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PROGRAM FOR MONITORING THE CHEMICAL QUALITY OF GROUND WATER IN UTAH--SUMMARY OF DATA COLLECTED THROUGH 1984

by

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Program for Monitoring the Chemical Quality of Ground Water in Utah--Summary of Data Collected through 1984

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ABSTRACT

The U.S. Geological Survey formally started a program for monitoring ground-water quality in Utah during 1957 in cooperation with the State of Utah. Most observation wells in the monitoring network are privately owned. Initially, the network consisted of fewer than 50 wells; by 1984, however, it had expanded to include more than 200 wells. Chemical analyses are available for water from some of the wells from as early as 1927, long before those wells were formally added to the network. The monitoring program was initiated to detect any changes in chemical quality that might be associated with the withdrawal of water from wells.

Dissolved-solids concentrations in water samples collected from the observation wells through 1984 ranged from 92 to 19,000 milligrams per liter. An observation well in the Uinta Basin yielded the sample with the smallest dissolved-solids concentration, and another well in the Uinta Basin yielded the sample with the largest dissolved-solids concentration. There was a progressive increase in salinity of water produced by several of the observation wells in Pahvant Valley and in the Milford and Beryl-Enterprise areas. The increases in salinity occurred during 1950-84, coinciding with the decline of water levels due to pumping for irrigation. Water-quality changes related either to ground-water withdrawals or ground-water recharge also were detected in several other areas, including Curlew Valley, Cedar City Valley, Northern Utah Valley, the lower Bear River valley, and the Sevier Desert.

Water produced from wells in Goshen Valley and the upper Fremont River valley had short term increases in chloride, sulfate, and dissolved-solids concentrations, indicating possible local contamination of the ground water. Also, since the late 1950's, dissolved-solids concentrations have increased in water produced by a well completed in the principal aquifer in Salt Lake Valley downgradient from areas where extensive use has been made of road salt.

INTRODUCTION

Monitoring Program

The U.S. Geological Survey, in cooperation with the Utah Division of Water Rights, began a program in 1957 to monitor the chemical quality of ground water in Utah. The purpose of the monitoring program was to detect any changes in chemical quality that might be associated with withdrawals of water from wells.

The monitoring network initially consisted of less then 50 observation wells, and an effort was made to obtain a water sample from each well every year. All the samples were analysed for concentrations of dissolved solids and major chemical ions. This practice continued through 1968, when the program was modified. For wells at which large water-quality changes had been detected or were suspected, the water samples continued to be collected each year and continued to be analysed for dissolved solids and major ions. For all other wells, the specific conductance of the water was determined; and if it was within 10 percent of the previous year's value, no further analysis was made. The specific conductance is a fairly good indication of dissolved-solids concentration. If the divergence exceeded 10 percent, an analysis was made for dissolved solids and major ions. Every 3 years, however, water produced by each of the observation wells was scheduled for sampling and analysis of dissolved solids and major ions.

The cost savings resulting from the changes in the program made possible an expansion of the monitoring network. In 1969, the number of wells in the network exceeded 100. By 1984, water from more than 200 wells in the expanding network was scheduled to be sampled and analyzed, and water from nearly 270 wells had been sampled and analyzed at least once.

This report is intended to summarize the results of the monitoring program through 1984. The general inorganic chemical quality of ground water is described for each area of monitoring, and significant changes in quality are discussed. Statistics for the variation of dissolved solids and major ions, which were provided by K. R. Thompson, U.S. Geological Survey, are based on analyses of water samples obtained during the monitoring program plus any analyses of water from the monitoring wells that were available prior to 1957. All analyses are on file with the U.S. Geological Survey, Salt Lake City, Utah. More detailed information about the chemical quality of ground water in the areas of monitoring (based partly on data from the monitoring program) can be found in reports for those areas as listed by LaPray and Hamblin (1980) or cited later in this report.

Observation Wells

Virtually all the observation wells in the monitoring program are privately owned and routinely used for irrigation, to provide domestic and stock supplies, or for other water-supply needs. Pumping from the wells is not continuous; thus, it may not be feasible to obtain a water sample from each well every year. Thanks are extended to the owners of the wells for their cooperation in making the wells available for use in the monitoring program.

Each of the wells is listed in table 1 by its local number and its station number. The local number is used when referring to specific wells in later sections of this report. The station number is used to enter into, and retrieve from, the computer files of the U.S. Geological Survey, all available data about the respective well. Those data include the chemical analyses of all water samples collected from the well.

Table 1.--Wells used to monitor the chemical quality of ground water in Utah

Area and local number	Station number
Bear Lake valley	
(A-13-6)30bbb-1	415048111194001
Beaver Valley	
(C-29-7)19bcd-1	381625112412901
(C-29-8)25cac-1	381516112422201
(C-29-8)31add-1	381435112471401
Beryl-Enterprise area	
(C-34-16)28dcc-2	374834113384301
(C-35-15)3dcc-1	374649113305501
(C-35-15)3dcc-2	374649113310201
(C-35-16)9add-1	374623113381301
(C-35-16)21dcc-3	374412113384503
(C-35-16)32dcd-2	374227113394101
(C-36-15)7cdd-1	374040113343102
(C-36-16)5L-1-1	374212113394501
(C-36-16)9bdc-1	374015113391501
(C-36-16)9bdc-2	374014113391101
(C-36-16)19abb-1	373854113411501
(C-36-16)27cdc-1	373710113381201
(C-36-16)29daa-1	373735113393801
(C-36-16)31ccc-1	373617113415101
(C-36-17)36aad-1	373656113415201
(C-37-16)4bdc-1	373551113391101
(C-37-17)12bdc-2	373456113423501
(C-37-17)12dbc-1	373447113422301
(C-37-17)14bac-1	373419113434201
Blue Creek Valley	
(B-13-5)31daa-1	414900112271701
(B-13-6)1dbb-1	415320112290901
(B-14-5)8ddd-1	415721112262301
Bluff area	
(D-40-22)30bbb-1	371716109325501
Cache Valley	
(A-11-1)8dda-3	414216111511001
(A-13-1)29bcd-1	415020111520401
Cedar City Valley	
(C-35-11)9dba-1	374619113053101
(C-35-11)11ccc-1	374550113040601
(C-35-11)31dbb-1	374248113075201
(C-35-11)33cac-1	374304113052901
(C-36-12)12dba-1	374105113084901
(C-36-12)21cbb-1	373915113125601
(C-37-12)9acc-1	373542113122401
(C-37-12)23acb-1	373407113100801
(C-37-12)34abb-1	373234113111601
Cedar Valley	
(C-6-1)18cdd-1	401730111594501
(C-6-2)15bbb-1	401818112034201
(C-6-2)26cbb-1	401607112023401
(C-6-2)29bdd-1	401610112053101
Central Sevier Valley	
(C-18-1)25ddc-1	391230111515001
(C-21-1)13abd-1	385910111512101
(C-23-2)15dcb-4	384800112002001
(C-23-2)19dab-1	384702112031001
(C-24-2)6abc-1	384450112034001
Central Virgin River area	
(C-38-12)20bba-1	372850113140001
(C-41-17)17cba-1	371305113470401
(C-42-15)34dba-2	370515113310302
(C-42-16)22dca-1	370651113304901
(C-43-14)31bbb-1	370036113282801
(C-43-15)25ddd-1	370013113233701
Cove Fort area	
(C-26-7)26cac-1	383101112365301

Table 1.--Wells used to monitor the chemical quality of ground water in Utah--Continued

Area and local number	Station number
Curlew Valley	
(B-12-11)4bcc-1	414745113063901
(B-12-11)5bbb-1	414813113075401
(B-12-11)5bdc-1	414747113073701
(B-12-11)8abb-1	414710113071601
(B-12-11)8baa-1	414721113072601
(B-14-8)11bca-1	415737112431601
(B-14-9)1dda-1	415805112481301
(B-14-9)5bbb-1	415847112540401
(B-14-9)7bbb-1	415754112551301
(B-14-10)1bbb-1	415845112562201
(B-15-8)31ccc-1	415850112481201
(B-15-9)28cbc-1	415956112525201
(B-15-10)36bbb-1	415939112562201
East Shore area	
(A-2-1)7aba-4	405535111525101
(B-2-1)24bad-3	405451111540801
(B-2-1)34add-2	405150111555001
(B-3-1)15bac-1	405959111564101
(B-4-2)27aba-1	410340112030001
(B-4-3)19caa-3	410354112135201
(B-5-1)29bdc-1	410830111584001
(B-5-1)30ada-1	410835111591501
(B-5-2)6bdd-3	411153112064602
(B-5-2)6bdd-4	411153112064601
(B-6-1)4ada-1	411726111565301
(B-6-2)27bba-2	411400112033001
(B-7-2)2cba-5	412214112023301
(B-7-2)16dcd-2	412011112041401
(B-7-2)32bbb-1	411824112060601
(B-7-2)34bbb-2	411821112034601
(B-7-3)31aac-2	411810112131802
(B-8-2)2dcb-1	412718112015801
(B-8-2)26bcd-1	412405112022501
(B-9-2)15daa-1	413057112023901

Area and local number	Station number
Goshen Valley	
(C-9-1)4ccc-1	400315111572001
(C-9-1)20ddd-1	400040111572701
(C-9-1)28ccb-1	395956111572101
(C-9-1)34ccc-1	395855111561201
(C-9-1)34dba-1	395918111552501
(C-9-1)34ddc-1	395855111552201
(C-10-1)3ddb-1	395814111552501
(C-10-1)4bbb-1	395848111571801
(C-10-1)4cbb-1	395825111571801
(C-10-1)9ccc-1	395710111571801
(C-10-1)17aaa-1	395704111572501
(C-11-1)6abc-1	395327111585501
Grouse Creek valley	
(B-10-18)33aaa-1	413300113543001
(B-11-18)33ada-1	413808113542501
(B-11-18)33adb-1	413806113543401
(B-11-18)33bdc-1	413758113551501
Juab Valley	
(C-12-1)24baa-1	394545111531001
(C-13-1)1cdd-1	394215111530501
(C-14-1)14cac-1	393527111541801
(D-12-1)19dbb-1	394518111515801
(D-13-1)4cca-1	394225111495701
(D-13-1)4ccb-1	394229111500401
(D-13-1)5ddb-1	394224111502601
(D-13-1)7dad-2	394136111512001
(D-13-1)7dbc-1	394137111515001
(D-13-1)7dda-1	394132111512001
(D-13-1)17bdd-1	394100111504501
(D-14-1)31dab-1	393301111512501

Table 1.--Wells used to monitor the chemical quality of ground water in Utah--Continued

Area and local number	Station number
Kanab Creek area	
(C-40-4 1/2)32bad-1	371739112200201
(C-42-5)11bdb-1	371034112230401
(C-42-6)19bdc-2	370843112340602
(C-43-5)25cda-1	370222112220901
Lower Bear River valley	
(B-11-4)3ccc-1	414233112174401
(B-12-4)27dbd-1	414454112173101
(B-12-4)34bbd-1	414406112173601
(B-12-4)34cca-1	414339112173401
(B-14-4)1dad-1	415833112145001
Milford area	
(C-28-10)5add-1	382924112592901
(C-28-10)5dad-2	382403112592601
(C-28-10)8add-2	382336112592601
(C-28-10)17ccc-1	382204113002501
(C-28-10)17cdc-2	382204113001302
(C-28-10)28ccc-1	382019112591701
(C-28-10)28cdd-1	382020112585901
(C-28-11)12dbc-1	382313113021201
(C-28-11)23cbb-2	382138113035301
(C-28-11)23cbb-3	382138113035302
(C-28-11)25dcd-1	382020113015701
(C-29-10)5cdd-5	381835113000001
(C-29-10)18daa-1	381714113003401
(C-29-11)1add-2	381901113014101
(C-29-11)11cdd-2	381741113032001
(C-29-11)14cdb-1	381700113033401
(C-29-11)27aad-1	381543113035501
(C-29-11)28add-2	381530113050201
Moab area	
(D-25-21)26dcc-1	383539109340901
Monticello area	
(D-33-24)30ddc-1	375222109192301

Area and local number	Station number
Northern Utah Valley	
(C-5-1)12daa-2	402355111531501
(D-5-1)1aaa-1	402518111462701
(D-5-1)18cab-2	402259111525201
(D-5-1)19ccc-1	402145111531101
(D-5-2)30ccb-2	402103111461601
(D-6-2)17aca-1	401801111442501
(D-7-2)4cbb-2	401414111435301
Pahvant Valley	
(C-18-5)34adb-3	391234112233701
(C-18-5)34baa-1	391248112240001
(C-20-4)6aca-1	390628112201401
(C-20-5)22bcc-1	390334112242801
(C-21-5)8bdc-2	390005112262301
(C-21-5)29cbc-1	385714112264701
(C-21-5)30dbc-1	385715112271201
(C-21-6)1ddb-1	390045112281201
(C-22-5)10bbb-2	385511112243501
(C-22-5)22adc-2	385303112234801
(C-22-5)33abd-1	385135112250301
(C-23-5)5acd-1	385026112261001
(C-23-6)8abd-1	384953112325101
(C-23-6)9bca-1	384946112321601
(C-23-6)9ccd-1	384910112321401
(C-23-6)10cdc-1	384909112311601
(C-23-6)15bca-1	384850112310701
(C-23-6)16bad-1	384857112315701
(C-23-6)16cda-1	384829112315901
(C-23-6)21add-1	384751112312201
(C-23-6)21bdd-1	384748112315801
Parowan Valley	
(C-32-8)35bcb-1	375852112440801
(C-33-8)31ccc-2	375257112483501
(C-33-9)33aad-1	375340112520001
(C-33-9)35acd-2	375320112510001
(C-34-9)9bbd-2	375151112525002
(C-34-9)16cdd-2	375022112522301
(C-34-10)13cbd-2	375033112561101

Table 1.--Wells used to monitor the chemical quality of ground water in Utah--Continued

Area and local number	Station number
Pilot Valley	
(B-3-19)1ccc-1	405951113584301
Rush Valley	
(C-4-5)33cca-2	402525112251502
(C-7-5)32bdd-1	400957112255101
(C-8-5)31ccd-5	400418112271701
Salt Lake Valley	
(B-1-2)2dac-2	405047112014301
(B-1-2)15bcd-2	404917112030001
(B-1-2)36baa-1	404659112005601
(C-1-1)18ddd-1	404333111591201
(C-1-1)33aba-1	404147111571501
(C-1-1)33ddd-1	404057111565401
(C-1-2)6aaa-4	404607112060701
(C-1-2)22bdd-4	404306112031201
(C-2-1)12bac-1	403952111541101
(C-3-1)9ccc-1	403357111575801
(C-3-1)12ccb-1	403408111543201
(C-3-1)15dda-1	403316111554301
(C-3-1)30acd-1	403147111593201
(C-4-1)15bdc-1	402819111563301
(C-4-1)15bdc-2	402823111563301
(C-4-1)23dbb-1	402721111550801
(C-4-2)1bbb-1	403027112012401
(D-1-1)7abd-6	404506111523301
(D-2-1)21dbc-1	403742111503201
(D-2-1)28ccc-1	403638111511701
(D-3-1)31abb-1	403116111524801
Sanpete Valley	
(D-14-3)7abb-1	393715111375301
(D-16-2)34acd-2	392253111394101
(D-16-3)4aaa-2	392740111345302
(D-18-2)1daa-2	391634111380701

Area and local number	Station number
Sevier Desert	
(C-15-4)8cba-1	393154112192901
(C-15-4)18daa-1	393102112194501
(C-15-4)26dcc-1	392854112154601
(C-15-5)2ddc-1	393221112221801
(C-15-5)13bbc-1	393113112215801
(C-15-5)26baa-1	392939112224101
(C-16-5)19cbd-1	392443112273101
(C-16-7)24bca-1	392445112353201
(C-16-8)26bdb-2	392359112431202
(C-17-6)26daa-2	391832112285501
(C-17-6)26daa-3	391832112285601
(C-17-7)34cbd-2	391732112375001
(C-18-6)6aba-2	391710112334701
Skull Valley	
(C-2-7)7dda-1	403914112400301
(C-3-8)28cbc-1	403128112453501
(C-3-8)28ddb-1	403126112444501
(C-6-8)11dad-1	401829112422401
Snake Valley area	
(C-10-19)22bcd-1	395633113584301
(C-11-17)11aaa-1	395319113431201
(C-17-19)4add-1	392135113585501
(C-18-19)20dad-1	391326113595801
(C-18-19)20ddd-1	391324114000001
(C-19-19)35cdd-1	390617113571601
(C-20-19)14bbc-1	390416113573801
(C-21-19)31acd-1	385650114010601
(C-22-19)6bac-1	385615114013801
(C-23-19)20bac-1	384818114002801

Table 1.--Wells used to monitor the chemical quality of ground water in Utah--Continued

Area and local number	Station number
Southern Utah Valley	
(D-7-3)28bdb-1	401101111364201
(D-7-3)33baa-1	401021111362701
(D-7-3)34cdb-1	400941111352701
(D-8-2)12ddc-1	400750111392001
(D-8-2)12ddc-2	400751111392202
(D-8-2)23dca-2	400613111404401
(D-9-1)36bbc-1	395942111594201
(D-9-2)9bac-1	400311111432001
(D-9-3)5bbd-1	400407111375101
Tooele Valley	
(C-2-4)22ccb-4	403735112172801
(C-2-4)33add-1	403608112174301
(C-2-4)35cbc-1	403559112162201
(C-2-5)36dcd-1	403539112212401
(C-2-6)23cbb-1	403802112301201
(C-3-4)8aaa-1	403447112184401
(C-3-5)4bbb-2	403532112253601
(C-3-5)7dcc-1	403451112271801
Uinta Basin area	
(D-3-21)30dcd-1	403116109360601
(D-10-22)10ada-1	395801109245801
U(B-1-1)27ada-1	402726109582601
U(C-1-2)15bbc-1	402402110061401
U(C-2-1)14ccc-2	401811109581701
U(C-2-1)15ddc-1	401809109583601
Upper Fremont River valley	
(D-27-3)19aaa-1	382717111365601
(D-28-3)26cda-1	382033111330601
(D-29-3)1cab-1	381902111321101
Upper Sevier Valleys	
(C-26-1)23ddb-1	383140111522001
(C-29-2)35bad-1	381440111584001
(C-30-2)28bdc-1	381003112010301
(C-31-2)23bcd-1	380920111585001
(C-32-5)35bab-1	375924112234001

The local number is based on the cadastral land-survey system of the U.S. Government. The number, in addition to designating the well, describes its position in the land net. By the land-survey system, the State is divided into four quadrants by the Salt Lake Base Line and Meridian, and these quadrants are designated by the letters A, B, C, and D indicating the northeast, northwest, southwest, and southeast quadrants, respectively (fig. 1). Numbers designating the township and range (in that order) follow the quadrant letter, and all three are enclosed in parentheses. The number after the parentheses indicates the section, and it is followed by three letters indicating the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section--generally 10 acres[1]; the letters a, b, c, and d indicate, respectively, the northeast, northwest, southwest, and southeast quarters of each subdivision. The number after the letters is the serial number of the well within the 10-acre tract. Thus, the number (A-13-6)30bbb-1 designates the first well constructed or inventoried in the NW1/4NW1/4NW1/4 Sec.30, T. 13 N., R. 6 E. If a well cannot be located within a 10-acre tract, only one or two location letters are used, and the serial number is omitted.

In the Unita Basin, part of the "D" quadrant has been subdivided by the Uintah Base Line and Meridian as shown in figure 1. Wells in this land parcel are numbered in the same manner described above, but the numbers are preceded by the letter "U" to show that they are related to the Uintah Base Line and Meridian. Thus, well U(C-2-1)15bbc-1 is the first well constructed or inventoried in the SW1/4NW1/4NW1/4 sec. 15, T. 2S., R. 1 W., Uintah Base Line and Meridian.

The station number for each of the observation wells also indicates the geographical location of the well. The first six digits of the number are the well's location in degrees, minutes, and seconds north latitude. The next seven digits are its location in degrees, minutes, and seconds west longitude. The last one or two digits is the serial number of the well in the indicated area. Thus, the well with the station number 415048111194001, well (A-13-6)30bbb-1 mentioned above, is also the first well constructed or inventoried at 41 degrees, 50 minutes, 48 seconds north latitude, and 111 degrees, 19 minutes, 40 seconds west longitude.

Areas of Monitoring

The general areas of monitoring are shown in figure 2 and identified in table 2. The location of each water-quality observation well within the respective areas of monitoring is shown in figures 3-38. Most of the areas of monitoring are regarded as the principal areas of ground-water withdrawal by wells in Utah. They are described as such in a report by Appel and others (1983) and in other editions of that report series.

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[1]Although the basic land unit, the section, is theoretically a 1-mile square, many sections are irregular. Such sections are subdivided into 10-acre tracts, generally beginning at the southeast corner, and the surplus or shortage is taken up in the tracts along the north and west sides of the section.

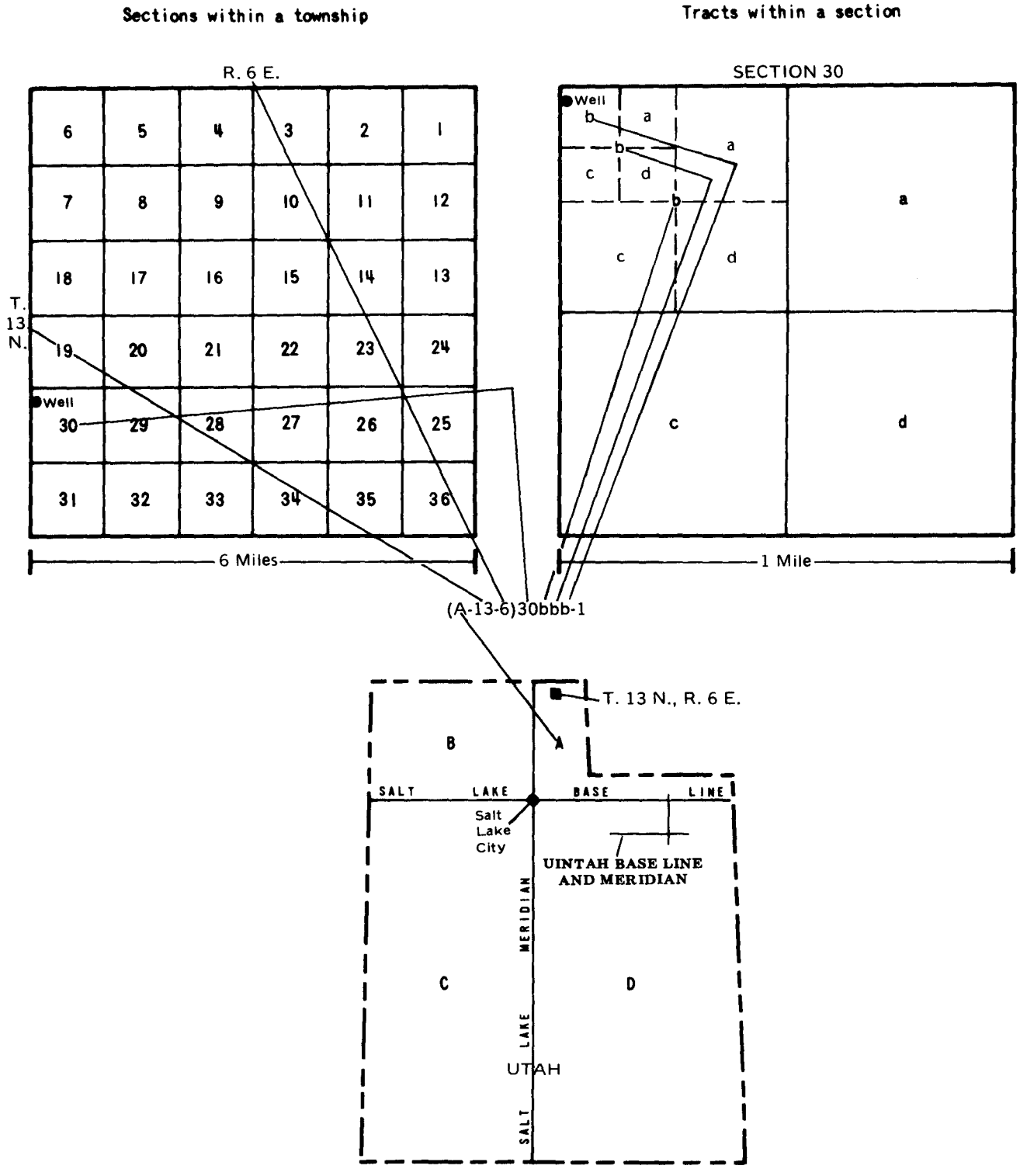


Figure 1.—Diagram illustrating the well-numbering system used in Utah.

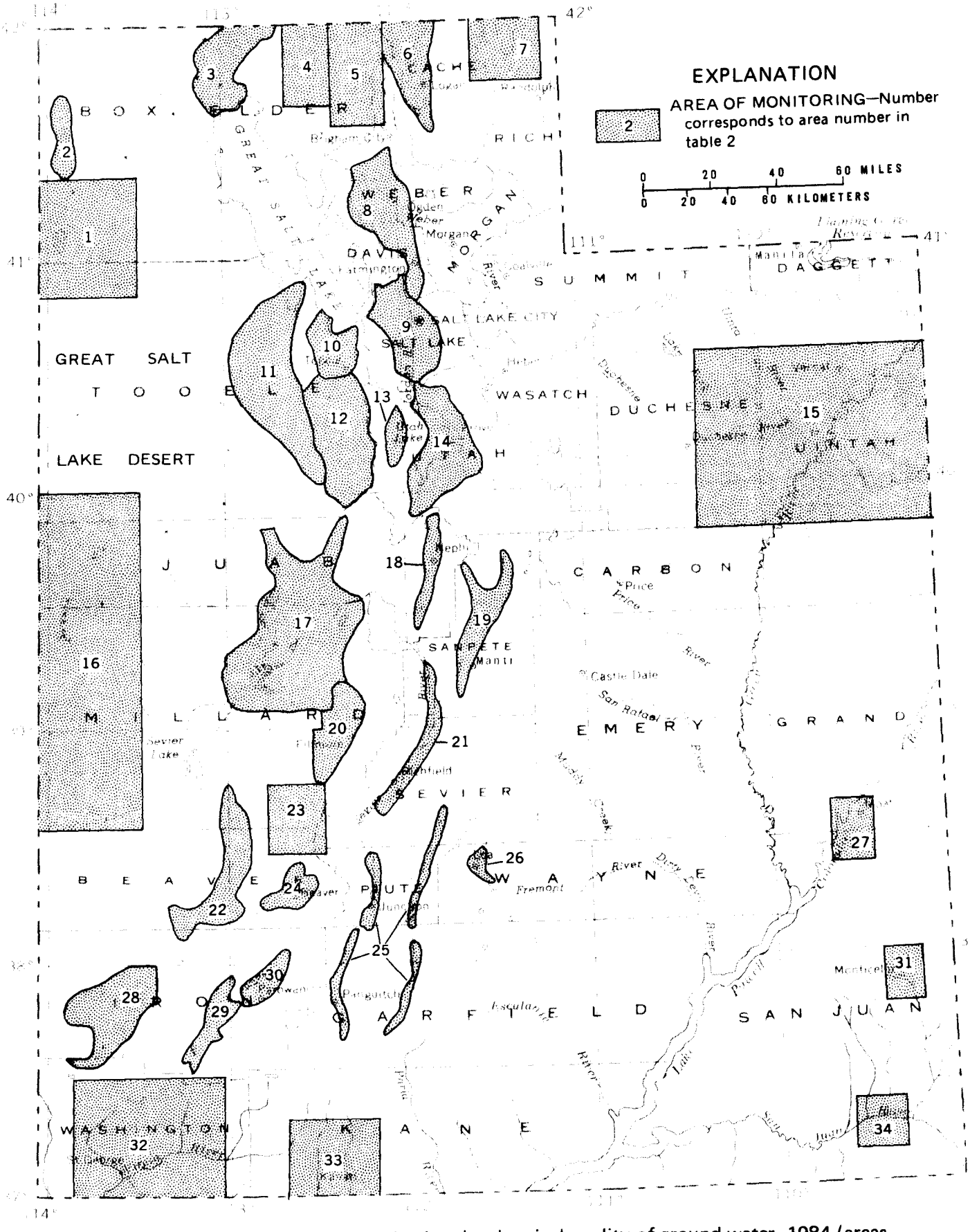


Figure 2.—General areas of monitoring the chemical quality of ground water, 1984 (areas shown in figs. 3-38).

Table 2.--General areas of monitoring for chemical quality of ground water, 1984

[Areas shown in figures 3-38]

Number in figure 2	Name	Principal type of water-yielding rocks
1	Pilot Valley	Unconsolidated
2	Grouse Creek valley	Do.
3	Curlew Valley	Unconsolidated and consolidated
4	Blue Creek Valley	Unconsolidated
5	Lower Bear River valley	Do.
6	Cache Valley	Do.
7	Bear Lake valley	Do.
8	East Shore area	Do.
9	Salt Lake Valley	Do.
10	Tooele Valley	Do.
11	Skull Valley	Do.
12	Rush Valley	Unconsolidated and consolidated
13	Cedar Valley	Unconsolidated
14	Goshen and Utah Valleys	Do.
15	Uinta Basin area	Unconsolidated and consolidated
16	Snake Valley area	Unconsolidated

Table 2.--General areas of monitoring for chemical quality of ground water, 1984--Continued

Number in figure 2	Name	Principal type of water-yielding rocks
17	Sevier Desert	Do.
18	Juab Valley	Do.
19	Sanpete Valley	Do.
20	Pahvant Valley	Unconsolidated and consolidated
21	Central Sevier Valley	Unconsolidated
22	Milford area	Do.
23	Cove Fort area	Do.
24	Beaver Valley	Do.
25	Upper Sevier Valleys	Unconsolidated and consolidated
26	Upper Fremont River valley	Do.
27	Moab area	Do.
28	Beryl-Enterprise area	Unconsolidated
29	Cedar City Valley	Do.
30	Parowon Valley	Unconsolidated and consolidated
31	Monticello area	Do.
32	Central Virgin River area	Unconsolidated and consolidated
33	Kanab Creek area	Do.
34	Bluff area	Consolidated

As indicated in table 2, the principal aquifers in 22 of the areas of monitoring consist of unconsolidated rocks. The unconsolidated rocks consist of sedimentary deposits of clay, silt, sand, gravel, and boulders that have been eroded from nearby mountains and plateaus. Principal aquifers consist of both unconsolidated and consolidated rocks in 11 areas of monitoring and of consolidated rocks in 1 area (table 2). In most areas, the consolidated-rock aquifers are sandstone; but in some areas, they are either limestone or igneous rocks. More specific information about the water-yielding rocks in each area of monitoring is given in the following sections, including cited reports, that deal with those areas.

SUMMARY OF DATA COLLECTED

Water samples collected from the monitoring wells are described in the following sections in accordance with a classification commonly used by the U.S. Geological Survey (Hem, 1970, p. 219):

Classification	Dissolved-solids concentration (milligrams per liter)
Fresh	Less than 1,000
Slightly saline	1,000 to 3,000
Moderately saline	3,000 to 10,000
Very saline	10,000 to 35,000
Briny	More than 35,000

Data collected for the monitoring program indicate that dissolved-solids concentrations ranged from 92 milligrams per liter (fresh) in a sample from a well in the Uinta Basin to 19,000 milligrams per liter (very saline) in a sample from another well in the Unita Basin.

Bear Lake Valley

The principal water-yielding rocks in Bear Lake valley are unconsolidated basin fill. Based on geologic and hydrologic conditions, the ground water there is assumed to be generally fresh. The one observation well in the valley, well (A-13-6)30bbb-1 (table 1 and fig. 3), is completed in basin fill. Dissolved-solids concentrations in water samples collected from the well during 1964-1981 varied from 250 milligrams per liter on July 27, 1978, to 260 milligrams per liter on July 25, 1975. The small variation in dissolved-solids concentration indicated that ground water in the vicinity of the observation well had not changed appreciably since monitoring was started at the well in 1964. A statistical analysis of the chemical analyses of all water samples collected from the well is shown in table 3.

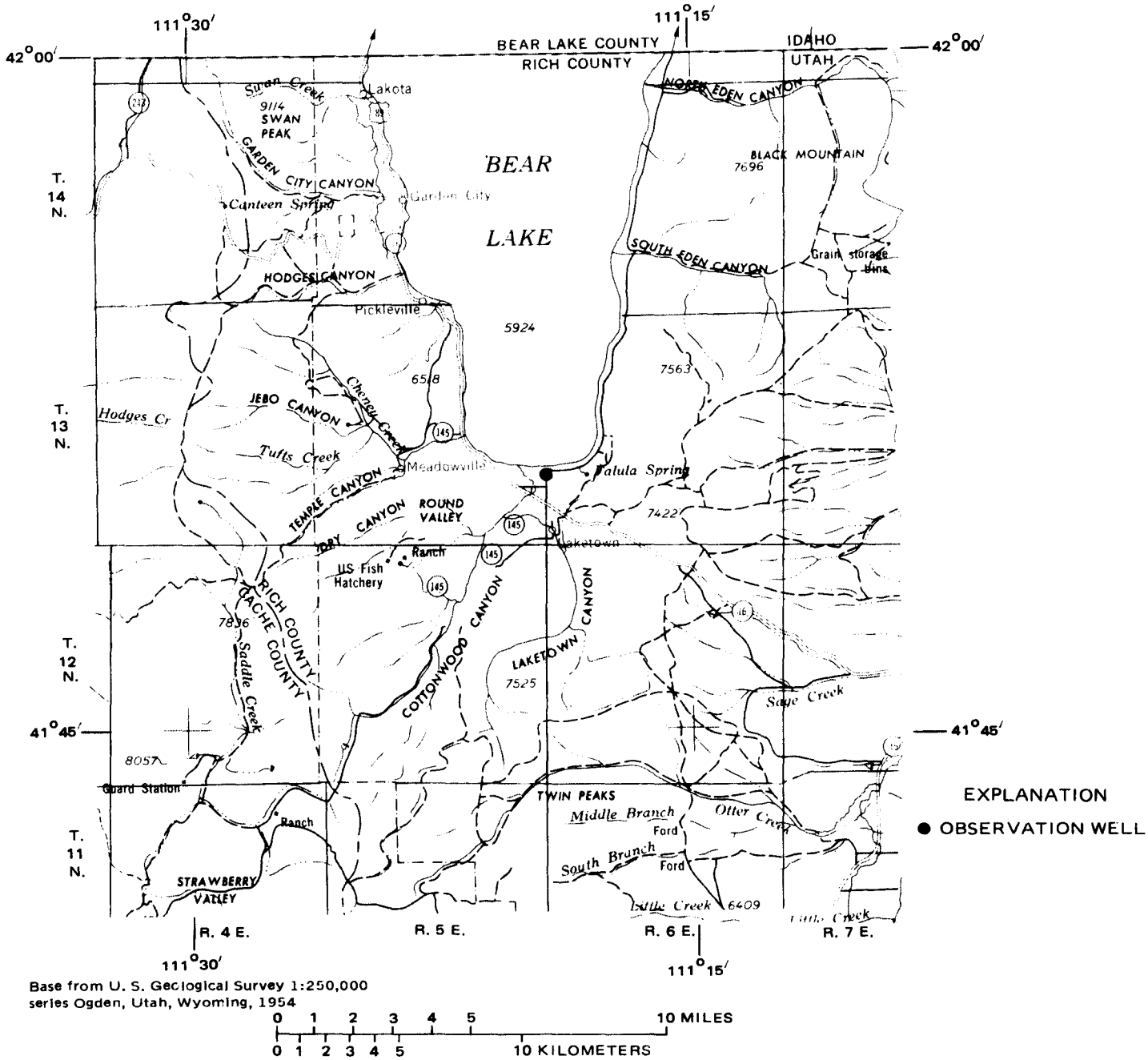


Figure 3.—Location of observation well in Bear Lake valley.

