GEOHYDROLOGIC DATA FOR THE SOUTH FORK NINNESCAH RIVER VALLEY AND ADJACENT PLAINS IN PRATT AND KINGMAN COUNTIES, SOUTH-CENTRAL KANSAS

By J.B. Gillespie, G.D. Hargadine, N.C. Myers, and D.A. Hargadine

U.S. GEOLOGICAL SURVEY
Open-File Report 91-186

Prepared in cooperation with the

KANSAS WATER OFFICE, the

CITY OF WICHITA, and SEDGWICK COUNTY

Lawrence, Kansas
1991

U.S. DEPARTMENT OF THE INTERIOR
MANUEL LUJAN, JR., Secretary
U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey
Water Resources Division
4821 Quail Crest Place
Lawrence, Kansas 66049

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports
Denver Federal Center
Box 25425, Building 810
Denver, Colorado 80225

CONTENTS

	Page
Abstract	1
Introduction	1
Purpose and scope	1
Well- and sampling-site numbering system	2
Acknowledgments	2
Well and water-level data	6
Geologic data	10
Water-quality data	10
Geophysical data	10
Selected references	10
Tables	25

ILLUSTRATIONS

Figure		Page
1.	Maps showing location of study area	2
2.	Generalized columnar section of geologic units in study area	3
3.	Map showing location of water wells and test holes and oil-or-gas wells and test holes from which data were collected or used	4
4.	Diagram illustrating well- and site-numbering system	5
5-14.	Maps showing:	
5.	Altitude of water levels in selected water wells completed in alluvial aquifer, January-April 1990	6
6.	Altitude of water levels in selected water wells completed near base of alluvial aquifer, January-April 1990	7
7.	Altitude of water levels in selected water wells completed in top of Permian aquifer, January-April 1990	8
8.	Saturated thickness of alluvial aquifer determined at selected water wells	9
9.	Location of selected water wells and test holes from which data were used to determine altitude of top of Permian bedrock	11
10.	Location of selected oil-or-gas wells and test holes from which data were used to determine altitude of top of Stone Corral Formation	12
11.	Presence or absence of salt in the Ninnescah Shale determined at selected oil-or-gas wells and test holes	13

CONTENTS--Continued

Figure		Page
12.	Chloride concentrations in samples collected from selected water wells completed in alluvial aquifer, near base of alluvial aquifer, and in top of Permian aquifer	14
13.	Sites where water samples were collected from streams, ponds, marshes, springs, the South Fork Ninnescah River, and from beneath river in the South Fork Ninnescah Valley	17
14.	Salinity and seepage measurement sites on South Fork Ninnescah River from Pratt to near Murdock streamflow-gaging stations	18
15.	Graph showing chloride concentrations, chloride discharges, and stream discharges for South Fork Ninnescah River from Pratt to near Cunningham, November 1988	19
16.	Graph showing chloride concentrations, chloride discharges, and stream discharges for South Fork Ninnescah River from Pratt to near Murdock, January and November 1989	19
17.	Graph showing chloride concentrations and discharges for South Fork Ninnescah River near Calista, 1963-88	20
18.	Map showing location of electromagnetic ground-conductivity traverses beneath and adjacent to South Fork Ninnescah River	20
19.	Graph showing apparent ground conductivity beneath South Fork Ninnescah River downstream from Pratt County bridge at 27S-11W-31BBBB	21
20.	Natural gamma logs from wells drilled by the U.S. Bureau of Reclamation	22

TABLES

Table		Page
1.	Altitude of land surface and water levels in selected wells completed in alluvial and Permian aquifers, January-April 1990	25
2.	Altitude of top of the Permian bedrock determined at selected water wells and test holes	28
3.	Altitude of top of the Stone Corral Formation and thickness of salt in the Ninnescah Shale determined at selected oil-or-gas wells and test holes	30
4.	Specific conductance and chloride concentrations in samples collected from selected water wells completed in the alluvial and Permian aquifers, 1982-89	34
5.	Specific conductance and chloride concentrations in water samples collected from streams, ponds, marshes, springs, the South Fork Ninnescah River, and from beneath streambed of river, 1988-89	37
6.	Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989	40
7.	Lithologic logs of wells drilled by U.S. Bureau of Reclamation	48

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	*By*	*To obtain*
inch	25.4	millimeter
foot	0.3048	meter
mile	1.609	kilometer
acre	4,047	square meter
ton per day	0.0105	kilogram per second
cubic foot per second	0.02832	cubic meter per second
degree Fahrenheit (°F)	°C = 5/9x (°F-32)	degree Celsius (°C)

Sea level: In this report, sea level refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

GEOHYDROLOGIC DATA FOR THE SOUTH FORK NINNESCAH RIVER VALLEY AND ADJACENT PLAINS IN PRATT AND KINGMAN COUNTIES, SOUTH-CENTRAL KANSAS

By

J.B. Gillespie[1], G.D. Hargadine[2], N.C. Myers[1], and D.A. Hargadine[1]

ABSTRACT

Saline ground-water discharges to the South Fork Ninnescah River in Pratt and Kingman Counties, south-central Kansas. This report presents geohydrologic data that are useful in planning for and studying the occurrence of saltwater in the area. Information on wells and water levels, geology, ground-water and surface-water quality, and geophysical data are presented in illustrations and tables. Geologic units in the study area are described in a generalized columnar section.

The altitude of water levels in 160 wells completed in the alluvial and top of the Permian aquifers is shown. The altitude of the tops of the Permian bedrock and the Stone Corral Formation in 106 selected water wells and test holes and 420 oil-or-gas wells and test holes is given. The presence or absence of salt and thickness of the salt in the Ninnescah Shale is given also.

Water-quality information includes specific conductance and chloride concentrations in water samples from 91 wells completed in the alluvial aquifer, near the base of the alluvial aquifer, and in the Permian aquifer and from 35 water samples that were collected from streams, ponds, marshes, springs, the South Fork Ninnescah River, and from beneath the streambed of the river. Salinity and seepage measurement data for the South Fork Ninnescah River are given also.

Electromagnetic ground-conductivity survey data are given for the South Fork Ninnescah River valley and beneath the river. Also shown are natural gamma and lithologic logs of the 15 wells drilled for this study.

INTRODUCTION

In July 1988, the U.S. Geological Survey, in cooperation with the City of Wichita and Sedgwick County, began an investigation of saline ground-water discharge to the South Fork Ninnescah River in Pratt and Kingman Counties, south-central Kansas. In July 1989, the Kansas Water Office became the cooperator for this investigation. The study area includes the South Fork Ninnescah River and valley from the city of Pratt in Pratt County to near Murdock in Kingman County and adjacent plains in eastern Pratt and the western edge of Kingman Counties (fig. 1).

Purpose and Scope

The purpose of this report is to present the geohydrologic data collected during the investigation of saline-water discharge for planning and management purposes. Information on wells and ground-water levels, geology, ground- and surface-water quality, and geophysical data are presented in illustrations and tables. A generalized columnar section of the geologic units in the study area is shown in figure 2. The location of water wells, oil-or-gas wells, and test holes from which data were collected are shown in figure 3. The land-surface altitude at each well was determined by leveling by personnel from the U.S. Bureau of Reclamation and the U.S. Geological Survey.

Data related to the South Fork Ninnescah River were collected and compiled for the entire reach in the study area, and geohydrologic data from water wells and oil-or-gas wells and test holes were collected only in the western part of the area where saline water is entering the river from the underlying alluvial aquifer.

[1] U.S. Geological Survey, Lawrence, Kansas.

[2] Kansas Water Office, Topeka, Kansas.

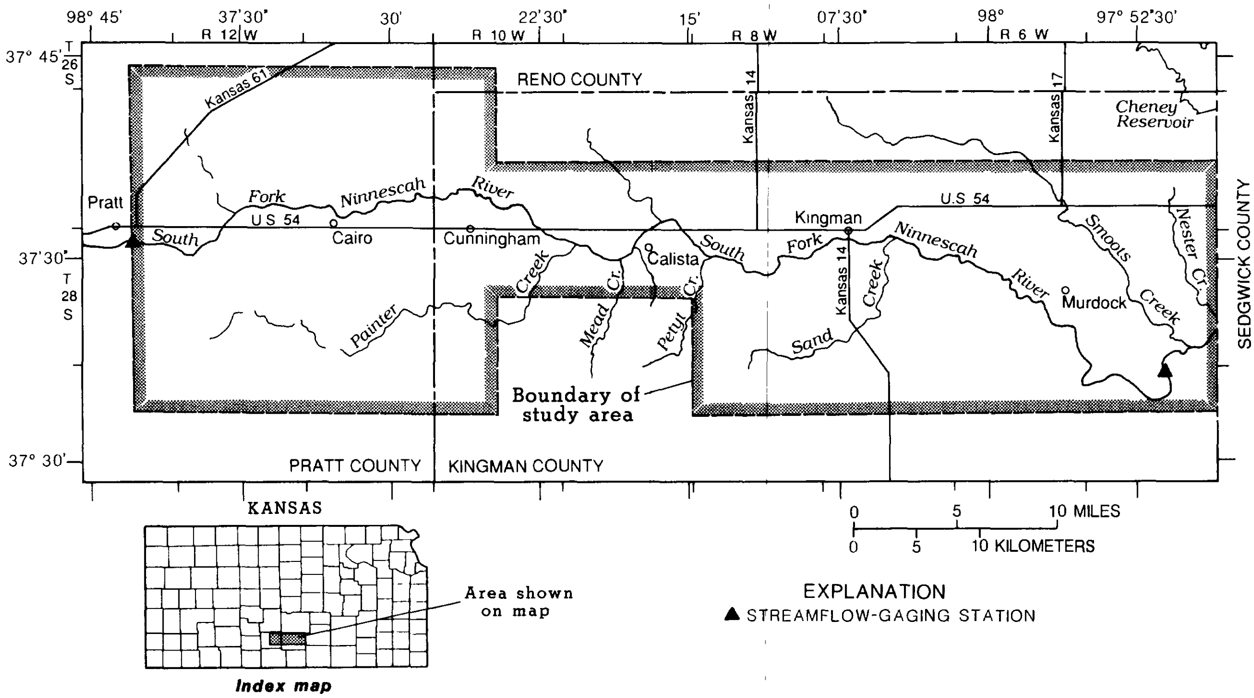


Figure 1. Location of study area.

