2014 and 1935–2014, respectively) in water samples collected from well (D-1-1)7abd-6, a flowing well at 800 South 500 East in Salt Lake City, are shown in figure 13. The concentration of dissolved solids has ranged from 554 to 879 mg/L with a median value of 706 mg/L. The concentration of dissolved solids generally increased from 576 mg/L in December 1931 to 879 mg/L in July 2009. The dissolved-solids concentration in June 2014, 805 mg/L, increased slightly (17 mg/L) from June 2013, but overall, decreased from the value of 874mg/L in 2012. The dissolved chloride concentration generally increased from 52 mg/L in July 1935 to 193 mg/L in June 2014, with a median value of 120 mg/L.

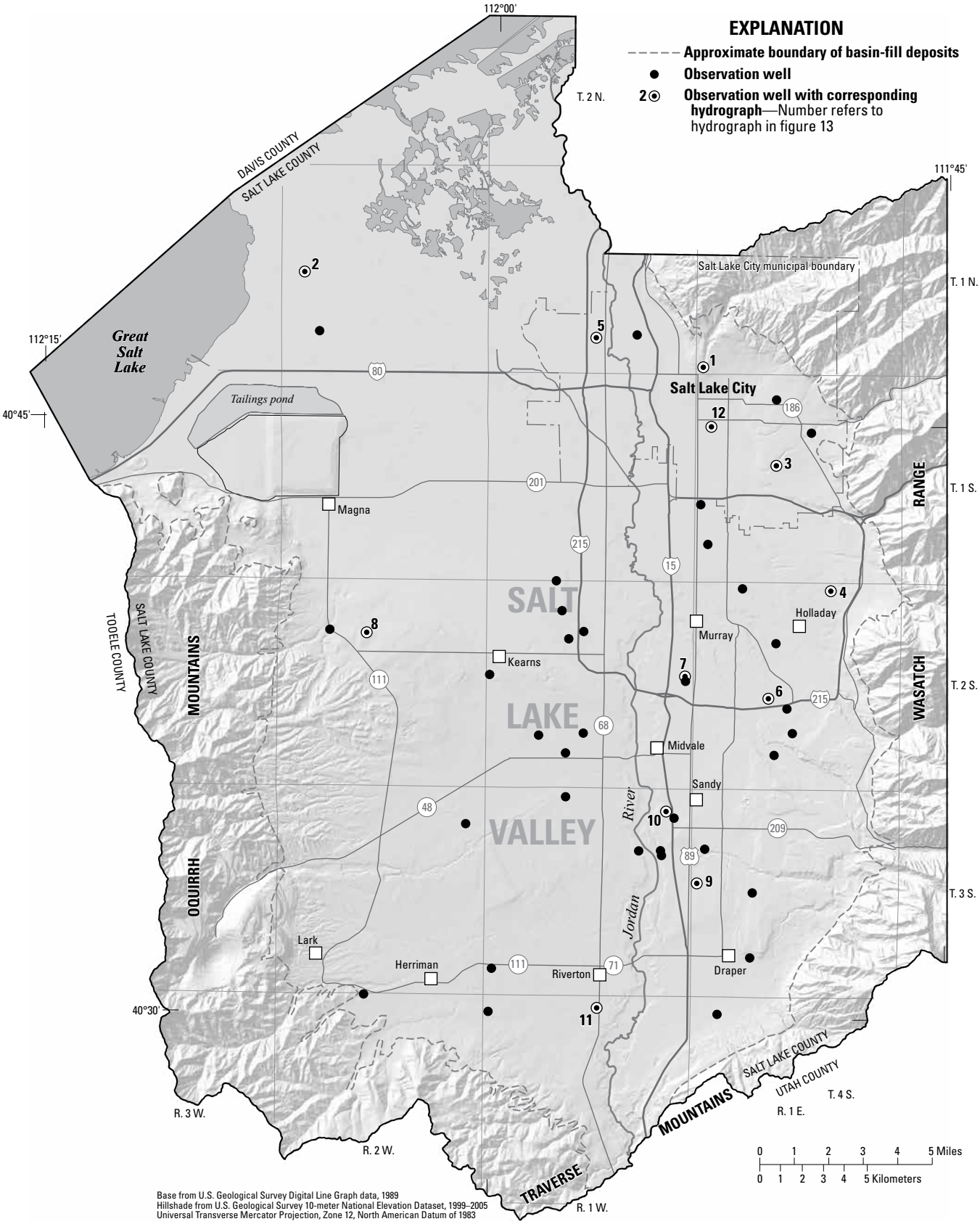



**Figure 11.** Location of wells in Salt Lake Valley in which the water level was measured during February 2015.

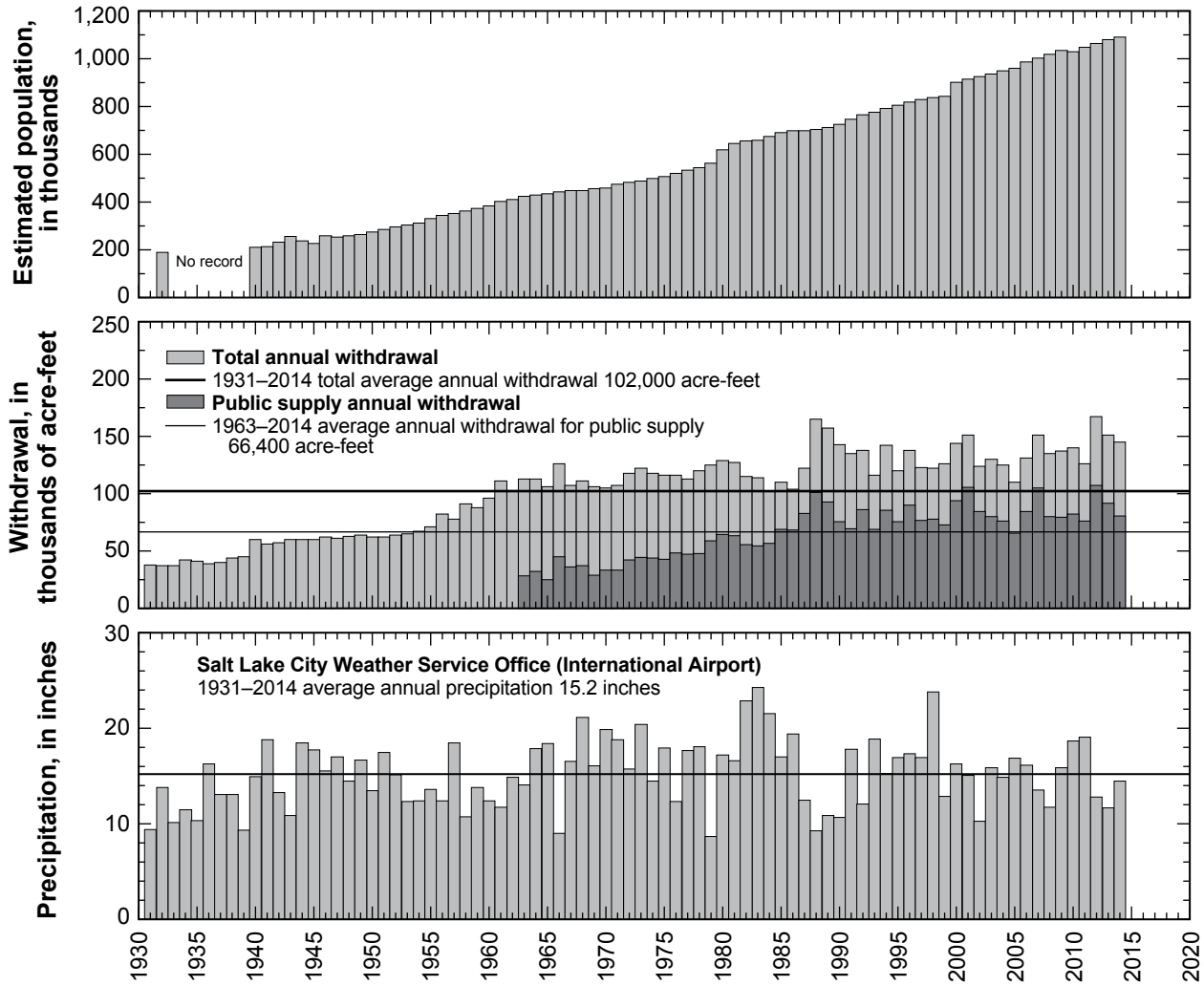



**Figure 12.** Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

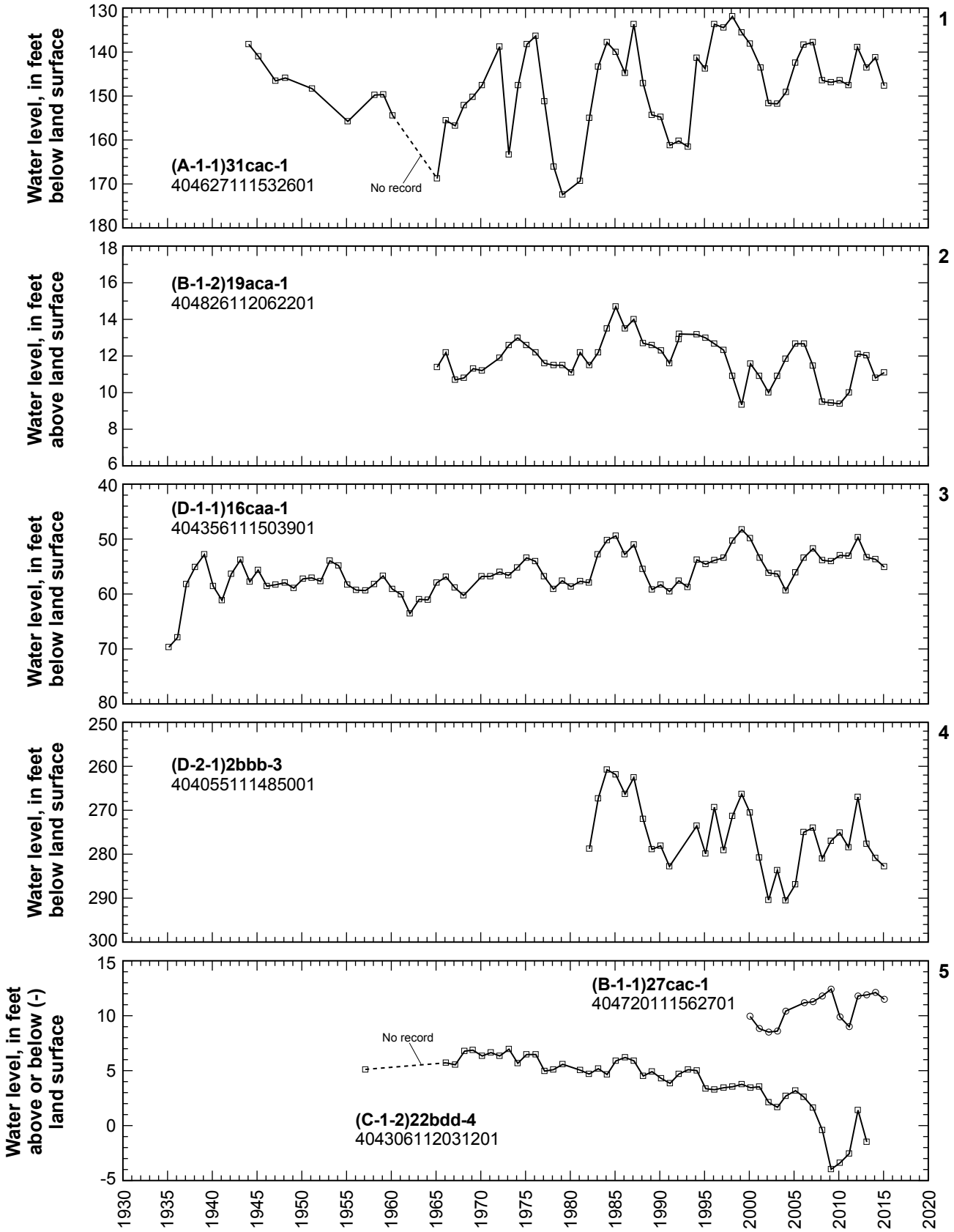



**Figure 13.** Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water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

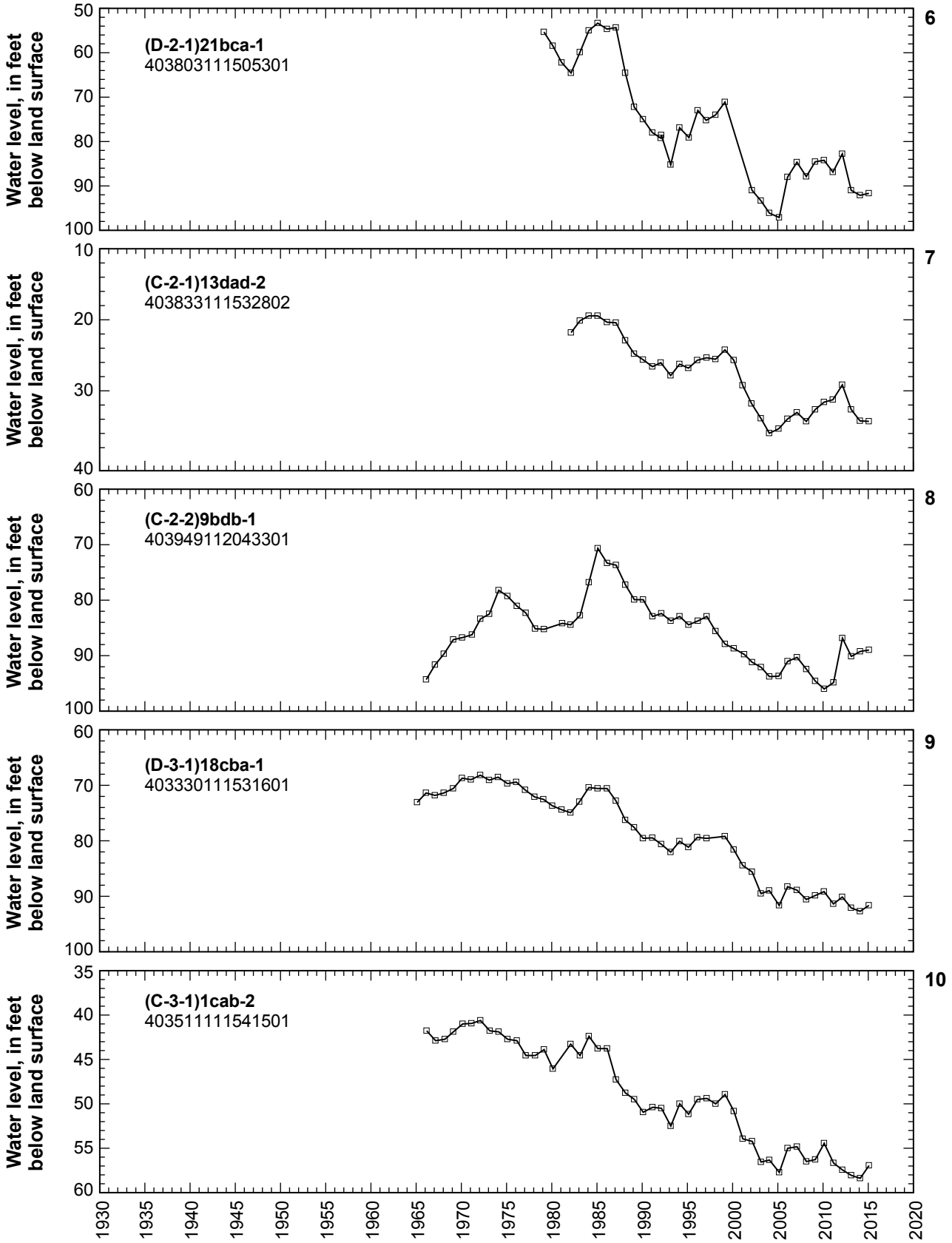



**Figure 13.** Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water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

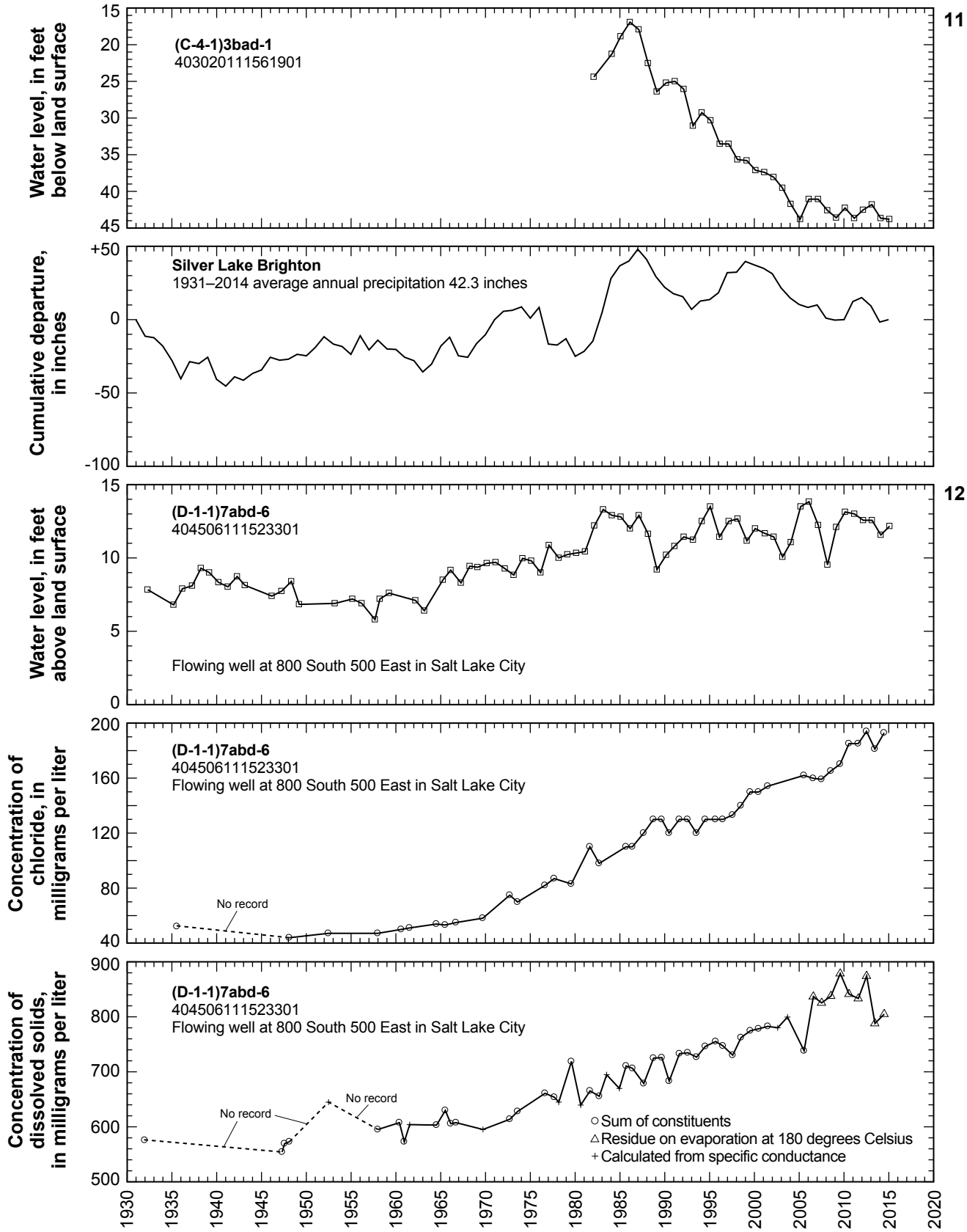



**Figure 13.** Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water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

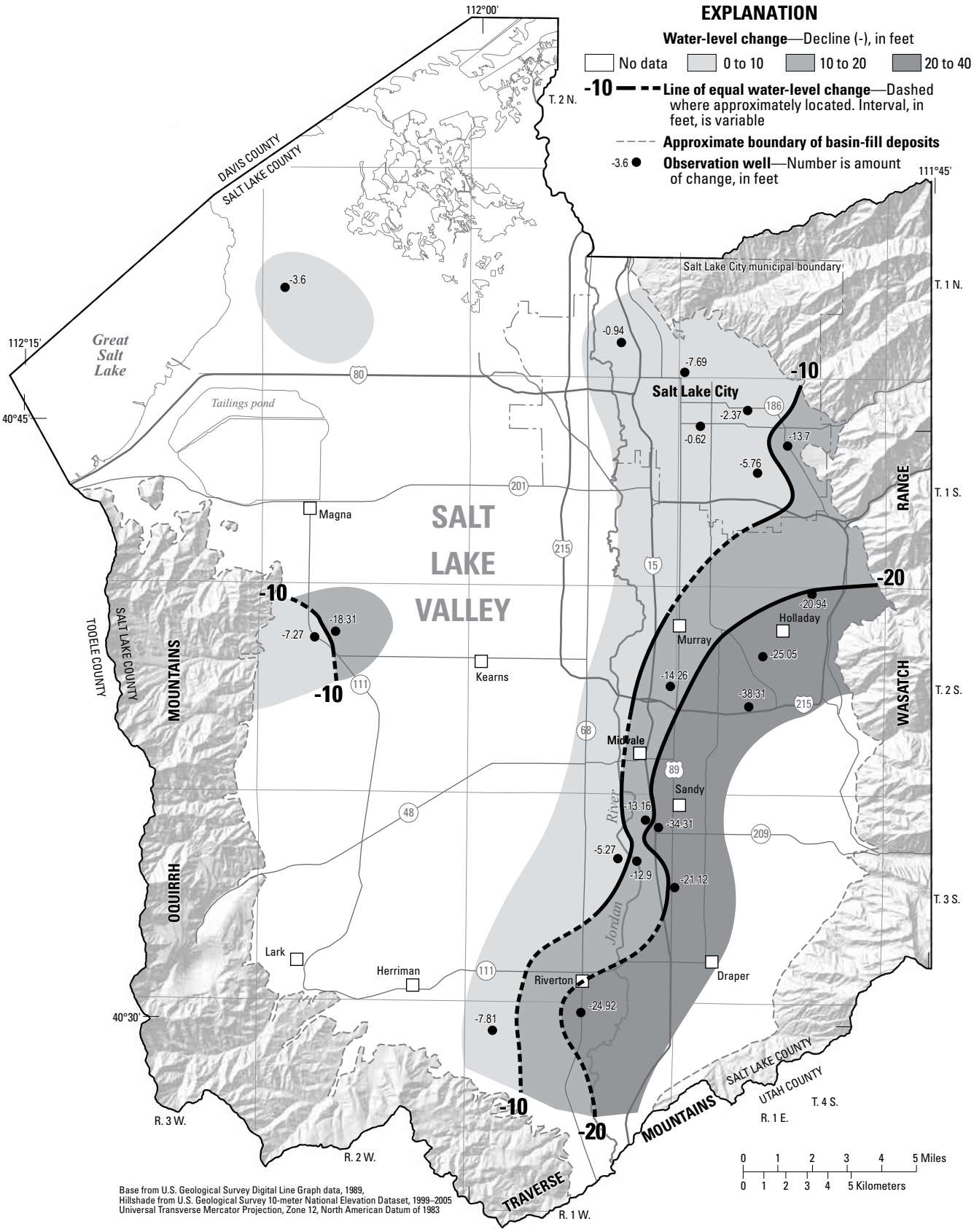



**Figure 14.** Water-level change in Salt Lake Valley from February 1985 to February 2015.

## Tooele Valley

By Paul Downhour

Tooele Valley lies between the Stansbury and Oquirrh Mountains and extends south from Great Salt Lake to South Mountain. The total area of the valley is about 250 square miles within Tooele County (fig. 15). Groundwater occurs in the bedrock and unconsolidated basin-fill deposits in Tooele Valley under both water-table and artesian conditions, but most of the water withdrawn by wells is from artesian aquifers in the unconsolidated deposits.

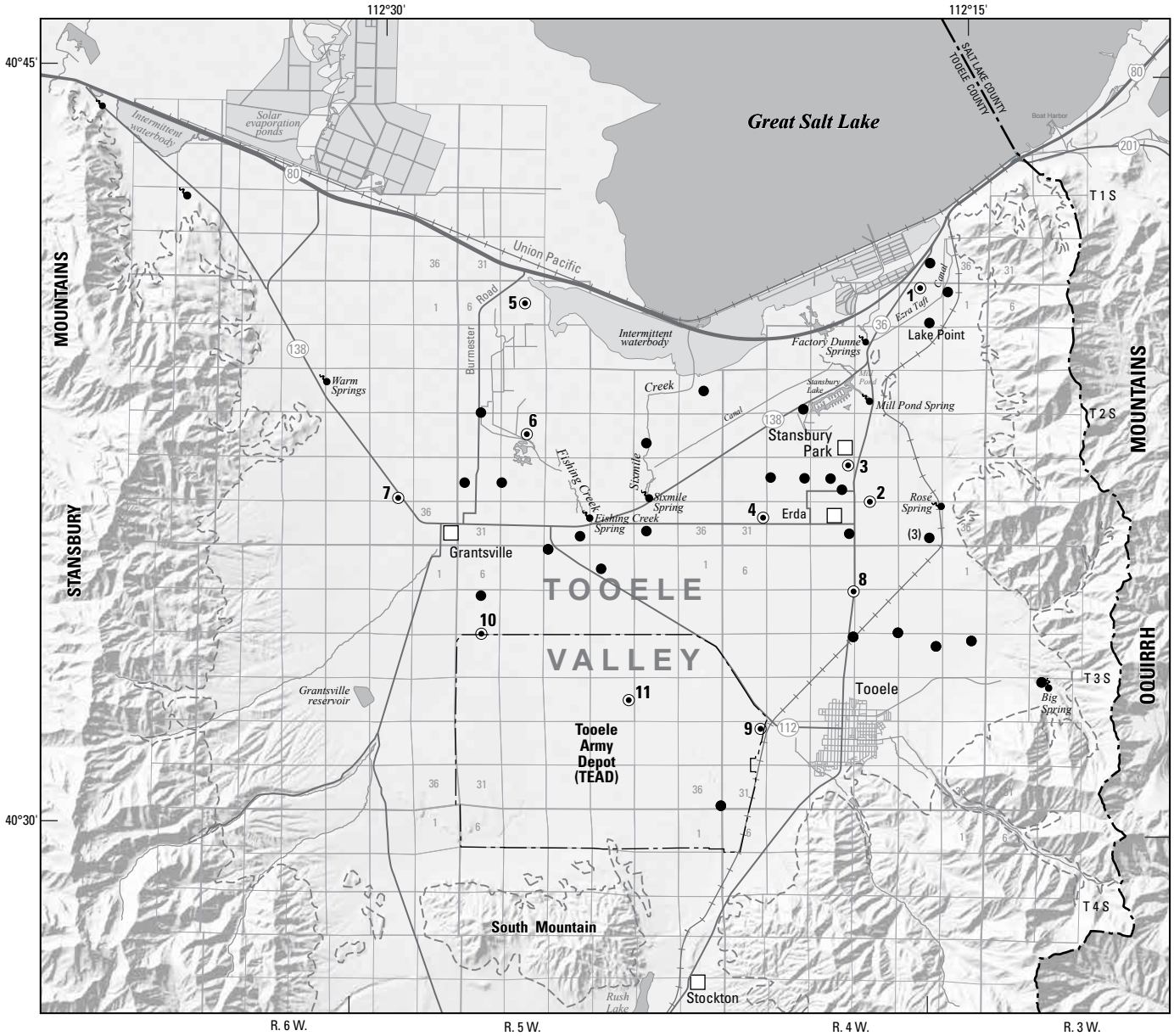
Total estimated withdrawal of water from wells in Tooele Valley in 2014 was about 22,000 acre-feet, which is about 3,000 acre-feet less than the total for 2013 and 2,000 acre-feet less than the average annual withdrawal for 2004–2013 (tables 2 and 3). Withdrawal for irrigation was about 10,000 acre-feet, which is 2,100 acre-feet less than the total for 2013. Withdrawal for public supply was about 11,000 acre-feet, which is 600 acre-feet less than in 2013. Withdrawal for industrial use was about 400 acre-feet, which is the same as in 2013.

The location of wells in Tooele Valley in which the water level was measured during March 2015 is shown in figure 15. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1 is shown in figure 16. Precipitation at Tooele during 2014 was about 15.4 inches, which is about 3.8 inches less than in 2013 and about 2.5 inches less than the average annual precipitation for 1936–2014.

Water levels declined from March 2014 to March 2015 in most of the wells measured in Tooele Valley. The largest decline, about 3.9 feet, occurred in a well about 3 miles northeast of Tooele.

Water levels declined from March 1985 to March 2015 in all parts of Tooele Valley for which data are available (fig. 17). The largest decline, almost 58 feet, occurred in a well southeast of Erda. Declines are probably the result of continued large withdrawals for irrigation and public supply.

The concentration of dissolved solids in water samples collected from well (C-2-4)33bdd-1, located at Erda, from 1977 to 2014, is shown in figure 16. The concentration has ranged from 456 to 616 mg/L with a median value of 577 mg/L. The concentration of dissolved solids in the water sample collected during June 2014 was 594 mg/L. The dissolved-solids concentration has generally increased since 1977.




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

0 1 2 3 4 5 Miles
0 1 2 3 4 5 Kilometers

**EXPLANATION**

**Approximate boundary of basin-fill deposits**

(3) **Observation well**—Number in parentheses refers to number of wells at that site

9 **Observation well with corresponding hydrograph**—Number refers to hydrograph in figure 16

**Figure 15.** Location of wells in Tooele Valley in which the water level was measured during March 2015.

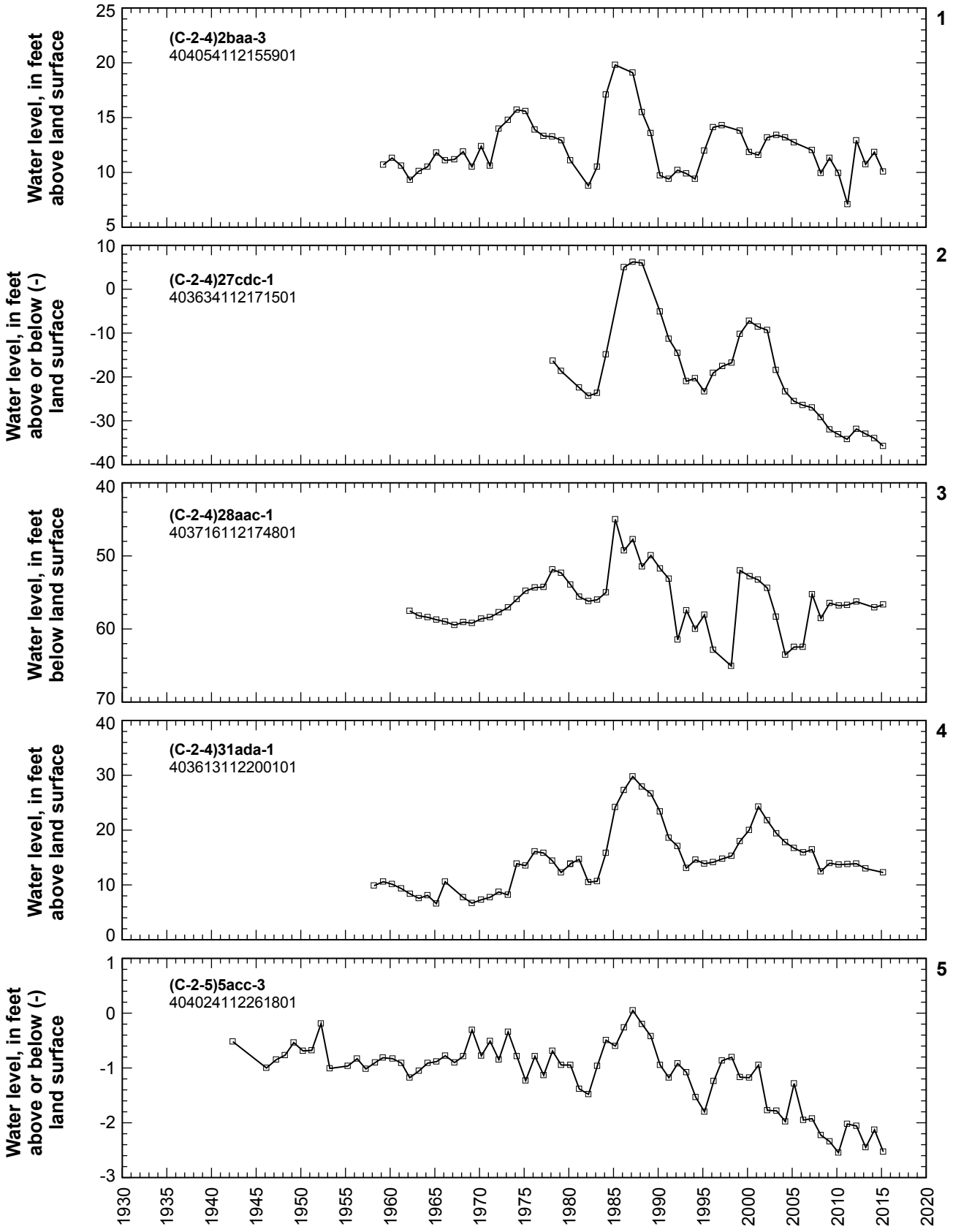



**Figure 16.** Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.

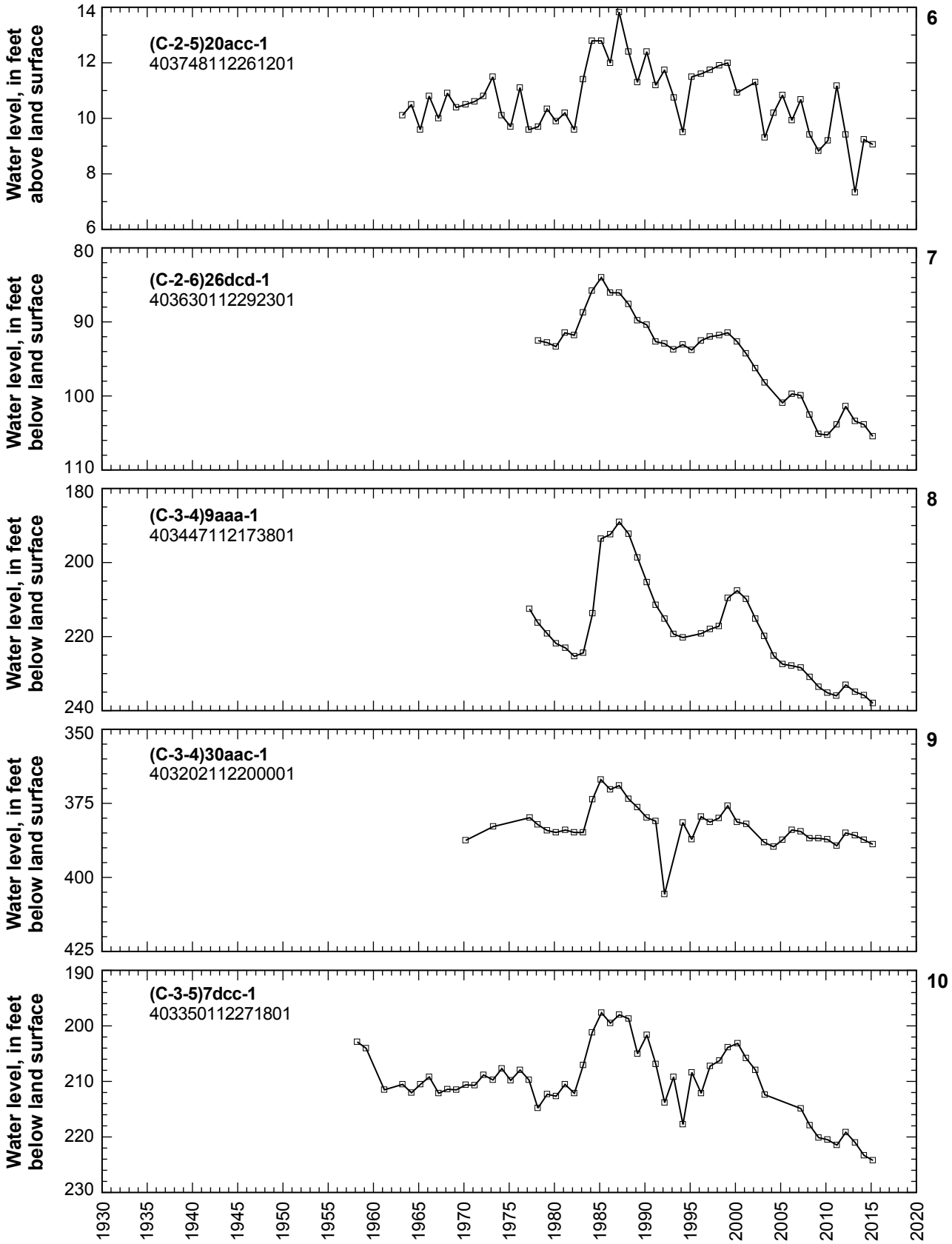



**Figure 16.** Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

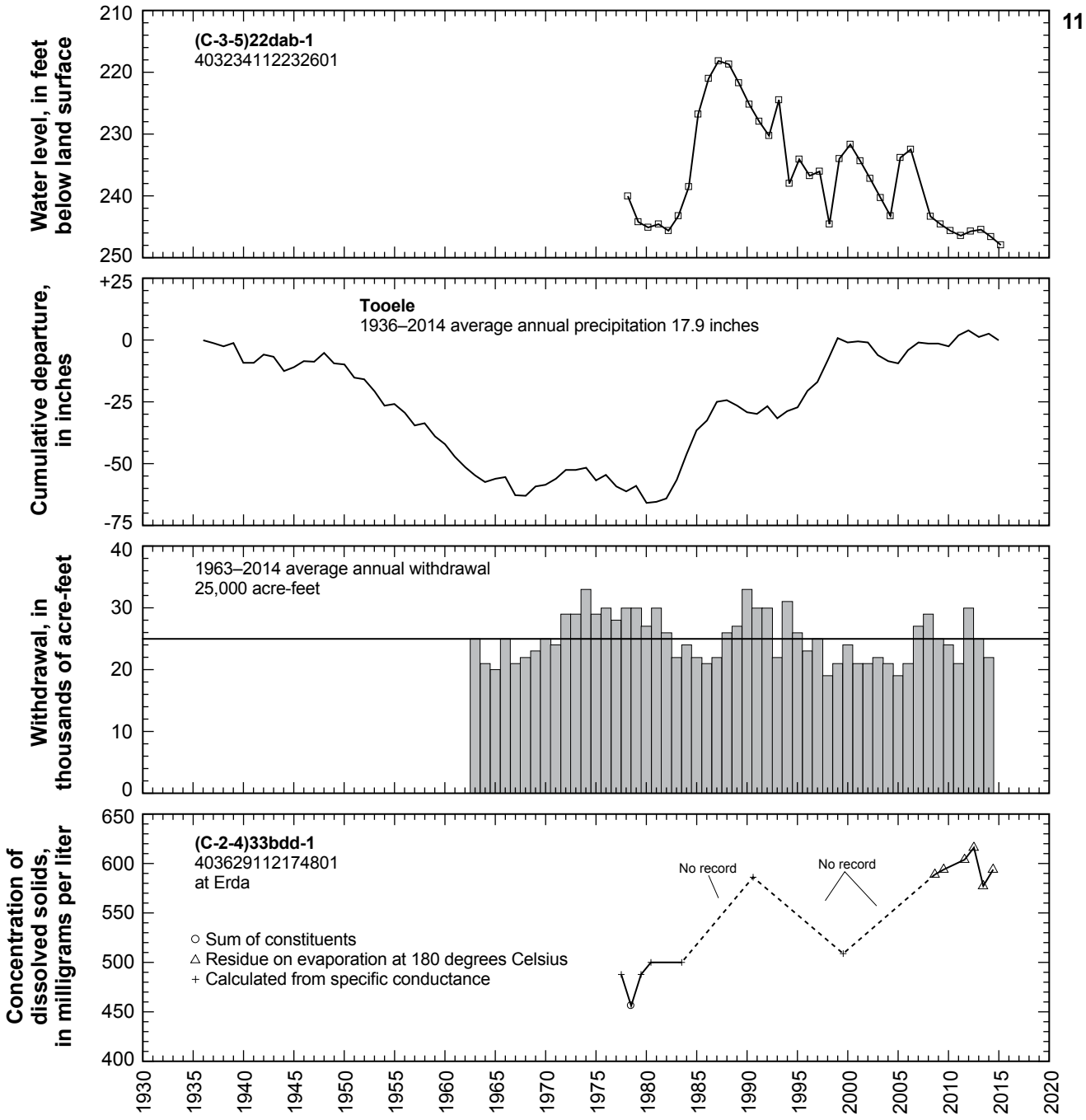
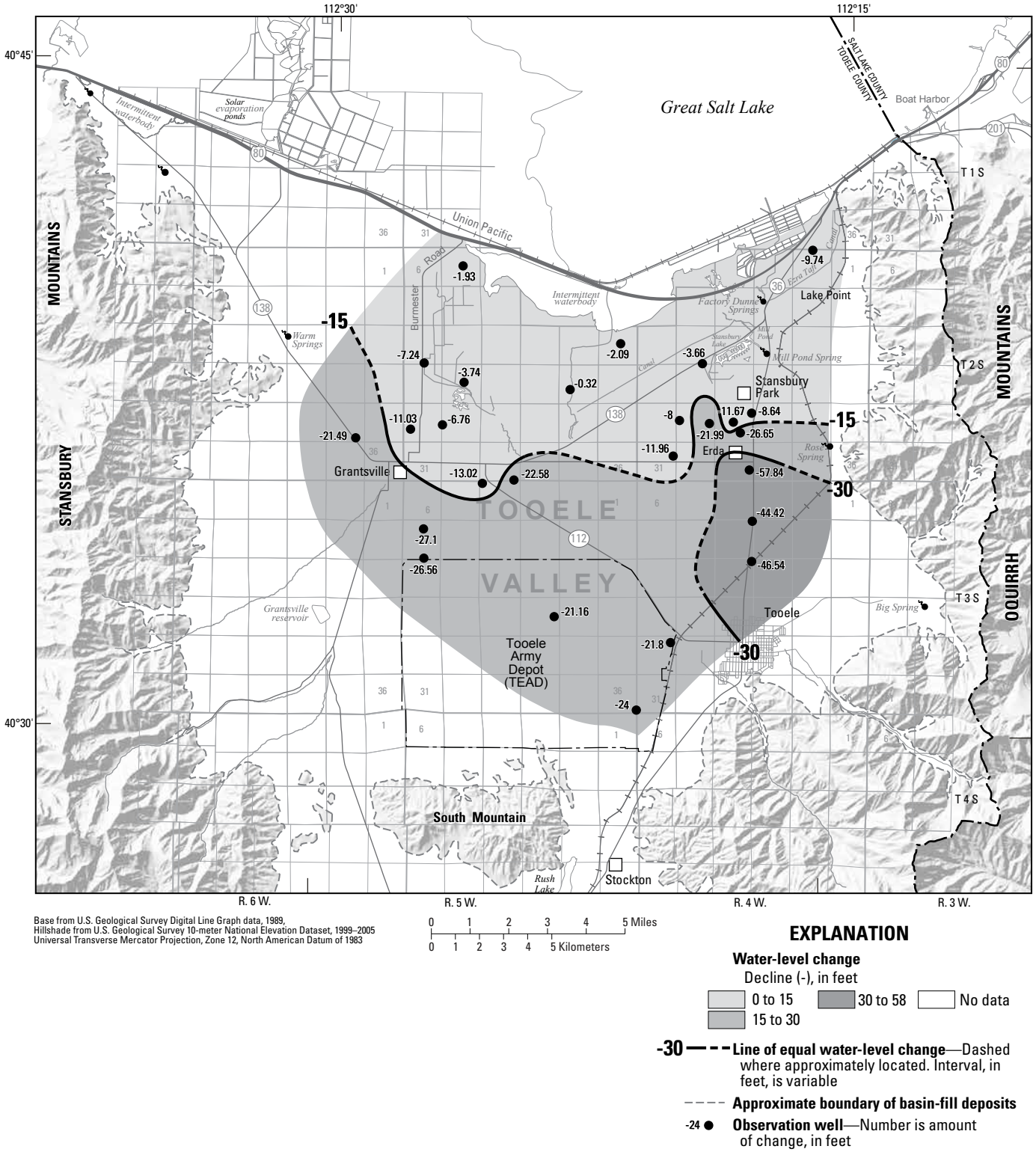



**Figure 16.** Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued




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

0 1 2 3 4 5 Miles
0 1 2 3 4 5 Kilometers

**EXPLANATION**

**Water-level change**
Decline (-), in feet

0 to 15
15 to 30
30 to 58
No data

-30 **Line of equal water-level change**—Dashed where approximately located. Interval, in feet, is variable

**Approximate boundary of basin-fill deposits**

-24 **Observation well**—Number is amount of change, in feet

**Figure 17.** Water-level change in Tooele Valley from March 1985 to March 2015.

## Utah and Goshen Valleys

By Lincoln Smith

Utah Valley is bounded by the Traverse Mountains, the Wasatch Range, West Mountain, and the northern extension of Long Ridge. The Valley is divided into two groundwater basins, northern and southern, which are separated by Provo Bay in northern Utah Valley (fig. 18). Northern Utah Valley is further divided by the Jordan River into two subbasins, northern Utah Valley-east and northern Utah Valley-west. Goshen Valley is bounded by West Mountain, Long Ridge, the Lake Mountains, and the East Tintic Mountains. Groundwater in Utah and Goshen Valleys occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions, but most wells discharge from artesian aquifers. The principal groundwater recharge area for the basin-fill deposits is in the eastern part of the valley, along the base of the Wasatch Range.

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 2014 was about 107,000 acre-feet, which is 8,000 acre-feet less than the revised value for 2013, and 1,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3). Withdrawal in northern Utah Valley (-east and -west) was about 53,800 acre-feet, which is 6,300 acre-feet less than the value for 2013. Total estimated withdrawal in northern Utah Valley-west was about 4,400 acre-feet, or about 8 percent of the total withdrawal in northern Utah Valley. Withdrawal in southern Utah Valley was 30,600 acre-feet, which is 4,600 acre-feet less than the value for 2013. Withdrawal in Goshen Valley was 22,500 acre-feet, which is 3,000 acre-feet more than the revised value for 2013. The overall decrease in total pumpage from all three valleys in 2014 was mainly due to decreased withdrawals for public-supply use.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2015 is shown in figure 18. Water levels declined from March 2014 to March 2015 in most of the wells measured in Utah and Goshen Valleys. Declines are probably due to continued large withdrawals for public supply and irrigation. Water levels have, overall, declined since the mid- to late 1980s. There have been intervening periods (1993–98, 2005–07, 2009–11) when water levels generally rose. These periods correspond to greater-than-average precipitation.

Water levels declined from March 1985 to March 2015 in all parts of Utah and Goshen Valleys for which data are available (fig. 20). The largest decline, more than 61 feet, occurred in a well northeast of American Fork. Declines are probably the result of continued large withdrawals, particularly for public-supply use.

The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, Utah, and to concentration of dissolved solids in water from three wells is shown in figure 19. Discharge of Spanish Fork at Castilla in 2014 was about 145,800 acre-feet, which is 24,100 acre-feet less than the 1933–2014 average annual discharge and 12,600 acre-feet less than in 2013. Precipitation at Silver Lake Brighton in 2014 was about 44.0 inches, which is about 1.7 inches more than the long-term average (1931–2014) and about 12.7 inches more than in 2013. Precipitation at Spanish Fork Power House in 2014 was about 19.9 inches, which is about 0.6 inch more than the long-term average (1930–2014) and about 3.0 inches more than the revised value for 2013.

The concentration of dissolved solids in water samples collected from wells (C-9-1)28ccb-1, located 4 miles north of Elberta, (D-7-2)4cbb-2, located 2 miles west of Provo at the mouth of the Provo River, and (D-9-1)36bbc-1, located 1 mile north of Santaquin, is shown in figure 19. The concentration of dissolved solids in water from well (C-9-1)28ccb-1 has ranged from 498 to 1,970 mg/L with a median value of 728 mg/L. The concentration of dissolved solids in the July 2014 sample was the maximum measured in this well (1,970 mg/L). The dissolved-solids concentration in water from well (D-7-2)4cbb-2 has ranged from 270 to 539 mg/L with a median value of 321 mg/L. The concentration of dissolved solids in the July 2014 sample was the lowest measured in this well (270 mg/L). The dissolved-solids concentration in water from well (D-9-1)36bbc-1 has ranged from 166 to 311 mg/L with a median value of 294 mg/L. The concentration of dissolved solids in the July 2014 sample was 248 mg/L.