Table 3.--Statistical analysis of chemical analyses of water from the observation well in Bear Lake valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	18	415	400	450	11.9	2.8
pH (standard units)	10	7.6	6.8	7.9	.3	4.4
Temperature (degrees Celsius)	17	10.0	8.5	13	1.2	11.7
Hardness (milligrams per liter as $CaCO_3$)	9	220	200	240	10.2	4.7
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	9	10	0	30	9.9	98.7
Calcium, dissolved (milligrams per liter as Ca)	7	53	44	57	4.4	8.3
Magnesium, dissolved (milligrams per liter as Mg)	7	20	18	21	1.0	5.0
Sodium, dissolved (milligrams per liter as Na)	6	9.7	7.4	17	3.9	40.1
Potassium, dissolved (milligrams per liter as K)	4	1.5	1.5	1.6	.05	3.3
Bicarbonate (milligrams per liter as HCO_3)	10	250	240	260	5.3	2.1
Carbonate (milligrams per liter as CO_3)	9	0	0	0	0	0
Sulfate, dissolved (milligrams per liter as SO_4)	6	11	9	13	1.5	13.6
Chloride, dissolved (milligrams per liter as Cl)	7	10	8.4	11	.9	9.0
Fluoride, dissolved (milligrams per liter as F)	4	.1	.1	.2	.05	40.0
Silica, dissolved (milligrams per liter as SiO_2)	6	28	25	30	1.7	6.1
Nitrite plus nitrate, dissolved (milligrams per liter as N)	3	.01	.01	.02	.01	43.3
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	2	.05	(1)	.09	.1	141.4
Solids, sum of constituents, dissolved (milligrams per liter)	6	257	250	260	4.6	1.8

(1) Not detected.

Beaver Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Beaver Valley. The water generally is fresh, and it is slightly saline only locally. (See Price, 1981a.) Three observation wells (all completed in basin fill) have been established in the valley (table 1 and fig. 4). Samples were collected from well (C-29-8)25cac-1 during 1945-84 and from the other two wells during about 1960-84. Dissolved-solids concentrations ranged from 220 milligrams per liter on July 17, 1979, at well (C-29-8)25cac-1 to 590 milligrams per liter on August 10, 1960, at well (C-29-8)31add-1. There was no apparent large change in the chemical quality of the ground water in the vicinity of the three observation wells since monitoring was started at each well. A statistical analysis of all chemical analyses of water samples collected from the observation wells is presented in table 4. The reader also is referred to Mower (1978, p. 36-40) for additional information about the chemical quality of ground water in the Beaver Valley.

Beryl-Enterprise Area

Unconsolidated deposits (basin fill) are the principal source of ground water in the Beryl-Enterprise area. Mower (1982, pl. 12) indicates that the water generally is fresh and is slightly saline only locally. Nineteen observation wells have been established in the area (table 1 and fig. 5), all probably completed in the basin fill. Two of the wells were sampled in 1927, but monitoring began at most of the other wells during 1949-79. Dissolved-solids concentrations in water samples collected from the wells ranged from 120 milligrams per liter on August 24, 1983, at well (C-37-17)12bdc-2 to 2,800 milligrams per liter on May 1, 1962, at well (C-35-15)3dcc-1. (See also table 5.) A progressive increase was detected in the specific conductance, chloride, sulfate, and dissolved-solids concentrations in samples collected from several observation wells since about 1950 (Mower, 1982, fig. 14). This reflects declining water levels associated with withdrawals from irrigation wells in the Beryl-Enterprise area. (See Appel and others, 1983, figs. 51 and 52.) Mower (1982, p. 45) attributes the progressive increase in salinity of water mostly to recycling of water pumped for irrigation--that is, seepage of some of the irrigation water back to the aquifer after being concentrated by evapotranspiration and dissolving additional minerals from the soil. North of Newcastle, some of the increase in salinity results from induced flow of naturally-occurring water which contains relatively large concentrations of dissolved solids.

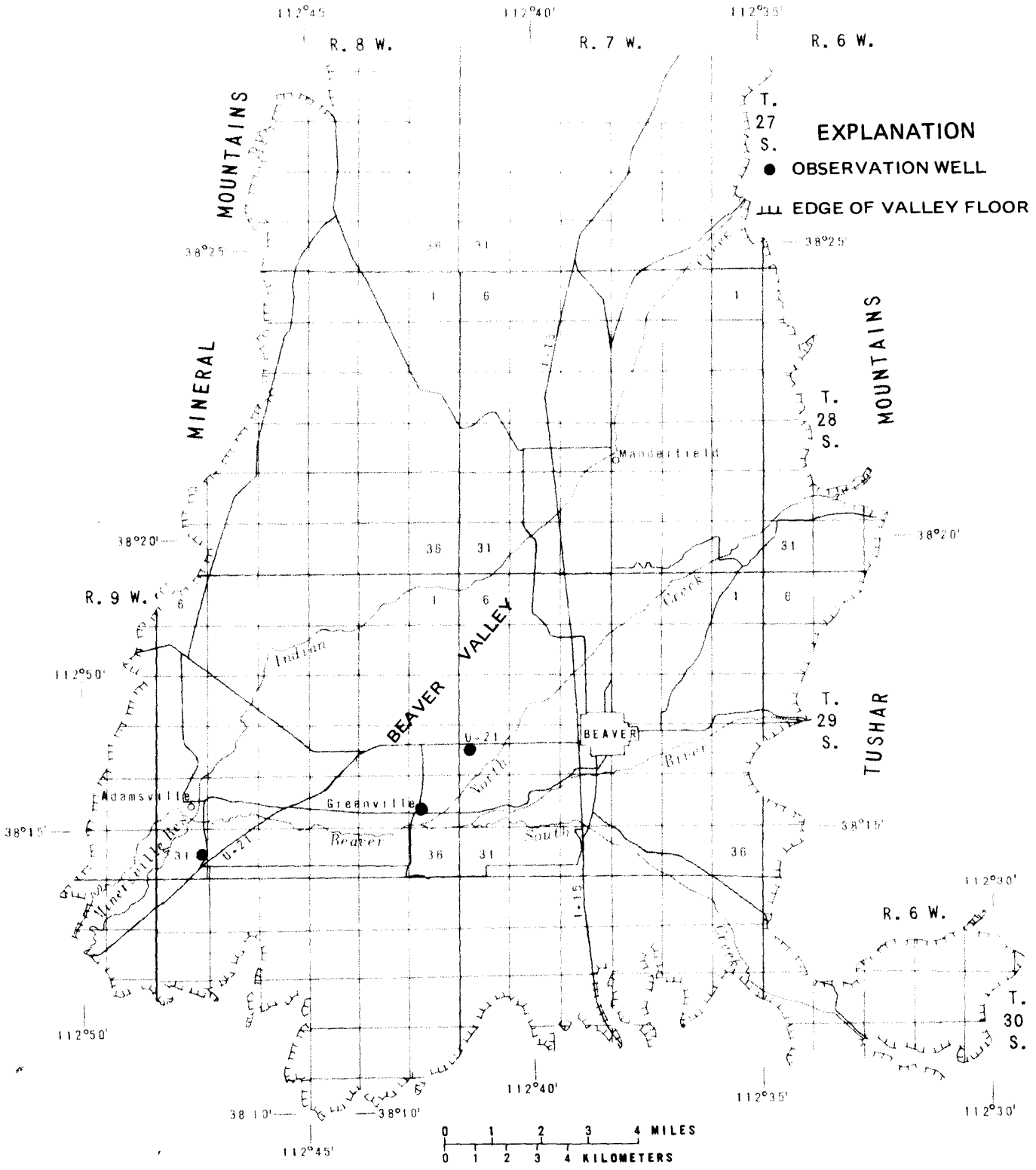


Figure 4.—Location of observation wells in Beaver Valley.

Table 4.--Statistical analysis of chemical analyses of water from the observation wells in Beaver Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	49	520	250	920	216.0	41.8
pH (standard units)	23	7.7	7.1	9	.5	6.3
Temperature (degrees Celsius)	50	15.0	10	23	3.4	22.7
Hardness (milligrams per liter as $CaCO_3$)	21	180	64	310	71.5	40.8
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	21	8.3	0	59	17.1	206.8
Calcium, dissolved (milligrams per liter as Ca)	21	53	17	92	20.3	38.5
Magnesium, dissolved (milligrams per liter as Mg)	21	11	4.6	19	5.4	49.8
Sodium, dissolved (milligrams per liter as Na)	15	49	20	97	31.9	65.4
Sodium plus potassium, dissolved (milligrams per liter as Na)	8	38	16	85	21.5	56.6
Potassium, dissolved (milligrams per liter as K)	15	6.2	4.4	8.8	1.4	22.6
Bicarbonate (milligrams per liter as HCO_3)	15	240	65	400	117.5	49.6
Carbonate (milligrams per liter as CO_3)	12	8	0	90	26.0	346.4
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	4	170	99	280	76.7	44.6
Sulfate, dissolved (milligrams per liter as SO_4)	20	53	29	90	17.7	33.7
Chloride, dissolved (milligrams per liter as Cl)	23	27	1.0	56	17.3	65.3
Fluoride, dissolved (milligrams per liter as F)	13	.7	.3	.9	.2	24.5
Silica, dissolved (milligrams per liter as SiO_2)	21	52	35	75	12.4	24.1
Nitrite plus nitrate, dissolved (milligrams per liter as N)	8	1.7	.05	3.1	1.2	68.2
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	2	.19	.09	.28	.1	72.6
Iron, dissolved (micrograms per liter as Fe)	4	20	10	30	9.6	61.0
Manganese, dissolved (micrograms per liter as Mn)	4	17	1	62	30.2	180.2
Solids, sum of constituents, dissolved (milligrams per liter)	18	357	220	590	122.4	34.3

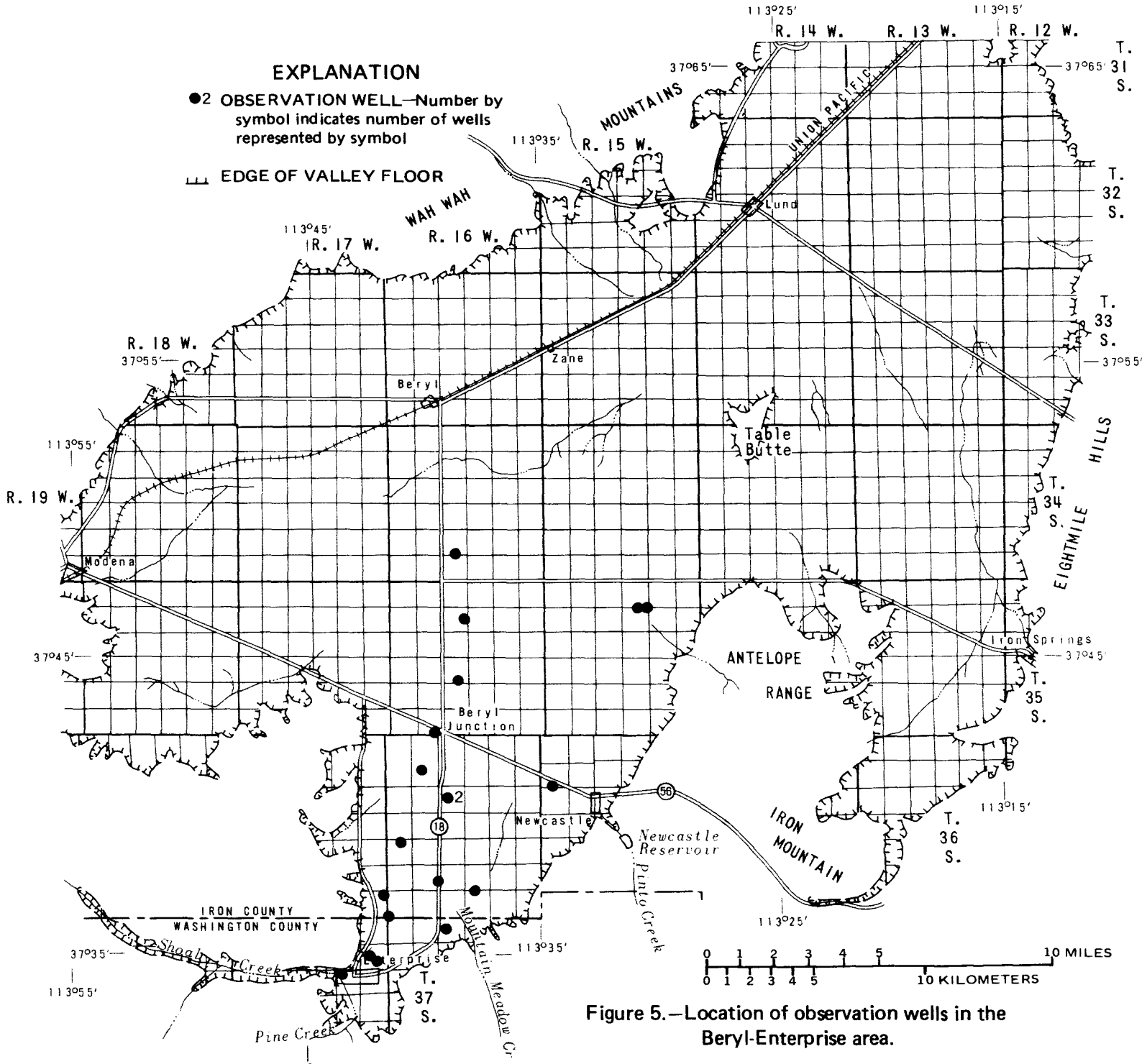


Figure 5.—Location of observation wells in the Beryl-Enterprise area.

Table 5.--Statistical analysis of chemical analyses of water from the observation wells in the Beryl-Enterprise area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	192	860	180	4100	694.5	80.5
pH (standard units)	136	7.5	6.8	8.2	.3	3.4
Temperature (degrees Celsius)	179	14.0	9.0	24.0	3.2	22.8
Hardness (milligrams per liter as $CaCO_3$)	149	360	76	1300	261	72.4
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	142	190	0	990	241	128.5
Calcium, dissolved (milligrams per liter as Ca)	128	110	9.9	350	69.1	64.6
Magnesium, dissolved (milligrams per liter as Mg)	127	25	3.0	130	26.0	104.4
Sodium, dissolved (milligrams per liter as Na)	104	48	8.8	480	76.5	159.6
Sodium plus potassium, dissolved (milligrams per liter as Na)	38	91	9.4	540	128	141.3
Potassium, dissolved (milligrams per liter as K)	101	6.4	1.7	48	4.7	73.1
Bicarbonate (milligrams per liter as HCO_3)	113	220	100	380	55.6	25.0
Carbonate (milligrams per liter as CO_3)	104	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	25	180	87	350	73.2	40.2
Sulfate, dissolved (milligrams per liter as SO_4)	135	140	4.8	1400	266	185.8
Chloride, dissolved (milligrams per liter as Cl)	166	110	4.7	530	119.5	108.1
Fluoride, dissolved (milligrams per liter as F)	83	.6	.1	4.9	1.1	178.0
Silica, dissolved (milligrams per liter as SiO_2)	124	47	23	72	9.5	20.3
Nitrite plus nitrate, dissolved (milligrams per liter as N)	67	3.3	.26	10	2.6	78.0
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	29	.15	(1)	.28	.06	40.1
Iron, dissolved (micrograms per liter as Fe)	33	20	(1)	130	36.61	173.3
Manganese, dissolved (micrograms per liter as Mn)	31	13	(1)	130	27.2	204.8
Solids, sum of constituents, dissolved (milligrams per liter)	124	600	120	2800	496	82.7

(1) Not detected.

Blue Creek Valley

The principal water-yielding rocks in Blue Creek Valley are unconsolidated deposits (basin fill). Ground water in the higher, northern part of the valley generally is fresh, whereas it is slightly to moderately saline in the lower, southern part of the valley (Bolke and Price, 1972, pl. 1). The three observation wells that have been established in the valley (table 1 and fig. 6) probably are completed in basin fill. Dissolved-solids concentrations in water samples collected from the wells since 1970 ranged from 400 milligrams per liter on July 7, 1970, at well (B-13-6)1dbb-1 to 1,100 milligrams per liter on June 22, 1976, at well (B-13-5)31daa-1. The dissolved-solids concentrations remained fairly constant at well (B-13-6)1dbb-1 during the sampling period and decreased slightly at wells (B-13-5)31daa-1 and (B-14-5)8ddd-1. The decrease in dissolved-solids concentration probably reflects increased recharge from greater-than-normal precipitation as recorded at Corinne (Appel and others, 1983, fig. 54) about 15 miles southeast of Blue Creek Valley.

Relatively large concentrations of nitrite plus nitrate (20-32 milligrams per liter as N) were detected in the samples from well (B-14-5)8ddd-1. This may have been caused by animal waste or decaying organic matter--it is not uncommon for small rodents or reptiles to fall into wells, where they drown and decay. Bolke and Price (1972, p. 14) describe in more detail the chemical quality of ground water throughout the drainage area of Blue Creek Valley, and a statistical analysis of chemical analyses of water sampled from all the observation wells is presented in table 6.

Bluff Area

Consolidated rocks, chiefly of sandstone, are the principal source of ground water in the Bluff area. The water generally is fresh (Price and Arnow, 1974, pl. 2A), but it is saline below depths of about 1,000 feet. Sampling at the one observation well in the area (table 1 and fig. 7), which apparently is completed in sandstone chiefly of Jurassic age, began in November 1933. Dissolved-solids concentrations in water samples collected from well (D-40-22)30bbb-1 varied from 267 milligrams per liter on September 10, 1958, to 560 milligrams per liter on March 2, 1978. This represents more than a 100-percent change in concentration, although the water still is fresh. The cause of the change could not be determined. A statistical analysis of all chemical analyses of water sampled from the well is presented in table 7.

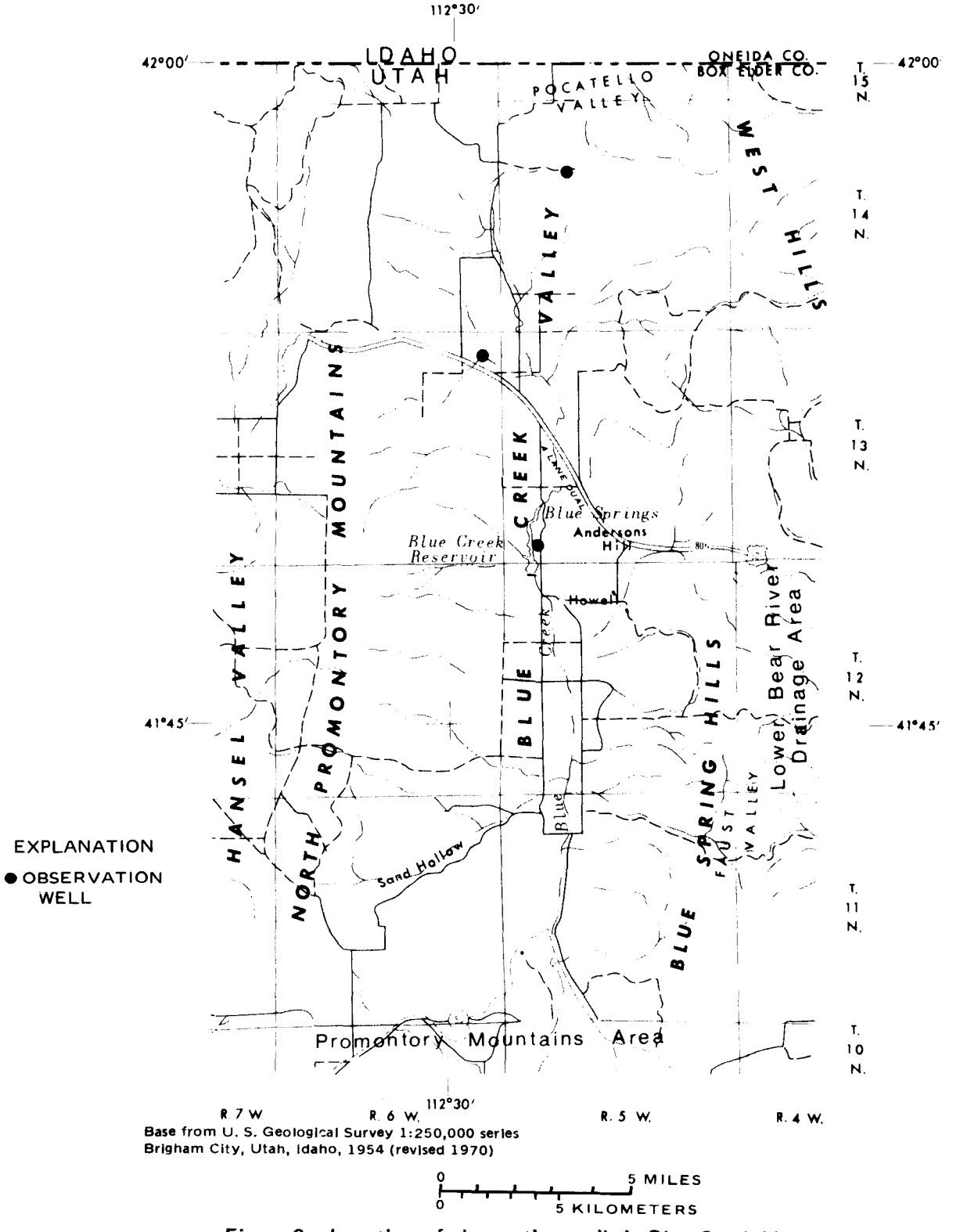


Figure 6.—Location of observation wells in Blue Creek Valley.

Table 6.--Statistical analysis of chemical analyses of water from the observation wells in Blue Creek Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	19	990	700	1860	380.8	38.3
pH (standard units)	19	7.6	7.2	8.4	.4	4.5
Temperature (degrees Celsius)	19	17.0	10.5	20.5	3.6	20.7
Hardness (milligrams per liter as $CaCO_3$)	17	310	260	400	50.4	16.0
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	17	91	9	150	51.0	55.8
Calcium, dissolved (milligrams per liter as Ca)	17	84	71	100	9.0	10.7
Magnesium, dissolved (milligrams per liter as Mg)	17	25	14	44	11.4	45.5
Sodium, dissolved (milligrams per liter as Na)	17	94	31	250	72.1	76.7
Potassium, dissolved (milligrams per liter as K)	15	7.7	1.6	12	4.4	56.8
Bicarbonate (milligrams per liter as HCO_3)	14	270	150	350	90.2	33.5
Carbonate (milligrams per liter as CO_3)	14	.3	0	4.0	1.1	374.2
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	3	230	130	280	88.9	38.7
Sulfate, dissolved (milligrams per liter as SO_4)	16	33	16	69	14.1	43.2
Chloride, dissolved (milligrams per liter as Cl)	17	160	18	430	133.4	82.2
Fluoride, dissolved (milligrams per liter as F)	14	.6	.1	1.5	.6	102.1
Silica, dissolved (milligrams per liter as SiO_2)	16	54	29	83	18.2	33.6
Nitrite plus nitrate, dissolved (milligrams per liter as N)	14	11	.09	32	12.9	120.4
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	11	.31	.03	1.1	.4	112.9
Iron, dissolved (micrograms per liter as Fe)	10	30	10	80	25.1	79.3
Manganese, dissolved (micrograms per liter as Mn)	10	61	1	440	134.2	221.2
Solids, sum of constituents, dissolved (milligrams per liter)	16	580	400	1100	243.5	41.8

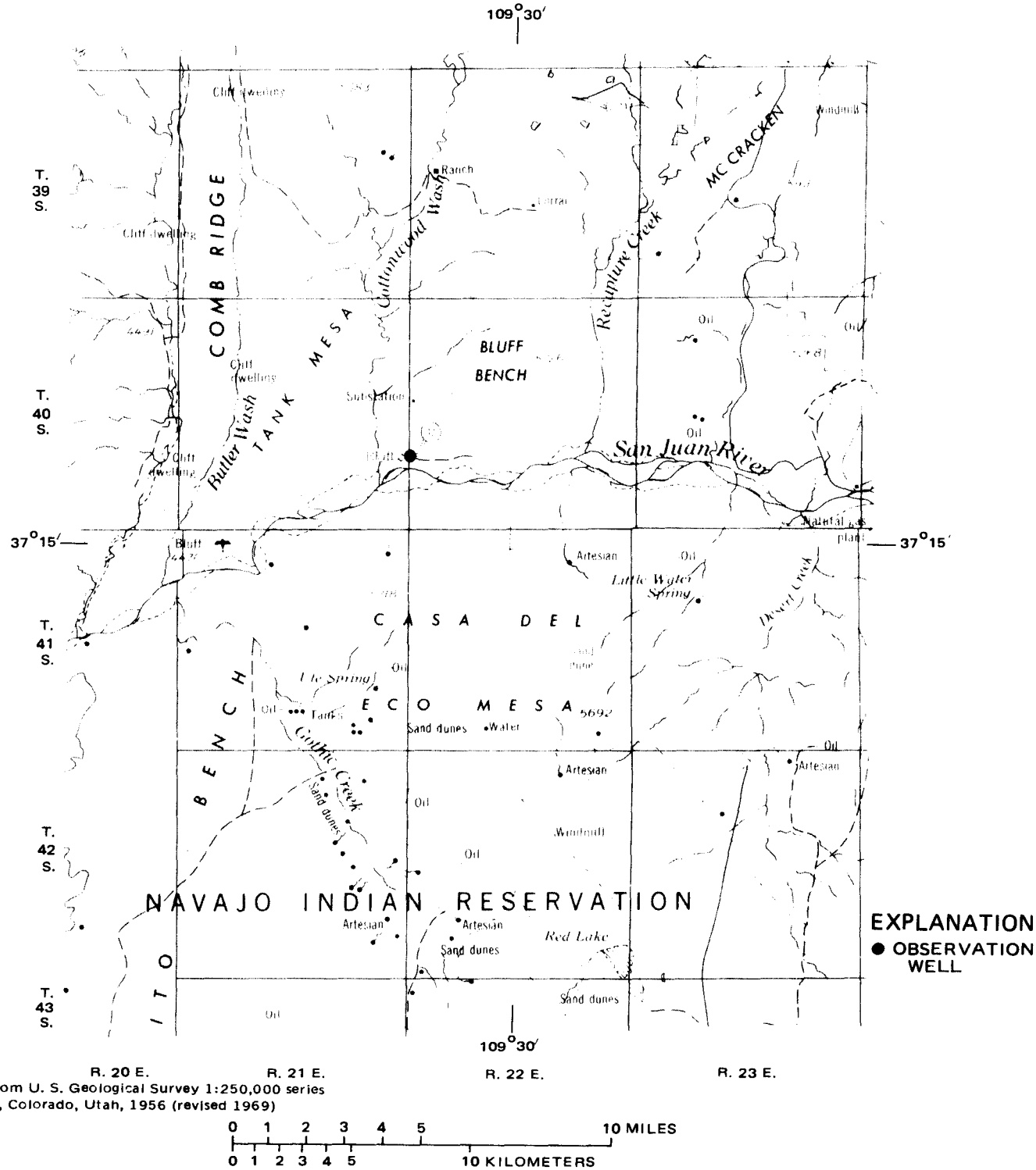


Figure 7.—Location of observation well in the Bluff area.

Table 7.--Statistical analysis of chemical analyses of water from the observation well in the Bluff area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	19	690	420	800	107.7	15.5
pH (standard units)	16	8.5	7.7	9	.4	4.4
Temperature (degrees Celsius)	18	20.5	15	25	2.2	10.8
Hardness (milligrams per liter as $CaCO_3$)	18	42	5	558	128.8	306.3
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	18	18	0	330	77.8	424.3
Calcium, dissolved (milligrams per liter as Ca)	17	3.4	1.5	5.7	1.3	39.6
Magnesium, dissolved (milligrams per liter as Mg)	17	.9	.2	3.1	.7	74.8
Sodium, dissolved (milligrams per liter as Na)	13	180	130	190	19.6	10.9
Sodium plus potassium, dissolved (milligrams per liter as Na)	6	140	98	194	31.3	22.1
Potassium, dissolved (milligrams per liter as K)	13	1.8	1.1	5	1.1	58.6
Bicarbonate (milligrams per liter as HCO_3)	15	330	190	420	73.4	22.4
Carbonate (milligrams per liter as CO_3)	14	15	0	27	9.7	65.7
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	2	330	320	339	13.4	4.1
Sulfate, dissolved (milligrams per liter as SO_4)	19	53	40	65	6.4	12.1
Chloride, dissolved (milligrams per liter as Cl)	19	15	4	48	9.5	64.1
Fluoride, dissolved (milligrams per liter as F)	11	.4	(1)	.8	.2	42.2
Silica, dissolved (milligrams per liter as SiO_2)	12	11	10	12	.4	3.9
Nitrite plus nitrate, dissolved (milligrams per liter as N)	6	.05	(1)	.10	.04	86.9
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	2	.11	.06	.15	.1	60.6
Iron, dissolved (micrograms per liter as Fe)	1	--	(1)	(1)	--	--
Solids, sum of constituents, dissolved (milligrams per liter)	15	444	267	560	80.9	18.2

(1)Not detected.

Cache Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Cache Valley, and according to Bjorklund and McGreevy (1971, pl. 5), the water generally is fresh. Two observation wells, (A-11-1)8dda-3 and (A-13-1)29bcd-1 (both completed in basin fill), have been established in the valley (table 1 and fig. 8), with sampling at well (A-11-1)8dda-3 beginning in 1964 and at well (A-13-1)29bcd-1 in 1970. No large change has been detected in the concentration of dissolved solids or any major ion since monitoring was started at the observation wells. Additional information about ground-water quality in Cache Valley is available in a report by Bjorklund and McGreevy (1971, p. 38-43), and a statistical analysis of all chemical analyses of water from the observation wells is presented in table 8.

Cedar City Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Cedar City Valley. The water in the valley ranges from fresh to slightly saline (Price, 1981b), with the slightly saline water mostly in the central part of the valley. Nine observation wells have been established in the valley (table 1 and fig. 9), and they all are completed in the basin fill. Monitoring began at four of the wells during 1961-66 and at the other wells during 1973-77. Dissolved-solids concentrations in water samples collected from the observation wells ranged from 230 milligrams per liter on June 30, 1982, at well (C-36-12)21cbb-1 to 1,000 milligrams per liter on June 17, 1976, at well (C-35-11)33cac-1. (See also table 9.) There has been no significant deterioration in the chemical quality of water produced by the wells during the monitoring period. There actually was a net decrease that exceeded 20 percent in dissolved-solids concentrations in water produced by well (C-36-12)12dba-1 during 1961-82. This may reflect increased recharge with fresh water from Coal Creek, which had greater-than-average flow during the period. The observation well is in an area where ground-water levels rose as much as 10 feet from March 1963 to March 1983 (Appel and others 1983, fig. 42). Bjorklund, Sumsion, and Sandberg (1978, p.45-52) describe in more detail the chemical quality of ground water in Cedar City Valley.

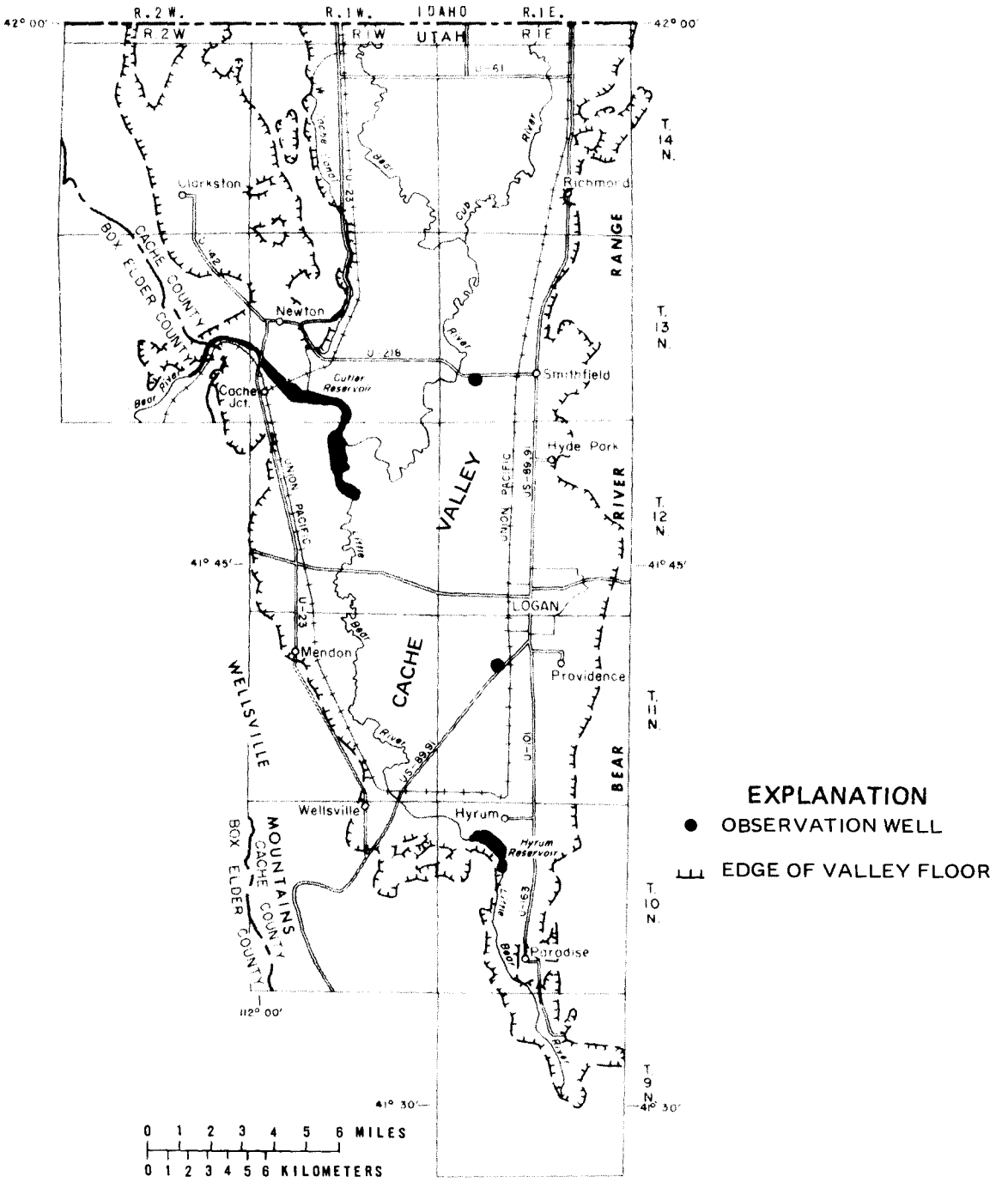


Figure 8.—Location of observation wells in Cache Valley.