Well- and Sampling-Site Numbering System

The numbering of wells and sampling sites used in this report is based on a modification of the U.S. Bureau of Land Management's system of land subdivision. The first number indicates the township south (S) of the Kansas-Nebraska State line; the second indicates the range west or east (W or E) of the sixth principal meridian; and the third indicates the section in which the well or sampling site is located. The first letter following the section number denotes the quarter section or 160-acre tract; a second letter, the quarter-quarter section or 40-acre tract; a third letter, the quarter-quarter-quarter section or 10-acre tract; and in some cases, a fourth letter, the quarter-quarter-quarter-quarter section or 2.5-acre tract. The 160-acre, 40-acre, 10-acre, and 2.5-acre tracts are designated A, B, C, and D in a counterclockwise direction beginning in the northeast quarter of the section. Where there is more than one well or sampling site in a tract, consecutive numbers are added, beginning with 2, in the order in which the wells were inventoried. For example, 27S-11W-31ADDD2 indicates the second well inventoried in the southeast quarter of the southeast quarter of the southeast quarter of the northeast quarter of sec. 31, T. 27 S., R. 11 W. (fig. 4).

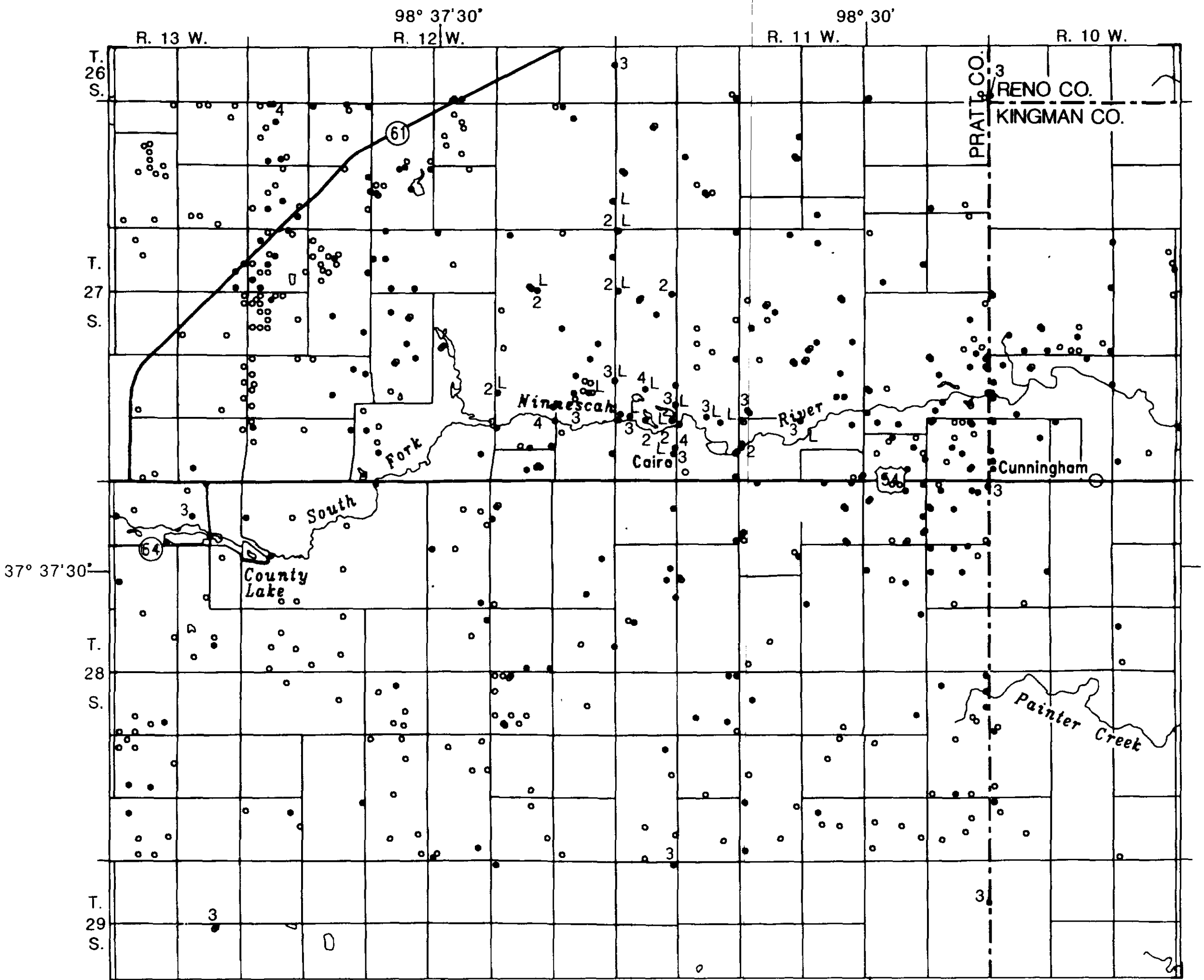
Acknowledgments

The authors appreciate the cooperation of the land owners, oil companies, and county and State highway officials who provided information or gave permission for collection of data. Special thanks are given to Jack Grier for access to his land, which contains a salt marsh, Sharon Falk and the personnel of the Big Bend Groundwater Management District No. 5 for consultation and data, the Northern Natural Gas Company for allowing access to their records and water wells, and D.O. Whittemore of the Kansas Geological Survey for his valuable knowledge of the water chemistry of the area and use of water-quality data for wells installed by the Kansas Geological Survey. Special acknowledgment is given to Shirley Shadix and drill crew of the U.S. Bureau of Reclamation for installing monitoring wells at 15 sites in the study area.

Substantial contributions, including data collection, were made by personnel of

System	Series	Geologic unit	Maximum thickness, in feet	Physical characteristics
Quaternary	Pleistocene	Undifferentiated Pleistocene deposits	300	Unconsolidated deposits of sand and gravel with interbedded lenses of clay, silt, and caliche. Windblown silt (loess) and dune sand occur at the surface over most of the area. Stream-laid deposits (alluvium) of late Quaternary age range from clay to gravel and occur along the South Fork Ninnescah River valley.
Permian	Lower Permian	Salt Plain Formation	300	Reddish-brown sandy siltstone and fine-grained sandstone.
		Harper Sandstone	250	Brownish-red siltstone with a few thin beds of silty sandstone.
		Stone Corral Formation	20	White and light-gray anhydrite and dolomite.
		Ninnescah Shale	400	Red and grayish-green shale, siltstone, and very fine-grained silty sandstone. A 20 to 50 foot thick salt member, when present, is about 50 feet below the top of the formation.
		Wellington Formation	500	Calcareous gray and blue shale, containing thin beds of anhydrite, gypsum, and limestone. The Hutchinson Salt Member, when present, is near the middle of the formation.

Figure 2. Generalized columnar section of geologic units in study area (modified from Fader and Stullken, 1978).



0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

EXPLANATION

2•L WATER WELL OR TEST HOLE--Number indicates more than one well at that location. L indicates well used for gamma logs in figure 20

∘ OIL-OR-GAS WELL OR TEST HOLE

Figure 3. Location of water wells and test holes and oil-or-gas wells and test holes from which data were collected or used.