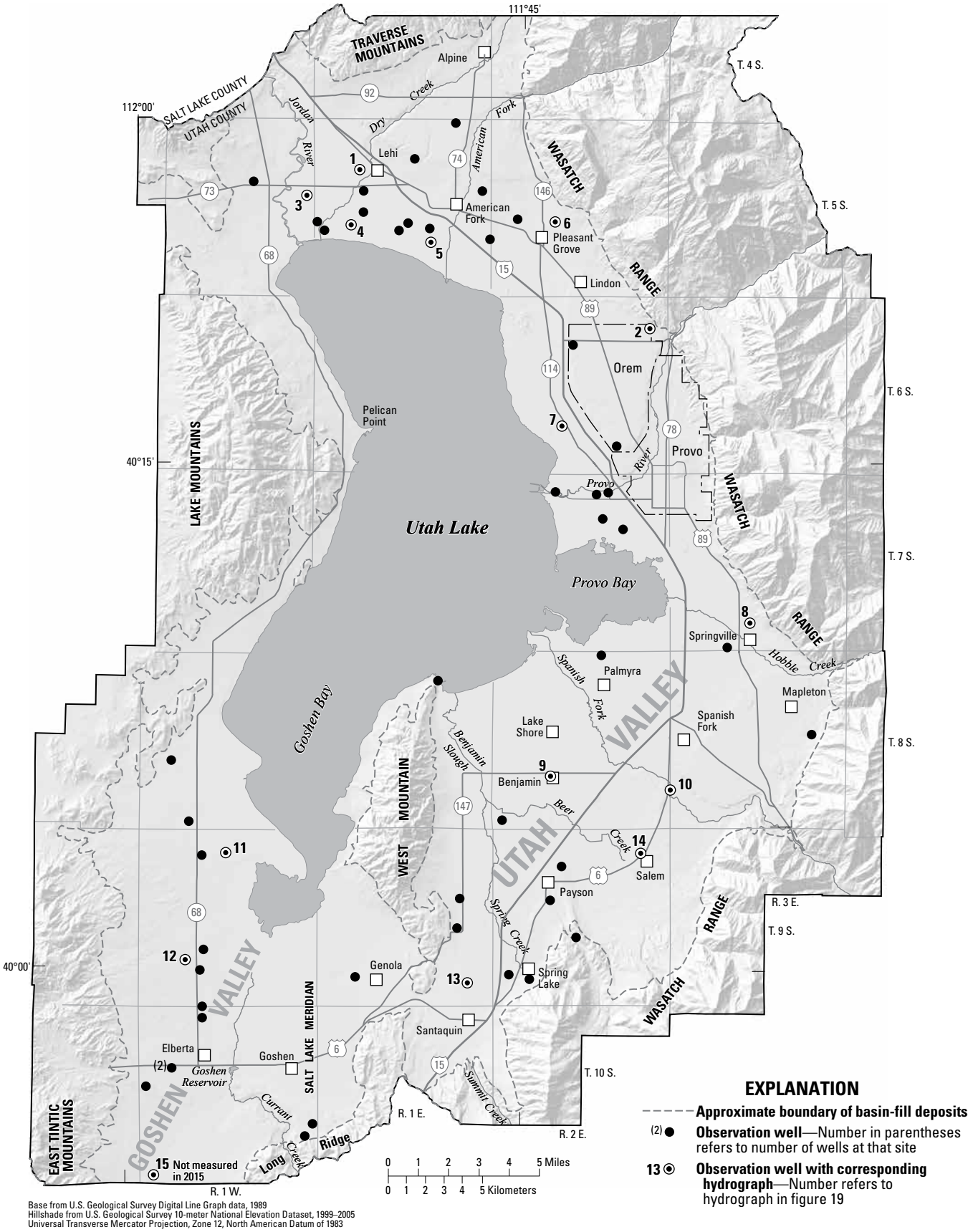



**Figure 18.** Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2015.

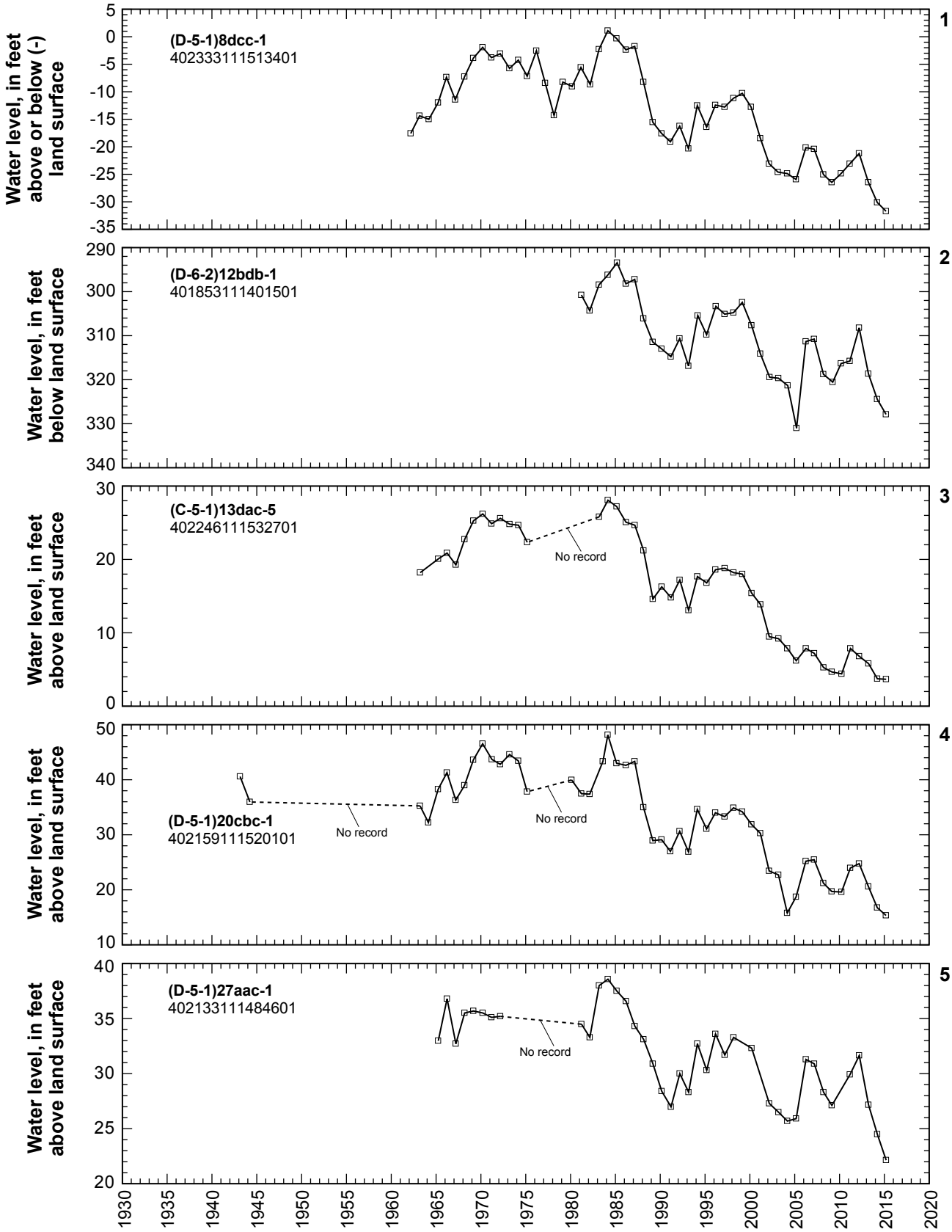



**Figure 19.** Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

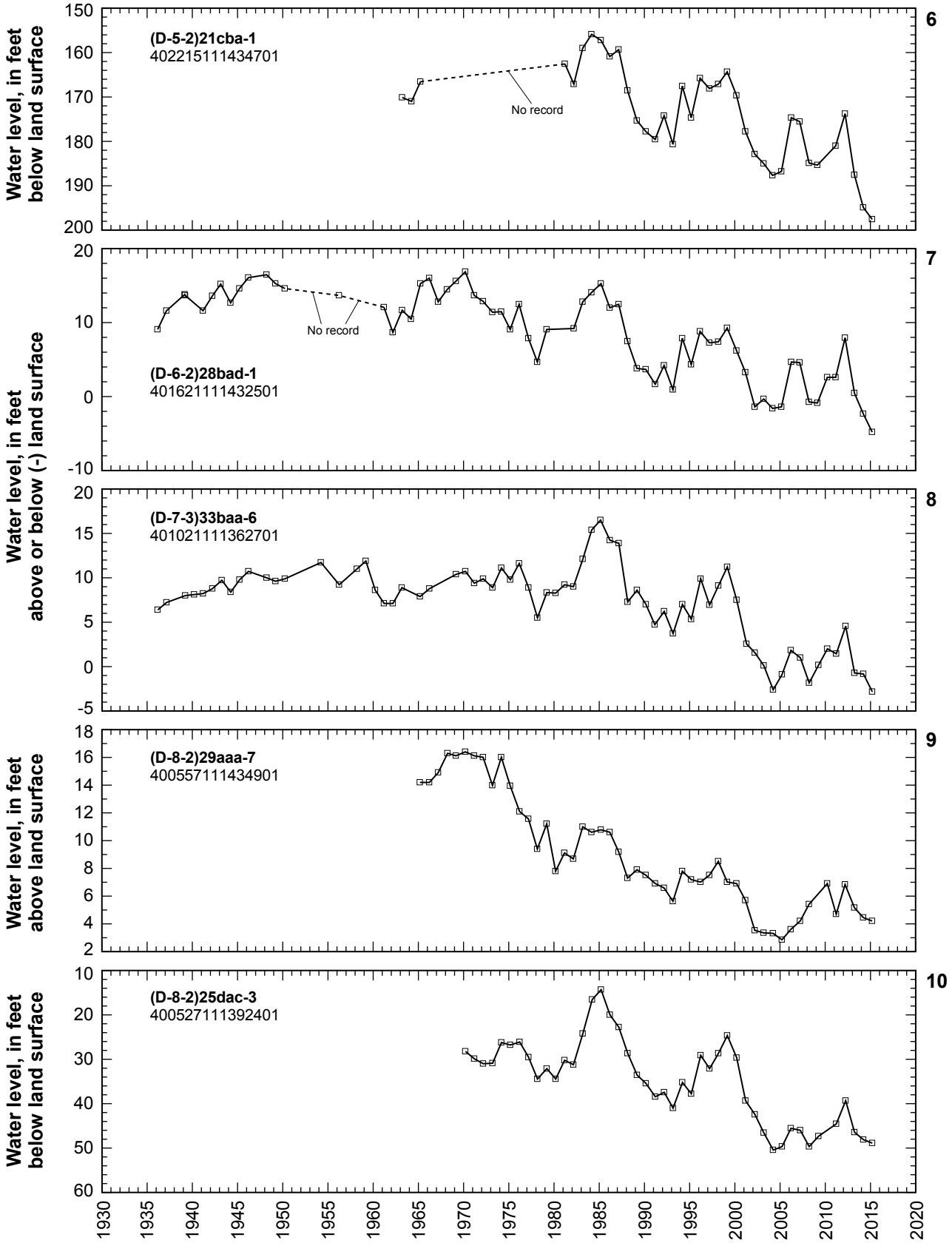



**Figure 19.** Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

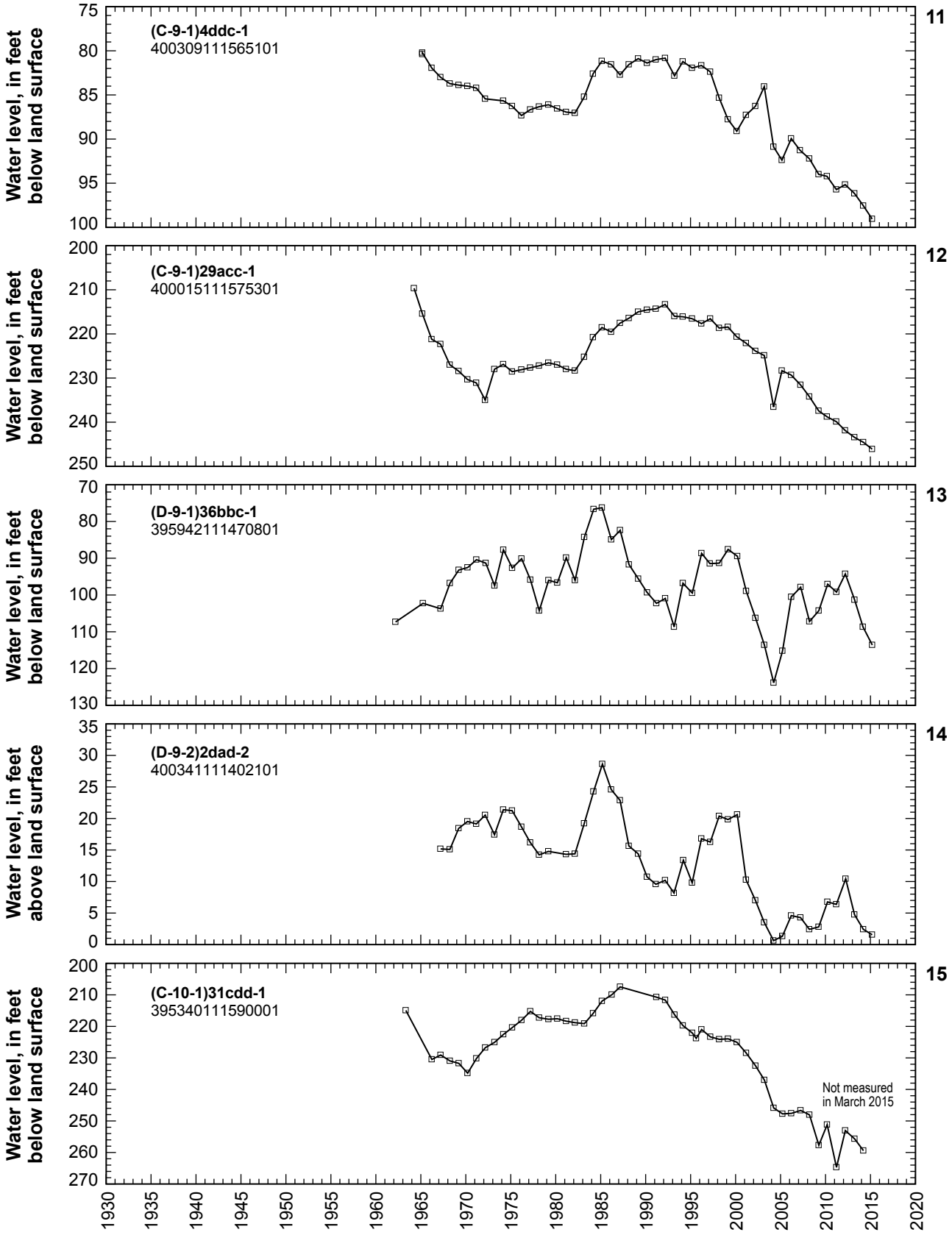



**Figure 19.** Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

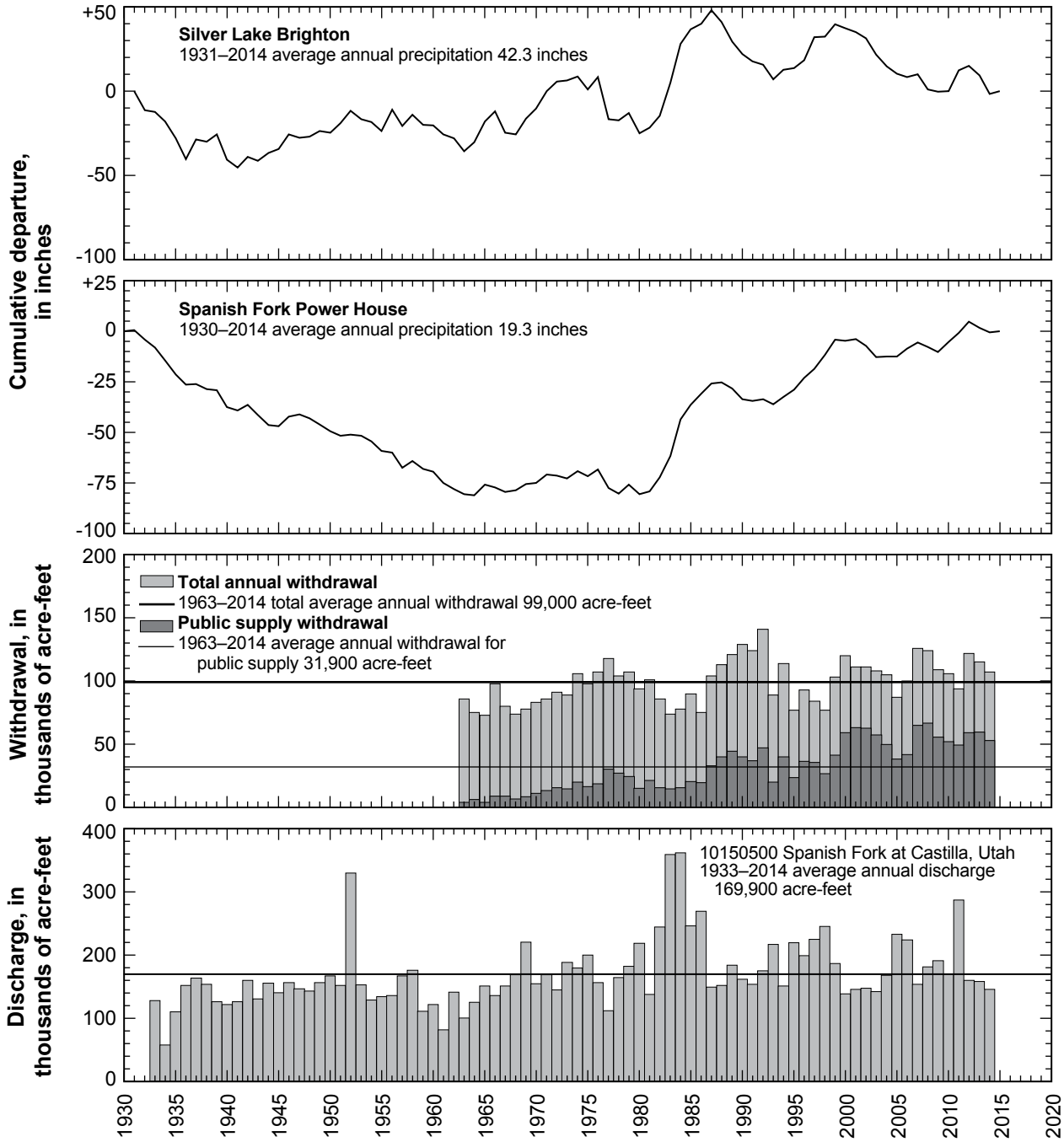



**Figure 19.** Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

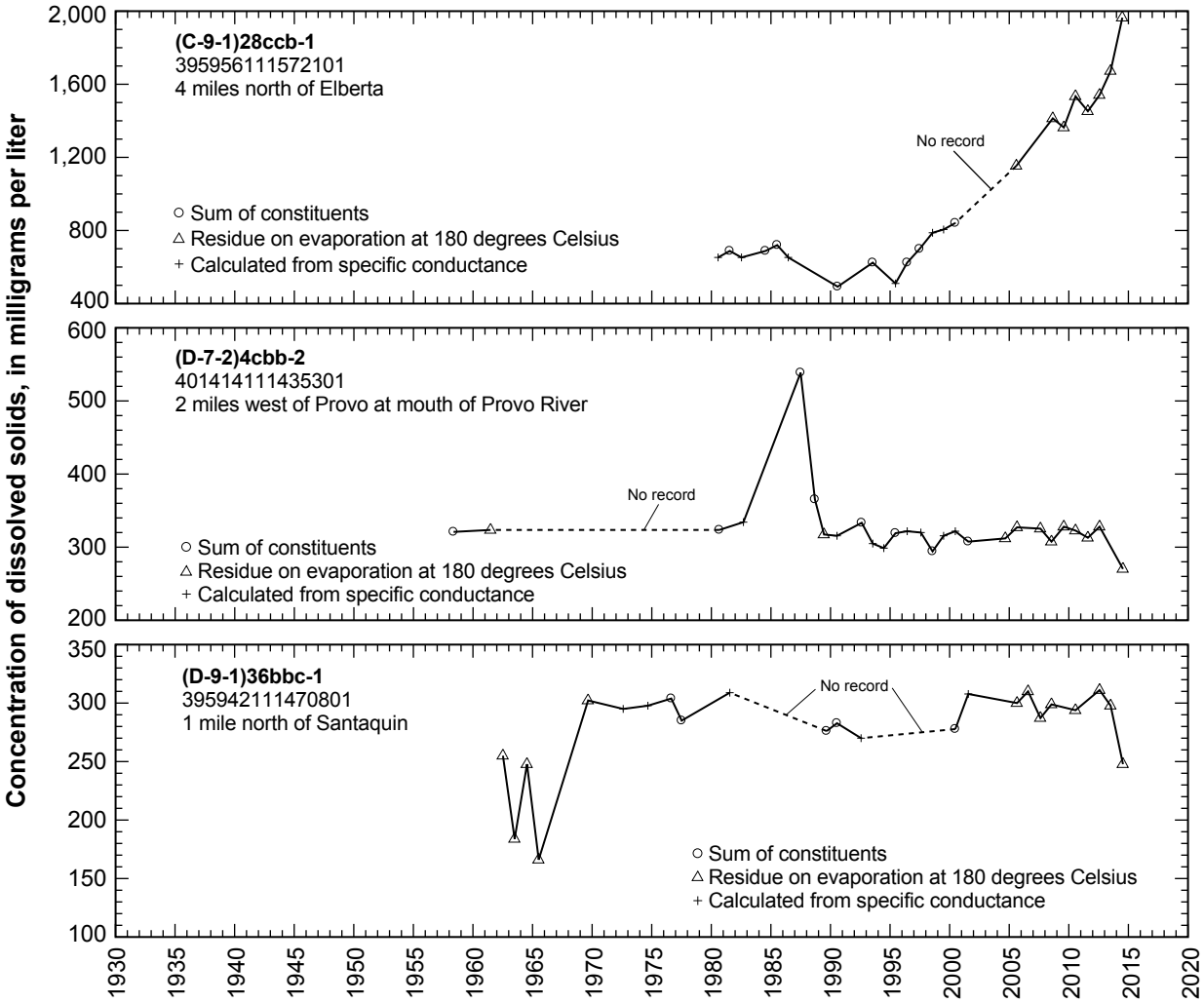



**Figure 19.** Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

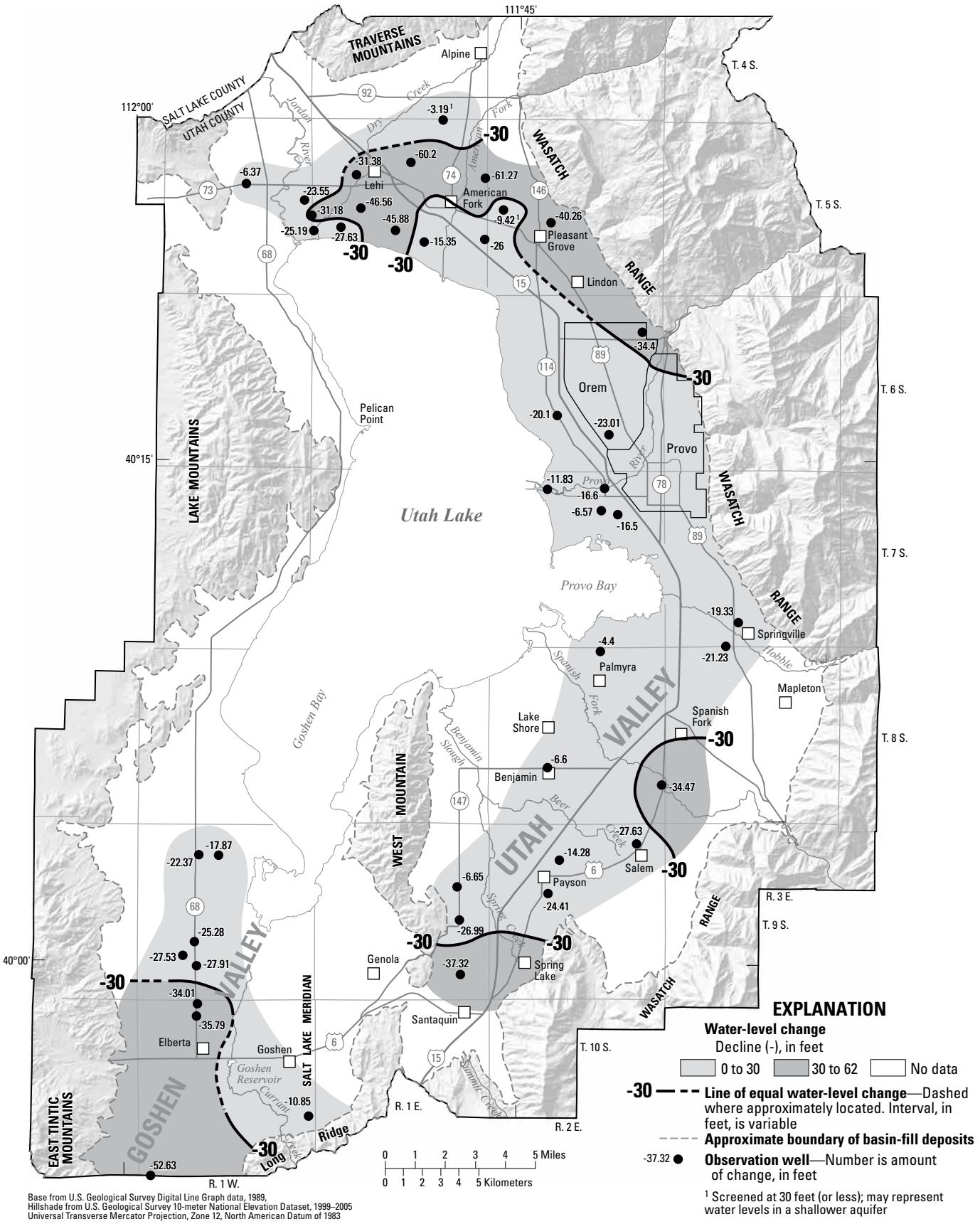



**Figure 20.** Water-level change in Utah and Goshen Valleys from March 1985 to March 2015.

## Juab Valley

By Robert J. Eacret

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

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

Total estimated withdrawal of water from wells in Juab Valley in 2014 was about 29,000 acre-feet, which is 2,000 acre-feet more than the amount reported for 2013 and 6,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3).

The location of wells in Juab Valley in which the water level was measured during March 2015 is shown in figure 21. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1, is shown in figure 22. Precipitation at Nephi during 2014 was about 11.3 inches, which is about 2.9 inches less than the average annual precipitation for 1935–2014, and about 2.9 inches more than in 2013.

Water levels declined in all of the wells measured in Juab Valley from March 2014 to March 2015 (fig. 22). Declines are probably the result of continued large withdrawals for irrigation and less-than-average precipitation. Water levels generally rose from 1978 to their highest level in 1985–87. This rise corresponds to a period of greater-than-average precipitation during 1978–86. Water levels generally declined from the late 1980s to 2014, although there was a substantial rise from 1993 to 1999.

Water levels declined from March 1985 to March 2015 in all areas of Juab Valley for which data are available (fig. 23). The largest decline, over 99 feet, occurred in a well southeast of Levan. Declines are probably the result of continued large withdrawals for irrigation.

The concentration of dissolved solids in water from well (C-14-1)26dbd-1, located 2 miles west of Levan, is shown in figure 22. The dissolved-solids concentration in the water sample collected in July 2014 was 765 mg/L.

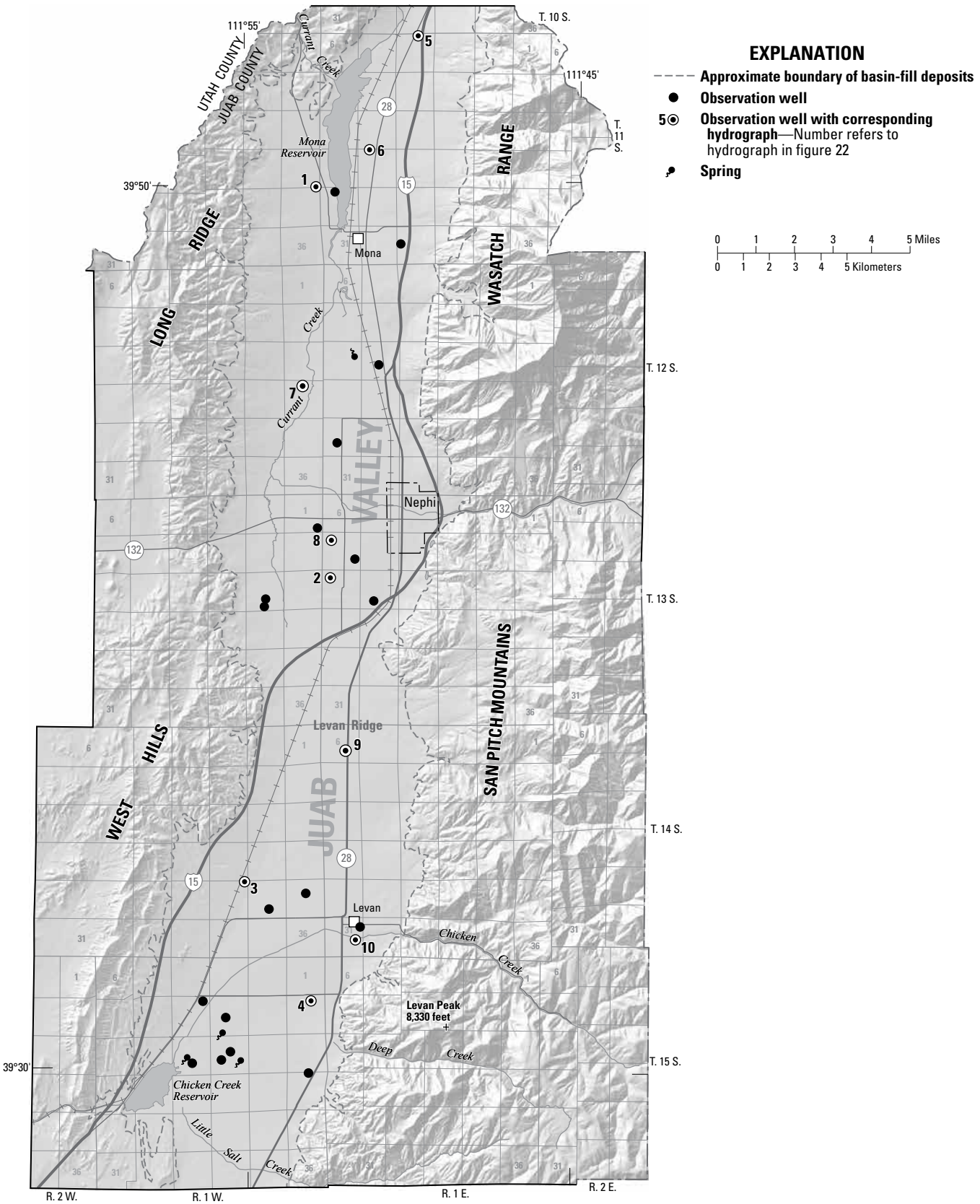



**Figure 21.** Location of wells in Juab Valley in which the water level was measured during March 2015.

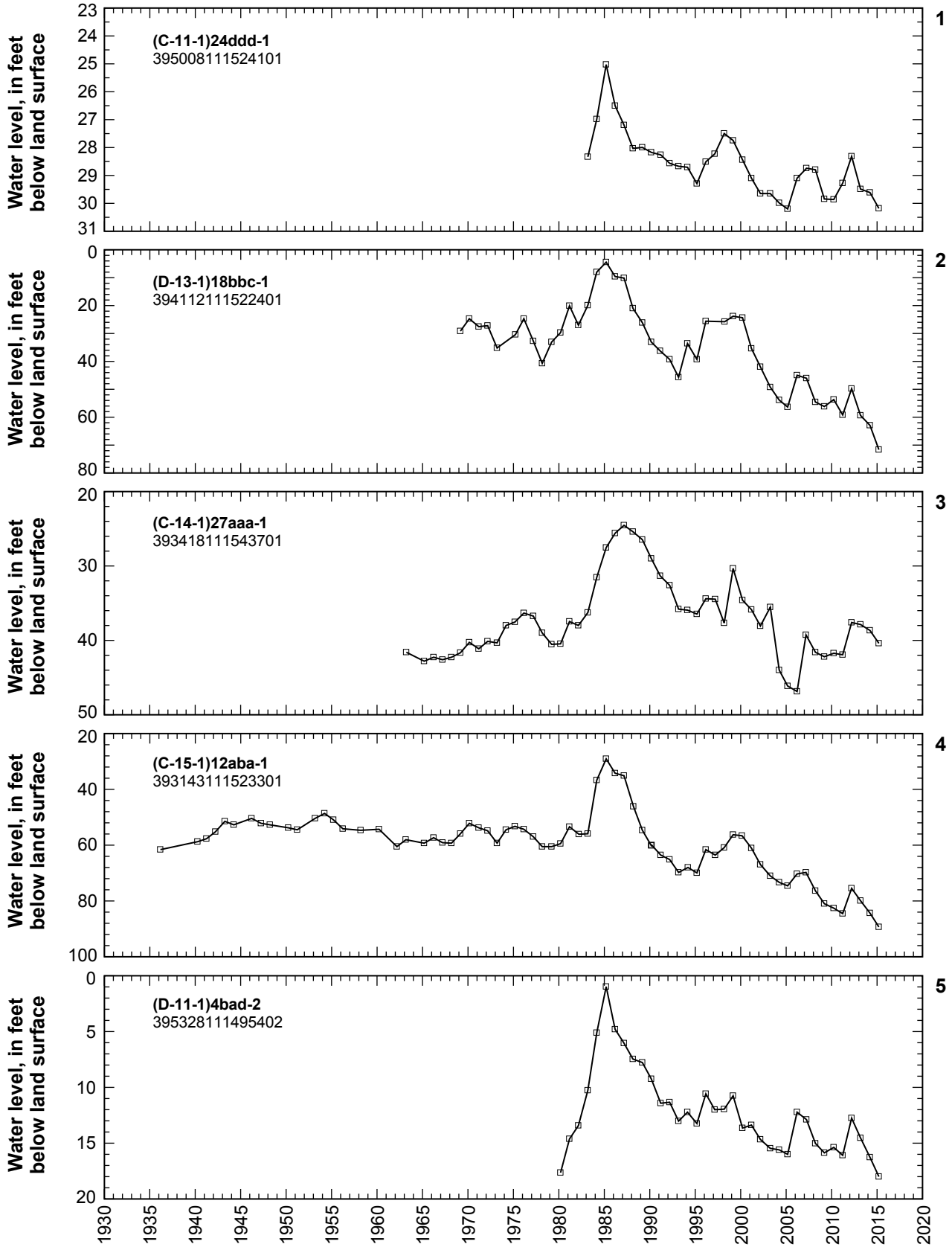



**Figure 22.** Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.

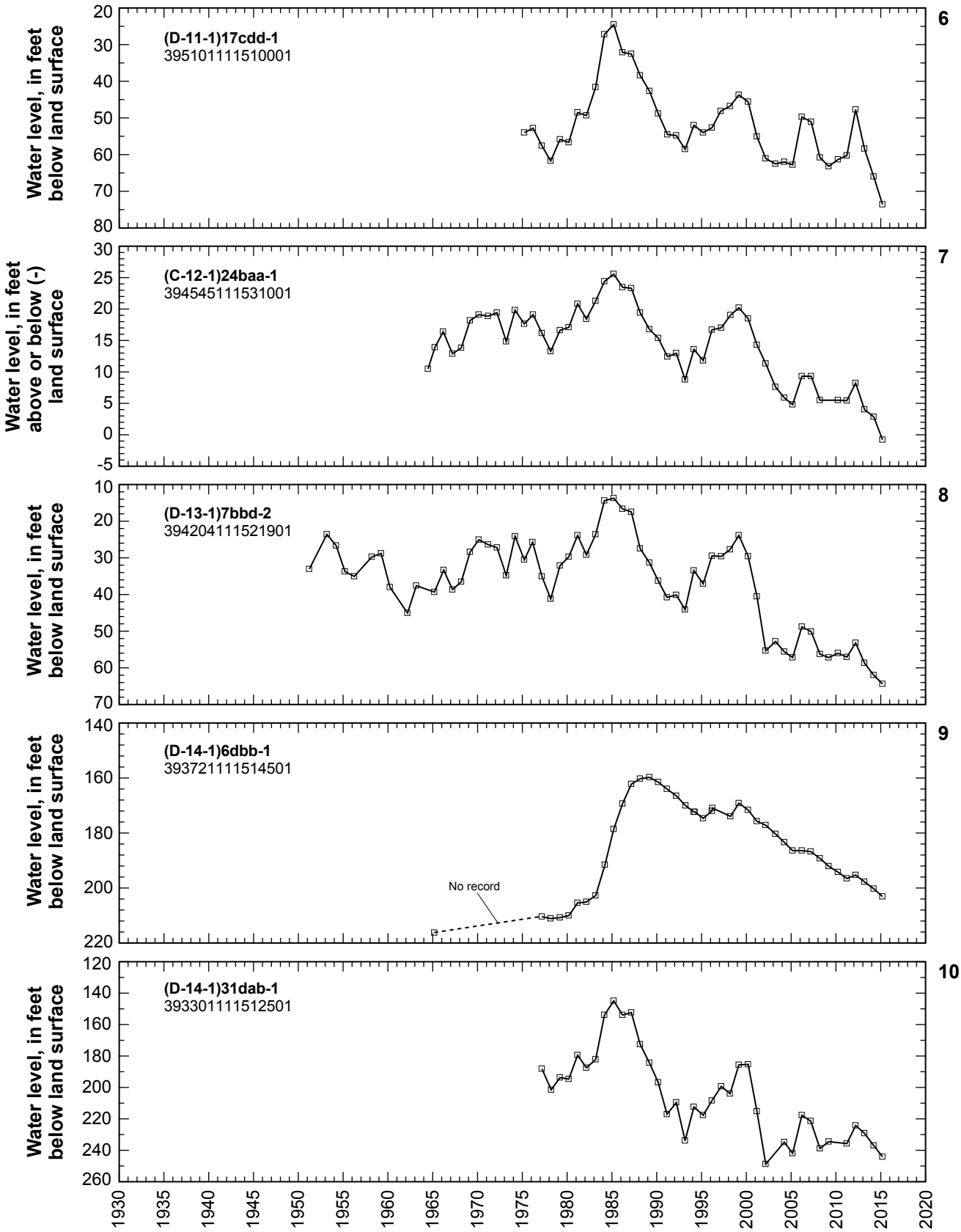



**Figure 22.** Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.—Continued

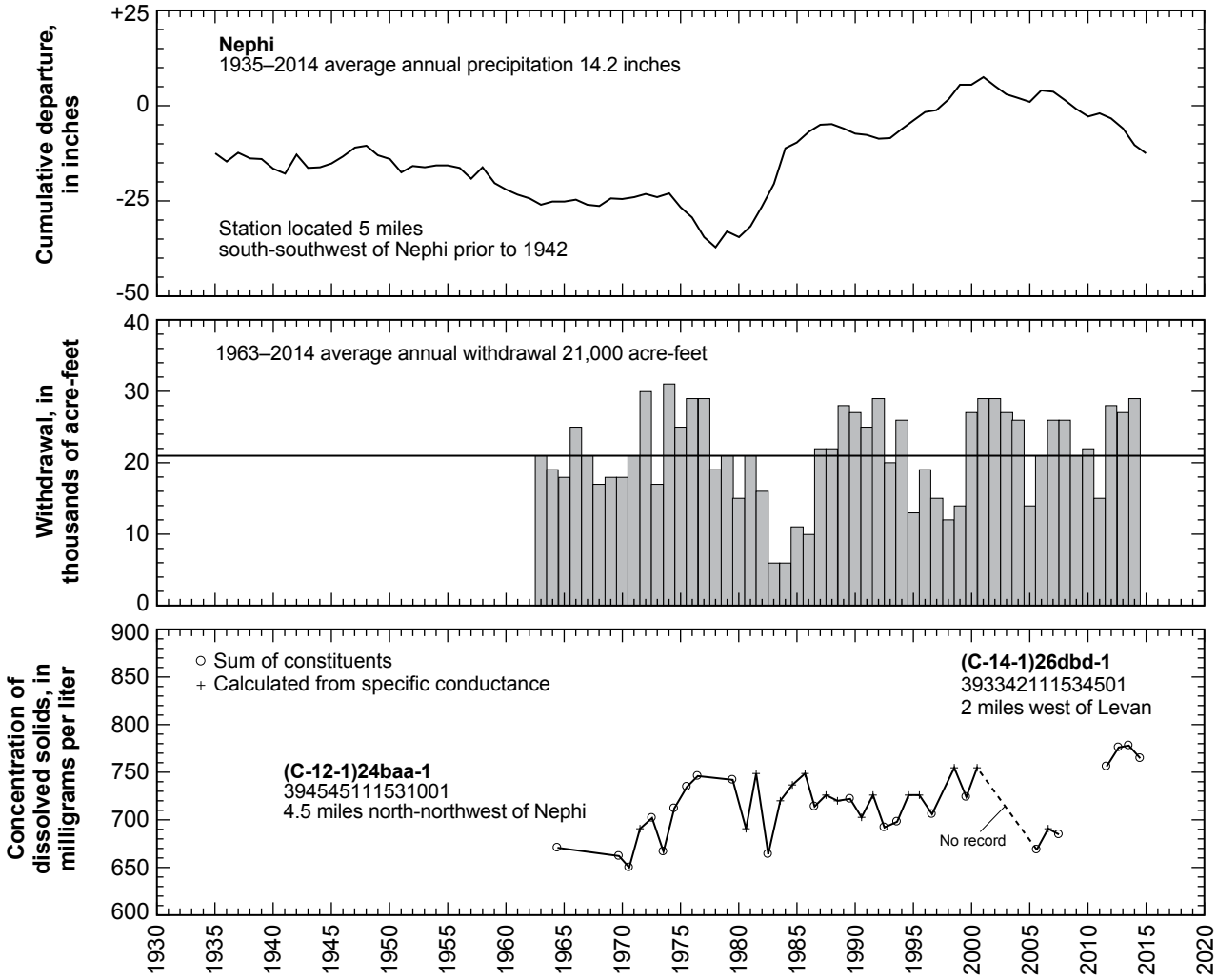



**Figure 22.** Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.—Continued

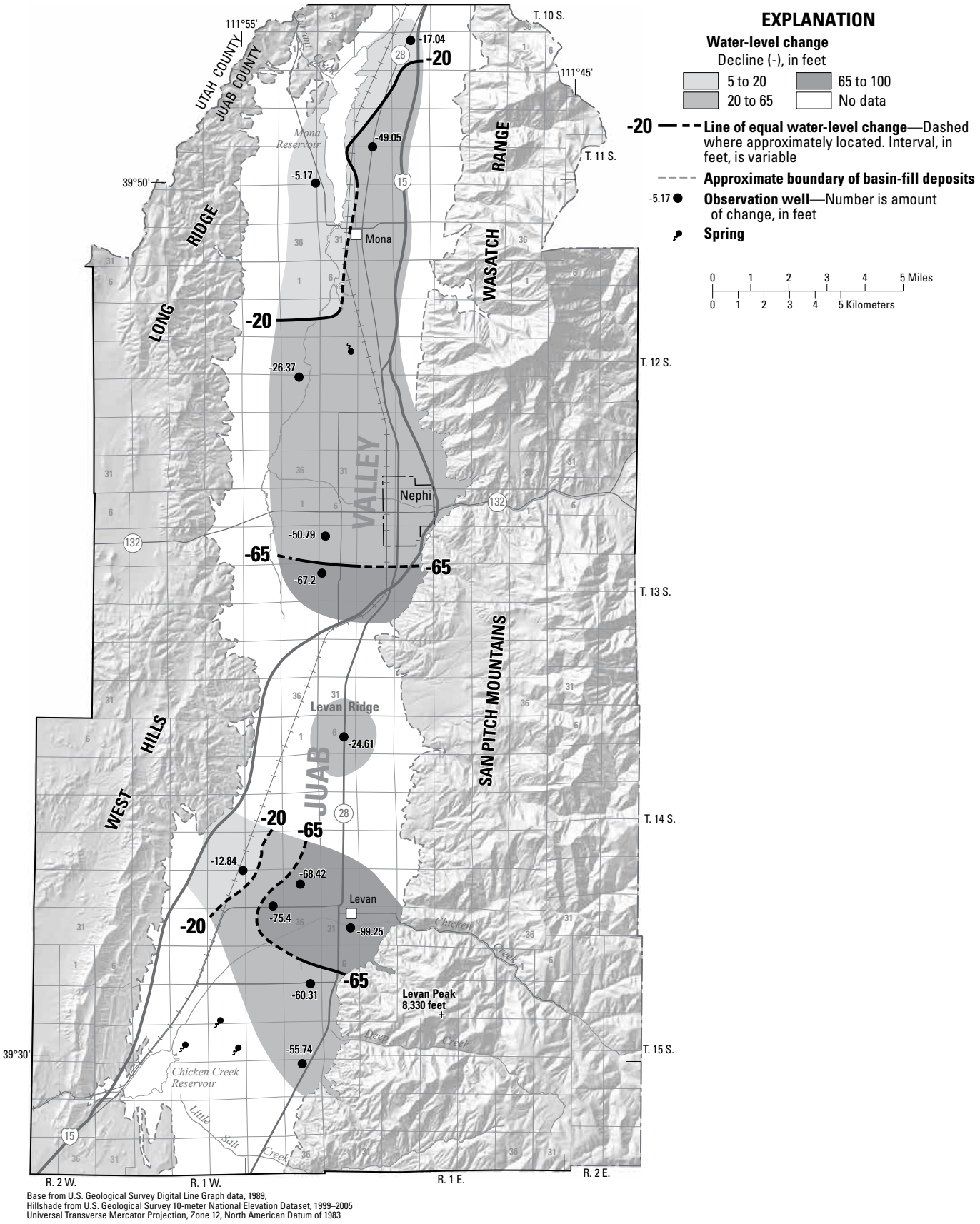



**Figure 23.** Water-level change in Juab Valley from March 1985 to March 2015.

## Sevier Desert

By Travis L. Gibson

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

Total estimated withdrawal of water from wells in the Sevier Desert in 2014 was about 53,000 acre-feet, which is 7,000 acre-feet more than the revised total for 2013 and about 18,000 acre-feet more than the 2004–2013 average annual withdrawal (tables 2 and 3). The increase in withdrawals was mainly due to increased pumpage for irrigation, which coincides with less-than-average discharge of, and corresponding decreased withdrawal of water from, the Sevier River.

The location of wells in the Sevier Desert in which the water level was measured during March 2015 is shown in figures 24 and 25. The relation of the water level in selected observation wells to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1 is shown in figure 26.

Discharge of the Sevier River near Juab in 2014 was 117,400 acre-feet, which is 2,600 acre-feet less than in 2013 and 62,400 acre-feet less than the long-term average (1935–2014). Precipitation at Oak City was about 11.7 inches in 2014, about 1.3 inches less than the 1930–2014 average annual precipitation and about the same as in 2013.

Most water levels in the shallow artesian and deep artesian aquifers declined from March 2014 to March 2015 (fig. 26). In the shallow artesian aquifer, declines of over 5 feet occurred. In the deep artesian aquifer, declines of over 7 feet occurred. Declines are probably the result of increased withdrawals for irrigation and less-than-average precipitation.

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

Water levels declined in both the shallow and deep artesian aquifers from March 1985 to March 2015 in all areas of the Sevier Desert for which data are available (figs. 27 and 28). In the shallow artesian aquifer, a decline of almost 30 feet occurred in a well about 4 miles south of Leamington. In the deep artesian aquifer, a decline of 37 feet was observed in a well about 8 miles northwest of Oak City. Declines are probably the result of continued large withdrawals for irrigation.

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 2014, is shown in figure 26. The concentration has ranged from 1,490 to 2,340 mg/L, with a median value of 2,030 mg/L. The dissolved-solids concentration in the water sample from July 2014 was 2,140 mg/L.

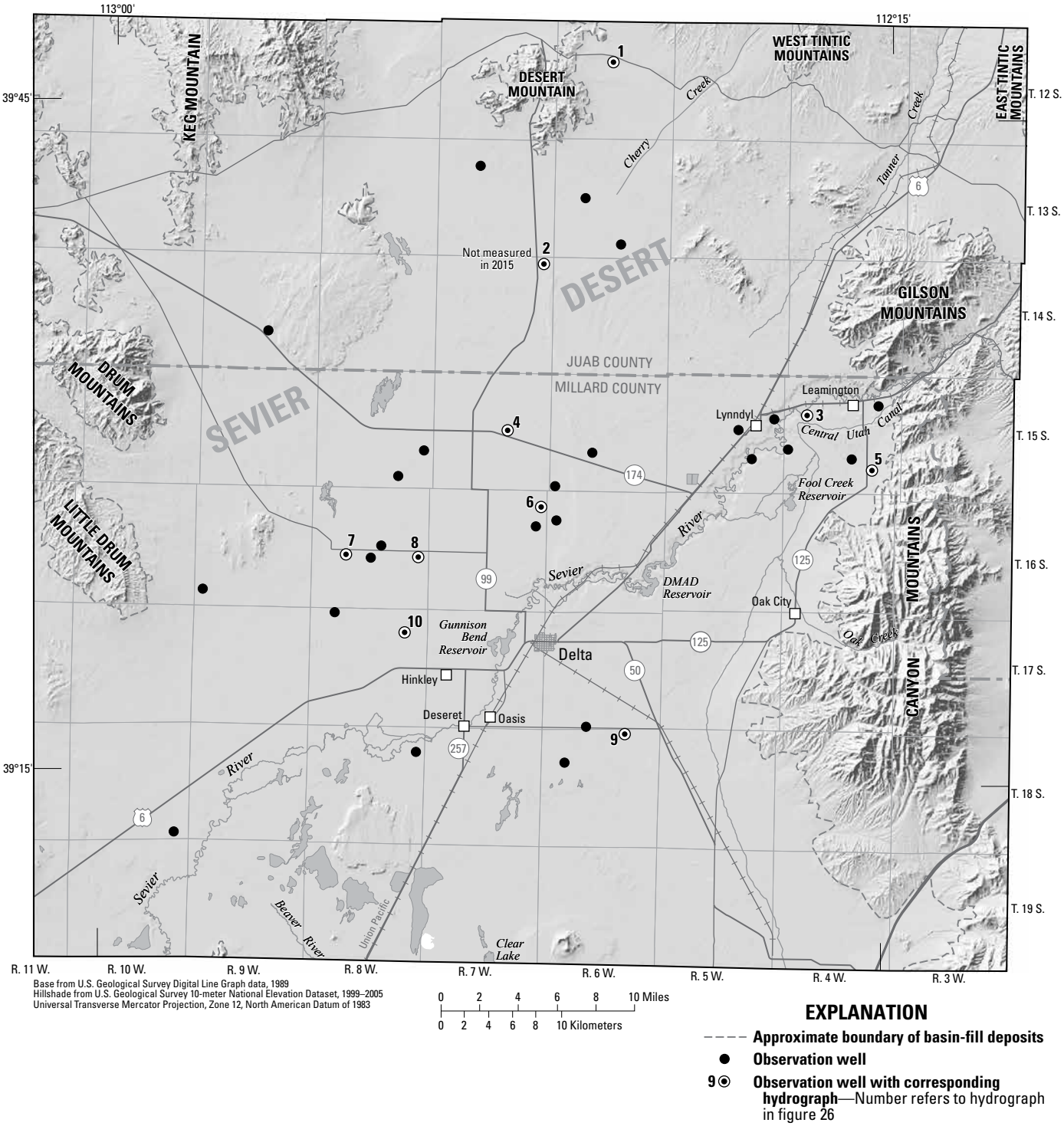



**Figure 24.** Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2015.

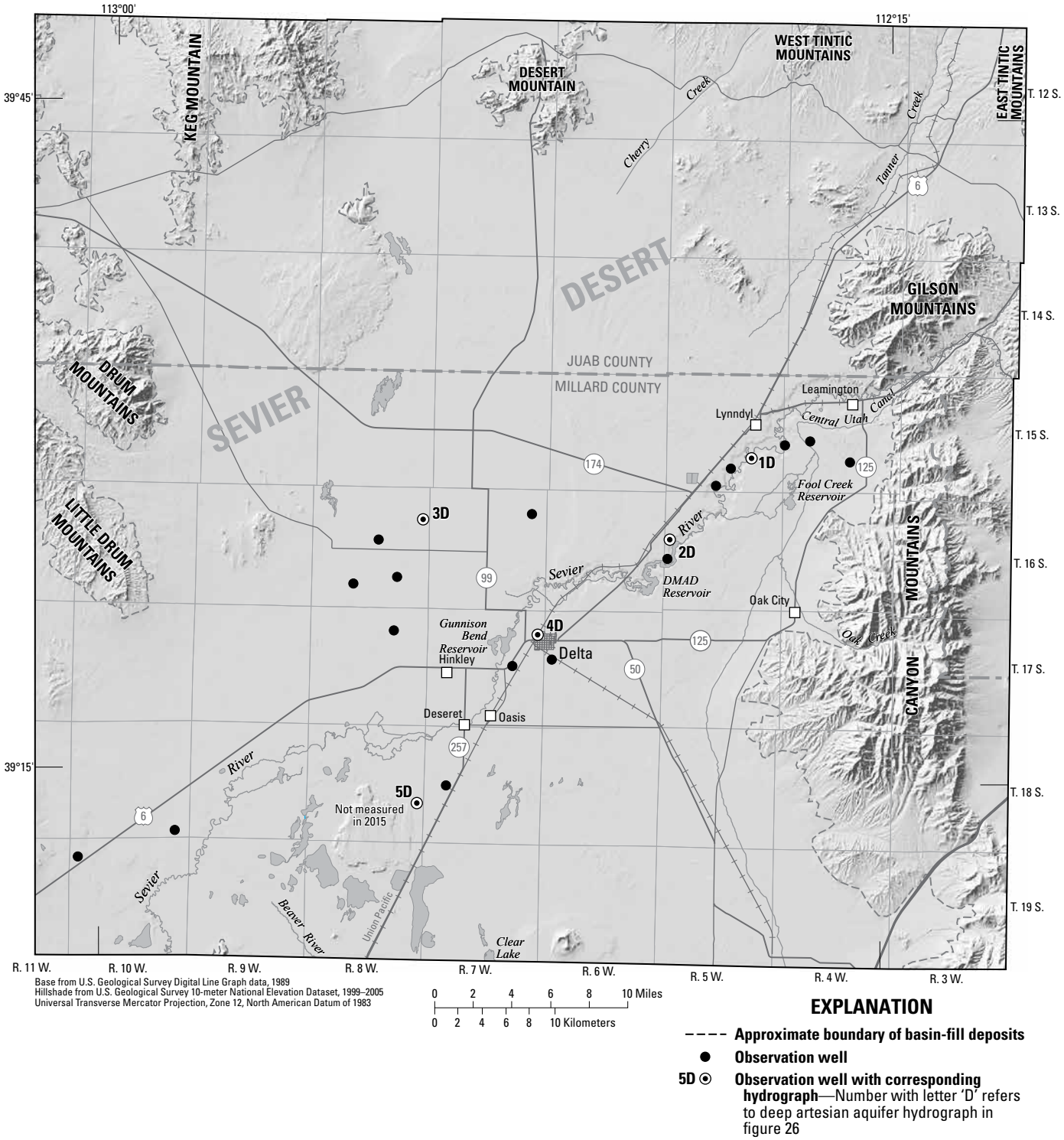



**Figure 25.** Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2015.

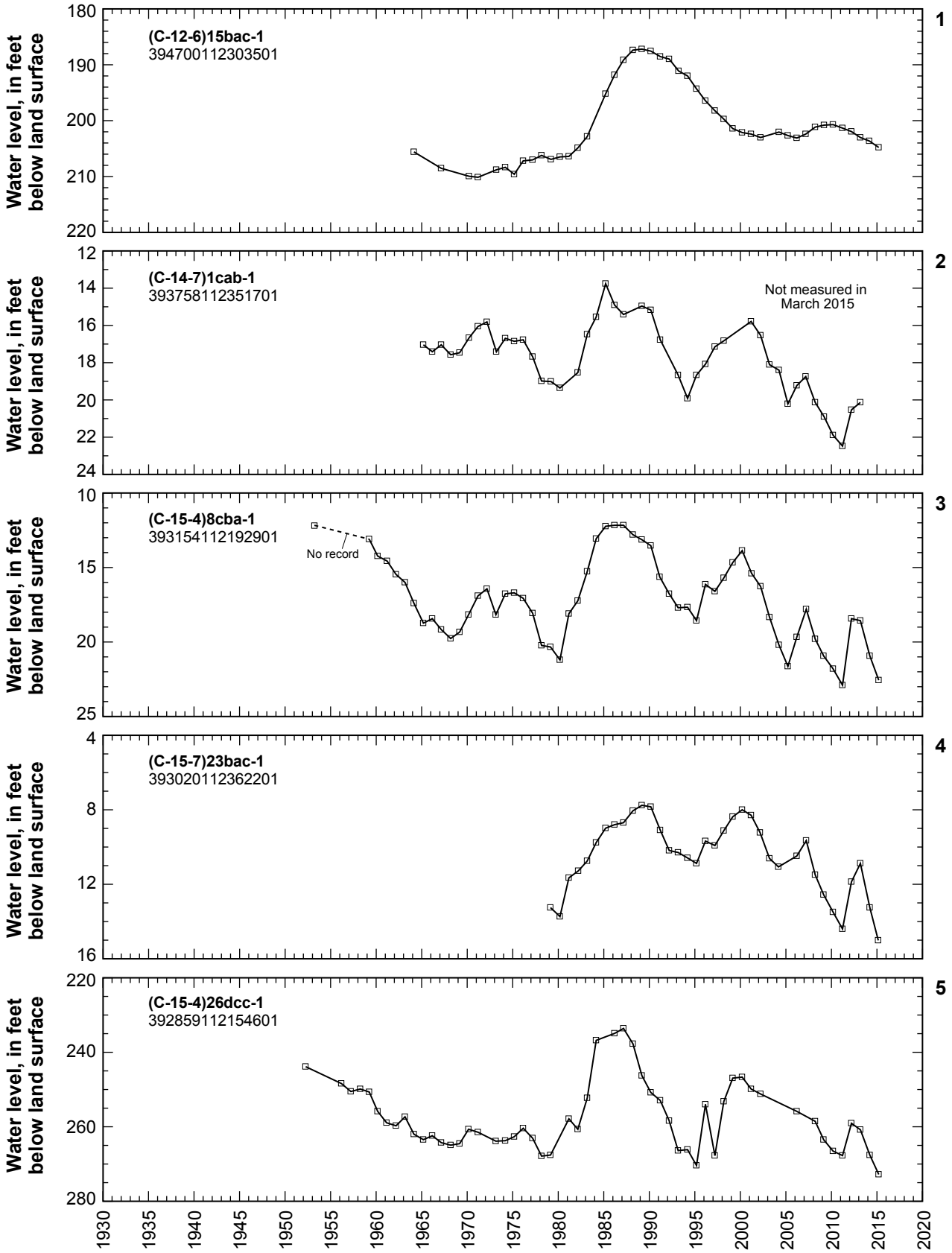



**Figure 26.** Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.

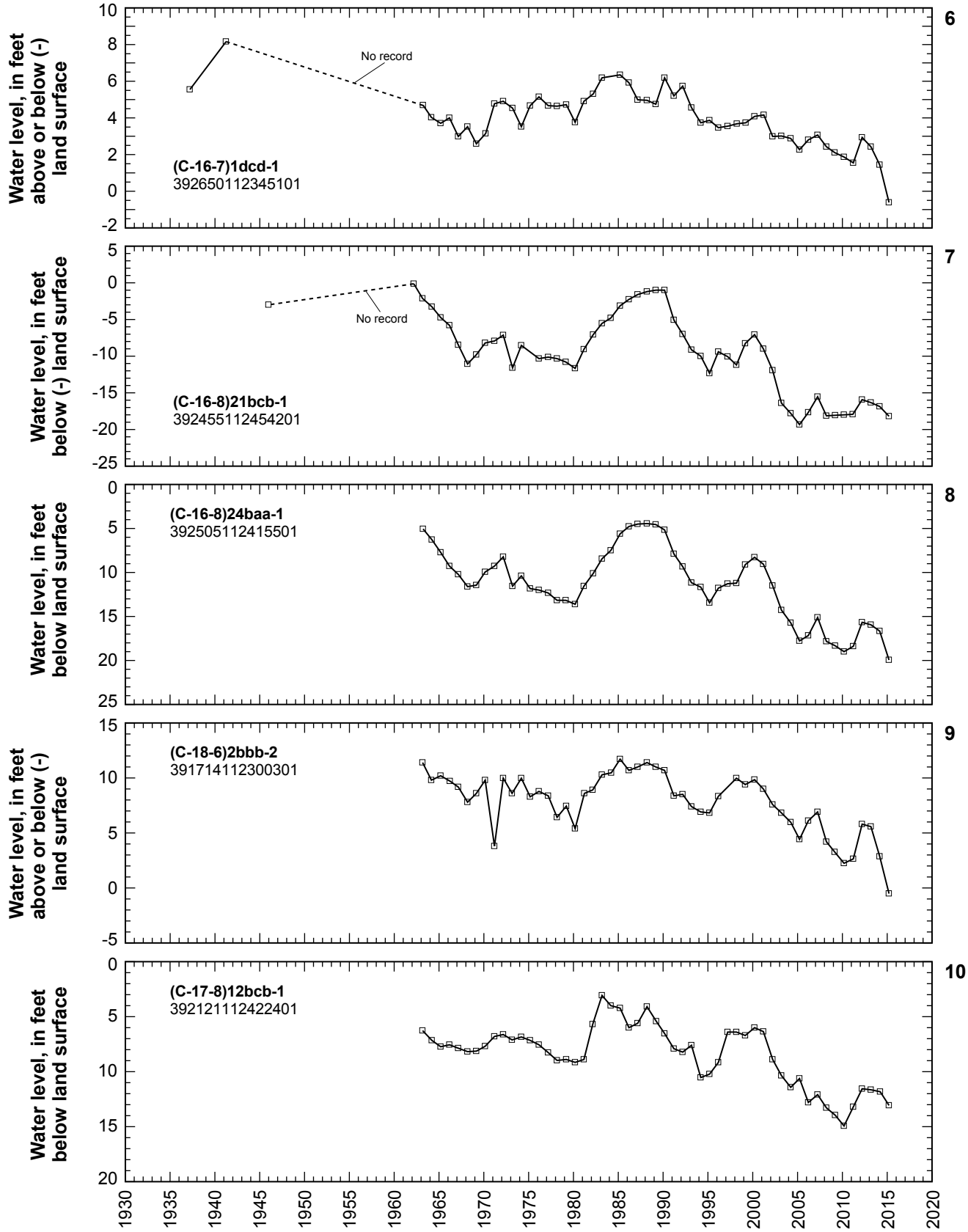



**Figure 26.** Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

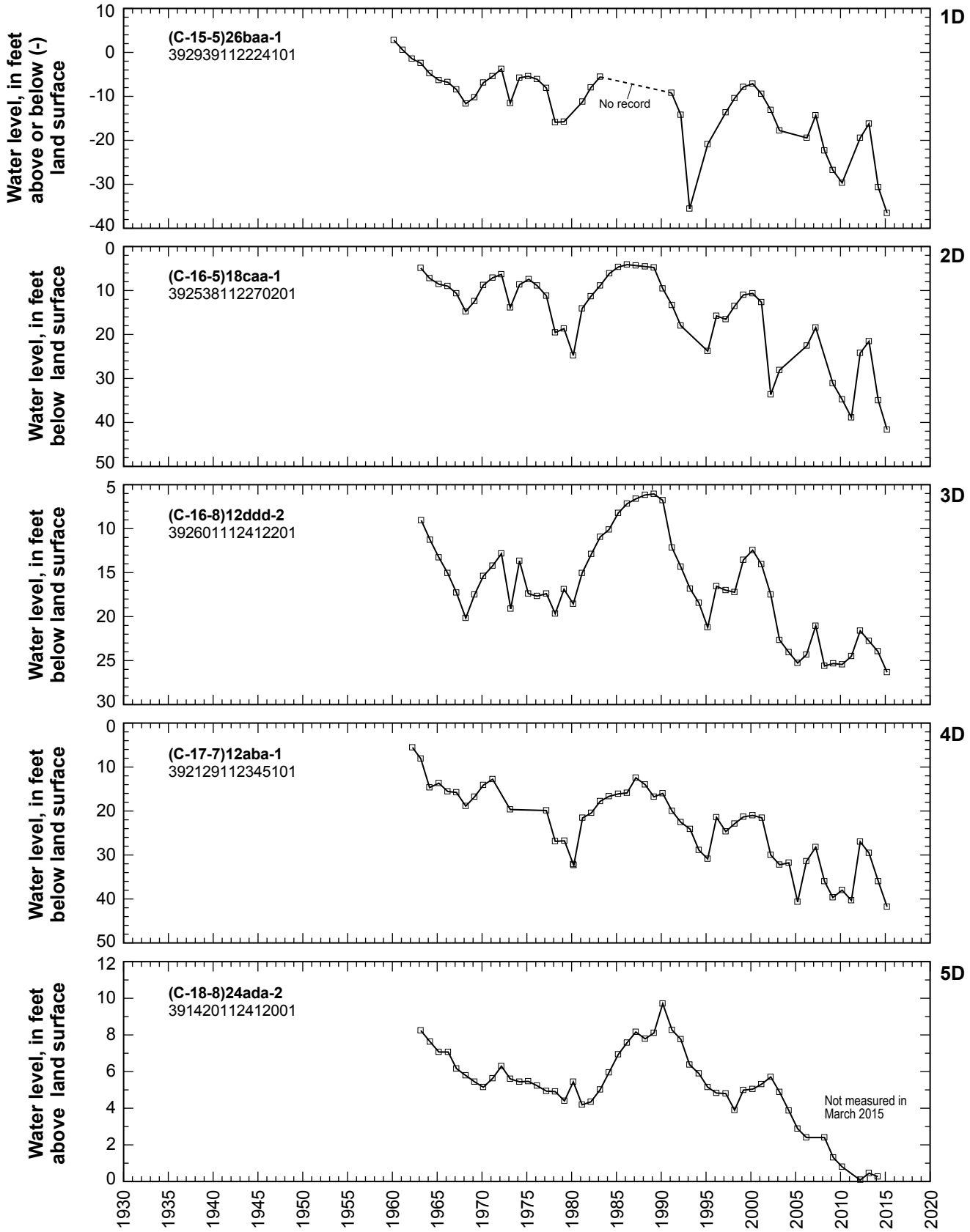



**Figure 26.** Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

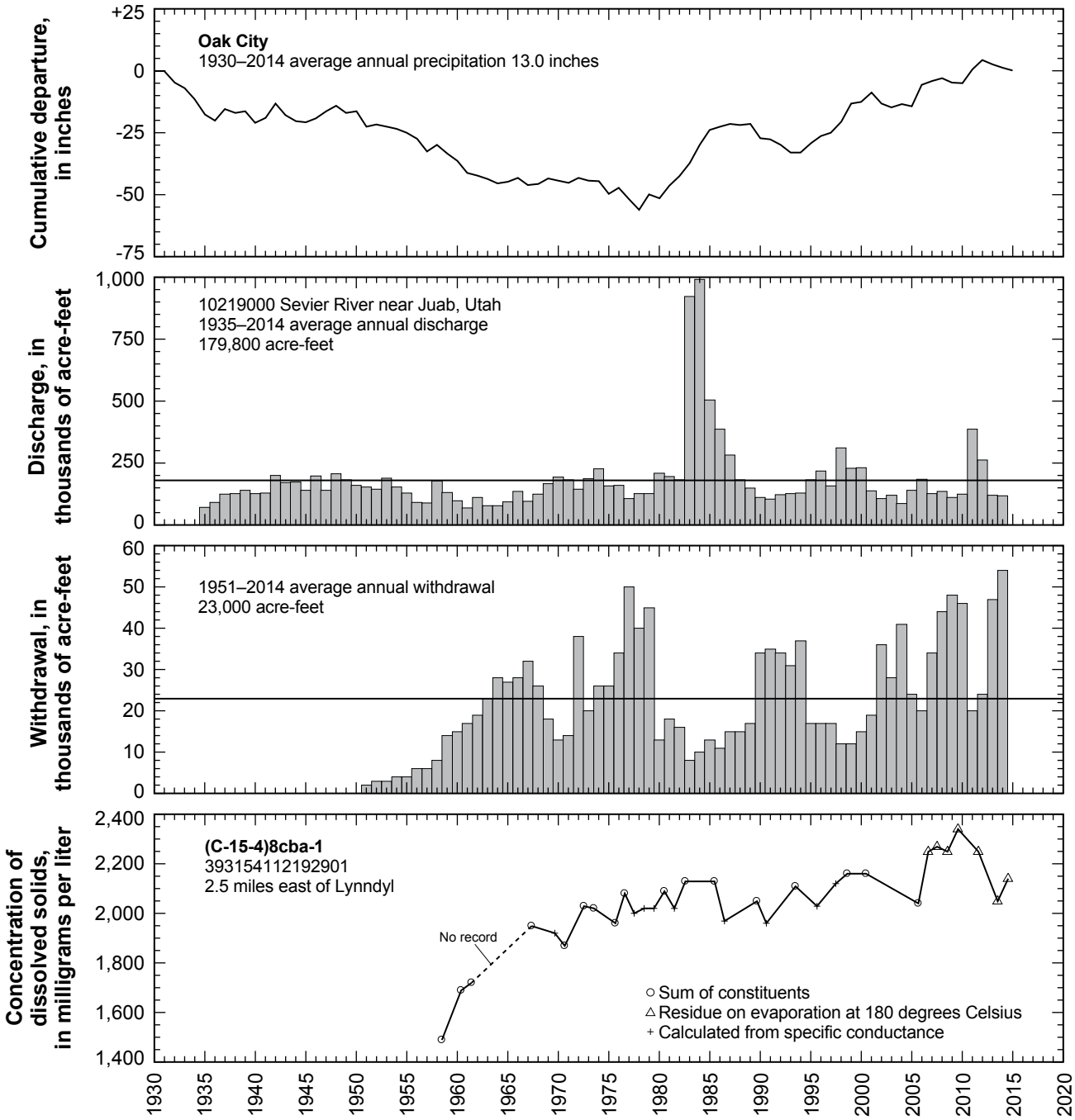



**Figure 26.** Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

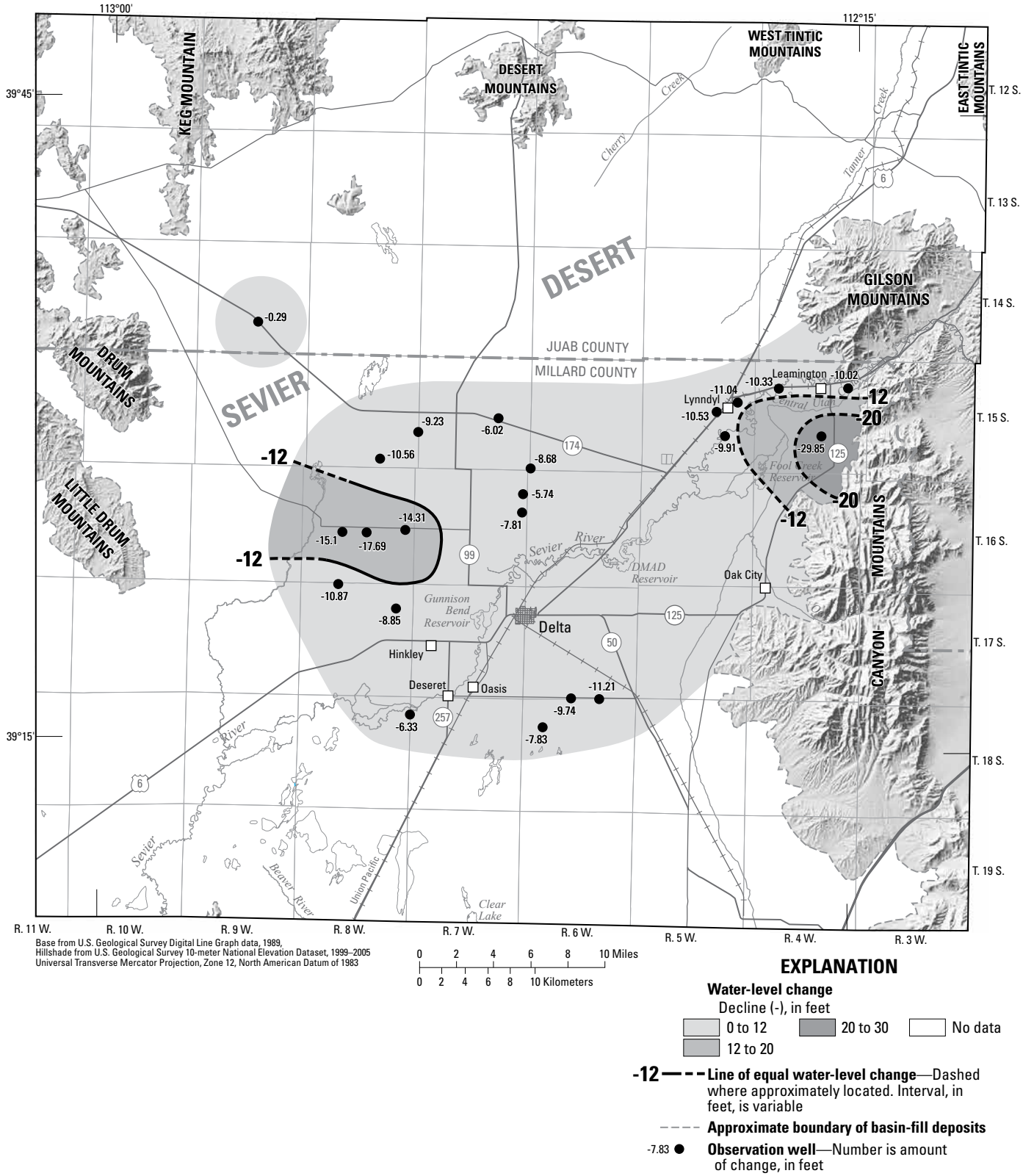



**Figure 27.** Water-level change in the shallow artesian aquifer in part of the Sevier Desert from March 1985 to March 2015.