Table 8.--Statistical analysis of chemical analyses of water from the observation wells in Cache Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	33	480	405	580	37.6	7.8
pH (standard units)	22	7.4	6.2	8	.5	6.3
Temperature (degrees Celsius)	33	11	8	14.5	1.5	13.0
Hardness (milligrams per liter as $CaCO_3$)	13	240	170	280	42.4	17.8
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	13	14	0	33	12.1	89.2
Calcium, dissolved (milligrams per liter as Ca)	10	53	37	67	13.1	24.8
Magnesium, dissolved (milligrams per liter as Mg)	10	24	20	27	2.5	10.5
Sodium, dissolved (milligrams per liter as Na)	10	17	6.4	30	10.9	64.6
Sodium plus potassium, dissolved (milligrams per liter as Na)	2	20	9	31	15.6	77.8
Potassium, dissolved (milligrams per liter as K)	10	1.5	1.2	2.6	.4	26.3
Bicarbonate (milligrams per liter as HCO_3)	9	300	270	310	14.4	4.8
Carbonate (milligrams per liter as CO_3)	9	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	4	230	210	250	17.1	7.5
Sulfate, dissolved (milligrams per liter as SO_4)	10	19	9	28	7.2	38.4
Chloride, dissolved (milligrams per liter as Cl)	11	9.8	7.2	13	2.1	21.6
Fluoride, dissolved (milligrams per liter as F)	8	.2	.1	.5	.1	79.4
Silica, dissolved (milligrams per liter as SiO_2)	10	9.9	9	11	.7	6.8
Nitrite plus nitrate, dissolved (milligrams per liter as N)	7	.88	.13	2.2	.8	84.6
Iron, dissolved (micrograms per liter as Fe)	4	110	7	260	124.8	111.6
Manganese, dissolved (micrograms per liter as Mn)	4	25	1	56	27.6	111.6
Solids, sum of constituents, dissolved (milligrams per liter)	10	271	250	290	16.6	6.1

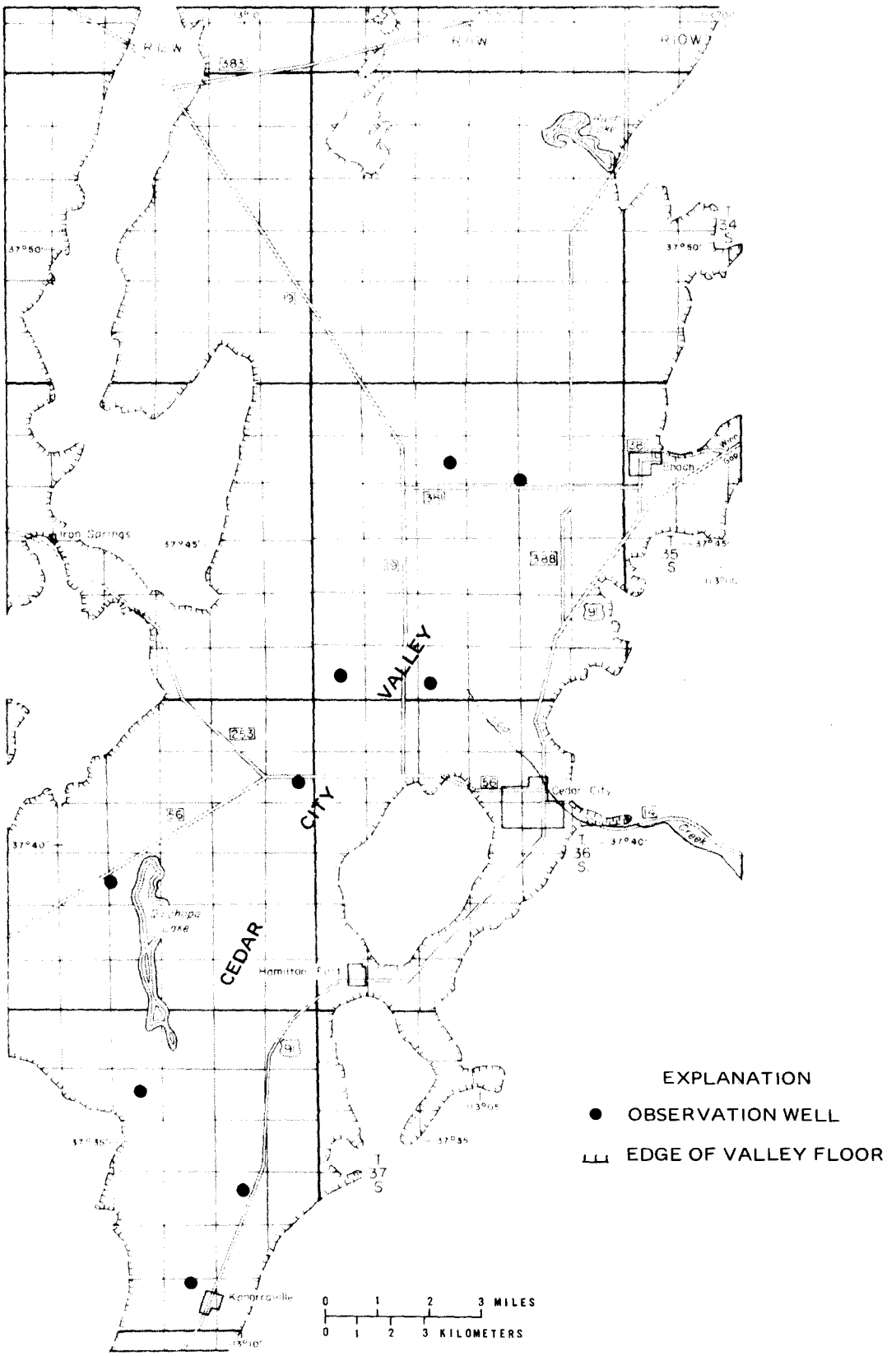


Figure 9.—Location of observation wells in Cedar City Valley.

Table 9.--Statistical analysis of chemical analyses of water from the observation wells in Cedar City Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	73	740	320	1610	267.7	36.3
pH (standard units)	46	7.6	6.7	8.3	.4	5.0
Temperature (degrees Celsius)	74	14	10.5	20.0	2.2	16.2
Hardness (milligrams per liter as $CaCO_3$)	43	410	140	960	206.0	50.0
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	43	210	8	710	161.0	76.4
Calcium, dissolved (milligrams per liter as Ca)	39	91	39	200	47.5	52.2
Magnesium, dissolved (milligrams per liter as Mg)	39	41	5.6	86	20.8	50.6
Sodium, dissolved (milligrams per liter as Na)	35	20	8.5	37	8.5	42.6
Sodium plus potassium, dissolved (milligrams per liter as Na)	11	20	7.8	39	9.4	45.8
Potassium, dissolved (milligrams per liter as K)	34	2.9	1.5	4.6	.9	29.7
Bicarbonate (milligrams per liter as HCO_3)	21	290	140	390	88.2	30.8
Carbonate (milligrams per liter as CO_3)	20	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	14	170	120	340	62.1	36.1
Sulfate, dissolved (milligrams per liter as SO_4)	41	210	12	670	152.9	72.7
Chloride, dissolved (milligrams per liter as Cl)	46	19	8.2	73	12.8	66.2
Fluoride, dissolved (milligrams per liter as F)	32	.2	.03	1.1	.2	72.3
Silica, dissolved (milligrams per liter as SiO_2)	36	25	7.3	54	11.8	46.7
Nitrite plus nitrate, dissolved (milligrams per liter as N)	34	2.4	.31	8.2	2.5	104.2
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	12	.09	(1)	.28	.1	76.9
Iron, dissolved (micrograms per liter as Fe)	21	10	(1)	29	7.2	70.7
Manganese, dissolved (micrograms per liter as Mn)	21	3	(1)	10	3.6	115.1
Solids, sum of constituents, dissolved (milligrams per liter)	39	513	230	1000	224.1	43.7

(1) Not detected.

Cedar Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Cedar Valley, and the water ranges from fresh to slightly saline (Feltis, 1967, fig. 7). Four observation wells (all completed in basin fill) have been established in the valley (table 1 and fig. 10), and monitoring was started at the wells during 1965. Dissolved-solids concentrations in water samples collected from the wells ranged from 230 milligrams per liter on June 17, 1975, at well (C-6-2)29bdd-1 to 430 milligrams per liter on June 7, 1978, at well (C-6-1)18cdd-1. (See also table 10.) No significant change in the chemical quality of the water in the vicinity of the four observation wells has been detected since monitoring began in 1965.

Central Sevier Valley

Unconsolidated deposits (stream-valley alluvium) are the principal source of ground water in the central Sevier Valley. The water generally is fresh, except in the Richfield-Salina area where locally it is slightly to moderately saline. (See Price, 1981a.) Five observation wells have been established in the central Sevier Valley (table 1 and fig. 11). Four of the wells reportedly are completed in the stream-valley alluvium, and the fifth well, (C-18-1)25ddc-1, probably is completed in older rocks. Monitoring was started at most of the wells during 1957-65. Dissolved-solids concentrations in water samples collected from the wells ranged from 300 milligrams per liter on August 27, 1981, at well (C-23-2)19dab-1 to 1,130 milligrams per liter on June 26, 1970, at well (C-24-2)6abc-1. (See also table 11.) There has been no significant net change in the dissolved-solids concentrations in the water samples collected from the observation wells. This indicates that there has been no significant change in the chemical quality of water in the vicinity of the observation wells.

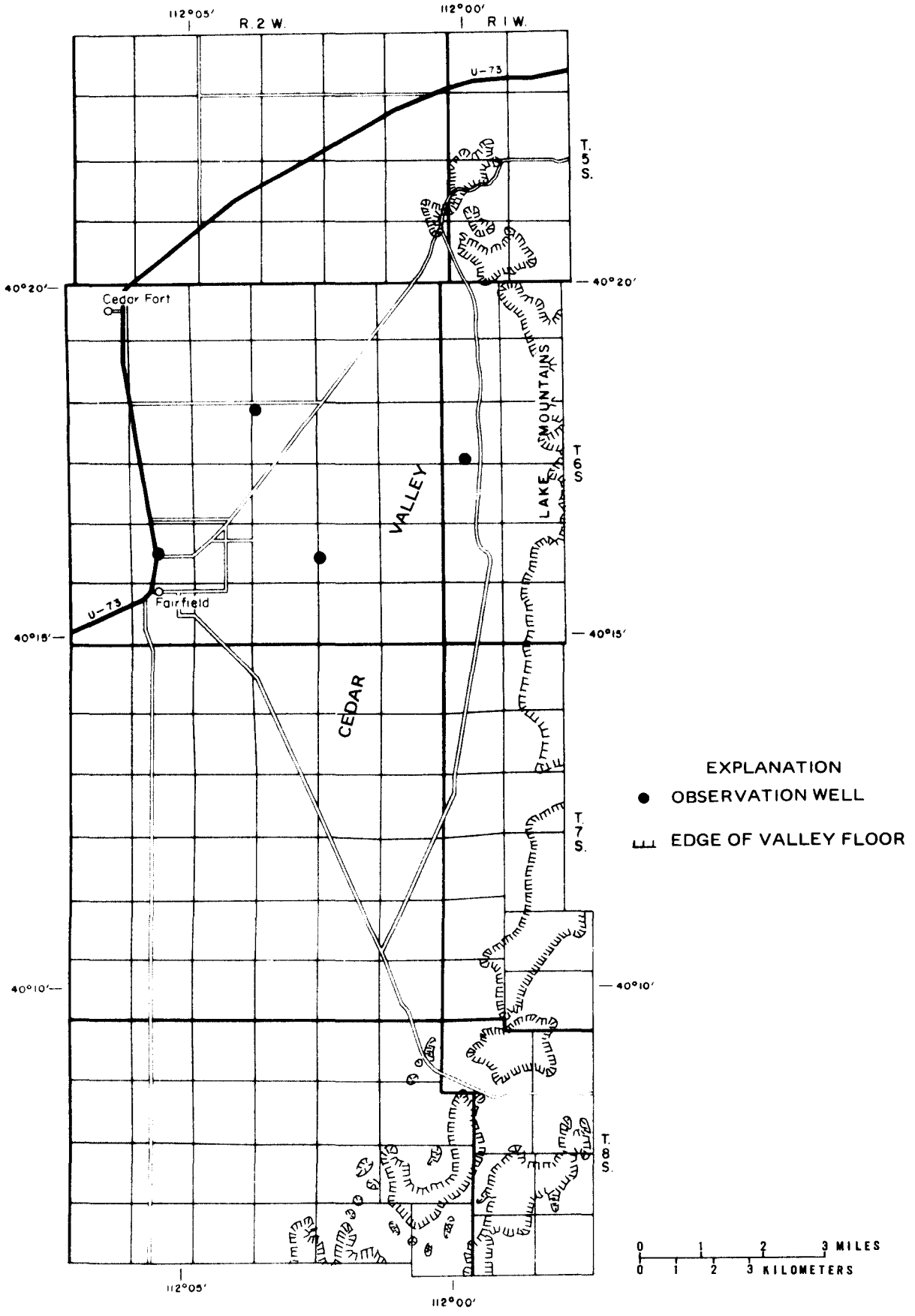


Figure 10.—Location of observation wells in Cedar Valley.

Table 10.--Statistical analysis of chemical analyses of water from the observation wells in Cedar Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	29	520	390	720	123.7	23.7
pH (standard units)	22	7.6	7.1	8.2	.3	3.6
Temperature (degrees Celsius)	29	16.0	10	30.5	8.4	51.7
Hardness (milligrams per liter as $CaCO_3$)	21	240	210	330	36.4	15.0
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	21	46	5	120	34.0	74.8
Calcium, dissolved (milligrams per liter as Ca)	21	54	36	80	14.2	26.2
Magnesium, dissolved (milligrams per liter as Mg)	21	26	17	33	5.5	21.3
Sodium, dissolved (milligrams per liter as Na)	20	21	5.9	42	12.5	58.7
Sodium plus potassium, dissolved (milligrams per liter as Na)	2	21	20	22	1.4	6.7
Potassium, dissolved (milligrams per liter as K)	17	2.7	.9	3.9	1.2	45.3
Bicarbonate (milligrams per liter as HCO_3)	16	240	180	260	20.3	8.5
Carbonate (milligrams per liter as CO_3)	13	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	3	200	180	210	14.5	7.3
Sulfate, dissolved (milligrams per liter as SO_4)	21	36	15	75	21.5	58.8
Chloride, dissolved (milligrams per liter as Cl)	21	36	14	80	24.7	69.3
Fluoride, dissolved (milligrams per liter as F)	17	.3	.1	.7	.2	66.9
Silica, dissolved (milligrams per liter as SiO_2)	21	32	10	58	19.7	61.9
Nitrite plus nitrate, dissolved (milligrams per liter as N)	17	1.1	.08	10	2.3	212.1
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	12	.07	(1)	.25	.1	116.3
Iron, dissolved (micrograms per liter as Fe)	12	20	(1)	90	23.7	122.8
Manganese, dissolved (micrograms per liter as Mn)	12	12	1	30	8.1	66.6
Solids, sum of constituents, dissolved (milligrams per liter)	21	326	230	430	72.4	22.2

(1) Not detected.

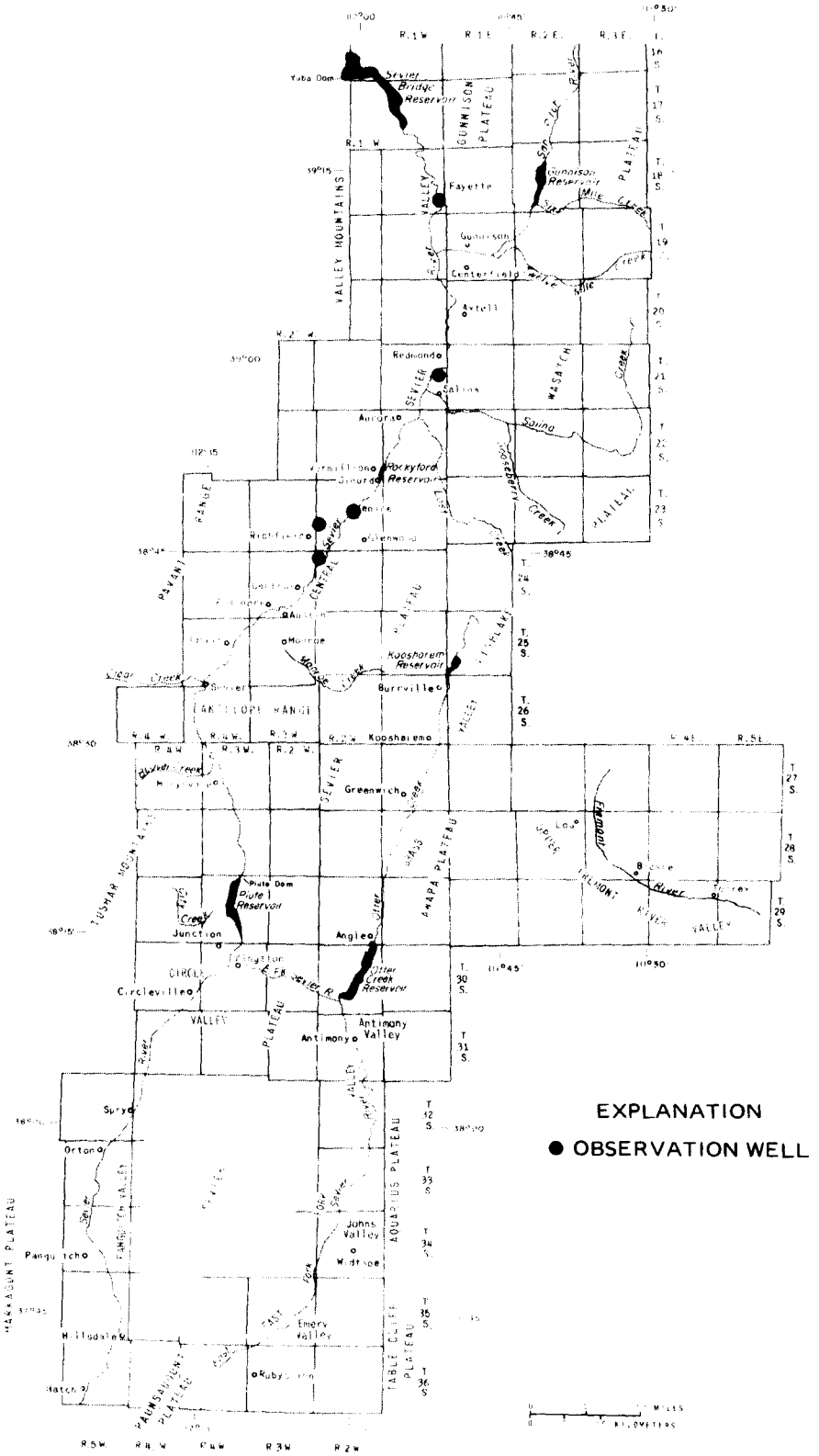


Figure 11.—Location of observation wells in the central Sevier Valley.

Table 11.--Statistical analysis of chemical analyses of water from the observation wells in the central Sevier Valley

Number: Number of determined values for the indicated property or constituent.

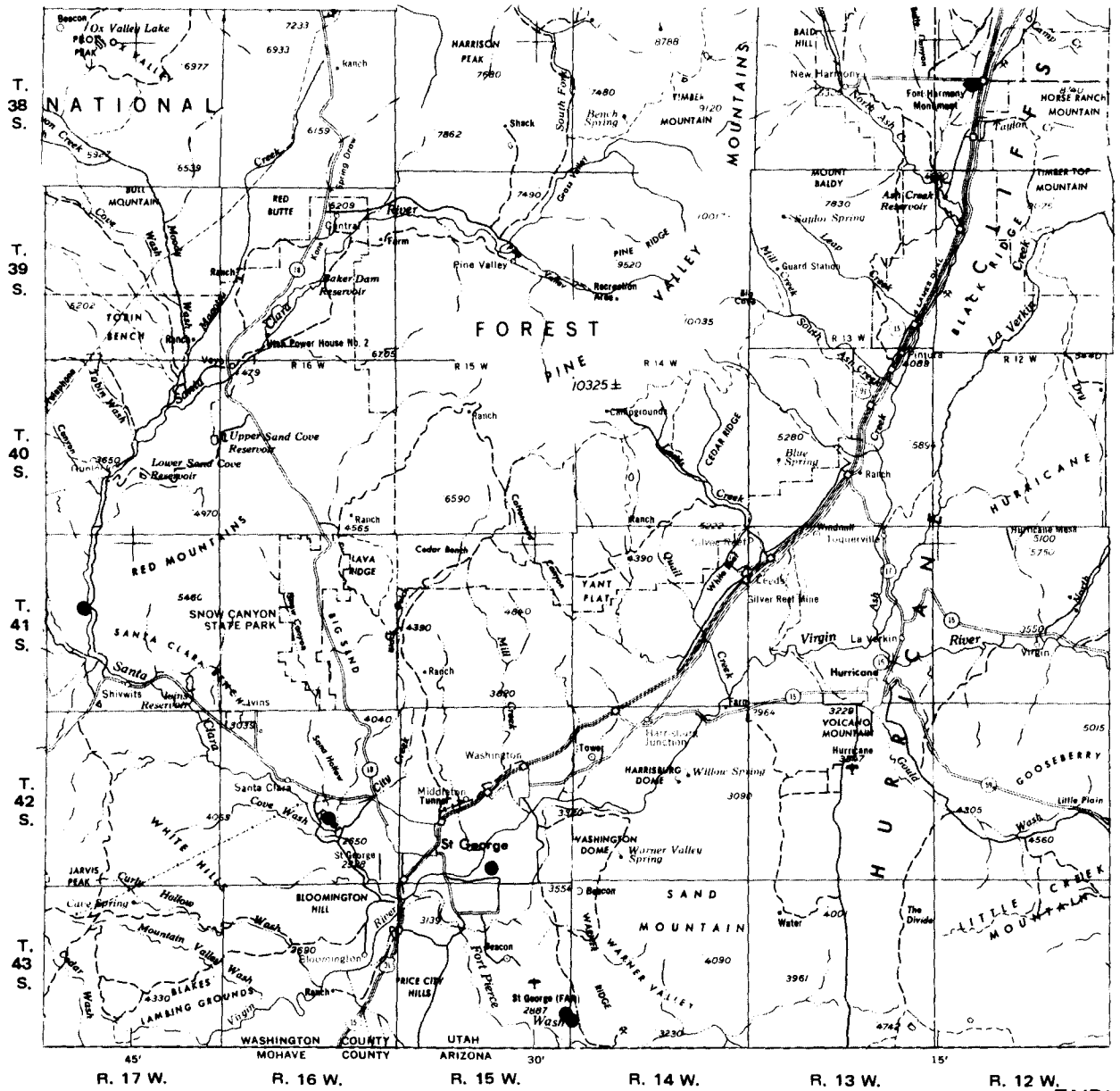
Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	169	990	480	1930	469.5	47.5
pH (standard units)	37	7.6	7.1	8.0	.2	2.9
Temperature (degrees Celsius)	69	12.5	9	19.0	2.6	21.05
Hardness (milligrams per liter as $CaCO_3$)	37	410	140	750	134.9	33.0
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	37	160	12	420	110.4	70.9
Calcium, dissolved (milligrams per liter as Ca)	28	89	30	200	47.1	52.8
Magnesium, dissolved (milligrams per liter as Mg)	28	44	17	69	12.2	28.0
Sodium, dissolved (milligrams per liter as Na)	27	74	15	210	72.3	97.2
Sodium plus potassium, dissolved (milligrams per liter as Na)	8	65	21	210	61.6	94.6
Potassium, dissolved (milligrams per liter as K)	24	3.5	2.3	4.7	.6	18.1
Bicarbonate (milligrams per liter as HCO_3)	30	320	270	410	28.9	9.1
Carbonate (milligrams per liter as CO_3)	30	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	5	230	120	310	77.7	33.6
Sulfate, dissolved (milligrams per liter as SO_4)	35	170	5.0	550	158.2	91.4
Chloride, dissolved (milligrams per liter as Cl)	42	100	19	420	144.7	142.6
Fluoride, dissolved (milligrams per liter as F)	12	.4	.2	.6	.2	36.7
Silica, dissolved (milligrams per liter as SiO_2)	25	26	6.0	41	9.1	34.9
Nitrite plus nitrate, dissolved (milligrams per liter as N)	10	.6	.07	2.5	.8	124.7
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	2	.06	.03	.09	.04	70.7
Iron, dissolved (micrograms per liter as Fe)	7	263	3	1800	677.8	257.7
Manganese, dissolved (micrograms per liter as Mn)	7	55	1	370	139.0	253.4
Solids, sum of constituents, dissolved (milligrams per liter)	28	652	300	1130	281.8	43.2

Central Virgin River Area

The principal water-yielding rocks in the central Virgin River area include unconsolidated deposits (stream-valley alluvium) and consolidated rocks (chiefly sandstone and conglomerate). The water ranges from fresh to moderately saline depending on the geologic unit in which it occurs. (See Cordova and others, 1972, table 3.) Six observation wells have been established in the area (table 1 and fig. 12). Four of the wells are completed in unconsolidated deposits, and the other two wells are completed in consolidated rocks. Dissolved-solids concentrations in water samples collected from the wells ranged from 270 milligrams per liter on August 24, 1979, at well (C-41-17)17cba-1 to 4,300 milligrams per liter on August 4, 1983, at well (C-42-15)34dba-2. (See also table 12.) There were no significant overall changes in the dissolved-solids concentrations at any of the observation wells. This indicates that there has been no significant change in the chemical quality of the water in the vicinity of any of the wells since monitoring began in 1967. Cordova and others (1972, p. 30-34) describe in more detail the chemical quality of ground water in the central Virgin River area.

Cove Fort Area

The principal water-yielding rocks in the Cove Fort area probably are unconsolidated deposits (basin fill). The water in the basin fill generally is fresh, but it is slightly to moderately saline west of Cove Fort. (See Price, 1981a.) Also, very saline thermal water occurs in the consolidated rocks beneath the basin fill in the Cove Fort area. The single observation well, (C-26-7)26cac-1, which has been established in the area (table 1 and fig. 13) is 250 feet deep and probably is completed in the basin fill. Dissolved-solids concentrations in water samples collected from the well since 1977 ranged from 370 to 420 milligrams per liter, and there is no indication of any significant overall change in the chemical quality of water produced by the well. The maximum recorded water temperature at the well was 17° C (nonthermal water); and this, and the freshness of the water, indicate that there is no upward discharge to the basin fill at the well of the thermal water in the underlying consolidated rocks. A statistical analysis of chemical analyses of all water samples collected at well (C-26-7)26cac-1 is presented in table 13.



Base from U. S. Geological Survey 1:250,000 series Cedar City, Utah, 1953 (revised 1971)

EXPLANATION

● OBSERVATION WELL

0 5 10 15 20 MILES

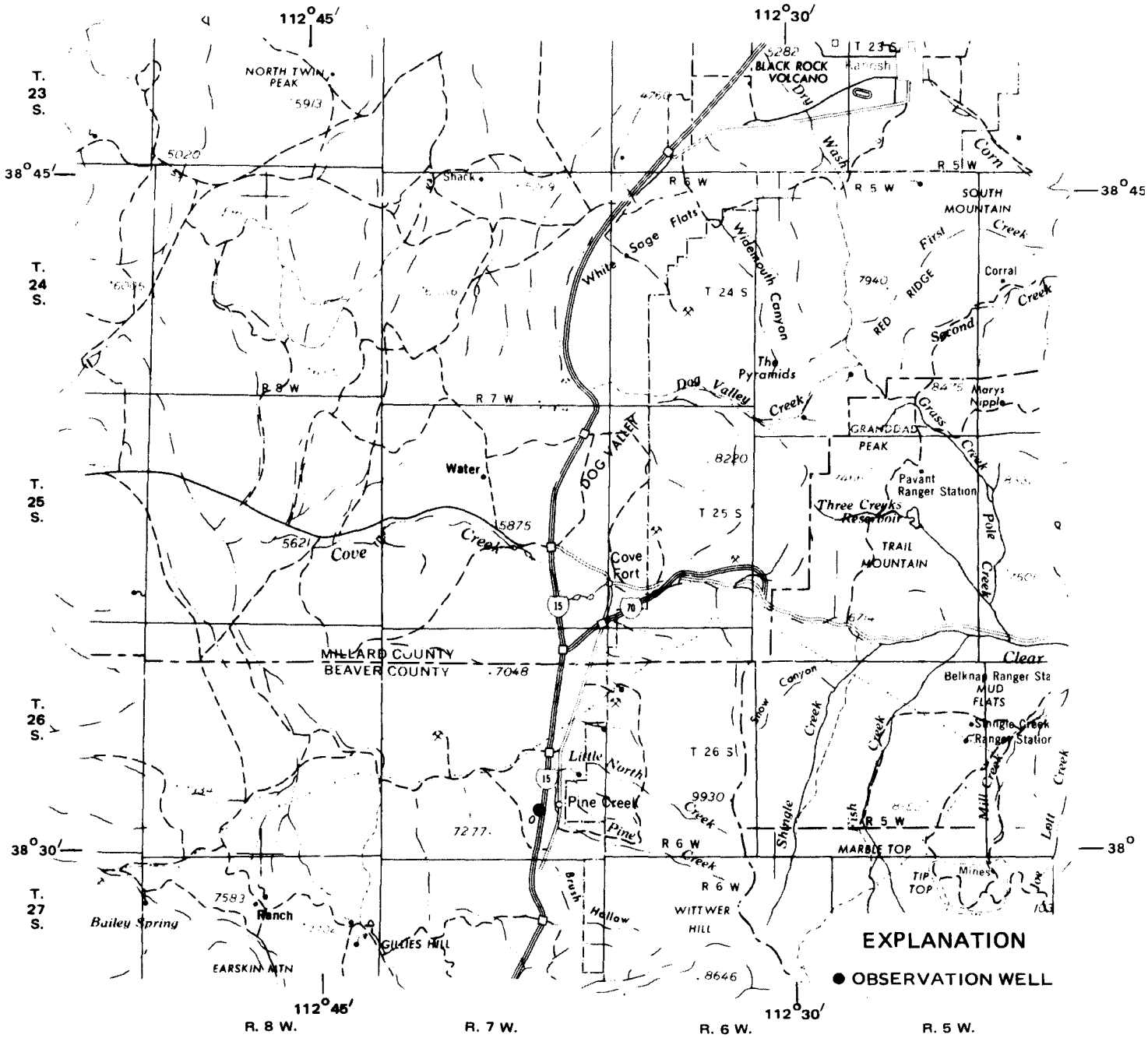
0 5 10 15 20 KILOMETERS

Figure 12.—Location of observation wells in the central Virgin River area.

Table 12.--Statistical analysis of chemical analyses of water from the observation wells in the central Virgin River area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	33	1950	425	5660	1423.4	72.9
pH (standard units)	21	7.3	6.6	8	.3	4.5
Temperature (degrees Celsius)	32	18	13.0	25	2.0	11.3
Hardness (milligrams per liter as $CaCO_3$)	22	1300	180	2300	825.3	61.6
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	21	1200	0	2200	897.8	74.9
Calcium, dissolved (milligrams per liter as Ca)	21	370	50	620	233.0	62.7
Magnesium, dissolved (milligrams per liter as Mg)	21	110	13	190	62.8	59.6
Sodium, dissolved (milligrams per liter as Na)	19	120	13	510	114.1	95.2
Sodium plus potassium, dissolved (milligrams per liter as Na)	4	1400	16	210	89.2	61.2
Potassium, dissolved (milligrams per liter as K)	19	10	1.8	20	6.9	68.9
Bicarbonate (milligrams per liter as HCO_3)	13	210	81	490	135.5	63.1
Carbonate (milligrams per liter as CO_3)	13	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	6	160	83	310	89.3	56.0
Sulfate, dissolved (milligrams per liter as SO_4)	22	1200	29	2300	903.8	73.2
Chloride, dissolved (milligrams per liter as Cl)	21	98	15	760	156.1	160.0
Fluoride, dissolved (milligrams per liter as F)	13	.3	.2	1.1	.2	66.9
Silica, dissolved (milligrams per liter as SiO_2)	20	20	12	38	7.6	37.1
Nitrite plus nitrate, dissolved (milligrams per liter as N)	11	6.6	.56	16	5.4	82.8
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	3	.06	.03	.09	.03	50.0
Iron, dissolved (micrograms per liter as Fe)	6	40	5	100	33.8	86.4
Manganese, dissolved (micrograms per liter as Mn)	6	15	10	20	5.2	35.2
Solids, sum of constituents, dissolved (milligrams per liter)	21	2100	270	4300	1341.3	63.9



Base from U. S. Geological Survey 1:250,000
series Richfield, Utah, 1953 (revised 1972)

0 1 2 3 4 5 10 MILES
0 1 2 3 4 5 10 KILOMETERS

Figure 13.—Location of observation well in the Cove Fort area.