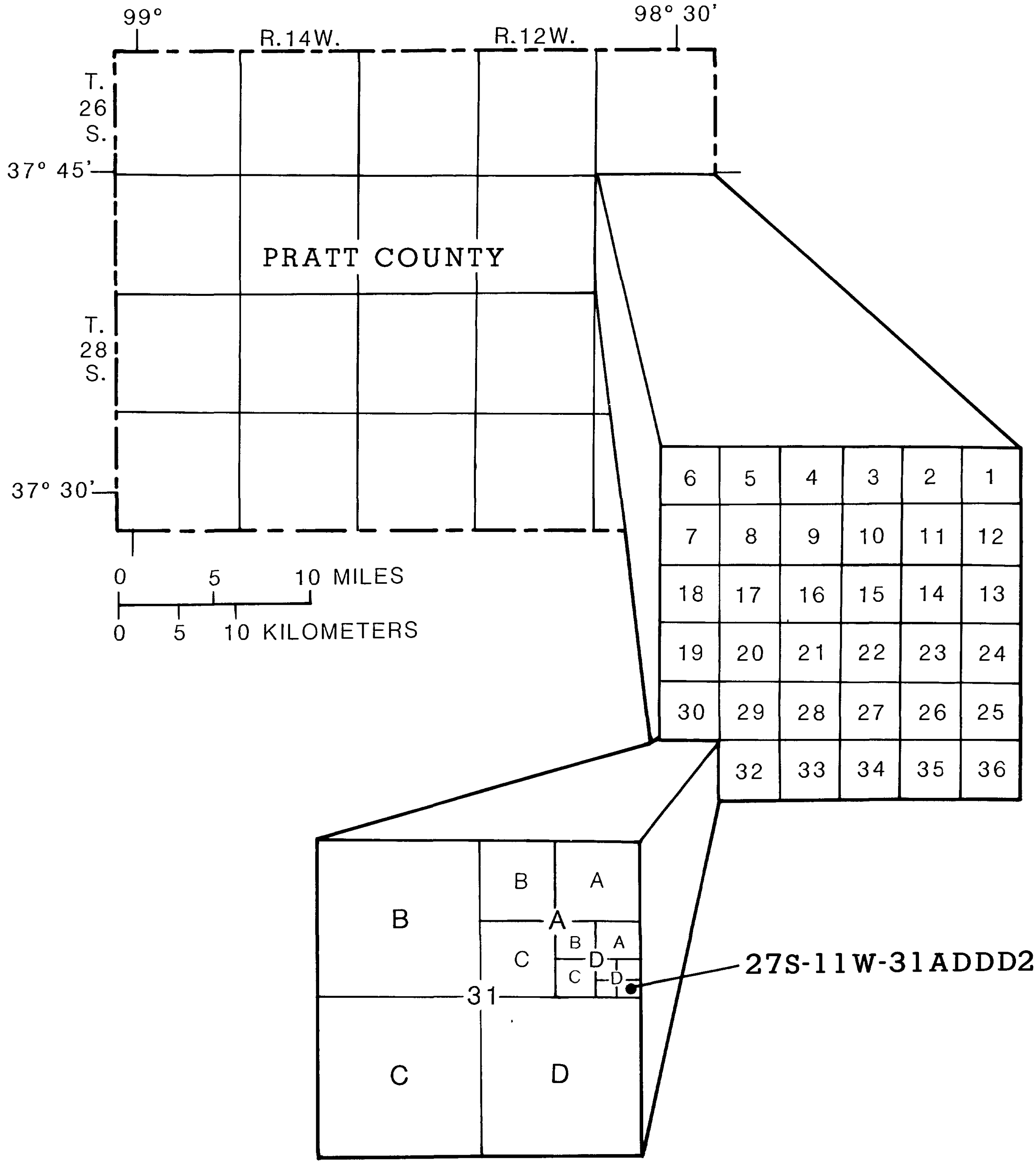


Figure 4. Well- and site-numbering system.

Groundwater Management District No. 5, the Water Resources Division of the Kansas State Board of Agriculture, and the U.S. Geological Survey. Those deserving special mention are K.D. Medina, who conducted the leveling, C.G. Sauer, who assisted in conducting the electromagnetic ground-conductivity surveys and the salinity and seepage surveys, and S.E. Studley for making a salinity-seepage survey.

WELL AND WATER-LEVEL DATA

The location and altitude of water levels in 160 selected water wells completed in the alluvial aquifer, near the base of the alluvial aquifer, and in the top of the Permian aquifer are shown in figures 5, 6, 7, respectively. The well number, date of measurement, depth to water below land surface, depth of well, altitude of

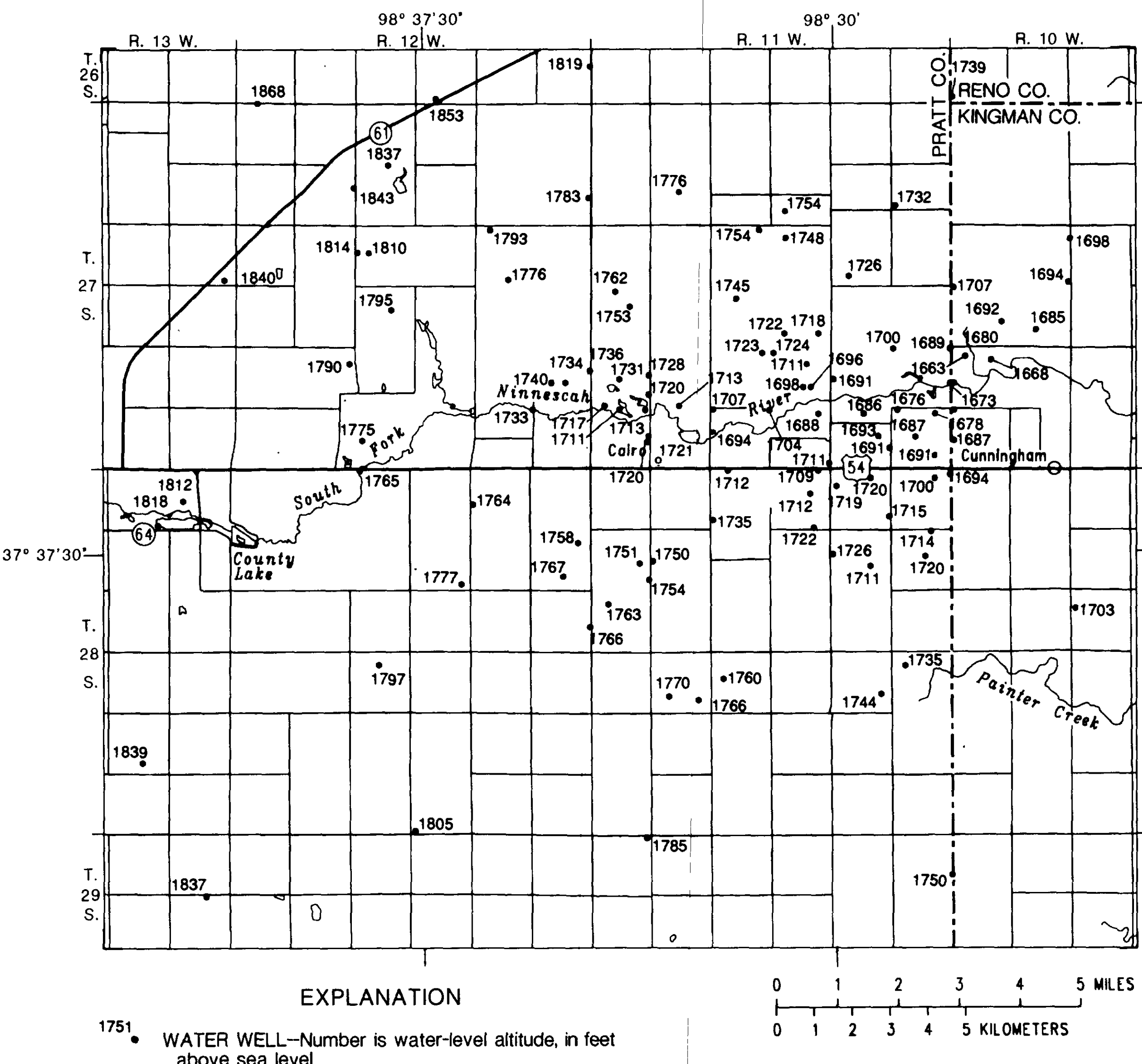
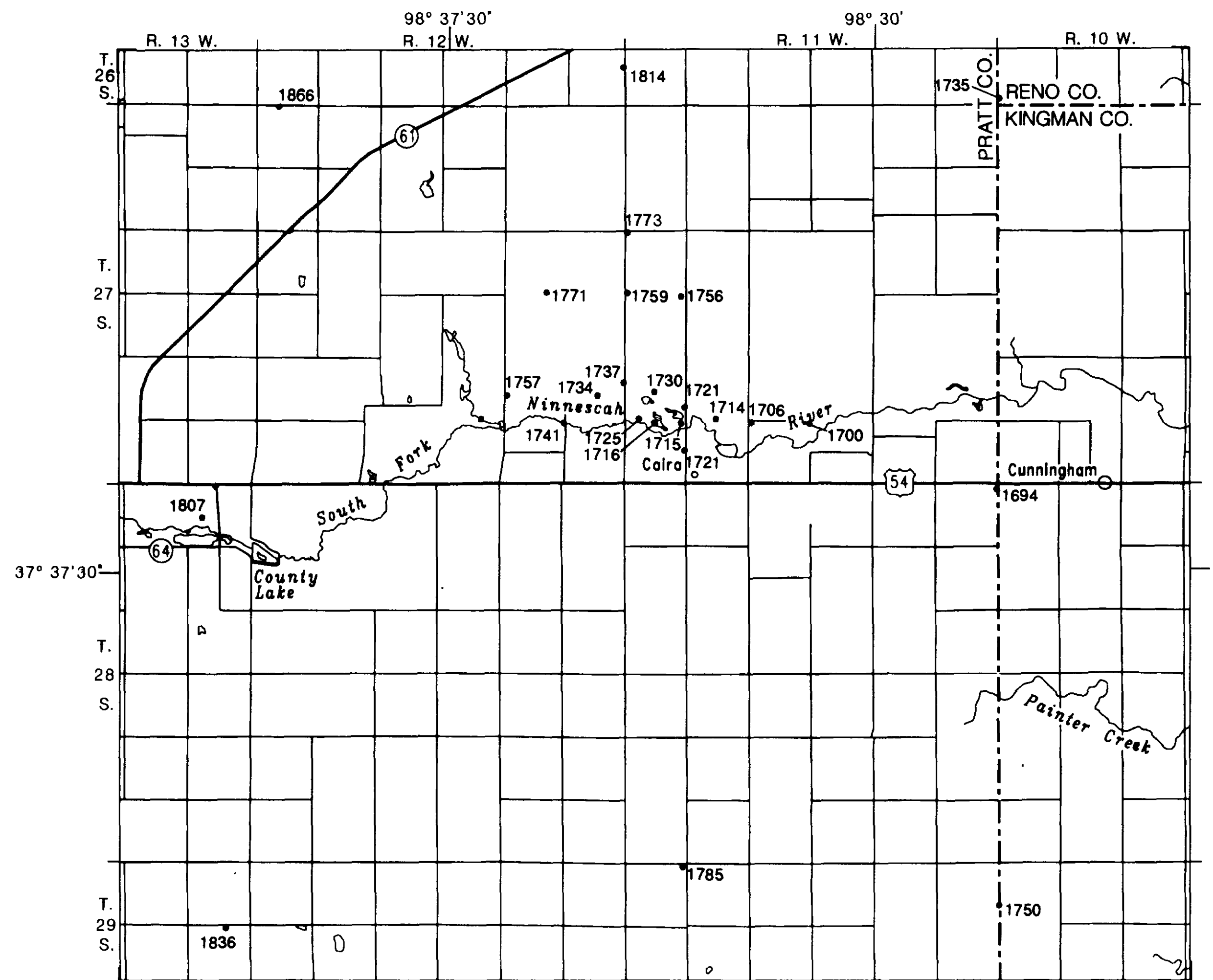


Figure 5. Altitude of water levels in selected water wells completed in alluvial aquifer, January-April 1990.