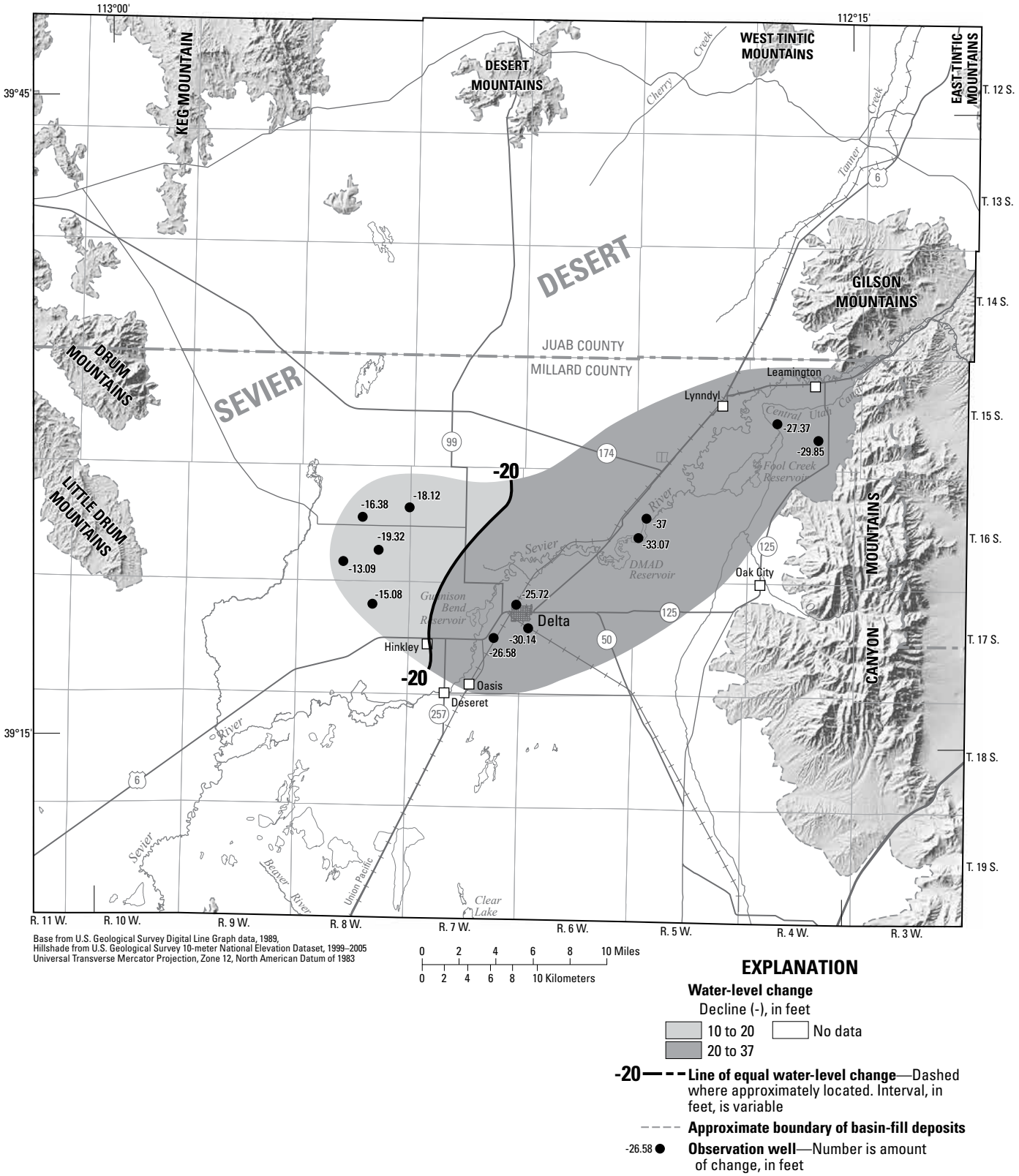



**Figure 28.** Water-level change in the deep artesian aquifer in part of the Sevier Desert from March 1985 to March 2015.

## Central Sevier Valley

By Bradley A. Slaugh

Central Sevier Valley, located in northern Piute, Sevier, and southern Sanpete Counties, in south-central Utah, is surrounded by the Sevier and Wasatch Plateaus to the east and the Tushar Mountains, Valley Mountains, and Pahvant Range to the west (fig. 29). Altitude ranges from 5,100 feet on the valley floor at the north end of the valley near Gunnison to more than 12,000 feet in the Tushar Mountains. Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in central Sevier Valley in 2014 was about 31,000 acre-feet, which is 3,000 acre-feet more than reported for 2013 and 8,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3).

The location of 24 wells in central Sevier Valley in which the water level was measured during March 2015 is shown in figure 29. The relation of the water level in selected observation wells to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 30.

Discharge of the Sevier River at Hatch, Utah, in 2014 was about 46,200 acre-feet, which is about 33,900 acre-feet less than the 1940–2014 average annual discharge. Precipitation at Richfield Radio KVSC was about 10.0 inches in 2014, which is about 1.9 inches more than the 1950–2014 average annual precipitation and about 1.0 inch more than in 2013.

Water levels in central Sevier Valley generally declined in most areas from March 2014 to March 2015. Hydrographs for selected wells show that March water levels generally rose from about 1978 to 1985 and declined from 1985 to about 1993. Since 1993, water levels have fluctuated depending upon the amount and timing of precipitation and recharge to the basin-fill aquifer from snowmelt runoff.

Water levels declined from March 1985 to March 2015 in the central Sevier Valley in areas where data are available (fig. 31). The greatest decline, about 20.5 feet, occurred in a well about 1 mile northeast of Richfield. Declines are probably the result of continued large withdrawals, particularly for irrigation.

The concentration of dissolved solids in water samples collected from well (C-23-2)15dcb-4, located 0.1 mile south of Sevier River in Venice, from 1955 to 2014, is shown in figure 30. The concentration has ranged from 307 to 630 mg/L. There were substantial increases and decreases in dissolved-solids concentration during the mid- to late 1960s and 1980s. Dissolved-solids concentrations in samples collected from 1990 through 2014 show little variability and are generally near the median value for all sample concentrations.

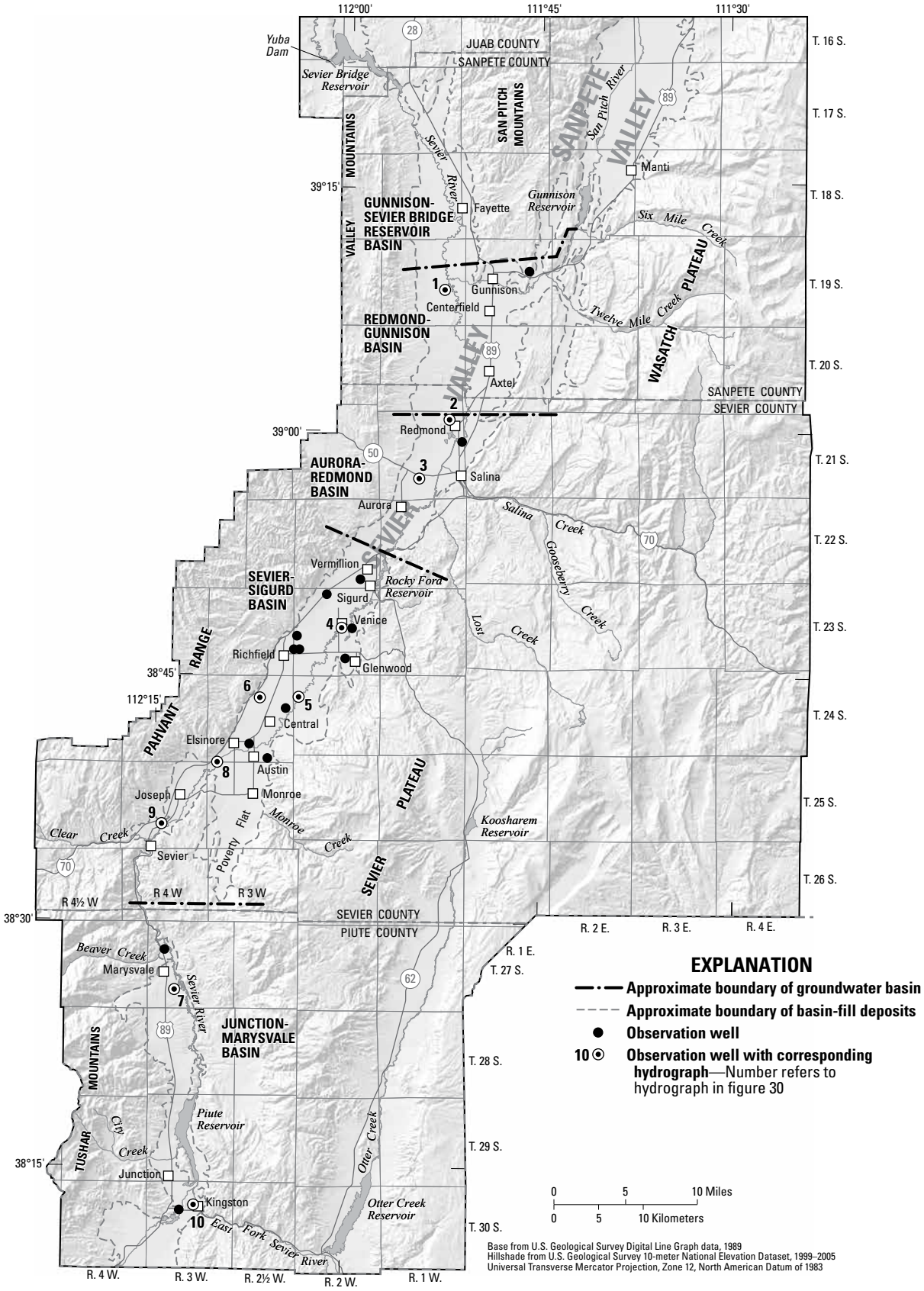



**Figure 29.** Location of wells in central Sevier Valley in which the water level was measured during March 2015.

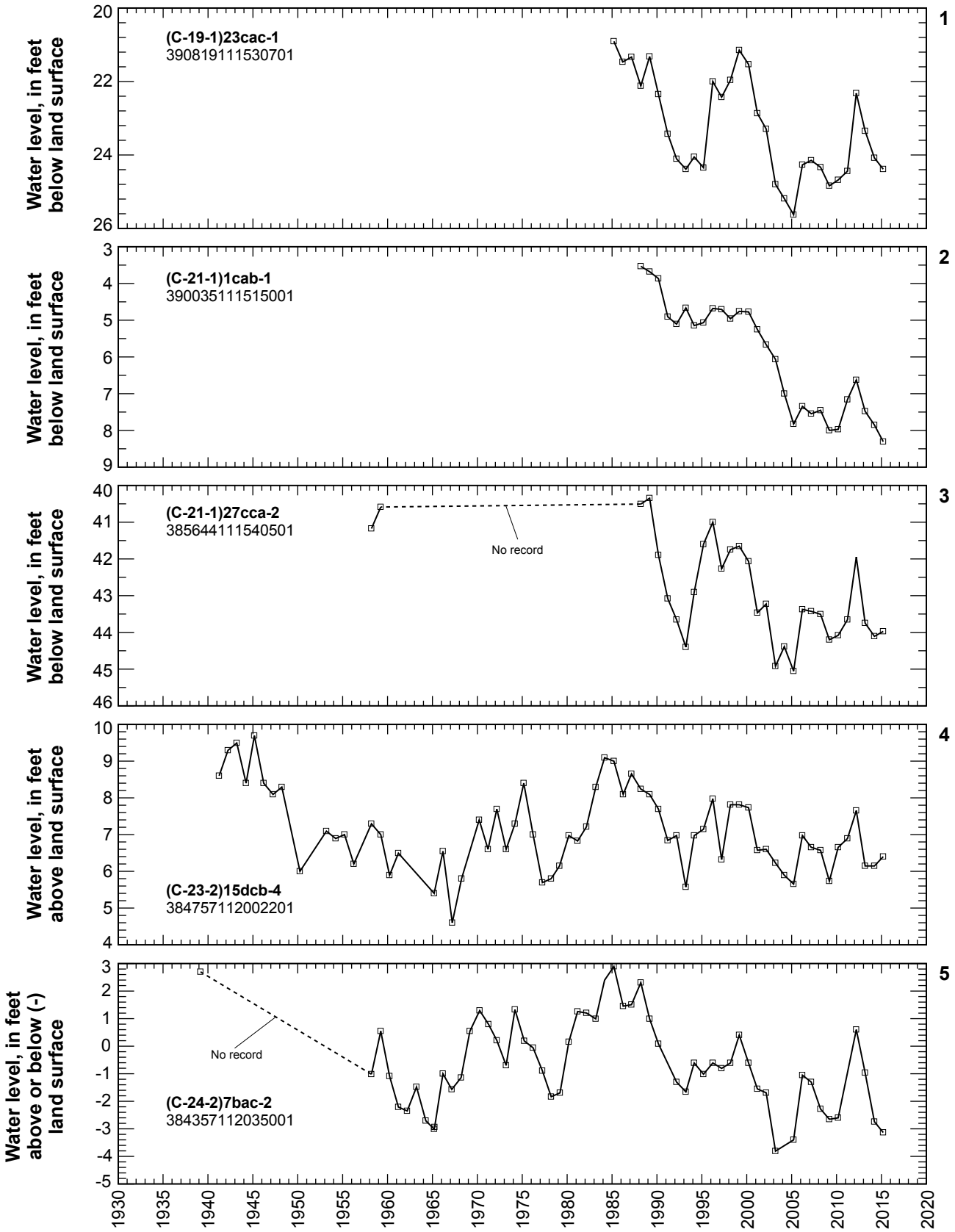



**Figure 30.** Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water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

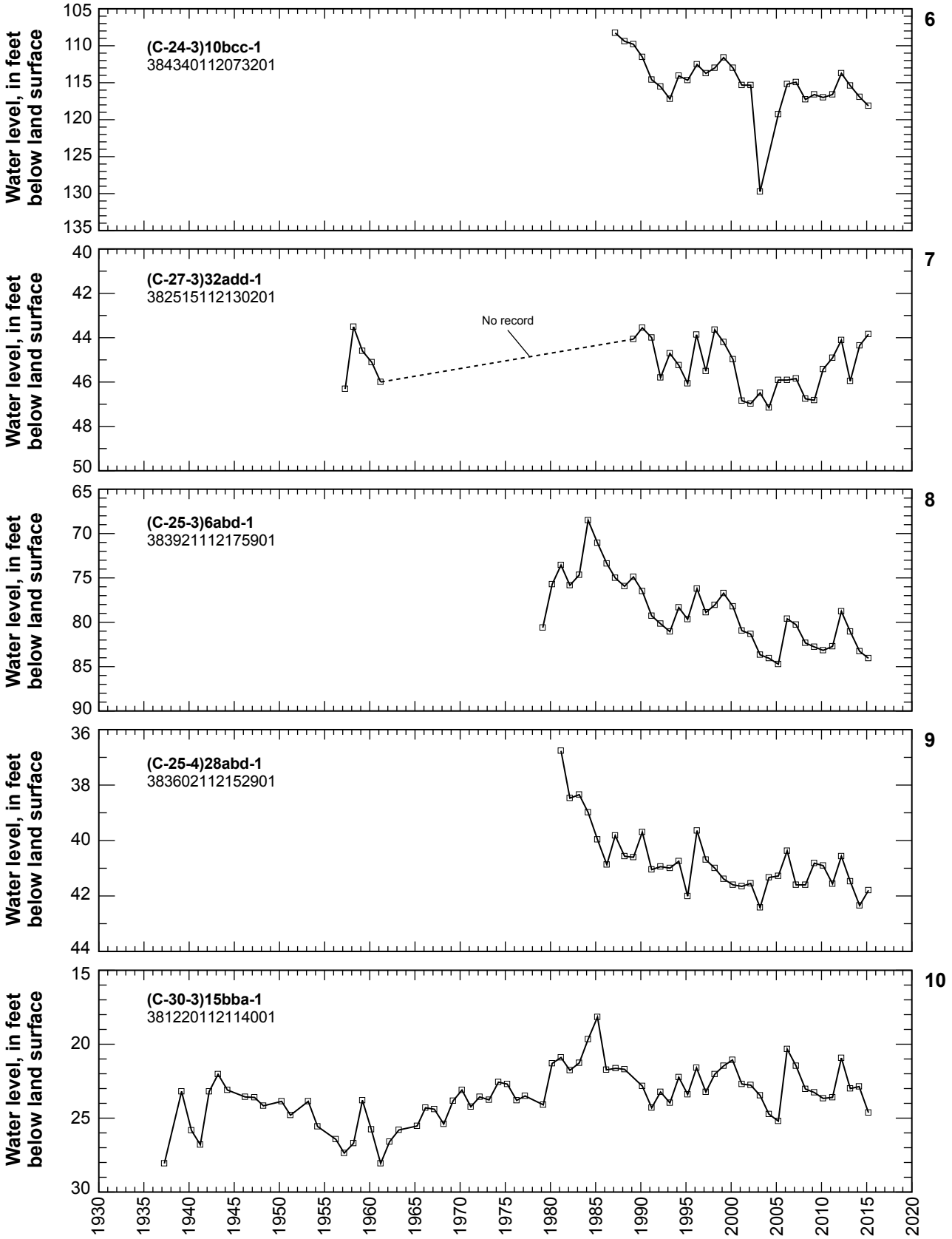



**Figure 30.** Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water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

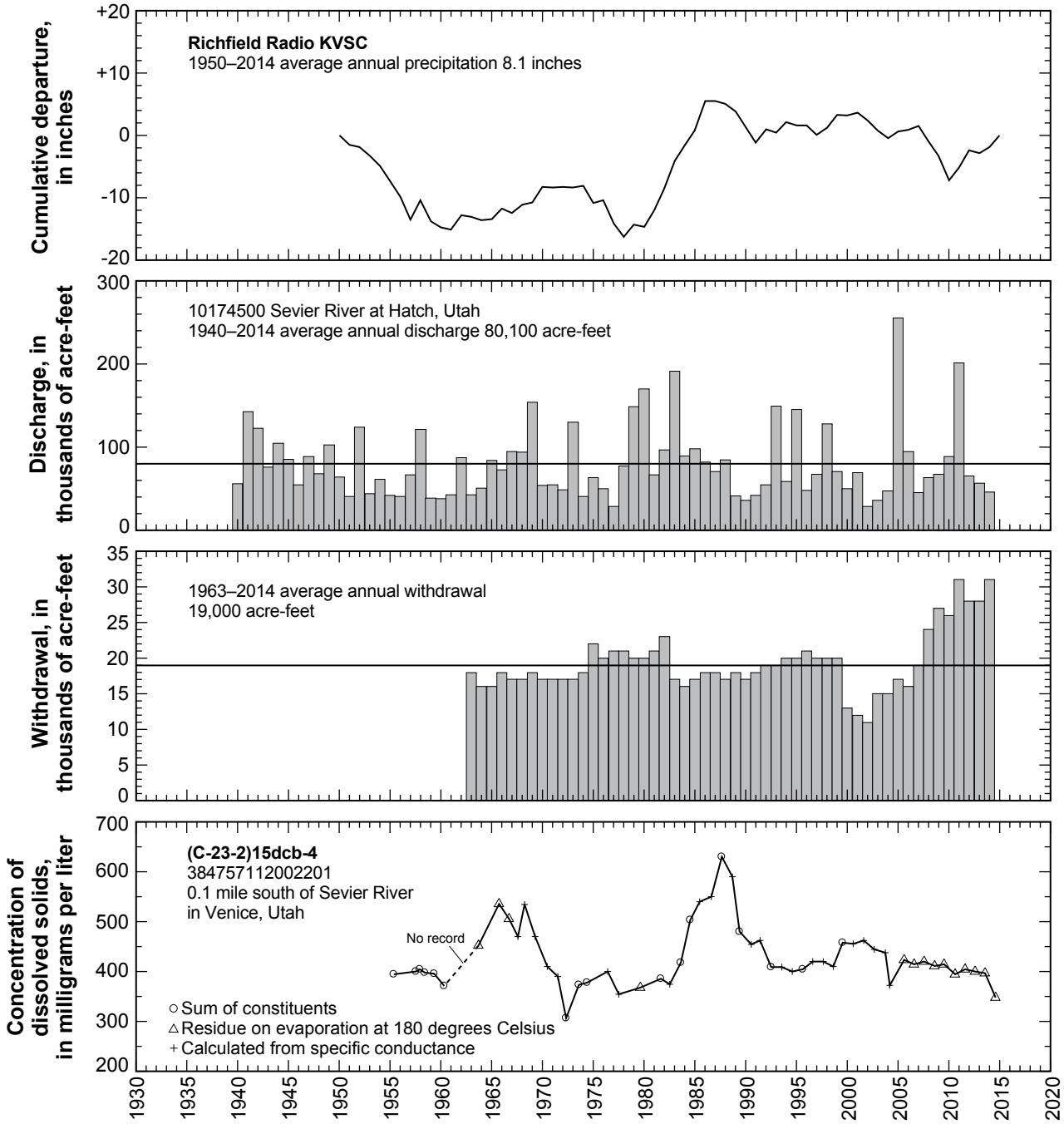



**Figure 30.** Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, Utah, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water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

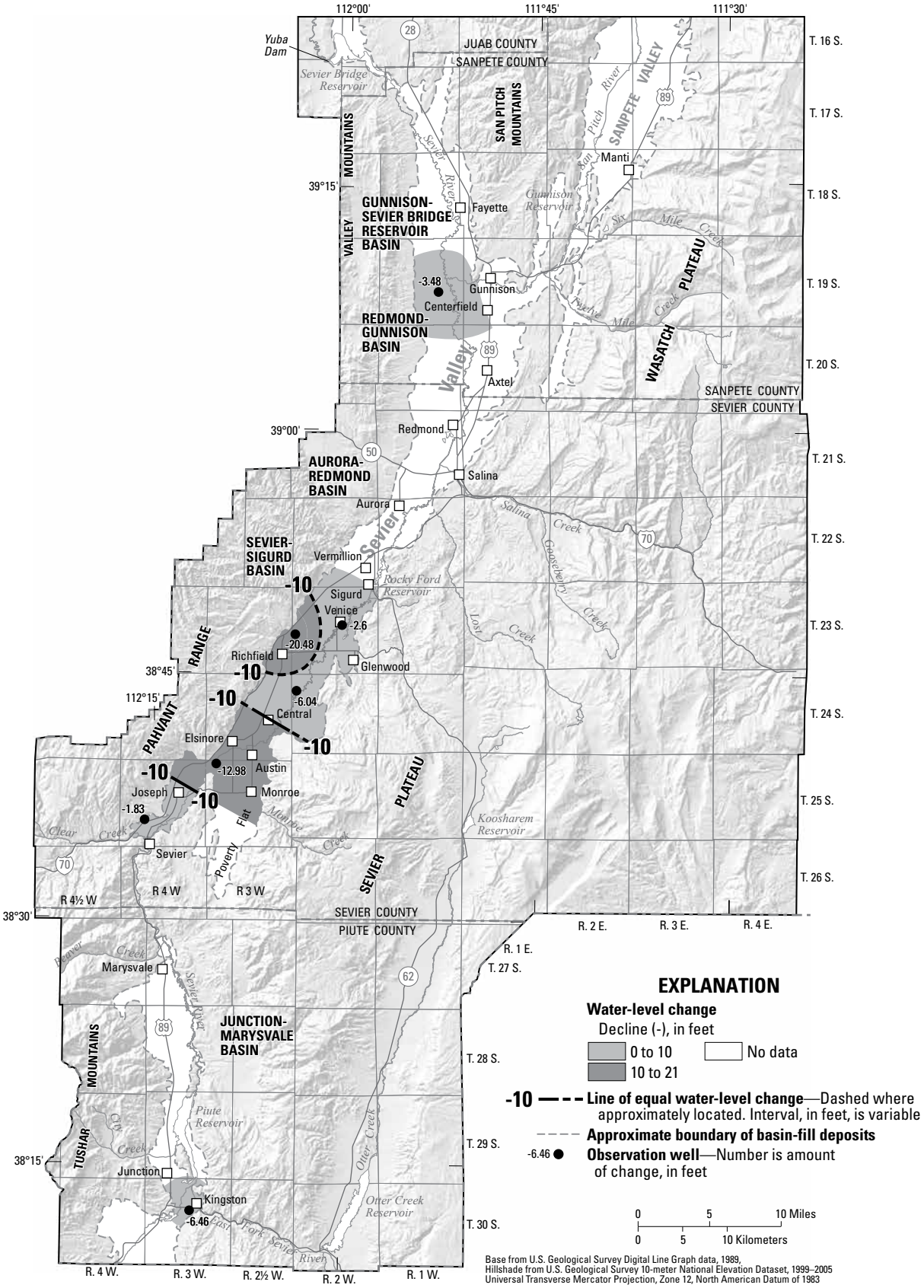



**Figure 31.** Water-level change in central Sevier Valley from March 1985 to March 2015.

## Pahvant Valley

By Nickolas R. Whittier

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

Total estimated withdrawal of water from wells in Pahvant Valley in 2014 was about 118,000 acre-feet, which is about 15,000 acre-feet more than was reported in 2013 and 23,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3). Withdrawal for irrigation in 2014 was about 117,000 acre-feet, which is 15,500 acre-feet more than was reported in 2013.

The location of wells in Pahvant Valley in which the water level was measured during March 2015 is shown in figure 32. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 33.

Precipitation at Fillmore during 2014 was about 16.9 inches, which is about 1.6 inches more than the average annual precipitation for 1930–2014 and about 2.1 inches more than in 2013.

Water levels declined from March 2014 to March 2015 in most parts of Pahvant Valley; however, there were a few wells in the southwest part of the valley in which water levels rose slightly. Water-level declines of more than 8 feet occurred in several wells north of Flowell. These declines are probably the result of continued large localized withdrawals for irrigation. Water levels generally declined from the early 1950s until 1982 as a result of generally less-than-average precipitation and increased withdrawals. Water levels rose substantially from 1982 to 1985 as a result of greater-than-average precipitation and decreased withdrawals for irrigation. Water levels generally have declined throughout the valley since the mid- to late 1980s.

Water levels declined from March 1985 to March 2015 in all parts of Pahvant Valley for which data are available (fig. 34). The greatest decline, almost 130 feet, occurred in a well near McCornick in the northern part of the valley. Declines are probably the result of continued large withdrawals for irrigation.

The concentration of dissolved solids in water samples collected from wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3, located in the Flowell area, from 1954 to 1958 and 1960 to 2014, respectively, and from well (C-23-6)8abd-1, located in the Kanosh area, from 1957 to 2014, is shown in figure 33. Wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3 are located near each other and are finished in the same aquifer. The dissolved-solids concentrations in water samples from these wells were combined to give an extended temporal record for this constituent. Dissolved-solids concentrations in water samples from these wells have ranged from 707 to 1,080 mg/L. The concentration of dissolved solids in the water sample collected in June 2014 was 989 mg/L. The concentration of dissolved solids in water samples from well (C-23-6)8abd-1 has ranged from 2,350 to 5,990 mg/L. The concentration of dissolved solids in the water sample collected from this well in June 2014 was 5,490 mg/L.

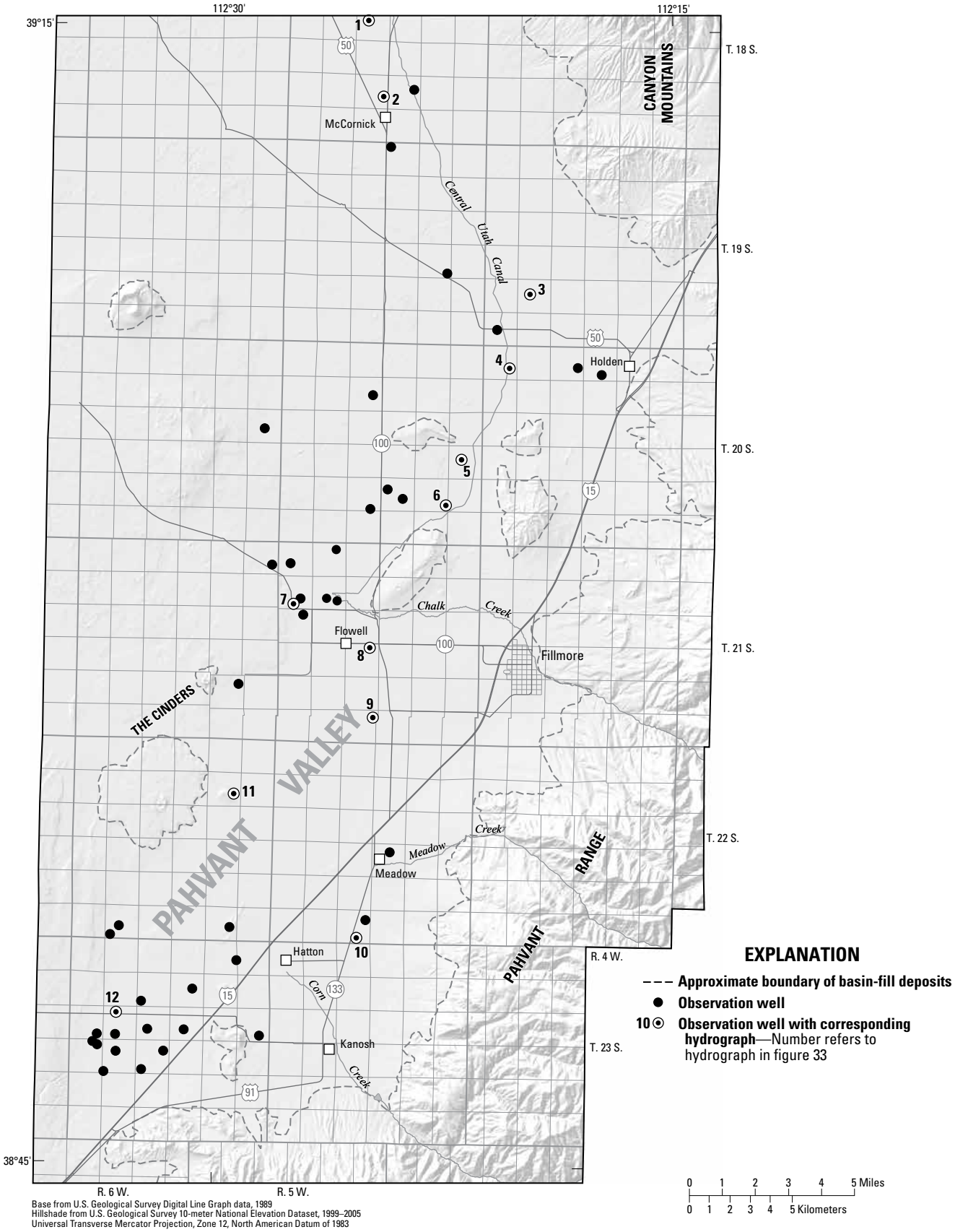



**Figure 32.** Location of wells in Pahvant Valley in which the water level was measured during March 2015.

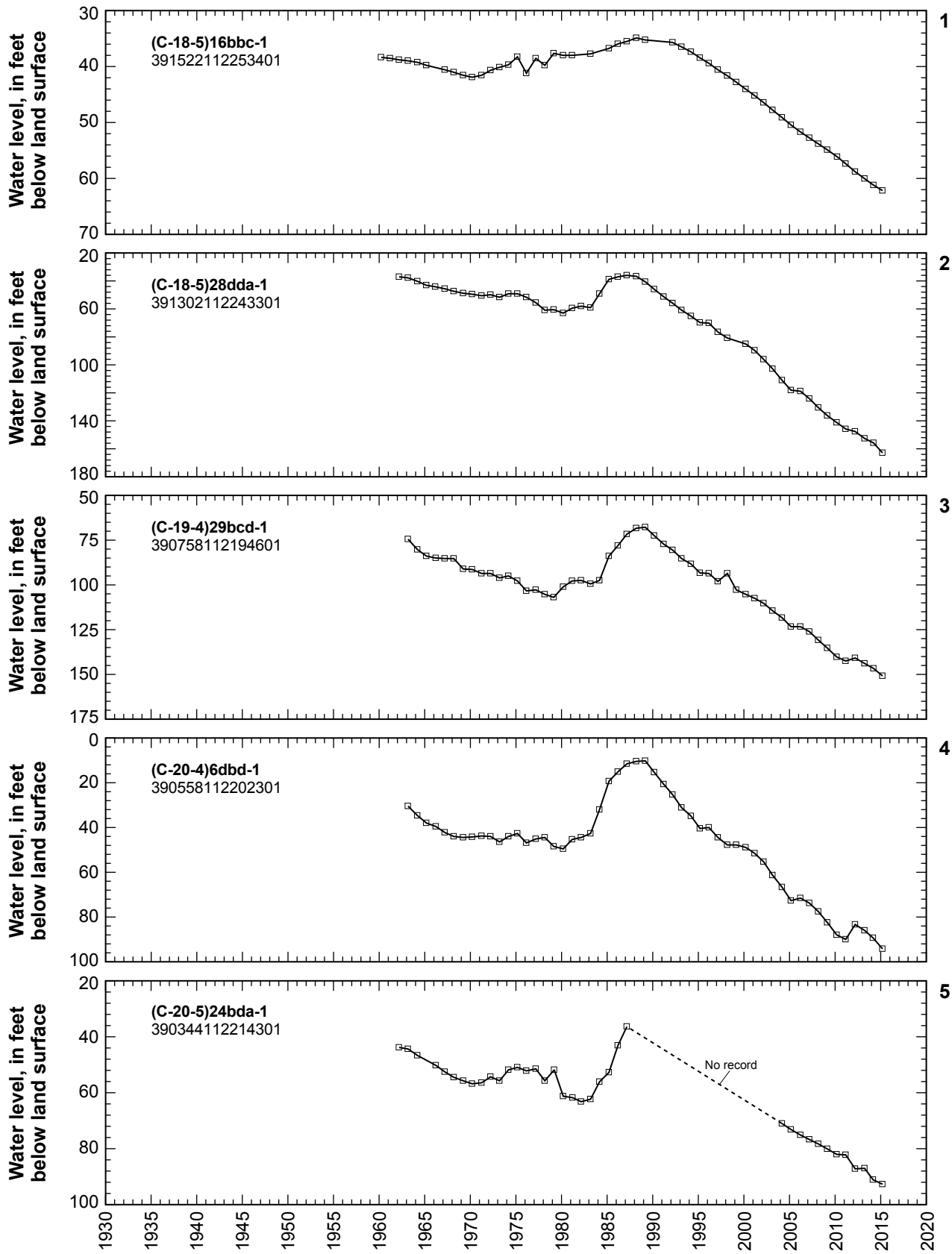



**Figure 33.** Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

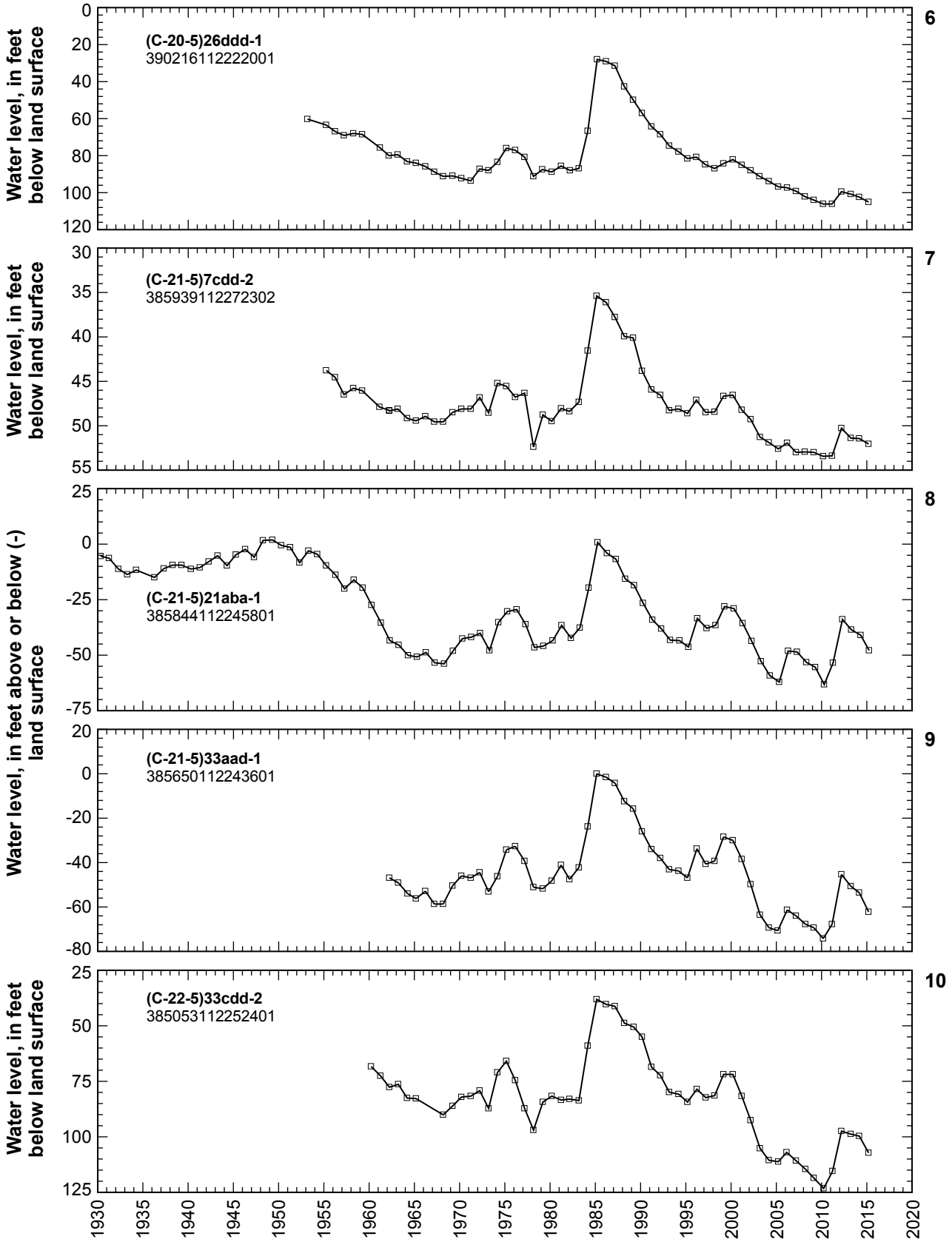



**Figure 33.** Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

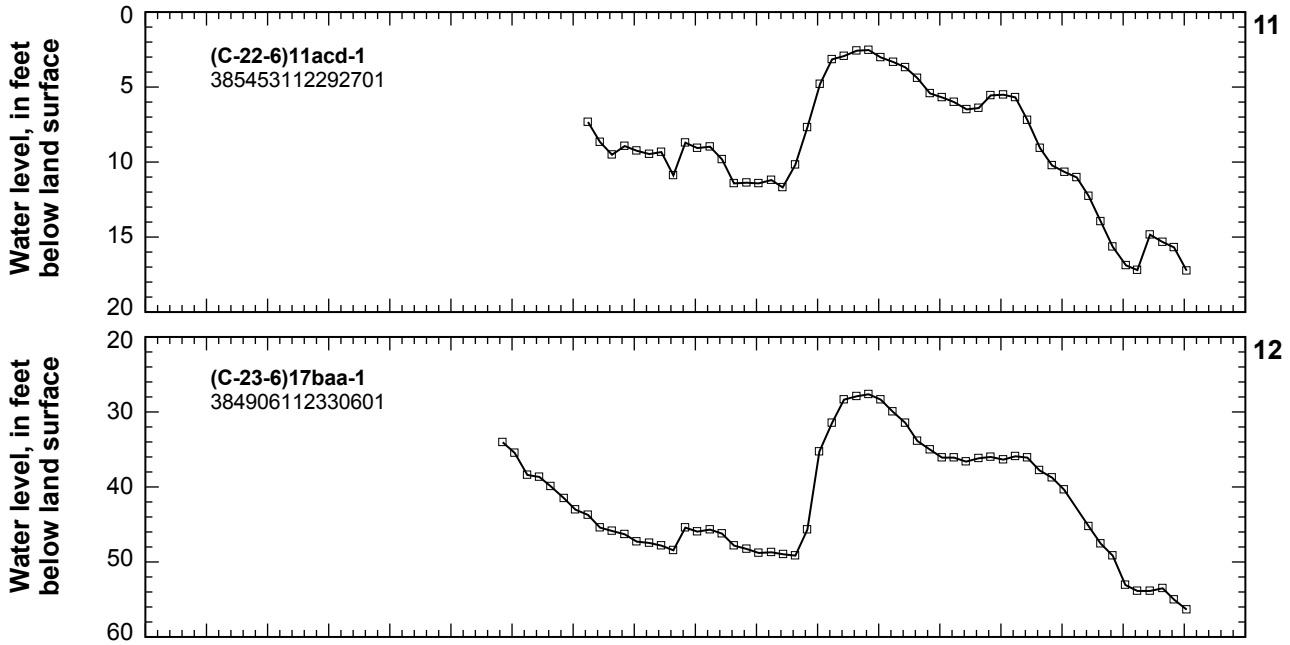



**Figure 33.** Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

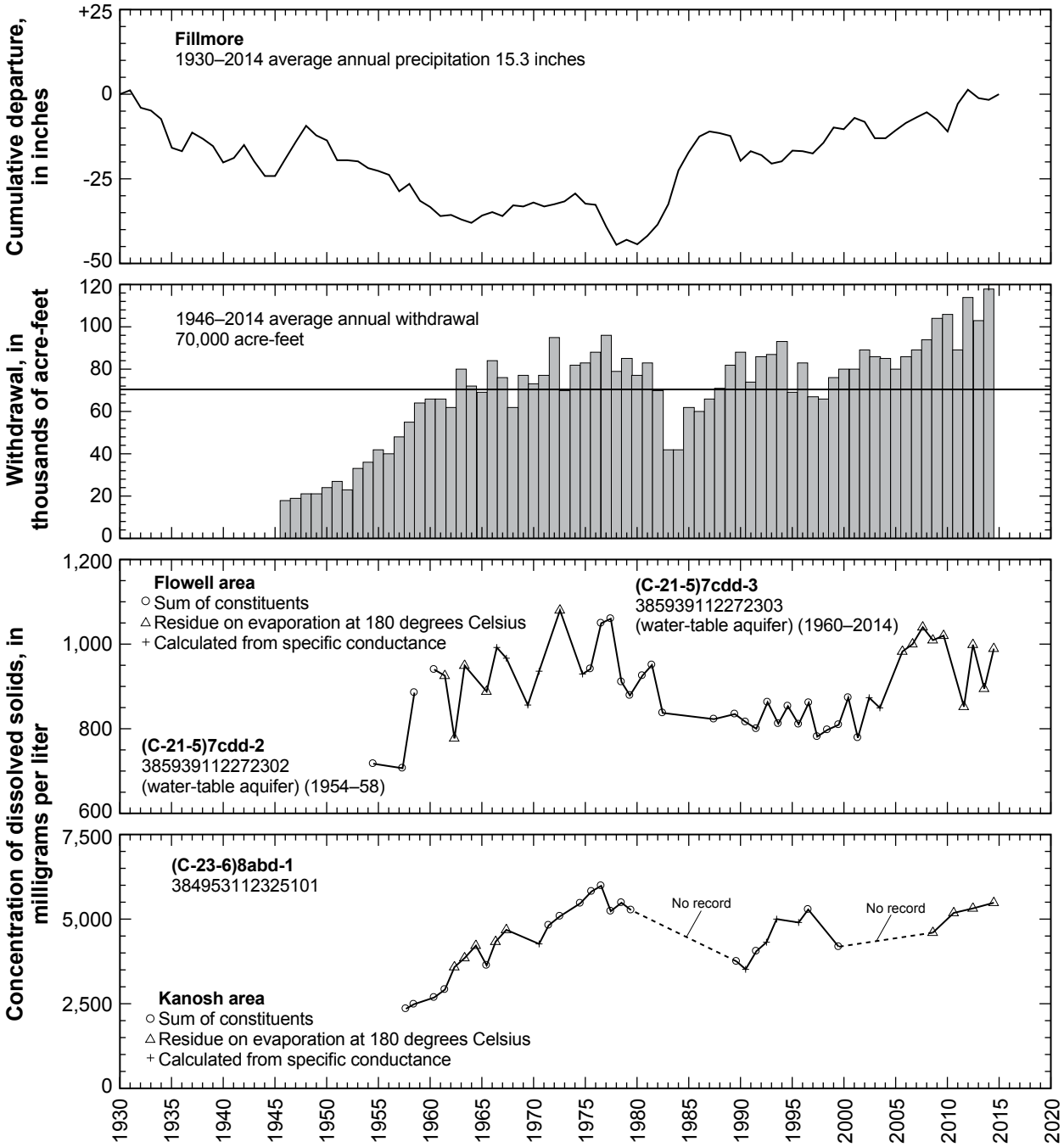



**Figure 33.** Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

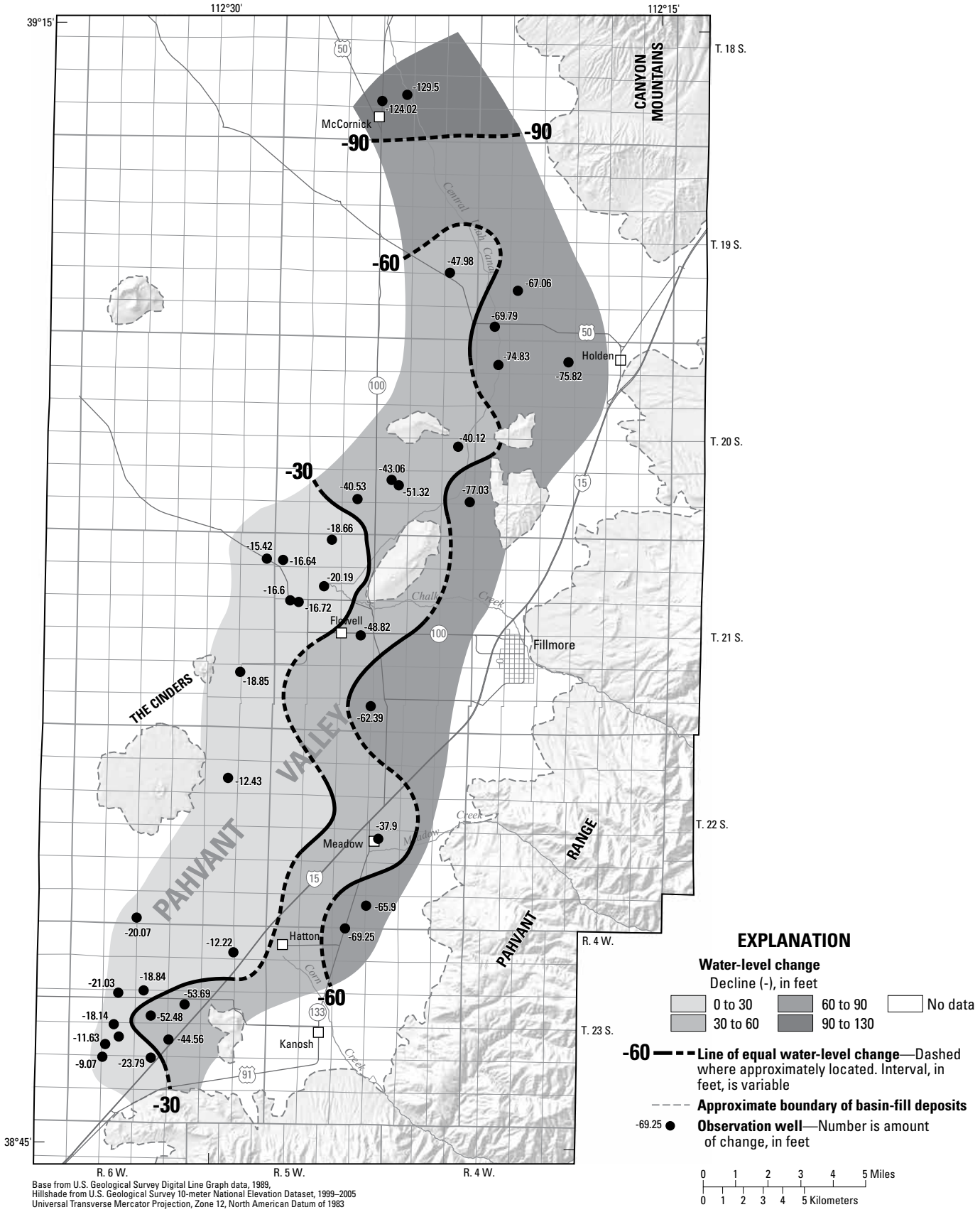



**Figure 34.** Water-level change in Pahvant Valley from March 1985 to March 2015.

## Cedar Valley, Iron County

By James H. Howells

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

Total estimated withdrawal of water from wells in Cedar Valley in 2014 was about 43,000 acre-feet, which is 4,000 acre-feet more than in 2013 and 6,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3).

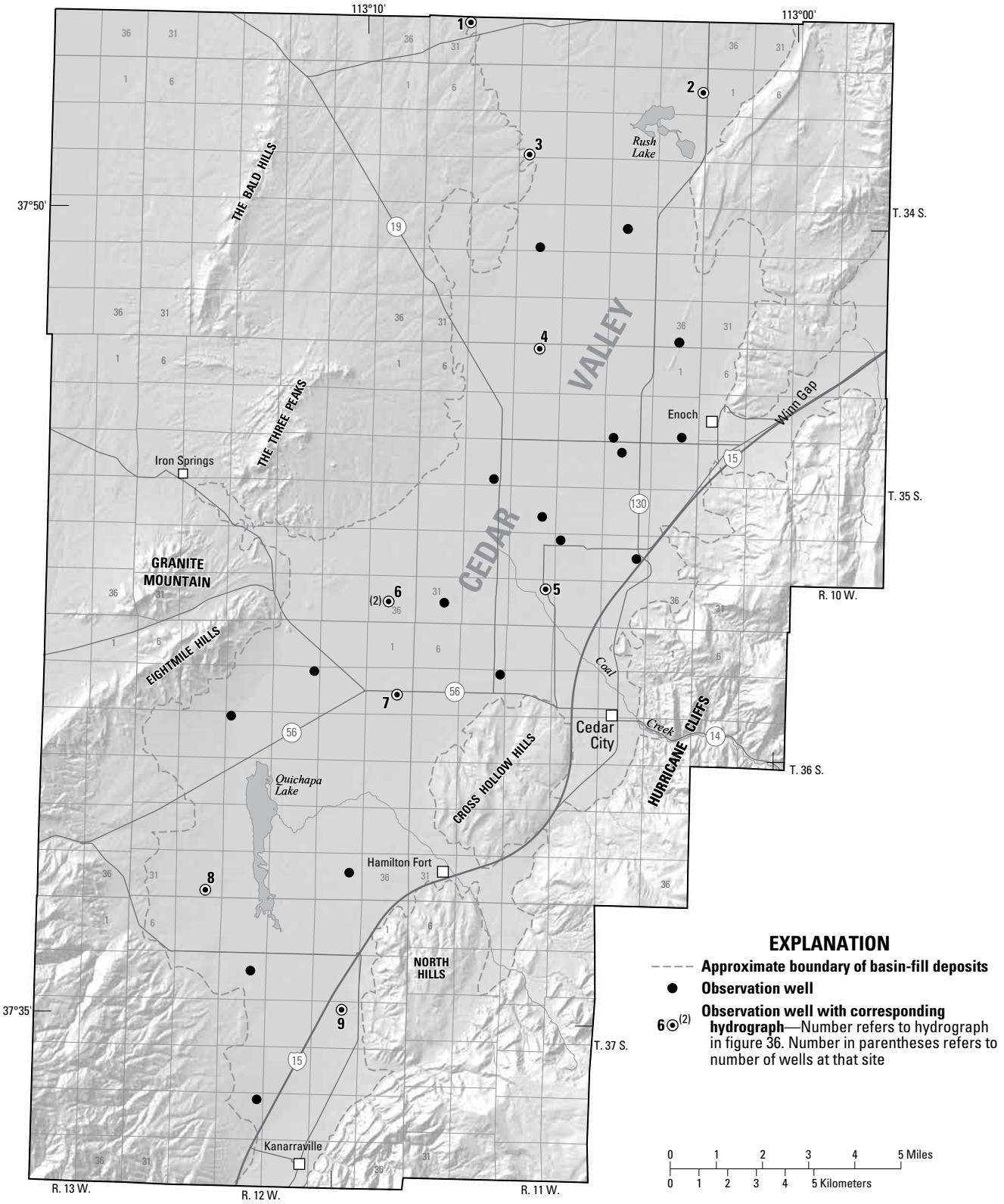
The location of wells in Cedar Valley in which the water level was measured during March 2015 is shown in figure 35. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 36.

Precipitation at Cedar City Federal Aviation Administration Airport in 2014 was about 9.8 inches, which is about 5.2 inches less than the revised total (15.0 inches) for 2013 and 1.1 inches less than the average annual precipitation for 1949–2014. Discharge of Coal Creek was about 11,800 acre-feet in 2014, which is 6,200 acre-feet less than the revised value (18,000 acre-feet) for 2013, and 12,600 acre-feet less than the average annual discharge for 1936 and 1939–2014.

Groundwater levels declined from March 2014 to March 2015 in most parts of Cedar Valley. The largest decline, greater than 12 feet, was measured in a well about 4 miles north of Cedar City. Water-level declines probably resulted from locally increased withdrawals and decreased recharge. A small water-level rise (0.12 foot) was measured in one well about 3 miles west of Rush Lake in the northern part of the valley. Water-level rises probably resulted from decreased localized withdrawals and increased recharge.

Groundwater levels declined from March 1985 to March 2015 in most parts of Cedar Valley for which data are available (fig. 37). The largest decline, about 71 feet, occurred in a well west of Quichapa Lake. Declines are probably the result of continued large withdrawals for irrigation. Rises of less than 3 feet were measured in three wells in the northern part of the valley. Localized rises may be the result of decreased withdrawals.