Table 13.--Statistical analysis of chemical analyses of water from the observation well in the Cove Fort area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	7	670	590	740	50.1	7.5
pH (standard units)	5	7.8	7.5	8.4	.4	4.8
Temperature (degrees Celsius)	6	15.5	15.0	17	.8	5.1
Hardness (milligrams per liter as $CaCO_3$)	5	290	260	310	20.7	7.2
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	5	110	90	130	15.2	13.3
Calcium, dissolved (milligrams per liter as Ca)	5	87	80	94	5.8	6.6
Magnesium, dissolved (milligrams per liter as Mg)	5	17	15	18	1.3	7.8
Sodium, dissolved (milligrams per liter as Na)	5	25	24	26	.9	3.6
Sodium plus potassium, dissolved (milligrams per liter as Na)	1	--	28	28	--	--
Potassium, dissolved (milligrams per liter as K)	5	3	2.5	3.3	.3	9.7
Bicarbonate (milligrams per liter as HCO_3)	2	220	210	220	7.1	3.3
Carbonate (milligrams per liter as CO_3)	2	1	0	2	1.4	141.4
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	1	--	170	170	--	--
Sulfate, dissolved (milligrams per liter as SO_4)	5	33	25	40	5.4	16.2
Chloride, dissolved (milligrams per liter as Cl)	5	93	82	100	6.8	7.2
Fluoride, dissolved (milligrams per liter as F)	5	.3	.2	.4	.1	34.4
Silica, dissolved (milligrams per liter as SiO_2)	5	42	40	44	1.5	3.6
Nitrite plus nitrate, dissolved (milligrams per liter as N)	4	2	1.8	2.3	.2	10.8
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	1	--	.03	.03	--	--
Iron, dissolved (micrograms per liter as Fe)	2	10	6	20	9.9	76.2
Manganese, dissolved (micrograms per liter as Mn)	2	2	(1)	3	2.1	141.4
Solids, sum of constituents, dissolved (milligrams per liter	5	402	370	420	21.7	5.4

(1) Not detected.

Curlew Valley

Unconsolidated deposits (basin fill) and consolidated rocks (basalt) are the principal sources of ground water in Curlew Valley. The water generally is fresh to slightly saline in most of the valley; but it generally ranges from slightly saline to briny in the southern part of the valley, which opens to Great Salt Lake (Baker, 1974, pl. 4). Thirteen observation wells have been established in the valley (table 1 and fig. 14). Seven of the wells reportedly are completed in the basin fill, and the other six wells also probably are completed in the fill. Collection of water samples from several of the wells began in the early 1960's and from the other wells during the late 1960's and early 1970's. Dissolved-solids concentrations in water samples collected from the wells ranged from 310 milligrams per liter on July 6, 1978, at well (B-15-10)36bbb-1 to 3,500 milligrams per liter on August 9, 1983, at well (B-15-9)28cbc-1. (See also table 14.) A progressive increase in dissolved-solids concentrations (more than 1,000 milligrams per liter) in the samples from well (B-15-9)28cbc-1 has been detected since monitoring began in 1964. This chiefly reflects a progressive increase of chloride concentration, which indicates encroachment of more saline water into the aquifer yielding water to the well. The saline-water encroachment may be related to large-scale withdrawal of water for irrigation (Baker, 1974, p. 26).

East Shore Area

Unconsolidated deposits (basin fill) are the principal source of ground water in the East Shore area. The water generally is fresh, but it is slightly saline northwest of Ogden and southwest of Bountiful (Price, 1985, fig. 32). Twenty observation wells have been established in the East Shore area (table 1 and fig. 15), and they all are completed in the basin fill. Sampling was done at well (A-2-1)7aba-4 in 1947, and it was started at the other wells during 1948-71. Dissolved-solids concentrations in the water samples collected from the wells ranged from 144 milligrams per liter on September 9, 1969, at well (B-7-2)2cba-5 to 1,750 milligrams per liter on August 20, 1968, at well (B-2-1)34add-2. Water-level declines exceeding 50 feet at, north, and west of Hill Air Force Base have resulted from large, continuing withdrawals of ground water for public and industrial supply. These large declines, however, apparently have not significantly affected the chemical quality of the water in the general area of the observation wells in the monitoring network. Bolke and Waddell (1972, p. 18-22) describe in more detail the chemical quality of ground water in the East Shore area. A statistical analysis of all chemical analyses of water samples collected from the observation wells is presented in table 15.

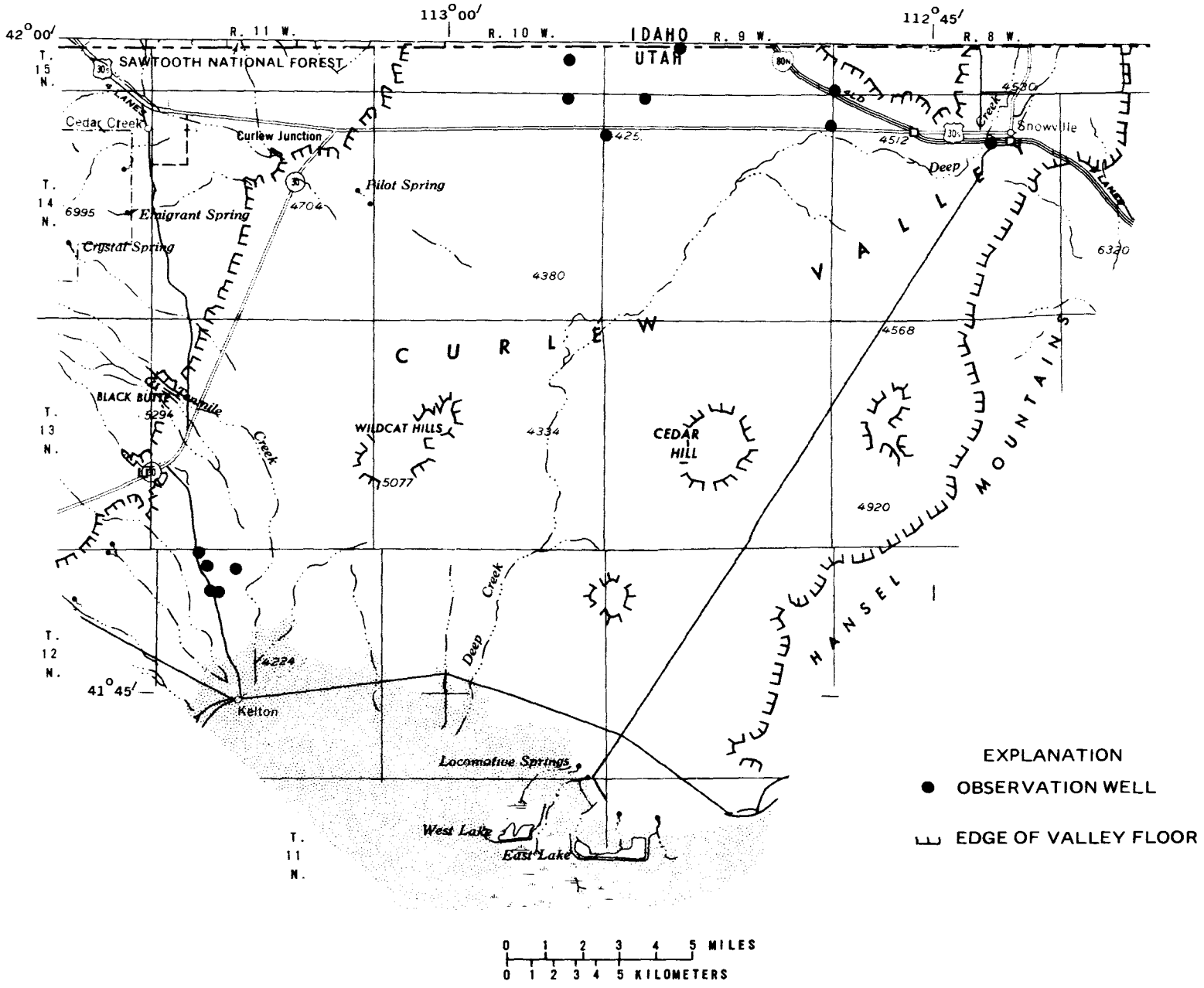


Figure 14.—Location of observation wells in Curlew Valley.

Table 14.--Statistical analysis of chemical analyses of water from the observation wells in Curlew Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	113	1990	440	6100	1448.1	72.6
pH (standard units)	86	7.3	6.6	7.9	.3	3.7
Temperature (degrees Celsius)	111	17.0	11.5	24.5	3.5	21.1
Hardness (milligrams per liter as $CaCO_3$)	69	690	180	1600	421.4	61.0
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	69	520	45	1500	416.5	80.7
Calcium, dissolved (milligrams per liter as Ca)	69	180	54	450	118.8	63.9
Magnesium, dissolved (milligrams per liter as Mg)	69	55	12	120	32.3	59.2
Sodium, dissolved (milligrams per liter as Na)	68	180	18	700	173.9	99.2
Sodium plus potassium, dissolved (milligrams per liter as Na)	5	200	37	560	236.5	115.2
Potassium, dissolved (milligrams per liter as K)	68	14	2.5	42	10.1	70.5
Bicarbonate (milligrams per liter as HCO_3)	51	210	130	400	69.0	32.4
Carbonate (milligrams per liter as CO_3)	51	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	14	170	100	250	45.0	26.7
Sulfate, dissolved (milligrams per liter as SO_4)	69	71	.2	310	74.1	104.3
Chloride, dissolved (milligrams per liter as Cl)	72	610	56	2000	533.5	87.0
Fluoride, dissolved (milligrams per liter as F)	59	.3	.1	1.6	.3	85.3
Silica, dissolved (milligrams per liter as SiO_2)	63	45	19	79	18.8	41.5
Nitrite plus nitrate, dissolved (milligrams per liter as N)	53	2.2	(1)	10	2.2	99.5
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	35	.1	(1)	.28	.1	80.4
Iron, dissolved (micrograms per liter as Fe)	43	30	4	150	29.0	103.0
Manganese, dissolved (micrograms per liter as Mn)	43	9	(1)	38	6.2	70.6
Solids, sum of constituents, dissolved (milligrams per liter)	63	1240	310	3500	881.1	71.2

(1) Not detected.

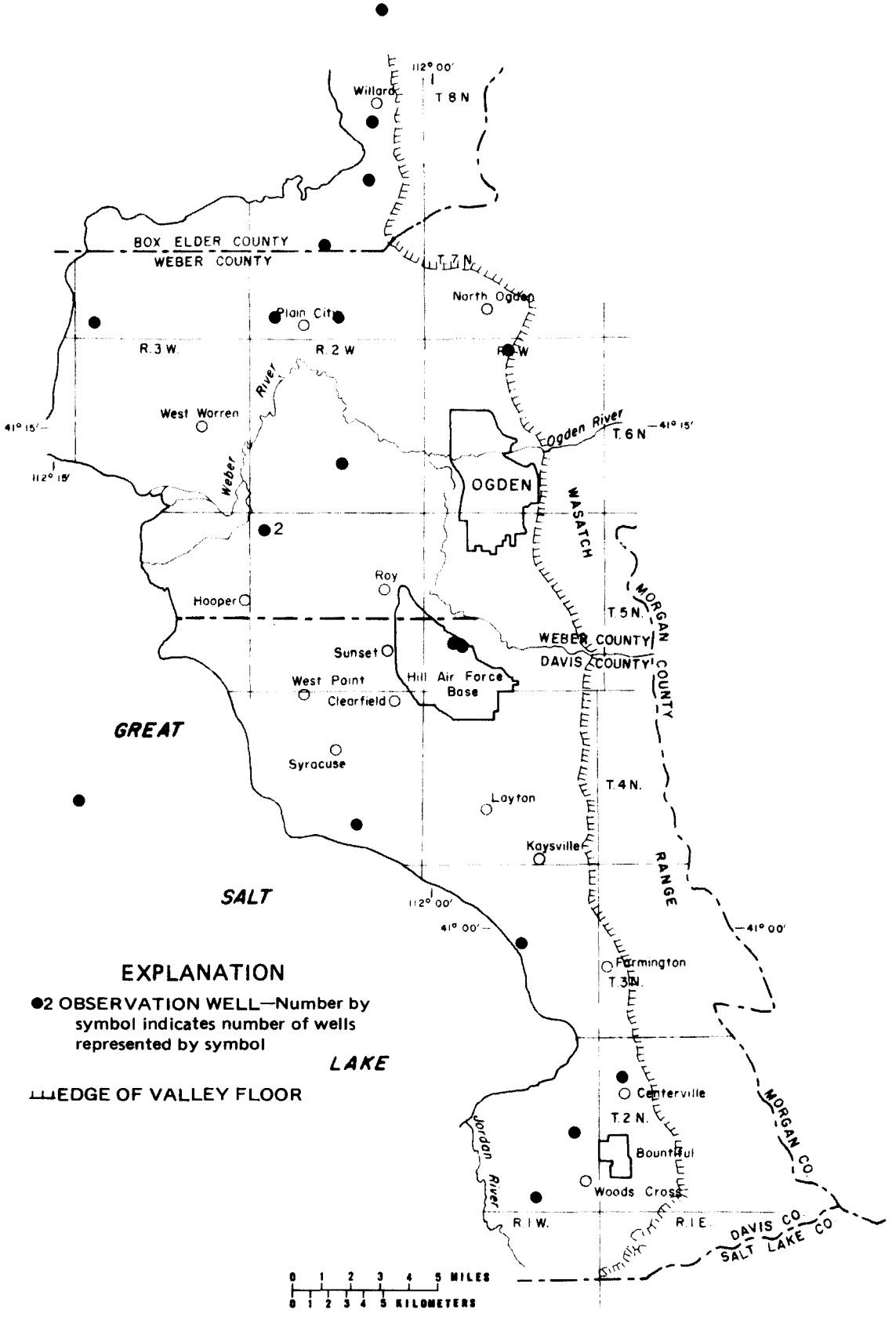


Figure 15.—Location of observation wells in the East Shore area. (One observation well is north of the map area).

Table 15.--Statistical analysis of chemical analyses of water from the observation wells in the East Shore area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	273	840	230	3230	707.3	83.7
pH (standard units)	180	7.7	6.9	8.8	.3	4.2
Temperature (degrees Celsius)	265	18	10.5	40.5	6.2	34.7
Hardness (milligrams per liter as $CaCO_3$)	173	220	9	590	133.3	60.4
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	173	67	0	480	119.0	178.2
Calcium, dissolved (milligrams per liter as Ca)	159	62	1.9	160	35.1	56.9
Magnesium, dissolved (milligrams per liter as Mg)	159	17	0.9	48	11.5	68.4
Sodium, dissolved (milligrams per liter as Na)	129	130	7.3	430	123.3	93.0
Sodium plus potassium, dissolved (milligrams per liter as Na)	36	75	13	460	107.9	143.3
Potassium, dissolved (milligrams per liter as K)	126	8.1	.1	100	11.9	146.4
Bicarbonate (milligrams per liter as HCO_3)	132	250	120	570	83.9	33.6
Carbonate (milligrams per liter as CO_3)	121	0.4	0	25	3.0	708.2
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	27	200	100	310	55.2	27.2
Sulfate, dissolved (milligrams per liter as SO_4)	159	17	(1)	44	15.0	87.0
Chloride, dissolved (milligrams per liter as Cl)	181	190	7.2	1000	270.3	142.6
Fluoride, dissolved (milligrams per liter as F)	115	.3	(1)	.7	.2	69.7
Silica, dissolved (milligrams per liter as SiO_2)	148	22	7.0	67	12.3	56.8
Nitrite plus nitrate, dissolved (milligrams per liter as N)	75	.5	(1)	5	.8	172.8
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	34	.5	(1)	4	1.0	197.7
Iron, dissolved (micrograms per liter as Fe)	53	310	1	2100	449.9	145.0
Manganese, dissolved (micrograms per liter as Mn)	52	96	(1)	340	104.9	108.9
Solids, sum of constituents, dissolved (milligrams per liter)	150	541	144	1750	395.3	73.0

(1) Not detected.

Goshen Valley

Unconsolidated deposits (basin fill) are the principal water-yielding rocks in Goshen Valley. The ground water near Goshen Bay of Utah Lake generally is slightly saline and locally moderately saline (Price, 1985, fig. 30), whereas elsewhere in Goshen Valley the ground water varies from fresh to slightly saline. Twelve observation wells have been established in the valley (table 1 and fig. 16), and they all probably are completed in the basin fill. Dissolved-solids concentrations in water samples collected from the wells ranged from 360 milligrams per liter on August 21, 1975, at well (C-11-1)6abc-1 to 2,600 milligrams per liter on August 11, 1972, at well (C-10-1)3ddb-1. (See also table 16.) The above mentioned maximum dissolved-solids concentration of 2,600 milligrams per liter was anomalous for the period of record at well (C-10-1)3ddb-1. It reflects significant short term increases in chloride and sulfate concentrations in water yielded by the well, but there is no definite explanation for these short-term increases. It does, however, indicate possible short-term contamination of ground water in the immediate vicinity of the well.

There was a progressive increase in dissolved-solids concentration in the water from well (C-9-1)4ccc-1 during 1975-82. The well is in an area of large withdrawals of ground water for irrigation, and declining water levels (Appel and others, 1983, fig. 21) associated with these large withdrawals may have induced the movement of more saline ground water in the Goshen Bay area to the vicinity of the well. This also may be the explanation for a progressive increase in salinity detected in the samples at wells (C-10-1)4cbb-1 and (C-10-1)17aaa-1. The source of the relatively large concentrations of nitrite plus nitrate (42-46 milligrams per liter) in the water produced by well (C-10-1)17aaa-1 is not known, but it might be fertilizer used on irrigated land above the aquifer yielding water to the well. Cordova (1970, p. 61) provides additional information about the chemical quality of ground water in Goshen Valley.

Grouse Creek Valley

The principal sources of ground water in Grouse Creek valley are unconsolidated deposits (basin fill and stream-valley alluvium) and partly consolidated sedimentary rocks (probably the Salt Lake Formation of Tertiary age) that underlie most of the valley floor. Ground water throughout the valley generally is fresh (Hood and Price, 1970, pl. 1), but it is slightly to moderately saline in the southernmost part of the valley which opens to the Great Salt Lake Desert. Four observation wells have been established in the valley (table 1 and fig. 17). All the wells probably are completed in the unconsolidated deposits; however, two of the wells also may produce some water from the Salt Lake Formation. Monitoring was started during the late 1950's at three of the wells and in 1968 at the other well. Dissolved-solids concentrations in water samples collected from the wells ranged from 510 milligrams per liter on August 16, 1979, at well (B-10-18)33aaa-1 to 840 milligrams per liter on July 31, 1984, at the same well. (See also table 17.) No large changes or trends in the concentrations of dissolved-solids was detected during the monitoring period for any of the other observation wells. Hood and Price (1970, p. 25-29) provide additional information about the chemical quality of ground water in Grouse Creek valley.

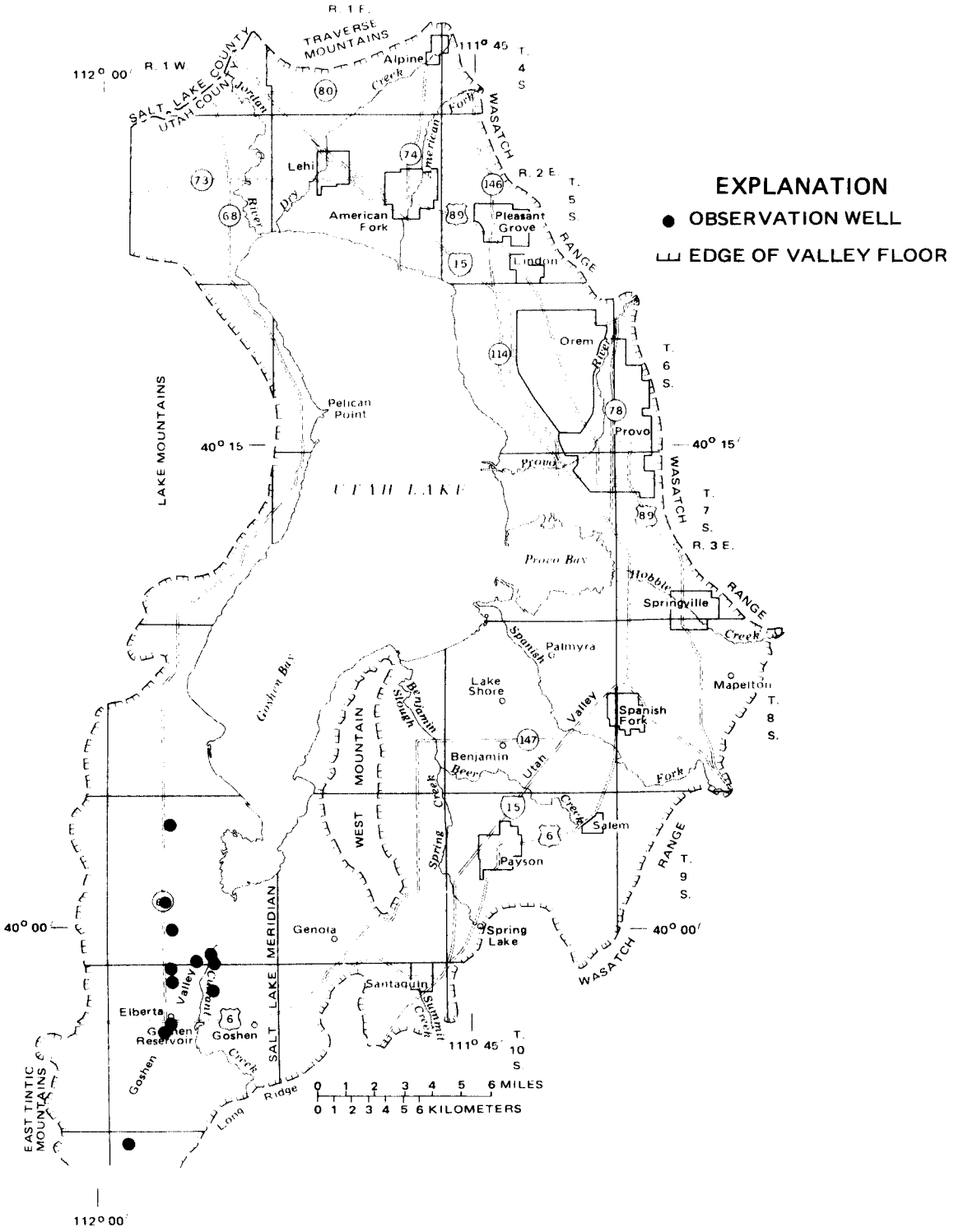


Figure 16.—Location of observation wells in Goshen Valley.

Table 16.--Statistical analysis of chemical analyses of water from the observation wells in Goshen Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	76	1500	580	4010	593.5	39.6
pH (standard units)	56	7.6	6.5	8.6	.5	6.3
Temperature (degrees Celsius)	64	17.5	11.5	20.0	2.3	13.2
Hardness (milligrams per liter as $CaCO_3$)	58	530	160	1200	281.4	53.5
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	58	380	14	1100	295.0	77.1
Calcium, dissolved (milligrams per liter as Ca)	58	120	40	290	66.0	53.0
Magnesium, dissolved (milligrams per liter as Mg)	58	52	14	130	30.9	59.1
Sodium, dissolved (milligrams per liter as Na)	55	110	28	560	74.7	69.2
Sodium plus potassium, dissolved (milligrams per liter as Na)	4	91	30	120	41.1	45.3
Potassium, dissolved (milligrams per liter as K)	55	13	3.5	30	3.9	31.2
Bicarbonate (milligrams per liter as HCO_3)	48	170	68	490	76.5	44.7
Carbonate (milligrams per liter as CO_3)	45	1.8	0	31	6.3	340.4
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	5	140	110	190	32.7	24.0
Sulfate, dissolved (milligrams per liter as SO_4)	58	220	33	620	174.0	79.4
Chloride, dissolved (milligrams per liter as Cl)	58	270	60	830	129.3	47.4
Fluoride, dissolved (milligrams per liter as F)	24	.2	.1	.3	.07	32.6
Silica, dissolved (milligrams per liter as SiO_2)	34	60	35	70	6.0	10.1
Nitrite plus nitrate, dissolved (milligrams per liter as N)	20	10	.73	46	15.2	144.6
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	10	.08	(1)	.15	.04	52.5
Iron, dissolved (micrograms per liter as Fe)	8	20	10	40	10.5	68.0
Manganese, dissolved (micrograms per liter as Mn)	8	2	1	5	1.9	81.0
Solids, sum of constituents, dissolved (milligrams per liter)	44	1020	360	2600	510.2	50.0

(1) Not detected.

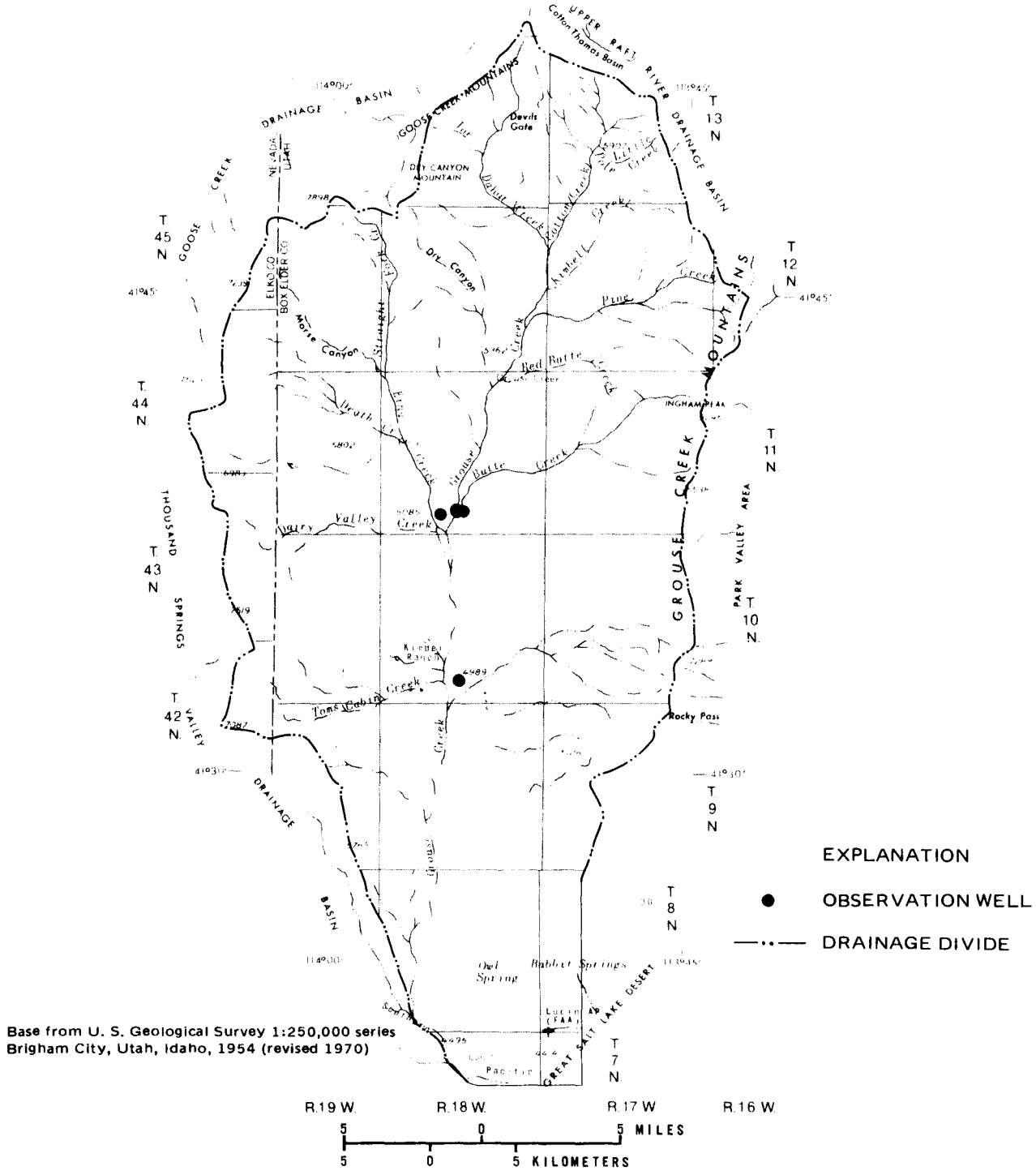


Figure 17.—Location of observation wells in Grouse Creek valley.

Table 17.--Statistical analysis of chemical analyses of water from the observation wells in Grouse Creek valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	36	1050	720	1490	170.7	16.2
pH (standard units)	24	7.5	6.8	8	.3	3.9
Temperature (degrees Celsius)	34	11	9.5	17	2.2	19.2
Hardness (milligrams per liter as $CaCO_3$)	23	390	290	520	59.6	15.3
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	23	110	0	380	96.5	85.0
Calcium, dissolved (milligrams per liter as Ca)	22	110	78	150	17.7	16.5
Magnesium, dissolved (milligrams per liter as Mg)	22	29	21	45	5.4	18.7
Sodium, dissolved (milligrams per liter as Na)	16	82	61	100	13.0	15.8
Sodium plus potassium, dissolved (milligrams per liter as Na)	7	81	46	95	16.0	19.8
Potassium, dissolved (milligrams per liter as K)	16	8.2	6.6	17	2.5	30.2
Bicarbonate (milligrams per liter as HCO_3)	19	360	260	450	48.9	13.8
Carbonate (milligrams per liter as CO_3)	18	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	3	270	240	300	27.9	10.4
Sulfate, dissolved (milligrams per liter as SO_4)	23	100	68	150	23.4	22.5
Chloride, dissolved (milligrams per liter as Cl)	25	130	77	260	50.9	38.8
Fluoride, dissolved (milligrams per liter as F)	13	.3	.2	.5	.08	22.7
Silica, dissolved (milligrams per liter as SiO_2)	20	40	3.2	64	10.6	26.4
Nitrite plus nitrate, dissolved (milligrams per liter as N)	9	1.0	.82	1.3	.18	17.7
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	5	.19	.12	.31	.08	40.2
Iron, dissolved (micrograms per liter as Fe)	8	20	3	40	14.8	77.7
Manganese, dissolved (micrograms per liter as Mn)	8	6	2	10	4.1	65.6
Solids, sum of constituents, dissolved (milligrams per liter)	20	652	510	840	79.5	12.2

Juab Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Juab Valley. The water in the valley generally is fresh, but locally it is slightly saline (Price, 1985, fig. 29; and Bjorklund and Robinson, 1968, p. 50). Twelve observation wells have been established in the valley (table 1 and fig. 18), and all probably are completed in the basin fill. Sampling was started at two of the wells in 1951 and at the other wells during 1965-78. Dissolved-solids concentrations in the samples collected from the observation wells ranged from 580 milligrams per liter on July 9, 1982, at well (C-13-1)1cdd-1 to 1,770 milligrams per liter on May 17, 1965, at well (C-14-1)14cac-1. (See also table 18.) Two water samples from well (D-13-1)17bdd-1 contained relatively large concentrations of nitrite plus nitrate (21 and 42 milligrams per liter as N). The well is 90 feet deep. Possible sources of the nitrogen are animal waste in the vicinity of the well or fertilizers used on surrounding fields.

Kanab Creek Area

Principal sources of ground water in the Kanab Creek area are unconsolidated deposits (stream-valley alluvium) and consolidated sedimentary rocks (chiefly sandstone). The ground water in the Kanab Creek area ranges from fresh to moderately saline depending chiefly on the geologic formation in which the water occurs. (See Price, 1981b and Cordova, 1981, table 2.) Four observation wells have been established in the area (table 1 and fig. 19). Two of the wells are completed in unconsolidated deposits (probably stream-valley alluvium), and the other two are completed in the Navajo Sandstone of Triassic (?) and Jurassic age (Cordova, 1981, table 18). Monitoring was started at all the wells during 1974-82, chiefly to determine baseline ground-water quality before possible development of the large coal reserves in the area. Of principal concern is the Navajo Sandstone, a potential source of water for development of the coal. Dissolved-solids concentrations in the water samples collected from the observation wells ranged from 130 milligrams per liter on August 21, 1980, at well (C-42-6)19bdc-2 which is completed in the Navajo Sandstone, to 1,100 milligrams per liter on September 6, 1979, at well (C-43-5)25cda-1, which also is completed the Navajo. (See also table 19.) There were no significant trends in the chemical quality of water yielded by the four observation wells during the relatively short monitoring period (1974-84).

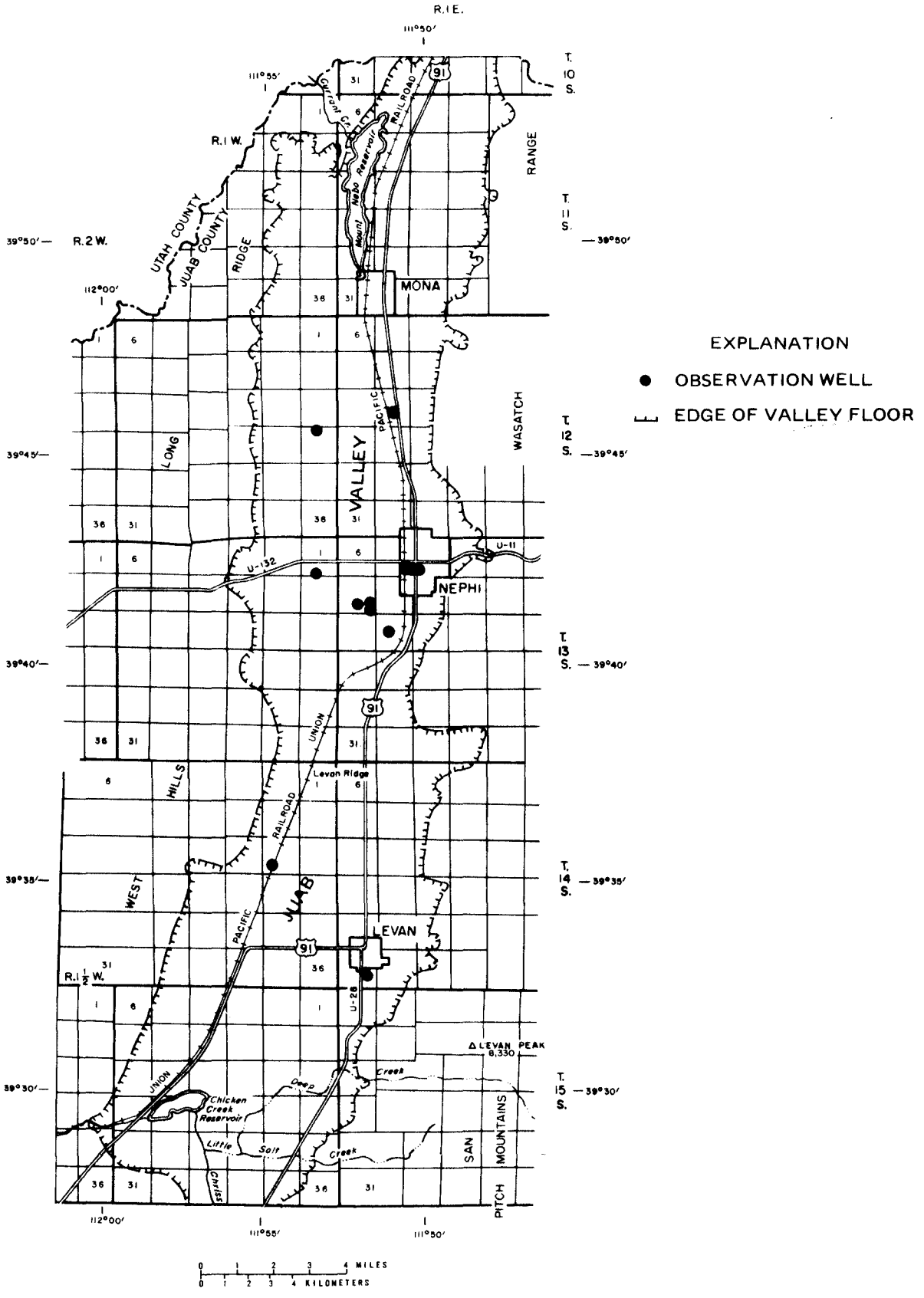


Figure 18.—Location of observation wells in Juab Valley.