EXPLANATION

1735• WATER WELL--Number is water-level altitude, in feet above sea level

0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

Figure 6. Altitude of water levels in selected water wells completed near base of alluvial aquifer, January-April 1990.

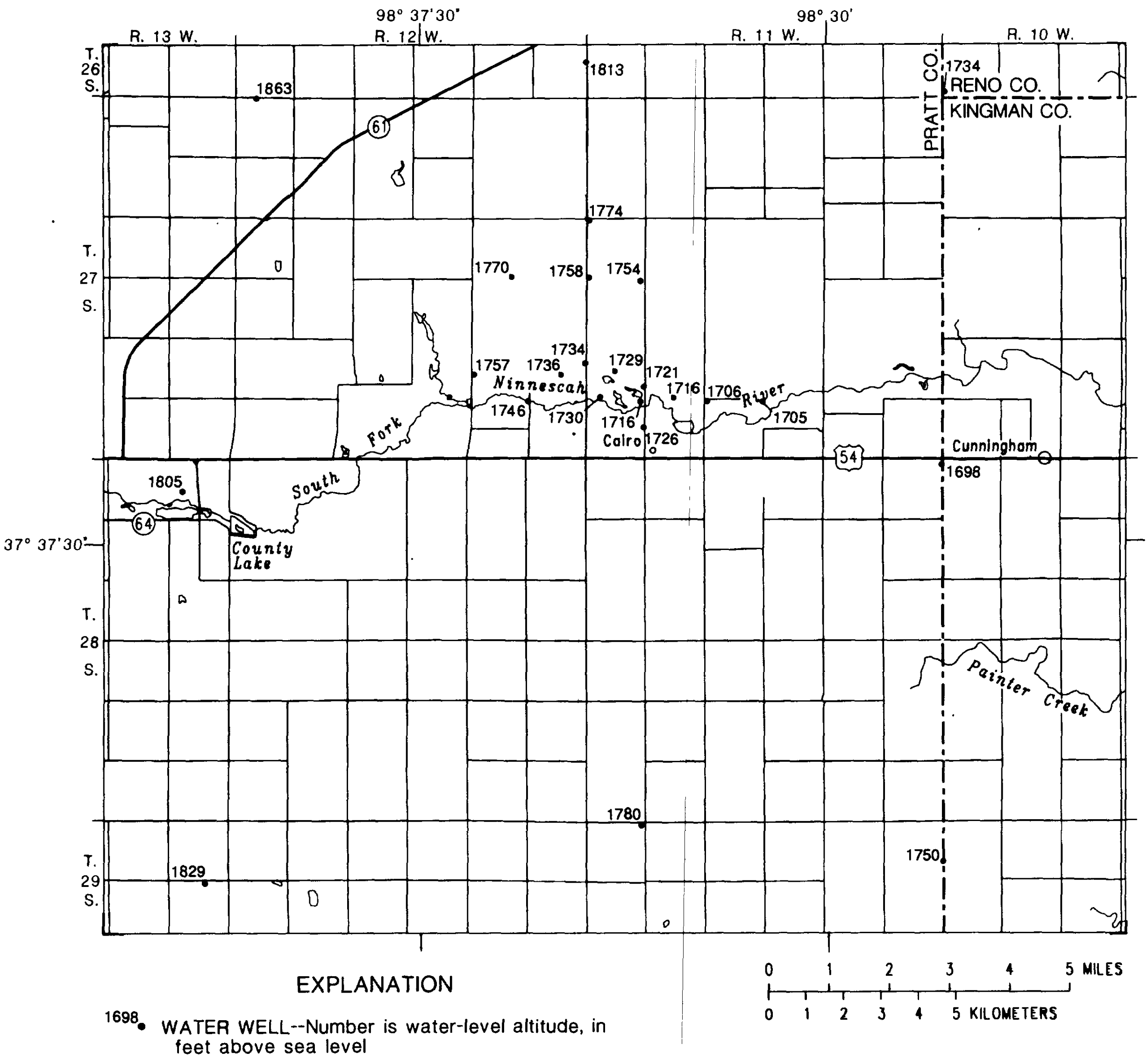
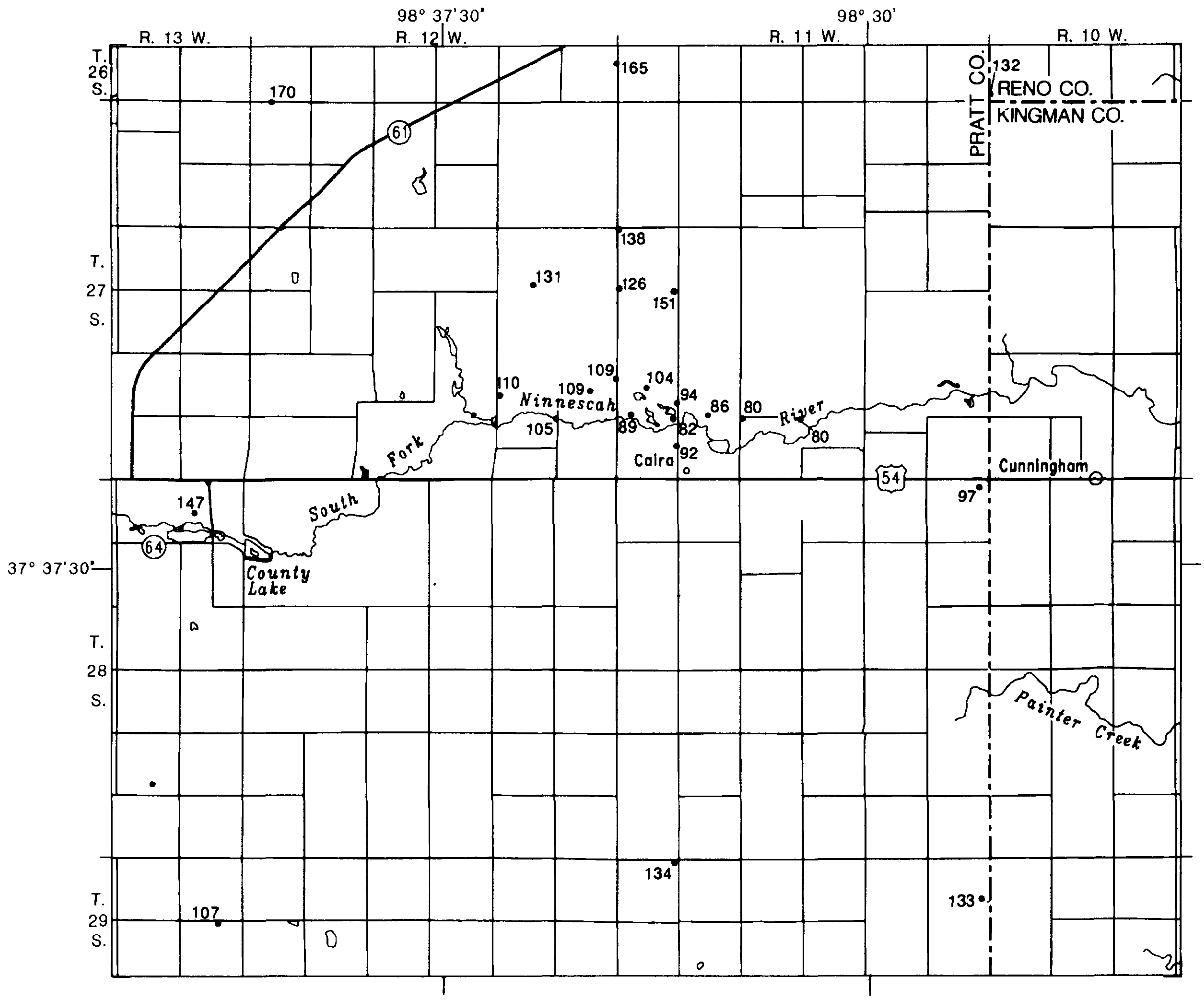


Figure 7. Altitude of water levels in selected water wells completed in top of Permian aquifer, January-April 1990.



EXPLANATION

170• WATER WELL--Number is saturated thickness of alluvial aquifer, in feet

0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

Figure 8. Saturated thickness of alluvial aquifer determined at selected water wells.

land surface, and altitude of water level for each selected water well are listed in table 1. The water level given is the most recently measured for each well from January through April 1990. All water levels were measured to the nearest 0.01 foot with a steel tape. The saturated thickness of the alluvial aquifer determined at selected water wells is shown in figure 8. Saturated thickness is the difference between the altitudes of the water level in the alluvial aquifer and the top of the Permian bedrock at each site where both altitudes were available. The altitude of the top of Stone Corral Formation and thickness of the salt in the Ninnescah Shale were determined from gamma logs from oil-or-gas wells and test holes.