The concentration of dissolved solids in water samples collected from well (C-37-12)23abd-1, located about 2.0 miles northeast of Kanarraville, from 1991 to 2014, and well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, from 1977 to 2014, is shown in figure 36. The dissolved-solids concentrations in water from both wells have generally increased.




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

**Figure 35.** Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2015.

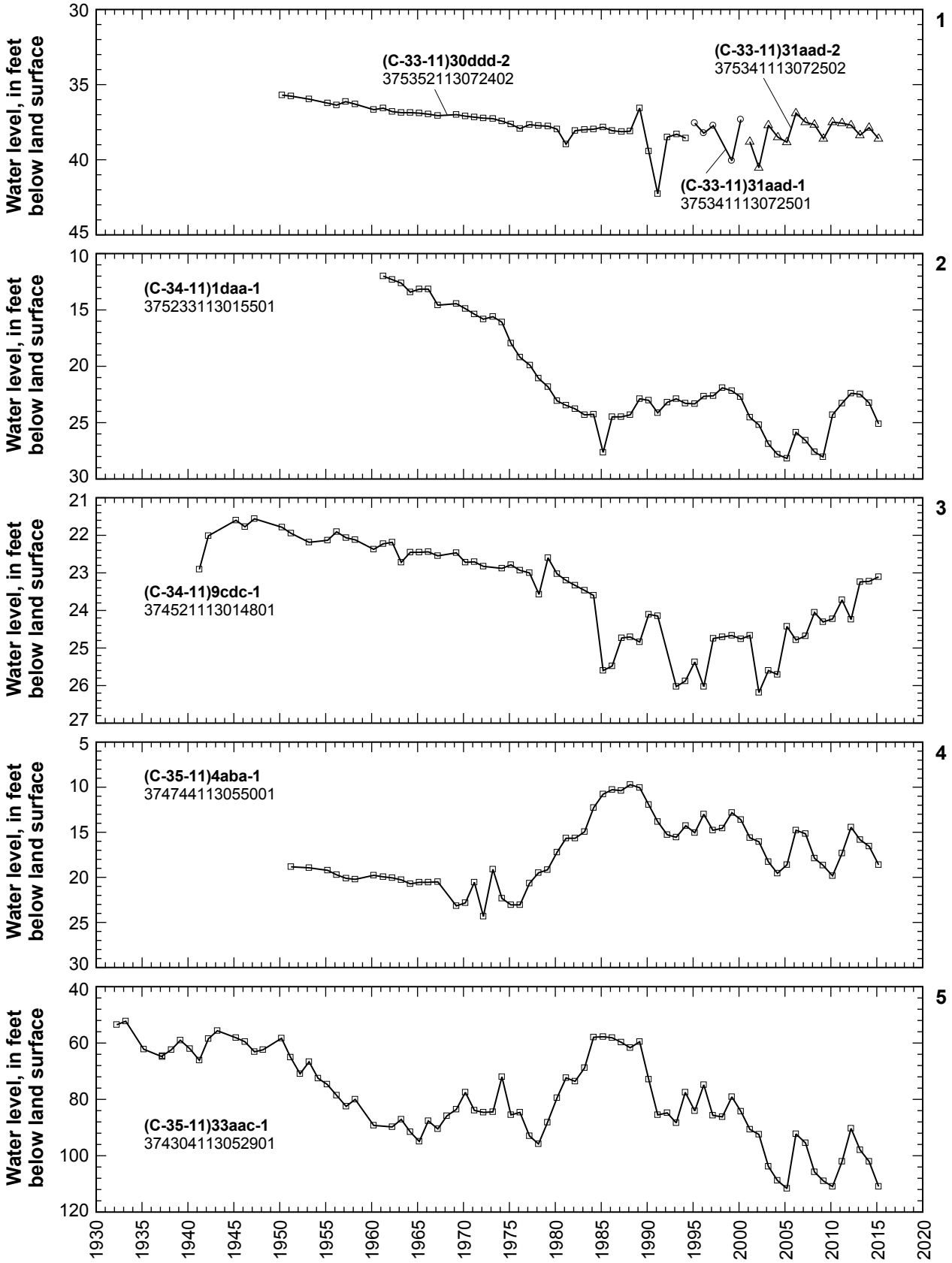



**Figure 36.** Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

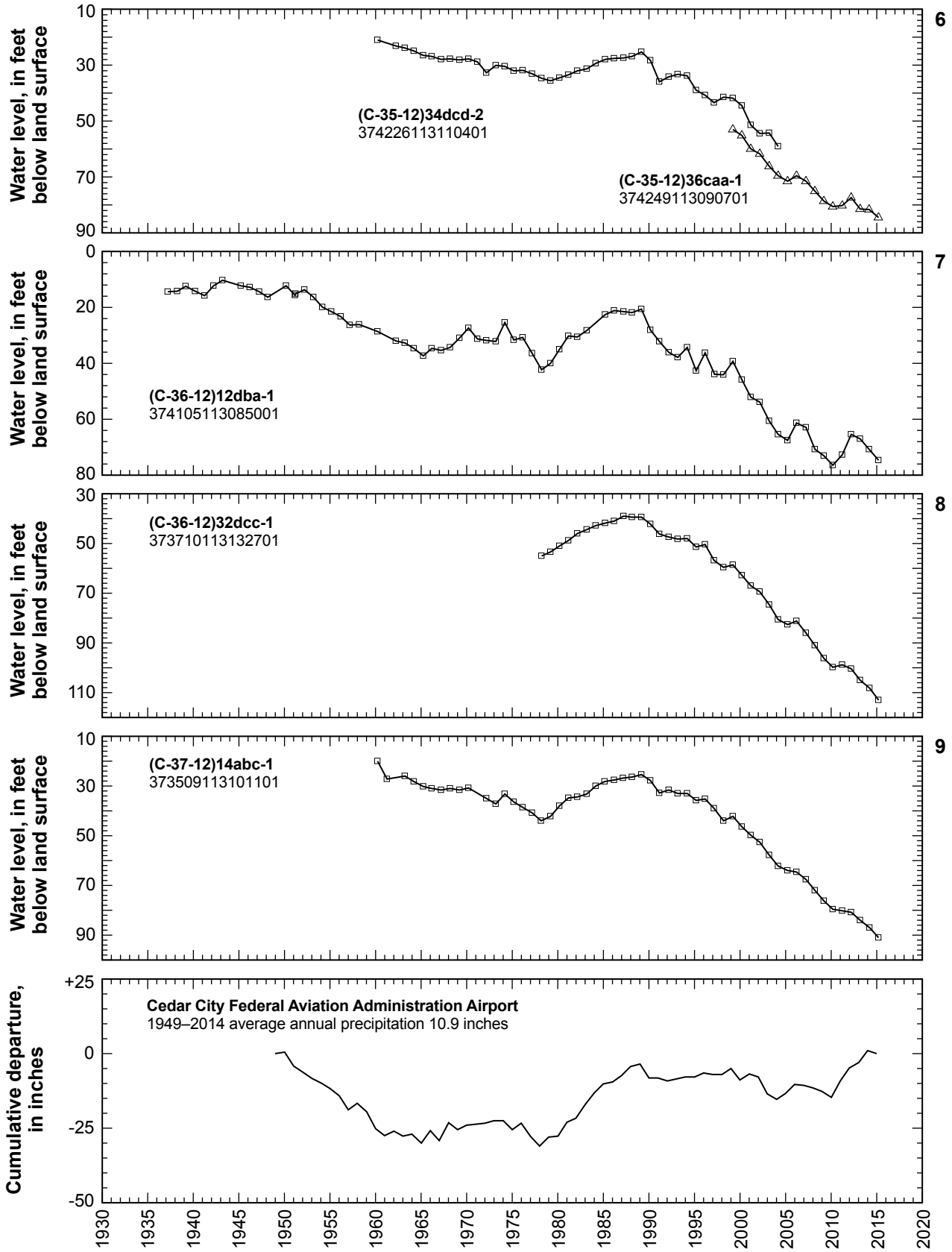



**Figure 36.** Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

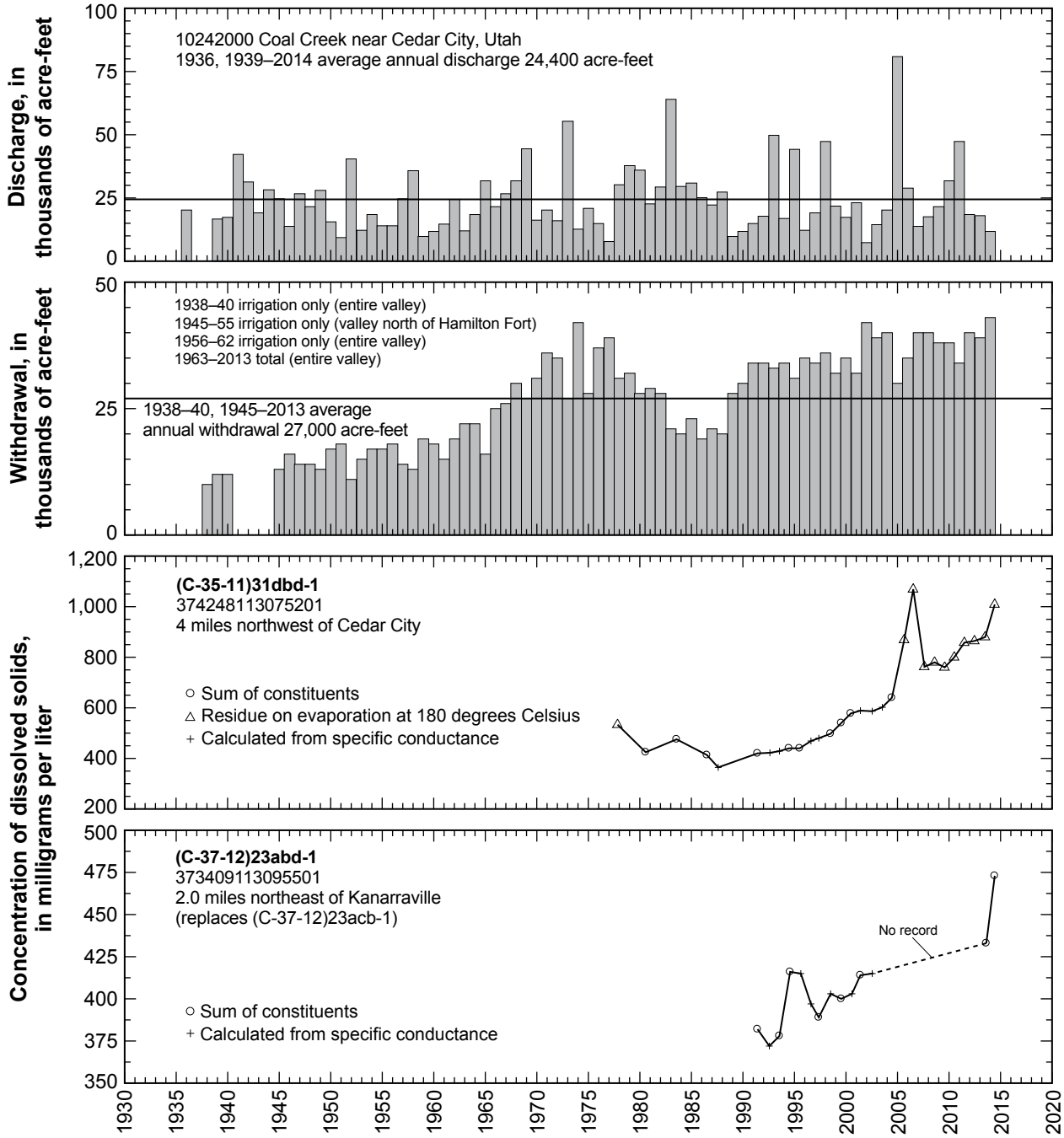



**Figure 36.** Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, Utah, to annual withdrawal from wells, and to concentration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

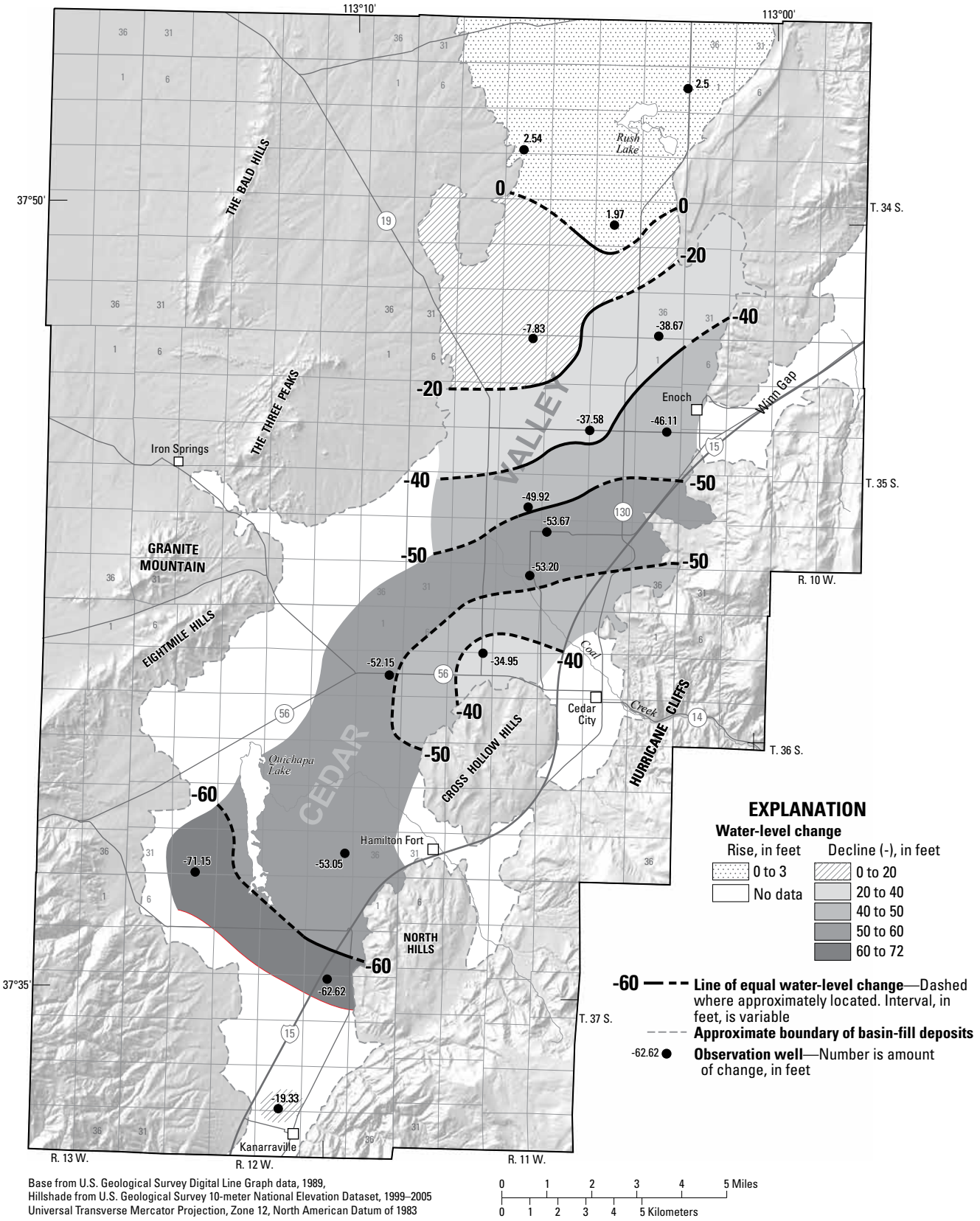



**Figure 37.** Water-level change in Cedar Valley, Iron County, from March 1985 to March 2015.

## 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 east of Black Mountain, and includes the towns of Paragonah and Parowan (fig. 38). Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Parowan Valley in 2014 was about 38,000 acre-feet, which is about 6,000 acre-feet more than was reported for 2013 and 4,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3). The increase is mainly due to increased withdrawals for irrigation.

The location of wells in Parowan Valley in which the water level was measured during March 2015 is shown in figure 38. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 39.

Precipitation at Cedar City Federal Aviation Administration Airport in 2014 was about 9.8 inches, which is about 5.2 inches less than the revised value for 2013 and 1.1 inches less than the average annual precipitation for 1949–2014.

Water levels declined from March 2014 to March 2015 in all parts of Parowan Valley for which data are available. The largest declines, more than 7 feet, were measured in two wells northwest of Parowan. Water levels in Parowan Valley generally have declined since 1950. Some rises occurred during 1973–74, 1983–85, 1996–99, 2006, and 2012. Declines in water levels are probably the result of continued large local withdrawals for irrigation. Rises are probably the result of less withdrawal for irrigation and several years of greater-than-average precipitation.

Water levels declined from March 1985 to March 2015 in all parts of Parowan Valley for which data are available (fig. 40). The largest decline, about 94 feet, occurred in a well north of Parowan and west of Paragonah. Declines are probably the result of continued large withdrawals for irrigation.

The concentration of dissolved solids in water samples collected from well (C-33-8)31ccc-1, located 2 miles west of Paragonah, from 1961 to 2014, is shown in figure 39. The water sample collected in July 2014 had a dissolved-solids concentration of 284 mg/L. With the exception of relatively high dissolved-solids concentrations in water samples collected in 1970, 1973, and 1974, concentrations have varied little.

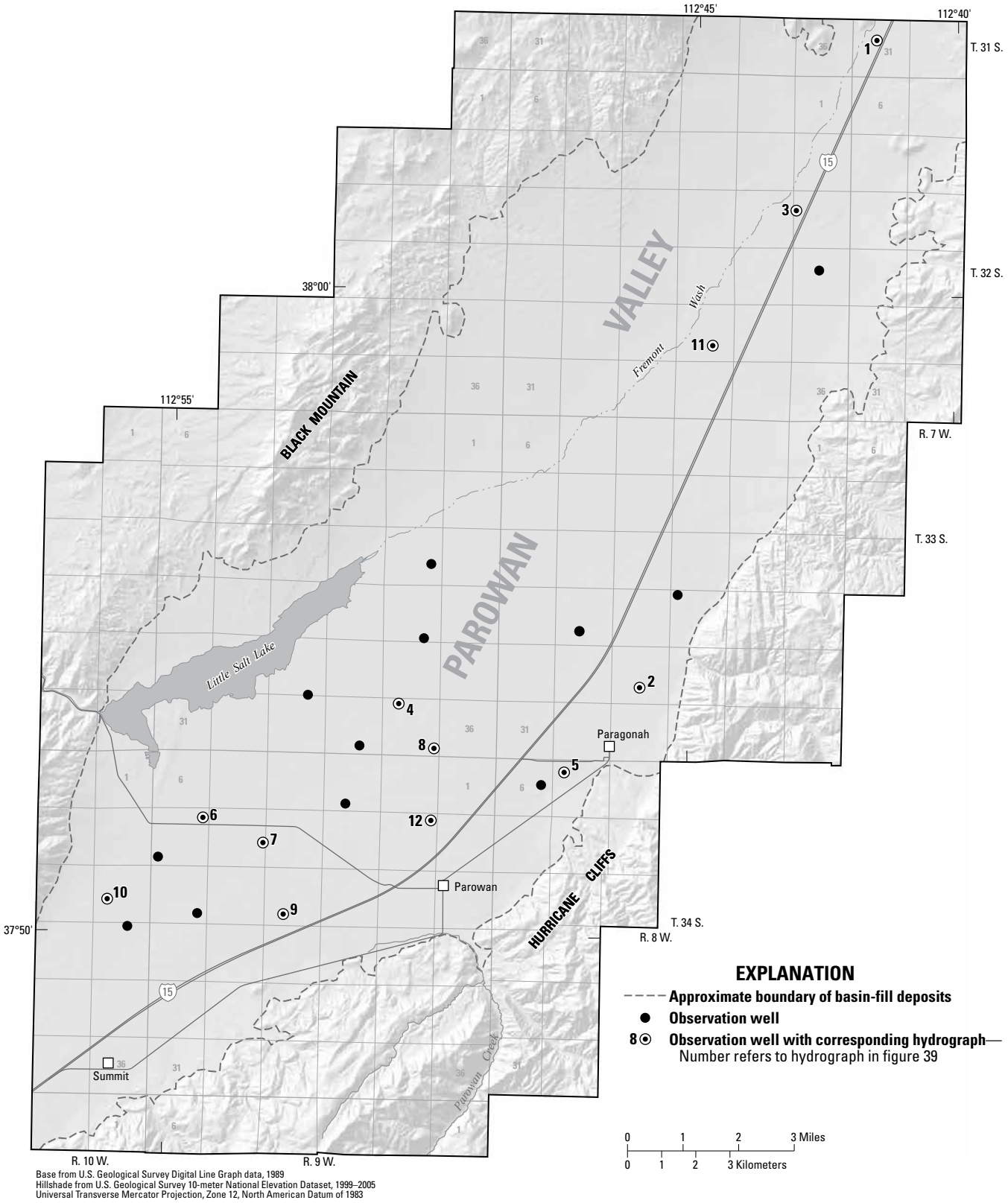



**Figure 38.** Location of wells in Parowan Valley in which the water level was measured during March 2015.

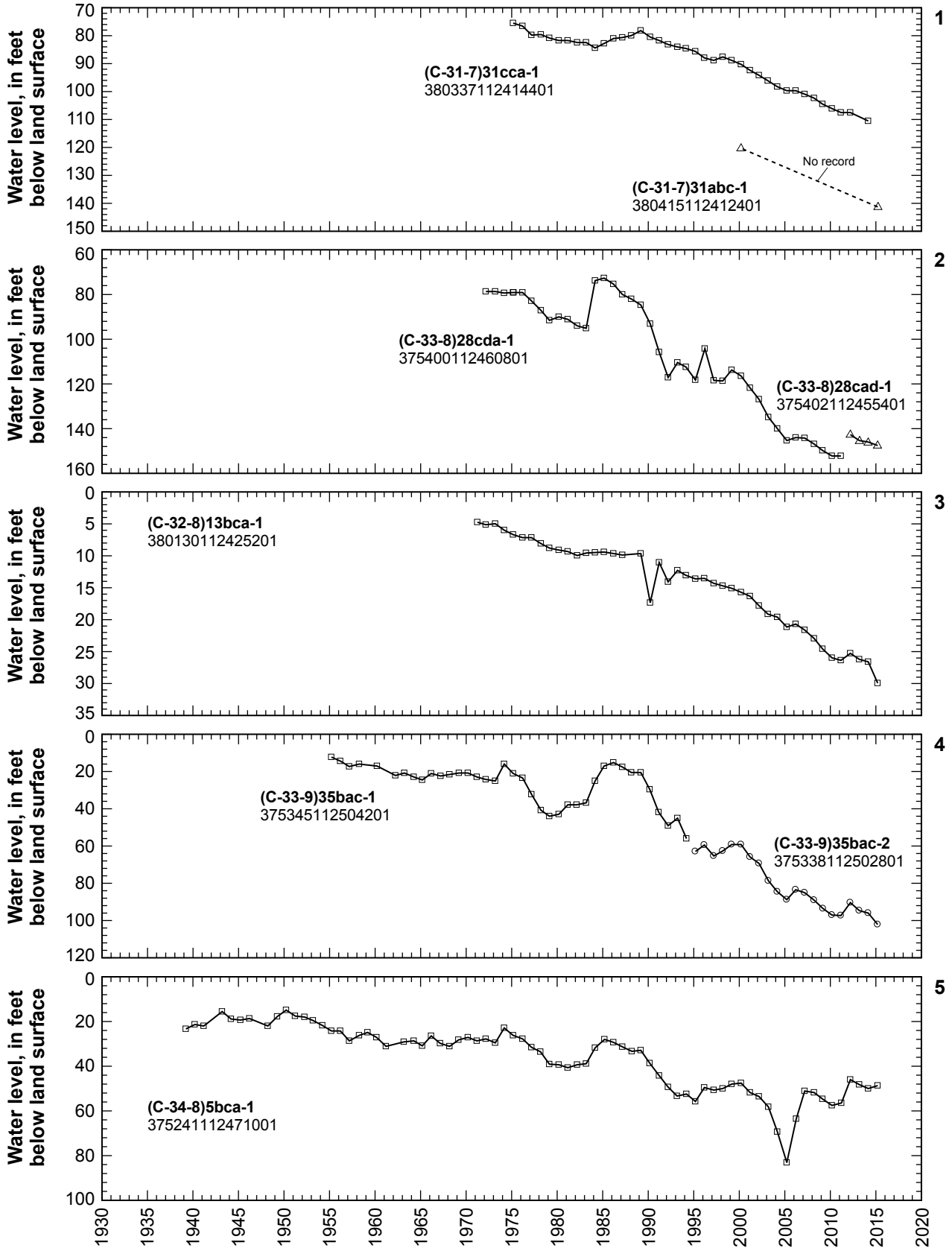



**Figure 39.** Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

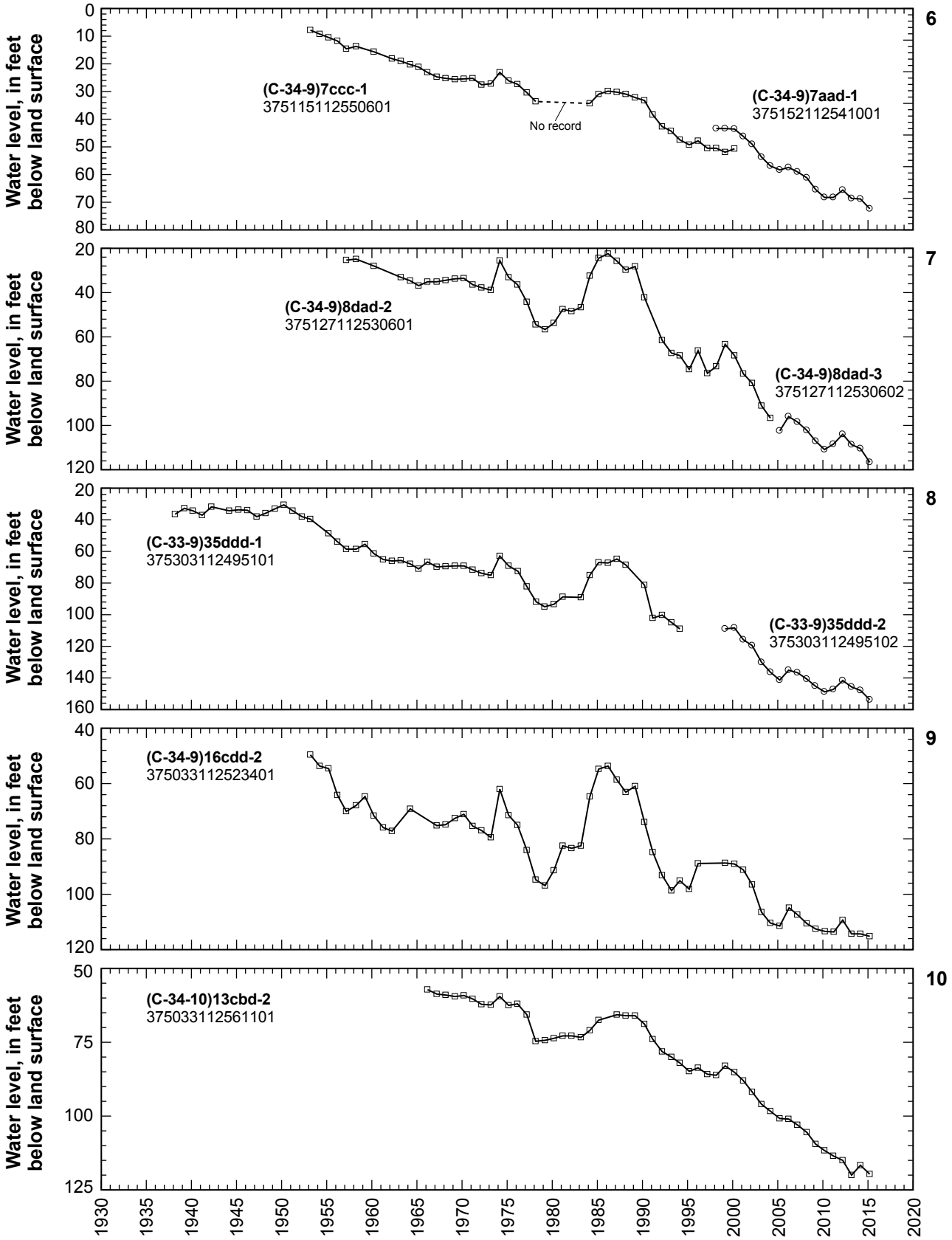



**Figure 39.** Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

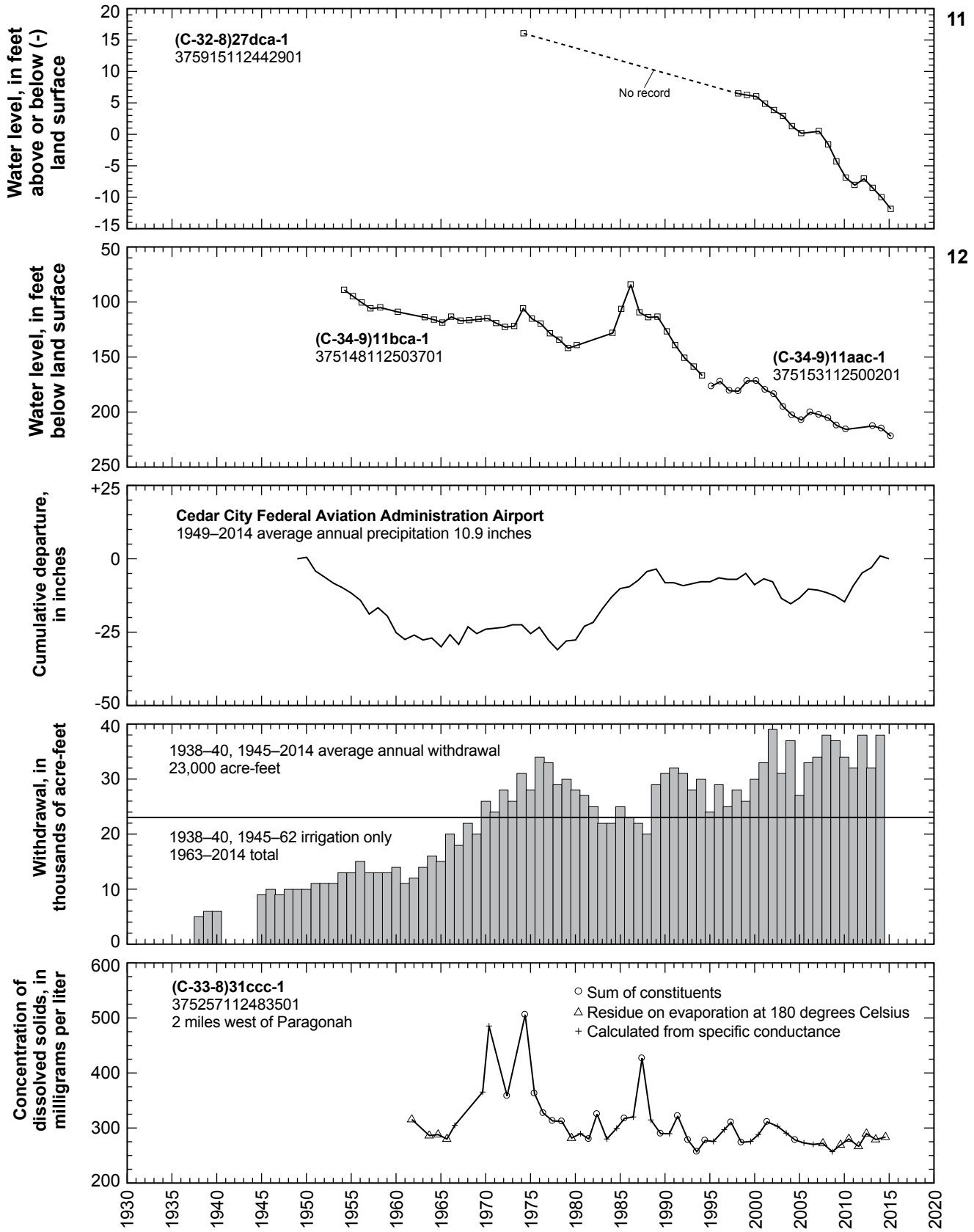



**Figure 39.** Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

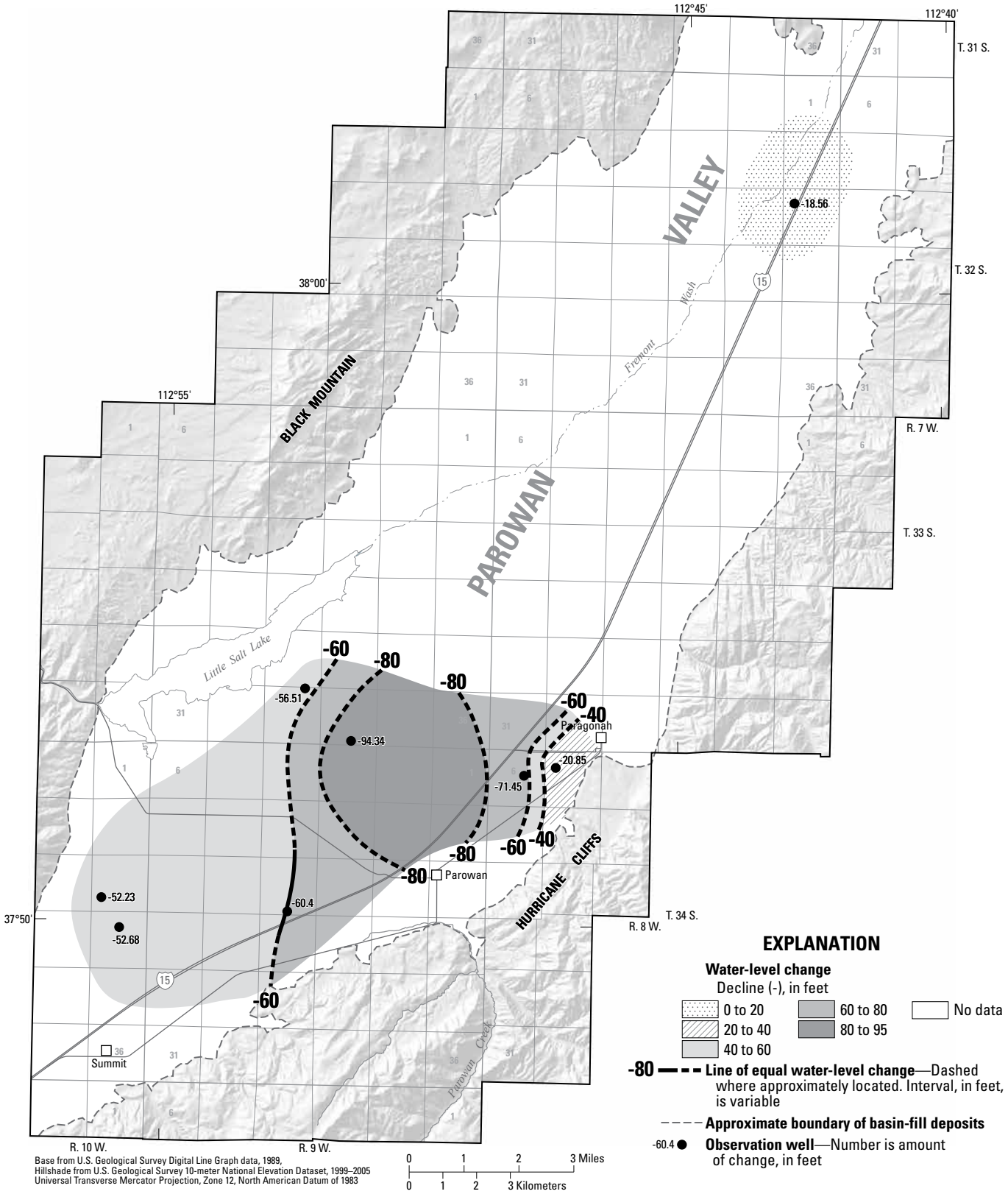



**Figure 40.** Water-level change in Parowan Valley from March 1985 to March 2015.

# Escalante Valley

## Milford Area

### By Bradley A. Slaugh

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

Total estimated withdrawal of water from wells in the Milford area of Escalante Valley in 2014 was about 67,000 acre-feet, which is 1,000 acre-feet less than was reported for 2013 and 13,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3).

The location of wells in the Milford area in which the water level was measured during March 2015 is shown in figure 41. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2 is shown in figure 42. Precipitation at Black Rock in 2014 was about 10.9 inches, about 2.8 inches more than in 2013 and about 1.9 inches more than the 1952–2014 average annual precipitation.

Water levels declined from March 2014 to March 2015 in most of the Milford area. The amount of water-level rise or decline depends largely on groundwater withdrawals, the amount and timing of precipitation, and recharge to the basin-fill aquifer from the Beaver River. Since the early 1950s, water levels generally have declined in the south-central Milford area in response to the long-term effects of groundwater withdrawals. Water-level rises during 1983–85 resulted from greater-than-average precipitation during 1982–85, greatly reduced withdrawals, and increased recharge to the basin-fill aquifer from record flow in the Beaver River during 1983–84.

Water levels generally declined from March 1985 to March 2015 throughout Milford Valley in areas where data are available (fig. 43). The greatest decline, more than 58 feet, occurred in a well about 4 miles southeast of Milford. Rises in water levels, up to 11 feet, occurred in the northeast part of the valley. Declines are probably the result of continued large withdrawals for irrigation. Localized rises may be due to decreased withdrawals and increased recharge.

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 2014, is shown in figure 42. The dissolved-solids concentration in the July 2014 sample was 469 mg/L. With the exception of a relatively high dissolved-solids concentration in the water sample collected in 2001 (909 mg/L), concentrations have varied little.

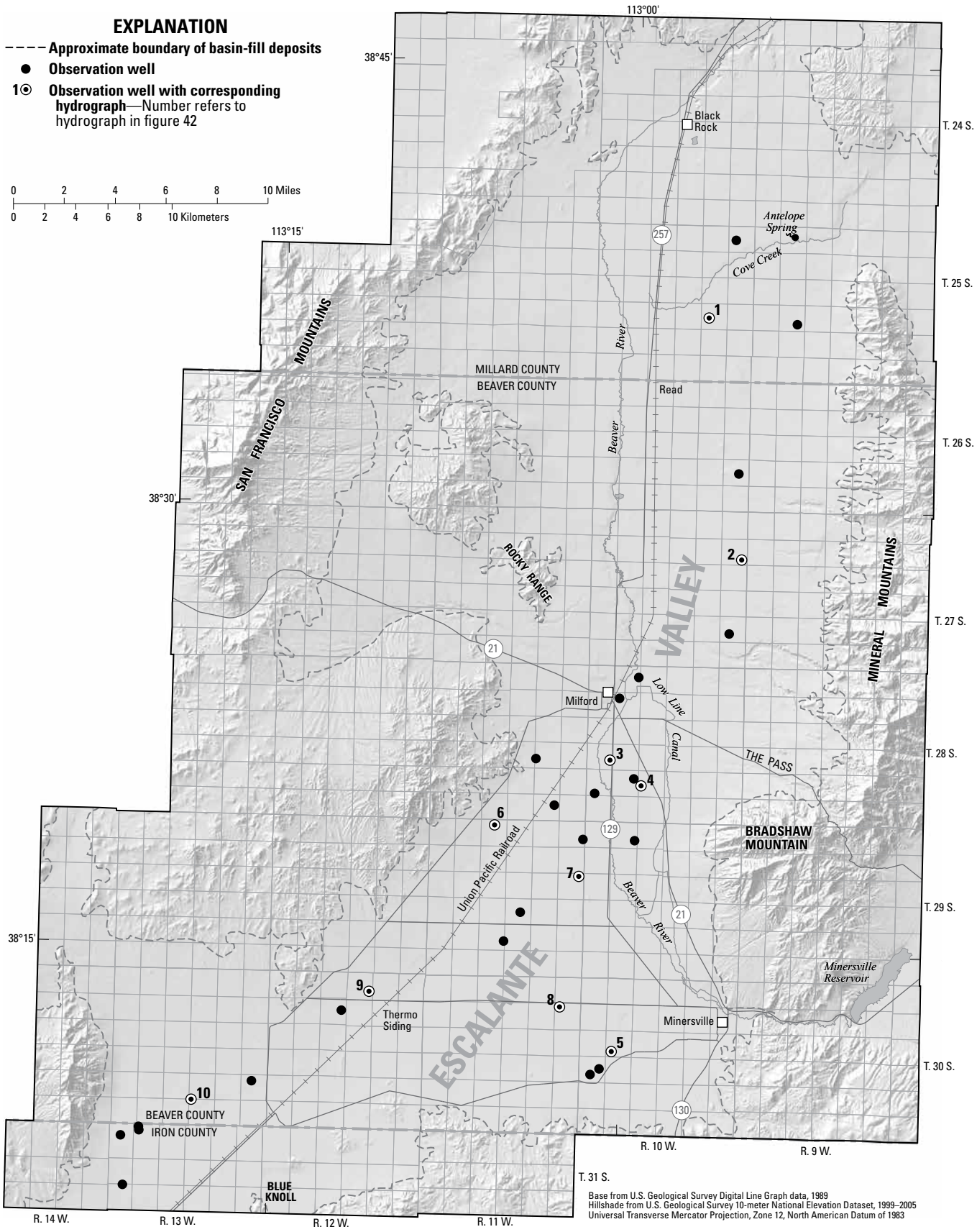



**Figure 41.** Location of wells in the Milford area in which the water level was measured during March 2015.

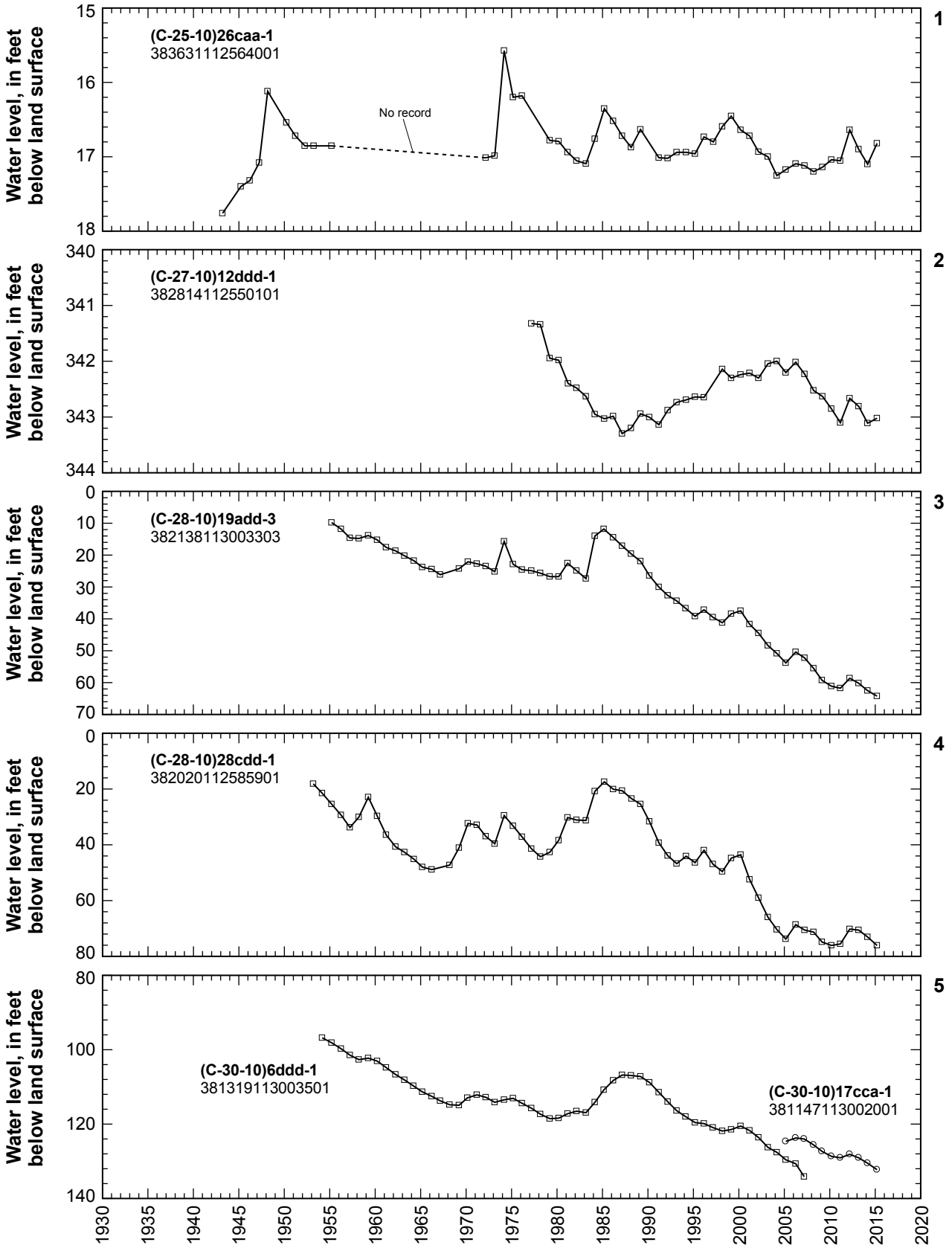



**Figure 42.** Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.

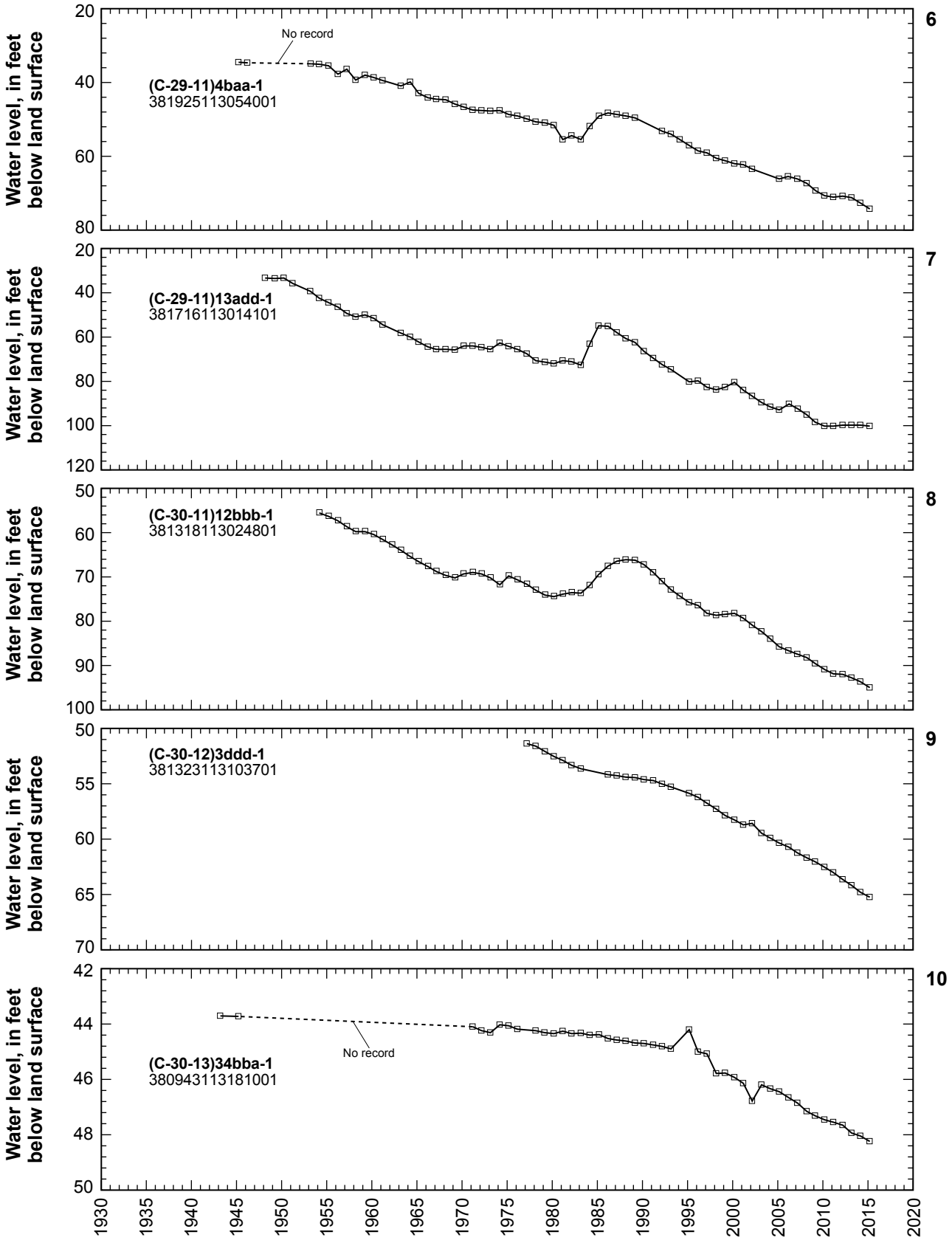



**Figure 42.** Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

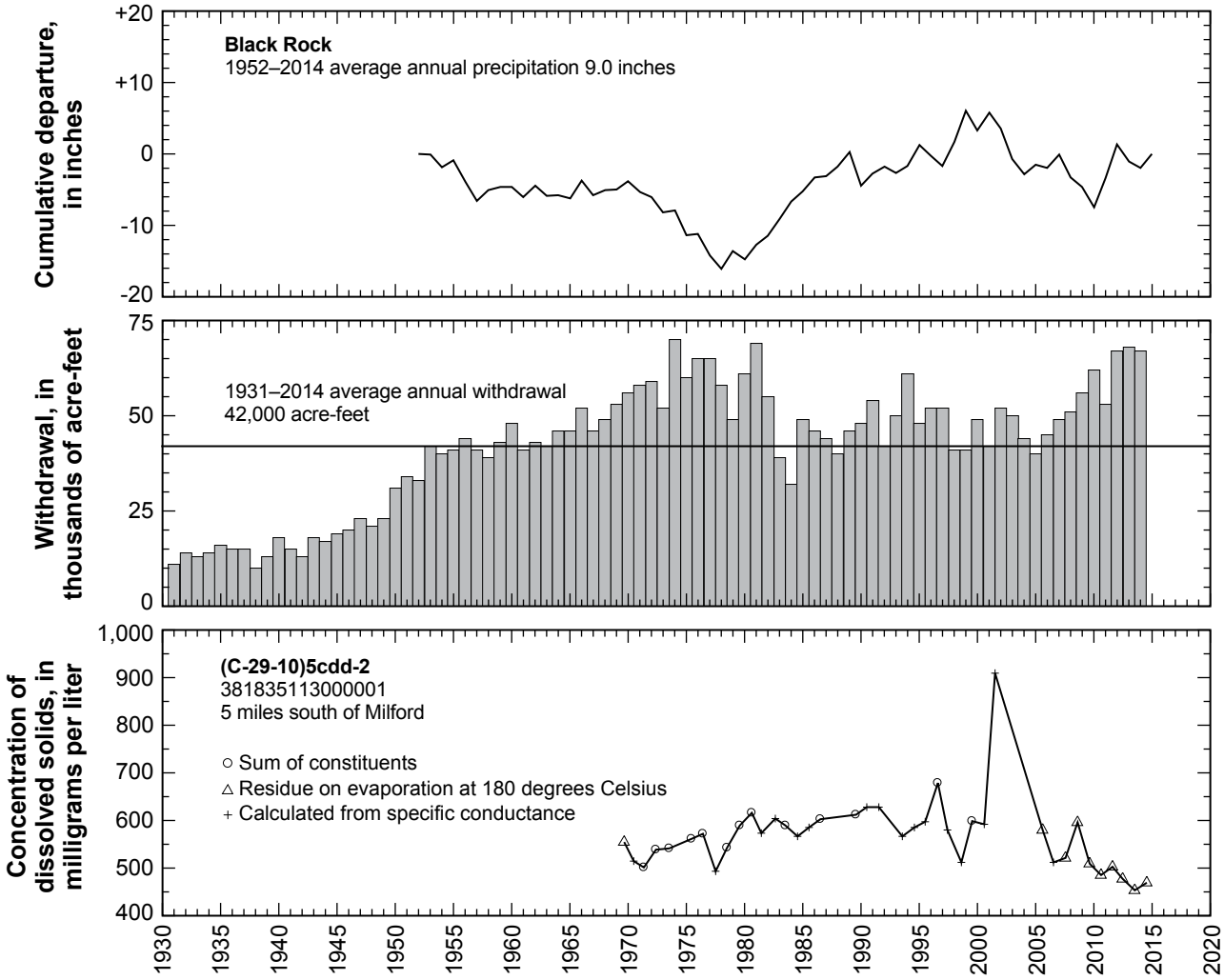



**Figure 42.** Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

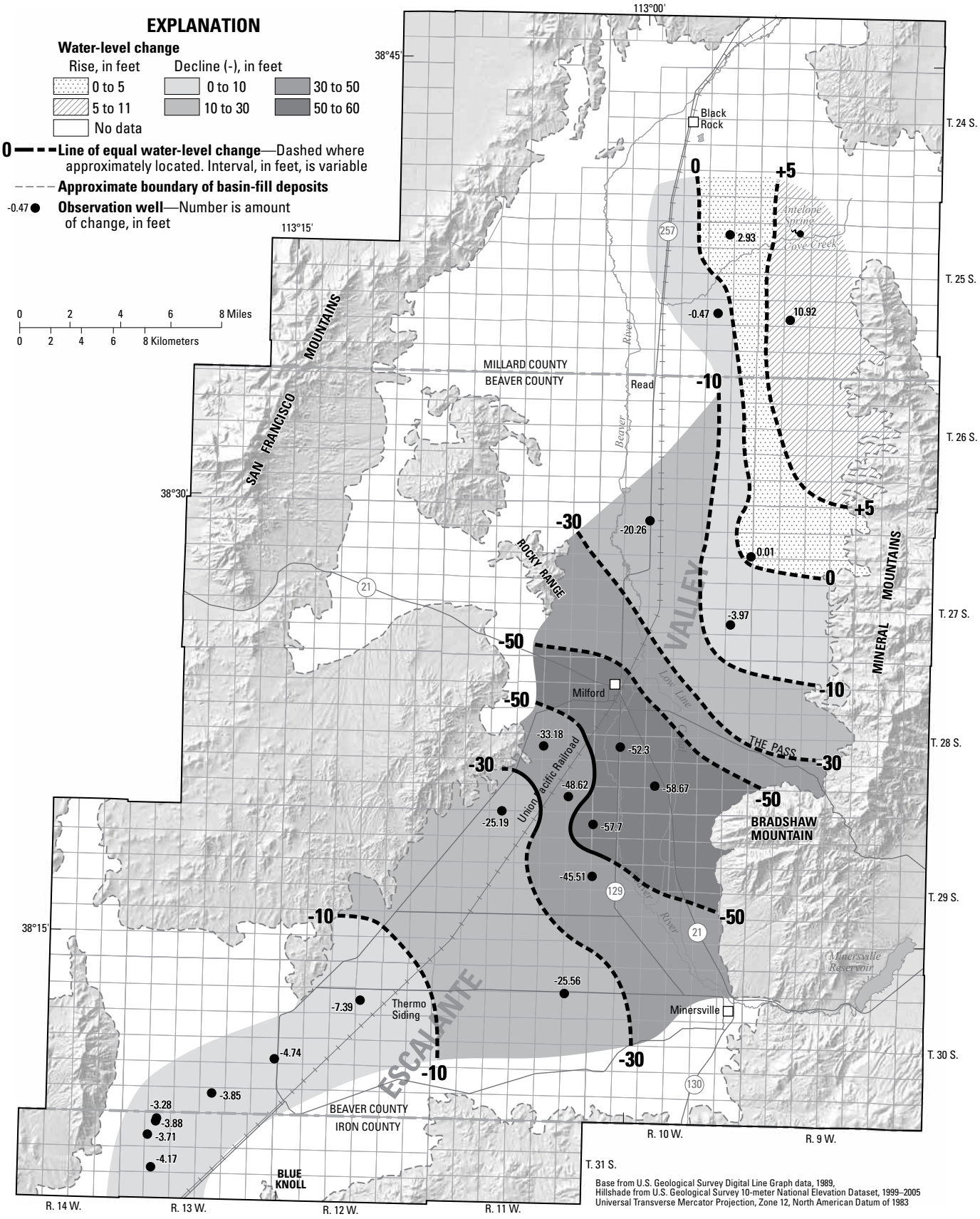



**Figure 43.** Water-level change in the Milford area from March 1985 to March 2015.

# Escalante Valley

## Beryl-Enterprise Area

### By Howard K. Christiansen

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

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 2014 was about 103,000 acre-feet, which is 10,000 acre-feet more than in 2013 and 15,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3).

The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2015 is shown in figure 44. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3 is shown in figure 45.

Precipitation at Enterprise in 2014 was about 14.6 inches, which is about 0.6 inch more than the average annual precipitation for 1955–2014 and about 2.8 inches more than in 2013.

Water levels declined from March 2014 to March 2015 in most of the wells measured in the Beryl-Enterprise area. Water levels throughout most of the area have declined steadily since 1950 and have shown little or no recovery, even during periods of greater-than-average precipitation. For example, water-level measurements in well (C-36-16)29daa-1, about 5 miles northeast of Enterprise, have shown a decline of nearly 139 feet from March 1948 to March 2015 (fig. 45). Declines such as this are a result of continued large withdrawals for irrigation beginning in about 1950.

Water levels from March 1985 to March 2015 declined in all of the Beryl-Enterprise area for which data are available (fig. 46). The greatest decline, more than 86 feet, occurred in a well about 3 miles north-northeast of Enterprise. Declines are probably the result of continued large withdrawals for irrigation.

The concentration of dissolved solids in water samples collected from well (C-34-16)28dcc-3, located 6 miles south-southeast of Beryl, is shown in figure 45. The concentration of dissolved solids in the water sample collected in August 2014 was 582 mg/L, a decrease of greater than 100 mg/L from the 2013 value.