Table 18.--Statistical analysis of chemical analyses of water from the observation wells in Juab Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	106	1520	1020	3900	523.4	34.4
pH (standard units)	62	7.4	1.9	8.3	.8	10.4
Temperature (degrees Celsius)	105	11.5	9.5	21.0	1.3	11.5
Hardness (milligrams per liter as $CaCO_3$)	70	490	310	1300	200.4	40.8
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	70	220	54	890	183.5	84.1
Calcium, dissolved (milligrams per liter as Ca)	70	120	63	320	45.0	38.2
Magnesium, dissolved (milligrams per liter as Mg)	70	48	23	160	29.1	60.2
Sodium, dissolved (milligrams per liter as Na)	60	130	42	280	49.0	36.8
Sodium plus potassium, dissolved (milligrams per liter as Na)	12	140	97	320	66.8	46.5
Potassium, dissolved (milligrams per liter as K)	60	4.2	2	33	3.9	91.5
Bicarbonate (milligrams per liter as HCO_3)	58	340	120	540	109.6	32.4
Carbonate (milligrams per liter as CO_3)	45	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	9	260	180	390	66.1	25.4
Sulfate, dissolved (milligrams per liter as SO_4)	70	130	59	410	86.7	65.3
Chloride, dissolved (milligrams per liter as Cl)	70	240	55	900	135.6	55.3
Fluoride, dissolved (milligrams per liter as F)	48	.2	.1	.3	.06	31.4
Silica, dissolved (milligrams per liter as SiO_2)	65	26	11	42	5.8	22.6
Nitrite plus nitrate, dissolved (milligrams per liter as N)	42	6.5	.97	42	6.8	104.3
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	28	.11	(1)	.34	.1	85.3
Iron, dissolved (micrograms per liter as Fe)	18	10	(1)	60	13.4	91.6
Manganese, dissolved (micrograms per liter as Mn)	18	6	(1)	20	5.5	90.3
Solids, sum of constituents, dissolved (milligrams per liter)	66	840	580	1770	241.1	28.7

(1) Not detected.

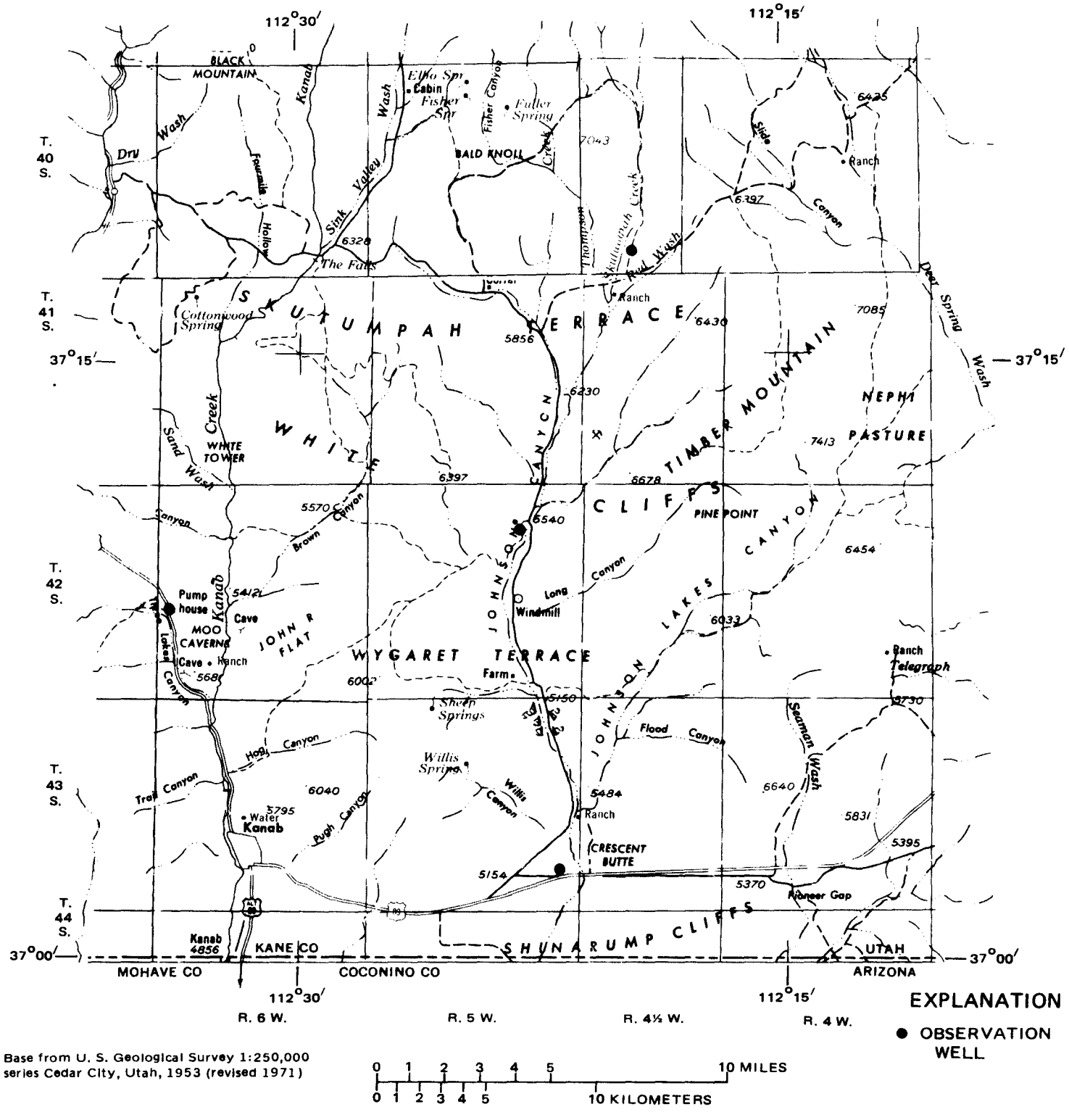


Figure 19.—Location of observation wells in the Kanab Creek area.

Table 19.--Statistical analysis of chemical analyses of water from the observation wells in the Kanab Creek area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	17	840	235	1890	634.7	75.8
pH (standard units)	12	7.4	6.5	8.0	.5	6.5
Temperature (degrees Celsius)	17	14.0	10.0	19.0	2.1	15.0
Hardness (milligrams per liter as $CaCO_3$)	14	400	120	750	254.6	64.2
Hardness, noncarbonate (milligrams per liter $CaCO_3$)	14	180	9	460	156.9	88.1
Calcium, dissolved (milligrams per liter as Ca)	14	74	23	120	43.5	58.7
Magnesium, dissolved (milligrams per liter as Mg)	14	51	15	110	36.8	71.6
Sodium, dissolved (milligrams per liter as Na)	14	39	3.8	120	43.3	112.3
Sodium plus potassium, dissolved (milligrams per liter as Na)	2	68	6.7	130	87.2	127.6
Potassium, dissolved (milligrams per liter as K)	14	4.9	2.2	8.8	2.8	57.1
Bicarbonate (milligrams per liter as HCO_3)	6	280	150	470	142.6	51.8
Carbonate (milligrams per liter as Co_3)	4	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	5	220	120	300	71.7	32.3
Sulfate, dissolved (milligrams per liter as SO_4)	14	210	5.1	490	194.2	91.3
Chloride, dissolved (milligrams per liter as Cl)	14	24	3.8	95	33.8	142.1
Fluoride, dissolved (milligrams per liter as F)	14	.2	.1	.5	.2	70.6
Silica, dissolved (milligrams per liter as SiO_2)	14	13	9.9	16	2.0	14.9
Nitrite plus nitrate, dissolved (milligrams per liter as N)	13	2.5	.1	4.9	1.4	57.8
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	5	.01	(1)	.06	.03	223.6
Iron, dissolved (micrograms per liter as Fe)	10	60	4	260	84.1	139.3
Manganese, dissolved (micrograms per liter as Mn)	10	78	1	480	151.3	193.0
Solids, sum of constituents, dissolved (milligrams per liter)	14	547	130	1100	399.0	72.9

(1) Not detected.

Lower Bear River Valley

Unconsolidated deposits (stream-valley alluvium and basin fill) are the principal source of ground water in the lower Bear River valley. The ground water in the area north of Tremonton generally is fresh to slightly saline; whereas south of Tremonton, nearer to Great Salt Lake, the ground water generally ranges from slightly to very saline. (See Bjorklund and McGreevey 1974, pl. 5 and Price, 1985, fig. 33.) Five observation wells were established in the area (table 1 and fig. 20) during 1969 and 1970, and they probably all tap the basin fill. Dissolved-solids concentrations in the water samples collected from the wells during 1969-84 ranged from 451 milligrams per liter on August 3, 1970, at well (B-14-4)1dad-1 to 1,300 milligrams per liter on June 28, 1984, at well (B-12-4)34bbd-1. (See also table 20.) There were no significant trends in the quality of water produced by three of the wells during the relatively short monitoring period. There were, however, progressive increases in the concentrations of dissolved solids, chloride, and sulfate in the samples collected at wells (B-12-4)34bdd-1 and (B-12-4)34cca-1, near Bothwell. These increases may be due to increased use of ground water for irrigation in the area of the two observation wells.

Milford Area

The principal water-yielding rocks in the Milford area are unconsolidated deposits (basin fill). The water varies from fresh to moderately saline (Price, 1981a). Eighteen observation wells have been sampled in the area (table 1 and fig. 21), and they apparently all are completed in the basin fill. Sampling was started at two of the wells in 1931-32, and at all the other wells during 1948-79. Dissolved-solids concentrations in the water samples collected from the observation wells ranged from 190 milligrams per liter on August 8, 1980, at well (C-29-11)1add-2 to 5,500 milligrams per liter on July 16, 1973, at well (C-28-10)5dad-2. The analyses of samples collected at well (C-28-10)8add-2 during 1969-83 indicated a progressive increase in salinity of the water. The observation well is in an area of large-scale withdrawal of ground water for irrigation, and declining water levels (Appel and others, 1983, figs. 48 and 49) associated with that withdrawal may have induced the movement of more saline ground water to the vicinity of the well. Mower and Cordova (1974, p. 38-44) describe in more detail the chemical quality of ground water throughout the Milford area. Also, a statistical analysis of all water samples collected from all the observation wells in the area is presented in table 21.

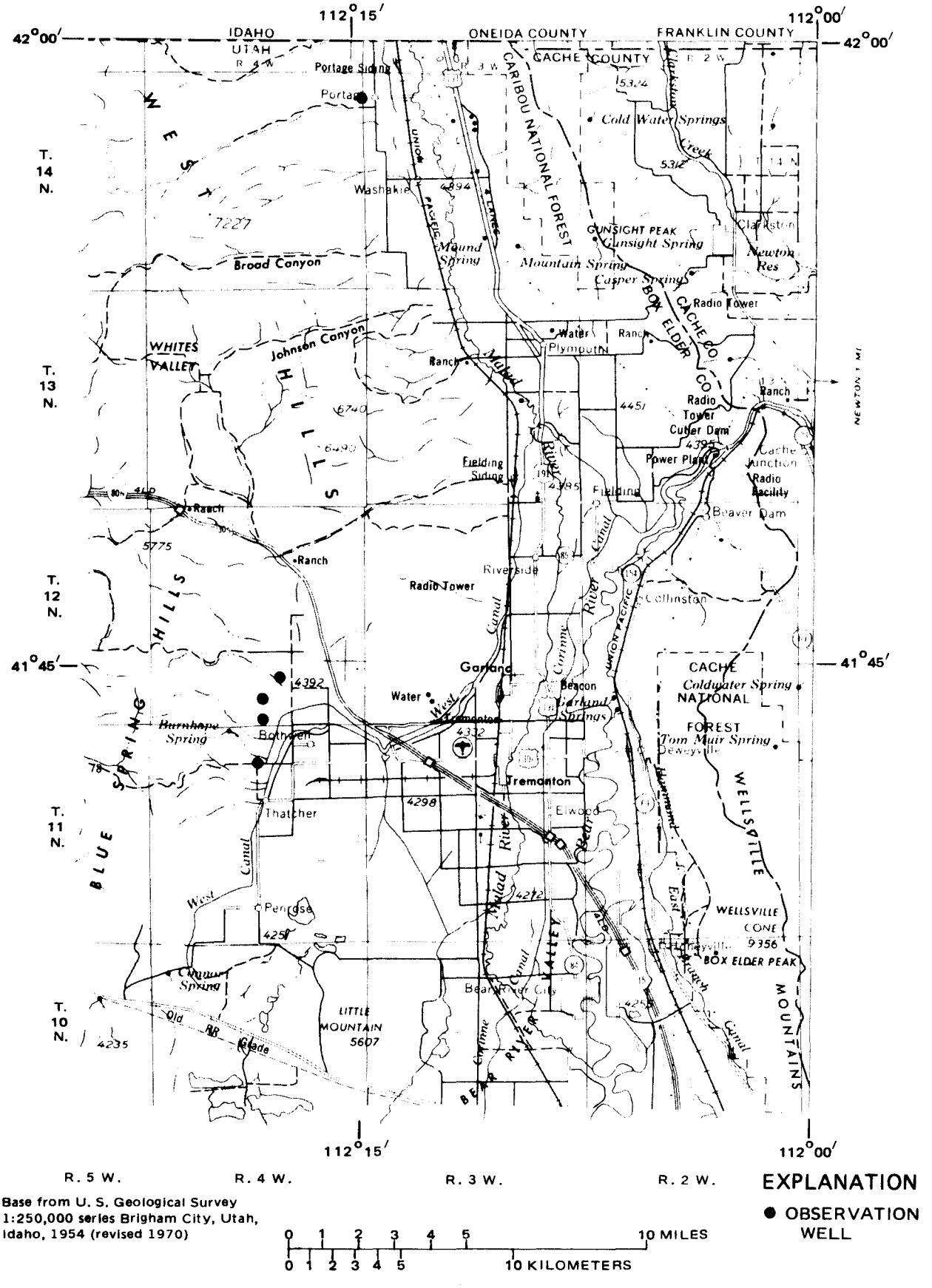


Figure 20.—Location of observation wells in the lower Bear River valley.

Table 20.--Statistical analysis of chemical analyses of water from the observation wells in the lower Bear River valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	52	1570	720	2080	319.0	20.3
pH (standard units)	43	7.5	6.7	8.1	.33	4.4
Temperature (degrees Celsius)	44	16.0	11.0	20.0	1.9	12.0
Hardness (milligrams per liter as $CaCO_3$)	39	420	220	770	96.4	22.8
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	39	230	0	590	109.1	47.4
Calcium, dissolved (milligrams per liter as Ca)	39	94	48	170	21.9	23.2
Magnesium, dissolved (milligrams per liter as Mg)	39	45	23	84	11.2	24.7
Sodium, dissolved (milligrams per liter as Na)	31	150	50	250	38.1	25.1
Sodium plus potassium, dissolved (milligrams per liter as Na)	10	130	52	170	37.6	29.0
Potassium, dissolved (milligrams per liter as K)	30	4.2	2.2	7.4	1.1	25.5
Bicarbonate (milligrams per liter as HCO_3)	29	250	120	420	54.6	22.0
Carbonate (milligrams per liter as CO_3)	27	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	5	180	170	200	10.5	5.7
Sulfate, dissolved (milligrams per liter as SO_4)	39	72	20	190	33.1	46.0
Chloride, dissolved (milligrams per liter as Cl)	39	340	52	550	111.6	33.2
Fluoride, dissolved (milligrams per liter as F)	19	.2	.1	.5	.1	41.2
Silica, dissolved (milligrams per liter as SiO_2)	30	22	16	26	2.2	10.4
Nitrite plus nitrate, dissolved (milligrams per liter as N)	16	2.3	1.6	3.4	.5	21.0
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	6	.05	(1)	.09	.04	81.6
Iron, dissolved (micrograms per liter as Fe)	8	20	(1)	80	25.7	133.6
Manganese, dissolved (micrograms per liter as Mn)	8	4	1	10	4.3	95.8
Solids, sum of constituents, dissolved (milligrams per liter)	31	849	451	1300	184.8	21.8

(1) Not detected.

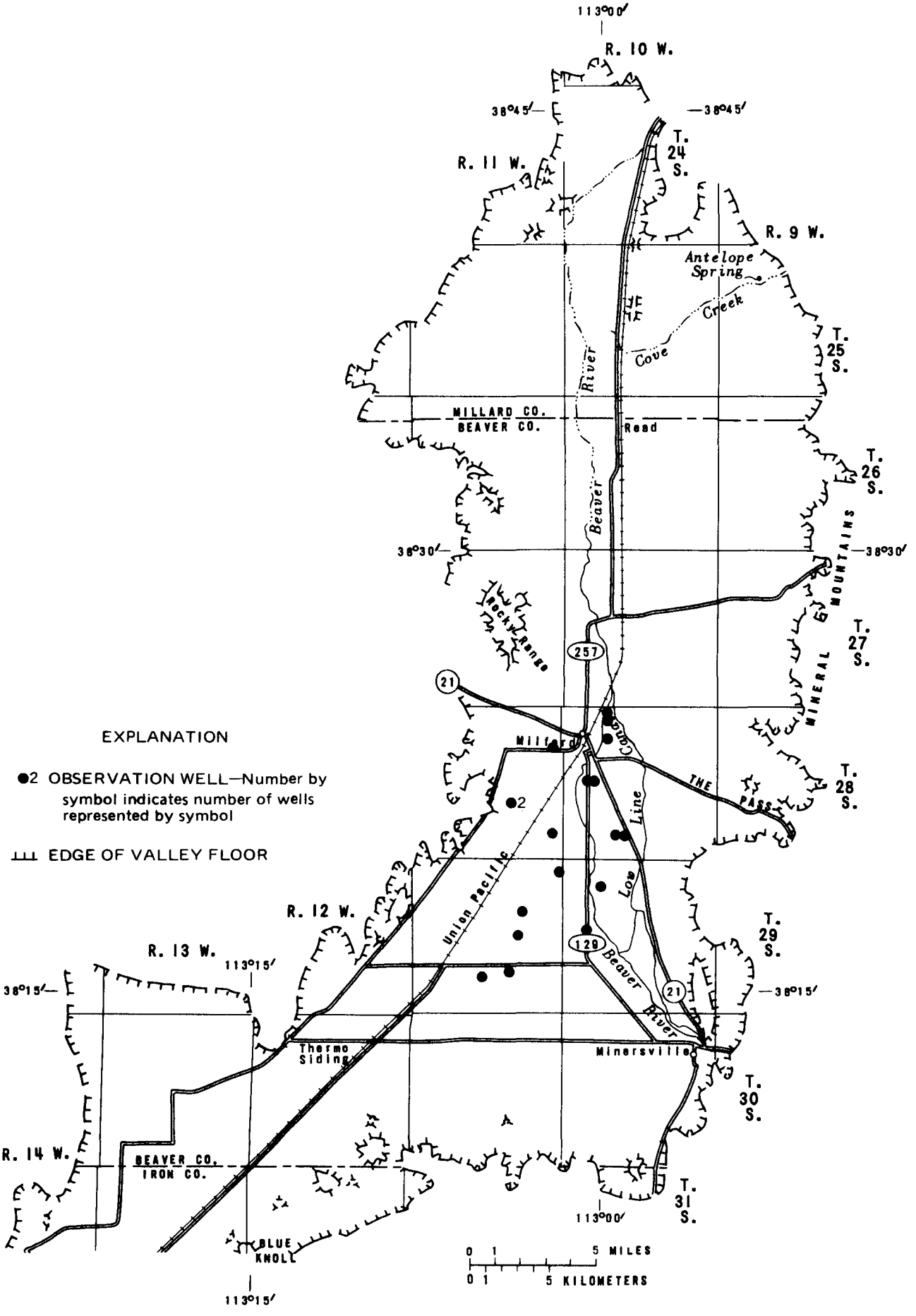


Figure 21.—Location of observation wells in the Milford area.

Table 21.--Statistical analysis of chemical analyses of water from the observation wells in the Milford area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	153	1550	295	6800	1273.5	82.4
pH (standard units)	127	7.6	6.8	8.2	.3	3.8
Temperature (degrees Celsius)	147	15.5	10.5	26.0	2.6	16.7
Hardness (milligrams per liter as $CaCO_3$)	130	630	90	2600	528.9	83.8
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	126	460	0	2300	495.3	107.7
Calcium, dissolved (milligrams per liter as Ca)	122	160	22	570	126.2	77.3
Magnesium, dissolved (milligrams per liter as Mg)	118	55	8.5	330	58.2	106.2
Sodium, dissolved (milligrams per liter as Na)	95	110	16	760	148.3	131.0
Sodium plus potassium, dissolved (milligrams per liter as Na)	34	87	14	390	96.1	110.0
Potassium, dissolved (milligrams per liter as K)	94	7.2	1.6	19	4.2	58.3
Bicarbonate (milligrams per liter as HCO_3)	104	200	120	470	60.5	30.0
Carbonate (milligrams per liter as CO_3)	95	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	13	160	71	256	62.6	37.8
Sulfate, dissolved (milligrams per liter as SO_4)	125	380	28	2900	482.0	125.7
Chloride, dissolved (milligrams per liter as Cl)	135	220	12	1000	253.4	112.1
Fluoride, dissolved (milligrams per liter as F)	74	.6	.1	2.2	.5	83.1
Silica, dissolved (milligrams per liter as SiO_2)	109	40	19	59	7.1	17.8
Nitrite plus nitrate, dissolved (milligrams per liter as N)	51	1.9	.08	4.5	1.3	67.4
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	35	.11	(1)	.37	.1	83.9
Iron, dissolved (micrograms per liter as Fe)	17	20	3	190	43.9	191.0
Manganese, dissolved (micrograms per liter as Mn)	17	3	(1)	12	3.4	127.4
Solids, sum of constituents, dissolved (milligrams per liter)	110	1060	190	5500	995.8	94.0

(1) Not detected.

Moab Area

The principal source of ground water in the Moab area is unconsolidated deposits that partly fill Spanish Valley, but a secondary source is sandstone of the Glen Canyon Group of Triassic and Jurassic age. The ground water generally is fresh, as indicated by Sumsion (1971, table 11). One observation well has been established in the area (table 1 and fig. 22). According to Sumsion (1971, table 9) the well is completed in unconsolidated deposits. Although dissolved-solids concentrations in water samples collected from the well during 1968-84 ranged from 260 to 530 milligrams per liter, there is no indication of any significant trend in the quality of the water. A statistical analysis of all chemical analyses of water sampled from the observation well is presented in table 22.

Monticello Area

Ground water is available from unconsolidated deposits and consolidated rock (chiefly sandstone) in the Monticello area. The water probably ranges from fresh to slightly saline depending on the geologic formation in which it occurs. One observation well was established in the area (table 1 and fig. 23) and was sampled during 1955-63. The well is completed in the Cretaceous Dakota Sandstone, which is an important aquifer in southeastern Utah and southwestern Colorado. Sampling at the well probably was done because of concern about possible contamination of ground water from a processing plant and disposal sites for uranium ore. Dissolved-solids concentrations in the water samples collected from the well during 1955-63 ranged from 420 to 450 milligrams per liter, and there was no indication of contamination of the water yielded by the well during the monitoring period. (See also table 23.)

Northern Utah Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in northern Utah Valley. The water generally is fresh except near the Jordan River where it is generally slightly saline and locally moderately saline (Price, 1985, fig 30). Seven observation wells have been established in the valley (table 1 and fig. 24), and they all are completed in the basin fill. Monitoring was started at several of the wells during 1957-58 and at the other wells during 1973-82. Dissolved-solids concentrations in water samples collected from the wells ranged from 135 milligrams per liter on May 26, 1961, at well (D-5-1)19ccc-1 to 500 milligrams per liter on April 5, 1982, at well (C-5-1)12daa-2. (See also table 24.) No large changes in the chemical quality of ground water in the vicinity of the observation wells has been observed since monitoring was started except at well (C-5-1)12daa-2, where the dissolved-solids concentration has increased from 262 to 434 milligrams per liter between 1957 and 1984. According to Clark and Appel (1985, p. 97), the increase may be due to migration of more mineralized water toward the observation well. Clark and Appel (1984, p. 85-99) describe in more detail the chemical quality of ground water in northern Utah Valley.

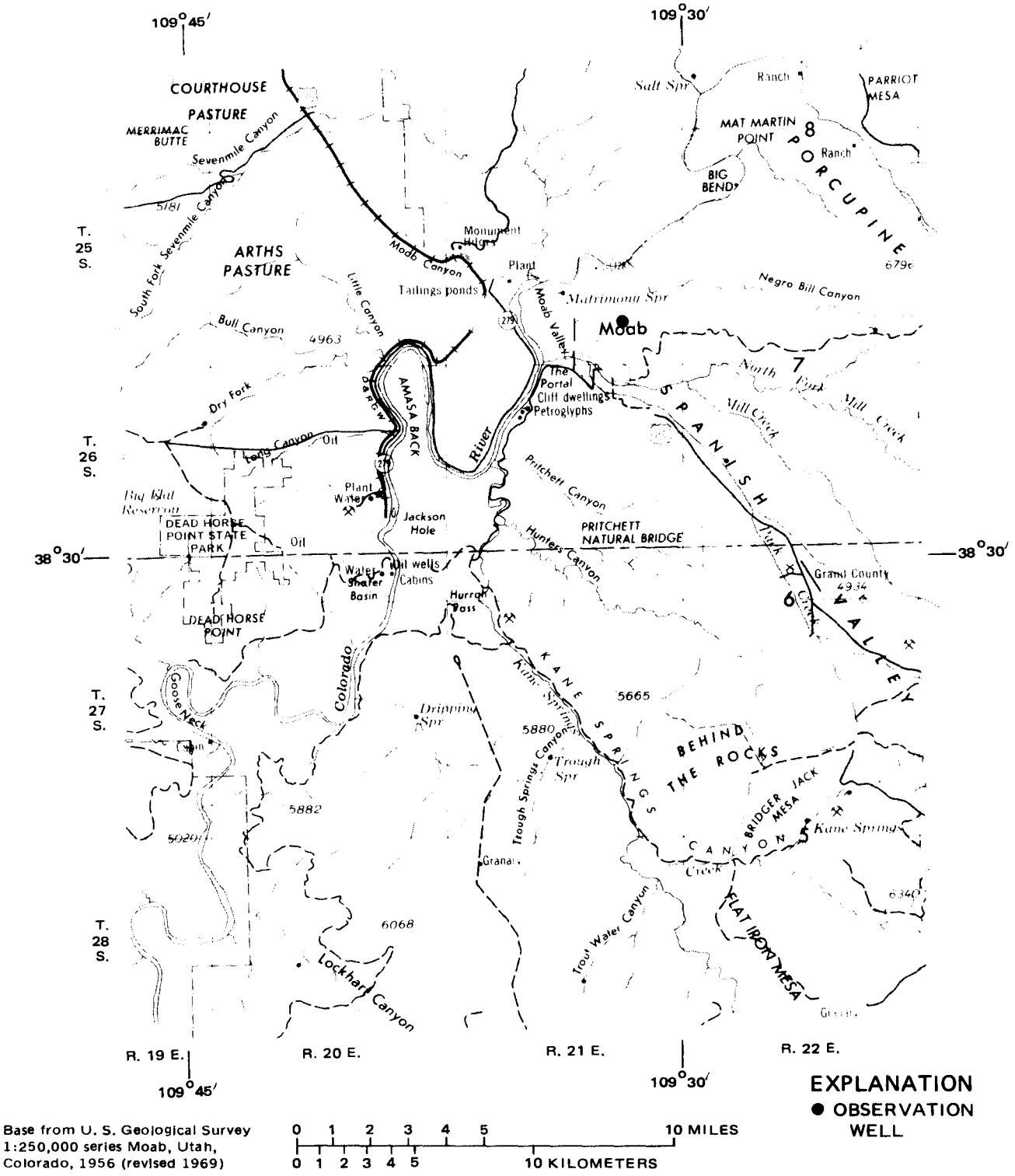


Figure 22.—Location of observation well in the Moab area.

Table 22.--Statistical analysis of chemical analyses of water from the observation well in the Moab area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	16	580	440	650	51.7	9.0
pH (standard units)	15	7.5	7.1	8	.3	3.5
Temperature (degrees Celsius)	17	20.0	10.0	29.5	7.0	35.0
Hardness (milligrams per liter as $CaCO_3$)	15	270	210	300	22.8	8.5
Hardness, noncarbonate (milligrams per liter $CaCO_3$)	15	100	30	260	49.7	47.2
Calcium, dissolved (milligrams per liter as Ca)	15	75	46	85	9.3	12.4
Magnesium, dissolved (milligrams per liter as Mg)	15	20	18	23	1.4	7.1
Sodium, dissolved (milligrams per liter as Na)	15	20	13	29	3.5	17.6
Sodium plus potassium, dissolved (milligrams per liter as Na)	1	21	21	21	--	--
Potassium, dissolved (milligrams per liter as K)	15	2.7	2.2	3.1	.3	9.9
Bicarbonate (milligrams per liter as HCO_3)	10	190	.2	220	68.2	35.3
Carbonate (milligrams per liter as CO_3)	9	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	3	180	160	190	16.5	9.2
Sulfate, dissolved (milligrams per liter as SO_4)	15	110	38	140	24.4	22.4
Chloride, dissolved (milligrams per liter as Cl)	15	18	12	22	2.7	14.6
Fluoride, dissolved (milligrams per liter as F)	15	.3	.1	.5	.09	31.7
Silica, dissolved (milligrams per liter as SiO_2)	15	14	11	25	3.3	24.6
Nitrite plus nitrate, dissolved (milligrams per liter as N)	12	.45	.04	1.1	.4	83.5
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	6	.08	(1)	.31	.1	161.0
Iron, dissolved (micrograms per liter as Fe)	3	20	3	40	20.3	121.8
Manganese, dissolved (micrograms per liter as Mn)	2	2	2	2	0	0
Solids, sum of constituents, dissolved (milligrams per liter)	15	367	260	530	60.3	16.4

(1) Not detected.

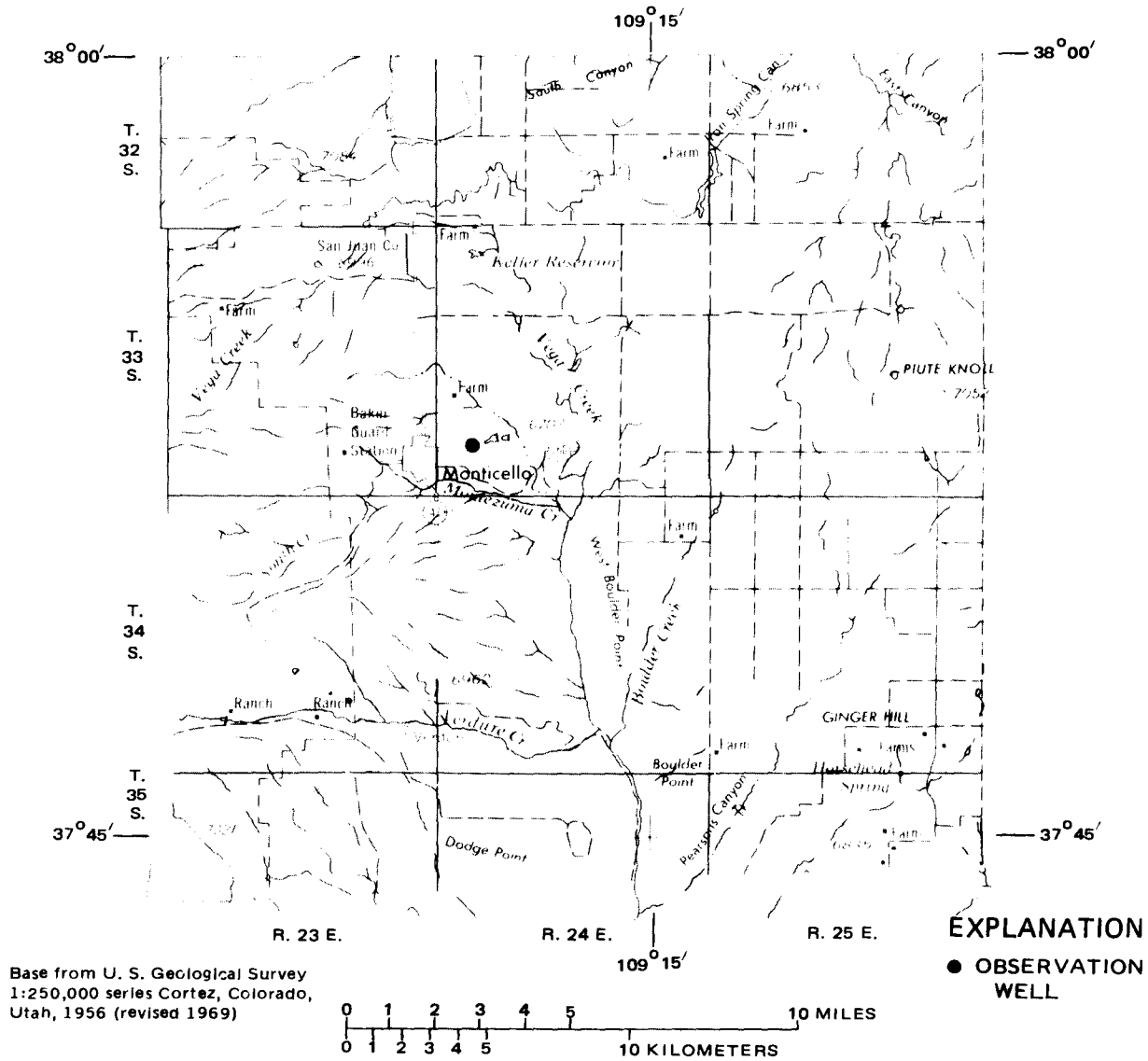


Figure 23.—Location of observation well in the Monticello area.