GEOLOGIC DATA

The location of selected water wells, oil-or-gas wells, and test holes from which data were used to determine the altitude of the top of the Permian bedrock and the Stone Corral Formation is shown in figures 9 and 10. The well number and the altitude of the top of the Permian bedrock in selected water wells and test holes is listed in table 2. The presence or absence of a salt layer in the Ninnescah Shale in selected oil-or-gas wells and test holes is shown in figure 11. The well number, altitude of top of Stone Corral Formation, and thickness of the salt in the Ninnescah Shale are listed in table 3.

WATER-QUALITY DATA

The well number, date of collection, depth of well, specific conductance, and chloride concentrations in water from 91 selected water wells completed in the alluvial aquifer, near the base of the alluvial aquifer, and in the top of the Permian aquifer are listed in table 4. Chloride concentrations in samples from selected water wells are shown in figure 12. Water samples were collected at 35 sites on streams, ponds, marshes, springs, the South Fork Ninnescah River, and from beneath the streambed of the river. The location of these sampling sites is shown in figure 13. Table 5 contains map reference numbers, site number, date the water sample was collected, specific conductance, chloride concentrations, and description of the sampling point or site for water samples collected from sampling sites.

A map of the location of the 24 salinity and seepage measurement sites on the South Fork Ninnescah River is given in figure 14. Chloride concentrations, chloride discharges, and stream discharges for the South Fork Ninnescah River during November 1988, are presented in figures 15 and 16. Chloride concentrations and discharges for the South Fork Ninnescah River near Calista are presented in figure 17 for 1963-88.

GEOPHYSICAL DATA

The apparent ground conductivity and map reference numbers for the location of the electromagnetic ground-conductivity survey land traverses are listed in table 6, and the location of the river traverses is shown in figure 18. These surveys were conducted beneath and adjacent to the South Fork Ninnescah River from January to July 1989. Electromagnetic ground-conductivity surveys measure the combined apparent ground conductivity of the soil, rock, and interstitial water from the land surface to the depth of penetration of the instrument, which depends on the spacing and orientation of the coils (McNeill, 1980). A graph showing the apparent ground conductivity beneath the South Fork Ninnescah River downstream from the Pratt County bridge at 27S-11W-31BBBB is presented in figure 19. Natural gamma logs of 15 wells drilled by the U.S. Bureau of Reclamation are shown in figure 20. Table 7 lists the lithologic logs of these wells. These logs were recorded by the authors and personnel from the U.S. Bureau of Reclamation by examining the drill cuttings as the wells were being drilled.

SELECTED REFERENCES

Fader, S.W., and Stullken, L.E., 1978, Geohydrology of the Great Bend Prairie, south-central Kansas: Kansas Geological Survey Irrigation Series 4, 19 p.

Hargadine, G.D., Balsters, Ronald, and Luehring, JoAnne, 1979, Mineral intrusion into Kansas surfaces waters--A technical report: Kansas Department of Health and Environment, Kansas Water-Quality Management Section, Kansas Water Resources Board, 211 p.

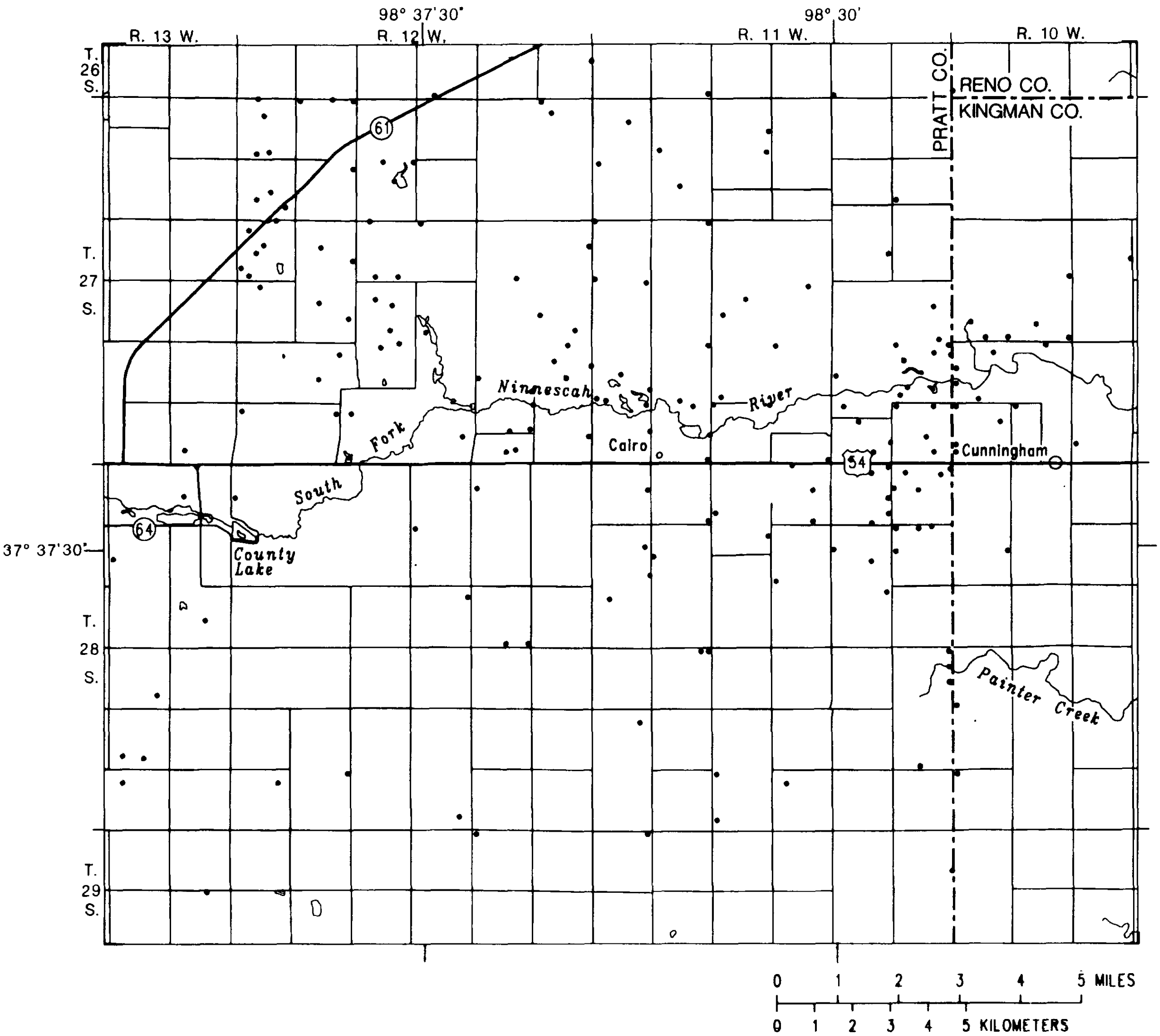


Figure 9. Location of selected water wells and test holes from which data were used to determine altitude of top of Permian bedrock.