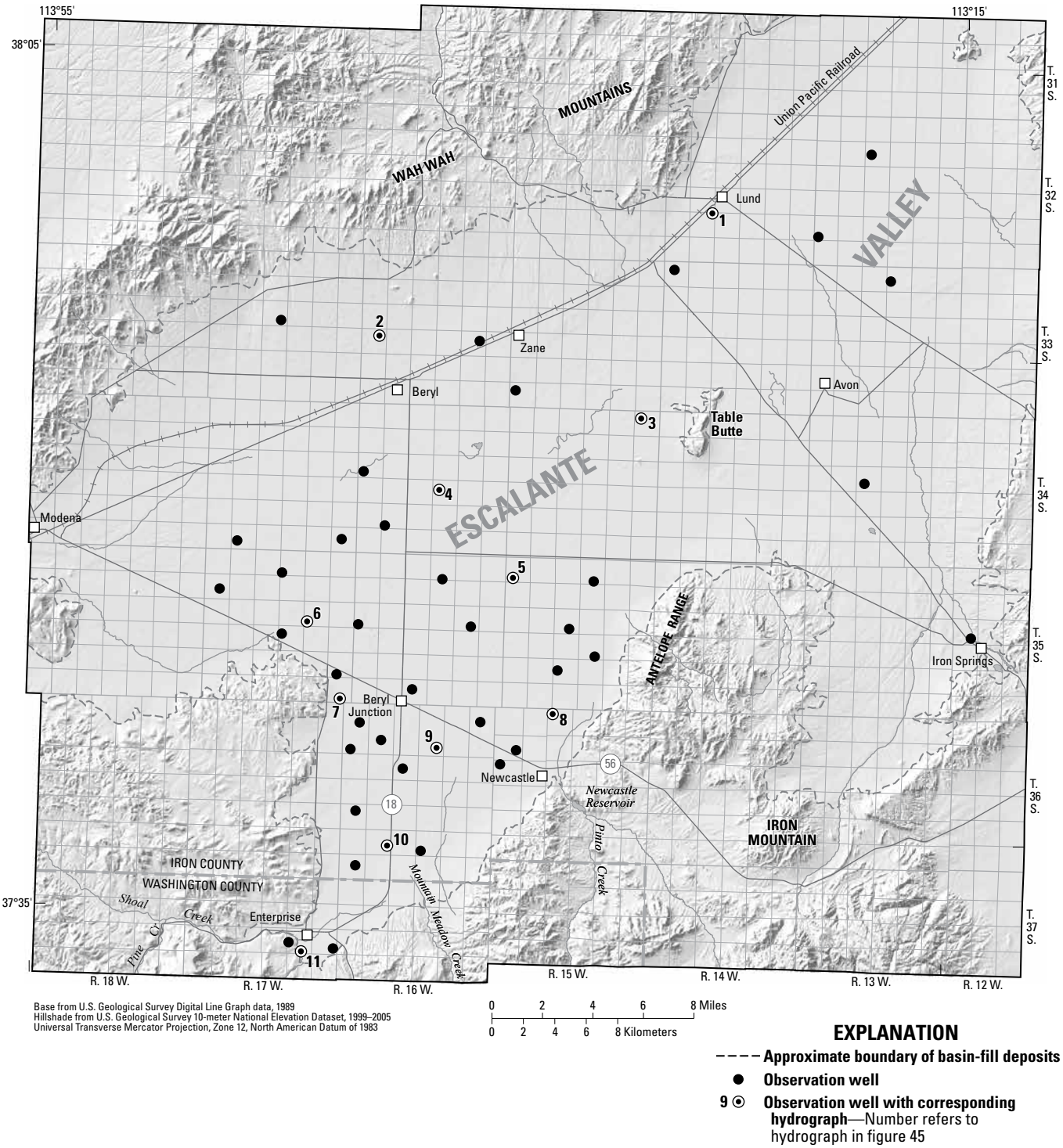



**Figure 44.** Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2015.

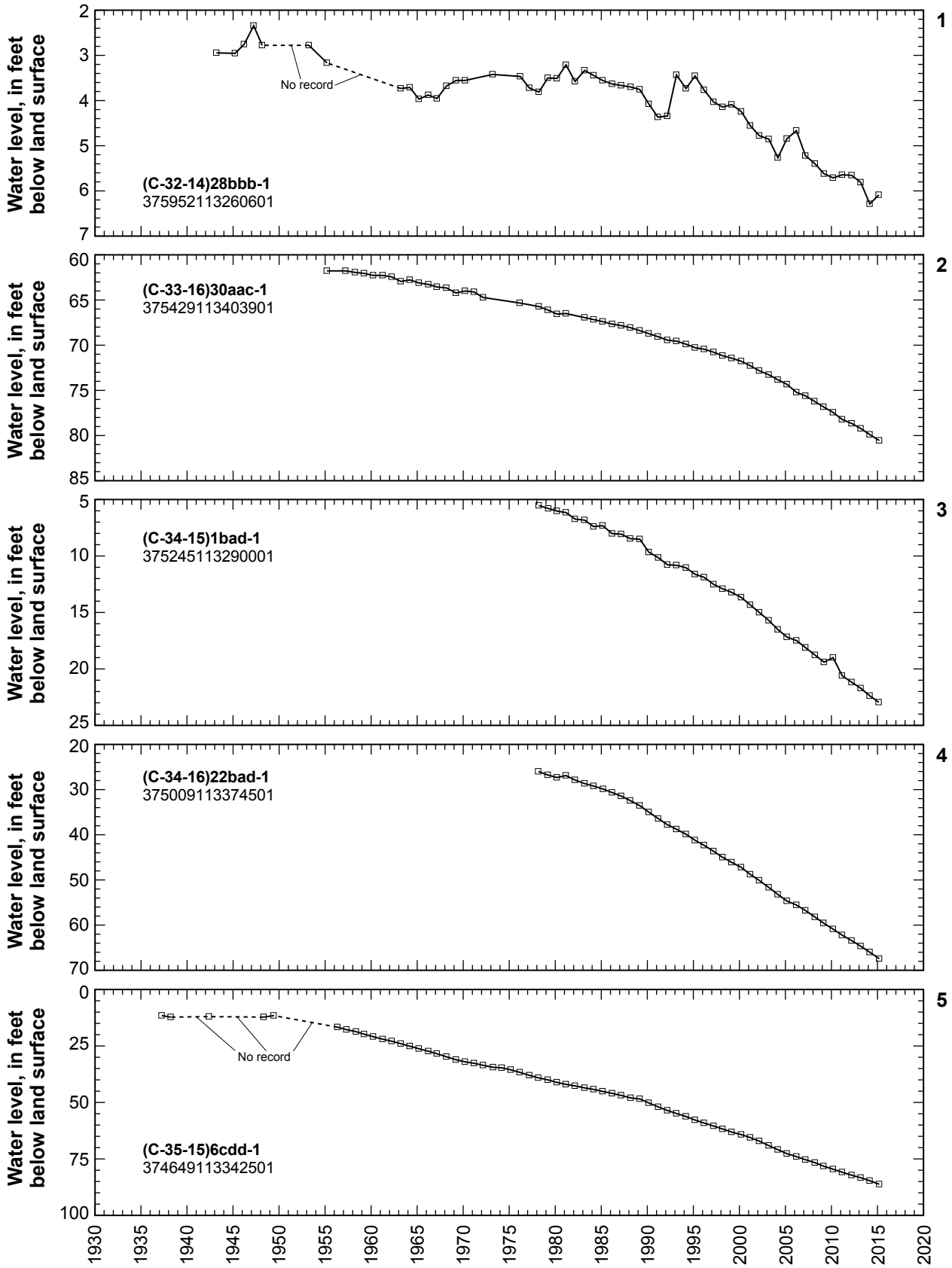



**Figure 45.** Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.

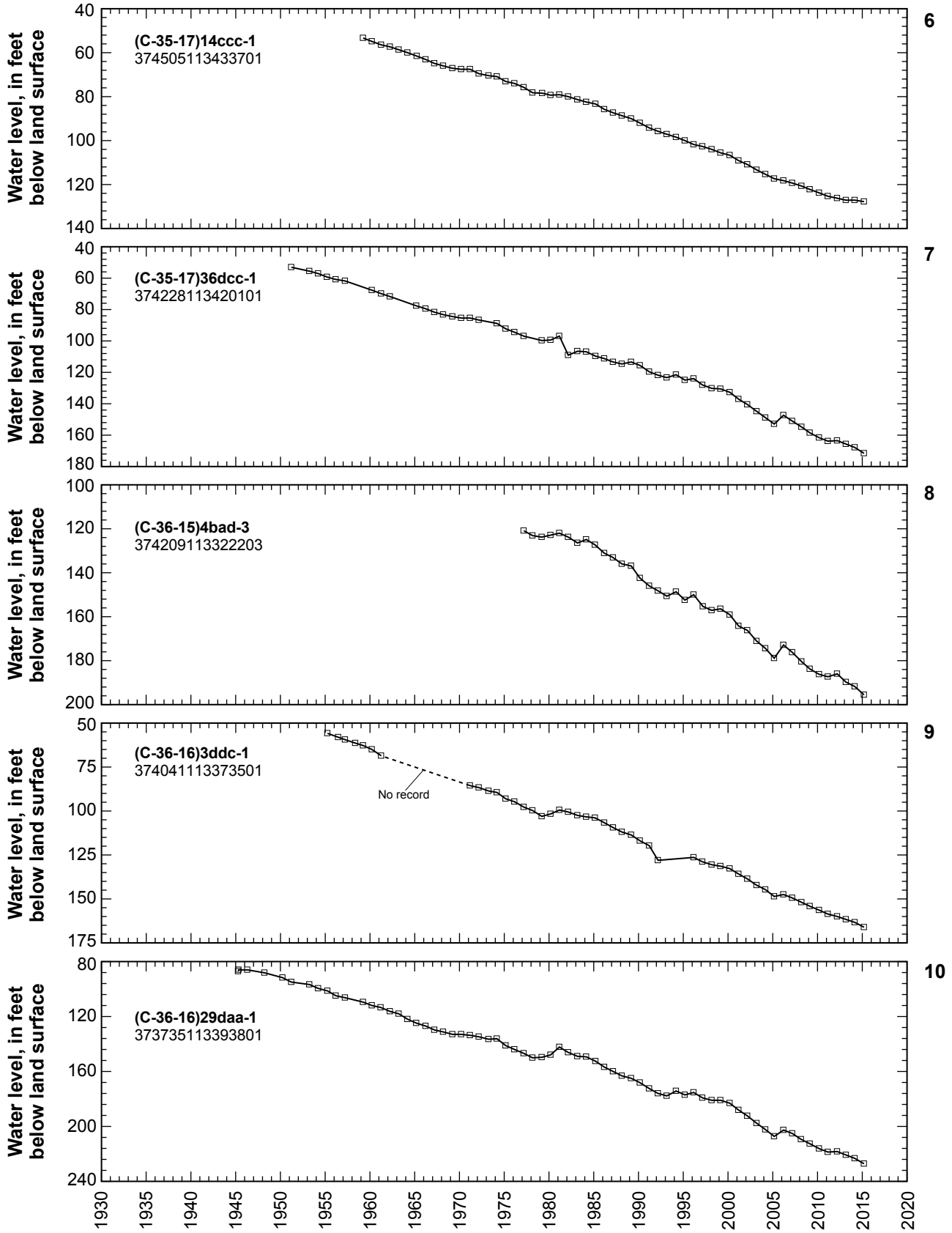



**Figure 45.** Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.—Continued

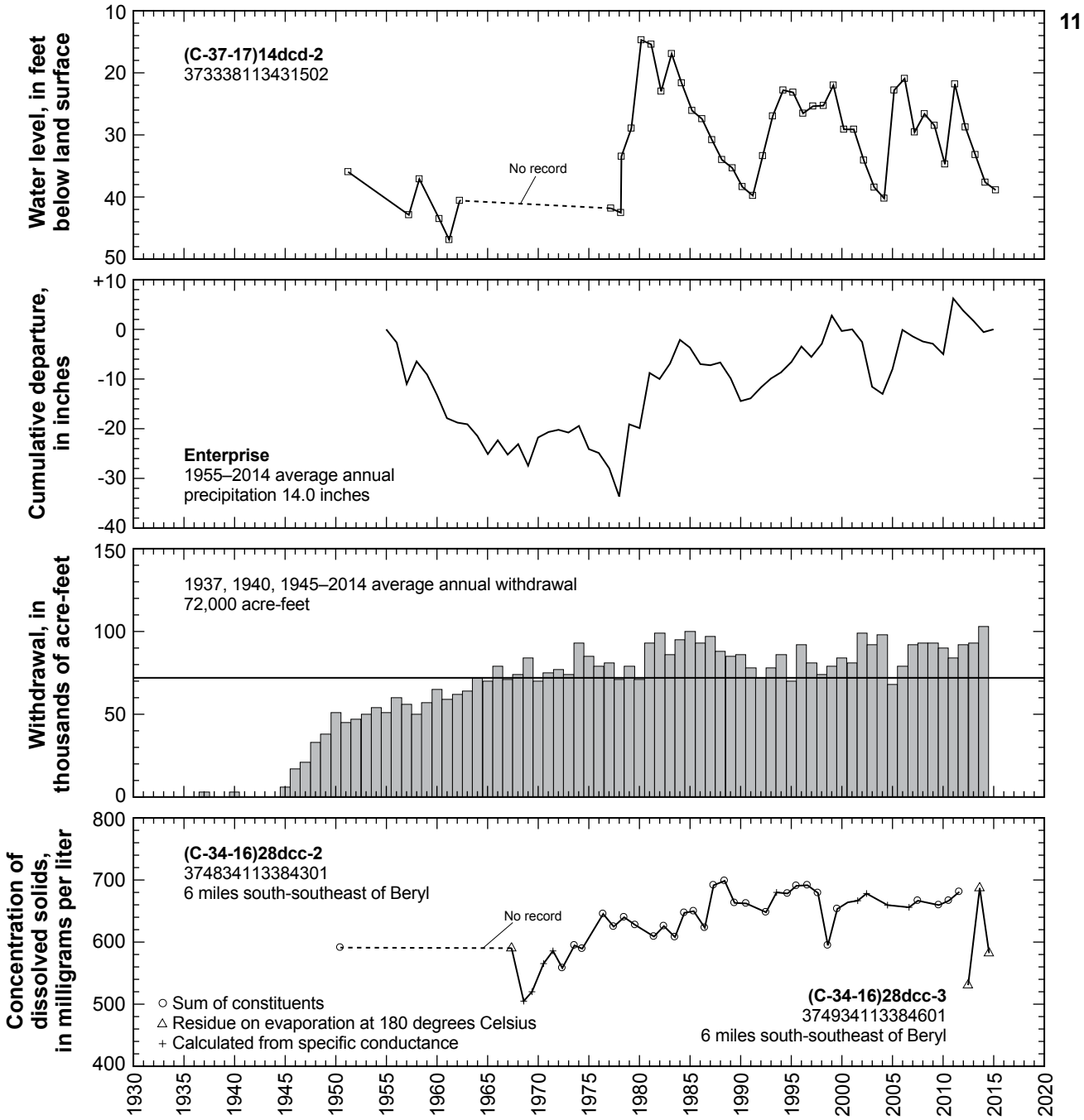



**Figure 45.** Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.—Continued

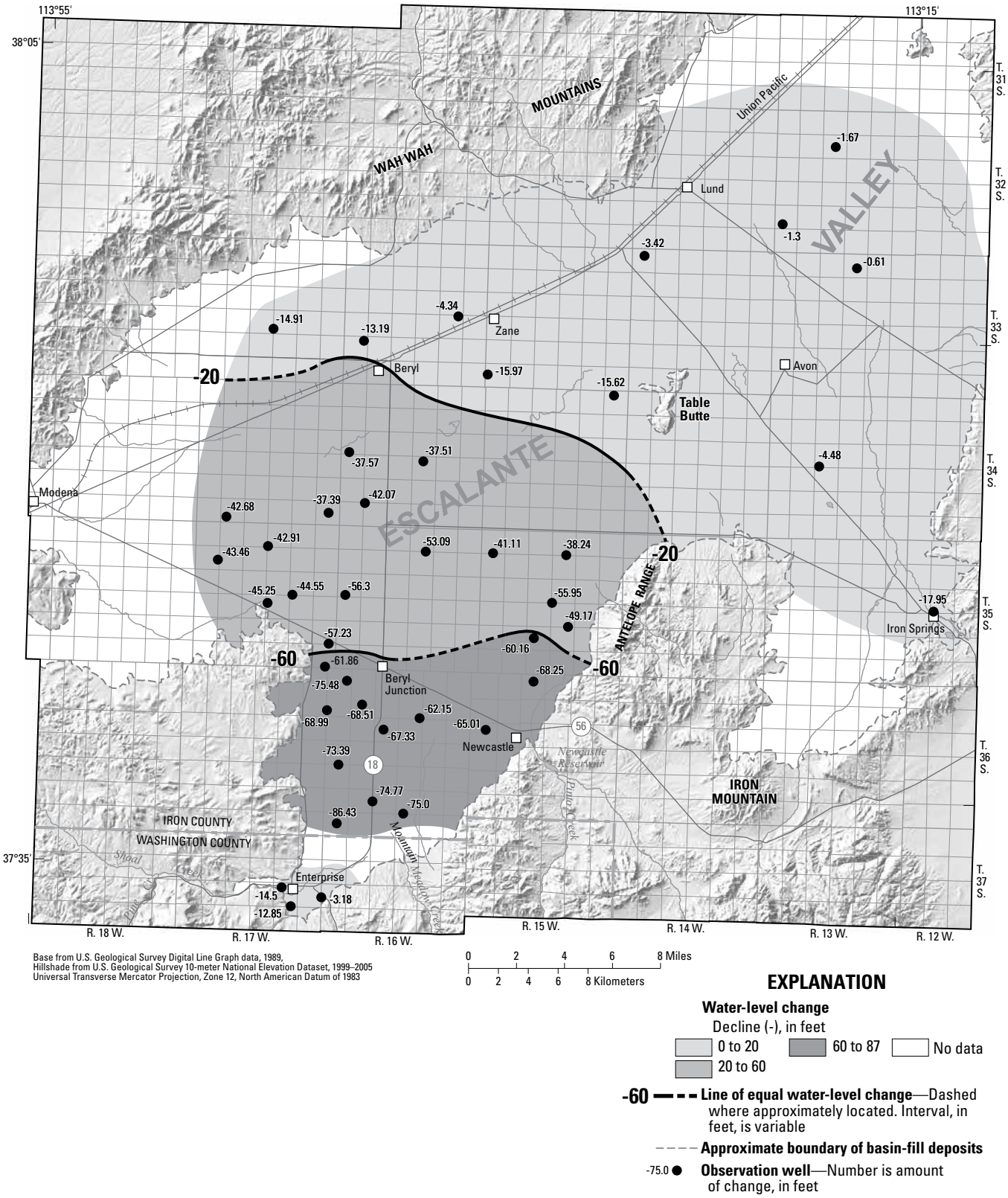



**Figure 46.** Water-level change in the Beryl-Enterprise area from March 1985 to March 2015.

## Central Virgin River Area

By Howard K. Christiansen

The central Virgin River area extends north from the Arizona border in Washington County and includes the Santa Clara and Virgin River drainages. The region is bounded on the west by the Beaver Dam and Bull Valley Mountains, on the north by the northern flank of the Pine Valley Mountains, and on the east and southeast by the Hurricane Cliffs and the Little Creek Mountains (fig. 47). Major groundwater development includes water from valley-fill aquifers that is used primarily for irrigation, and water from consolidated-rock and valley-fill aquifers 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 2014 was about 31,000 acre-feet, which is 2,000 acre-feet more than in 2013 and 1,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3). Withdrawals for irrigation, industrial, and public-supply use increased from 2013 to 2014. Domestic and stock use was about the same as in 2013.

The location of wells in the central Virgin River area in which the water level was measured during February 2015 is shown in figure 47. The relation of the water level in selected observation wells to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2 is shown in figure 48.

Discharge of the Virgin River at Virgin, Utah, in 2014 was about 78,400 acre-feet, which is 12,600 acre-feet less than the value for 2013 and about 54,200 acre-feet less than the long-term average for 1931–70 and 1979–2014. Precipitation at La Verkin was about 11.6 inches, which is about 0.8 inches more than the average annual precipitation for 1951–2014 and 1.0 inch less than in 2013. Precipitation data for St. George in 2014 were not available.

Water levels from February 2014 to February 2015 declined, or rose only slightly, in most of the central Virgin River area. The largest decline, about 4.4 feet, occurred in a well southeast of New Harmony. Declines are probably the result of continued large withdrawals for public-supply and irrigation use.

Water-level changes from February 1985 to February 2015 are shown in figure 49. Water levels generally declined in most areas where data are available. The greatest decline, about 19 feet, occurred in a well in Kanarraville. Rises occurred in wells in the south-central part of the area. The largest rise, about 12 feet, occurred in a well east-southeast of Washington. Declines are probably the result of continued large withdrawals, particularly for public supply. Localized rises may be the result of decreased withdrawals.

The concentration of dissolved solids in water samples collected from wells (C-41-17)8cbd-1 and (C-41-17)8cbd-2, located 1.5 miles south of Gunlock Reservoir, from 1966 to 2013, is shown in figure 48. These wells are located near each other and are finished in the same aquifer. The dissolved-solids concentrations in water samples from both wells were combined on one graph to give an extended temporal record for this constituent. This well was not sampled in 2014.

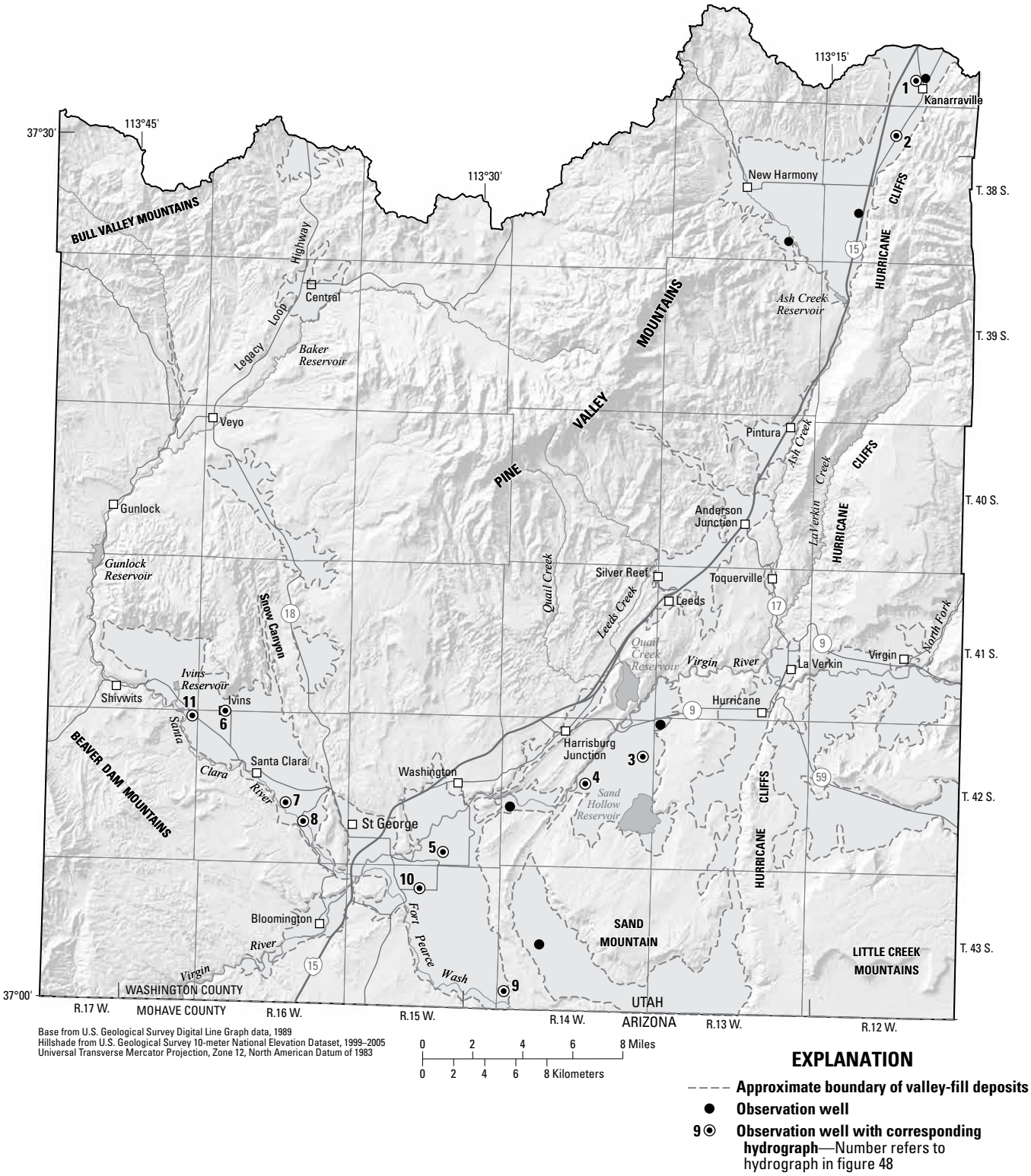



**Figure 47.** Location of wells in the central Virgin River area in which the water level was measured during February 2015.

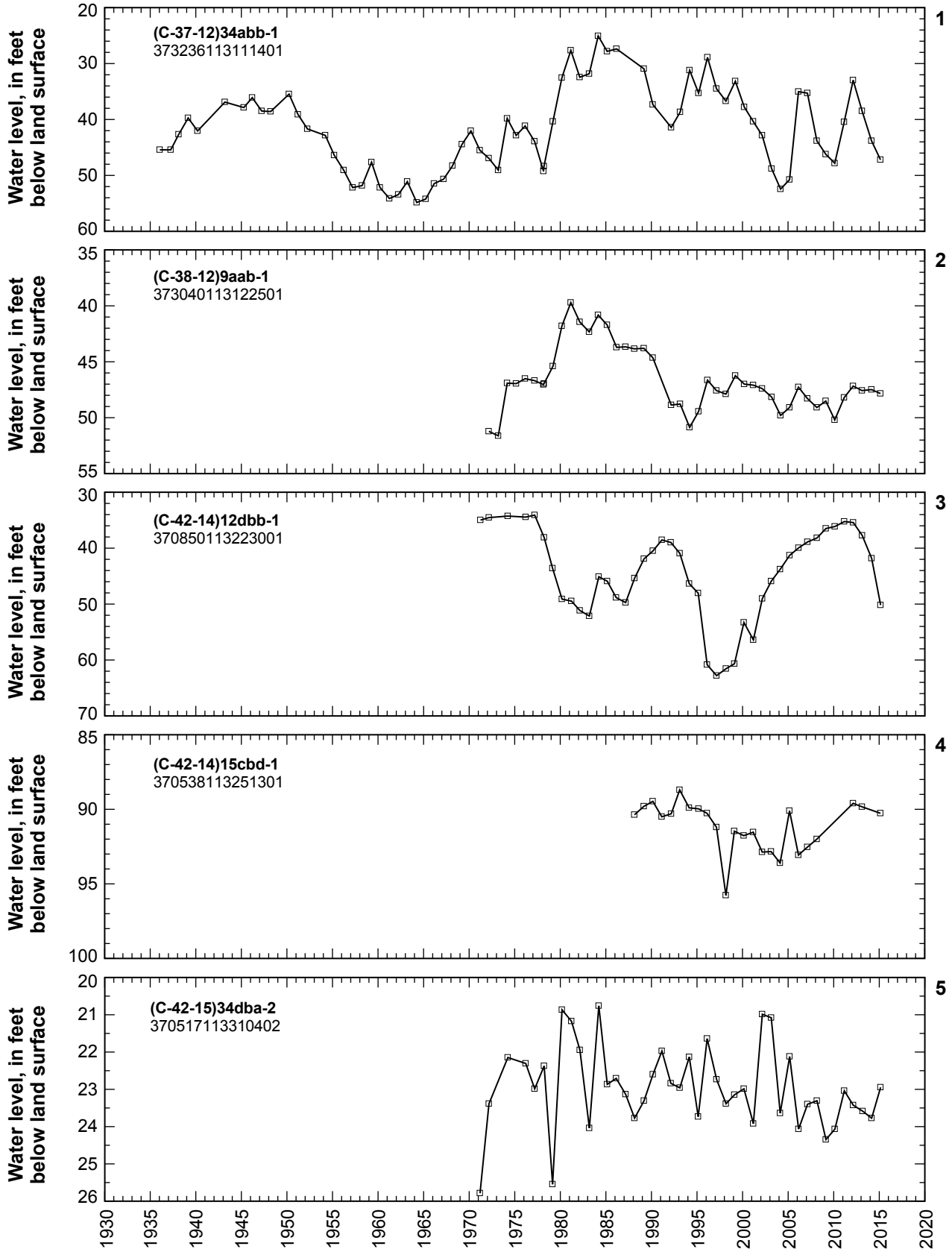



**Figure 48.** Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water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

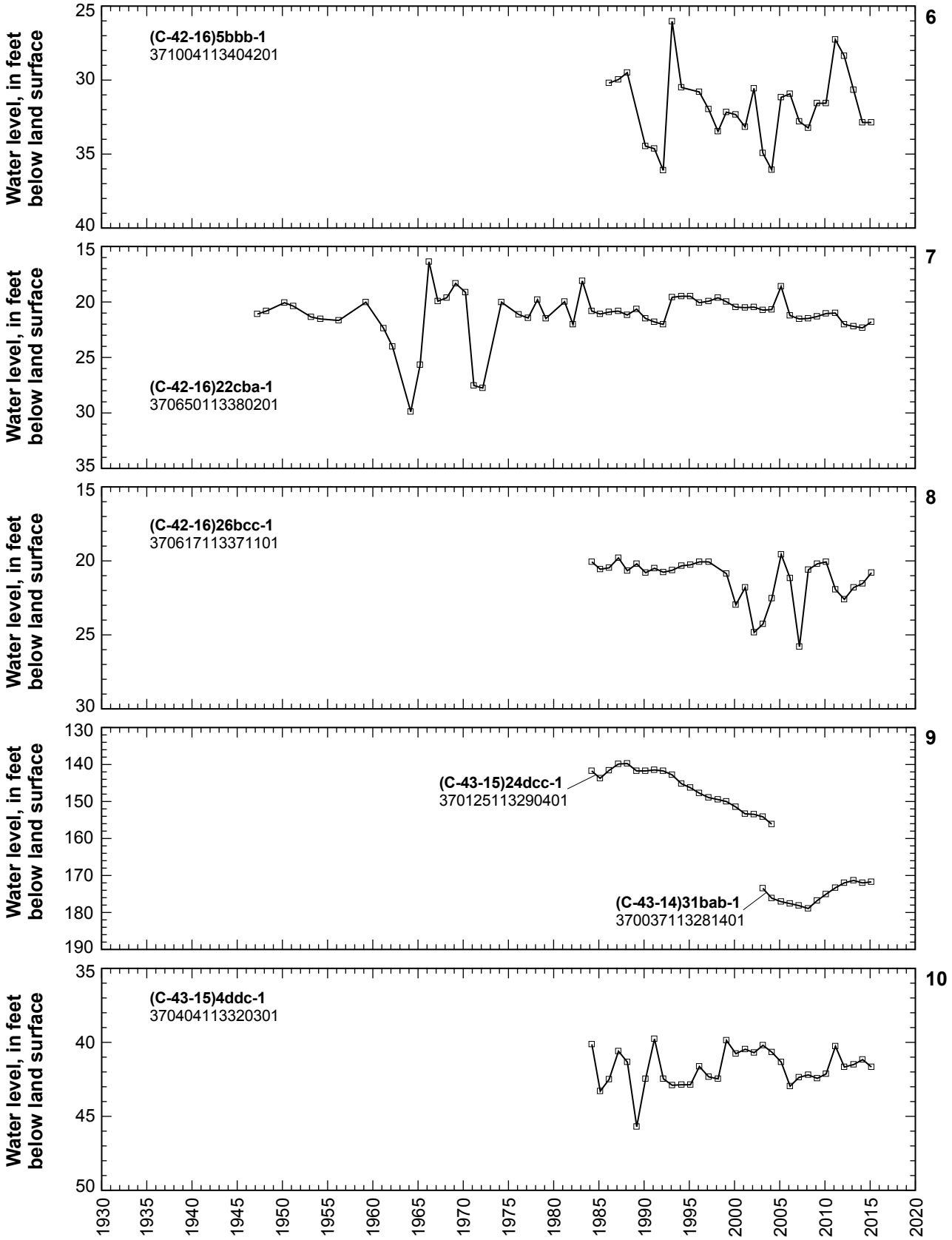



**Figure 48.** Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water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

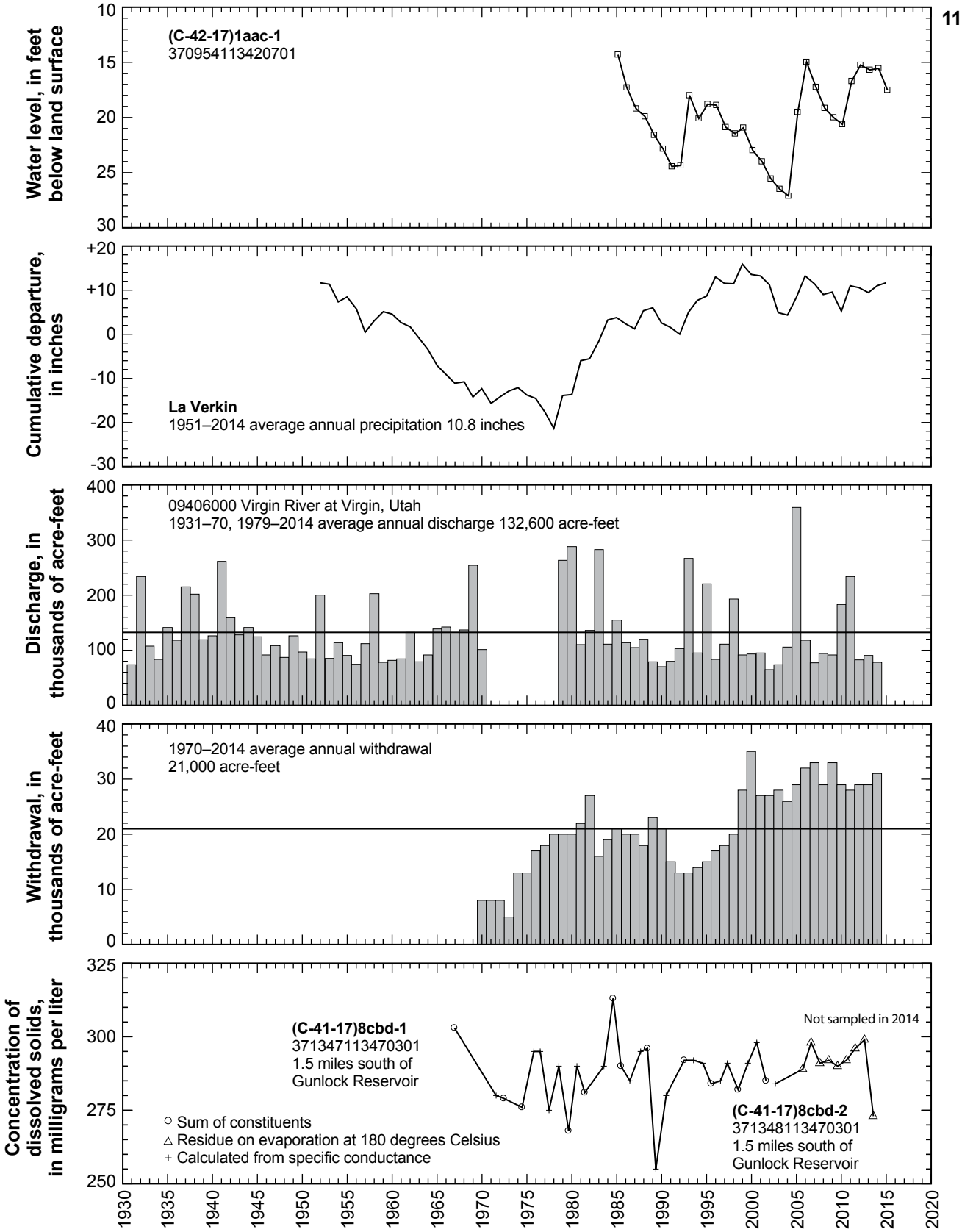



**Figure 48.** Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at La Verkin, to annual withdrawal from wells, and to concentration of dissolved solids in water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

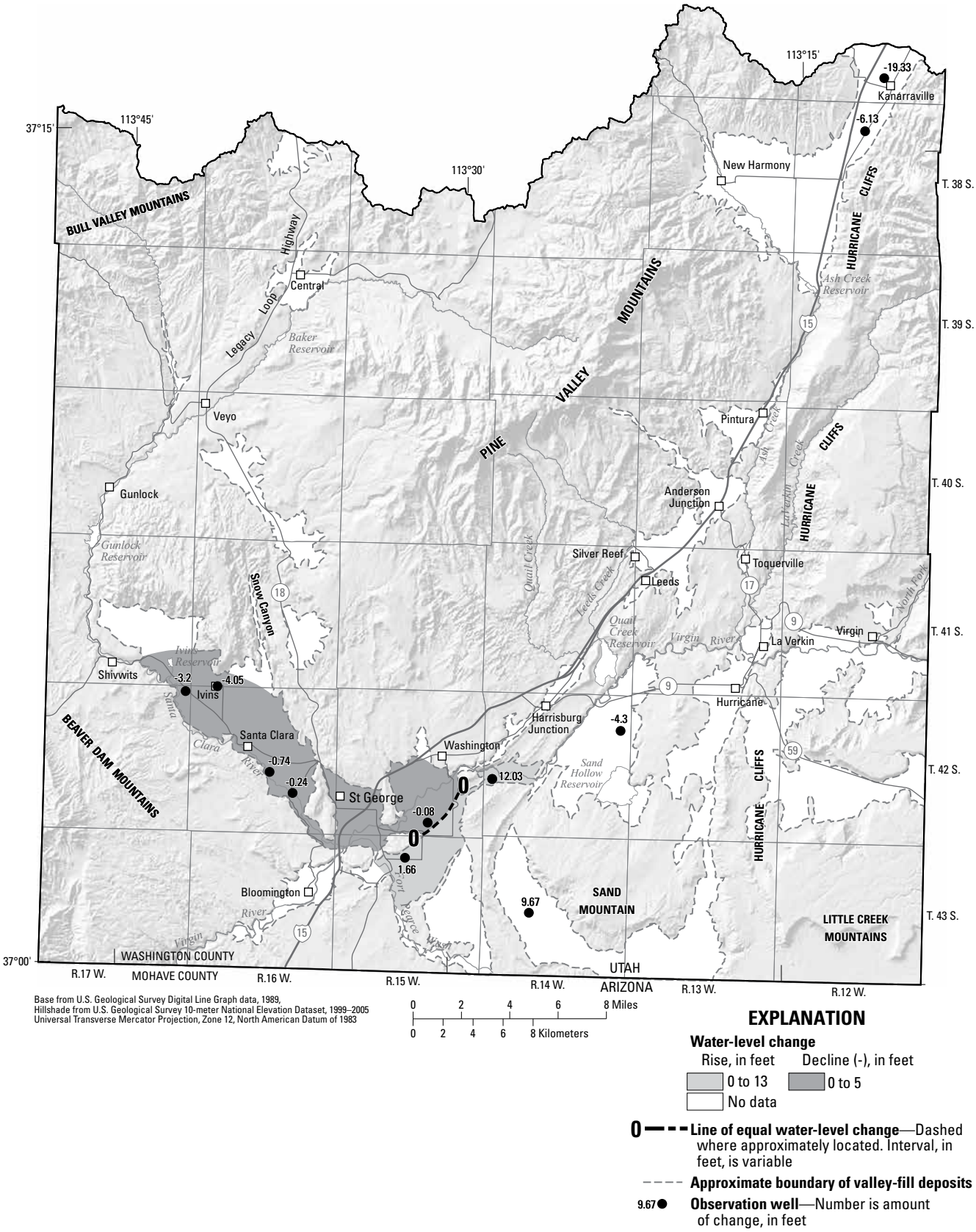



**Figure 49.** Water-level change in the central Virgin River area from February 1985 to February 2015.

## Other Areas

By Martel J. Fisher

Total estimated withdrawal of water from wells in other areas of Utah (table 4) in 2014 was about 159,000 acre-feet, which is 14,000 acre-feet more than in 2013 and 23,000 acre-feet more than the average annual withdrawal for 2004–2013 (tables 2 and 3). The largest increases were due to increased withdrawals for irrigation and industrial use. In most of the areas listed in table 4, withdrawals in 2014 were more than in 2013, except in Grouse Creek Valley and Park Valley, where irrigation use decreased; in lower Bear River Valley, where public-supply withdrawals decreased; and in Sanpete Valley, where increased withdrawals for irrigation were offset by decreased withdrawals for industrial, public supply, and domestic and stock use.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2015, is shown in figure 50. The relation of the water level in selected observation wells in Cedar Valley to cumulative departure from average annual precipitation at Provo BYU is shown in figure 51.

Water levels in selected wells in Cedar Valley generally rose during the 1970s. Water levels rose sharply from the early to mid-1980s as a result of greater-than-average precipitation, and then declined during the mid- to late 1980s and early 1990s. Water levels in these wells have been relatively stable since 1995. Water levels declined in most of the wells from March 2014 to March 2015.

Water levels generally rose in the eastern part of Cedar Valley, and generally declined in the western part, from March 1985 to March 2015, in areas where data are available (fig. 52). The largest rise, more than 26 feet, occurred in a well about 4 miles northeast of Fairfield. The largest decline, nearly 69 feet, occurred in a well near Cedar Fort.

The location of wells in Sanpete Valley in which the water level was measured during March 2015 is shown in figure 53. The relation of the water level in selected observation wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti is shown in figure 54.

Water levels in selected wells in Sanpete Valley rose from the late 1970s to the mid-1980s as a result of greater-than-average precipitation and have varied since the mid-1980s, but overall have declined. Water levels declined in all of the selected observation wells from March 2014 to March 2015.

Water levels declined from March 1985 to March 2015 in all parts of Sanpete Valley for which data are available (fig. 55). The largest decline, almost 33 feet, occurred in a well northeast of Spring City.

The location of wells in Snake Valley in which the water level was measured during March 2015 is shown in figure 56. The relation of the water level in selected observation wells in Snake Valley to cumulative departure from average annual precipitation at Callao is shown in figure 57.

Water levels in all of the selected wells in Snake Valley declined from March 2014 to March 2015. Water levels rose sharply in the early to mid-1980s as a result of greater-than-average precipitation, but have generally declined since the mid-1980s.

Water levels declined from March 1985 to March 2015 in all parts of Snake Valley for which data are available (fig. 58). The largest decline, about 21 feet, occurred in a well near Garrison.

The relation of the water level in wells in the remaining selected areas of Utah (table 4) to cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 59. Water levels declined or rose only slightly in most of the selected observation wells from March 2014 to March 2015.

**Table 4.** Estimated withdrawal of water from wells in other areas of Utah, 2014.

| Number in figure 1 | Area | Estimated withdrawal from wells (acre-feet) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2014 | | | | | 2013 total (rounded) |
| | | Irrigation | Industrial | Public supply | Domestic and stock | Total (rounded) | |
| 1 | Grouse Creek Valley | 1,600 | 0 | 0 | 20 | 1,600 | 2,100 |
| 2 | Park Valley area | 1,800 | 0 | 0 | 10 | 1,800 | 2,100 |
| 4 | Lower Bear River area | 3,700 | 510 | 6,600 | 200 | 11,000 | 12,100 |
| 8 | Ogden Valley | 0 | 0 | 12,400 | 20 | 12,400 | 11,400 |
| 13 | Rush Valley | 5,200 | 270 | 170 | 30 | 5,700 | 5,600 |
| 14 | Skull Valley, Dugway area, and Old River Bed | 2,300 | 5,200 | 890 | 10 | 8,400 | 8,200 |
| 15 | Cedar Valley, Utah County | 90 | 0 | 6,400 | 40 | 6,500 | 6,000 |
| 20 | Sanpete Valley | 9,300 | 930 | 870 | 3,000 | 14,100 | 14,400 |
| 25 | Snake Valley | 23,000 | 0 | 90 | 50 | 23,100 | 20,300 |
| 27 | Beaver Valley | 11,500 | 20 | 330 | 480 | 12,300 | 8,400 |
| | Remainder of State | 12,900 | 26,400 | 19,800 | 2,600 | 61,700 | 54,600 |
| Total (rounded) | | 71,400 | 33,300 | 47,600 | 6,500 | 159,000 | 145,000 |

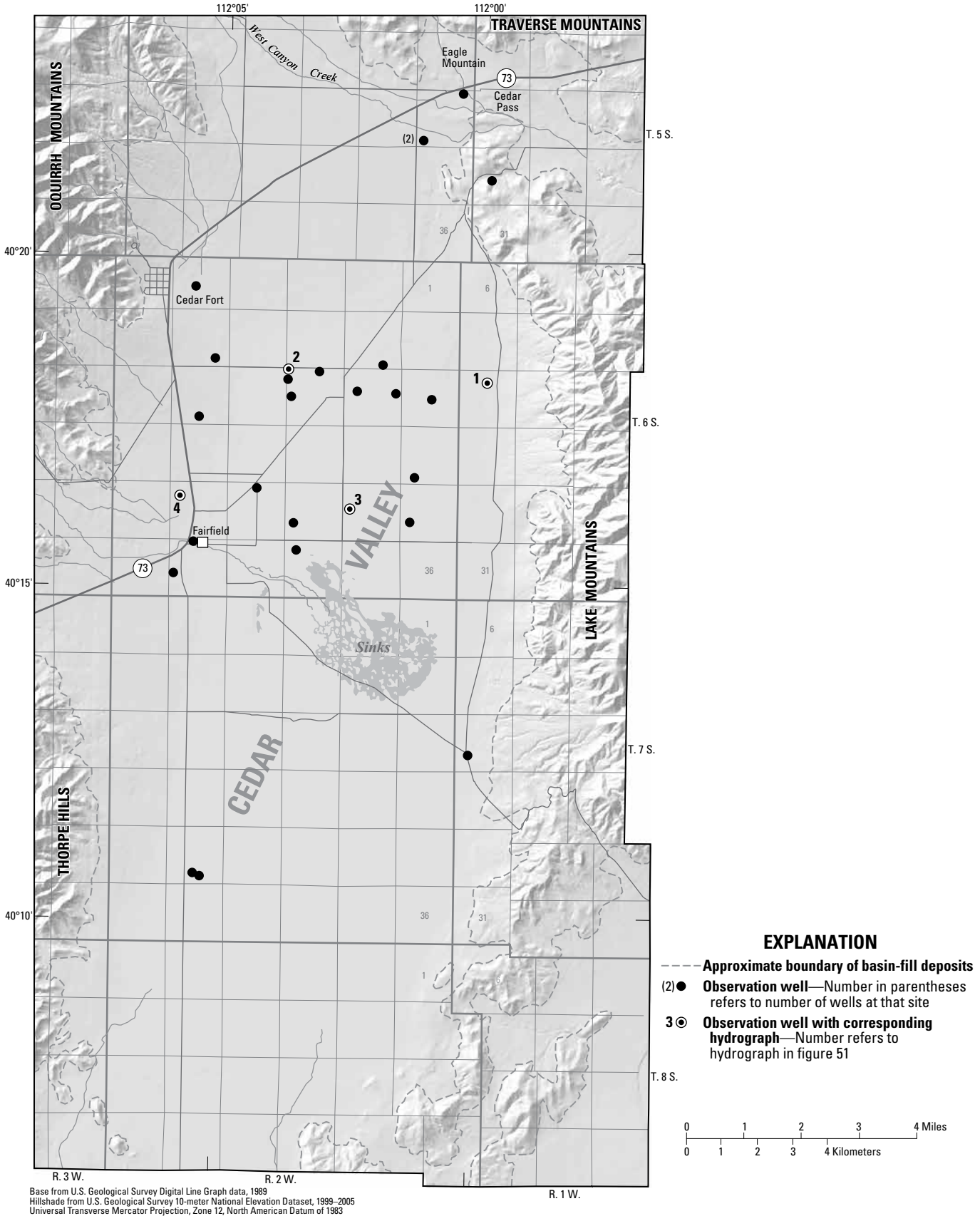



**Figure 50.** Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2015.

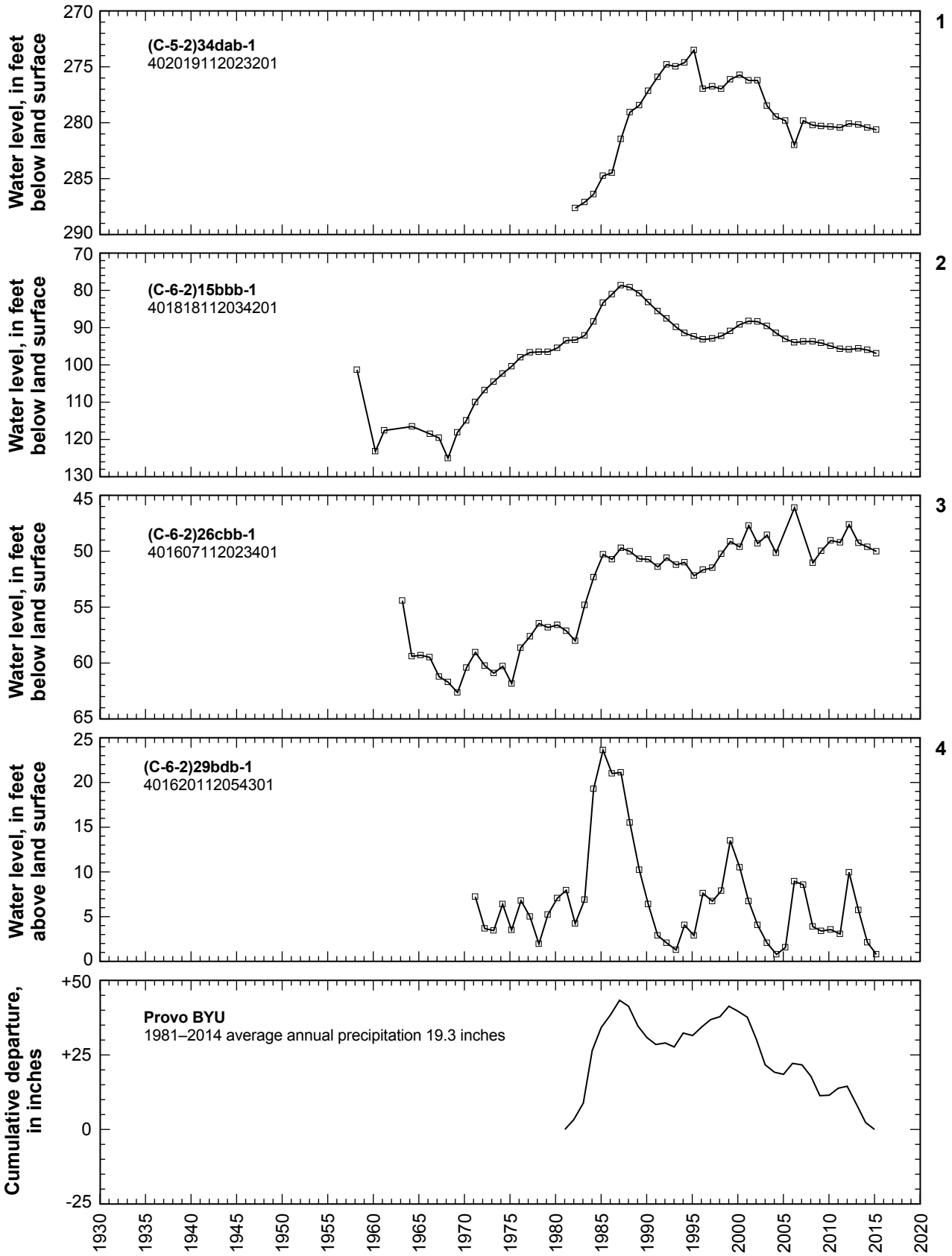



**Figure 51.** Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Provo BYU.

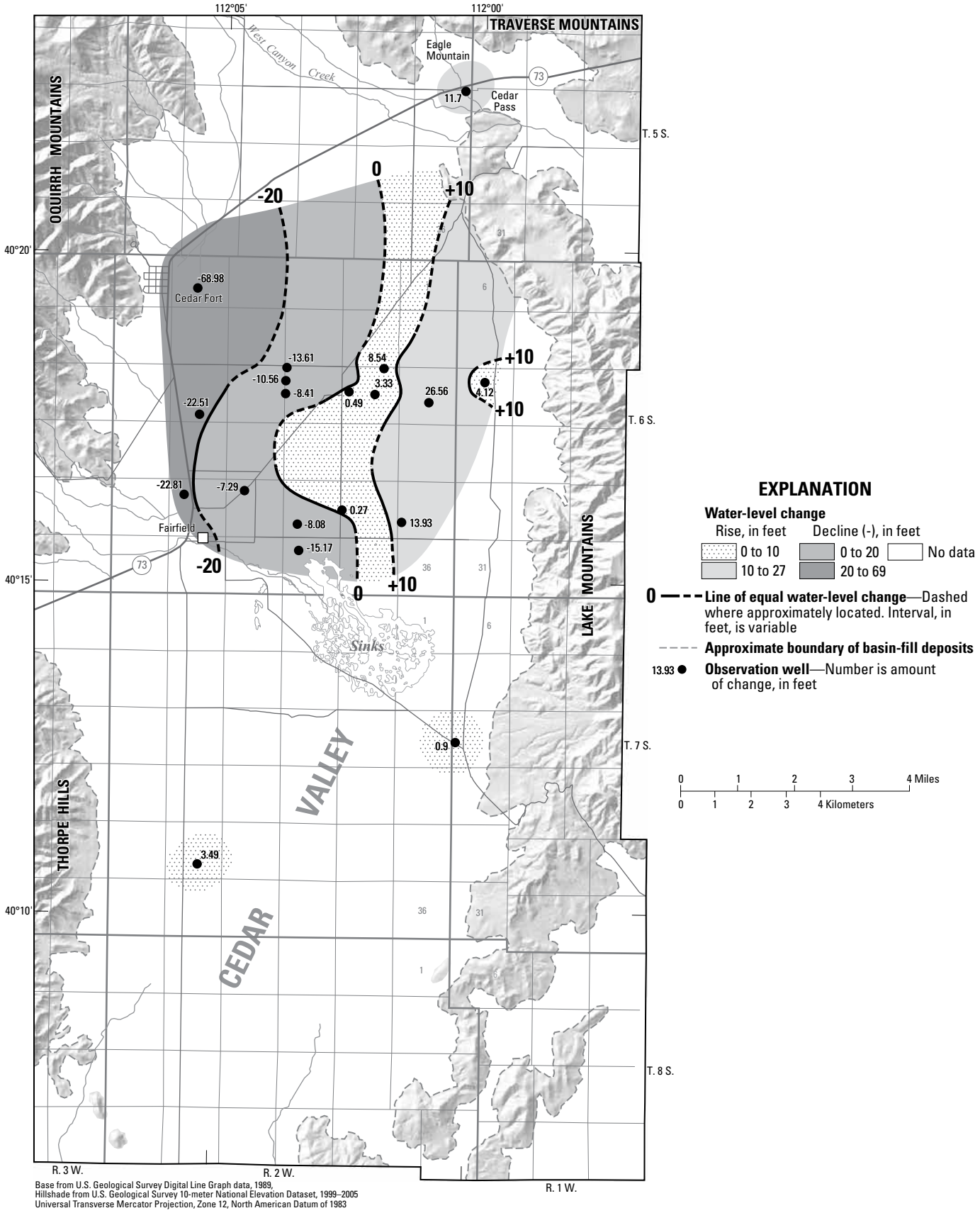
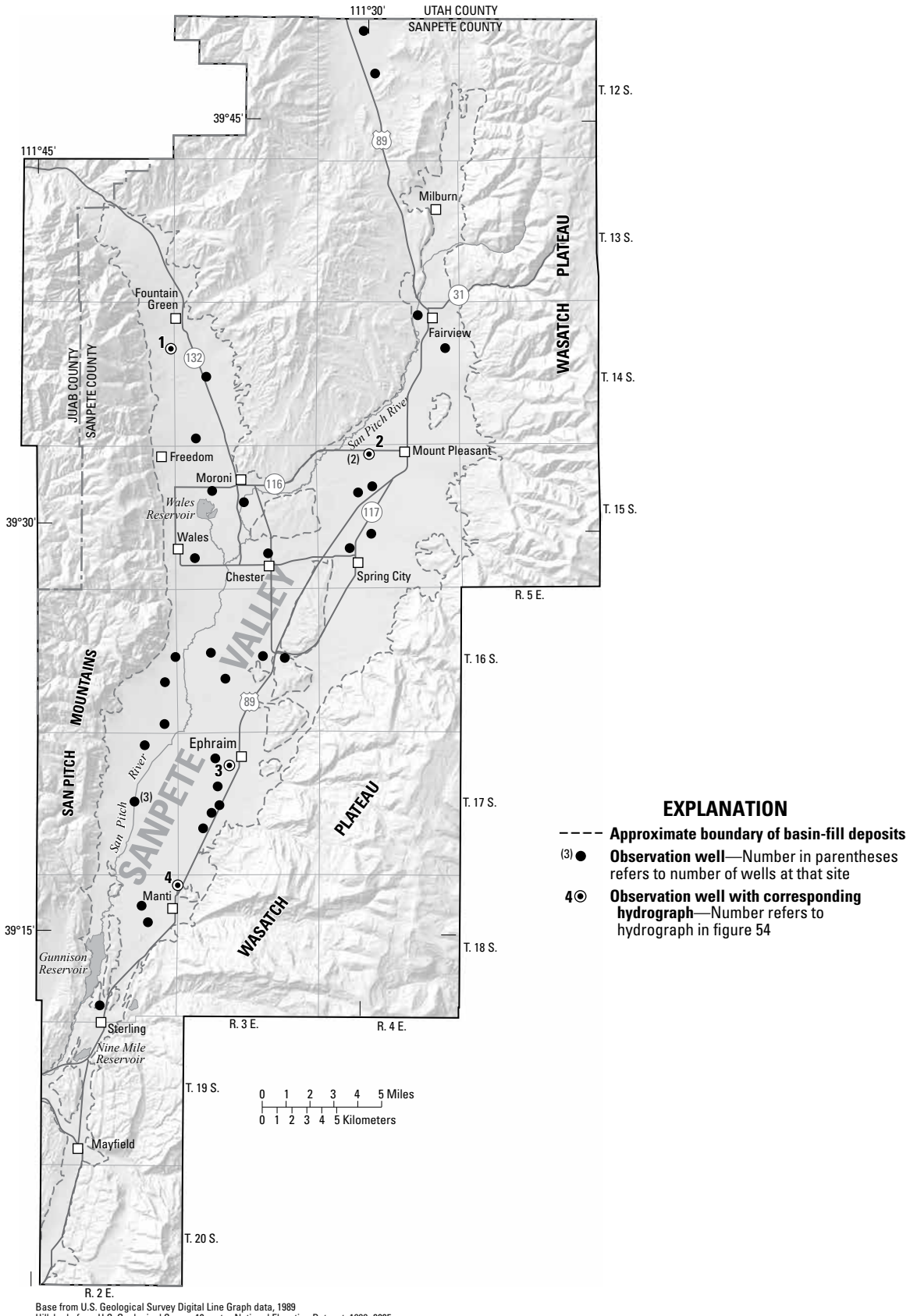