Table 23.--Statistical analysis of chemical analyses of water from the observation well in the Monticello area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	4	670	660	680	8.3	1.2
pH (standard units)	4	7.4	7.1	7.9	.3	4.6
Temperature (degrees Celsius)	1	--	13.5	13.5	--	--
Hardness (milligrams per liter as $CaCO_3$)	4	210	210	220	5.4	2.6
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	4	12	0	47	23.3	194.5
Calcium, dissolved (milligrams per liter as Ca)	3	59	55	61	3.5	5.9
Magnesium, dissolved (milligrams per liter as Mg)	3	16	13	20	3.6	22.5
Sodium, dissolved (milligrams per liter as Na)	3	67	66	68	1.2	1.7
Sodium plus potassium, dissolved (milligrams per liter as Na)	1	--	70	70	--	--
Potassium, dissolved (milligrams per liter as K)	3	3.1	2.8	3.2	.2	7.5
Bicarbonate (milligrams per liter as HCO_3)	4	240	210	260	22.9	9.4
Carbonate (milligrams per liter as CO_3)	3	0	0	0	0	0
Sulfate, dissolved (milligrams per liter as F)	4	140	130	180	23.7	16.5
Chloride, dissolved (milligrams per liter as Cl)	4	9.5	8	10	1.0	10.5
Fluoride, dissolved, (milligrams per liter as F)	1	--	.2	.2	--	--
Silica, dissolved (migrograms per liter as SiO^2)	4	10	8	15	2.8	26.1
Iron, dissolved (micrograms per liter as Fe)	1	--	8100	8100	--	--
Solids, sum of constituents, dissolved (milligrams per liter)	4	431	420	450	13.2	3.0

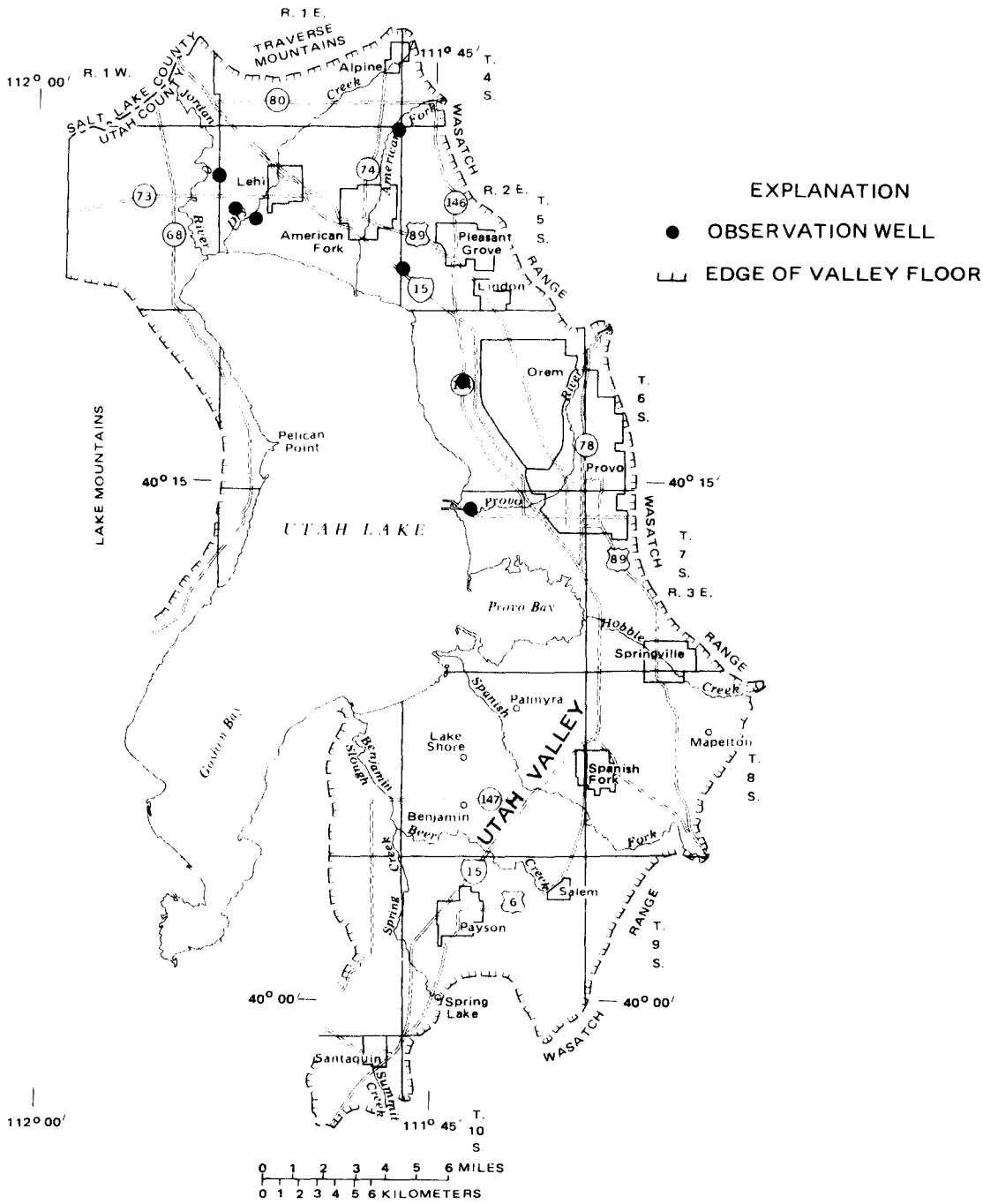


Figure 24.—Location of observation wells in northern Utah Valley.

Table 24.--Statistical analysis of chemical analyses of water from the observation wells in northern Utah Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	62	4075	220	850	184.5	45.3
pH (standard units)	29	7.6	6.7	8	.3	3.9
Temperature (degrees Celsius)	61	13.0	7	18	2.2	16.4
Hardness (milligrams per liter as $CaCO_3$)	28	180	110	400	84.9	48.1
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	28	37	0	250	64.1	174.3
Calcium, dissolved (milligrams per liter as Ca)	28	42	23	110	21.8	52.2
Magnesium, dissolved (milligrams per liter as Mg)	28	18	9	37	8.3	46.6
Sodium, dissolved (milligrams per liter as Na)	18	18	5.7	35	9.4	52.7
Sodium plus potassium, dissolved (milligrams per liter as Na)	12	17	5.7	29	9.1	55.4
Potassium, dissolved (milligrams per liter as K)	15	2.3	.5	5.6	1.5	63.8
Bicarbonate (milligrams per liter as HCO_3)	18	160	140	280	41.6	25.1
Carbonate (milligrams per liter as CO_3)	13	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	8	150	120	200	31.6	20.7
Sulfate, dissolved (milligrams per liter as SO_4)	28	31	5	160	36.2	115.3
Chloride, dissolved (milligrams per liter as Cl)	29	27	5.2	120	32.9	119.9
Fluoride, dissolved (milligrams per liter as F)	14	.3	.1	.4	.1	30.3
Silica, dissolved (milligrams per liter as SiO_2)	25	15	8.5	23	3.7	24.0
Nitrite plus nitrate, dissolved (milligrams per liter as N)	11	.9	(1)	4	1.2	128.9
Iron, dissolved (micrograms per liter as Fe)	12	30	6	150	40.5	138.7
Manganese, dissolved (micrograms per liter as Mn)	10	12	(1)	80	24.6	206.7
Solids, sum of constituents, dissolved (milligrams per liter)	27	238	135	500	114.0	47.8

(1)Not detected.

Pahvant Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Pahvant Valley, but locally the fill includes some interbedded water-yielding lava flows. Ground water in the eastern part of the valley generally is fresh. Westward across the valley, the ground water becomes progressively more saline; and it ranges from slightly to moderately saline in the areas west of Filmore and Kanosh (Price, 1981a). Twenty-one observation wells have been established in the valley (table 1 and fig. 25). Most of the wells are completed in the basin fill, but two wells produce water from an interbedded lava flow (the Pahvant Lava flow). Monitoring was started at one well in 1944, at another well in 1957, and at the other wells during 1960-76. Dissolved-solids concentrations in water samples collected from the observation wells ranged from 320 milligrams per liter on June 21, 1978, at well (C-22-5)33abd-1 to 6,400 milligrams per liter on May 1, 1979, and June 20, 1984, at well (C-23-6)21bdd-1. (See also table 25.) There was a progressive increase in the salinity of samples collected at well (C-23-6)21bdd-1 during 1964-81. The well is in an area where ground-water levels declined as much as 20 feet during 1963-83 (Appel and others, 1983, fig. 38) due to large-scale withdrawal of ground water for irrigation. Mower (1965, p. 70-72) attributed the progressive increase of salinity in the general area of well (C-23-6)21bdd-1 to recycling of water pumped for irrigation and the encroachment of more saline water from the west.

Parowan Valley

Unconsolidated deposits (basin fill) are the principal source of ground water throughout Parowan Valley, whereas consolidated rocks of volcanic origin are an important source of water in the northern part of the valley. The ground water generally is fresh, but it is slightly saline locally (Bjorklund and others, 1978, p. 46). Seven observation wells have been established in the valley (table 1 and fig. 26), and all probably are completed in the basin fill. Monitoring was started at four of the wells in 1961, and at the other three wells during 1966-81. Dissolved-solids concentrations in water samples collected from the wells ranged from 170 milligrams per liter on July 21, 1980, at well (C-32-8)35bcb-1 to 880 milligrams per liter on October 3, 1973, at well (C-33-8)31ccc-2. (See also table 26.) The concentration of dissolved solids increased slightly in water produced by well (C-33-8)31ccc-2 during the early 1970's and then decreased again in later years to its original level. The reason for these changes is not known.

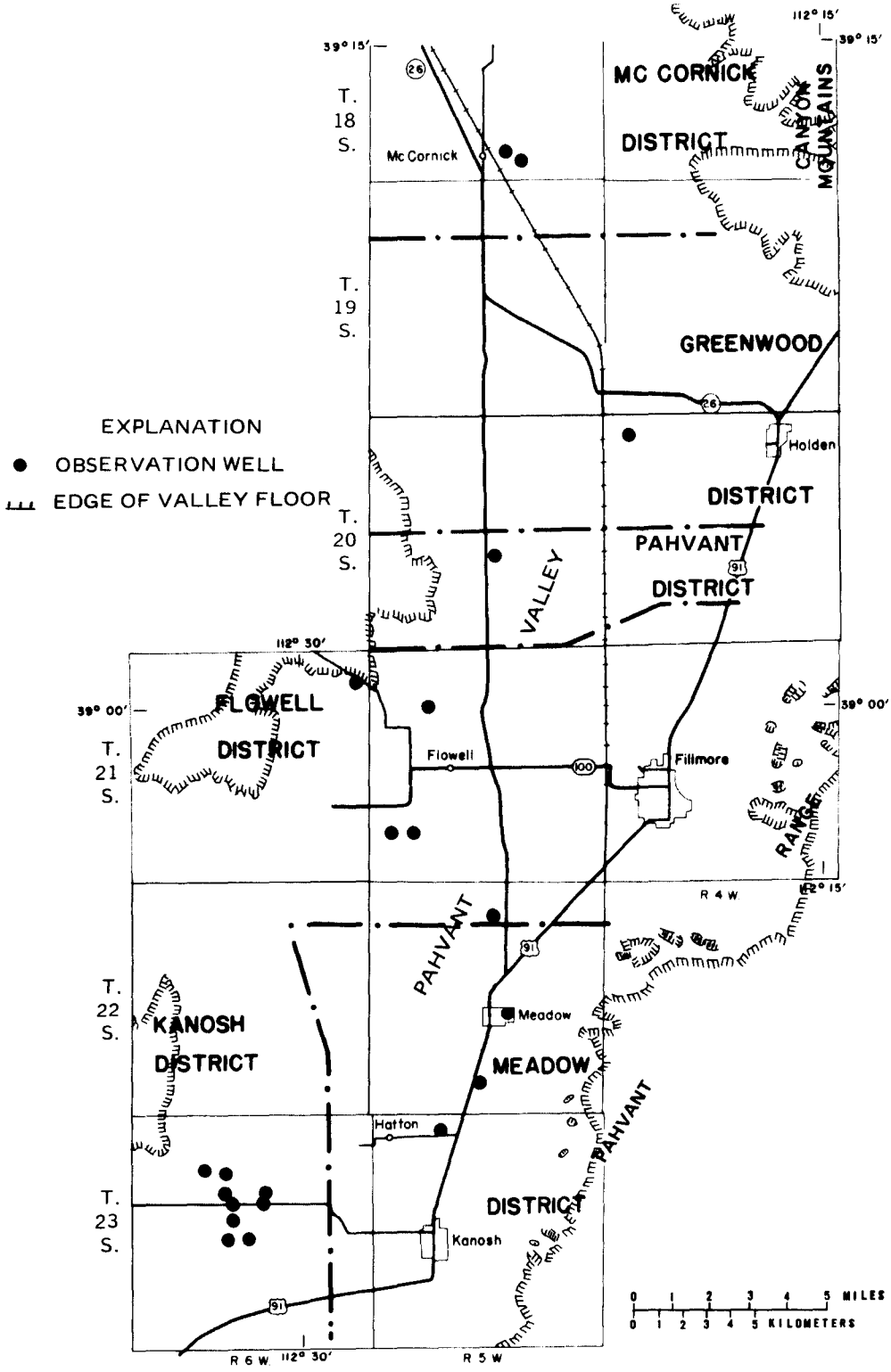


Figure 25.—Location of observation wells in Pahvant Valley.

Table 25.--Statistical analysis of chemical analyses of water from the observation wells in Pahvant Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	195	3500	550	9680	2774.0	79.2
pH (standard units)	152	7.3	6.6	8.1	.3	4.5
Temperature (degrees Celsius)	190	15.5	12	20.5	2.3	14.8
Hardness (milligrams per liter as $CaCO_3$)	159	1200	270	3500	866.7	72.8
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	158	940	50	3300	858.0	91.3
Calcium, dissolved (milligrams per liter as Ca)	145	300	69	760	212.4	70.7
Magnesium, dissolved (milligrams per liter as Mg)	145	120	17	400	89.1	76.4
Sodium, dissolved (milligrams per liter as Na)	138	390	23	1100	332.8	84.3
Sodium plus potassium, dissolved (milligrams per liter as Na)	20	300	38	990	344.4	114.9
Potassium, dissolved (milligrams per liter as K)	124	38	1.5	150	38.4	100.4
Bicarbonate (milligrams per liter as HCO_3)	108	310	140	500	66.9	21.3
Carbonate (milligrams per liter as CO_3)	96	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	35	260	160	380	60.0	22.0
Sulfate, dissolved (milligrams per liter as SO_4)	156	540	23	1700	410.7	75.6
Chloride, dissolved (milligrams per liter as Cl)	168	870	44	2800	834.4	96.2
Fluoride, dissolved (milligrams per liter as F)	107	.6	.1	2.2	.5	78.5
Silica, dissolved (milligrams per liter as SiO_2)	134	29	12	58	12.0	41.7
Nitrite plus nitrate, dissolved (milligrams per liter as N)	106	4.2	.25	27	5.9	140.5
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	44	.12	(1)	.31	.1	57.4
Iron, dissolved (micrograms per liter as Fe)	41	30	(1)	100	26.7	80.2
Manganese, dissolved (micrograms per liter as Mn)	41	10	(1)	40	9.7	96.6
Solids, sum of constituents, dissolved (milligrams per liter)	135	2450	320	6400	1925.1	78.6

(1) Not detected.

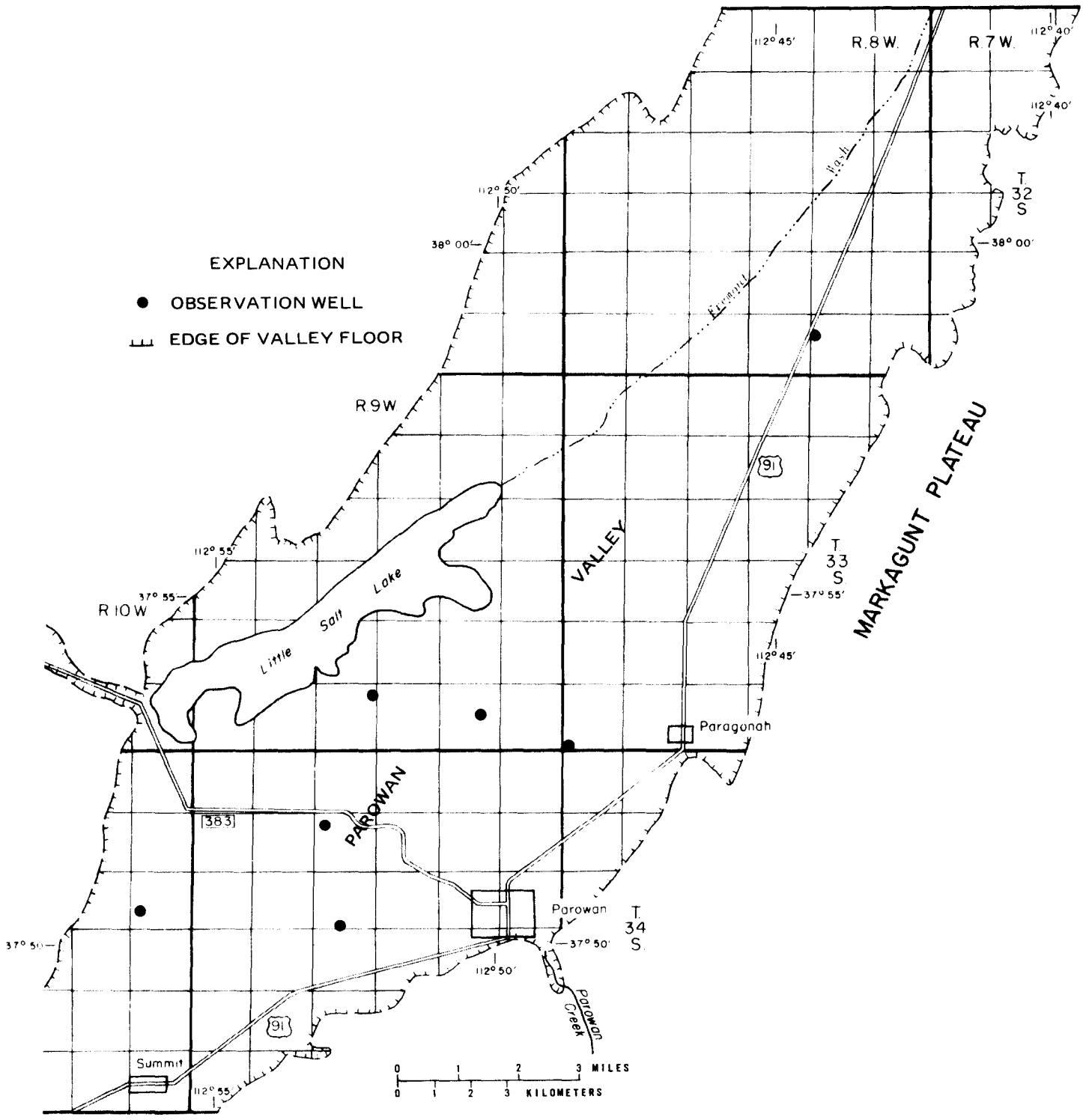


Figure 26.—Location of observation wells in Parowan Valley.

Table 26.--Statistical analysis of chemical analyses of water from the observation wells in Parowan Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	70	520	230	1320	164.9	31.4
pH (standard units)	35	7.7	6.5	8.3	.3	4.4
Temperature (degrees Celsius)	70	14.0	9.0	24.5	3.0	22.0
Hardness (milligrams per liter as $CaCO_3$)	35	240	--	660	105.3	43.2
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	34	38	0	320	58.8	156.2
Calcium, dissolved (milligrams per liter as Ca)	29	55	19	140	23.5	43.1
Magnesium, dissolved (milligrams per liter as Mg)	29	28	5.9	76	12.0	43.0
Sodium, dissolved (milligrams per liter as Na)	21	27	9.5	130	26.2	95.4
Sodium plus potassium, dissolved (milligrams per liter as Na)	12	22	8.5	32	7.8	36.1
Potassium, dissolved (milligrams per liter as K)	21	3.2	1	5.2	1.0	31.1
Bicarbonate (milligrams per liter as HCO_3)	23	270	120	420	60.5	22.7
Carbonate (milligrams per liter as CO_3)	22	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	7	220	170	350	60.0	27.6
Sulfate, dissolved (milligrams per liter as SO_4)	33	38	7.6	160	29.0	77.0
Chloride, dissolved (milligrams per liter as Cl)	43	30	7.2	200	31.4	105.2
Fluoride, dissolved (milligrams per liter as F)	16	.2	.1	.4	.1	33.8
Silica, dissolved (milligrams per liter as SiO_2)	29	31	24	44	6.4	20.4
Nitrite plus nitrate, dissolved (milligrams per liter as N)	18	2.2	.50	5	1.1	50.7
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	8	.07	(1)	.12	.04	59.3
Iron, dissolved (micrograms per liter as Fe)	10	6.2	(1)	10	3.9	63.5
Manganese, dissolved (micrograms per liter as Mn)	10	2.3	(1)	10	2.9	126.4
Solids, sum of constituents, dissolved (milligrams per liter)	24	346	170	880	147.9	42.6

(1) Not detected.

Pilot Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Pilot Valley. The ground water along the west edge of the valley is fresh to slightly saline, but eastward across the valley the water ranges from moderately saline to briny. One observation well, (B-3-19)1ccc-1, has been established in the valley (table 1 and fig. 27). The well apparently is completed in alluvial-fan deposits in the basin fill. Monitoring was started at the well in 1975, and dissolved-solids concentrations in water samples collected from the well during 1975-82 ranged from 180 to 220 milligrams per liter. (See also table 27.) The well is in an area where pumping (and associated water-level declines) could cause movement to the well of more saline water from the east. Although the well was pumped for irrigation during the monitoring period, the available data show no indication of saline-water intrusion. Stephens (1973, p. 17-19) and Lines (1979, fig. 44) provide additional information about the chemical quality of ground water in Pilot Valley.

Rush Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Rush Valley. Partly consolidated sedimentary rocks (Salt Lake Formation) and fractured consolidated rock (chiefly quartzite) also yield water to wells in the valley (Hood and others, 1969, table 12). The ground water in Rush Valley generally is fresh, but locally it is slightly saline. (See Hood and others, 1969, pl. 1.) The three observation wells in the valley (table 1 and fig. 28) apparently are completed in the basin fill, and monitoring was started at those wells during the mid 1970's. Dissolved-solids concentrations in water samples collected from the wells ranged from 420 milligrams per liter on June 10, 1976, at well (C-8-5)31ccd-5 to 3,200 milligrams per liter on July 7, 1975, at well (C-7-5)32bdd-1. (See also table 28.) Hood and others (1969, p. 33-37) describe in more detail the chemical quality of ground water in Rush Valley (including a discussion of local changes in the quality).

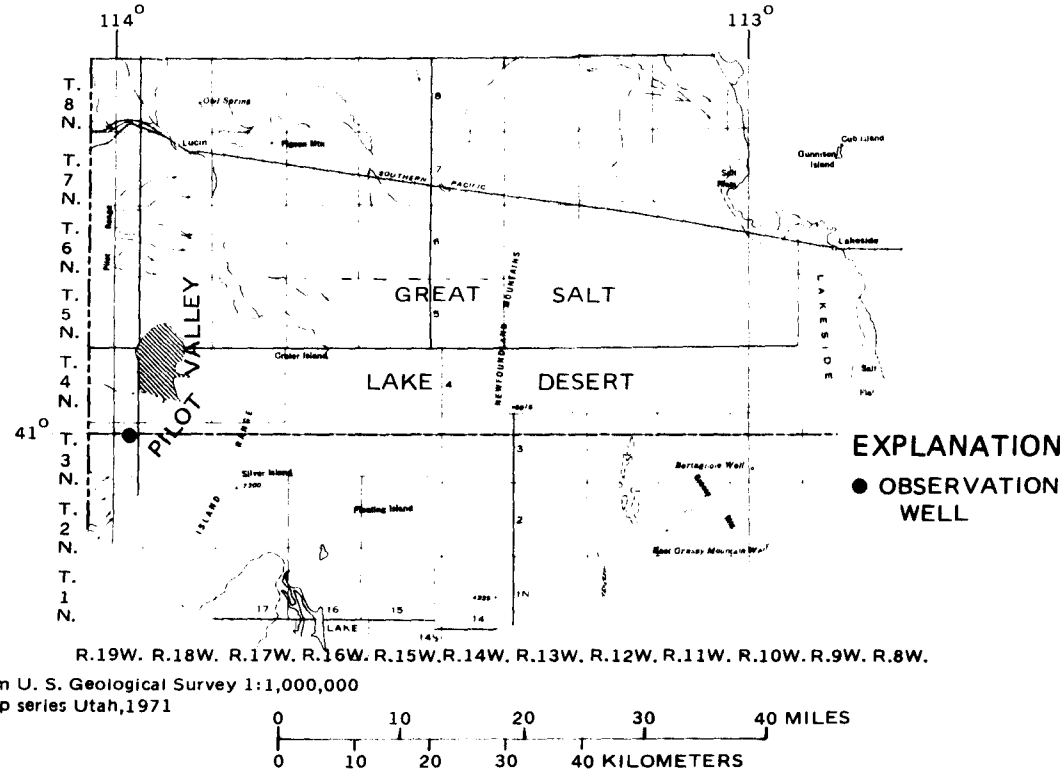


Figure 27.—Location of observation well in Pilot Valley.

Table 27.--Statistical analysis of chemical analyses of water from the observation well in Pilot Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	5	340	320	380	27.5	8.1
pH (standard units)	4	7.8	7.6	8	.2	2.6
Temperature (degrees Celsius)	5	16	15.5	16	.22	1.4
Hardness (milligrams per liter as $CaCO_3$)	4	110	96	120	11.2	10.6
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	4	19	8	32	10.0	52.6
Calcium, dissolved (milligrams per liter as Ca)	4	25	22	30	3.6	14.2
Magnesium, dissolved (milligrams per liter as Mg)	4	10	9.8	11	.5	5.3
Sodium, dissolved (milligrams per liter as Na)	4	28	24.0	32	4.1	14.6
Potassium, dissolved (milligrams per liter as K)	4	3.6	3.4	3.8	.2	4.8
Bicarbonate (milligrams per liter as HCO_3)	2	100	100	102	1.4	1.4
Carbonate (milligrams per liter as CO_3)	2	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	1	--	88	88	--	--
Sulfate, dissolved (milligrams per liter as SO_4)	4	15	12	18	2.5	17.0
Chloride, dissolved (milligrams per liter as Cl)	4	49	44	59	7.1	14.4
Fluoride, dissolved (milligrams per liter as F)	4	.1	.1	.1	0	0
Silica, dissolved (milligrams per liter as SiO_2)	4	13	12	13	.6	4.6
Nitrite plus nitrate, dissolved (milligrams per liter as N)	4	.2	.19	.26	.03	13.8
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	2	.01	(1)	.03	.02	141.4
Iron, dissolved (micrograms per liter as Fe)	2	2	(1)	3	2.1	141.4
Manganese, dissolved (micrograms per liter as Mn)	2	1	(1)	2	1.4	141.4
Solids, sum of constituents, dissolved (milligrams per liter)	4	195	180	220	17.32	8.9

(1)Not detected.

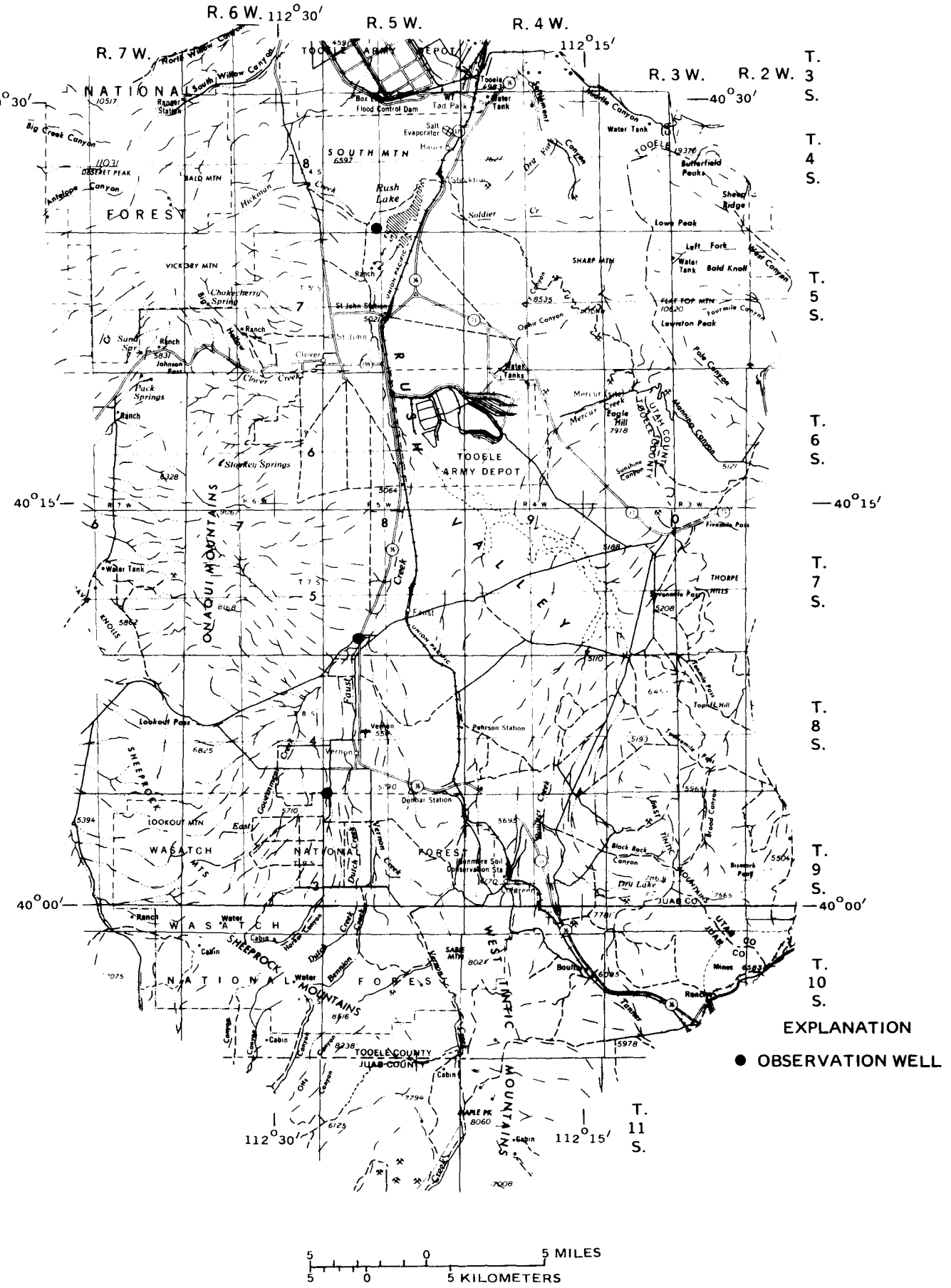


Figure 28.—Location of observation wells in Rush Valley.

Table 28.--Statistical analysis of chemical analyses of water from the observation wells in Rush Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	22	1550	750	4900	1319.2	85.1
pH (standard units)	16	7.4	7.1	7.8	.2	2.4
Temperature (degrees Celsius)	22	12.0	11.0	14	.7	5.4
Hardness (milligrams per liter as $CaCO_3$)	14	620	290	1700	471.6	76.0
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	14	400	160	1400	397.8	100.3
Calcium, dissolved (milligrams per liter as Ca)	14	140	90	270	57.1	40.9
Magnesium, dissolved (milligrams per liter as Mg)	14	67	17	260	82.9	124.1
Sodium, dissolved (milligrams per liter as Na)	14	160	36	510	184.7	111.5
Sodium plus potassium, dissolved (milligrams per liter as Na)	1	40	40	40	--	--
Potassium, dissolved (milligrams per liter as K)	14	4.1	1.3	14	4.7	114.8
Bicarbonate (milligrams per liter as HCO_3)	11	300	160	500	119.8	39.9
Carbonate (milligrams per liter as CO_3)	10	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	2	180	130	230	73.5	41.3
Sulfate, dissolved (milligrams per liter as SO_4)	14	140	35	480	156.4	111.1
Chloride, dissolved (milligrams per liter as Cl)	14	440	140	1500	462.2	106.2
Fluoride, dissolved (milligrams per liter as F)	12	.3	.1	.9	.3	103.3
Silica, dissolved (milligrams per liter as SiO_2)	14	25	14	52	15.4	61.6
Nitrite plus nitrate, dissolved (milligrams per liter as N)	12	1.3	.04	3.7	1.0	74.1
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	9	.27	.03	1.1	.3	127.3
Iron, dissolved (micrograms per liter as Fe)	9	30	9	110	41.0	123.4
Manganese, dissolved (micrograms per liter as Mn)	9	11	1	20	7.3	63.8
Solids, sum of constituents, dissolved (milligrams per liter)	14	1120	420	3200	1006.0	90.2

Salt Lake Valley

Unconsolidated deposits (basin fill) are the principal water-yielding rocks in Salt Lake Valley. Ground water in the east one-half of the valley generally is fresh. In the southwest part of the valley, the ground water generally is slightly to moderately saline. In the northwest part of the valley, adjacent to Great Salt Lake, the ground-water quality is variable, ranging from fresh to moderately saline. At a thermal-spring area north of Salt Lake City, the ground water generally is saline (Price, 1985, fig. 31). The little information available for ground-water quality in the west-central part of the valley indicates that the water may be slightly saline. Twenty-one observation wells have been established in Salt Lake Valley (table 1 and fig. 29). They all are completed in the basin fill. Sampling was started at one of the wells in 1929 and at most of the others from 1957-66. Dissolved-solids concentrations in water samples collected from the observation wells ranged from 120 milligrams per liter on May 29, 1961, at well (D-2-1)28ccc-1 to 4,110 milligrams per liter on July 7, 1964, at well (B-1-2)36baa-1. (See also table 29.)

Salt Lake Valley experienced a considerable increase in population and industry since about 1950, and this significantly increased the potential for ground-water contamination, chiefly from solid- and fluid-waste disposal. There has been a progressive increase in the dissolved-solids and chloride concentrations in the water produced by well (D-1-1)7abd-6 since the late 1950's. The well is completed in the principal artesian aquifer, and the increased concentrations may be due to storage and use of road salt in the recharge areas for the aquifer and in the canyons of the Wasatch Range. There also was a 15-percent increase in the specific conductance of the water produced by well (C-1-2)22bdd-4 from 1958 to 1983. This probably reflects a proportionate increase in the dissolved-solids concentration in the water. That increase may be related to activities associated with population increase in the northwest part of Salt Lake Valley. The data from the other observation wells, which all are completed in the principal artesian aquifer, do not indicate significant changes in the quality of ground water at the wells. It should be noted, however, that Seiler and Waddell (1984, p. 10) detected possible contamination of shallow, unconfined ground water near solid-waste-disposal areas in the valley. Also, information gained during a recently completed study indicated contamination of water in the principal artesian aquifer on the west side of the valley due to activities associated with mining in the adjacent Oquirrh Mountains (Waddell and others, 1986, p. 11).