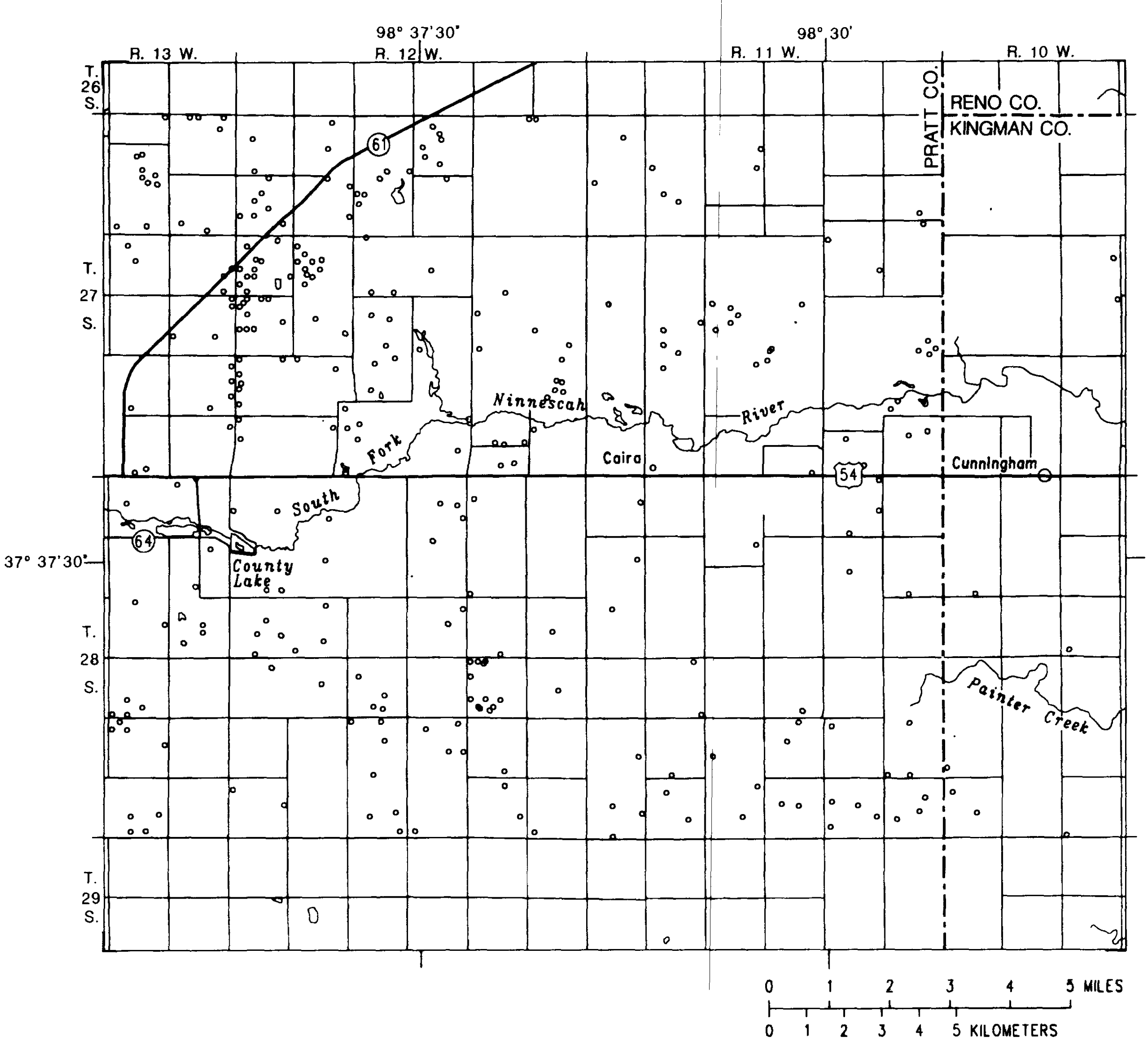
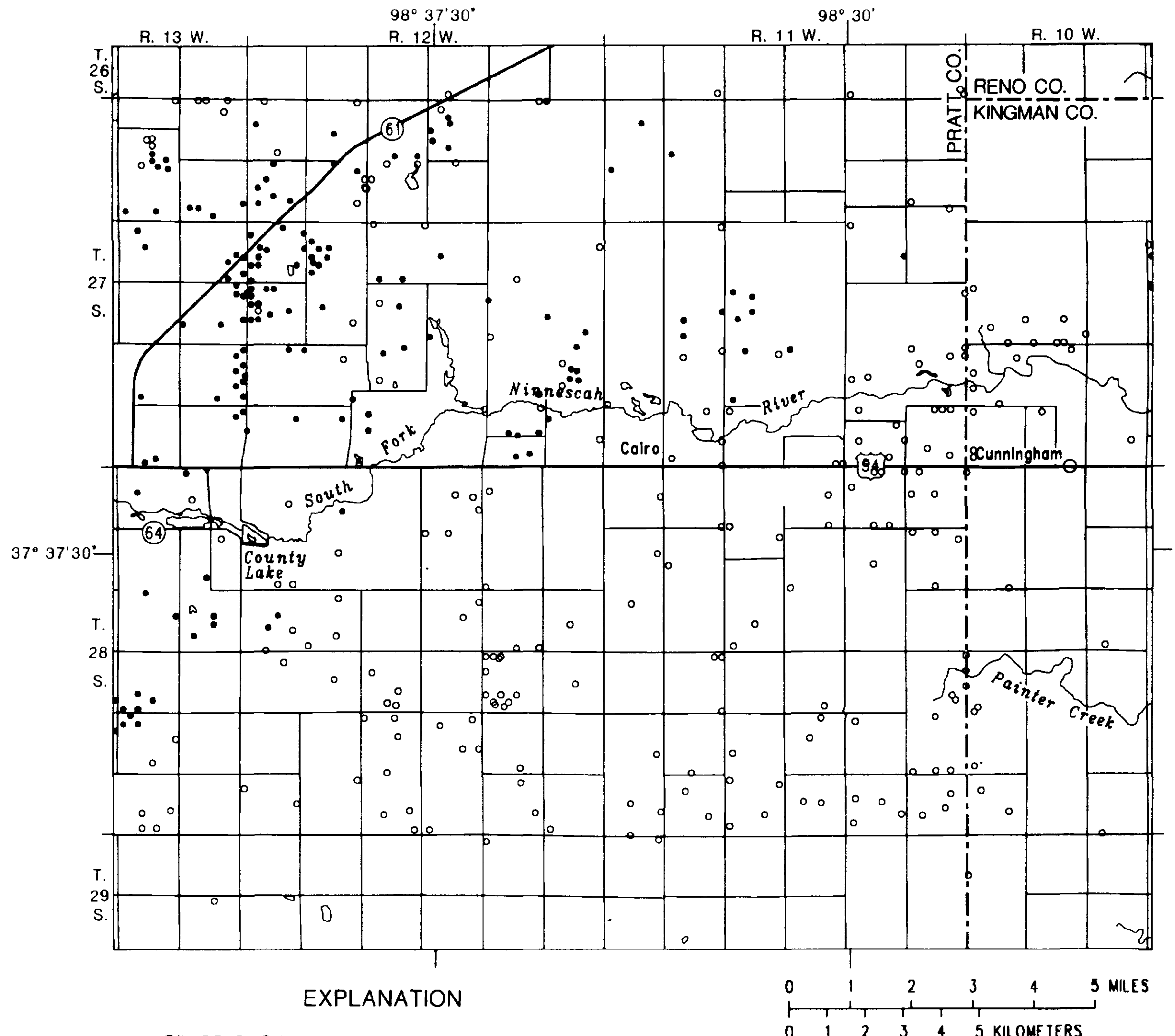


Figure 10. Location of selected oil-or-gas wells and test holes from which data were used to determine altitude of top of Stone Corral Formation.



EXPLANATION

OIL-OR-GAS WELL OR TEST HOLE

- • Salt formation present
- ○ Salt formation absent

Figure 11. Presence or absence of salt in the Ninnescah Shale determined at selected oil-or-gas wells and test holes.