**Figure 52.** Water-level change in Cedar Valley, Utah County, from March 1985 to March 2015.




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

**Figure 53.** Location of wells in Sanpete Valley in which the water level was measured during March 2015.

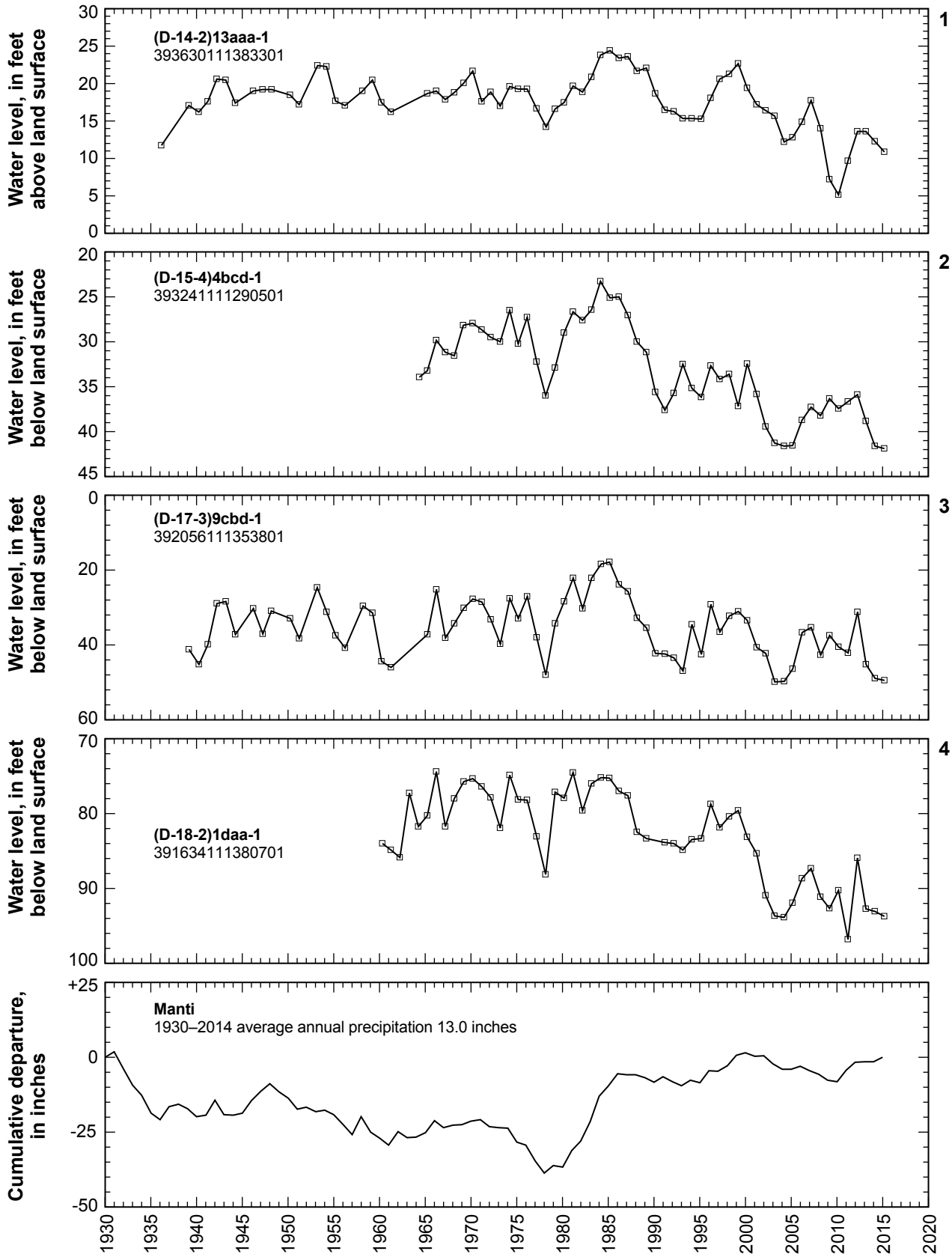
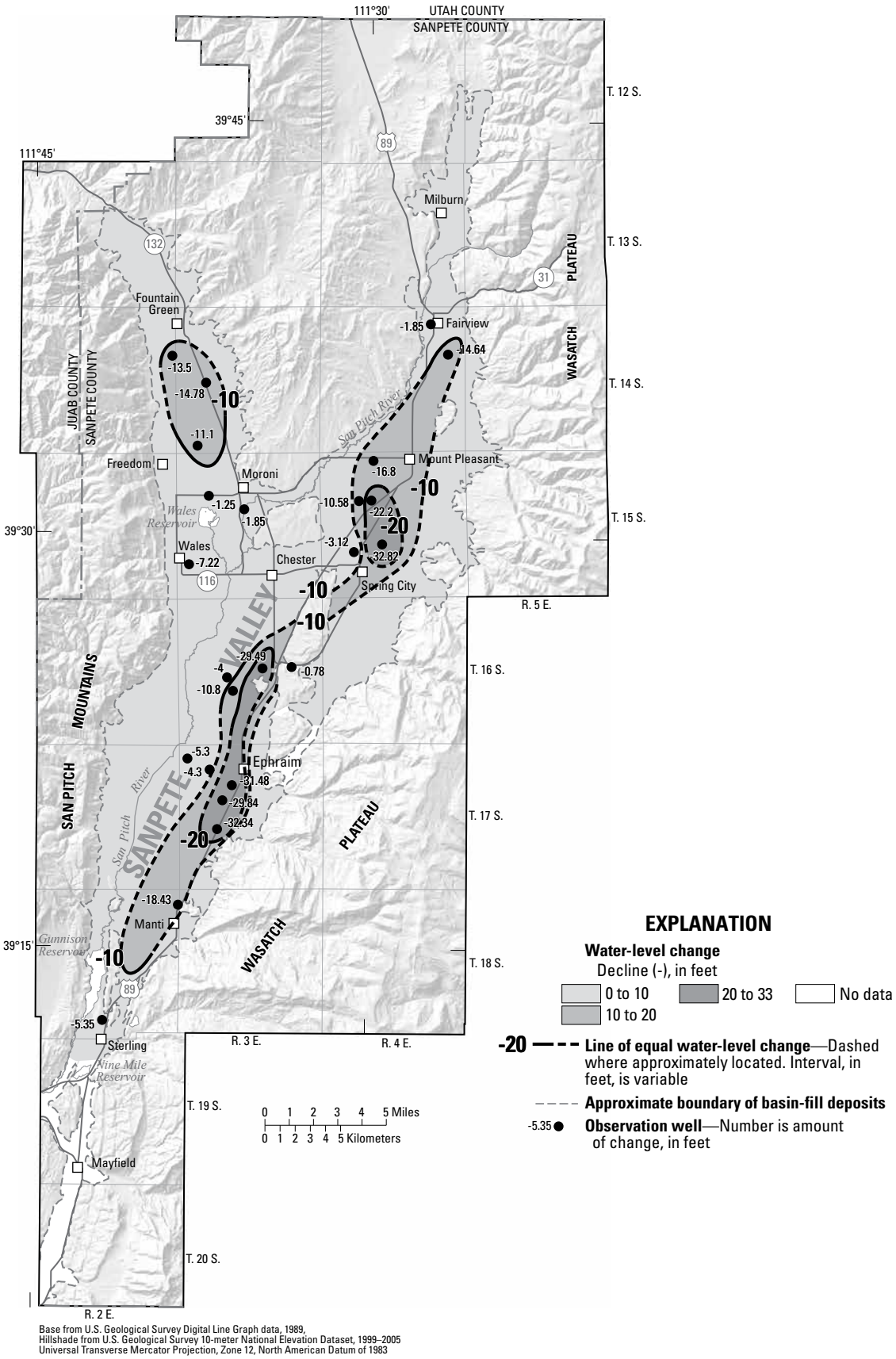



**Figure 54.** Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.




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

**Figure 55.** Water-level change in Sanpete Valley from March 1985 to March 2015.

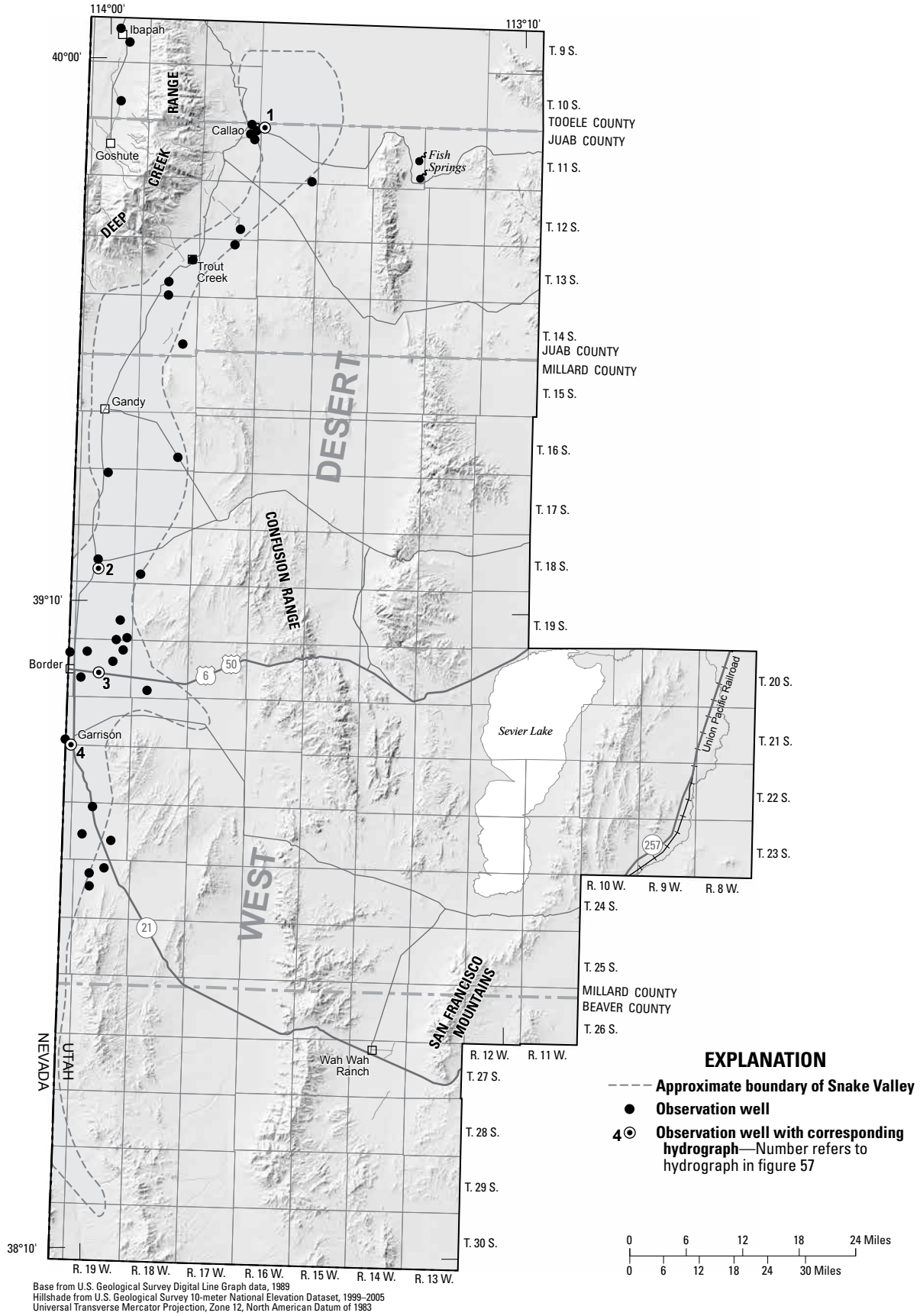



**Figure 56.** Location of wells in Snake Valley in which the water level was measured during March 2015.

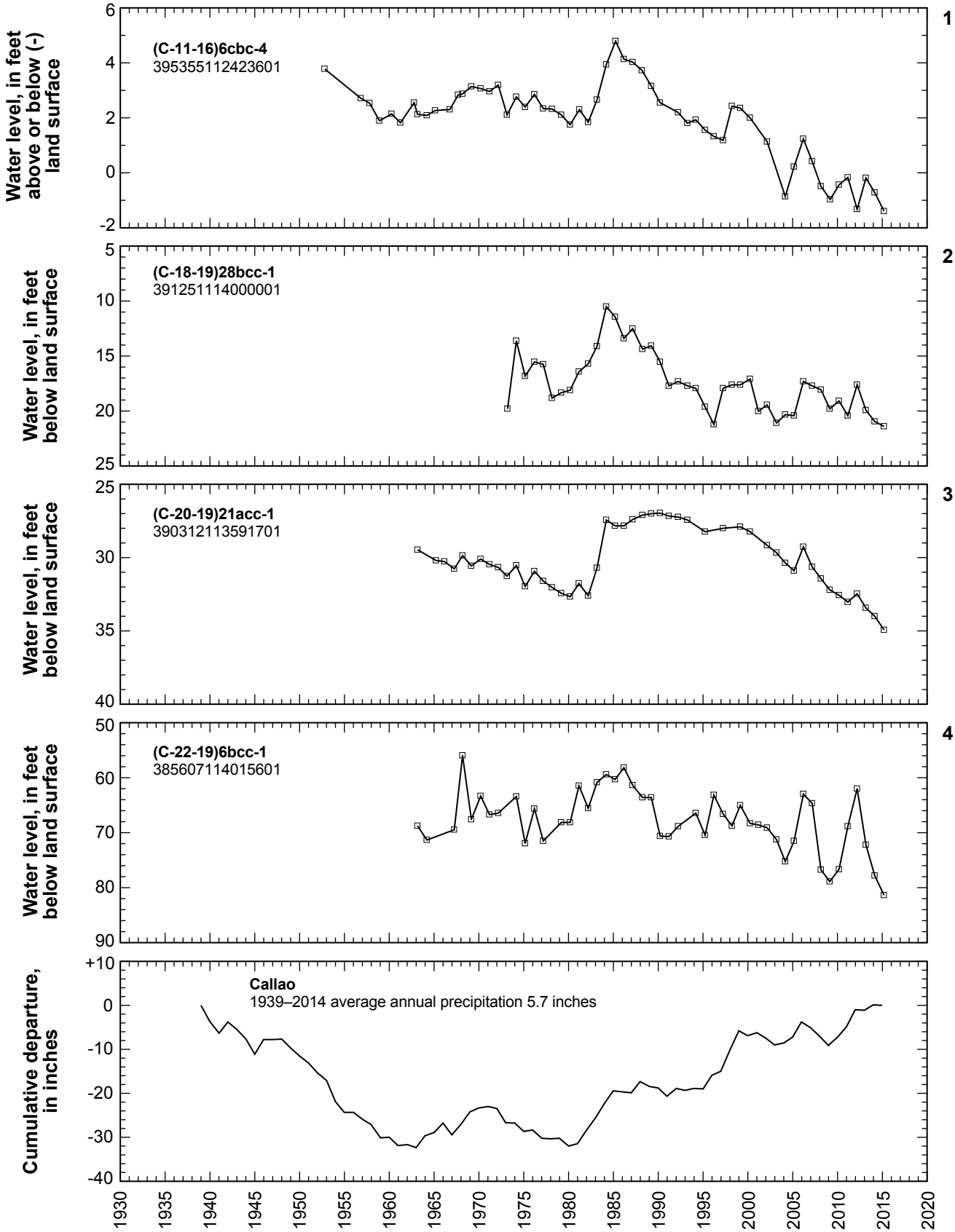



**Figure 57.** Relation of water level in selected wells in Snake Valley to cumulative departure from average annual precipitation at Callao.

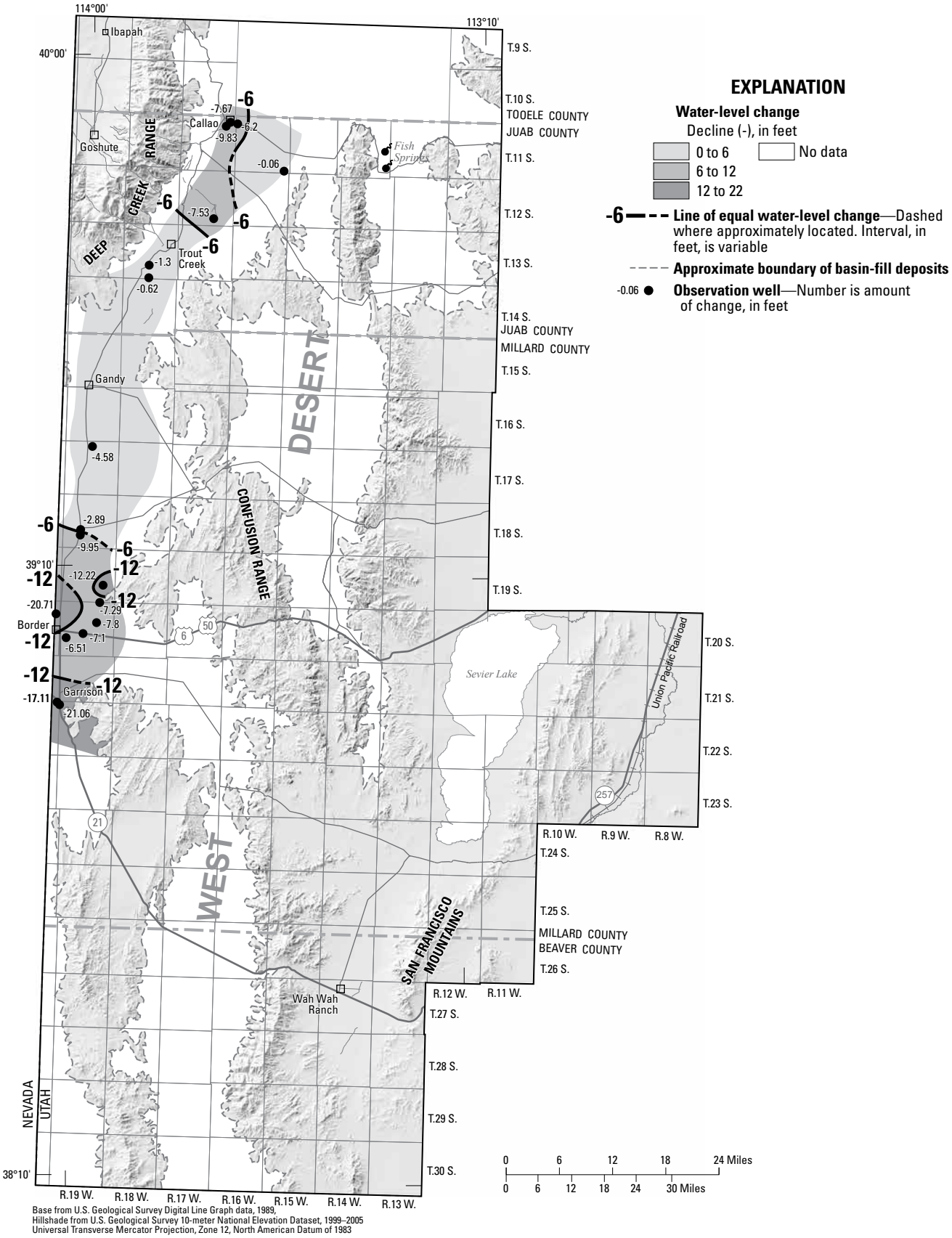



**Figure 58.** Water-level change in Snake Valley from March 1985 to March 2015.

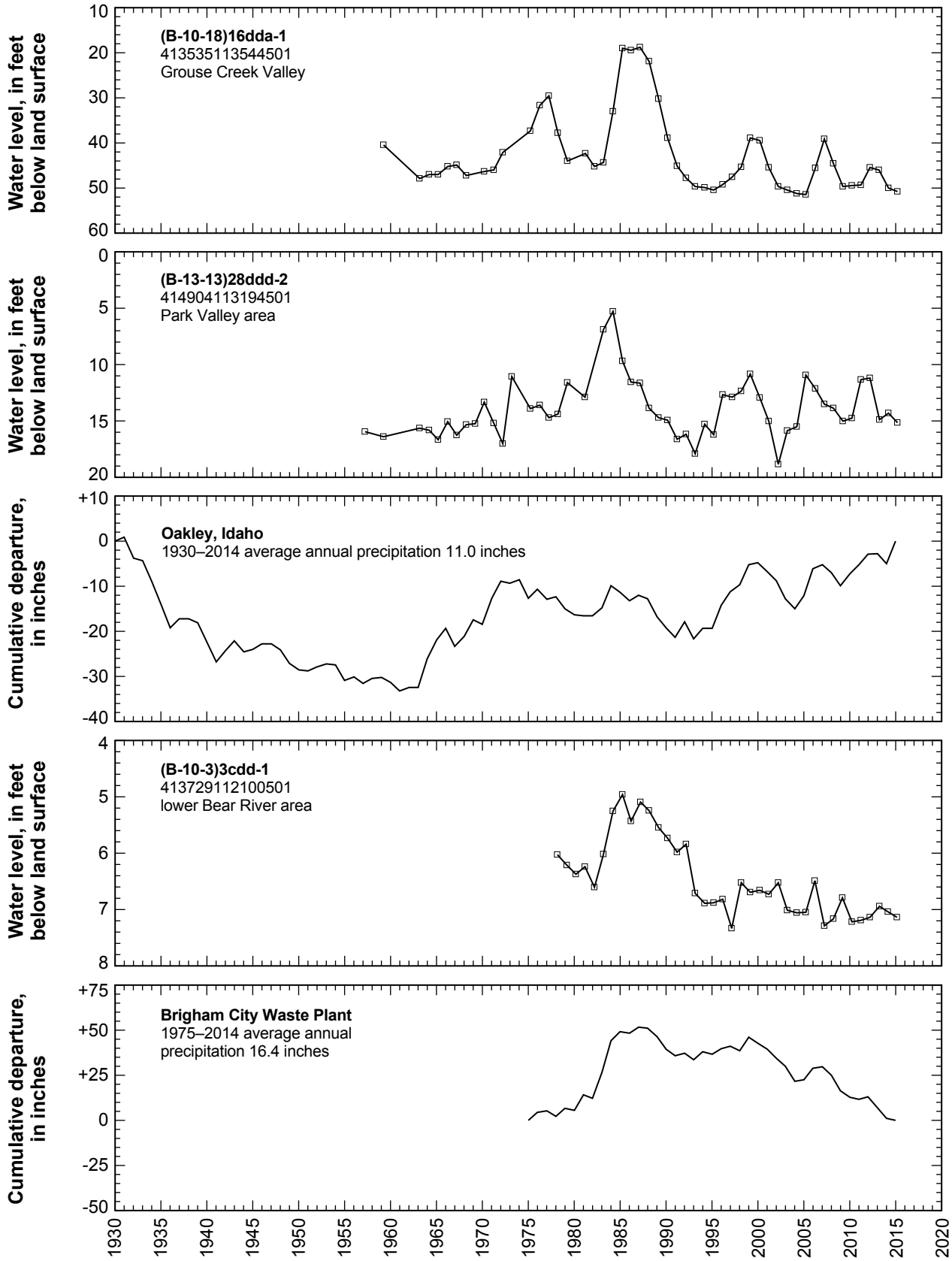



**Figure 59.** Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

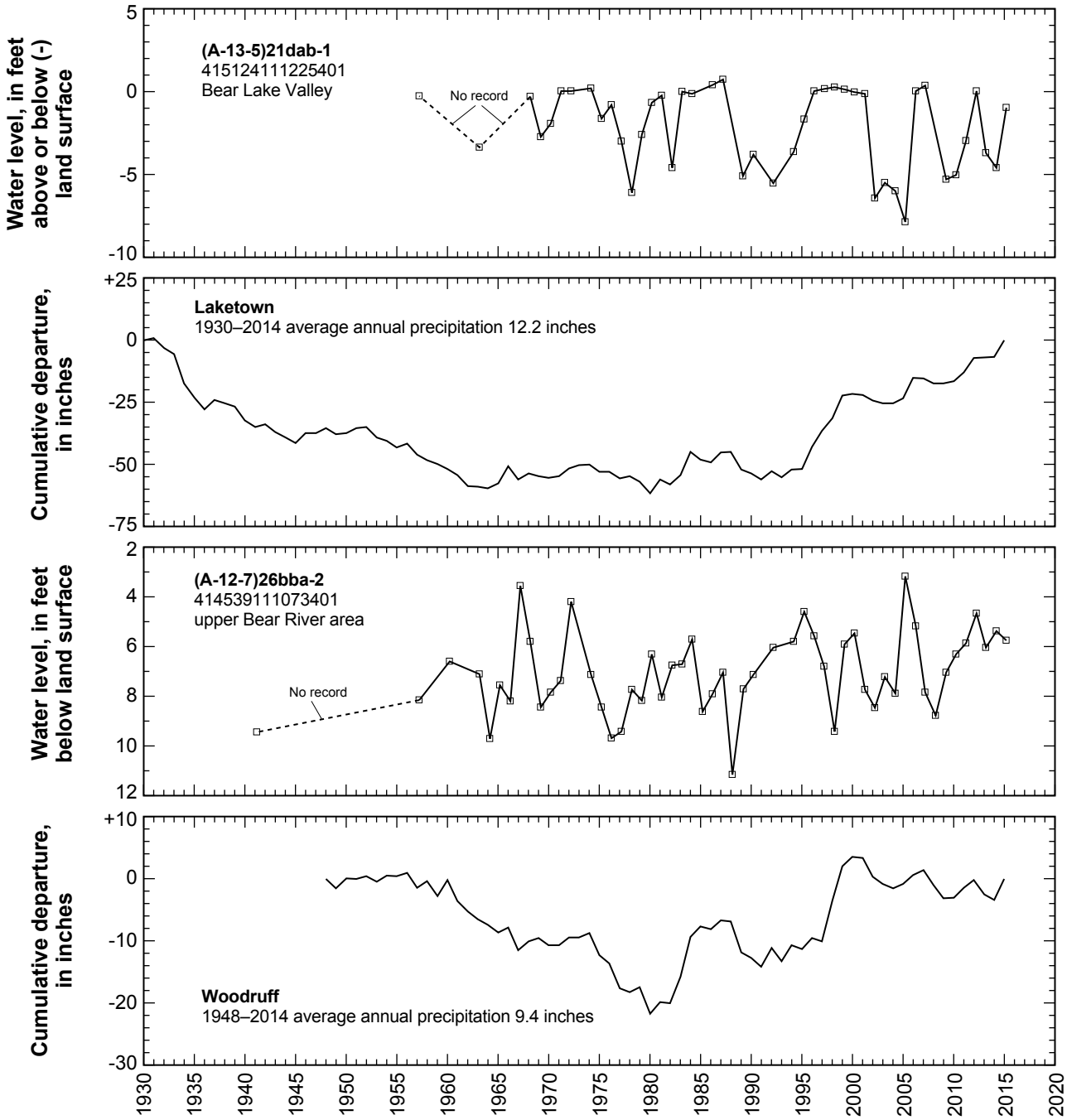



**Figure 59.** Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

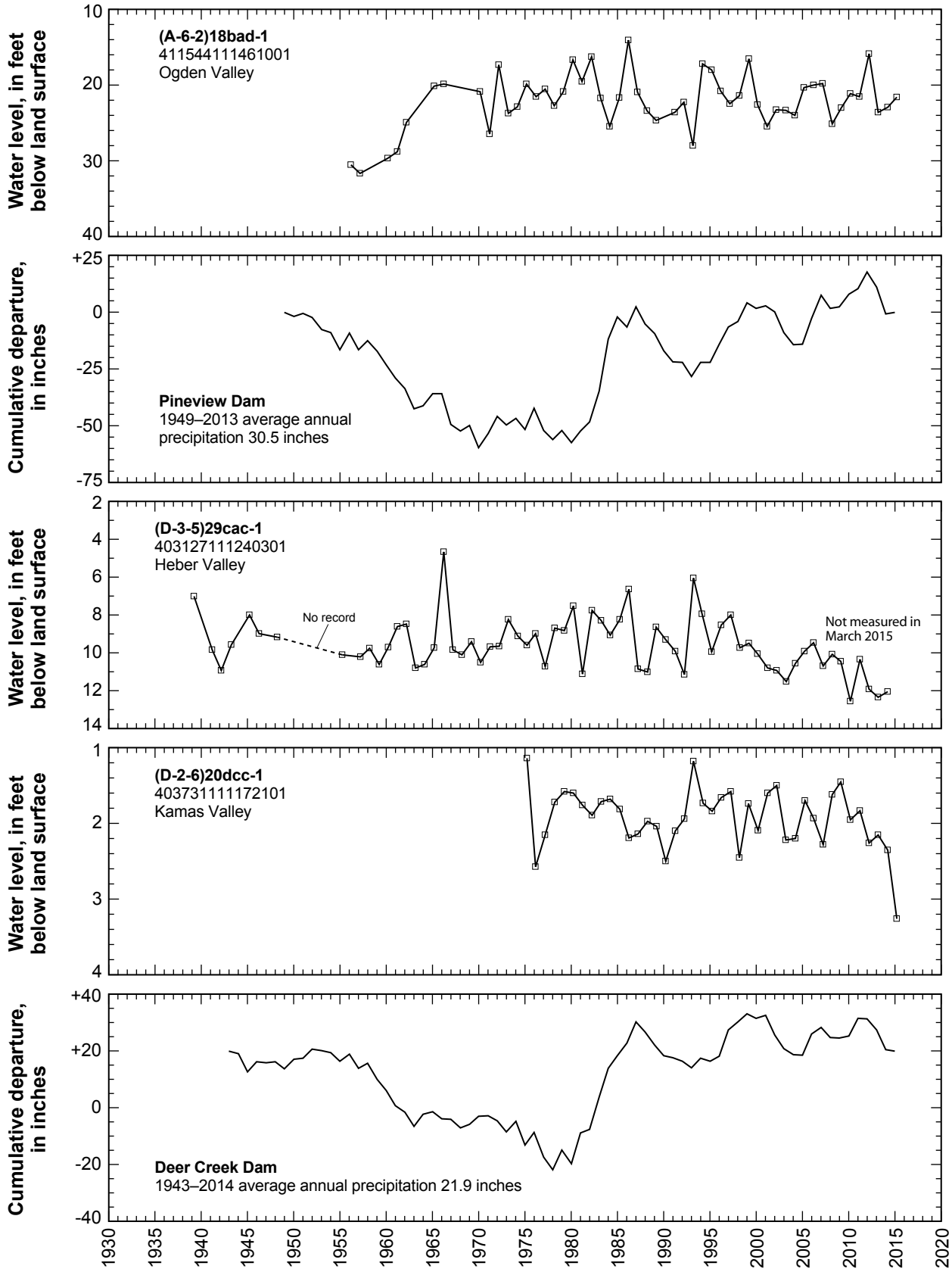



**Figure 59.** Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

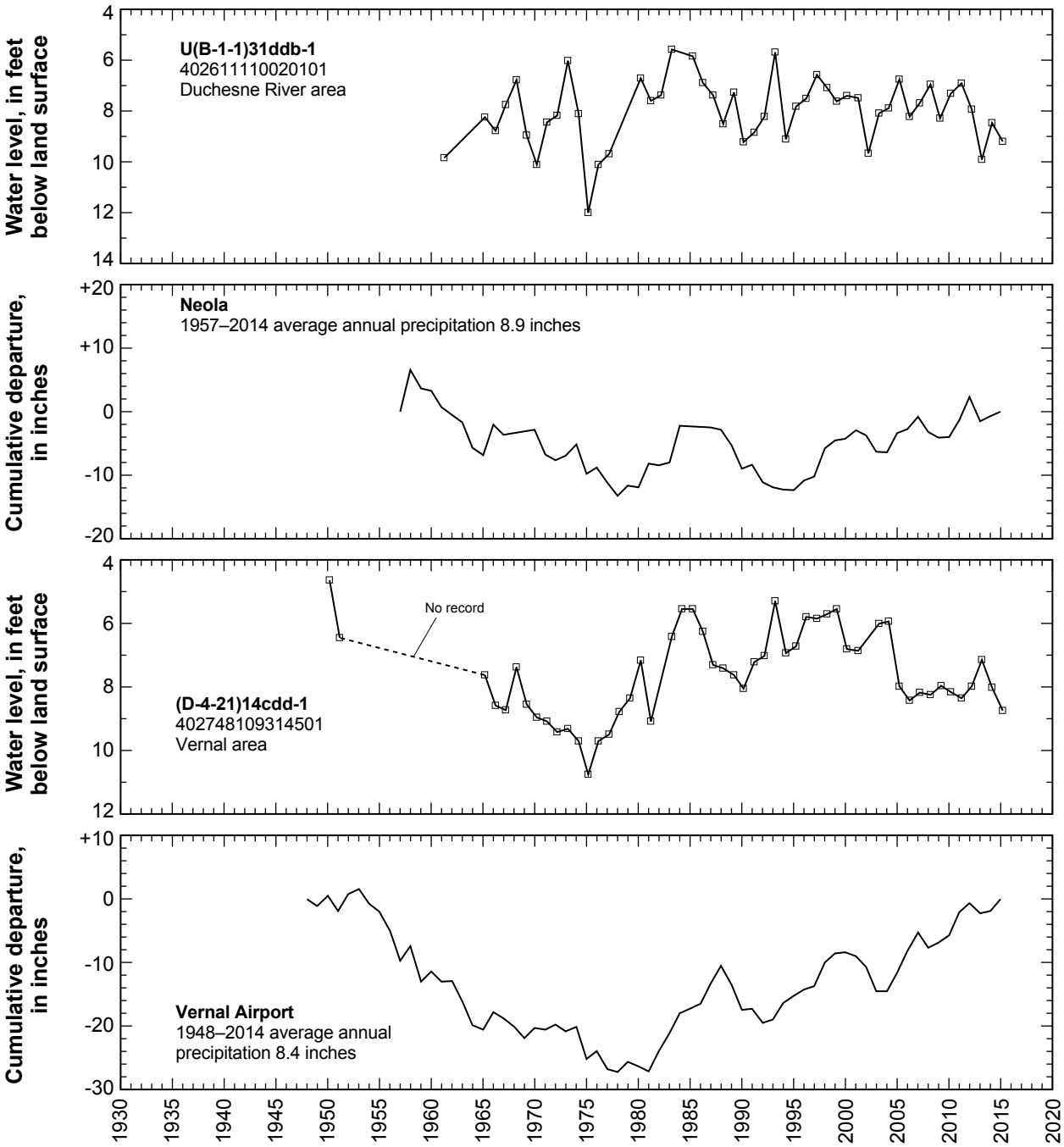



**Figure 59.** Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

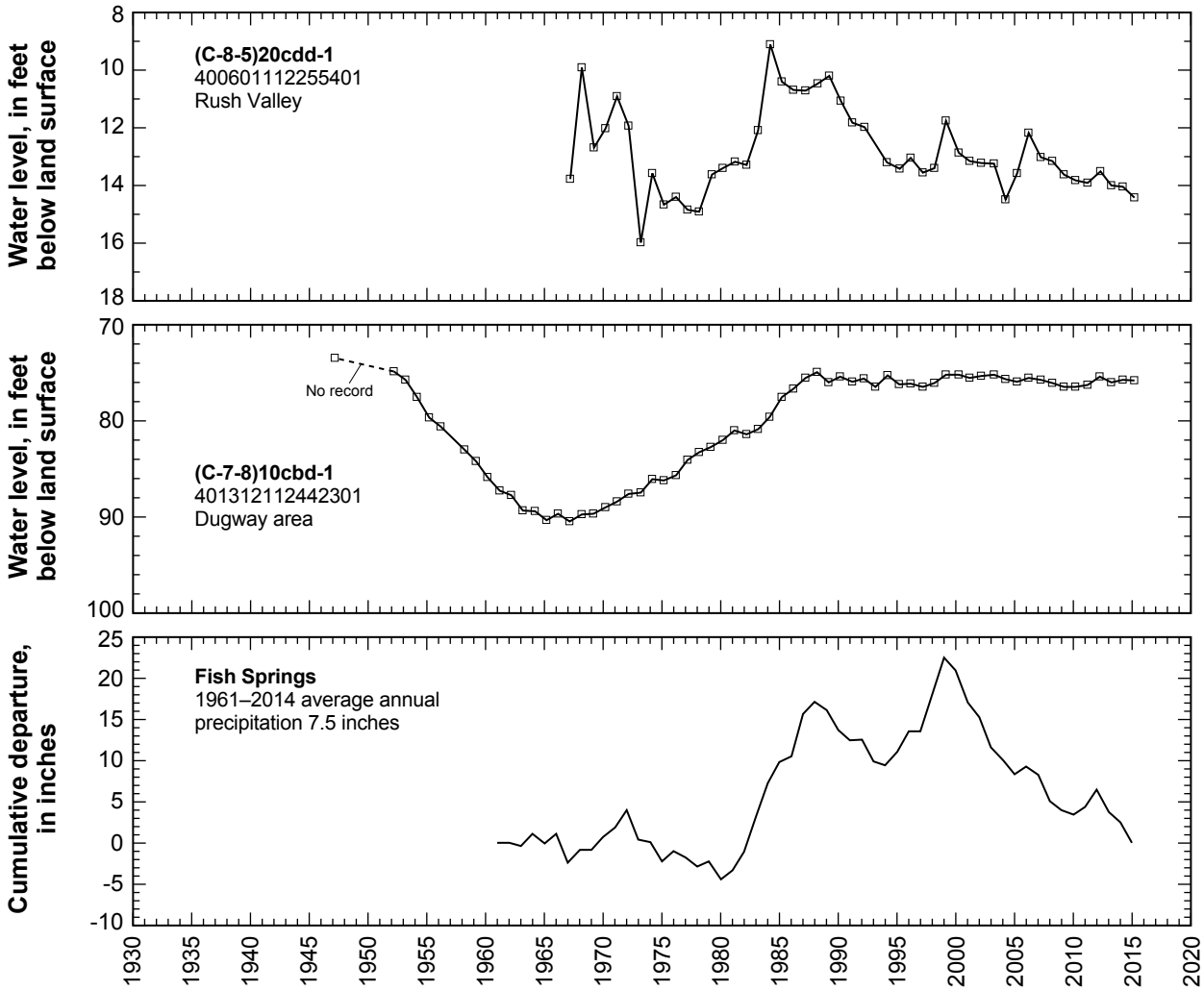



**Figure 59.** Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

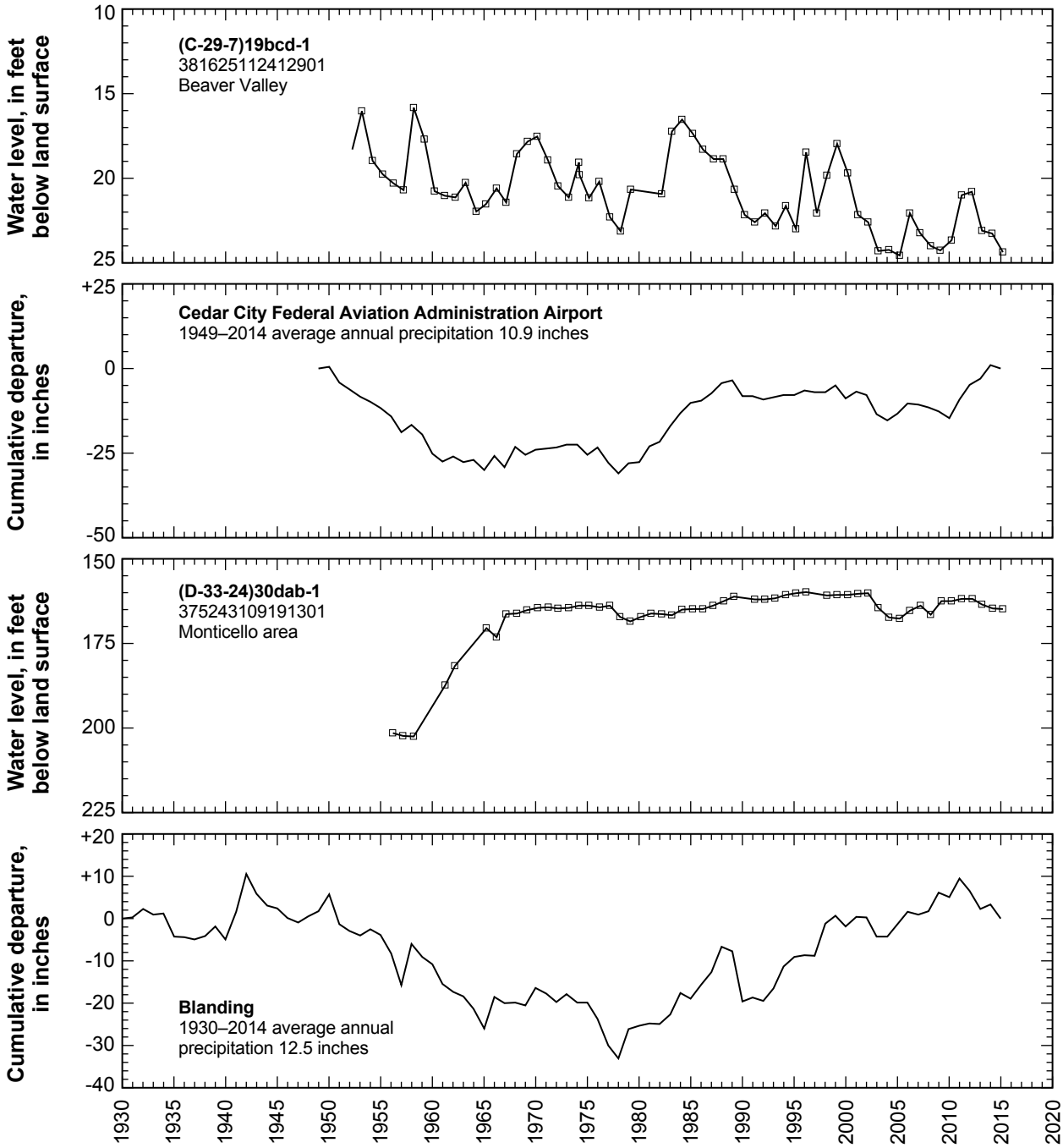



**Figure 59.** Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

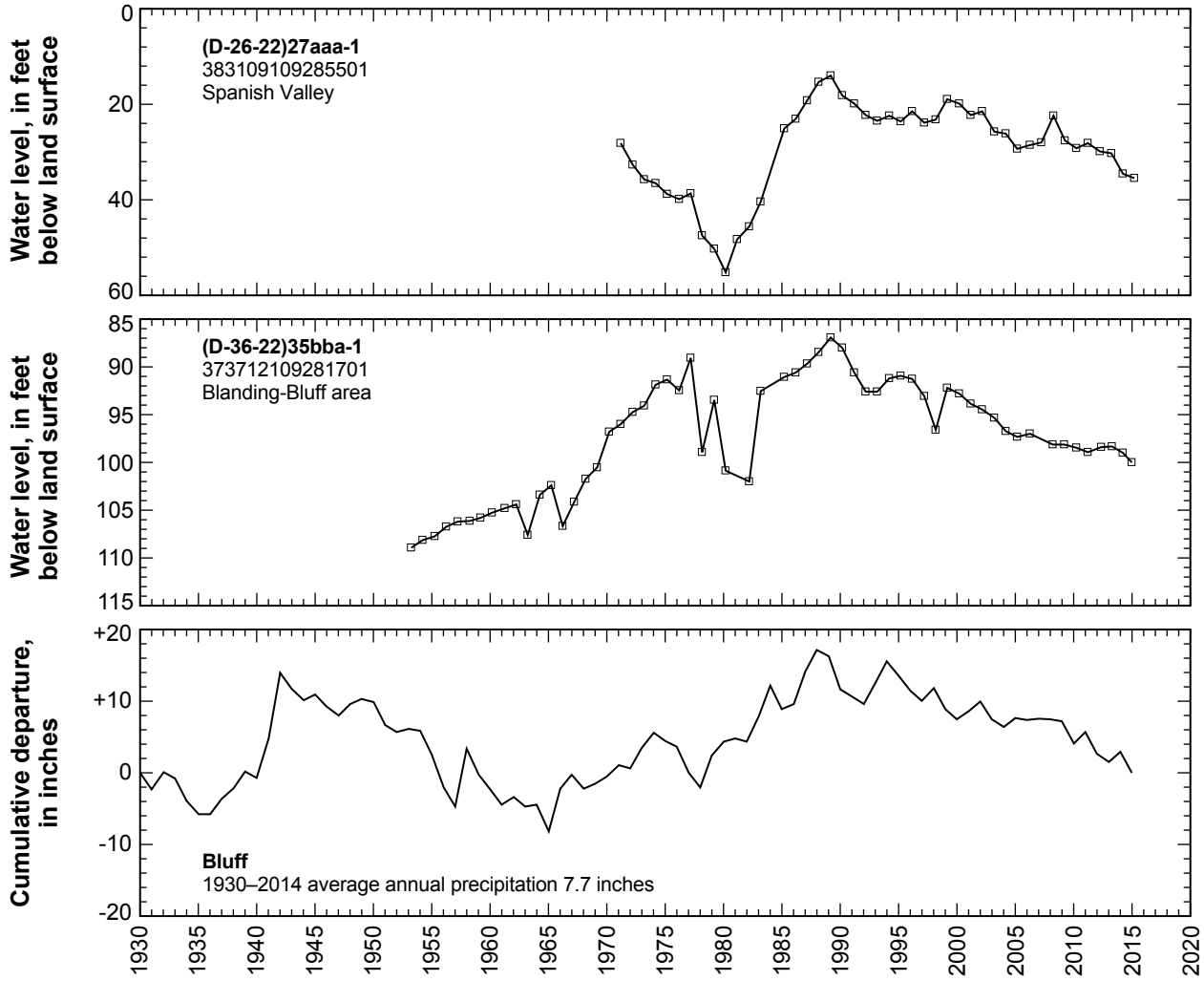



**Figure 59.** Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

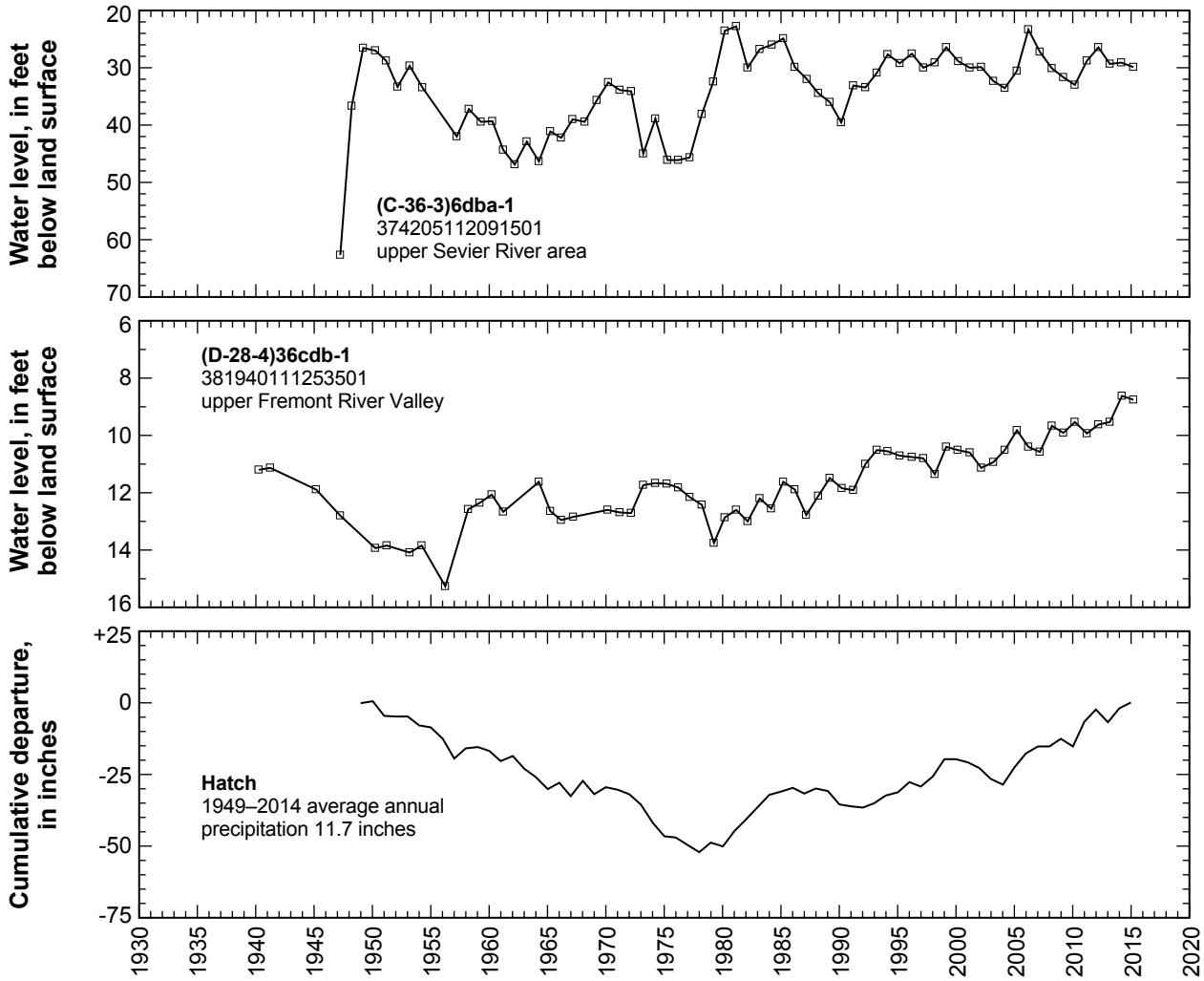



**Figure 59.** Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

# Quality of Water from Selected Wells in Utah, Summer of 2014

From June through September 2014, the U.S. Geological Survey (USGS) Utah Water Science Center, in cooperation with the Utah Department of Environmental Quality, Division of Water Quality, sampled water from 104 wells located in 21 counties (fig. 60). Samples were collected during this time period to limit seasonal variability in the data. The majority of water samples were collected from irrigation wells. Field parameters that were measured at the time the water samples were collected included pH, specific conductance, and water temperature. Chemical constituents that were analyzed in the water samples included major ions, dissolved solids, nutrients (nitrate plus nitrite, and orthophosphate), and selected trace elements. The USGS National Water Quality Laboratory in Denver, Colorado, analyzed the water samples. Field parameter values and analytical results for major ions, dissolved solids, and nutrients are shown in table 5. Analytical results for trace elements are shown in table 6.

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

Water-quality field blanks were collected to determine if samples were being contaminated during equipment decontamination and/or sample collection and processing procedures. A field blank is an inorganic blank water sample that is prepared by the USGS National Water Quality Laboratory, carried in the field, and processed using the same methods and equipment as the environmental water samples. The field blank is subject to processing in the field, preservation, shipment, laboratory handling procedures, and analytical protocols. Fifteen field blank water samples were processed during the 2014 sampling period. Analytical results for all constituents in the field blanks were less than the laboratory reporting limits.

Replicate water samples also were collected at two wells. A replicate sample is collected concurrent with an environmental sample and is used to assess the repeatability of the laboratory analytical results. Analytical results for the replicate water samples were in good agreement with the results of the environmental samples and within 2 percent for all constituents.