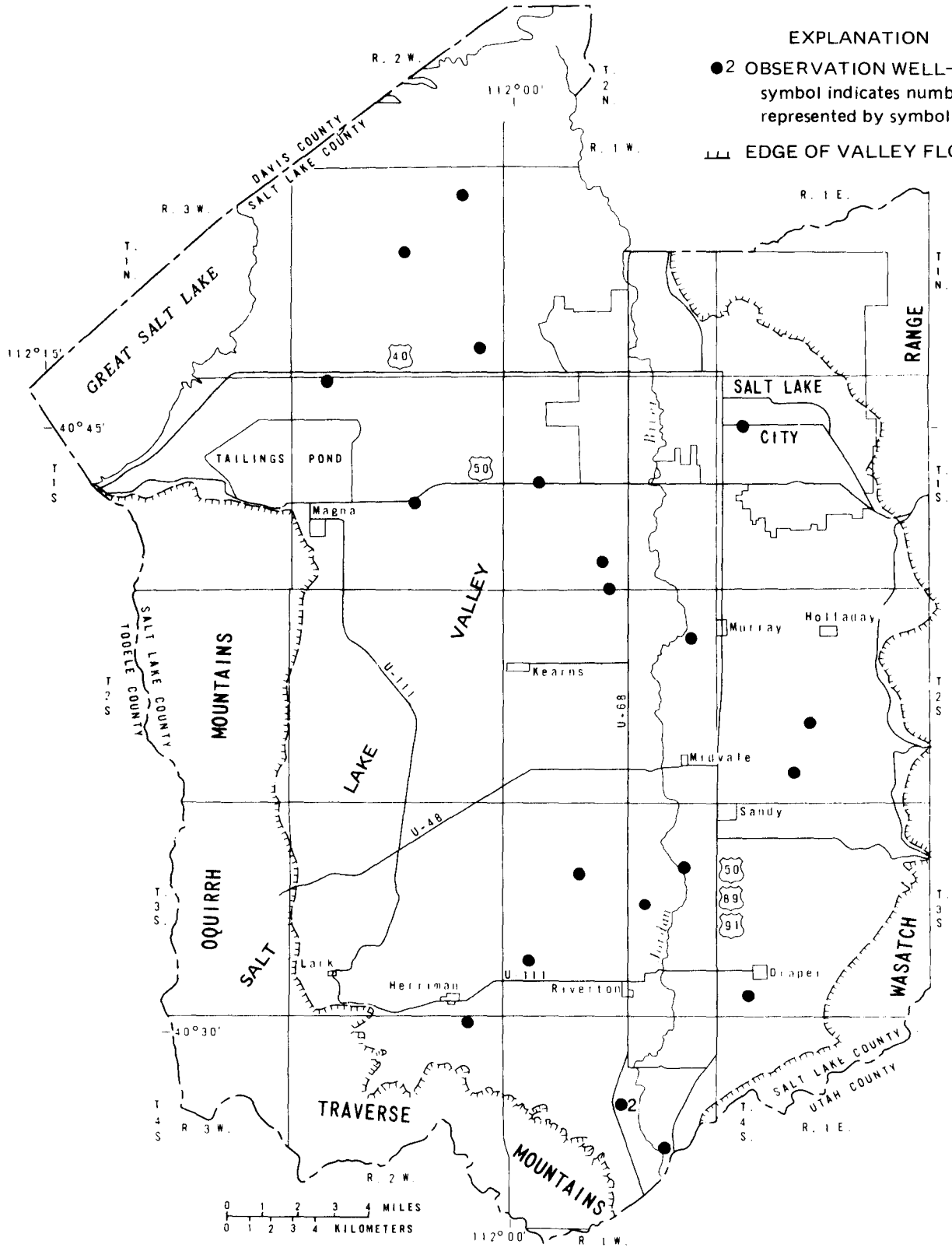


Figure 29.—Location of observation wells in Salt Lake Valley.

Table 29.--Statistical analysis of chemical analyses of water from the observation wells in Salt Lake Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	226	1750	205	7000	1729.2	99.1
pH (standard units)	156	7.6	6.6	8.4	.3	4.0
Temperature (degrees Celsius)	225	19.0	10.0	125	9.0	47.2
Hardness (milligrams per liter as $CaCO_3$)	166	430	28	1900	322.7	75.5
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	166	260	0	1400	283.0	110.1
Calcium, dissolved (milligrams per liter as Ca)	153	100	4.5	490	83.8	83.4
Magnesium, dissolved (milligrams per liter as Mg)	153	40	3.6	170	28.4	71.6
Sodium, dissolved (milligrams per liter as Na)	80	230	7.2	1100	316.5	137.4
Sodium plus potassium, dissolved (milligrams per liter as Na)	89	230	7.8	2000	358.2	155.5
Potassium, dissolved (milligrams per liter as K)	79	8.4	1.1	27	6.8	80.9
Bicarbonate (milligrams per liter as HCO_3)	136	230	46	662	92.8	40.2
Carbonate (milligrams per liter as CO_3)	134	.03	0	4	.4	1157.6
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	22	180	82	240	54.4	29.4
Sulfate, dissolved (milligrams per liter as SO_4)	167	130	.4	1340	206.8	160.0
Chloride, dissolved (milligrams per liter as Cl)	176	460	5	2240	663.6	144.5
Fluoride, dissolved (milligrams per liter as F)	64	.6	(1)	2.2	.6	100.2
Silica, dissolved (milligrams per liter as SiO_2)	151	32	1.9	69	14.7	45.5
Nitrite plus nitrate, dissolved (milligrams per liter as N)	42	1.5	.01	11.00	2.3	150.1
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	7	.16	.09	.25	.1	35.4
Iron, dissolved (micrograms per liter as Fe)	38	90	(1)	1200	222.3	239.1
Manganese, dissolved (micrograms per liter as Mn)	32	67	(1)	500	142.8	213.8
Solids, sum of constituents, dissolved (milligrams per liter)	152	1070	120	4110	1003.1	93.8

(1) Not detected.

Sanpete Valley

Unconsolidated deposits (basin fill and stream-valley alluvium) are the principal source of ground water in Sanpete Valley. The ground water generally ranges from fresh to slightly saline (Robinson, 1971, pl. 4). Four observation wells have been established in the valley (table 1 and fig. 30), and they all apparently are completed in the basin fill. Monitoring was started at two of the wells in 1975, and at the other two wells several years later. Dissolved-solids concentrations in the samples collected from the wells ranged from 330 milligrams per liter on August 10, 1977, at well (D-14-3)7abb-1 to 750 milligrams per liter on August 9, 1979, at well (D-16-2)34acd-2. The available data indicate no significant trends or changes in the chemical quality of ground water in the vicinity of the four observation wells during the relatively short monitoring periods at the wells. A statistical analysis of all chemical analyses of water sampled from the observation wells is presented in table 30.

Sevier Desert

Unconsolidated deposits (basin fill) contain the principal aquifers in the Sevier Desert. Water in the principal aquifers generally is fresh in the central part of the Sevier Desert, but it is slightly saline (and possibly moderately saline locally) around the margins. (See Mower and Feltis, 1968, pl. 6.) Thirteen observation wells have been established in the Sevier Desert (table 1 and fig. 31), and all probably are completed in the basin fill. Sampling was started at well (C-15-4)26dcc-1 in 1952 and at most of the other wells during the late 1950's and early 1960's. Dissolved-solids concentrations in water samples collected from the wells since monitoring was started ranged from 185 milligrams per liter on July 27, 1964, at well (C-16-5)19cbd-1 to 2,100 milligrams per liter on August 11, 1982, at well (C-15-4)8cba-1. (See also table 31.) A slight, but progressive increase occurred in the dissolved-solids concentrations in the water samples collected at well (C-15-4)8cba-1 during 1958-82. Water levels in the aquifer (upper artesian aquifer) yielding water to the well rose 0-3 feet during 1963-83 (Appel and others, 1983, fig. 32). Apparently, more mineralized recharge to that aquifer from applied irrigation water, canal leakage, and leakage from the Sevier River caused the rising water levels and the increased dissolved-solids concentration in water produced by well (C-15-4)8cba-1. (See Holmes, 1984, p. 25.)

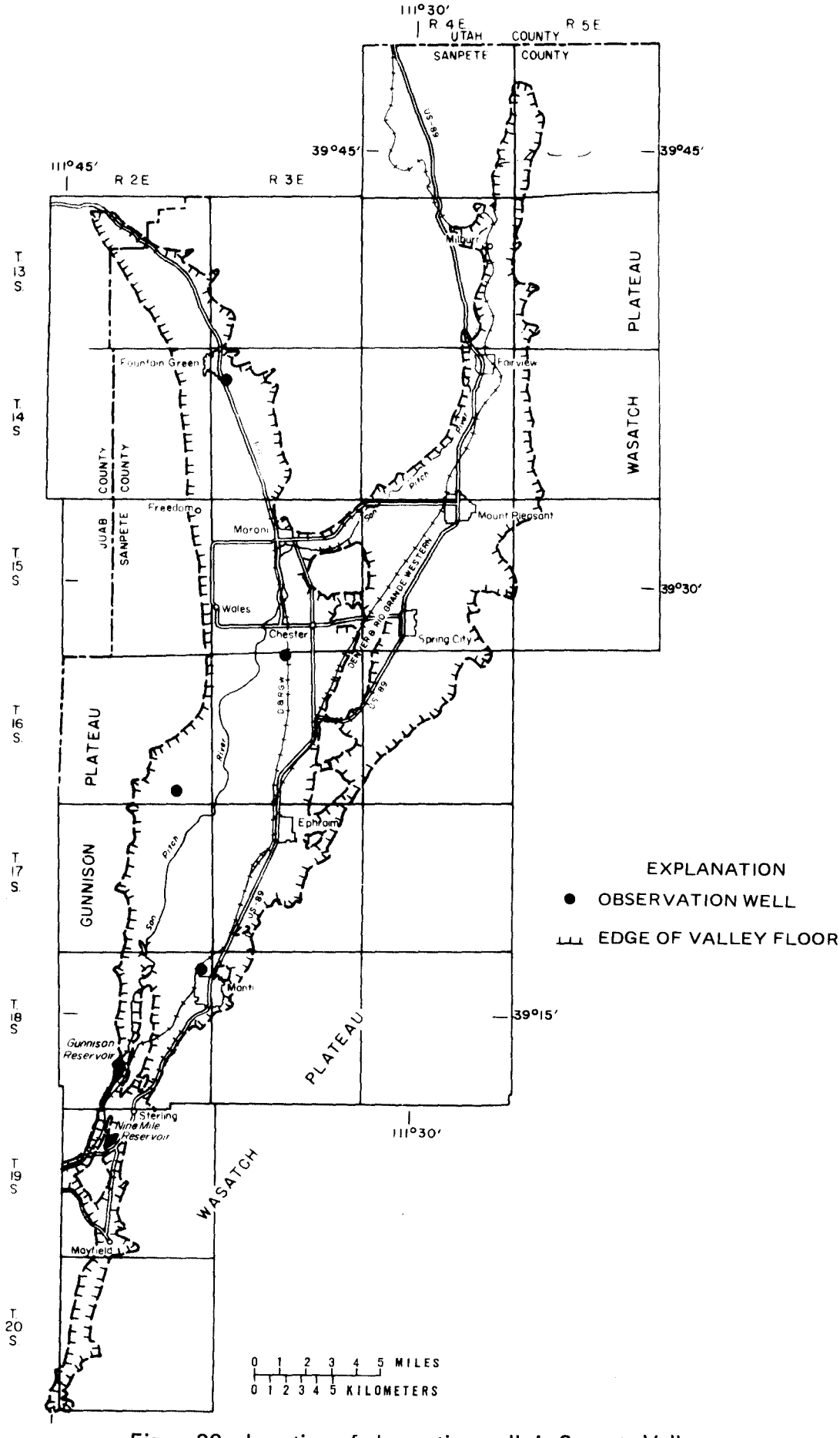


Figure 30.—Location of observation wells in Sanpete Valley.

Table 30.--Statistical analysis of chemical analyses of water from the observation wells in Sanpete Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	10	840	530	1200	224.5	26.6
pH (standard units)	6	7.4	7.1	7.7	.3	3.8
Temperature (degrees Celsius)	10	11.5	10	15	1.4	12.1
Hardness (milligrams per liter as $CaCO_3$)	10	390	290	480	72.8	18.5
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	10	73	29	120	32.2	44.0
Calcium, dissolved (milligrams per liter as Ca)	10	75	66	86	6.5	8.7
Magnesium, dissolved (milligrams per liter as Mg)	10	50	22	76	20.6	40.9
Sodium, dissolved (milligrams per liter as Na)	10	41	13	99	30.6	74.4
Sodium plus potassium, dissolved (milligrams per liter as Na)	1	--	94	94	--	--
Potassium, dissolved (milligrams per liter as K)	10	2.6	1.8	8.5	2.1	76.6
Bicarbonate (milligrams per liter as HCO_3)	7	380	320	430	52.1	13.8
Carbonate (milligrams per liter as CO_3)	5	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	2	330	330	330	1.4	.4
Sulfate, dissolved (milligrams per liter as SO_4)	10	93	15	180	57.1	61.4
Chloride, dissolved (milligrams per liter as Cl)	10	34	19	88	25.0	73.9
Fluoride, dissolved (milligrams per liter as F)	8	.2	.1	.4	.1	42.8
Silica, dissolved (milligrams per liter as SiO_2)	10	23	16	54	11.3	49.4
Nitrite plus nitrate, dissolved (milligrams per liter as N)	6	3.5	.6	6.1	2.3	66.6
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	3	.18	.03	.46	.2	131.0
Iron, dissolved (micrograms per liter as Fe)	3	70	3	190	100.9	135.1
Manganese, dissolved (micrograms per liter as Mn)	3	9	1	17	8.0	85.9
Solids, sum of constituents, dissolved (milligrams per liter)	10	513	330	750	148.9	29.0

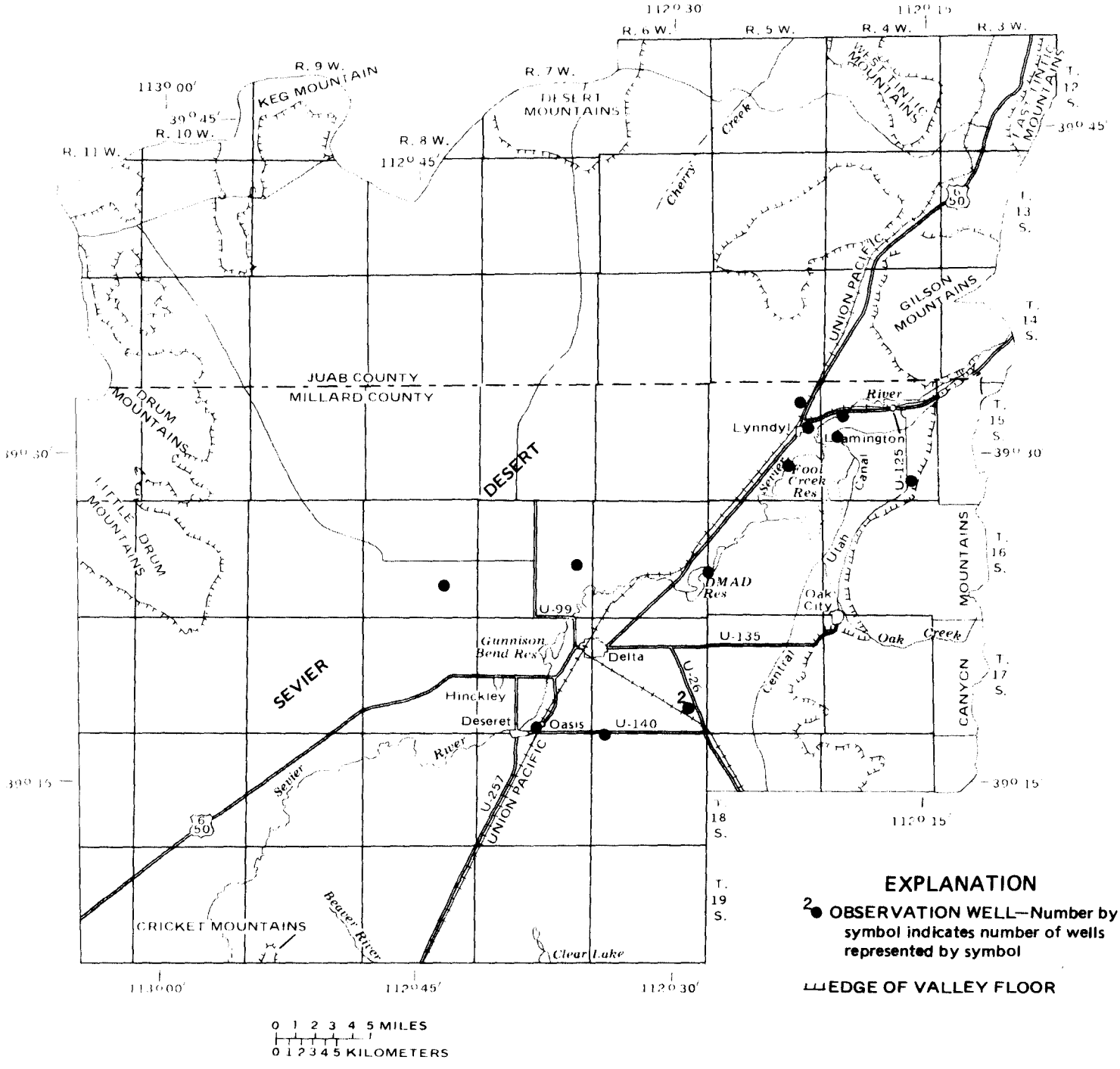


Figure 31.—Location of observation wells in the Sevier Desert.

Table 31.--Statistical analysis of chemical analyses of water from the observation wells in the Sevier Desert

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	128	1260	315	3400	941.0	74.7
pH (standard units)	100	7.7	6.5	8.7	.4	5.7
Temperature (degrees Celsius)	125	18.5	12.0	28.0	4.7	25.6
Hardness (milligrams per liter as $CaCO_3$)	96	390	12	1200	395.3	100.6
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	95	260	0	990	326.2	124.9
Calcium, dissolved (milligrams per liter as Ca)	87	92	2.6	270	88.8	96.0
Magnesium, dissolved (milligrams per liter as Mg)	86	45	.2	140	45.2	99.3
Sodium, dissolved (milligrams per liter as Na)	52	120	19	320	83.9	72.4
Sodium plus potassium, dissolved (milligrams per liter as Na)	47	100	19	430	81.0	77.5
Potassium, dissolved (milligrams per liter as K)	51	4.9	.7	18	4.3	87.1
Bicarbonate (milligrams per liter as HCO_3)	81	230	36	400	73.2	31.6
Carbonate (milligrams per liter as CO_3)	80	1.1	0	23	4.2	380.0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	5	180	98	330	91.8	52.1
Sulfate, dissolved (milligrams per liter as SO_4)	94	130	2.3	520	146.8	112.2
Chloride, dissolved (milligrams per liter as Cl)	106	210	22	960	227.3	107.7
Fluoride, dissolved (milligrams per liter as F)	8	.6	(1)	3	.6	96.5
Silica, dissolved (milligrams per liter as SiO_2)	80	28	12.6	76	9.9	35.5
Nitrite plus nitrate, dissolved (milligrams per liter as N)	40	2.8	(1)	16	5.1	184.0
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	23	.05	(1)	.12	.04	81.0
Iron, dissolved (micrograms per liter as Fe)	38	60	(1)	320	86.3	136.5
Manganese, dissolved (micrograms per liter as Mn)	35	110	(1)	670	193.7	180.9
Solids, sum of constituents, dissolved (milligrams per liter)	82	766	185	2100	567.7	74.1

(1) Not detected.

Skull Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Skull Valley. The ground water in the southern and central parts of the valley generally is fresh but locally is slightly saline. In the northern part of the valley, which contains a major thermal-spring area and also is open to Great Salt Lake, the ground water generally is slightly to moderately saline (Hood and Waddell, 1968, pl. 2). Four observation wells have been established in the valley (table 1 and fig. 32), and all probably are completed in the unconsolidated deposits. Monitoring was started at well (C-6-8)11dad-1 in 1965 and at the other three wells during 1973 and 1974. Dissolved-solids concentrations in water samples collected from the wells ranged from 280 milligrams per liter on July 31, 1973, at well (C-3-8)28cbc-1 to 2,700 milligrams per liter on July 27, 1978, at well (C-2-7)7dda-1. (See also table 32.) There were no significant changes or trends in the chemical quality of the water produced by the four wells during the monitoring period.

Snake Valley Area

The Snake Valley area includes Snake Valley and that part of the Deep Creek valley that extends into Utah (fig. 33). Unconsolidated deposits (basin fill) are the principal source of ground water in the area. The ground water throughout most of the area generally is fresh but locally is slightly to very saline. (See Hood and Rush, 1965, table 8, and Hood and Waddell, 1969, table 10.) The saline ground water probably is more widespread in the northern part of the area, which merges with the Great Salt Lake Desert. Ten observation wells have been established in the area (table 1 and fig. 33), and they all apparently are completed in the basin fill, one in the Deep Creek valley and the rest in Snake Valley. Monitoring was started at well (C-23-19)20bac-1 in 1964 and at the other wells during 1972-75. Dissolved-solids concentrations in water samples collected from the observation wells ranged from 180 milligrams per liter on July 10, 1979, at well (C-18-19)20dad-1 to 740 milligrams per liter on August 13, 1981, at well (C-23-19)20bac-1. (See also table 33.) No significant changes or trends were detected in the quality of water yielded by any of the observation wells during monitoring.

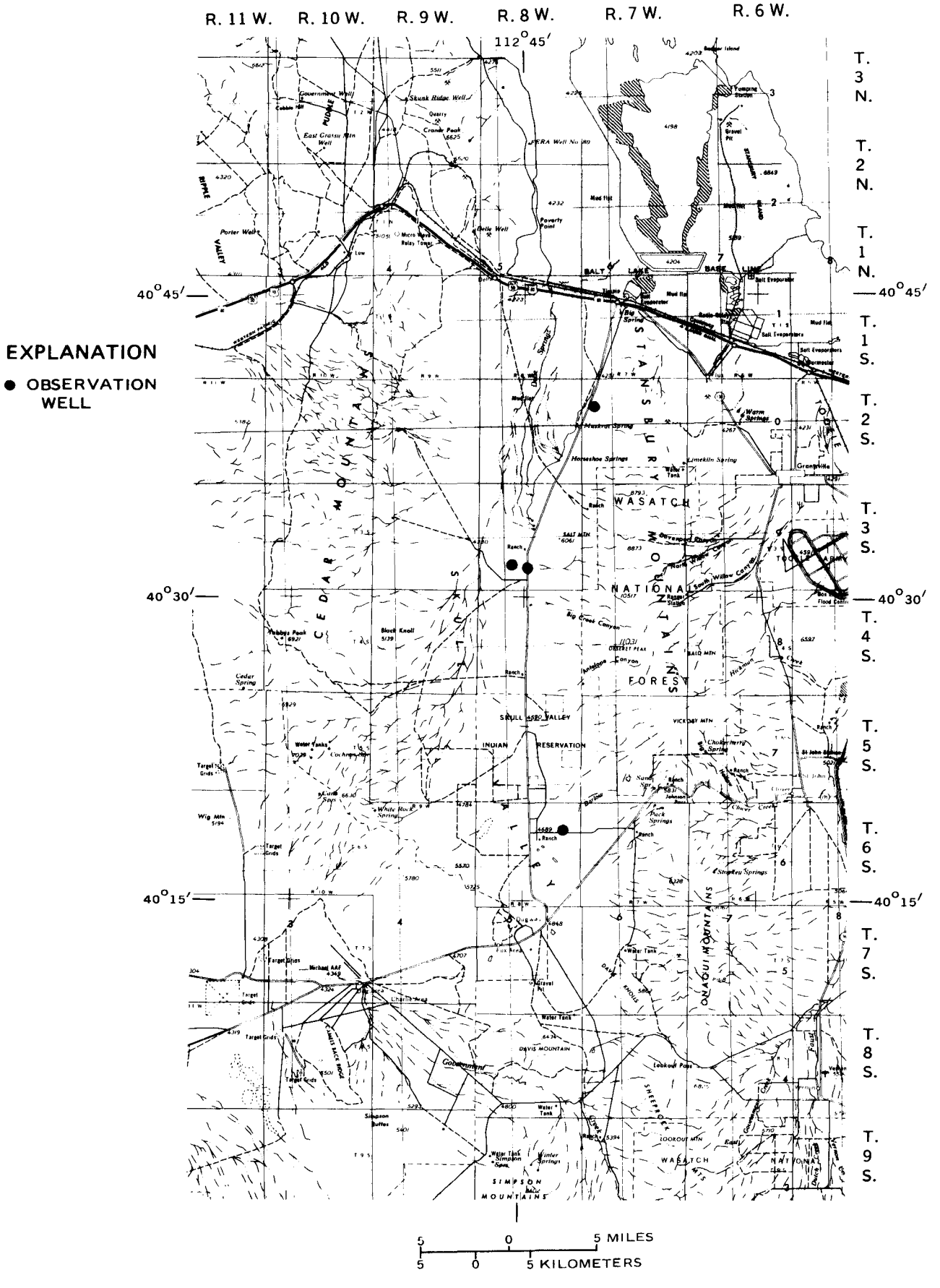


Figure 32.—Location of observation wells in Skull Valley.

Table 32.--Statistical analysis of chemical analyses of water from the observation wells in Skull Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	22	1910	450	4690	1700.0	89.1
pH (standard units)	17	7.6	7.1	8.2	.3	3.8
Temperature (degrees Celsius)	21	15	11.5	19	2.2	14.4
Hardness (milligrams per liter as $CaCO_3$)	16	310	140	550	150.5	49.0
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	16	170	29	370	121.7	73.3
Calcium, dissolved (milligrams per liter as Ca)	16	72	39	130	28.7	40.1
Magnesium, dissolved (milligrams per liter as Mg)	16	31	10	68	21.6	68.8
Sodium, dissolved (milligrams per liter as Na)	16	350	44	890	347.2	99.8
Sodium plus potassium, dissolved (milligrams per liter as Na)	2	435	50	820	544.5	125.2
Potassium, dissolved (milligrams per liter as K)	16	14	1.4	36	14.1	101.1
Bicarbonate (milligrams per liter as HCO_3)	11	170	134	220	35.9	20.7
Carbonate (milligrams per liter as CO_3)	8	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	2	140	120	160	31.1	22.7
Sulfate, dissolved (milligrams per liter as SO_4)	16	71	12	130	48.8	68.8
Chloride, dissolved (milligrams per liter as Cl)	16	610	79	1400	553.2	99.6
Fluoride, dissolved (milligrams per liter as F)	13	.3	.1	.9	.3	79.6
Silica, dissolved (milligrams per liter as SiO_2)	16	25	17	41	8.1	31.7
Nitrite plus nitrate, dissolved (milligrams per liter as N)	12	.84	(1)	1.5	.6	66.5
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	7	.06	.03	.09	.0	50.0
Iron, dissolved (micrograms per liter as Fe)	9	40	8	90	30.0	77.6
Manganese, dissolved (micrograms per liter as Mn)	9	36	1	100	41.2	115.4
Solids, sum of constituents, dissolved (milligrams per liter)	16	1260	280	2700	1000.5	79.4

(1) Not detected.

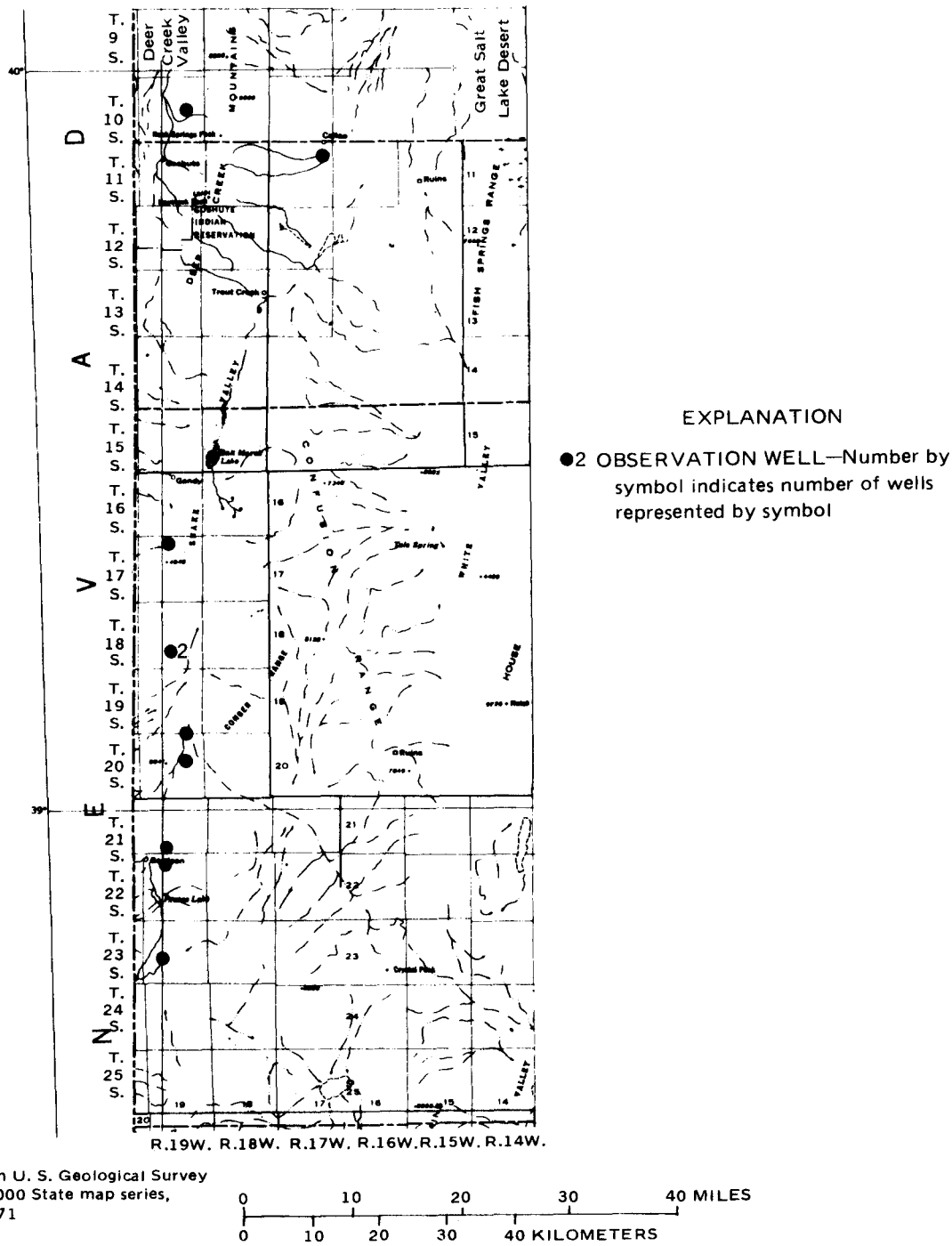


Figure 33.—Location of observation wells in the Snake Valley area.

Table 33.--Statistical analysis of chemical analyses of water from the observation wells in the Snake Valley area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	82	560	300	1200	216.4	38.6
pH (standard units)	53	7.4	6.8	8	.2	2.9
Temperature (degrees Celsius)	78	14.0	10.0	22	2.9	20.6
Hardness (milligrams per liter as $CaCO_3$)	45	230	93	1000	138.7	60.2
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	45	32	0	840	124.7	388.8
Calcium, dissolved (milligrams per liter as Ca)	45	57	28	390	54.0	94.8
Magnesium, dissolved (milligrams per liter as Mg)	45	21	1.9	58	14.4	67.3
Sodium, dissolved (milligrams per liter as Na)	44	42	7.7	140	35.5	84.8
Sodium plus potassium, dissolved (milligrams per liter as Na)	1	--	8.1	8.1	--	--
Potassium, dissolved (milligrams per liter as K)	40	2.1	.4	3.9	1.0	46.7
Bicarbonate (milligrams per liter as HCO_3)	36	257	160	380	77.0	30.0
Carbonate (milligrams per liter as CO_3)	36	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	7	200	160	320	75.8	37.1
Sulfate, dissolved (milligrams per liter as SO_4)	45	30	8.0	110	29.9	98.5
Chloride, dissolved (milligrams per liter as Cl)	46	40	4.5	150	31.3	77.9
Fluoride, dissolved (milligrams per liter as F)	36	.4	.1	1.2	.3	89.8
Silica, dissolved (milligrams per liter as SiO_2)	45	23	11	51	11.1	47.4
Nitrite plus nitrate, dissolved (milligrams per liter as N)	34	1.2	.01	4.4	1.3	107.2
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	23	.08	(1)	.28	.08	100.5
Iron, dissolved (micrograms per liter as Fe)	24	20	3	77	19.2	103.6
Manganese, dissolved (micrograms per liter as Mn)	24	7	1	10	4.0	58.0
Solids, sum of constituents, dissolved (milligrams per liter)	45	334	180	740	143.8	43.1

(1) Not detected.

Southern Utah Valley

Unconsolidated deposits (basin fill) contain the principal aquifers in southern Utah Valley, and the water in the principal aquifers generally is fresh (Price, 1985, fig. 30). Nine observation wells have been established in the valley (table 1 and fig. 34), and they apparently all are completed in the basin fill. Monitoring at the wells was started during 1959-70. Dissolved-solids concentrations in water samples collected from the wells ranged from 200 milligrams per liter on August 18, 1975, at well (D-7-3)34cdb-1 to 1,080 milligrams per liter on June 21, 1963, at well (D-7-3)28bdb-1. (See also table 34.) Although southern Utah Valley has had a large increase in population since the monitoring began, there is no indication from the available data that the population increase and related activities (including increased ground-water withdrawal and production of potential contaminants) have affected the chemical quality of ground water in the area of the observation wells during the monitoring period. Cordova (1970, p. 60-66) describes in more detail the chemical quality of ground water throughout southern Utah valley.

Tooele Valley

Unconsolidated deposits (basin fill) are the principal source of ground water in Tooele Valley. The ground water generally is fresh on the east and west sides of the valley, generally slightly saline but locally fresh or moderately saline in the central part of the valley, and locally very saline in the northern part of the valley, which opens to Great Salt Lake (Razem and Steiger, 1981, fig. 13). Eight observation wells have been established in the valley (table 1 and fig. 35), and they all are completed in the basin fill. Monitoring was started at three of the wells during 1964 and at the others during 1975-78. Dissolved-solids concentrations in water samples collected from the observation wells ranged from 290 milligrams per liter on July 26, 1977, at well (C-3-5)7dcc-1 to 2,600 milligrams per liter on July 23, 1979, at well (C-2-5)36dcd-1. (See also table 35.) There is no indication of any significant change or trend in the chemical quality of the water yielded by any of the observation wells during the monitoring periods at those wells.