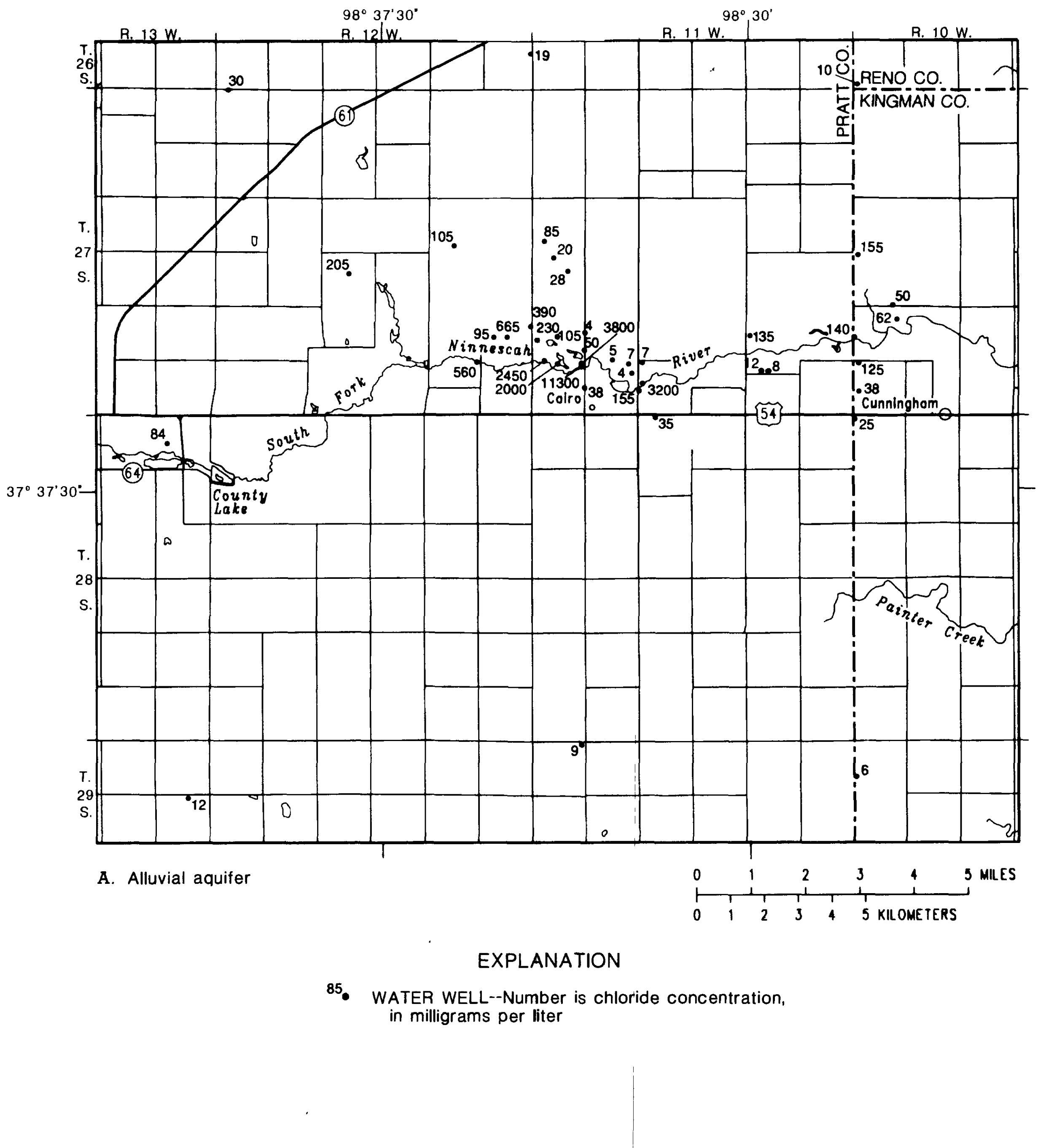
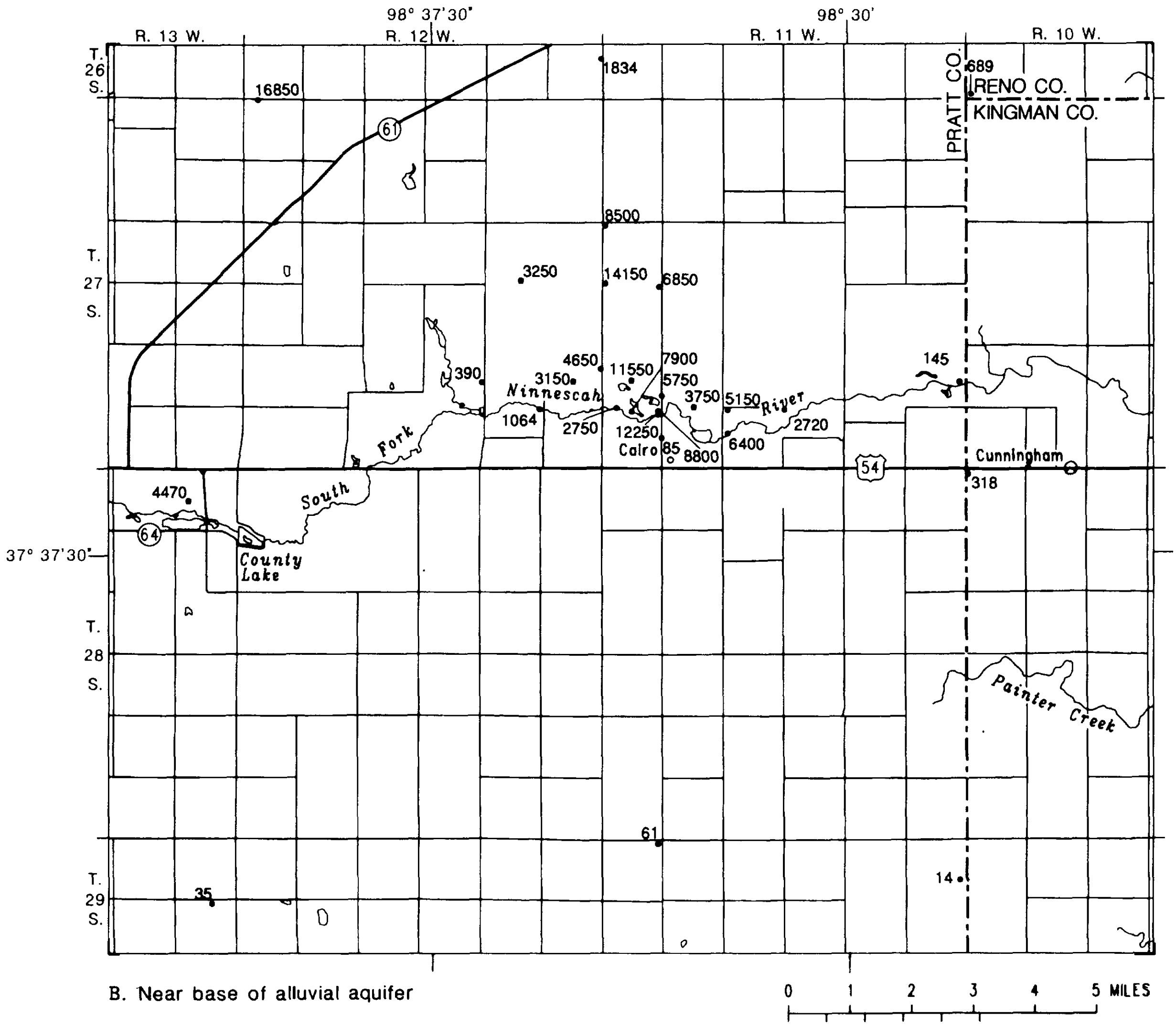
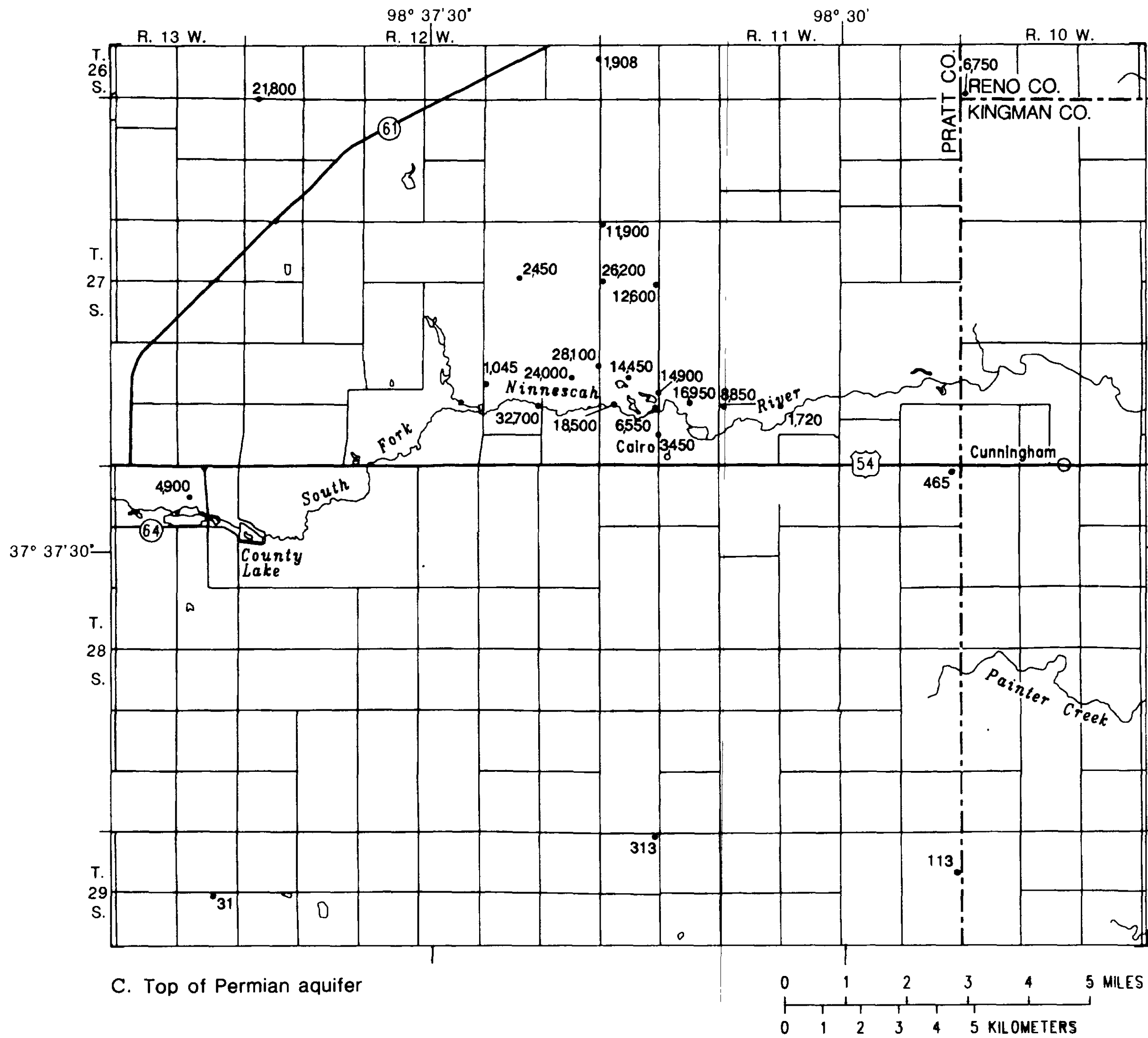


Figure 12. Chloride concentrations in samples collected from selected water wells completed in (A) alluvial aquifer, (B) near base of alluvial aquifer, and (C) in top of Permian aquifer.