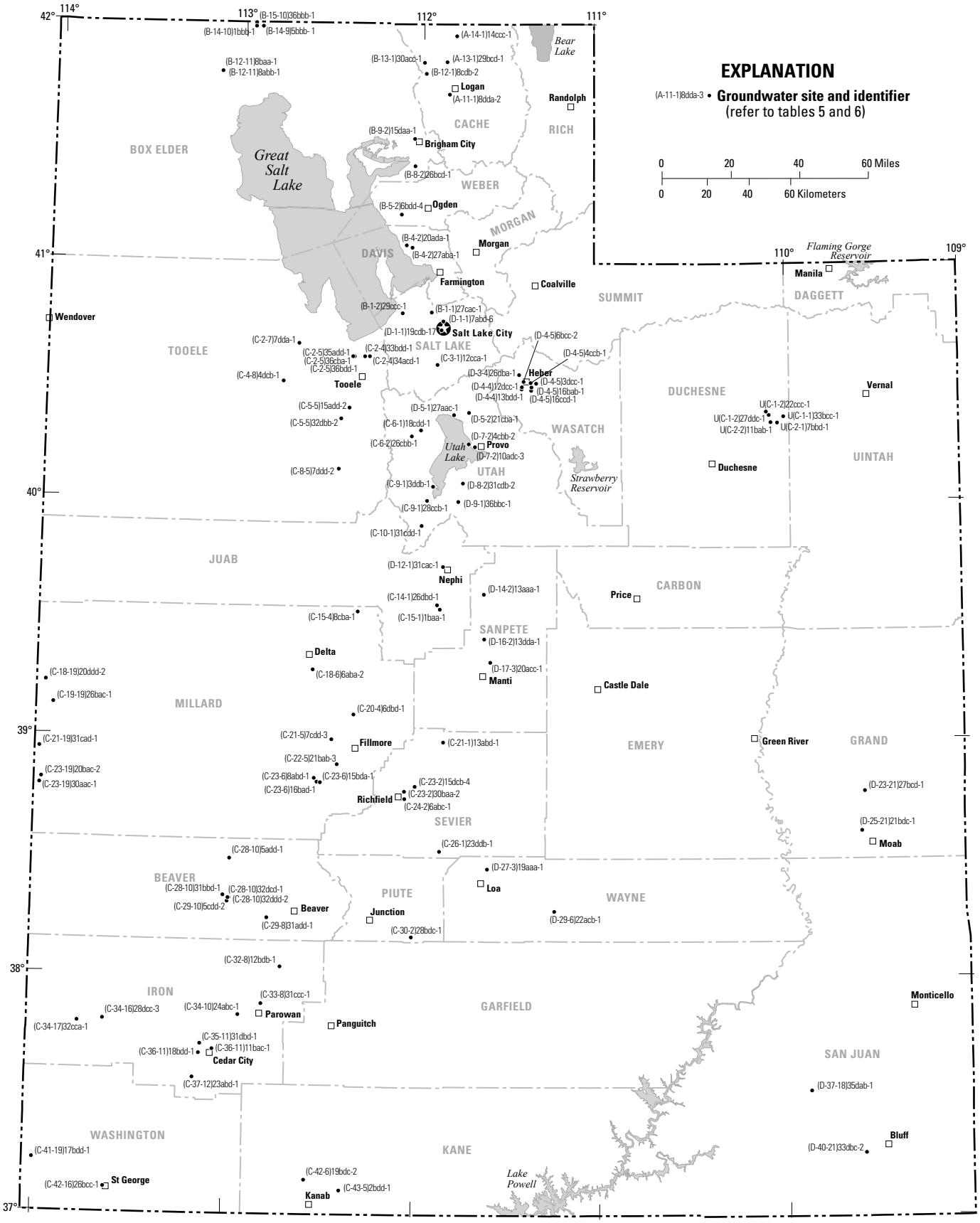



**Figure 60.** Location of groundwater sites sampled during the summer of 2014.

**Table 5.** Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2014.

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

| Local identifier (refer to figure 60) | Station number | Date (YYYYMMDD) | pH, field, in standard units | Specific conductance, field, in µS/cm at 25 °C | Water temperature, field, in °C | Hardness, water, in mg/L as $CaCO_3$ | Calcium, dissolved, in mg/L | Magnesium, dissolved, in mg/L |
|---|---|---|---|---|---|---|---|---|
| **Beaver County** | | | | | | | | |
| *Beaver Valley* | | | | | | | | |
| (C-29-8)31add-1 | 381435112471401 | 20140618 | 7.4 | 955 | 11.9 | 324 | 91.1 | 23.5 |
| *Escalante Valley, Milford area* | | | | | | | | |
| (C-28-10)5add-1 | 382924112592901 | 20140721 | 7.2 | 841 | 18.4 | 238 | 57.2 | 23.1 |
| (C-28-10)31bbd-1 | 382008113012301 | 20140721 | 7.5 | 819 | 18.3 | 326 | 90 | 24.5 |
| (C-28-10)32dcd-1 | 381927112594501 | 20140721 | 7.1 | 1,180 | 15.5 | 515 | 152 | 32.7 |
| (C-28-10)32ddd-2 | 381928112592701 | 20140721 | 7.4 | 1,590 | 14.8 | 735 | 207 | 52.7 |
| (C-29-10)5cdd-2 | 381835113000001 | 20140721 | 7.1 | 740 | 15.9 | 329 | 97.9 | 20.5 |
| **Box Elder County** | | | | | | | | |
| *Curlew Valley* | | | | | | | | |
| (B-12-11)8abb-1 | 414710113071601 | 20140616 | 6.9 | 6,190 | 13.7 | 2,100 | 597 | 149 |
| (B-12-11)8baa-1 | 414721113072601 | 20140616 | 6.8 | 2,940 | 14.1 | 661 | 182 | 50.5 |
| (B-14- 9)5bbb-1 | 415847112540401 | 20140616 | 7.1 | 1,260 | 17.1 | 406 | 118 | 27.2 |
| (B-14-10)1bbb-1 | 415845112562201 | 20140616 | 7.2 | 863 | 19.2 | 267 | 74.7 | 19.7 |
| (B-15-10)36bbb-1 | 415939112562201 | 20140616 | 7.3 | 553 | 15.8 | 188 | 55.1 | 12.2 |
| *East Shore area* | | | | | | | | |
| (B-8-2)26bcd-1 | 412405112022501 | 20140624 | 7.3 | 191 | 14.6 | 37 | 7.3 | 4.51 |
| *Lower Bear River area* | | | | | | | | |
| (B-9-2)15daa-1 | 413057112023901 | 20140624 | 8.3 | 606 | 16.6 | 8.7 | 2 | 0.91 |
| **Cache County** | | | | | | | | |
| *Cache Valley* | | | | | | | | |
| (A-11-1)8dda-2 | 414211111510902 | 20140821 | 6.7 | 549 | 10.6 | 293 | 71 | 28.1 |
| (A-13-1)29bcd-1 | 415020111520401 | 20140820 | 7.1 | 449 | 13.4 | 199 | 41.8 | 23 |
| (A-14-1)14ccc-1 | 415653111485401 | 20140820 | 6.7 | 435 | 10.8 | 301 | 75.4 | 27.4 |
| (B-12-1)8cdb-2 | 414721111590001 | 20140820 | 7.2 | 770 | 13.7 | 137 | 30.3 | 14.9 |
| (B-13-1)30acc-1 | 415008111593901 | 20140821 | 7.1 | 645 | 14.0 | 231 | 57 | 21.6 |
| **Davis County** | | | | | | | | |
| *East Shore area* | | | | | | | | |
| (B-4-2)20ada-1 | 410410112050001 | 20140623 | 7.6 | 344 | 15.3 | 143 | 38.3 | 11.4 |
| (B-4-2)27aba-1 | 410340112030001 | 20140623 | 7.9 | 598 | 14.3 | 46 | 11.7 | 4.11 |
| **Duchesne County** | | | | | | | | |
| *Duchesne River area* | | | | | | | | |
| U(C-1-1)33bcc-1 | 402114110003301 | 20140908 | 7.4 | 1,520 | 12.3 | 696 | 184 | 57.6 |
| U(C-1-2)22ccc-1 | 402227110061401 | 20140909 | 7.0 | 386 | 12.6 | 202 | 49.2 | 19.2 |
| U(C-1-2)27ddc-1 | 402135110051901 | 20140910 | 7.4 | 333 | 11.5 | 174 | 48.4 | 12.9 |
| U(C-2-1)7bbd-1 | 401940110023601 | 20140909 | 7.9 | 770 | 14.6 | 52 | 13.5 | 4.37 |
| U(C-2-2)11bab-1 | 401946110044601 | 20140908 | 7.2 | 358 | 14.5 | 176 | 44.1 | 16 |
| **Grand County** | | | | | | | | |
| *Spanish Valley* | | | | | | | | |
| (D-23-21)27bcd-1 | 384654109353601 | 20140811 | 7.9 | 526 | 20.8 | 197 | 29.7 | 29.7 |
| (D-25-21)21bdc-1 | 383655109364001 | 20140811 | 7.3 | 1,430 | 20.0 | 391 | 95.1 | 37.2 |

| Potassium, dissolved, in mg/L | Sodium, dissolved, in mg/L | ANC, fixed end point, lab, in mg/L as $CaCO_3$ | Bromide, dissolved, in mg/L | Chloride, dissolved, in mg/L | Fluoride, dissolved, in mg/L | Silica, dissolved, in mg/L | Sulfate, dissolved, in mg/L | Solids, dissolved, residue at 180 °C, in mg/L | Nitrate plus nitrite, dissolved, in mg/L as N | Orthophosphate, dissolved, in mg/L as P |
|---|---|---|---|---|---|---|---|---|---|---|
| **Beaver County** | | | | | | | | | | |
| *Beaver Valley* | | | | | | | | | | |
| 5.71 | 80.7 | 303 | 0.19 | 67.8 | 0.61 | 44.5 | 86.6 | 566 | 3.03 | 0.07 |
| *Escalante Valley, Milford area* | | | | | | | | | | |
| 2.56 | 66.8 | 107 | 0.19 | 138 | 0.27 | 24.6 | 90.7 | 492 | 0.72 | 0.011 |
| 4.93 | 33.6 | 134 | 0.23 | 111 | 0.43 | 37.3 | 99.2 | 514 | 2.6 | 0.016 |
| 5.8 | 37.7 | 233 | 0.43 | 152 | 0.28 | 36.4 | 128 | 793 | 4.82 | 0.037 |
| 6.41 | 38.5 | 132 | 0.82 | 268 | 0.25 | 36.4 | 274 | 1,160 | 4.41 | 0.027 |
| 4.46 | 26.4 | 232 | 0.17 | 52.6 | 0.27 | 34.3 | 67.2 | 469 | 2.54 | 0.048 |
| **Box Elder County** | | | | | | | | | | |
| *Curlew Valley* | | | | | | | | | | |
| 14.3 | 206 | 101 | <1.5 | 1,630 | <0.2 | 20.2 | 30.6 | 4,790 | 1.03 | 0.009 |
| 7.96 | 248 | 227 | 0.53 | 651 | <0.15 | 20.1 | 51.8 | 1,830 | 4.06 | 0.012 |
| 12 | 40.2 | 128 | 0.22 | 245 | 0.18 | 50.2 | 20.8 | 891 | 1.99 | 0.026 |
| 10.2 | 36.3 | 144 | 0.14 | 138 | 0.28 | 52.8 | 27.3 | 521 | 0.52 | 0.016 |
| 8.36 | 18.4 | 140 | 0.05 | 57.9 | 0.22 | 59.3 | 18.8 | 338 | 0.81 | 0.027 |
| *East Shore area* | | | | | | | | | | |
| 3.6 | 25.4 | 76 | <0.03 | 6.6 | 0.09 | 13.9 | 10.5 | 115 | 0.64 | 0.135 |
| *Lower Bear River area* | | | | | | | | | | |
| 1.7 | 144 | 309 | <0.03 | 13.4 | 0.67 | 15.4 | 1.16 | 403 | <0.04 | 1.39 |
| **Cache County** | | | | | | | | | | |
| *Cache Valley* | | | | | | | | | | |
| 1.65 | 9.34 | 191 | <0.03 | 12.8 | 0.1 | 9.68 | 24.7 | 241 | 0.98 | 0.014 |
| 1.69 | 26.1 | 188 | <0.03 | 8.5 | 0.09 | 10.4 | 10.9 | 215 | 0.12 | 0.01 |
| 0.9 | 5.48 | — | <0.03 | 15.6 | 0.07 | 11.7 | 4.8 | 225 | 3.75 | 0.01 |
| 7.18 | 122 | 289 | 0.06 | 55 | 2.45 | 59.9 | 38.6 | 501 | <0.04 | 0.055 |
| 9.31 | 54.9 | 309 | 0.05 | 34.4 | 0.5 | 63.8 | 1.17 | 411 | <0.04 | 0.152 |
| **Davis County** | | | | | | | | | | |
| *East Shore area* | | | | | | | | | | |
| 2.92 | 18.2 | 164 | <0.03 | 14.6 | 0.17 | 21.1 | 0.19 | 211 | <0.04 | 0.054 |
| 5.29 | 118 | 266 | 0.06 | 42.8 | 0.38 | 29.8 | 0.12 | 388 | <0.04 | 0.621 |
| **Duchesne County** | | | | | | | | | | |
| *Duchesne River area* | | | | | | | | | | |
| 3.65 | 143 | 103 | <0.06 | 0.78 | 1.15 | 7.07 | 733 | 1,270 | <0.04 | <0.004 |
| 3.64 | 10.5 | 166 | <0.03 | 1.39 | 0.44 | 8.32 | 32.3 | 200 | <0.04 | <0.004 |
| 3.43 | 4.4 | 89 | <0.03 | 0.61 | 0.51 | 8.53 | 39.1 | 191 | <0.04 | <0.004 |
| 2.45 | 181 | 236 | <0.03 | 65 | 1.84 | 8.05 | 57.5 | 444 | <0.04 | <0.004 |
| 3.68 | 11.3 | 130 | <0.03 | 1.21 | 0.57 | 9.47 | 51.2 | 210 | <0.04 | <0.004 |
| **Grand County** | | | | | | | | | | |
| *Spanish Valley* | | | | | | | | | | |
| 6.05 | 35 | 178 | 0.04 | 37.6 | 0.41 | 9.45 | 36.4 | 294 | 0.76 | <0.004 |
| 8.68 | 148 | 181 | 0.29 | 171 | 0.38 | 11.8 | 227 | 848 | 5.71 | <0.004 |

**Table 5.** Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2014.—Continued

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

| Local identifier (refer to figure 60) | Station number | Date (YYYYMMDD) | pH, field, in standard units | Specific conductance, field, in µS/cm at 25 °C | Water temperature, field, in °C | Hardness, water, in mg/L as $CaCO_3$ | Calcium, dissolved, in mg/L | Magnesium, dissolved, in mg/L |
|---|---|---|---|---|---|---|---|---|
| **Iron County** | | | | | | | | |
| *Cedar Valley* | | | | | | | | |
| (C-35-11)31dbd-1 | 374248113075201 | 20140616 | 7.3 | 1,170 | 14.4 | 664 | 132 | 81.3 |
| (C-36-11)11bac-1 | 374122113034801 | 20140616 | 7.5 | 2,240 | — | 1,400 | 310 | 153 |
| (C-36-11)18bdd-1 | 374017113080401 | 20140616 | 7.4 | 1,310 | 14.9 | 650 | 138 | 74.1 |
| (C-37-12)23abd-1 | 373409113095501 | 20140618 | 7.5 | 747 | 16.0 | 317 | 73 | 32.6 |
| *Escalante Valley, Beryl-Enterprise area* | | | | | | | | |
| (C-34-16)28dcc-3 | 374934113384601 | 20140721 | 8.0 | 772 | 13.5 | 301 | 90.7 | 18.1 |
| (C-34-17)32cca-1 | 374753113464601 | 20140721 | 7.2 | 1,010 | 19.6 | 389 | 126 | 17.8 |
| *Parowan Valley* | | | | | | | | |
| (C-32-8)12bdb-1 | 380218112424401 | 20140618 | 7.8 | 539 | 18.2 | 211 | 62.7 | 13.2 |
| (C-33-8)31ccc-1 | 375257112483501 | 20140806 | 7.6 | 516 | 14.4 | 219 | 45.4 | 25.7 |
| (C-34-10)24abc-1 | 375006112554801 | 20140616 | 7.5 | 384 | 14.6 | 143 | 28.8 | 17.3 |
| **Juab County** | | | | | | | | |
| *Juab Valley* | | | | | | | | |
| (C-14-1)26dbd-1 | 393342111534501 | 20140702 | 7.4 | 1,150 | 13.7 | 515 | 109 | 59.1 |
| (C-15-1)1baa-1 | 393236111525300 | 20140702 | 6.6 | 1,260 | 12.6 | 631 | 161 | 55.7 |
| (D-12-1)31cac-1 | 394323111515501 | 20140702 | 6.8 | 1,160 | 12.2 | 346 | 84.7 | 32.8 |
| **Kane County** | | | | | | | | |
| *Kanab area* | | | | | | | | |
| (C-42-6)19bdc-2 | 370843112340602 | 20140722 | 7.2 | 238 | 13.8 | 128 | 23.8 | 16.6 |
| (C-43-5)2bdd-1 | 370608112230001 | 20140722 | 7.3 | 714 | 12.6 | 359 | 82.3 | 37.1 |
| **Millard County** | | | | | | | | |
| *Pahvant Valley* | | | | | | | | |
| (C-20-4)6dbd-1 | 390558112202301 | 20140623 | 6.8 | 1,890 | 18.5 | 990 | 274 | 74.6 |
| (C-21-5)7cdd-3 | 385939112272303 | 20140623 | 7.4 | 1,520 | 11.8 | 539 | 118 | 59.2 |
| (C-22-5)21bab-3 | 385323112253401 | 20140623 | 7.2 | 1,180 | 14.7 | 310 | 84.8 | 23.9 |
| (C-23-6)8abd-1 | 384953112325101 | 20140623 | 6.8 | 7,920 | 15.8 | 2,160 | 536 | 199 |
| (C-23-6)15bda-1 | 384848112305101 | 20140623 | 7.2 | 2,290 | 14.6 | 662 | 163 | 62 |
| (C-23-6)16bad-1 | 384856112315701 | 20140623 | 7.5 | 6,060 | 17.1 | 1,310 | 355 | 104 |
| *Sevier Desert* | | | | | | | | |
| (C-15-4)8cba-1 | 393154112192901 | 20140709 | 6.5 | 3,360 | 13.6 | 970 | 215 | 105 |
| (C-18-6)6aba-2 | 391710112334701 | 20140709 | 8.1 | 406 | 25.6 | 37 | 8.47 | 3.91 |
| *Snake Valley* | | | | | | | | |
| (C-18-19)20ddd-2 | 391324114000001 | 20140708 | 7.4 | 323 | 22.0 | 114 | 28.3 | 10.6 |
| (C-19-19)26bac-1 | 390748113572201 | 20140708 | 7.5 | 819 | 12.7 | 321 | 77.8 | 30.9 |
| (C-21-19)31cad-1 | 385640114012401 | 20140708 | 7.5 | 521 | 12.5 | 240 | 55 | 25 |
| (C-23-19)20bac-2 | 384900114003001 | 20140708 | 7.4 | 820 | 14.1 | 254 | 38 | 38.7 |
| (C-23-19)30aac-1 | 384729114010301 | 20140708 | 7.3 | 1,620 | 12.9 | 483 | 94 | 60.4 |
| **Piute County** | | | | | | | | |
| *Upper Sevier River area* | | | | | | | | |
| (C-30-2)28bdc-1 | 381003112010301 | 20140804 | 7.6 | 417 | 17.6 | 182 | 44.7 | 17.2 |

| Potassium, dissolved, in mg/L | Sodium, dissolved, in mg/L | ANC, fixed end point, lab, in mg/L as $CaCO_3$ | Bromide, dissolved, in mg/L | Chloride, dissolved, in mg/L | Fluoride, dissolved, in mg/L | Silica, dissolved, in mg/L | Sulfate, dissolved, in mg/L | Solids, dissolved, residue at 180 °C, in mg/L | Nitrate plus nitrite, dissolved, in mg/L as N | Orthophosphate, dissolved, in mg/L as P |
|---|---|---|---|---|---|---|---|---|---|---|
| **Iron County** | | | | | | | | | | |
| *Cedar Valley* | | | | | | | | | | |
| 2.47 | 11.6 | 128 | <0.06 | 14.8 | 0.24 | 19.2 | 491 | 1,010 | 2.72 | 0.009 |
| 4.23 | 35.4 | 216 | <0.15 | 34.2 | 0.22 | 20.4 | 981 | 2,080 | 7.26 | 0.009 |
| 3.53 | 45.1 | 158 | 0.17 | 50 | 0.28 | 32.5 | 482 | 1,040 | 3.87 | 0.015 |
| 1.45 | 35.2 | 170 | 0.25 | 45.7 | 0.1 | 18.7 | 152 | 532 | 2.77 | 0.018 |
| *Escalante Valley, Beryl-Enterprise area* | | | | | | | | | | |
| 8.34 | 34.8 | 129 | 0.48 | 128 | 1.15 | 65.2 | 61.1 | 582 | 1.16 | 0.025 |
| 11 | 49 | 133 | 0.48 | 157 | 0.48 | 68.8 | 119 | 801 | 5.77 | 0.022 |
| *Parowan Valley* | | | | | | | | | | |
| 6.41 | 17.7 | 116 | 0.29 | 63.8 | 0.21 | 53.4 | 47 | 397 | 2.15 | 0.024 |
| 2.73 | 21.6 | 185 | 0.07 | 26.7 | 0.17 | 28.1 | 23.9 | 284 | 1.98 | 0.027 |
| 4.26 | 22.1 | 154 | 0.04 | 16.2 | 0.38 | 40.9 | 22.6 | 253 | 0.57 | 0.021 |
| **Juab County** | | | | | | | | | | |
| *Juab Valley* | | | | | | | | | | |
| 3.19 | 60.4 | 207 | 0.06 | 59.9 | 0.25 | 18.1 | 323 | 734 | 1.92 | 0.019 |
| 2.01 | 44.6 | 165 | 0.05 | 62.1 | 0.19 | 12.4 | 369 | 815 | 2.01 | 0.008 |
| 4.21 | 108 | 213 | 0.08 | 177 | 0.17 | 28.3 | 75.1 | 696 | 2.81 | 0.034 |
| **Kane County** | | | | | | | | | | |
| *Kanab area* | | | | | | | | | | |
| 2.12 | 3.54 | 122 | 0.04 | 4 | 0.07 | 13.9 | 4.45 | 159 | 2.27 | 0.015 |
| 2.72 | 21.2 | 191 | 0.08 | 7.53 | 0.14 | 11.5 | 176 | 478 | 5.21 | 0.026 |
| **Millard County** | | | | | | | | | | |
| *Pahvant Valley* | | | | | | | | | | |
| 5.57 | 54.9 | 227 | 0.27 | 158 | 0.66 | 16.3 | 653 | 1,490 | 2.5 | 0.009 |
| 4.86 | 120 | 310 | 0.27 | 177 | 0.17 | 24.2 | 252 | 989 | 5.9 | 0.022 |
| 12.9 | 112 | 228 | 0.25 | 190 | 1.08 | 12.9 | 79.8 | 634 | 0.78 | 0.009 |
| 78.9 | 896 | 329 | 2.34 | 1,680 | 1.07 | 37.6 | 1,090 | 5,490 | 1.93 | 0.047 |
| 22.9 | 208 | 222 | 0.7 | 459 | 0.4 | 29.2 | 236 | 1,480 | 4.13 | 0.022 |
| 72.9 | 646 | 346 | 1.6 | 1,160 | 1.0 | 36 | 695 | 3,710 | 2.44 | 0.041 |
| *Sevier Desert* | | | | | | | | | | |
| 8.21 | 362 | 406 | <0.15 | 574 | 0.2 | 26.6 | 538 | 2,140 | 0.40 | 0.024 |
| 1.57 | 72.5 | 140 | 0.04 | 31.9 | 0.59 | 26.3 | 21.1 | 256 | <0.04 | 0.015 |
| *Snake Valley* | | | | | | | | | | |
| 1.72 | 21.3 | 134 | 0.04 | 18.8 | 0.11 | 13.1 | 9.61 | 186 | 0.18 | 0.006 |
| 3.42 | 43.4 | 204 | 0.15 | 72.9 | 0.26 | 23.4 | 76.8 | 472 | 1.22 | 0.016 |
| 1.49 | 14.2 | 203 | <0.03 | 17.5 | 0.08 | 15.5 | 14.1 | 254 | 1.73 | 0.008 |
| 3.76 | 71.5 | 297 | <0.06 | 55.4 | 1.21 | 47.1 | 61.8 | 503 | 0.88 | 0.051 |
| 5.2 | 159 | 269 | <0.06 | 174 | 0.69 | 40.8 | 291 | 1,050 | 1.52 | 0.032 |
| **Piute County** | | | | | | | | | | |
| *Upper Sevier River area* | | | | | | | | | | |
| 4.79 | 16.4 | 189 | 0.06 | 10.3 | 0.28 | 33.3 | 16.4 | 256 | 0.24 | 0.035 |

**Table 5.** Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2014.—Continued

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

| Local identifier (refer to figure 60) | Station number | Date (YYYYMMDD) | pH, field, in standard units | Specific conductance, field, in µS/cm at 25 °C | Water temperature, field, in °C | Hardness, water, in mg/L as $CaCO_3$ | Calcium, dissolved, in mg/L | Magnesium, dissolved, in mg/L |
|---|---|---|---|---|---|---|---|---|
| **Salt Lake County** | | | | | | | | |
| *Salt Lake Valley* | | | | | | | | |
| (B-1-1)27cac-1 | 404720111562701 | 20140625 | 7.5 | 962 | 13.2 | 154 | 30.9 | 18.7 |
| (B-1-2)29ccc-1 | 404704112060401 | 20140625 | 8.0 | 8,320 | 15.4 | 215 | 31.3 | 33.3 |
| (C-3-1)12cca-1 | 403410111542501 | 20140625 | 7.3 | 929 | 19.7 | 281 | 61.3 | 30.9 |
| (D-1-1)7abd-6 | 404506111523301 | 20140625 | 7.1 | 1,370 | 14.3 | 606 | 148 | 57.7 |
| (D-1-1)19cdb-17 | 404253111530901 | 20140625 | 7.0 | 1,140 | 14.2 | 515 | 136 | 42.8 |
| **San Juan County** | | | | | | | | |
| *Blanding-Bluff area* | | | | | | | | |
| (D-37-18)35dab-1 | 373130109534501 | 20140903 | 7.3 | 1,060 | 12.5 | 511 | 92.1 | 68.3 |
| (D-40-21)33dbc-2 | 371545109364402 | 20140903 | 8.0 | 416 | 17.3 | 9 | 2.38 | 0.73 |
| **Sanpete County** | | | | | | | | |
| *Sanpete Valley* | | | | | | | | |
| (D-14-2)13aaa-1 | 393630111383301 | 20140829 | 7.7 | 487 | 12.5 | 248 | 63.3 | 21.9 |
| (D-16-2)13dda-1 | 392511111382001 | 20140829 | 7.5 | 1,120 | 14.0 | 380 | 64.6 | 53 |
| (D-17-3)20acc-1 | 391920111361901 | 20140829 | 7.7 | 732 | 15.0 | 364 | 62.8 | 50.3 |
| **Sevier County** | | | | | | | | |
| *Central Sevier Valley* | | | | | | | | |
| (C-21-1)13abd-1 | 385910111512101 | 20140805 | 7.8 | 763 | 17.8 | 150 | 31.5 | 17.4 |
| (C-23-2)15dcb-4 | 384757112002201 | 20140805 | 7.3 | 660 | 11.6 | 312 | 63.8 | 37.1 |
| (C-23-2)30baa-2 | 384641112034601 | 20140805 | 6.9 | 915 | 14.3 | 460 | 93.4 | 55.1 |
| (C-24-2)6abc-1 | 384450112034001 | 20140805 | 7.1 | 1,170 | 12.3 | 616 | 152 | 57.7 |
| *Upper Sevier River area* | | | | | | | | |
| (C-26-1)23ddb-1 | 383140111522001 | 20140804 | 7.6 | 225 | 12.8 | 88 | 28.5 | 4.19 |
| **Tooele County** | | | | | | | | |
| *Rush Valley* | | | | | | | | |
| (C-5-5)15add-2 | 402310112231002 | 20140604 | 7.1 | 565 | 11.7 | 265 | 56.8 | 29.9 |
| (C-5-5)32dbb-2 | 402024112254601 | 20140604 | 6.9 | 1,220 | 10.0 | 452 | 130 | 31 |
| (C-8-5)7ddd-2 | 400745112263101 | 20140604 | 7.5 | 542 | 16.7 | 202 | 37 | 26.6 |
| *Skull Valley* | | | | | | | | |
| (C-2-7)7dda-1 | 403914112400301 | 20140605 | 7.5 | 5,460 | 18.0 | 475 | 101 | 54 |
| (C-4-8)4dcb-1 | 402942112450001 | 20140605 | 8.8 | 3,140 | 17.9 | 94 | 30.2 | 4.54 |
| *Tooele Valley* | | | | | | | | |
| (C-2-4)33bdd-1 | 403629112174801 | 20140603 | 7.3 | 1,060 | 14.1 | 300 | 76.4 | 26.4 |
| (C-2-4)34acd-1 | 403609112164201 | 20140603 | 7.2 | 877 | 14.0 | 341 | 75.4 | 37 |
| (C-2-5)35add-1 | 403606112221201 | 20140603 | 7.2 | 1,590 | 18.5 | 373 | 92 | 34.8 |
| (C-2-5)36bdd-1 | 403605112214201 | 20140605 | 7.3 | 1,640 | 17.9 | 285 | 72.3 | 25.4 |
| (C-2-5)36cba-1 | 403603112215801 | 20140603 | 7.2 | 1,810 | 19.9 | 313 | 77.7 | 28.8 |

| Potassium, dissolved, in mg/L | Sodium, dissolved, in mg/L | ANC, fixed end point, lab, in mg/L as $CaCO_3$ | Bromide, dissolved, in mg/L | Chloride, dissolved, in mg/L | Fluoride, dissolved, in mg/L | Silica, dissolved, in mg/L | Sulfate, dissolved, in mg/L | Solids, dissolved, residue at 180 °C, in mg/L | Nitrate plus nitrite, dissolved, in mg/L as N | Orthophosphate, dissolved, in mg/L as P |
|---|---|---|---|---|---|---|---|---|---|---|
| Salt Lake County | | | | | | | | | | |
| *Salt Lake Valley* | | | | | | | | | | |
| 9.82 | 153 | 462 | 0.10 | 56.5 | 0.5 | 27.9 | 0.09 | 580 | <0.04 | 0.244 |
| 20.6 | 1,560 | 321 | <1.5 | 2,320 | 1.75 | 18.8 | 180 | 4,750 | <0.04 | 0.183 |
| 8.16 | 77.6 | 180 | 0.11 | 125 | 0.24 | 31.8 | 116 | 568 | 0.24 | 0.017 |
| 2.98 | 59.8 | 290 | 0.10 | 193 | 0.18 | 18.6 | 172 | 805 | 4.68 | 0.04 |
| 3.86 | 46.4 | 255 | 0.07 | 106 | 0.26 | 16.2 | 218 | 714 | 2.98 | 0.016 |
| San Juan County | | | | | | | | | | |
| *Blanding-Bluff area* | | | | | | | | | | |
| 7.86 | 42.6 | 232 | 0.17 | 23.2 | 0.25 | 6.28 | 249 | 635 | <0.04 | <0.004 |
| 1.08 | 108 | 212 | <0.03 | 3.01 | 0.12 | 9.68 | 31 | 279 | <0.04 | 0.006 |
| Sanpete County | | | | | | | | | | |
| *Sanpete Valley* | | | | | | | | | | |
| 1.01 | 11 | 190 | 0.03 | 11.6 | 0.08 | 14.6 | 11.1 | 226 | 2.69 | 0.018 |
| 3.69 | 101 | 215 | 0.11 | 145 | 0.45 | 22.4 | 139 | 667 | <0.04 | 0.012 |
| 1.48 | 23.3 | 262 | 0.04 | 14.4 | 0.27 | 14.4 | 69.5 | 419 | 2.59 | 0.008 |
| Sevier County | | | | | | | | | | |
| *Central Sevier Valley* | | | | | | | | | | |
| 4.29 | 92.2 | 114 | 0.08 | 110 | 0.58 | 39.5 | 91.7 | 462 | 0.28 | 0.017 |
| 3.19 | 19.4 | 250 | 0.07 | 26.7 | 0.39 | 33.7 | 47.2 | 348 | 1.04 | 0.041 |
| 1.84 | 31.3 | 381 | 0.07 | 14.6 | 0.17 | 15.6 | 31.9 | 413 | 3.62 | 0.024 |
| 3.92 | 40.3 | 284 | 0.08 | 20 | 0.16 | 31.7 | 352 | 800 | 2.51 | 0.029 |
| *Upper Sevier River area* | | | | | | | | | | |
| 2.96 | 9.71 | 84 | 0.05 | 13.4 | 0.22 | 42.2 | 4.81 | 158 | 0.45 | 0.018 |
| Tooele County | | | | | | | | | | |
| *Rush Valley* | | | | | | | | | | |
| 1.17 | 15.4 | 195 | 0.06 | 50.7 | 0.15 | 11.3 | 21.5 | 292 | 1.49 | 0.004 |
| 1.32 | 87.2 | 256 | 0.16 | 186 | 0.24 | 17.2 | 53.5 | 546 | 1.77 | 0.013 |
| 2.45 | 34.9 | 155 | 0.06 | 66.3 | 0.66 | 13.1 | 25.4 | 312 | 0.04 | 0.007 |
| *Skull Valley* | | | | | | | | | | |
| 33.8 | 845 | 147 | <1.5 | 1,580 | 0.22 | 21.9 | 115 | 3,140 | 2.92 | 0.009 |
| 24.7 | 528 | 96 | 0.54 | 825 | 0.1 | 8.97 | 56.7 | 1,690 | 0.84 | 0.106 |
| *Tooele Valley* | | | | | | | | | | |
| 2.1 | 120 | 217 | 0.12 | 152 | 0.12 | 12.4 | 112 | 594 | 1.83 | 0.023 |
| 1.46 | 65.6 | 233 | 0.07 | 49.7 | 0.06 | 12.6 | 152 | 520 | 2.8 | 0.021 |
| 3.41 | 258 | 188 | 0.33 | 505 | 0.16 | 17.5 | 33.2 | 1,170 | 2.37 | 0.009 |
| 2.95 | 204 | 212 | 0.24 | 366 | 0.18 | 15.6 | 53.2 | 895 | 3.76 | 0.014 |
| 3.28 | 239 | 187 | 0.28 | 421 | 0.16 | 16.6 | 33 | 991 | 3.06 | 0.013 |

**Table 5.** Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2014.—Continued

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

| Local identifier (refer to figure 60) | Station number | Date (YYYYMMDD) | pH, field, in standard units | Specific conductance, field, in µS/cm at 25 °C | Water temperature, field, in °C | Hardness, water, in mg/L as $CaCO_3$ | Calcium, dissolved, in mg/L | Magnesium, dissolved, in mg/L |
|---|---|---|---|---|---|---|---|---|
| **Utah County** | | | | | | | | |
| *Cedar Valley* | | | | | | | | |
| (C-6-1)18cdd-1 | 401730111594501 | 20140618 | 7.2 | 1,500 | 29.7 | 281 | 68.6 | 26.6 |
| (C-6-2)26cbb-1 | 401607112023401 | 20140618 | 7.3 | 1,710 | 11.0 | 375 | 62.6 | 53 |
| *Goshen Valley* | | | | | | | | |
| (C-9-1)3ddb-1 | 400325111552501 | 20140701 | 7.0 | 1,570 | 14.0 | 321 | 81.6 | 28.4 |
| (C-9-1)28ccb-1 | 395956111572101 | 20140701 | 7.1 | 2,320 | 17.5 | 754 | 197 | 63.6 |
| (C-10-1)31cdd-1 | 395340111590001 | 20140701 | 7.1 | 917 | 19.2 | 370 | 93.7 | 33 |
| *Northern Utah Valley* | | | | | | | | |
| (D-5-1)27aac-1 | 402133111484601 | 20140715 | 7.1 | 678 | 11.5 | 327 | 77.2 | 32.5 |
| (D-5-2)21cba-1 | 402215111434701 | 20140716 | 7.1 | 754 | 13.2 | 393 | 89 | 41.4 |
| *Southern Utah Valley* | | | | | | | | |
| (D-7-2)4cbb-2 | 401414111435301 | 20140715 | 7.4 | 537 | 12.8 | 259 | 65.2 | 23.3 |
| (D-7-2)10adc-3 | 401332111414401 | 20140715 | 7.3 | 561 | 13.2 | 266 | 63.5 | 26.1 |
| (D-8-2)31cdb-2 | 400423111454001 | 20140715 | 6.9 | 3,420 | 23.9 | 329 | 83.2 | 29.5 |
| (D-9-1)36bbc-1 | 395942111470801 | 20140716 | 7.2 | 557 | 11.2 | 296 | 76.8 | 25.3 |
| **Wasatch County** | | | | | | | | |
| *Heber Valley* | | | | | | | | |
| (D-3-4)26dba-1 | 403146111272701 | 20140805 | 6.8 | 846 | 13.0 | 396 | 120 | 23.6 |
| (D-4-4)12dcc-1 | 402842111263101 | 20140806 | 6.6 | 750 | 11.9 | 344 | 97 | 24.8 |
| (D-4-4)13bdd-1 | 402810111263601 | 20140805 | 7.2 | 508 | 20.2 | 239 | 56.9 | 23.4 |
| (D-4-5)3dcc-1 | 402937111214901 | 20140806 | 6.5 | 536 | 11.3 | 251 | 82.9 | 10.8 |
| (D-4-5)4ccb-1 | 402946111233901 | 20140806 | 6.5 | 459 | 13.7 | 224 | 71.5 | 10.9 |
| (D-4-5)6bcc-2 | 403003111255801 | 20140805 | 7.0 | 396 | 11.8 | 192 | 58.4 | 11.1 |
| (D-4-5)16bab-1 | 402840111232201 | 20140805 | 6.8 | 629 | 11.5 | 315 | 86.5 | 24 |
| (D-4-5)16ccd-1 | 402750111232701 | 20140806 | 7.2 | 464 | 12.3 | 224 | 54 | 21.6 |
| **Washington County** | | | | | | | | |
| *Central Virgin River area* | | | | | | | | |
| (C-41-19)17bdd-1 | 371315113594901 | 20140903 | 7.1 | 626 | 15.8 | 286 | 81.7 | 20 |
| (C-42-16)26bcc-1 | 370617113371101 | 20140903 | 7.0 | 5,970 | 17.7 | 2,340 | 519 | 254 |
| **Wayne County** | | | | | | | | |
| *Upper Fremont River Valley* | | | | | | | | |
| (D-29-6)22acb-1 | 381644111152501 | 20140820 | 7.3 | 1,030 | 12.3 | 538 | 159 | 34.4 |
| *Upper Sevier River Valley* | | | | | | | | |
| (D-27-3)19aaa-1 | 382717111365601 | 20140804 | 6.9 | 1,090 | 10.8 | 578 | 175 | 34.6 |
| **Weber County** | | | | | | | | |
| *East Shore area* | | | | | | | | |
| (B-5-2)6bdd-4 | 411153112064601 | 20140623 | 7.8 | 430 | 15.6 | 148 | 36.2 | 14.1 |

| Potassium, dissolved, in mg/L | Sodium, dissolved, in mg/L | ANC, fixed end point, lab, in mg/L as $CaCO_3$ | Bromide, dissolved, in mg/L | Chloride, dissolved, in mg/L | Fluoride, dissolved, in mg/L | Silica, dissolved, in mg/L | Sulfate, dissolved, in mg/L | Solids, dissolved, residue at 180 °C, in mg/L | Nitrate plus nitrite, dissolved, in mg/L as N | Orthophosphate, dissolved, in mg/L as P |
|---|---|---|---|---|---|---|---|---|---|---|
| **Utah County** | | | | | | | | | | |
| *Cedar Valley* | | | | | | | | | | |
| 3.28 | 37.6 | 182 | 0.09 | 73 | 0.58 | 18.8 | 67 | 396 | 1.07 | 0.006 |
| 3.56 | 22.2 | 186 | 0.16 | 140 | 0.32 | 51.3 | 32.5 | 505 | 0.26 | 0.028 |
| *Goshen Valley* | | | | | | | | | | |
| 11.7 | 171 | 156 | 0.29 | 355 | 0.45 | 62.3 | 104 | 960 | 0.93 | 0.027 |
| 17.4 | 141 | 105 | 0.86 | 576 | 0.21 | 59.7 | 136 | 1,970 | 25.7 | 0.024 |
| 7.16 | 31.1 | 132 | 0.23 | 133 | 0.21 | 52.4 | 84.7 | 655 | 11.6 | 0.03 |
| *Northern Utah Valley* | | | | | | | | | | |
| 1.46 | 25.2 | 225 | 0.03 | 19.8 | 0.28 | 15.5 | 107 | 385 | 2.33 | 0.013 |
| 1.13 | 24 | 231 | 0.05 | 28.8 | 0.23 | 11.5 | 134 | 430 | 2.68 | 0.005 |
| *Southern Utah Valley* | | | | | | | | | | |
| 2.71 | 16.1 | 227 | 0.03 | 12.8 | 0.23 | 19.6 | 46.3 | 270 | <0.04 | 0.021 |
| 2.36 | 17.7 | 232 | 0.04 | 17.8 | 0.25 | 20.2 | 51.7 | 277 | <0.04 | 0.028 |
| 34.4 | 540 | 463 | 0.42 | 708 | 1.71 | 48.1 | 158 | 1,890 | <0.04 | 0.015 |
| 1.48 | 8.69 | 220 | <0.03 | 21.4 | 0.22 | 16.3 | 21.6 | 248 | 2.92 | 0.01 |
| **Wasatch County** | | | | | | | | | | |
| *Heber Valley* | | | | | | | | | | |
| 6.41 | 27.3 | 226 | 0.09 | 35.8 | 0.52 | 19.5 | 122 | 439 | 3.01 | 0.028 |
| 1.45 | 23.3 | 204 | 0.04 | 60.1 | 0.08 | 21.5 | 38.1 | 357 | 4.26 | 0.049 |
| 1.74 | 11.3 | 163 | <0.03 | 26 | 0.3 | 12.9 | 17.5 | 200 | 0.48 | 0.008 |
| 3.08 | 7.44 | 186 | <0.03 | 41.1 | 0.08 | 36.4 | 8.25 | 353 | 6.03 | 0.095 |
| 2.59 | 5.49 | 174 | <0.03 | 21.8 | 0.08 | 39.8 | 13.7 | 292 | 4.73 | 0.1 |
| 1.86 | 7.29 | 164 | <0.03 | 13.1 | 0.08 | 27.2 | 21.5 | 231 | 1.85 | 0.048 |
| 1.55 | 13.8 | 217 | 0.03 | 23.6 | 0.18 | 30.8 | 21 | 306 | 3.01 | 0.039 |
| 1.05 | 7.95 | 202 | <0.03 | 10.8 | 0.14 | 12.3 | 27.9 | 236 | 0.82 | 0.012 |
| **Washington County** | | | | | | | | | | |
| *Central Virgin River area* | | | | | | | | | | |
| 3.01 | 25.6 | 154 | 0.11 | 23.3 | 0.46 | 33.3 | 76.4 | 414 | 0.14 | 0.019 |
| 14.5 | 794 | 284 | <1.5 | 275 | 0.46 | 19 | 2,490 | 5,630 | 18.1 | 0.025 |
| **Wayne County** | | | | | | | | | | |
| *Upper Fremont River Valley* | | | | | | | | | | |
| 4.85 | 21.8 | 228 | <0.06 | 16 | 0.21 | 25.5 | 297 | 682 | 0.08 | 0.008 |
| *Upper Sevier River Valley* | | | | | | | | | | |
| 3.57 | 22.8 | 166 | <0.06 | 10.5 | 0.16 | 29.9 | 332 | 792 | 1.78 | 0.031 |
| **Weber County** | | | | | | | | | | |
| *East Shore area* | | | | | | | | | | |
| 7.23 | 32.3 | 215 | 0.03 | 16.7 | 0.22 | 25.8 | 0.13 | 260 | 0.04 | 0.154 |

**Table 6.** Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2014.

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

| Local identifier (refer to figure 60) | Station number | Date (YYYYMMDD) | Arsenic, dissolved, in µg/L | Iron, dissolved, in µg/L | Manganese, dissolved, in µg/L | Molybdenum, dissolved, in µg/L | Selenium, dissolved, in µg/L | Uranium, dissolved, in µg/L |
|---|---|---|---|---|---|---|---|---|
| **Beaver County** | | | | | | | | |
| *Beaver Valley* | | | | | | | | |
| (C-29-8)31add-1 | 381435112471401 | 20140618 | 4 | <4 | <0.2 | 2.84 | 0.9 | 21.7 |
| *Escalante Valley, Milford area* | | | | | | | | |
| (C-28-10)5add-1 | 382924112592901 | 20140721 | 1.5 | 5.5 | 0.23 | 1.02 | 1.5 | 8.72 |
| (C-28-10)31bbd-1 | 382008113012301 | 20140721 | 5 | 8 | 0.21 | 1.56 | 3.1 | 10.7 |
| (C-28-10)32dcd-1 | 381927112594501 | 20140721 | 2.3 | <4 | <0.2 | 0.75 | 1.6 | 34.2 |
| (C-28-10)32ddd-2 | 381928112592701 | 20140721 | 2.5 | 4.9 | <0.2 | 1.06 | 5.2 | 11.4 |
| (C-29-10)5cdd-2 | 381835113000001 | 20140721 | 2.2 | 7.6 | <0.2 | 0.61 | 0.6 | 24.2 |
| **Box Elder County** | | | | | | | | |
| *Curlew Valley* | | | | | | | | |
| (B-12-11)8abb-1 | 414710113071601 | 20140616 | 1.1 | 12.8 | <0.6 | 0.64 | 1 | 3.63 |
| (B-12-11)8baa-1 | 414721113072601 | 20140616 | 1.2 | <8 | <0.4 | 0.57 | 1.7 | 3.86 |
| (B-14-9)5bbb-1 | 415847112540401 | 20140616 | 2.1 | 9.8 | <0.2 | 0.88 | 2 | 1.47 |
| (B-14-10)1bbb-1 | 415845112562201 | 20140616 | 1.4 | 40.1 | 58.5 | 1.27 | 1.3 | 1.93 |
| (B-15-10)36bbb-1 | 415939112562201 | 20140616 | 2.6 | <4 | <0.2 | 0.87 | 1.2 | 1.74 |
| *East Shore area* | | | | | | | | |
| (B-8-2)26bcd-1 | 412405112022501 | 20140624 | 0.6 | 11.5 | 2.07 | 0.64 | 0.4 | 0.149 |
| *Lower Bear River area* | | | | | | | | |
| (B-9-2)15daa-1 | 413057112023901 | 20140624 | <0.1 | 367 | 11.3 | 0.42 | <0.05 | 0.349 |
| **Cache County** | | | | | | | | |
| *Cache Valley* | | | | | | | | |
| (A-11-1)8dda-2 | 414211111510902 | 20140821 | 0.23 | <4 | <0.2 | 0.40 | 0.63 | 0.869 |
| (A-13-1)29bcd-1 | 415020111520401 | 20140820 | 5.6 | 157 | 66 | 0.78 | 0.05 | 0.29 |
| (A-14-1)14ccc-1 | 415653111485401 | 20140820 | 0.19 | <4 | <0.2 | 0.13 | 0.05 | 0.506 |
| (B-12-1)8cdb-2 | 414721111590001 | 20140820 | 17.3 | 46.1 | 63.8 | 5.6 | <0.05 | 2.03 |
| (B-13-1)30acc-1 | 415008111593901 | 20140821 | <0.1 | 481 | 75.5 | 0.27 | <0.05 | <0.014 |
| **Davis County** | | | | | | | | |
| *East Shore area* | | | | | | | | |
| (B-4-2)20ada-1 | 410410112050001 | 20140623 | 0.84 | 117 | 55.8 | 2.14 | <0.05 | <0.014 |
| (B-4-2)27aba-1 | 410340112030001 | 20140623 | 19.8 | 318 | 50.7 | 0.35 | <0.05 | <0.014 |
| **Duchesne County** | | | | | | | | |
| *Duchesne River area* | | | | | | | | |
| U(C-1-1)33bcc-1 | 402114110003301 | 20140908 | 3.1 | 695 | 25.9 | 3.74 | <0.05 | 0.95 |
| U(C-1-2)22ccc-1 | 402227110061401 | 20140909 | 1.3 | 747 | 9.43 | 0.85 | <0.05 | 0.193 |
| U(C-1-2)27ddc-1 | 402135110051901 | 20140910 | 0.68 | 898 | 13.2 | 0.45 | <0.05 | 0.18 |
| U(C-2-1)7bbd-1 | 401940110023601 | 20140909 | 0.67 | 309 | 7.3 | 5.85 | <0.05 | 0.135 |
| U(C-2-2)11bab-1 | 401946110044601 | 20140908 | 0.1 | 278 | 8.42 | 0.39 | <0.05 | 0.127 |
| **Grand County** | | | | | | | | |
| *Spanish Valley* | | | | | | | | |
| (D-23-21)27bcd-1 | 384654109353601 | 20140811 | 0.17 | 5.1 | <0.2 | 1.71 | 3.1 | 2.21 |
| (D-25-21)21bdc-1 | 383655109364001 | 20140811 | <0.5 | 5.6 | <0.2 | 2.21 | 9.2 | 6.9 |

**Table 6.** Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2014.—Continued

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

| Local identifier (refer to figure 60) | Station number | Date (YYYYMMDD) | Arsenic, dissolved, in µg/L | Iron, dissolved, in µg/L | Manganese, dissolved, in µg/L | Molybdenum, dissolved, in µg/L | Selenium, dissolved, in µg/L | Uranium, dissolved, in µg/L |
|---|---|---|---|---|---|---|---|---|
| **Iron County** | | | | | | | | |
| *Cedar Valley* | | | | | | | | |
| (C-35-11)31dbd-1 | 374248113075201 | 20140616 | 0.74 | 11.3 | <0.2 | 0.49 | 1.6 | 2.98 |
| (C-36-11)11bac-1 | 374122113034801 | 20140616 | 0.53 | 15.7 | <0.4 | 0.46 | 3.9 | 6.74 |
| (C-36-11)18bdd-1 | 374017113080401 | 20140616 | 2.7 | 6.1 | <0.2 | 1.77 | 3.5 | 4.39 |
| (C-37-12)23abd-1 | 373409113095501 | 20140618 | 0.81 | 5.2 | 0.81 | 0.72 | 4.5 | 1.45 |
| *Escalante Valley, Beryl-Enterprise area* | | | | | | | | |
| (C-34-16)28dcc-3 | 374934113384601 | 20140721 | 16.4 | <4 | <0.2 | 1.65 | 1.8 | 3.1 |
| (C-34-17)32cca-1 | 374753113464601 | 20140721 | 3.3 | 5.3 | <0.2 | 0.83 | 1.7 | 4.61 |
| *Parowan Valley* | | | | | | | | |
| (C-32-8)12bdb-1 | 380218112424401 | 20140618 | 2 | <4 | <0.2 | 0.78 | 2 | 2.73 |
| (C-33-8)31ccc-1 | 375257112483501 | 20140806 | 3.6 | <4 | <0.2 | 0.45 | 1.1 | 2.01 |
| (C-34-10)24abc-1 | 375006112554801 | 20140616 | 6.6 | 8.6 | 0.55 | 1.76 | 0.44 | 2.92 |
| **Juab County** | | | | | | | | |
| *Juab Valley* | | | | | | | | |
| (C-14-1)26dbd-1 | 393342111534501 | 20140702 | 1.4 | 8.5 | <0.2 | 1.7 | 0.85 | 2.18 |
| (C-15-1)1baa-1 | 393236111525300 | 20140702 | 0.7 | <4 | <0.2 | 0.38 | 0.99 | 1.08 |
| (D-12-1)31cac-1 | 394323111515501 | 20140702 | 2.2 | <4 | <0.2 | 0.82 | 2.2 | 2.12 |
| **Kane County** | | | | | | | | |
| *Kanab area* | | | | | | | | |
| (C-42-6)19bdc-2 | 370843112340602 | 20140722 | 0.9 | <4 | <0.2 | <0.05 | 0.38 | 0.434 |
| (C-43-5)2bdd-1 | 370608112230001 | 20140722 | 0.55 | 14.1 | 7.85 | 0.16 | 3 | 4.02 |
| **Millard County** | | | | | | | | |
| *Pahvant Valley* | | | | | | | | |
| (C-20-4)6dbd-1 | 390558112202301 | 20140623 | 2.8 | 22.8 | <0.2 | 1.14 | 2.3 | 1.09 |
| (C-21-5)7cdd-3 | 385939112272303 | 20140623 | 2.2 | <4 | <0.2 | 1.54 | 3 | 3.6 |
| (C-22-5)21bab-3 | 385323112253401 | 20140623 | 0.55 | 15.3 | 0.96 | 2.21 | 0.76 | 0.46 |
| (C-23-6)8abd-1 | 384953112325101 | 20140623 | 11.4 | 25.2 | <0.8 | 2.61 | 16.2 | 11.9 |
| (C-23-6)15bda-1 | 384848112305101 | 20140623 | 3.1 | 13 | <0.4 | 0.72 | 3.6 | 1.89 |
| (C-23-6)16bad-1 | 384856112315701 | 20140623 | 8.5 | <12 | <0.6 | 0.90 | 2.8 | 2.92 |
| *Sevier Desert* | | | | | | | | |
| (C-15-4)8cba-1 | 393154112192901 | 20140709 | 3.1 | 192 | 395 | 2.84 | 0.2 | 5.76 |
| (C-18-6)6aba-2 | 391710112334701 | 20140709 | 21.3 | <4 | 3.99 | 2.03 | <0.05 | 1.59 |
| *Snake Valley* | | | | | | | | |
| (C-18-19)20ddd-2 | 391324114000001 | 20140708 | 0.99 | <4 | <0.2 | 0.45 | 0.37 | 1.34 |
| (C-19-19)26bac-1 | 390748113572201 | 20140708 | 3.4 | <4 | <0.2 | 1.7 | 4 | 7.44 |
| (C-21-19)31cad-1 | 385640114012401 | 20140708 | 0.84 | <4 | <0.2 | 0.26 | 0.32 | 2.03 |
| (C-23-19)20bac-2 | 384900114003001 | 20140708 | 20.9 | <4 | <0.2 | 14.1 | 14.6 | 6.38 |
| (C-23-19)30aac-1 | 384729114010301 | 20140708 | 7.5 | 4.6 | <0.2 | 5.06 | 21.2 | 14.5 |
| **Piute County** | | | | | | | | |
| *Upper Sevier River area* | | | | | | | | |
| (C-30-2)28bdc-1 | 381003112010301 | 20140804 | 7.1 | <4 | <0.2 | 1.26 | 0.26 | 2.87 |

**Table 6.** Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2014.—Continued

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

| Local identifier (refer to figure 60) | Station number | Date (YYYYMMDD) | Arsenic, dissolved, in µg/L | Iron, dissolved, in µg/L | Manganese, dissolved, in µg/L | Molybdenum, dissolved, in µg/L | Selenium, dissolved, in µg/L | Uranium, dissolved, in µg/L |
|---|---|---|---|---|---|---|---|---|
| **Salt Lake County** | | | | | | | | |
| *Salt Lake Valley* | | | | | | | | |
| (B-1-1)27cac-1 | 404720111562701 | 20140625 | 20.1 | 1,420 | 47.1 | 0.50 | 0.08 | <0.014 |
| (B-1-2)29ccc-1 | 404704112060401 | 20140625 | 238 | 790 | 74.8 | 21.3 | 0.35 | 0.174 |
| (C-3-1)12cca-1 | 403410111542501 | 20140625 | 3.4 | 7.2 | <0.2 | 1.47 | 1.4 | 4.71 |
| (D-1-1)7abd-6 | 404506111523301 | 20140625 | 1.1 | 9.9 | 4 | 1.19 | 1.9 | 1.75 |
| (D-1-1)19cdb-17 | 404253111530901 | 20140625 | 0.76 | 6.6 | <0.2 | 0.48 | 2 | 1.16 |
| **San Juan County** | | | | | | | | |
| *Blanding-Bluff area* | | | | | | | | |
| (D-37-18)35dab-1 | 373130109534501 | 20140903 | 1.3 | 3,960 | 26.9 | 0.62 | <0.05 | 0.05 |
| (D-40-21)33dbc-2 | 371545109364402 | 20140903 | 25.5 | <4 | 3.77 | 0.85 | <0.05 | 0.1 |
| **Sanpete County** | | | | | | | | |
| *Sanpete Valley* | | | | | | | | |
| (D-14-2)13aaa-1 | 393630111383301 | 20140829 | 0.57 | <4 | <0.2 | 0.42 | 1.1 | 0.955 |
| (D-16-2)13dda-1 | 392511111382001 | 20140829 | 0.65 | 23.4 | 50.9 | 9.7 | 0.05 | 2.53 |
| (D-17-3)20acc-1 | 391920111361901 | 20140829 | 0.53 | <4 | <0.2 | 1.16 | 1.8 | 1.99 |
| **Sevier County** | | | | | | | | |
| *Central Sevier Valley* | | | | | | | | |
| (C-21-1)13abd-1 | 385910111512101 | 20140805 | 9.7 | <4 | <0.2 | 3.47 | 0.45 | 4.25 |
| (C-23-2)15dcb-4 | 384757112002201 | 20140805 | 3.6 | <4 | <0.2 | 3.39 | 1.1 | 4.93 |
| (C-23-2)30baa-2 | 384641112034601 | 20140805 | 1.9 | <4 | <0.2 | 0.32 | 0.46 | 2.62 |
| (C-24-2)6abc-1 | 384450112034001 | 20140805 | 1.7 | <16 | 16.8 | 0.44 | 0.75 | 16.3 |
| *Upper Sevier River area* | | | | | | | | |
| (C-26-1)23ddb-1 | 383140111522001 | 20140804 | 3.3 | <4 | <0.2 | 0.42 | 0.29 | 2.47 |
| **Tooele County** | | | | | | | | |
| *Rush Valley* | | | | | | | | |
| (C-5-5)15add-2 | 402310112231002 | 20140604 | 1.3 | <4 | <0.2 | 0.73 | 1.7 | 1.77 |
| (C-5-5)32dbb-2 | 402024112254601 | 20140604 | 2.1 | 91.9 | 22.7 | 1 | 2.3 | 4.24 |
| (C-8-5)7ddd-2 | 400745112263101 | 20140604 | 16.7 | <4 | <0.2 | 2.93 | 0.09 | 1.85 |
| *Skull Valley* | | | | | | | | |
| (C-2-7)7dda-1 | 403914112400301 | 20140605 | 1.7 | 96.2 | 6.35 | 0.92 | 1.4 | 1.4 |
| (C-4-8)4dcb-1 | 402942112450001 | 20140605 | 4.9 | <8 | <0.4 | 0.22 | 0.87 | 0.279 |
| *Tooele Valley* | | | | | | | | |
| (C-2-4)33bdd-1 | 403629112174801 | 20140603 | 1.2 | <4 | <0.2 | 0.50 | 2.2 | 2.03 |
| (C-2-4)34acd-1 | 403609112164201 | 20140603 | 1.7 | <4 | <0.2 | 0.31 | 12.6 | 1.86 |
| (C-2-5)35add-1 | 403606112221201 | 20140603 | 1.1 | 55.5 | 2.22 | 0.66 | 1.2 | 1.69 |
| (C-2-5)36bdd-1 | 403605112214201 | 20140605 | 1.4 | 4.9 | <0.2 | 0.78 | 2 | 1.76 |
| (C-2-5)36cba-1 | 403603112215801 | 20140603 | 1.6 | 11 | <0.2 | 0.75 | 1.3 | 1.64 |

**Table 6.** Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2014.—Continued

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

| Local identifier (refer to figure 60) | Station number | Date (YYYYMMDD) | Arsenic, dissolved, in µg/L | Iron, dissolved, in µg/L | Manganese, dissolved, in µg/L | Molybdenum, dissolved, in µg/L | Selenium, dissolved, in µg/L | Uranium, dissolved, in µg/L |
|---|---|---|---|---|---|---|---|---|
| **Utah County** | | | | | | | | |
| *Cedar Valley* | | | | | | | | |
| (C-6-1)18cdd-1 | 401730111594501 | 20140618 | 5.1 | <4 | <0.2 | 2.43 | 1.1 | 2.03 |
| (C-6-2)26cbb-1 | 401607112023401 | 20140618 | 5.8 | 13.6 | 23.6 | 2.66 | 0.85 | 4.16 |
| *Goshen Valley* | | | | | | | | |
| (C-9-1)3ddb-1 | 400325111552501 | 20140701 | 6.7 | 5.3 | <0.2 | 2.78 | 3.5 | 5.23 |
| (C-9-1)28ccb-1 | 395956111572101 | 20140701 | 4.7 | <8 | <0.4 | 1.72 | 10.7 | 6.14 |
| (C-10-1)31cdd-1 | 395340111590001 | 20140701 | 4.1 | <4 | <0.2 | 0.87 | 3.4 | 2.57 |
| *Northern Utah Valley* | | | | | | | | |
| (D-5-1)27aac-1 | 402133111484601 | 20140715 | 1.6 | 5.3 | <0.2 | 1.35 | 4.5 | 2.98 |
| (D-5-2)21cba-1 | 402215111434701 | 20140716 | 0.19 | 8.5 | 0.21 | 1.03 | 6.1 | 4.15 |
| *Southern Utah Valley* | | | | | | | | |
| (D-7-2)4cbb-2 | 401414111435301 | 20140715 | 1.8 | 698 | 75.5 | 0.92 | <0.05 | 0.019 |
| (D-7-2)10adc-3 | 401332111414401 | 20140715 | 5.9 | 645 | 222 | 0.89 | <0.05 | 0.146 |
| (D-8-2)31cdb-2 | 400423111454001 | 20140715 | 5.8 | 6,800 | 132 | 2.15 | <0.1 | 2.19 |
| (D-9-1)36bbc-1 | 395942111470801 | 20140716 | 0.4 | 5.1 | <0.2 | 0.47 | 1.5 | 1.63 |
| **Wasatch County** | | | | | | | | |
| *Heber Valley* | | | | | | | | |
| (D-3-4)26dba-1 | 403146111272701 | 20140805 | 11.4 | <4 | <0.2 | 0.69 | 0.46 | 0.822 |
| (D-4-4)12dcc-1 | 402842111263101 | 20140806 | 1 | <4 | 0.26 | 0.15 | 0.23 | 1.58 |
| (D-4-4)13bdd-1 | 402810111263601 | 20140805 | 0.77 | 21.8 | 10.2 | 1.03 | 0.77 | 1.53 |
| (D-4-5)3dcc-1 | 402937111214901 | 20140806 | 1.2 | <4 | 0.76 | 0.07 | 0.13 | 1.36 |
| (D-4-5)4ccb-1 | 402946111233901 | 20140806 | 1.3 | 6.6 | 0.79 | 0.09 | 0.07 | 1.22 |
| (D-4-5)6bcc-2 | 403003111255801 | 20140805 | 1.1 | <4 | 0.53 | 0.18 | 0.19 | 1.15 |
| (D-4-5)16bab-1 | 402840111232201 | 20140805 | 1.9 | <4 | <0.2 | 0.45 | 0.36 | 1.85 |
| (D-4-5)16ccd-1 | 402750111232701 | 20140806 | 1.1 | <4 | 0.56 | 1.49 | 1.1 | 1.82 |
| **Washington County** | | | | | | | | |
| *Central Virgin River area* | | | | | | | | |
| (C-41-19)17bdd-1 | 371315113594901 | 20140903 | 2.3 | 53.9 | 67.9 | 1.35 | 0.34 | 2.69 |
| (C-42-16)26bcc-1 | 370617113371101 | 20140903 | 2 | 112 | 1,720 | 5.99 | 19 | 78.5 |
| **Wayne County** | | | | | | | | |
| *Upper Fremont River Valley* | | | | | | | | |
| (D-29-6)22acb-1 | 381644111152501 | 20140820 | 0.45 | 11.5 | <0.2 | 0.58 | 0.27 | 3.19 |
| *Upper Sevier River area* | | | | | | | | |
| (D-27-3)19aaa-1 | 382717111365601 | 20140804 | 1.1 | <4 | <0.2 | 0.21 | 0.56 | 11.4 |
| **Weber County** | | | | | | | | |
| *East Shore area* | | | | | | | | |
| (B-5-2)6bdd-4 | 411153112064601 | 20140623 | 11.3 | 335 | 108 | 0.42 | <0.05 | <0.014 |

# References Cited

Burden, C.B., and others, 2014, Groundwater conditions in Utah, spring of 2014: Utah Division of Water Resources Cooperative Investigations Report No. 55, 118 p.

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

Utah Department of Environmental Quality

State of Utah

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*Governor*

SPENCER J. COX
*Lieutenant Governor*

Department of
Environmental Quality

Alan Matheson
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DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
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# MEMORANDUM

TO: Water Quality Board

THROUGH: Walter L. Baker, P.E.
Leah Ann Lamb

FROM: Jeff Studenka, Storm Water Section Manager
Rhonda Thiele, MS4 Program Coordinator

DATE: January 15, 2016

SUBJECT: Request for Approval to proceed with EPA joint Consent Decree Settlement Agreement for Salt Lake County MS4 Program, UPDES Permit No. UTS000001

## PRELUDE

The Utah Water Quality Act (UCA 19-5-104 (3) (h) (i, ii)) requires that any Settlement Agreement negotiated by the Director, in excess of $25,000, must be reviewed and approved or disapproved by the Water Quality Board.

## BACKGROUND

An EPA inspection of unincorporated Salt Lake County's (County) municipal storm water program was conducted on March 5, 2012 – March 9, 2012. The inspection was prompted as part of EPA's Municipal Infrastructure National Enforcement Initiative, which is a nation-wide initiative and includes Municipal Separate Storm Sewer Systems (MS4s) as well as sanitary sewer overflows. The purpose of the inspection was to verify compliance with the County's UPDES MS4 Permit, No. UTS0000001. The County's MS4 permit is comprised of six minimum control measures which include; 1)Public Education and Outreach on Storm Water Impacts, 2) Public Involvement/Participation, 3) Illicit Discharge Detection and Elimination (IDDE), 4) Construction Site Storm Water Runoff Control, 5) Long-term Storm Water Management, and 6) Pollution Prevention and Good Housekeeping for Municipal Operations.

As a Phase I medium-sized MS4, the County is also required to develop Industrial and High Risk Runoff and Wet Weather Monitoring programs. The County is required to develop a Storm Water

Management Program (SWMP) document which describes how the permit requirements will be addressed including measurable goals, interim milestones and frequency of actions.

The EPA inspection consisted of an opening conference outlining the inspection process, a records review, interviews with personnel and a tour/field visit of municipal areas, industrial facilities, monitoring locations, and construction sites. The County's MS4 permit was also reviewed by the EPA as part of the Municipal Infrastructure National Enforcement Initiative to support permit reissuance. Although this was not officially a "joint inspection" with DWQ & EPA, DWQ personnel were present at all times and did actively participate in reviewing files and documenting other observations, including an illicit discharge scenario as described below, during specific field inspections.