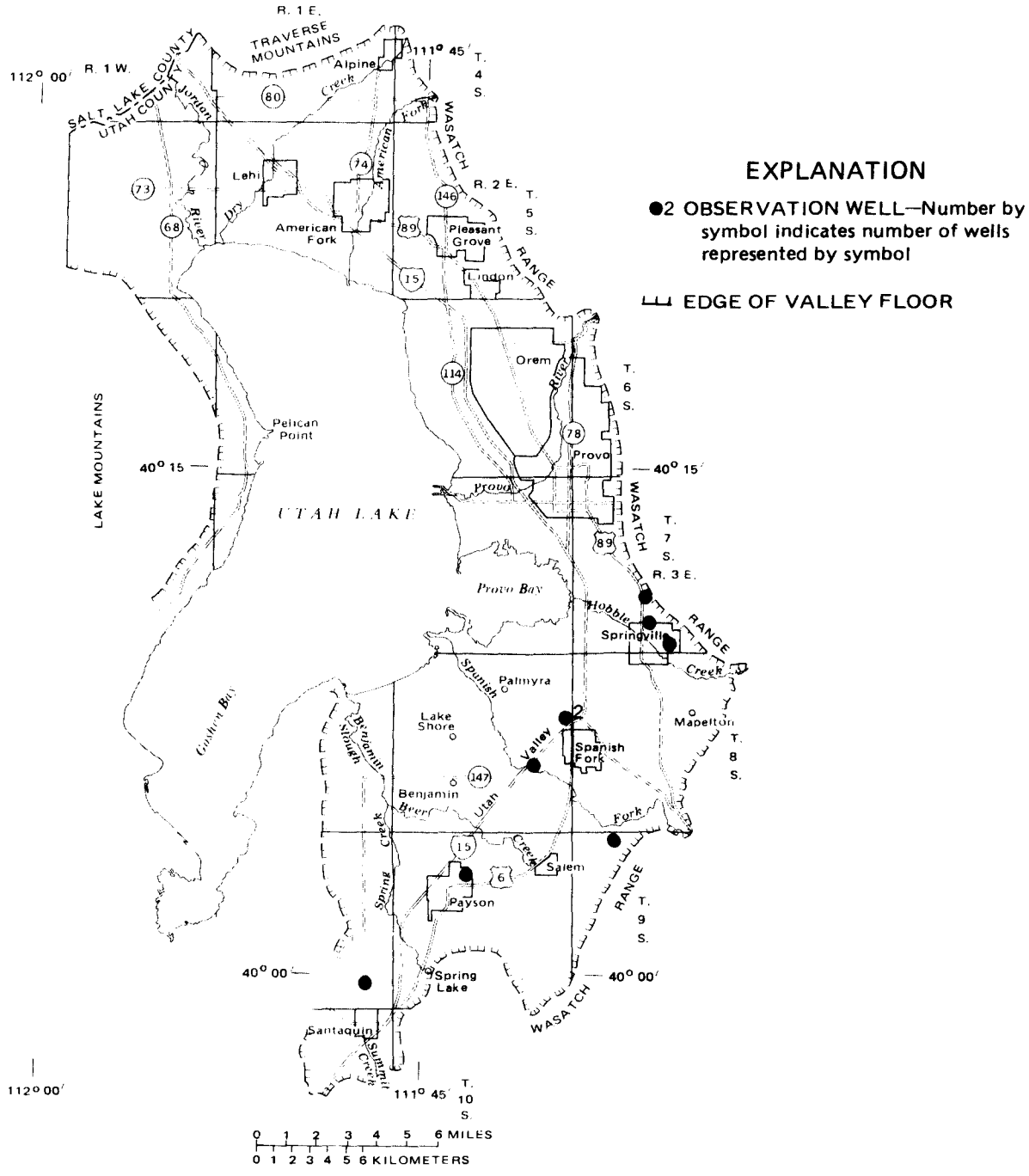


Figure 34.—Location of observation wells in Southern Utah Valley.

Table 34.--Statistical analysis of chemical analyses of water from the observation wells in southern Utah Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	80	690	350	1490	236.6	34.1
pH (standard units)	45	7.6	6.5	8.7	.6	7.8
Temperature (degrees Celsius)	64	13.5	9	19	2.1	15.3
Hardness (milligrams per liter as $CaCO_3$)	45	300	170	730	101.1	33.1
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	45	97	0	520	152.4	157.1
Calcium, dissolved (milligrams per liter as Ca)	42	70	30	190	21.9	31.4
Magnesium, dissolved (milligrams per liter as Mg)	42	33	18	80	16.2	48.8
Sodium, dissolved (milligrams per liter as Na)	29	27	3.6	75	21.4	79.2
Sodium plus potassium, dissolved (milligrams per liter as Na)	15	37	8.7	80	27.7	75.6
Potassium, dissolved (milligrams per liter as K)	28	3.9	.5	9.1	3.0	76.9
Bicarbonate (milligrams per liter as HCO_3)	36	270	36	410	88.8	32.9
Carbonate (milligrams per liter as CO_3)	36	.6	0	11	2.0	366.2
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	6	240	220	260	19.4	8.1
Sulfate, dissolved (milligrams per liter as SO_4)	42	110	7.0	540	155.4	144.5
Chloride, dissolved (milligrams per liter as Cl)	42	33	3.3	87	26.0	79.2
Fluoride, dissolved (milligrams per liter as F)	22	.2	.1	.3	.05	26.7
Silica, dissolved (milligrams per liter as SiO_2)	38	18	.7	53	15.2	86.1
Nitrite plus nitrate, dissolved (milligrams per liter as N)	16	1.7	.10	4.00	1.2	67.1
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	8	.04	(1)	.12	.04	102.4
Iron, dissolved (micrograms per liter as Fe)	8	30	7	140	45.5	156.8
Manganese, dissolved (micrograms per liter as Mn)	6	3	1	10	3.5	125.1
Solids, sum of constituents, dissolved (milligrams per liter)	39	415	200	1080	186.1	44.9

(1) Not detected.

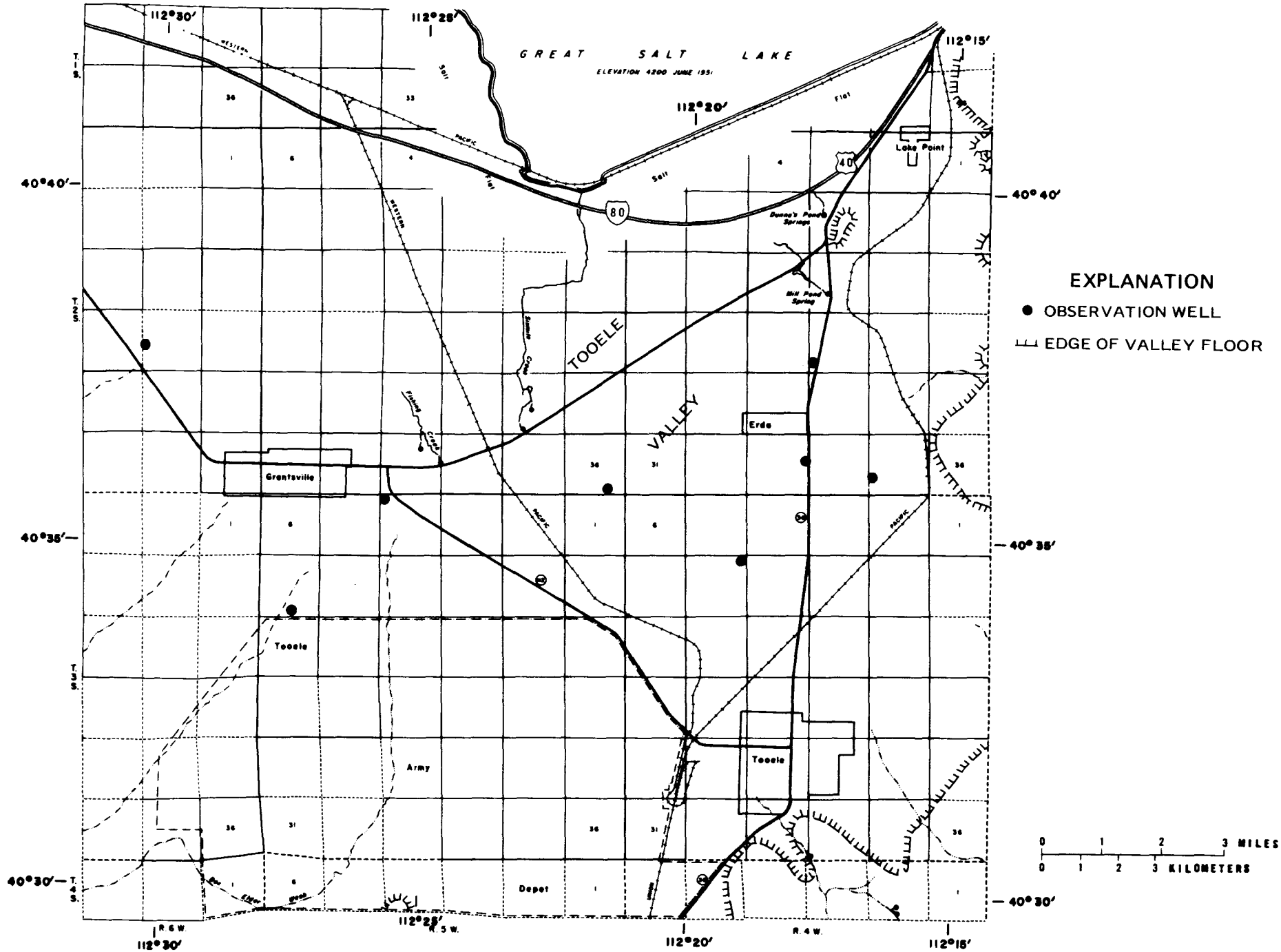


Figure 35.—Location of observation wells in Tooele Valley.

Table 35.--Statistical analysis of chemical analyses of water from the observation wells in Tooele Valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	82	1570	490	4500	947.1	60.2
pH (standard units)	30	7.6	6.5	8.2	.4	5.3
Temperature (degrees Celsius)	77	16.0	12	20.5	2.4	15.0
Hardness (milligrams per liter as $CaCO_3$)	39	380	130	840	188.2	50.0
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	38	190	0	600	161.8	85.7
Calcium, dissolved (milligrams per liter as Ca)	36	92	33	200	44.6	48.7
Magnesium, dissolved (milligrams per liter as Mg)	36	35	11	83	19.7	55.6
Sodium, dissolved (milligrams per liter as Na)	36	210	21	800	185.2	86.2
Sodium plus potassium, dissolved (milligrams per liter as Na)	4	350	50	810	361.4	101.9
Potassium, dissolved (milligrams per liter as K)	33	7.0	1.6	23	6.5	93.3
Bicarbonate (milligrams per liter as HCO_3)	29	240	180	310	41.6	17.4
Carbonate (milligrams per liter as CO_3)	18	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	5	180	150	190	16.2	9.1
Sulfate, dissolved (milligrams per liter as SO_4)	36	110	13	610	164.0	146.0
Chloride, dissolved (milligrams per liter as Cl)	44	370	52	1400	305.4	82.6
Fluoride, dissolved (milligrams per liter as F)	27	.2	.1	.7	.2	86.5
Silica, dissolved (milligrams per liter as SiO_2)	36	24	11	55	13.3	54.9
Nitrite plus nitrate, dissolved (milligrams per liter as N)	18	1.8	.64	3.3	.9	50.6
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	6	.08	(1)	.15	.05	70.4
Iron, dissolved (micrograms per liter as Fe)	11	20	3	90	25.9	108.6
Manganese, dissolved (micrograms per liter as Mn)	11	6	1	20	6.0	91.8
Solids, sum of constituents, dissolved (milligrams per liter)	37	960	290	2600	585.4	60.8

(1) Not detected.

Uinta Basin Area

Principal sources of ground water in the Uinta Basin area are (1) unconsolidated deposits (stream-valley alluvium along the larger tributaries of the Green River and basin fill in Ashley Valley) and (2) consolidated sedimentary rocks (chiefly sandstone). Ground water in the higher altitudes along the rim of the Uinta Basin generally is fresh. In the lower altitudes, the ground water generally ranges from slightly saline to briny depending on depth-to-water and the geologic formation. (See Hood and others, 1976, table 10.) The fresher ground water is always subject to contamination through development of the energy resources for which the Uinta Basin area is noted. For example, faulty oil-well construction could allow saline water to flow through the well into a freshwater aquifer. Also, poorly managed disposal of oil-field brine over a freshwater aquifer could contaminate the water in that aquifer.

Six observation wells have been established in the Uinta Basin (table 1 and fig. 36). Two of the wells are completed in unconsolidated deposits and the others are completed in sedimentary rocks. Sampling was started at well (D-3-21)30dcd-1 in 1948 and at the other wells during the 1960's and 1970's. Dissolved-solids concentrations in water samples collected from the wells ranged from 92 milligrams per liter on July 17, 1980, at well U(B-1-1)27ada-1 to 19,000 milligrams per liter on May 3, 1977, at well (D-10-22)10ada-1. (See also table 36.) There was no significant change or trend in the chemical quality of the water yielded by any of the observation wells during their monitoring periods.

Upper Fremont River Valley

Principal sources of ground water in the upper Fremont River valley are unconsolidated deposits (basin fill and stream-valley alluvium) and consolidated rocks of volcanic origin. The ground water generally is fresh but locally is slightly saline (Bjorklund, 1969, fig. 10). Three observation wells have been established in the valley (table 1 and fig. 37), and all three wells are completed in unconsolidated deposits. Monitoring was started at wells (D-27-3)19aaa-1 and (D-28-3)26cda-1 during 1966 and at well (D-29-3)1cab-1 during 1982. Dissolved-solids concentrations in water samples collected from the three wells ranged from 170 milligrams per liter on July 8, 1982, at well (D-29-3)1cab-1 to 1,300 milligrams per liter on July 8, 1982, at well (D-27-3)19aaa-1. (See also table 37.) A sample collected on June 14, 1976, at well (C-28-3)26cda-1 had a significantly larger dissolved-solids concentration than did samples collected from that well during previous or later years. The larger dissolved-solids concentration reflects significantly larger concentrations of chloride and sulfate ions in the sample. The reason for the larger concentrations is not known. It may have been, however, short-term contamination of the ground water in the immediate vicinity of the well.

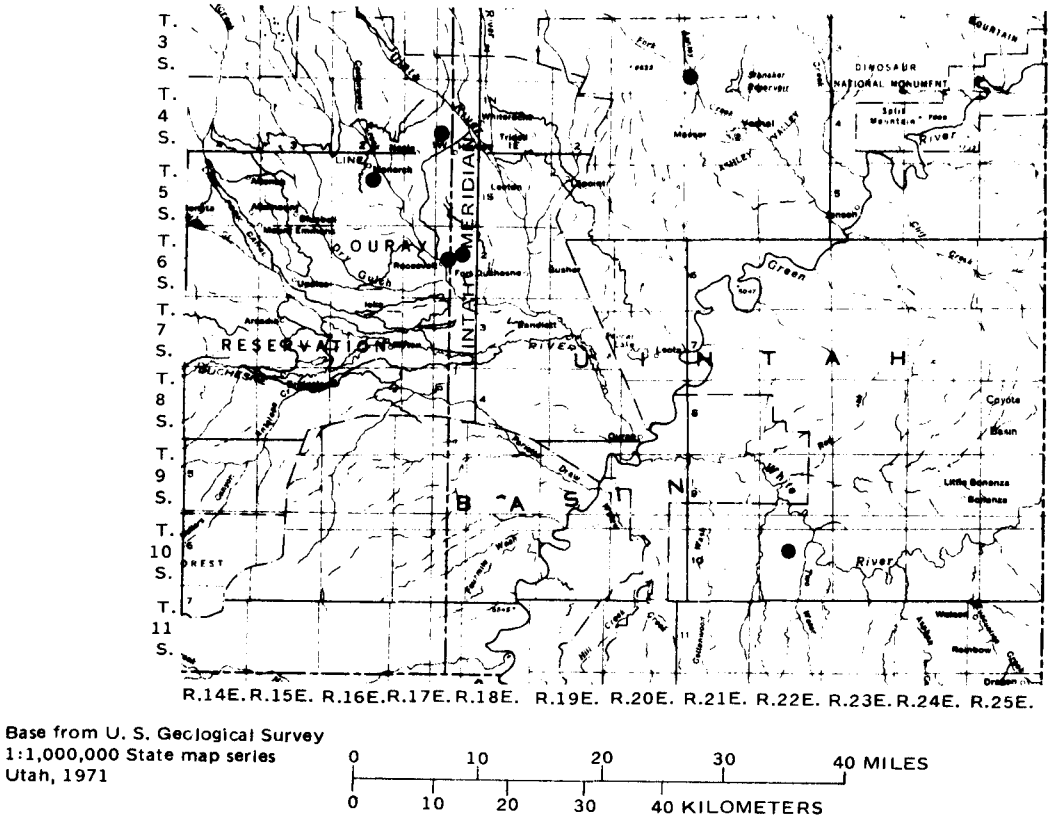


Figure 36.—Location of observation wells in the Uinta Basin area.

Table 36.--Statistical analysis of chemical analyses of water from the observation wells in the Uinta Basin area

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	65	3170	160	20000	5881.2	185.5
pH (standard units)	30	8.0	7.2	9.1	.5	6.4
Temperature (degrees Celsius)	57	13	7.0	25	3.6	27.9
Hardness (milligrams per liter as $CaCO_3$)	26	790	4	4600	1504.0	190.3
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	26	590	0	4000	1242.7	211.5
Calcium, dissolved (milligrams per liter as Ca)	25	65	0	370	103.5	160.0
Magnesium, dissolved (milligrams per liter as Mg)	25	160	.30	890	310.9	196.6
Sodium, dissolved (milligrams per liter as Na)	19	1530	2.6	4700	2010.4	131.5
Sodium plus potassium, dissolved (milligrams per liter as Na)	7	130	10	210	58.7	46.8
Potassium, dissolved (milligrams per liter as K)	19	6.8	.5	20	7.3	107.3
Bicarbonate (milligrams per liter as HCO_3)	24	400	100	980	259.2	64.3
Carbonate (milligrams per liter as CO_3)	20	6.2	0	48	12.9	208.5
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	1	--	240	240	0	0
Sulfate, dissolved (milligrams per liter as SO_4)	26	2400	6.6	12000	4782.0	199.6
Chloride, dissolved (milligrams per liter as Cl)	26	330	.9	3400	882.4	270.6
Fluoride, dissolved (milligrams per liter as F)	18	.8	.1	2	.6	72.5
Silica, dissolved (milligrams per liter as SiO_2)	25	8.5	5.9	11	1.6	18.2
Nitrite plus nitrate,dissolved (milligrams per liter as N)	14	.22	(1)	1	.3	135.0
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	11	.05	(1)	.12	.05	99.6
Iron, dissolved (micrograms per liter as Fe)	6	610	20	3000	1176.8	191.9
Manganese, dissolved (micrograms per liter as Mn)	6	29	3	90	37.2	129.8
Solids, sum of constituents, dissolved (milligrams per liter)	25	4440	92	19000	7243.9	163.2

(1) Not detected.

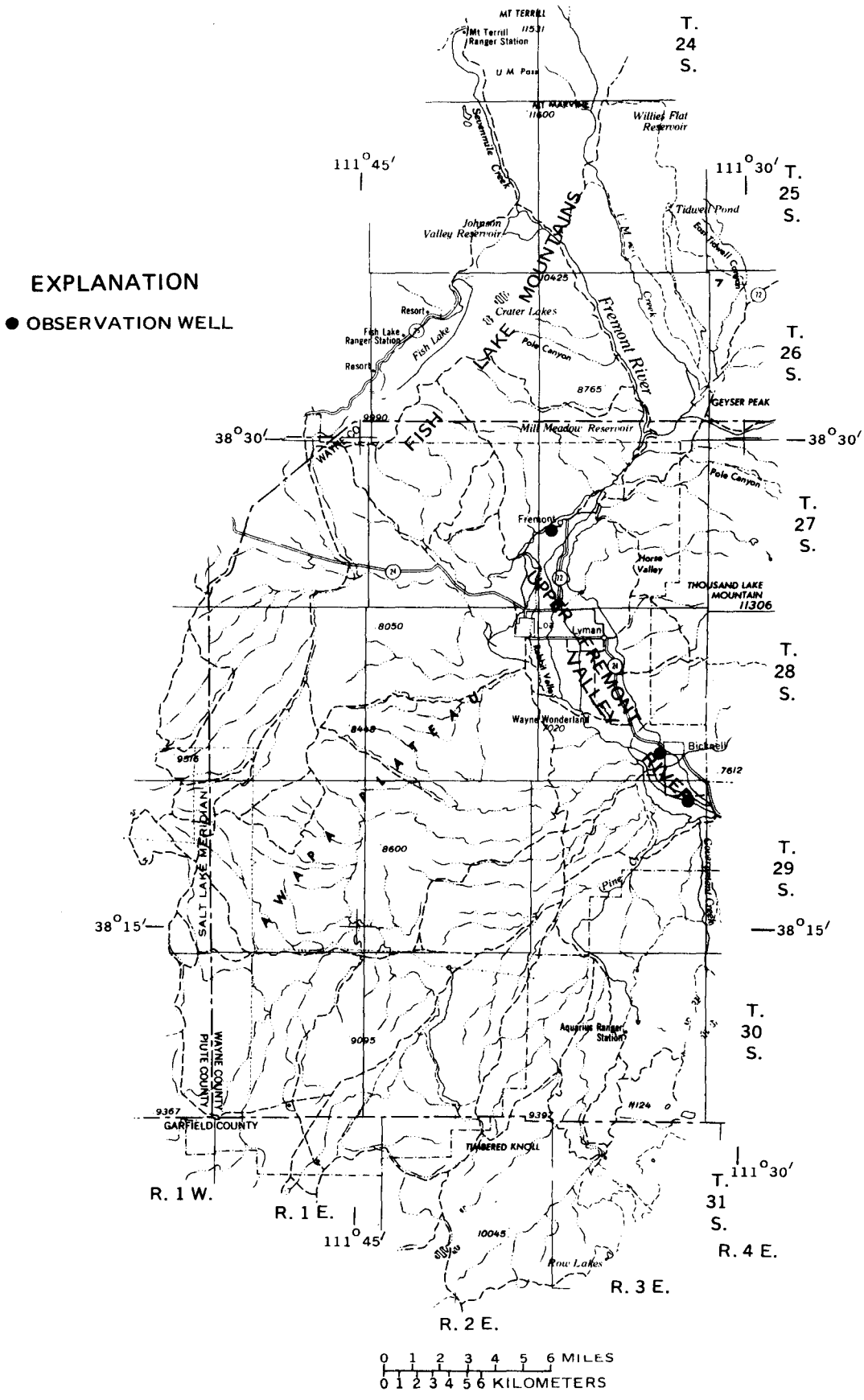


Figure 37.—Location of observation wells in the upper Fremont River valley.

Table 37.--Statistical analysis of chemical analyses of water from the observation wells in the upper Fremont River valley

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	14	1230	205	1650	529.9	43.2
pH (standard units)	11	7.7	7.4	8.3	.3	3.7
Temperature (degrees Celsius)	14	12.0	10	21.5	3.2	26.5
Hardness (milligrams per liter as $CaCO_3$)	11	650	83	920	328.2	50.8
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	11	480	0	720	311.5	65.2
Calcium, dissolved (milligrams per liter as Ca)	11	190	22	280	103.8	54.0
Magnesium, dissolved (milligrams per liter as Mg)	11	40	6.7	53	17.0	42.1
Sodium, dissolved (milligrams per liter as Na)	9	40	8.8	100	30.6	77.2
Sodium plus potassium, dissolved (milligrams per liter as Na)	3	47	33	73	22.3	47.1
Potassium, dissolved (milligrams per liter as K)	9	4.5	3.0	7.7	1.4	31.9
Bicarbonate (milligrams per liter as HCO_3)	7	230	180	280	40.3	17.4
Carbonate (milligrams per liter as CO_3)	7	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	2	120	69	180	77.1	62.4
Sulfate, dissolved (milligrams per liter as SO_4)	11	505	34	750	294.3	58.2
Chloride, dissolved (milligrams per liter as Cl)	11	29	5.5	150	41.7	144.9
Fluoride, dissolved (milligrams per liter as F)	9	.2	.1	.5	.2	81.4
Silica, dissolved (milligrams per liter as SiO_2)	11	35	27	45	7.4	21.4
Nitrite plus nitrate, dissolved (milligrams per liter as N)	6	2.1	.38	4.3	1.3	59.5
Phosphate, ortho, dissolved (milligrams per liter as PO_4)	3	.12	.03	.18	.1	66.1
Iron, dissolved (micrograms per liter as Fe)	3	30	9	57	25.7	93.0
Manganese, dissolved (micrograms per liter as Mn)	3	2	1	3	1.2	49.5
Solids, sum of constituents, dissolved (milligrams per liter)	11	948	170	1300	391.7	41.3

Upper Sevier Valleys

Unconsolidated deposits (stream-valley alluvium and local basin fill) are the principal source of ground water in the upper Sevier Valleys. Other important sources of water locally are consolidated sedimentary and igneous rocks. The ground water generally is fresh. Five observation wells have been established in the upper Sevier Valleys (table 1 and fig. 38). Well (C-29-2)35bad-1 is completed in the Tertiary Brian Head Formation, of former usage, and the other wells apparently all are completed in the unconsolidated deposits. Monitoring was started at the wells during 1962 and 1963. Dissolved-solids concentrations in water samples collected from the wells ranged from 130 milligrams per liter on May 24, 1974, at well (C-26-1)23ddb-1 to 332 milligrams per liter on May 28, 1962, at well (C-31-2)23bcd-1. (See also table 38.) There was no significant change or trend in the chemical quality of water yielded by any of the observation wells during the monitoring period of 1962-84. Additional information about ground-water quality in the upper Sevier Valleys can be found in a report by Carpenter and others (1967, p. 79-84).

CONCLUSIONS

The U.S. Geological Survey formally began a monitoring program for ground-water quality in Utah in 1957 with an observation-well network consisting of fewer than 50 wells. The monitoring program was initiated to detect any changes in inorganic-chemical quality that might be associated with the withdrawal of water from wells. By 1984, the network had expanded to include more than 200 wells scattered throughout the State. The program has produced considerable information about the inorganic chemical quality of ground water in the monitored areas. The chemical-quality data have indicated a slight, but progressive degradation of water quality in Pahvant Valley and the Milford and Beryl-Enterprise areas of the Escalante Valley, where water levels have declined due to pumping for irrigation. The data also have indicated a degradation of the chemical quality of water locally in the principal artesian aquifer in Salt Lake Valley and possible short-term contamination in Goshen Valley and the upper Fremont River valley. Water-quality changes, related either to ground-water withdrawals or ground-water recharge also were detected in several other areas, including Curlew Valley, Cedar City Valley, Northern Utah Valley, the lower Bear River valley, and the Sevier Desert.

The monitoring program has been modified from time to time, chiefly to make it more cost-effective. With the rapid population and industrial increase in Utah during the past several decades, however, additional modification of the program seems appropriate to make it still more cost-effective and applicable to current conditions. For example, the observation-well network could be decreased to include only the most strategically-located wells based on current (1985) knowledge of hydrologic conditions, population distribution, industrial activity, and land-use practices throughout the State. The type of water-quality data determined could be modified at individual observation wells, depending on potential water-quality problems in the vicinity of the observation well. For example, the chemical analysis of

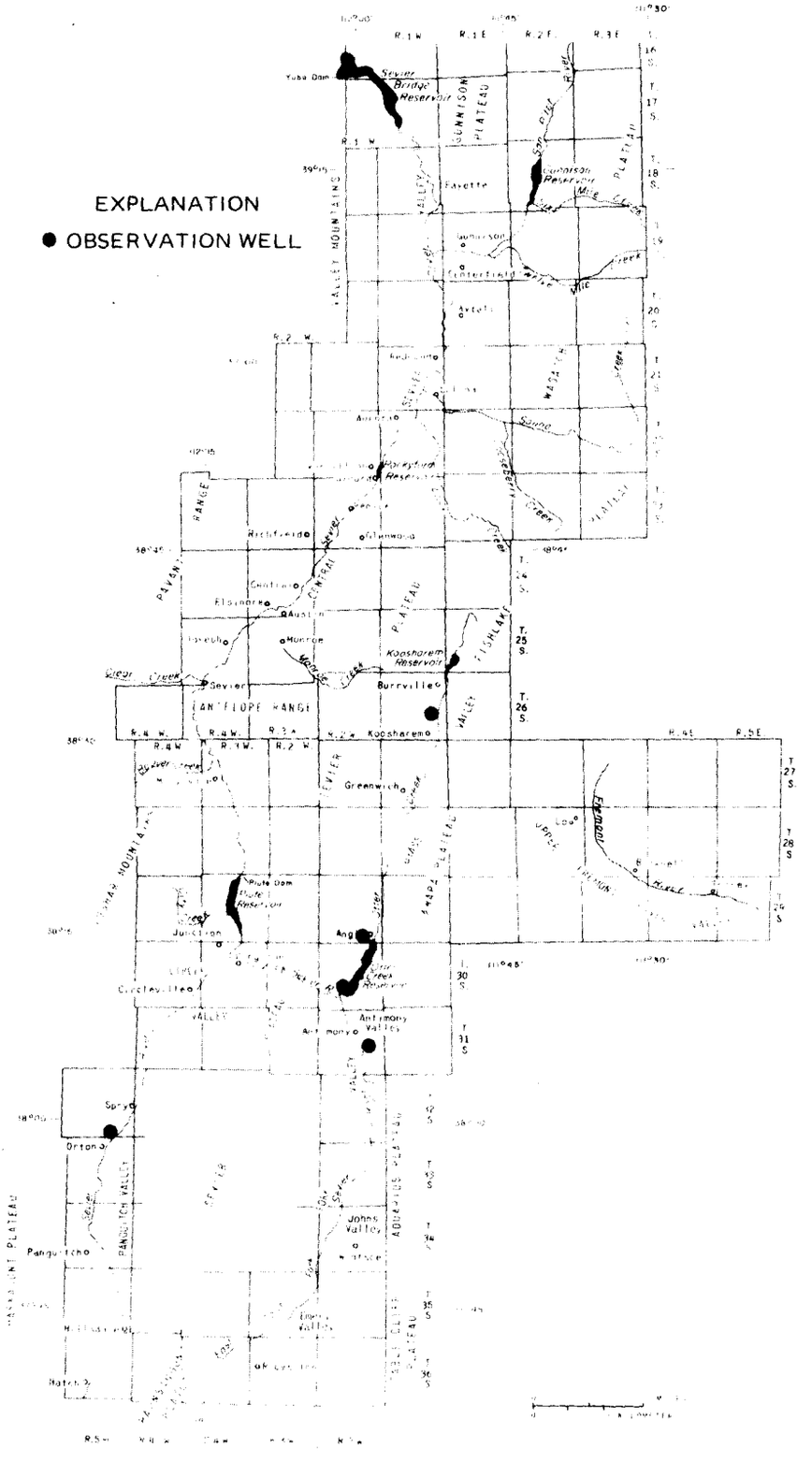


Figure 38.—Location of observation wells in the upper Sevier Valleys.

Table 38.--Statistical analysis of chemical analyses of water from the observation wells in the upper Sevier Valleys

Number: Number of determined values for the indicated property or constituent.

Property or constituent	Number	Mean value	Minimum value	Maximum value	Standard deviation	Coefficient of variability
Specific conductance (microsiemens per centimeter at 25 °Celsius)	66	350	150	560	135.9	39.1
pH (standard units)	31	7.5	7.0	8.4	.3	3.7
Temperature (degrees Celsius)	66	13.5	8.5	19.0	2.2	15.9
Hardness (milligrams per liter as $CaCO_3$)	33	160	62	250	66.2	41.9
Hardness, noncarbonate (milligrams per liter as $CaCO_3$)	33	9.7	0	37	13.3	137.3
Calcium, dissolved (milligrams per liter as Ca)	26	44	20	85	18.6	41.8
Magnesium, dissolved (milligrams per liter as Mg)	26	9.5	(1)	16	5.4	56.6
Sodium, dissolved (milligrams per liter as Na)	18	12	7.8	19	3.3	26.7
Sodium plus potassium, dissolved (milligrams per liter as Na)	12	15	12	21	3.1	20.2
Potassium, dissolved (milligrams per liter as K)	16	4.3	2.4	6.2	1.5	35.2
Bicarbonate (milligrams per liter as HCO_3)	23	190	93	290	69.1	35.9
Carbonate (milligrams per liter as CO_3)	23	0	0	0	0	0
Alkalinity, laboratory (milligrams per liter as $CaCO_3$)	6	140	78	195	54.4	38.7
Sulfate, dissolved (milligrams per liter as SO_4)	31	14	.9	31	9.0	63.1
Chloride, dissolved (milligrams per liter as Cl)	33	15	1.9	36	10.9	74.2
Fluoride, dissolved (milligrams per liter as F)	13	.3	.2	.5	.1	36.7
Silica, dissolved (milligrams per liter as SiO_2)	24	42	32	51	5.5	13.3
Nitrite plus nitrate, dissolved (milligrams per liter as N)	9	.57	.19	.86	.3	46.4
Iron, dissolved (micrograms per liter as Fe)	10	30	3	200	60.3	201.8
Manganese, dissolved (micrograms per liter as Mn)	10	11	1	90	27.9	263.3
Solids, sum of constituents, dissolved (milligrams per liter)	22	229	130	332	76.3	33.2

(1)Not detected.

water samples from an observation well near a waste-disposal facility that might contain trace inorganic or organic contaminants or harmful radionuclides would include analyses for the suspected trace inorganic and organic contaminants or radionuclides. Such analyses are more costly than analyses for major inorganic-chemcial constituents, however, that increased cost could be offset to some extent by decreasing the total number of observation wells to those only most strategically located.

Virtually all the observation wells listed in table 1 of this report are privately-owned wells which were designed, located, and constructed for uses other than to monitor the chemical quality of ground water. Although considerable valuable information about the chemical quality of ground water in Utah has been collected at those wells, much better information about the chemical quality of ground water could be gained at wells designed, located, and constructed specifically to collect chemical-quality data. Therefore, any plan to modify the observation-well network in Utah needs to seriously consider including a drilling program under which desired water-quality observation wells can be constructed. This is especially true when considering areas of potentially dangerous ground-water contamination in which privately-owned wells are not available for use in the network. Such a well-construction program doubtless would be costly. It could, however, result in early detection and prevention of the spread of a dangerous contaminant in the ground-water system. When measured in terms of human health and life, therefore, the cost of the well-construction program would be small.

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