EPA completed and submitted their inspection report on June 19, 2012. The report consists of corrective actions and recommendations to address EPA's inspection findings. DWQ also previously conducted an inspection of the County's MS4 program in August 2007. EPA found many repeat findings in which the County failed to address deficiencies noted by DWQ's 2007 inspection report. One of the most significant repeat findings was the failure to conduct training on storm water best management practices for preventing and reducing polluted runoff from municipal operations.

Other deficiencies as observed included:

- Lack of training and clear procedures for coordination and identification of organizations and/or employees responsible for implementation of the SWMP was observed in multiple areas of the MS4 program.
- An illicit discharge was discovered during the EPA's inspection of the County's Parks and Recreation Maintenance Facility. The facility was using a storm drain inlet for the discharge of non-storm water related to equipment and vehicle washing as well as for oil and fuel disposal. This storm drain ultimately discharged to Millcreek. Other violations included the County's failure to implement the SWMP plan as it is written, in particular, the scheduled inspections and other activities for the Construction Site Runoff Control program and Industrial and High Risk Runoff Program.
- The County has also failed to operate and maintain each of its five wet weather monitoring stations, take appropriate enforcement procedures or actions against entities responsible for illicit discharges to the MS4, develop a land use master plan and comprehensive master planning process to address storm water runoff from new development and redevelopment, and develop and implement a plan for ensuring, post-construction, the continued maintenance of storm water system controls at new developments and redevelopments.

Upon receiving the EPA inspection report, Salt Lake County provided their formal responses to EPA and DWQ on September 5, 2012 and subsequent information was then exchanged and

reviewed over the next two years leading up to EPA enlisting the U.S. Department of Justice (DOJ) to lead an enforcement action, with DWQ as a joint party, against the County. The DOJ conducted a settlement discussion meeting with the County on March 11, 2015 at the County offices, with EPA, DWQ and the Utah Attorney General Office (AG) present as well. Over the next several months, the DOJ and EPA worked up a draft Consent Decree Settlement Agreement (SA) and negotiated with the County on all final terms and conditions. DWQ and AG offices reviewed and ultimately concurred with the final terms of the SA, which was signed by the County in early December 2015.

Included in the attached SA is; Compliance Requirements, Civil Penalty, Reporting Requirements, Stipulated Penalties for future non-compliance, as well as other general provisions and conditions.

The terms of the financial settlement in the SA are as follows:

| | |
|---|---|
| Monetary Penalty to be paid to EPA | $140,000 |
| Monetary Penalty to be paid to DWQ | $140,000 |
| Optional Mitigation Projects (may offset a portion of payment to DWQ) | TBD |
| **Total Settlement** | **$280,000** |

CONCLUSION

The public comment period for the proposed SA ran from December 23, 2015 through January 22, 2016. At the time of this memo, no comments have been received. Any comments received will be addressed separately as appropriate.

It is the Division of Water Quality's recommendation to approve this settlement and proceed with EPA/DOJ to finalize as appropriate.

Attachment: EPA Joint Consent Decree Settlement Agreement (DWQ-2015-014350)

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF UTAH

| | | |
|---|---|---|
| UNITED STATES OF AMERICA, and THE STATE OF UTAH, | ) | |
| Plaintiffs, | ) | |
| | ) | Civil Action No. |
| v. | ) | |
| | ) | CONSENT DECREE |
| SALT LAKE COUNTY, UTAH, | ) | |
| Defendant. | ) | |

TABLE OF CONTENTS

I. JURISDICTION AND VENUE ..... 1

II. APPLICABILITY ..... 2

III. OBJECTIVES ..... 3

IV. DEFINITIONS ..... 3

V. COMPLIANCE REQUIREMENTS ..... 6

VI. CIVIL PENALTY ..... 14

VII. REPORTING REQUIREMENTS ..... 16

VIII. STIPULATED PENALTIES ..... 18

IX. FORCE MAJEURE ..... 24

X. DISPUTE RESOLUTION ..... 26

XI. INFORMATION COLLECTION AND RETENTION ..... 29

XII. EFFECT OF SETTLEMENT/RESERVATION OF RIGHTS ..... 31

XIII. COSTS ..... 33

XIV. NOTICES ..... 33

XV. EFFECTIVE DATE ..... 35

XVI. RETENTION OF JURISDICTION ..... 35

XVII. MODIFICATION ..... 36

XVIII. TERMINATION ..... 36

XIX. PUBLIC PARTICIPATION ..... 37

XX. SIGNATORIES/SERVICE ..... 38

XXI. INTEGRATION/HEADINGS ..... 38

XXII. FINAL JUDGMENT ..... 39

The United States of America, on behalf of the United States Environmental Protection Agency ("EPA"), and the State of Utah, on behalf of the Utah Division of Water Quality ("UDWQ"), have filed a complaint in this action concurrently with this Consent Decree alleging that Defendant Salt Lake County, Utah (the "County"), violated the Clean Water Act ("Act") and Utah Code Ann. §§ 19-5-107 and 108.

Specifically, the Complaint alleges that the County failed to operate its municipal separate storm sewer system ("MS4") in accordance with the requirements of its National Pollutant Discharge Elimination System ("NPDES") permit.[1]

The County does not admit any liability to the United States or the State arising out of the transactions or occurrences alleged in the Complaint.

The Parties recognize, and the Court by entering this Consent Decree finds, that this Consent Decree has been negotiated by the Parties in good faith and will avoid litigation among the Parties, and that this Consent Decree is fair, reasonable, and in the public interest.

NOW, THEREFORE, before the taking of any testimony, without the adjudication or admission of any issue of fact or law except as provided in Section I, and with the consent of the Parties, IT IS HEREBY ADJUDGED, ORDERED, AND DECREED as follows:

## I. JURISDICTION AND VENUE

1. This Court has jurisdiction over the subject matter of this action, pursuant to 28 U.S.C. §§ 1331, 1345, and 1355, and Section 309(b) of the Act, 33 U.S.C. § 1319(b), and over

[1] The County's NPDES permit is referred to as an UPDES permit, or Utah Pollutant Discharge Elimination System permit, because it was issued by the Utah Department of Environmental Quality, Division of Water Quality.

the Parties. Venue lies in this District pursuant to Section 309(b) of the Act, 33 U.S.C. § 1319(b), and 28 U.S.C. §§ 1391(b) and (c) and 1395(a), because the violations alleged in the Complaint are alleged to have occurred in, and the County is located in, this judicial district. For purposes of this Decree, or any action to enforce this Decree, the County consents to the Court's jurisdiction over this Decree and any such action and over the County and consents to venue in this judicial district.

2. For purposes of this Consent Decree, the County agrees that the Complaint states claims upon which relief may be granted pursuant to Section 309(b) of the Act.

## II. APPLICABILITY

3. The obligations of this Consent Decree apply to and are binding upon the United States and the State, and upon the County and any successors, assigns, or other entities or persons otherwise bound by law.

4. The County shall provide a copy of this Consent Decree to all officers, employees, and agents whose duties might reasonably include compliance with any provision of this Decree, as well as to any contractor retained to perform work required under this Consent Decree. The County shall condition any such contract upon performance of the work in conformity with the terms of this Consent Decree.

5. In any action to enforce this Consent Decree, the County shall not raise as a defense the failure by any of its officers, directors, employees, agents, or contractors to take any actions necessary to comply with the provisions of this Consent Decree.

## III. OBJECTIVES

6. All actions taken pursuant to this Consent Decree, and any attachment thereto, shall have the objective of causing the County to achieve and maintain full compliance with the Act, applicable state law, and the terms and conditions of its MS4 Permit.

## IV. DEFINITIONS

7. Terms used in this Consent Decree that are defined in the Act or in regulations promulgated pursuant to the Act shall have the meanings assigned to them in the Act or such regulations, unless otherwise provided in this Decree. Whenever the terms set forth below are used in this Consent Decree, the following definitions shall apply:

a. "Complaint" shall mean the complaint filed by the United States and the State of Utah in this action;

b. "Consent Decree" or "Decree" shall mean this Decree;

c. "County's MS4" shall mean the entire Municipal Separate Storm Sewer System owned and operated by Defendant Salt Lake County, Utah;

d. "Date of Lodging" shall mean the date that this Consent Decree is lodged with the Clerk of the Court for the United States District Court for the District of Utah;

e. "Day" shall mean a calendar day unless expressly stated to be a business day. In computing any period of time under this Consent Decree, where the last day would fall on a Saturday, Sunday, or federal holiday, the period shall run until the close of business of the next business day;

f. "Defendant" shall mean Salt Lake County, Utah (the "County");

g. "EPA" shall mean the United States Environmental Protection Agency and any of its successor departments or agencies;

h. "Effective Date" shall have the definition provided in Section XV;

i. "Full-Time Equivalent" and "FTE" shall mean the total number of hours worked in a week (part time, full time, and contracted) divided by 40 hours. The result is the number of equivalent employees working full-time, where one FTE is equivalent to one employee working full-time. For example: if three employees worked 50 hours, 40 hours, and 10 hours per week respectively – totaling 100 hours – the Full-Time Equivalent calculation would be 100 hours divided by 40 hours, or 2.5 FTE;

j. "Inspection" shall mean a visit by a qualified inspector to a facility or site, including direct observations of facility operations and/or conditions, that is adequate in scope and thoroughness to determine whether the facility or site is in compliance with relevant obligations. The term "Inspection," when used in connection with the Industrial and High Risk Runoff requirements, shall mean an inspection meeting the requirements of Part 4.3.4.2 of the MS4 Permit. "Inspect" shall mean to carry out an Inspection;

k. "Maintain," when used in connection with the staffing requirements in this Consent Decree, shall mean that the County has – either on the County payroll or under contract – the required type and number of personnel. In the event that a County employee or contractor leaves a position (whether as the result of retirement, resignation, termination, or otherwise), that this Decree requires the County to staff, the County shall return to the minimum staffing levels set by this Decree (meaning the employee or contractor has reported for duty) within 90 days of the date of the departing employee's or contractor's departure;

l. "MS4 Permit" shall mean the UPDES permit issued by UDWQ to the County authorizing discharges from the County's municipal separate storm sewer system. The current MS4 Permit is Permit No. UTS000001 with an effective date of September 5, 2013;

m. "New Development and Redevelopment Sites" shall mean construction sites disturbing one or more acres, including projects less than one acre that are part of a larger common plan of development or sale;

n. "Paragraph" shall mean a portion of this Decree identified by an Arabic numeral;

o. "Parties" shall mean the United States, the State of Utah, and the County;

p. "Priority Construction Site" shall mean a construction site that has the potential to threaten water quality when considering the following factors: soil erosion potential; site slope; project size and type; sensitivity of the receiving waterbodies; proximity to receiving waterbodies; non-storm water discharges and past record of noncompliance by operators of the construction site;

q. "Section" shall mean a portion of this Decree identified by a Roman numeral;

f. "Storm Water Management Program" and "SWMP" shall mean the County's program to manage storm water developed pursuant to Part 4.0 of the MS4 Permit;

s. "State" shall mean the State of Utah;

t. "UDWQ" shall mean the Utah Division of Water Quality and any of its successor departments or agencies;

u. "United States" shall mean the United States of America, acting on behalf of EPA.

## V. COMPLIANCE REQUIREMENTS

8. Overall Compliance. The County shall fully comply with all applicable provisions of the CWA and the Utah Water Quality Act. The County shall also fully comply with all terms and conditions of its MS4 Permit.

9. SWMP Implementation. No later than November 20, 2015, the County shall submit to EPA and UDWQ, for review and comment, a revised SWMP document (including measurable goals) that meets the requirements of the MS4 Permit and addresses EPA and UDWQ's Evaluation of the County's November 2014 SWMP (which was provided to the County on July 10, 2015). No later than April 29, 2016, the County shall fully implement the SWMP document. If the County makes any changes to the SWMP document, other than minor corrections or adjustments, the County shall submit the revised provisions to EPA for review, with a copy to the State. Changes to the SWMP document shall not be considered modifications of the Consent Decree.

10. Resources. Beginning January 1, 2016, the County shall ensure there are adequate resources for each operating year in an amount reasonably expected to be sufficient to implement all measures in the SWMP, comply with the MS4 Permit, and comply with all requirements of this Consent Decree. The County shall include in the Semi-Annual Reports required by this Decree information regarding its SWMP implementation budget.

11. Personnel. The County shall Maintain adequate personnel to implement the SWMP, comply with the MS4 Permit, and comply with the requirements of this Consent Decree. At a minimum, beginning April 1, 2016, the County shall Maintain at least nine FTE to carry out the County's responsibilities under the SWMP and the MS4 Permit. Of the nine FTE required by this Paragraph, at least one shall be charged with overall management of the County's MS4 Permit and program.

12. Training. The County shall document and ensure that all personnel with responsibilities for compliance with this Section of the Consent Decree receive necessary and appropriate training to carry out their obligations for MS4 program implementation.

13. Illicit Discharge Detection and Elimination

a. The County shall implement and enforce its Illicit Discharge Detection and Elimination ("IDDE") Program to systematically find and eliminate sources of non-storm water discharges.

b. No later than 30 days after the Effective Date, the County shall finalize standard operating procedures with other County departments, including but not limited to Parks and Recreation Operations, that contain formal procedures by which these departments will proactively employ BMPs to prevent non-storm water discharges to the MS4. The County shall ensure that County departments are following these procedures.

c. The County shall provide IDDE training, at least annually, to all field staff who, as part of their normal job responsibilities, might reasonably come into contact with or otherwise observe an illicit discharge (e.g. County facility workers, maintenance staff,

inspectors). The County shall keep current a list of all field staff subject to this sub-paragraph. The County shall provide IDDE training, at least annually, to all staff on the list. The County shall keep records documenting that all staff on the list have completed the training at least annually.

14. Construction Site Storm Water Control

a. Beginning on and after the Effective Date, the County shall implement, in a manner that meets the requirements of the MS4 Permit, the procedures in the (i) Pre-construction Storm Water Pollution Prevention Plan ("SWPPP") Review Standard Operating Procedures ("SOP") (as submitted to EPA and UDWQ on August 10, 2015 and as may thereafter be revised); and (ii) Construction Site Inspection and Enforcement SOP (including a description of the County's enforcement strategy (i.e. when and how escalating enforcement options will be used)) (as submitted to EPA and UDWQ on August 10, 2015 and as may thereafter be revised).

b. Within six months of the Effective Date, the County shall complete a review of the County's construction site database, remove any sites that should be closed out, and ensure that all procedures are followed and documented relating to the close out of a site with the State (e.g. submission of a Notice of Termination). The County shall thereafter ensure that the database is kept current and that the County's procedures for closing out construction sites are followed.

c. The County shall Inspect, at least once every month, all active construction sites disturbing one acre or more or that are part of a common plan of development or sale.

d. The County shall Inspect, at least twice per week, all active Priority Construction Sites.

e. The County shall provide training, at least annually, to all staff whose job duties are related to implementing the construction storm water program, plan review, construction site inspections, and enforcement. The County shall keep current a list of employees and contractors whose jobs relate to implementing the construction storm water program, plan review, construction site inspections, and enforcement. The County shall provide training, at least annually, to all employees on the list. The County shall keep records documenting that all employees on the list have completed the training at least annually.

15. Post-Construction Storm Water Management

a. No later than six months after the Effective Date, the County shall prepare and submit to EPA and UDWQ an inventory of all permanent (post-construction) storm water control structures at New Development and Redevelopment Sites constructed since January 1, 2001.

b. No later than six months after the Effective Date, the County shall develop and submit to EPA and UDWQ for review and comment a plan for the continued maintenance of storm water runoff controls at New Development and Redevelopment Sites. This plan shall include, at a minimum, plan review, confirmation that structures were built to specifications, inspections, enforcement, and maintenance by either the private property owner, a qualified third party, or the County in the event that a maintenance agreement cannot be obtained or is not adequately implemented. Following EPA review and comment, the County shall implement the plan in a manner that meets the requirements of the MS4 Permit.

c. No later than six months after the Effective Date, the County shall develop and enter into letters of intent ("LOI") with each County agency for the continued maintenance of County-owned storm water runoff controls. These LOIs shall require agencies to inspect and maintain storm water controls at facilities they operate and keep records of inspections and any maintenance. The LOIs shall require the agencies to provide the County with all records of inspections and maintenance activities. The County shall keep these records, and provide them to EPA and UDWQ upon request, for at least five years. The County shall meet regularly with agencies to review their compliance with the LOIs and do periodic Inspections of County-owned permanent (post-construction) storm water runoff controls to ensure that they are being properly maintained.

d. Beginning June 1, 2016, and continuing annually thereafter, the County shall certify to EPA and UDWQ that it is maintaining records of post-construction program implementation, including but not limited to LOIs, and provide to EPA and UDWQ an identification of the records it has added to its inventory during the previous 12-month period.

16. Pollution Prevention and Good Housekeeping for Municipal Operations

a. By December 31, 2015, the County shall develop and submit to EPA and UDWQ a training program for preventing or reducing polluted runoff from municipal operations. The training requirements should be based on job duties. The County shall maintain records of all training and shall develop and follow procedures for ensuring that all employees who require training receive that training, at least annually.

b. Within six months of the Effective Date, the County shall develop and implement site-specific Storm Water Pollution Prevention Plans ("SWPPP") for all high priority

County-owned facilities that include, at a minimum, maintenance procedures, good housekeeping, inspection schedules, documentation, and site maps that include the location of storm water BMPs, flow paths, storm drains, chemical storage areas, and vehicle maintenance and maintenance equipment.

17. Industrial and High Risk Runoff

a. Beginning January 1, 2016, and at least annually thereafter, the County shall update its inventory of all industrial and commercial sites as required by Part 4.3.1 of the MS4 Permit.

b. No later than three months after the Effective Date, the County shall develop and document procedures for identifying priority industrial and commercial sites based on the sites' potential to generate polluted storm water runoff to the MS4. These procedures should include consideration of industry type, activities performed at the facility, types of chemicals used at the facility and where they are stored, and any past record of non-compliance at the facility. Following these procedures, the County shall indicate on the inventory which industrial and commercial sites are "priority facilities." As part of the annual update of the inventory, the County shall reconsider which facilities are "priority facilities."

c. The County shall develop an inspection schedule that ensures that the County Inspects at least 20% of all industrial and commercial sites each calendar year and every priority facility at least at a frequency to comply with the requirements in Paragraph 17.e.

d. The County shall Inspect at least 20% of all industrial and commercial sites each calendar year to ensure that all facilities are inspected at least once during the term of the permit.

e. As long as there are no more than 40 priority facilities, the County shall Inspect each priority facility at least once a year. If there are more than 40 priority facilities, the County shall inspect each priority facility at least once every two years.

f. Beginning no later than the Effective Date, the County shall require the use of storm water BMPs and control measures at all industrial and commercial sites to minimize storm water pollution using UDWQ's industrial storm water permit as a guide. The County will impose specific requirements on owners of industrial and commercial sites as needs are identified through inspections.

18. Monitoring

a. Beginning on and after the Effective Date, the County shall operate and maintain four monitoring locations that meet the requirements of Part 5.2.2 of the MS4 Permit in order to obtain accurate and reliable data during wet weather monitoring events.

b. No later than the Effective Date, the County shall update its outfall inventory to show the location of all municipal storm sewer outfalls. The County shall thereafter ensure that this inventory is updated bi-annually.

19. Approval of Deliverables. After review of any plan, report, or other item that is required to be submitted for approval under this Consent Decree, EPA, after a reasonable opportunity for review and comment by UDWQ, shall in writing: i) approve the submission; ii) approve the submission upon specified conditions; iii) approve part of the submission and disapprove the remainder; or iv) disapprove the submission.

a. If the submission is approved pursuant to Paragraph 19.i, the County shall take all actions required by the plan, report, or other document, in accordance with the schedules

and requirements of the plan, report, or other document, as approved. If the submission is conditionally approved or approved only in part, pursuant to Paragraph 19.ii or .iii, the County shall, upon written direction from EPA, take all actions required by the approved plan, report, or other item that EPA determines are technically severable from any disapproved portions, subject to the County's right to dispute only the specified conditions or the disapproved portions, under Section X (Dispute Resolution).

b. If the submission is disapproved in whole or in part pursuant to Paragraph 19.iii or .iv, the County shall, within 30 days or such other time as the Parties agree to in writing, correct all deficiencies and resubmit the plan, report, or other item, or disapproved portion thereof, for approval, in accordance with the preceding subparagraphs. If the resubmission is approved in whole or in part, the County shall proceed in accordance with the preceding subparagraph.

20. Any stipulated penalties applicable to the original submission, as provided in Section VIII, shall accrue during the 30-day period or other specified period, but shall not be payable unless the resubmission is untimely or is disapproved in whole or in part; provided that, if the original submission was so deficient as to constitute a material breach of the County's obligations under this Decree, the stipulated penalties applicable to the original submission shall be due and payable notwithstanding any subsequent resubmission.

21. If a resubmitted plan, report, or other item, or portion thereof, is disapproved in whole or in part, EPA, after a reasonable opportunity for review and comment by UDWQ, may again require the County to correct any deficiencies, in accordance with the preceding Paragraphs, or may itself correct any deficiencies, subject to the County's right to invoke Dispute

Resolution and the right of EPA and the State to seek stipulated penalties as provided in the preceding Paragraphs.

## VI. CIVIL PENALTY

22. The County shall pay the sum of $280,000 as a civil penalty, together with interest accruing from the date on which the Consent Decree is lodged with the Court, at the rate specified in 28 U.S.C. § 1961 as of the Date of Lodging. Of the total amount, the County shall pay 50% (i.e. $140,000 plus associated interest) to the United States and 50% (i.e. $140,000 plus associated interest) to the State.

23. Within 30 days after the Effective Date, the County shall pay the civil penalty due to the United States by FedWire Electronic Funds Transfer ("EFT") to the U.S. Department of Justice in accordance with written instructions to be provided to the County, following lodging of the Consent Decree, by the Financial Litigation Unit of the U.S. Attorney's Office for the District of Utah, 185 South State Street #300, Salt Lake City, Utah 84101, (801) 524-5682. At the time of payment, the County shall send a copy of the EFT authorization form and the EFT transaction record, together with a transmittal letter, which shall state that the payment is for the civil penalty owed pursuant to the Consent Decree in United States, *et al.* v. Salt Lake County, Utah, and shall reference the civil action number and DOJ case number 90-5-1-1-10984, to the United States in accordance with Section XIV (Notices); by email to acctsreceivable.cinwd@epa.gov; and by mail to:

EPA Cincinnati Finance Office
26 Martin Luther King Drive
Cincinnati, Ohio 45268

24. Within 6 months after the Effective Date, the County shall satisfy the civil penalty due to the State of Utah in one of the following ways:

a. By check in the amount of $140,000 (plus associated interest) made payable to the State of Utah and delivered or mailed to:

Delivery:

Utah Department of Environmental Quality
Division of Water Quality
195 North 1950 West, 3rd Floor
Salt Lake City, Utah

Mail:

Utah Department of Environmental Quality
Division of Water Quality
P.O. Box 144870
Salt Lake City, Utah 84114-4870

or

b. By entering into a written agreement with the State to (i) pay a portion of the civil penalty in cash and (ii) satisfy the balance of the penalty by performing one or more mitigation projects in accordance with R317-1-8.4, Utah Administrative Code. If the County and State are unable to agree upon a mitigation project or projects, are unable to agree upon the portion of the civil penalty to be reduced, or are otherwise unable to finalize a written agreement within 6 months after the Effective Date, the County shall pay the entire civil penalty (plus associated interest) to the State in accordance with the payment instructions in Paragraph 24.a.

25. The County shall not deduct any penalties paid under this Decree pursuant to this Section or Section VIII (Stipulated Penalties) in calculating its federal, State or local income tax.

## VII. REPORTING REQUIREMENTS

26. The County shall submit the following reports:

a. After the lodging of this Consent Decree, the County shall submit to the United States and the State in accordance with the requirements of Section XIV (Notices), a periodic Semi-Annual Report within 45 days after the end of each half of the calendar year (January through June, and July through December). The Semi-Annual Report shall include the following items: the County's MS4 budget for the current fiscal year, to be included in the report due in February; the number of FTE currently maintained by the County for carrying our SWMP and MS4 Permit responsibilities, as specified in Paragraph 11; the County's annually updated inventory of industrial and commercial facilities as specified in Paragraph 17.a, showing changes made to the inventory since the previous update; the list of all field staff who satisfy the criteria in Paragraph 13.c and records documenting that all staff on the list have completed the training at least annually; records documenting that applicable staff have completed the training required by Paragraphs 14.e and 16.a; and once annually, all items required to be included in the annual report required by the MS4 Permit.

b. The report shall also include a description of any non-compliance with the requirements of this Consent Decree and an explanation of the violation's likely cause and of the remedial steps taken, or to be taken, to prevent or minimize such violation. If the County violates, or has reason to believe that it may violate, any requirement of this Consent Decree, the County shall notify the United States and the State of such violation and its likely duration, in writing, within 10 days of the day the County first becomes aware of the violation, with an explanation of the violation's likely cause and of the remedial steps taken, or to be taken, to

prevent or minimize such violation. If the cause of a violation cannot be fully explained at the time the report is due, the County shall so state in the report. The County shall investigate the cause of the violation and shall then submit an amendment to the report, including a full explanation of the cause of the violation, within 30 days of the day the County becomes aware of the cause of the violation. Nothing in this Section relieves the County of its obligation to provide the notice required by Section IX (Force Majeure).

27. The County shall post to its public website the following information and also notify EPA and UDWQ of the posting web address. The County shall post this information within 30 days following the due date for each of the requirements referenced in this Paragraph, or within 30 days following approval by EPA and UDWQ, whichever is later:

a. Finalized standard operating procedures the County has developed with other County departments, including but not limited to Parks and Recreation Operations, as required by Paragraph 13.b;

b. The construction site storm water control SOPs required by Paragraph 14.a and b.;

c. The inventory of municipal storm sewer outfalls, including location information, and all bi-annual updates to the inventory, as required by Paragraph 18.b.

28. Whenever any violation of this Consent Decree, the MS4 Permit, or any other event affecting the County's performance under this Decree, may pose an immediate threat to public health or welfare or the environment, the County shall notify EPA and the State orally or by electronic or facsimile transmission as soon as possible, but no later than 24 hours after the

County first knew of the violation or event. This procedure is in addition to the requirements set forth elsewhere in this Section.

29. All reports shall be submitted to the persons designated in Section XIV (Notices).

30. The County shall ensure that each report submitted under this Section is signed by an official of the submitting party and includes the following certification:

> I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

This certification requirement does not apply to emergency or similar notifications where compliance would be impractical.

31. The reporting requirements of this Consent Decree do not relieve the County of any reporting obligations required by the Clean Water Act or implementing regulations, or by any other federal, state, or local law, regulation, permit, or other requirement.

32. Any information provided pursuant to this Consent Decree may be used by the United States in any proceeding to enforce the provisions of this Consent Decree and as otherwise permitted by law.

## VIII. STIPULATED PENALTIES

33. The County shall be liable for stipulated penalties to the United States and the State for violations of this Consent Decree as specified below, unless excused under Section IX

(Force Majeure). A violation includes failing to perform any obligation required by the terms of this Decree, including any work plan or schedule approved under this Decree, according to all applicable requirements of this Decree and within the specified time schedules established by or approved under this Decree.

34. Late Payment of Civil Penalty

If the County fails to pay the civil penalty required to be paid under Section VI (Civil Penalty) when due, the County shall pay a stipulated penalty of $1,000 per day for each day that the payment is late.

35. Compliance Requirements.

| Consent Decree Violation | Stipulated Penalty |
|---|---|
| Failure to submit a revised SWMP document as required by Paragraph 9 | $250 per day for the first 15 days of noncompliance; $500 per day from the 16th to 30th days of noncompliance; and $1,000 per day thereafter |
| Failure to implement the SWMP document as required by Paragraph 9 | $250 per violation for the first through fifth occurrences; $500 per violation for the sixth through 10th occurrences; and $1,000 for each violation thereafter |
| Failure to maintain at least nine FTE, including at least one charged with overall management of the MS4 program, as required by Paragraph 11 | $500 per day per missing FTE for the first 15 days of noncompliance; $1,000 per day per missing FTE from the 16th to 30th days of noncompliance; and $1,500 per day per missing FTE thereafter |
| Failure to finalize SOPs with other County departments as required by Paragraph 13.b | $100 per day per missing SOP for the first 15 days of noncompliance; $200 per day per missing SOP from the 16th to 30th days of noncompliance; and $500 per day per missing SOP thereafter |
| Failure to provide annual IDDE training in | $250 per person, up to a maximum of $3,000 |

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| accordance with the requirements of Paragraph 13.c, as determined by a lack of records documenting the delivery of IDDE training | per calendar year in which the County fails to complete the requirements of Paragraph 13.c |
| Failure to implement the procedures in the Pre-Construction SWPP Review SOP and/or Construction Site Inspection and Enforcement SOP as required by Paragraph 14.a | $250 per violation for the first through fifth occurrences; $500 per violation for the sixth through 10th occurrences; and $750 for each violation thereafter |
| Failure to complete a review of the construction site database, remove any sites that should be closed out, and ensure that all procedures are followed and documented relating to the close out of a site as required by Paragraph 14.b | $250 per day for the first 15 days of noncompliance; $500 per day from the 16th to 30th days of noncompliance; and $1,000 per day thereafter |
| Failure to Inspect, at least once every month, all active construction sites disturbing one acre or more or that are part of a common plan of development or sale as required by Paragraph 14.c | $250 per missed inspection |
| Failure to Inspect, at least twice per week, all active Priority Construction Sites as required by Paragraph 14.d | $250 per missed inspection |
| Failure to provide annual training to all staff whose job duties are related to implementing the construction storm water program, plan review, construction site inspections, and enforcement as required by Paragraph 14.e, as determined by a lack of records documenting the delivery of this training | $250 per person, up to a maximum of $3,000 per calendar year in which the County fails to complete the requirements of Paragraph 14.f |
| Failure to prepare and submit an inventory of all permanent (post-construction) storm water control structures at New Development and Redevelopment Sites as required by Paragraph 15.a | $100 per day for the first 15 days of noncompliance; $200 per day from the 16th to 30th days of noncompliance; and $300 per day thereafter |
| Failure to develop and submit a plan for the continued maintenance of storm water runoff controls at New Development and | $250 per day for the first 15 days of noncompliance; $500 per day from the 16th to 30th days of noncompliance; and $1,000 per |

| | |
|---|---|
| Redevelopment Sites as required by Paragraph 15.b | day thereafter |
| Failure to develop and enter letters of intent (LOI) with each County agency for the continued maintenance of County-owned storm water runoff controls as required by Paragraph 15.c | $100 per day per missing LOI for the first 15 days of noncompliance; $200 per day per missing LOI from the 16th to 30th days of noncompliance; and $500 per day per missing LOI thereafter |
| Failure to certify maintenance of records of post-construction program implementation or failing to identify records added to inventory as required by Paragraph 15.d | $100 per day for the first 15 days of noncompliance; $200 per day from the 16th to 30th days of noncompliance; and $300 per day thereafter |
| Failure to develop and submit a training program for preventing or reducing polluted runoff from municipal operations as required by Paragraph 16.a, as determined by a lack of records documenting the delivery of this training | $250 per day for the first 15 days of noncompliance; $500 per day from the 16th to 30th days of noncompliance; and $1,000 per day thereafter |
| Failure to develop and implement site-specific SWPPPs for all County-owned facilities as required by Paragraph 16.b | $100 per day per missing SWPPP for the first 15 days of noncompliance; $200 per day per missing SWPPP from the 16th to 30th days of noncompliance; and $500 per day per missing SWPPP thereafter |
| Failure to prepare or update an inventory of all industrial and commercial sites as required by Paragraph 17.a | $100 per day for the first 15 days of noncompliance; $200 per day from the 16th to 30th days of noncompliance; and $300 per day thereafter |
| Failure to develop and document procedures for identifying priority industrial and commercial sites as required by Paragraph 17.b | $250 per day for the first 15 days of noncompliance; $500 per day from the 16th to 30th days of noncompliance; and $1,000 per day thereafter |
| Failure to inspect at least 20% of all industrial and commercial sites each calendar year as required by Paragraph 17.d | $1,000 per missed inspection |
| Failure to inspect priority facilities as required by Paragraph 17.e | $1,000 per missed inspection |

| | |
|---|---|
| Failure to require the use of storm water BMPs and control measures at all industrial and commercial sites as required by Paragraph 17.f | $500 per violation for the first through fifth occurrences; $1,000 per violation for the sixth through 10th occurrences; and $2,000 for each violation thereafter |
| Failure to operate and maintain the four monitoring locations as required by Paragraph 18.a | $250 per day per monitoring location for the first 15 days of noncompliance; $500 per day per monitoring location thereafter |
| Failure to update outfall inventory as required by Paragraph 18.b | $2,500 for the first occurrence; $5,000 each for the second and third occurrences; $10,000 for each occurrence thereafter |

36. Reporting Requirements. The following stipulated penalties shall accrue per violation per day for each violation of the reporting requirements of Section VII (Reporting Requirements):

| Penalty Per Violation Per Day | Period of Noncompliance |
|---|---|
| $250 | 1st through 14th Day |
| $1,000 | 15th through 30th Day |
| $3,000 | 31st Day and beyond |

37. Stipulated penalties under this Section shall begin to accrue on the day after performance is due or on the day a violation occurs, whichever is applicable, and shall continue to accrue until performance is satisfactorily completed or until the violation ceases. Stipulated penalties shall accrue simultaneously for separate violations of this Consent Decree.

38. The County shall pay any stipulated penalty within 30 days of receiving the United States' written demand. Stipulated penalties shall be paid 50% to the United States and 50% to the State of Utah in the manner set forth and with the confirmation notices required by

Paragraphs 23 and 24.a respectively, except that the transmittal letter shall state that the payment is for stipulated penalties and shall state for which violation(s) the penalties are being paid.

39. The United States may in the unreviewable exercise of its discretion, reduce or waive stipulated penalties otherwise due it under this Consent Decree.

40. Stipulated penalties shall continue to accrue as provided in Paragraph 37, during any Dispute Resolution, but need not be paid until the following:

a. If the dispute is resolved by agreement or by a decision of EPA that is not appealed to the Court, the County shall pay accrued penalties determined to be owing, together with interest, to the United States and the State within 30 Days of the effective date of the agreement or the receipt of EPA's decision or order.

b. If the dispute is appealed to the Court and the United States prevails in whole or in part, the County shall pay all accrued penalties determined by the Court to be owing, together with interest, within 60 days of receiving the Court's decision or order, except as provided in subparagraph c, below.

41. If any Party appeals the District Court's decision, the County shall pay all accrued penalties determined to be owing, together with interest, within 15 days of receiving the final appellate court decision.

42. If the County fails to pay stipulated penalties according to the terms of this Consent Decree, the County shall be liable for interest on such penalties, as provided for in 28 U.S.C. § 1961, accruing as of the date payment became due. Nothing in this Paragraph shall be construed to limit the United States and the State from seeking any remedy otherwise provided by law for the County's failure to pay any stipulated penalties.

43. Subject to the provisions of Section XII (Effect of Settlement/Reservation of Rights), the stipulated penalties provided for in this Consent Decree shall be in addition to any other rights, remedies, or sanctions available to the United States for the County's violation of this Consent Decree or applicable law. Where a violation of this Consent Decree is also a violation of the Clean Water Act or the MS4 Permit, the County shall be allowed a credit for any stipulated penalties paid against any statutory penalties imposed for such violation.

## IX. FORCE MAJEURE

44. "Force majeure," for purposes of this Consent Decree, means any event arising from causes beyond the control of the County, of any entity controlled by the County, or of the County's contractors that delays or prevents the performance of any obligation under this Consent Decree despite the County's best efforts to fulfill the obligation. The requirement that the County exercise "best efforts to fulfill the obligation" includes using best efforts to anticipate any potential force majeure event and best efforts to address the effects of any such event (a) as it is occurring and (b) after it has occurred to prevent or minimize any resulting delay to the greatest extent possible. "Force Majeure" does not include the County's financial inability to perform any obligation under this Consent Decree.

45. If any event occurs or has occurred that may delay the performance of any obligation under this Consent Decree, whether or not caused by a force majeure event, the County shall provide notice orally or by electronic transmission to EPA and UDWQ, within 72 hours of when the County first knew that the event might cause a delay. Within seven days thereafter, the County shall provide in writing to EPA and UDWQ an explanation and

description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or the effect of the delay; the County's rationale for attributing such delay to a force majeure event if it intends to assert such a claim; and a statement as to whether, in the opinion of the County, such event may cause or contribute to an endangerment to public health or welfare, or the environment. The County shall include with any notice all available documentation supporting the claim that the delay was attributable to a force majeure. Failure to comply with the above requirements shall preclude the County from asserting any claim of force majeure for that event for the period of time of such failure to comply, and for any additional delay caused by such failure. The County shall be deemed to know of any circumstance of which the County, any entity controlled by the County, or the County's contractors knew or should have known.

46. If EPA, after a reasonable opportunity for review and comment by UDWQ, agrees that the delay or anticipated delay is attributable to a force majeure event, the time for performance of the obligations under this Consent Decree that are affected by the force majeure event will be extended by EPA, after a reasonable opportunity for review and comment by UDWQ, for such time as is necessary to complete those obligations. An extension of the time for performance of the obligations affected by the force majeure event shall not, of itself, extend the time for performance of any other obligation. EPA will notify the County in writing of the length of the extension, if any, for performance of the obligations affected by the force majeure event.

47. If EPA, after a reasonable opportunity for review and comment by UDWQ, does not agree that the delay or anticipated delay has been or will be caused by a force majeure event, EPA will notify the County in writing of its decision.

48. If the County elects to invoke the dispute resolution procedures set forth in Section X (Dispute Resolution), it shall do so no later than 15 days after receipt of EPA's notice. In any such proceeding, the County shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a force majeure event, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that best efforts were exercised to avoid and mitigate the effects of the delay, and that the County complied with the requirements of Paragraphs 43 and 44, above. If the County carries this burden, the delay at issue shall be deemed not to be a violation by the County of the affected obligation of this Consent Decree identified to EPA and the Court.

## X. DISPUTE RESOLUTION

49. Unless otherwise expressly provided for in this Consent Decree, the dispute resolution procedures of this Section shall be the exclusive mechanism to resolve disputes arising under or with respect to this Consent Decree. The County's failure to seek resolution of a dispute under this Section shall preclude the County from raising any such issue as a defense to an action by the United States or the State to enforce any obligation of the County arising under this Decree.

50. Informal Dispute Resolution. Any dispute subject to Dispute Resolution under this Consent Decree shall first be the subject of informal negotiations. The dispute shall be

considered to have arisen when the County sends the United States and the State a written Notice of Dispute. Such Notice of Dispute shall state clearly the matter in dispute. The period of informal negotiations shall not exceed 20 days from the date the dispute arises, unless that period is modified by written agreement. If the Parties cannot resolve a dispute by informal negotiations, then the position advanced by the United States, after consultation with the State, shall be considered binding unless, within 30 days after the conclusion of the informal negotiation period, the County invokes formal dispute resolution procedures as set forth below.

51. Formal Dispute Resolution. The County shall invoke formal dispute resolution procedures, within the time period provided in the preceding Paragraph, by serving on the United States and the State a written Statement of Position regarding the matter in dispute. The Statement of Position shall include, but need not be limited to, any factual data, analysis, or opinion supporting the County's position and any supporting documentation relied upon by the County.

52. The United States, after consultation with the State, shall serve its Statement of Position within 45 days of receipt of the County's Statement of Position. The United States' Statement of Position shall include, but need not be limited to, any factual data, analysis, or opinion supporting that position and any supporting documentation relied upon by the United States. The United States' Statement of Position shall be binding on the County, unless the County files a motion for judicial review of the dispute in accordance with the following Paragraph.

53. The County may seek judicial review of the dispute by filing with the Court and serving on the United States, in accordance with Section XIV (Notices), a motion requesting

judicial resolution of the dispute. The motion must be filed within 14 days of receipt of the United States' Statement of Position pursuant to the preceding Paragraph. The motion shall contain a written statement of the County's position on the matter in dispute, including any supporting factual data, analysis, opinion, or documentation, and shall set forth the relief requested and any schedule within which the dispute must be resolved for orderly implementation of the Consent Decree.

54. The United States shall respond to the County's motion within the time period allowed by the Local Rules of this Court. The County may file a reply memorandum, to the extent permitted by the Local Rules.

55. Standard of Review

a. Disputes Concerning Matters Accorded Record Review. Except as otherwise provided in this Consent Decree, in any dispute pertaining to the adequacy or appropriateness of plans, procedures to implement plans, schedules or any other items requiring approval by EPA under this Consent Decree; the adequacy of the performance of work undertaken pursuant to this Consent Decree; and all other disputes that are accorded review on the administrative record under applicable principles of administrative law, the County shall have the burden of demonstrating, based on the administrative record, that the position of the United States is arbitrary and capricious or otherwise not in accordance with law.

b. Other Disputes. Except as otherwise provided in this Consent Decree, in any other dispute, the County shall bear the burden of demonstrating that its position complies with this Consent Decree and better furthers the objectives of the Consent Decree.

56. The invocation of dispute resolution procedures under this Section shall not, by itself, extend, postpone, or affect in any way any obligation of the County under this Consent Decree, unless and until final resolution of the dispute so provides. Stipulated penalties with respect to the disputed matter shall continue to accrue from the first day of noncompliance, but payment shall be stayed pending resolution of the dispute as provided in Paragraph 40. If the County does not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section VIII (Stipulated Penalties).

## XI. INFORMATION COLLECTION AND RETENTION

57. The United States, the State, and their representatives, including attorneys, contractors, and consultants, shall have the right of entry into any facility covered by this Consent Decree, at all reasonable times, upon presentation of credentials, to:

a. monitor the progress of activities required under this Consent Decree;

b. verify any data or information submitted to the United States or the State in accordance with the terms of this Consent Decree;

c. obtain samples and, upon request, splits of any samples taken by the County or its representatives, contractors, or consultants;

d. obtain documentary evidence, including photographs and similar data; and

e. assess the County's compliance with this Consent Decree.

58. Upon request, the County shall provide EPA, the State, or their authorized representatives splits of any samples taken by the County. Upon request, EPA and the State shall provide the County splits of any samples taken by EPA or the State.

59. Until five years after the termination of this Consent Decree, the County shall retain, and shall instruct its contractors and agents to preserve, all non-identical copies of all documents, records, or other information (including documents, records, or other information in electronic form) in its or its contractors' or agents' possession or control, or that come into its or its contractors' or agents' possession or control, and that relate in any manner to the County's performance of its obligations under this Consent Decree. This information-retention requirement shall apply regardless of any contrary corporate or institutional policies or procedures. At any time during this information-retention period, upon request by the United States or the State, the County shall provide copies of any documents, records, or other information required to be maintained under this Paragraph.

60. At the conclusion of the information-retention period provided in the preceding Paragraph, the County shall notify the United States and the State at least 90 days prior to the destruction of any documents, records, or other information subject to the requirements of the preceding Paragraph and, upon request by the United States or the State, the County shall deliver any such documents, records, or other information to EPA or the State. The County may assert that certain documents, records, or other information is privileged under the attorney-client privilege or any other privilege recognized by federal law. If the County asserts such a privilege, it shall provide the following: (1) the title of the document, record, or information; (2) the date of the document, record, or information; (3) the name and title of each author of the document, record, or information; (4) the name and title of each addressee and recipient; (5) a description of the subject of the document, record, or information; and (6) the privilege asserted by the County.

However, no documents, records, or other information created or generated pursuant to the requirements of this Consent Decree shall be withheld on grounds of privilege.

61. The County may also assert that information required to be provided under this Section is protected as Confidential Business Information ("CBI") under 40 C.F.R. Part 2. As to any information that the County seeks to protect as CBI, the County shall follow the procedures set forth in 40 C.F.R. Part 2.

62. This Consent Decree in no way limits or affects any right of entry and inspection, or any right to obtain information, held by the United States or the State pursuant to applicable federal or state laws, regulations, or permits, nor does it limit or affect any duty or obligation of the County to maintain documents, records, or other information imposed by applicable federal or state laws, regulations, or permits.

## XII. EFFECT OF SETTLEMENT/RESERVATION OF RIGHTS

63. This Consent Decree resolves the civil claims of the United States and the State for the violations alleged in the Complaint filed in this action through the date of lodging.

64. The United States and the State reserve all legal and equitable remedies available to enforce the provisions of this Consent Decree, except as expressly stated in Paragraph 62. This Consent Decree shall not be construed to limit the rights of the United States or the State to obtain penalties or injunctive relief under the Act or implementing regulations, or under other federal or state laws, regulations, or permit conditions, except as expressly specified in Paragraph 62.

65. The United States and the State further reserve all legal and equitable remedies to address any imminent and substantial endangerment to public health or welfare or the environment arising at, or posed by, the County's MS4, whether related to the violations addressed in this Consent Decree or otherwise.

66. In any subsequent administrative or judicial proceeding initiated by the United States or the State for injunctive relief, civil penalties, or other appropriate relief relating to the County's MS4, the County shall not assert, and may not maintain, any defense or claim based upon the principles of waiver, res judicata, collateral estoppel, issue preclusion, claim preclusion, claim-splitting, or other defenses based upon any contention that the claims raised by the United States or the State in the subsequent proceeding were or should have been brought in the instant case, except with respect to claims that have been specifically resolved pursuant to Paragraph 62 of this Section.

67. This Consent Decree is not a permit, or a modification of any permit, under any federal, State, or local laws or regulations. The County is responsible for achieving and maintaining complete compliance with all applicable federal, State, and local laws, regulations, and permits; and the County's compliance with this Consent Decree shall be no defense to any action commenced pursuant to any such laws, regulations, or permits, except as set forth herein. The United States and the State do not, by their consent to the entry of this Consent Decree, warrant or aver in any manner that the County's compliance with any aspect of this Consent Decree will result in compliance with provisions of the Act, 33 U.S.C. § 1251 *et seq.*, or with any other provisions of federal, State, or local laws, regulations, or permits.

68. This Consent Decree does not limit or affect the rights of the County or of the United States or the State against any third parties, not party to this Consent Decree, nor does it limit the rights of third parties, not party to this Consent Decree, against the County, except as otherwise provided by law.

69. This Consent Decree shall not be construed to create rights in, or grant any cause of action to, any third party not party to this Consent Decree.

70. Nothing in the Consent Decree limits the rights or defenses available under Section 309(e) of the CWA, 33 U.S.C. Section 1319(e).

## XIII. COSTS

71. The Parties shall bear their own costs of this action, including attorneys' fees, except that the United States and the State shall be entitled to collect the costs (including attorneys' fees) incurred in any action necessary to collect any portion of the civil penalty or any stipulated penalties due but not paid by the County.

## XIV. NOTICES

72. Unless otherwise specified in this Consent Decree, whenever notifications, submissions, or communications are required by this Consent Decree, they shall be made in writing via electronic means and addressed as follows. To proceed electronically, the County shall notify all Parties of the mechanism by which notifications, submissions, and communications will be conveyed and be made accessible to all Parties.

To the United States Department of Justice:

Chief, Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
Box 7611 Ben Franklin Station
Washington, D.C. 20044-7611
Re: DOJ No. 90-5-1-1-10984

To EPA:

Chief, NPDES Enforcement Unit
U.S. Environmental Protection Agency, Region 8
1595 Wynkoop Street, 8ENF-W-NP
Denver, Colorado 80202
Phone: (303) 312-6463
Email: campbell.gwen@epa.gov

with a copy to:

Wendy I. Silver
U.S Environmental Protection Agency, Region 8
1595 Wynkoop Street, 8ENF-L
Denver, Colorado 80202
Phone: (303) 312-6637
Email: silver.wendy@epa.gov

To the State:

Walter L. Baker, Director
Utah Division of Water Quality
195 North 1950 West
P.O. Box 144870
Salt Lake City, Utah 84114-4870

with a copy to:

Sandra K. Allen, Assistant Attorney General
Utah Attorney General's Office
195 North 1950 West, 2nd Floor
P.O. Box 140873
Salt Lake City, Utah 84114-0873

To Defendant:

Salt Lake County Mayor
2001 South State, N2-100
Salt Lake City, Utah 84190

Salt Lake County District Attorney
2001 South State, S3-600
Salt Lake City, Utah 84190

73. Any Party may, by written notice to the other Parties, change its designated notice recipient or notice address provided above.

74. Notices submitted pursuant to this Section shall be deemed submitted upon mailing, unless otherwise provided in this Consent Decree or by mutual agreement of the Parties in writing.

## XV. EFFECTIVE DATE

75. The Effective Date of this Consent Decree shall be the date upon which this Consent Decree is entered by the Court or a motion to enter the Consent Decree is granted, whichever occurs first, as recorded on the Court's docket; provided, however, that the County agrees that it shall be bound to perform duties scheduled to occur prior to the Effective Date. In the event the United States withdraws or withholds consent to this Consent Decree before entry, or the Court declines to enter the Consent Decree, then the preceding requirement to perform duties scheduled to occur before the Effective Date shall terminate.

## XVI. RETENTION OF JURISDICTION

The Court shall retain jurisdiction over this case until termination of this Consent Decree, for the purpose of resolving disputes arising under this Decree or entering orders

modifying this Decree, pursuant to Sections X (Dispute Resolution) and XVII (Modification), or effectuating or enforcing compliance with the terms of this Decree.

## XVII. MODIFICATION

76. The terms of this Consent Decree, including any attached appendices, may be modified only by a subsequent written agreement signed by all the Parties. Where the modification constitutes a material change to this Decree, it shall be effective only upon approval by the Court.

77. Any disputes concerning modification of this Decree shall be resolved pursuant to Section X (Dispute Resolution), provided, however, that, instead of the burden of proof provided by Paragraph 54, the Party seeking the modification bears the burden of demonstrating that it is entitled to the requested modification in accordance with Federal Rule of Civil Procedure 60(b).

## XVIII. TERMINATION

78. No earlier than three years after the Effective Date, if (i) the County is in compliance with the requirements of Section V (Compliance Requirements), (ii) for the 12-month period preceding the County's request for termination, the County Maintained compliance with the staffing requirements of Paragraph 11 (Personnel) and complied with the Inspection requirements of Paragraphs 14.c and 14.d (Construction Site Storm Water Control) and 17.d, and 17.e (Industrial and High Risk Runoff), and (iii) the County has paid the civil penalty and any accrued stipulated penalties as required by this Consent Decree, the County may serve upon the United States and the State a Request for Termination, stating that the County has satisfied those requirements, together with all necessary supporting documentation.

79. Following receipt by the United States and the State of the County's Request for Termination, the Parties shall confer informally concerning the Request and any disagreement that the Parties may have as to whether the County has satisfactorily complied with the requirements for termination of this Consent Decree. The period of informal discussions shall not exceed 45 days from the date of the County's Request for Termination, unless that period is extended by written agreement. If the United States, after consultation with the State, agrees that the Decree may be terminated, the Parties shall submit, for the Court's approval, a joint stipulation terminating the Decree.

80. If the United States, after consultation with the State, does not agree that the Decree may be terminated, the County may file and serve a motion seeking termination of the Consent Decree; provided, however, that the County shall not file or serve such a motion until 30 days after the conclusion of the period or informal consultation provided by Paragraph 78.

## XIX. PUBLIC PARTICIPATION

81. This Consent Decree shall be lodged with the Court for a period of not less than 30 days for public notice and comment in accordance with 28 C.F.R. § 50.7. The United States reserves the right to withdraw or withhold its consent if the comments regarding the Consent Decree disclose facts or considerations indicating that the Consent Decree is inappropriate, improper, or inadequate. This Consent Decree shall also be submitted to the Utah Water Quality Board to review and approve or disapprove in accordance with Subsection 19-5-104(3)(h) of the Utah Code Ann. The County consents to entry of this Consent Decree without further notice and agrees not to withdraw from or oppose entry of this Consent Decree by the Court or to challenge

any provision of the Decree, unless the United States or the State has notified the County in writing that it no longer supports entry of the Decree.

## XX. SIGNATORIES/SERVICE

82. Each undersigned representative of the County, the State, EPA, UDWQ, and the Assistant Attorney General for the Environment and Natural Resources Division of the Department of Justice certifies that he or she is fully authorized to enter into the terms and conditions of this Consent Decree and to execute and legally bind the Party he or she represents to this document.

83. This Consent Decree may be signed in counterparts, and its validity shall not be challenged on that basis. The County agrees to accept service of process by mail with respect to all matters arising under or relating to this Consent Decree and to waive the formal service requirements set forth in Rules 4 and 5 of the Federal Rules of Civil Procedure and any applicable Local Rules of this Court including, but not limited to, service of a summons.

## XXI. INTEGRATION/HEADINGS

84. This Consent Decree constitutes the final, complete, and exclusive agreement and understanding among the Parties with respect to the settlement embodied in the Decree and supercedes all prior agreements and understandings, whether oral or written, concerning the settlement embodied herein. Other than deliverables that are subsequently submitted and approved pursuant to this Decree, no other document, nor any representation, inducement, agreement, understanding, or promise, constitutes any part of this Decree or the settlement it represents, nor shall it be used in construing the terms of this Decree.

85. Headings to the Sections and Paragraphs of this Consent Decree are provided for convenience and do not affect the meaning or interpretation of the provisions of this Consent Decree.

## XXII. FINAL JUDGMENT

86. Upon approval and entry of this Consent Decree by the Court, this Consent Decree shall constitute a final judgment of the Court as to the United States, the State, and the County.

SO ORDERED this ____ day of _____, 2016.

_____
UNITED STATES DISTRICT JUDGE
District of Utah

FOR PLAINTIFF UNITED STATES OF AMERICA:

Date: _____

JOHN C. CRUDEN
Assistant Attorney General
Environment and Natural Resources Division
U.S. Department of Justice

Date: _____

MARK C. ELMER
Senior Counsel
Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
999 18th Street, Suite 370
Denver, CO 80202
Phone: (303) 844-1352
Mark.Elmer@usdoj.gov

FOR THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY:

Date: 11/20/15

MARK POLLINS
Director, Water Enforcement Division
Office of Civil Enforcement
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency

FOR THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION 8:

Date: 12/16/15

SUZANNE J. BOLIAN
Assistant Regional Administrator
Office of Enforcement, Compliance and
Environmental Justice
Region 8
U.S. Environmental Protection Agency
1595 Wynkoop Street
Denver, CO 80202

Of Counsel:

WENDY SILVER
Senior Enforcement Attorney
Legal Enforcement Program
Office of Enforcement, Compliance and
Environmental Justice
Region 8
U.S. Environmental Protection Agency
1595 Wynkoop Street
Denver, CO 80202

FOR PLAINTIFF STATE OF UTAH:

Date: _____

_____
WALTER L. BAKER
Director
Utah Division of Water Quality
Utah Department of Environmental Quality

Approved as to form:

Date: _____

_____
SANDRA K. ALLEN
Assistant Attorney General
Utah Office of Attorney General, Environment
P.O. Box 140873
Salt Lake City, UT 84114-0873
Phone: (801) 536-4122
skallen@utah.gov

FOR DEFENDANT SALT LAKE COUNTY, UTAH:

Date: 12/8/15

BEN McADAMS
Mayor, Salt Lake County Utah

APPROVED AS TO FORM
District Attorney's Office

By: _____
Deputy District Attorney

Adam Miller
Print Name

Date: 2 Dec 2015

State of Utah

GARY R. HERBERT
*Governor*

SPENCER J. COX
*Lieutenant Governor*

Department of
Environmental Quality

Alan Matheson
*Executive Director*

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
*Director*

**Water Quality Board**
Myron E. Bateman, Chair
Shane E. Pace, Vice-Chair
Clyde L. Bunker
Steven K. Earley
Gregg A. Galecki
Jennifer Grant
Michael D. Luers
Alan Matheson
Walter L. Baker
*Executive Secretary*

# MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E.

FROM: Judy Etherington, Wastewater Certification Program Coordinator

DATE: January 14, 2016

SUBJECT: Recommendations for Appointments to the 2016–2019 Wastewater Operator Certification Council

As of January 31, 2016, the terms of service for three members of the Wastewater Operator Certification Council will expire. Those individuals who have served for the past three years are: Kerry Eppich, representing wastewater management; and Dan James and Richard Jex, representing wastewater treatment operators (shown as "vacant" on the following table.)

By current administrative rule the make-up of the ***seven-member*** Council is as follows:

| **Representation** | **Member** |
|---|---|
| Wastewater treatment operator (1) | *Vacant* |
| Wastewater treatment operator (2) | *Vacant* |
| Wastewater collection operator (3) | Tom Pendley |
| Wastewater collection operator (4) | Lawrence Burton |
| Municipal wastewater management | *Vacant* |
| At large: Education / Vocational Training / Private Sector (1) | Dr. Michael McFarland |
| At large: Education / Vocational Training / Private Sector (2) | Dr. James Callison |

With the change in the certification rule, and the way the representation assignments were adjusted to implement it, the terms of both "treatment" operators now expire in the same year, and both "collection" operators' terms also expire in the same year. The Certification Council recommends that the assignments be adjusted once again to allow one "treatment" and one "collection" representative to serve simultaneous terms. To facilitate that recommendation, Tom

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Mailing Address: P.O. Box 144870 • Salt Lake City, UT 84114-4870
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*www.deq.utah.gov*
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Pendley, who currently represents "collection" operators, has volunteered to change assignments and fill one of the "treatment" positions for the balance of his current term. In anticipation of that adjustment, the division solicited recommendations from the Utah League of Cities and Towns; four universities in Utah; the Utah Association of Special Districts; the Water Environment Association of Utah (WEAU); and the Rural Water Association of Utah (RWAU). A request for recommendations was also included in a recent Water Quality Actions listserv mailing. Council members may be reappointed.

Upon consideration of the recommendations submitted, we recommend that *Kerry Eppich* be reappointed to fill the vacancy "representing municipal wastewater management"; *Giles Demke* be appointed to fill one vacancy "representing wastewater treatment operators"; *Tom Pendley* (currently representing collection operators) be reassigned to fill the other position "representing wastewater treatment operators"; and *Gordon Evans* be appointed to fill the position "representing wastewater collection operators." The terms for the new appointments would begin February 1, 2016, and continue through January 31, 2019.

The proposed composition of the Council would be:

| **Representation** | **Member** |
|---|---|
| Wastewater treatment operator (1) | *Tom Pendley (reassigned)* |
| Wastewater treatment operator (2) | *Giles Demke (new)* |
| Wastewater collection operator (3) | *Gordon Evans (new)* |
| Wastewater collection operator (4) | Lawrence Burton |
| Municipal wastewater management | *Kerry Eppich (reappointed)* |
| At large: Education / Vocational Training / Private Sector (1) | Dr. Michael McFarland |
| At large: Education / Vocational Training / Private Sector (2) | Dr. James Callison |

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FILE: CERTIFICATION COUNCIL APPOINTMENTS 2016