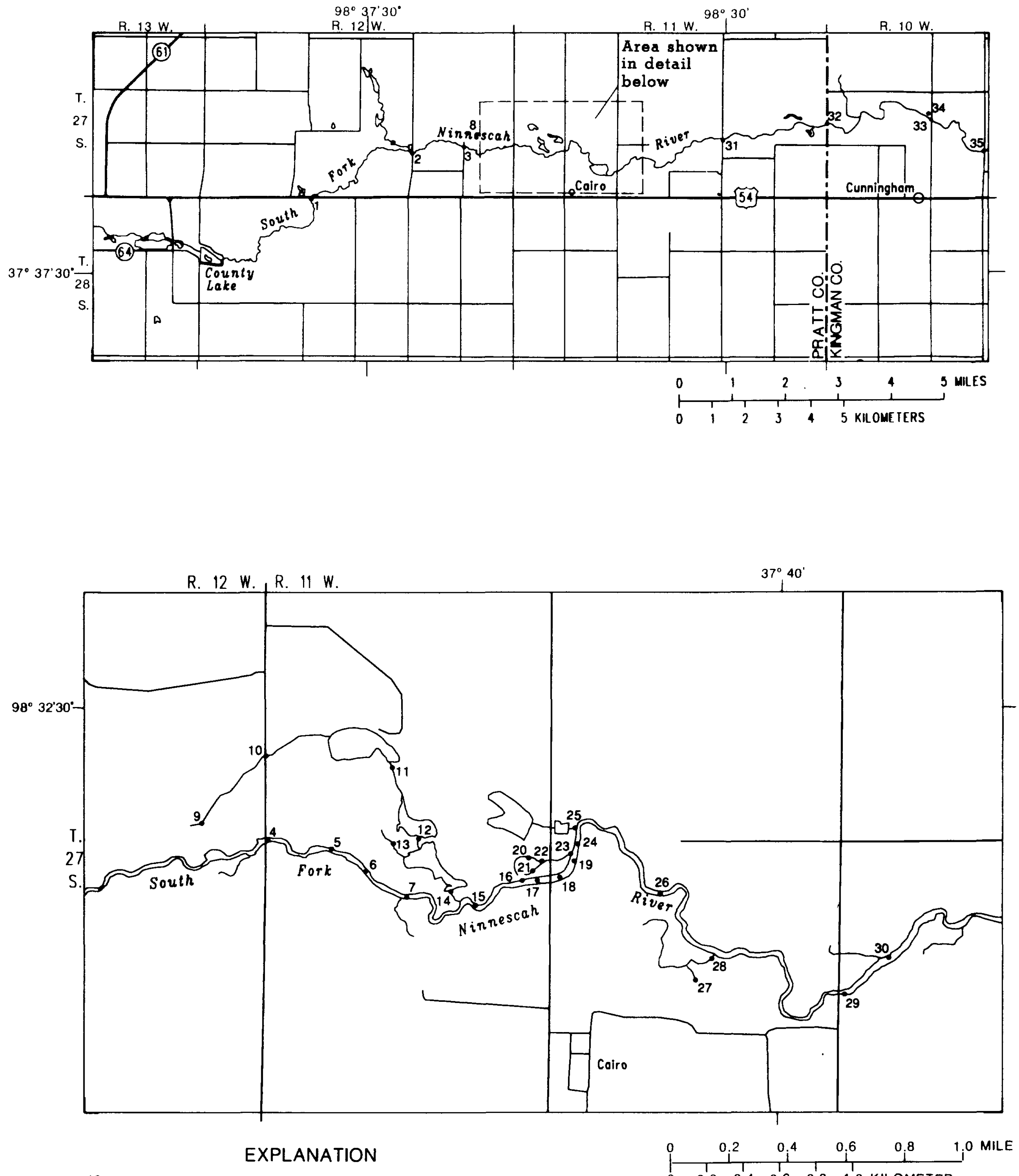
B. Near base of alluvial aquifer

Figure 12. Chloride concentrations in samples collected from selected water wells completed in (A) alluvial aquifer, (B) near base of alluvial aquifer, and (C) in top of Permian aquifer--Continued.



C. Top of Permian aquifer

Figure 12. Chloride concentrations in samples collected from selected water wells completed in (A) alluvial aquifer, (B) near base of alluvial aquifer, and (C) in top of Permian aquifer--Continued.



EXPLANATION

12 • WATER-SAMPLE COLLECTION SITE--Numeral is map reference located in table 6

Figure 13. Sites where water samples were collected from streams, ponds, marshes, springs, the South Fork Ninnescah River, and from beneath river in the South Fork Ninnescah Valley.

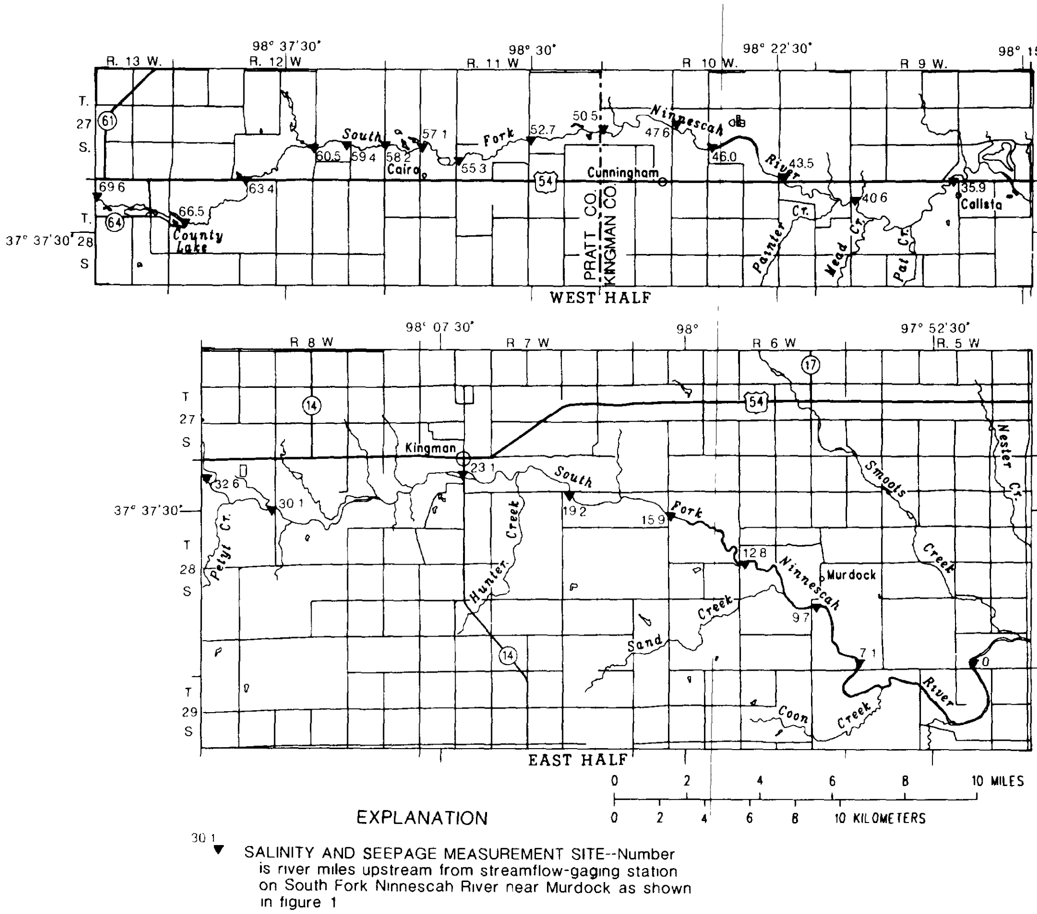


Figure 14. Salinity and seepage measurement sites on South Fork Ninnescah River from Pratt to near Murdock streamflow-gaging stations (shown in fig. 1).

Hargadine, G.D., and Luehring, JoAnne, 1978, Mineral intrusion into Kansas surface waters--A summary and management report: Kansas Department of Health and Environment, Kansas Water-QualityManagement Section, Kansas Water Resources Board, 64 p.

Lane, C.W., 1960, Geology and ground-water resources of Kingman County, Kansas: Kansas Geological Survey Bulletin 144, 173 p.

Layton, D.W., and Berry, D.W., 1973, Geology and ground-water resources of Pratt County, south-central Kansas: Kansas Geological Survey Bulletin 205, 33 p.

McNeill, J.D., 1980, Electromagnetic terrain conductivity measurement at low induction numbers: Mississauga, Ontario, Geonics, Ltd., Technical Note TN-6, 15 p.

Merriam, D.F., 1958, Preliminary regional structural contour map on top of the Stone Corral Formation (Permian) in Kansas: Kansas Geological Survey Oil and Gas Investigation No. 17, scale 1:633,600, 1 sheet.

Stullken, L.E., and Fader, S.W., 1976, Hydrogeologic data from the Great Bend Prairie, south-central Kansas: Kansas Geological Survey Basic Data Series, Ground-Water Release No. 5, 50 p.

Zeller, D.E., ed., 1968, The stratigraphic succession in Kansas: Kansas Geological Survey Bulletin 189, 81 p.

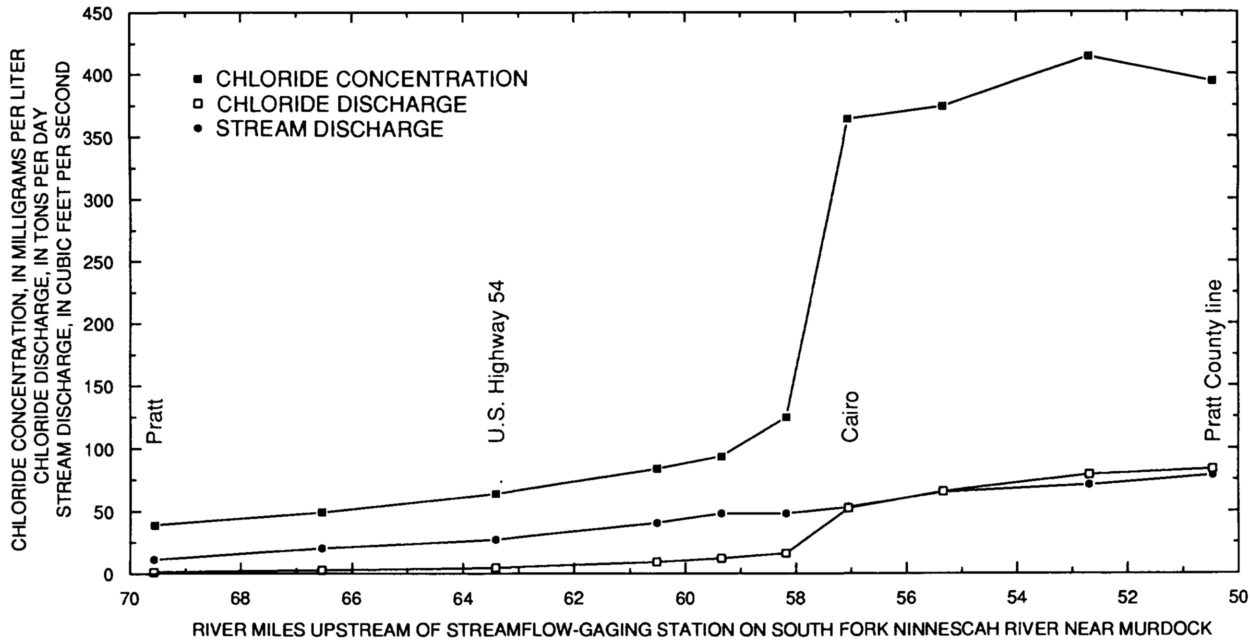


Figure 15. Chloride concentrations, chloride discharges, and stream discharges for South Fork Ninnescah River from Pratt to near Cunningham, November 1988.

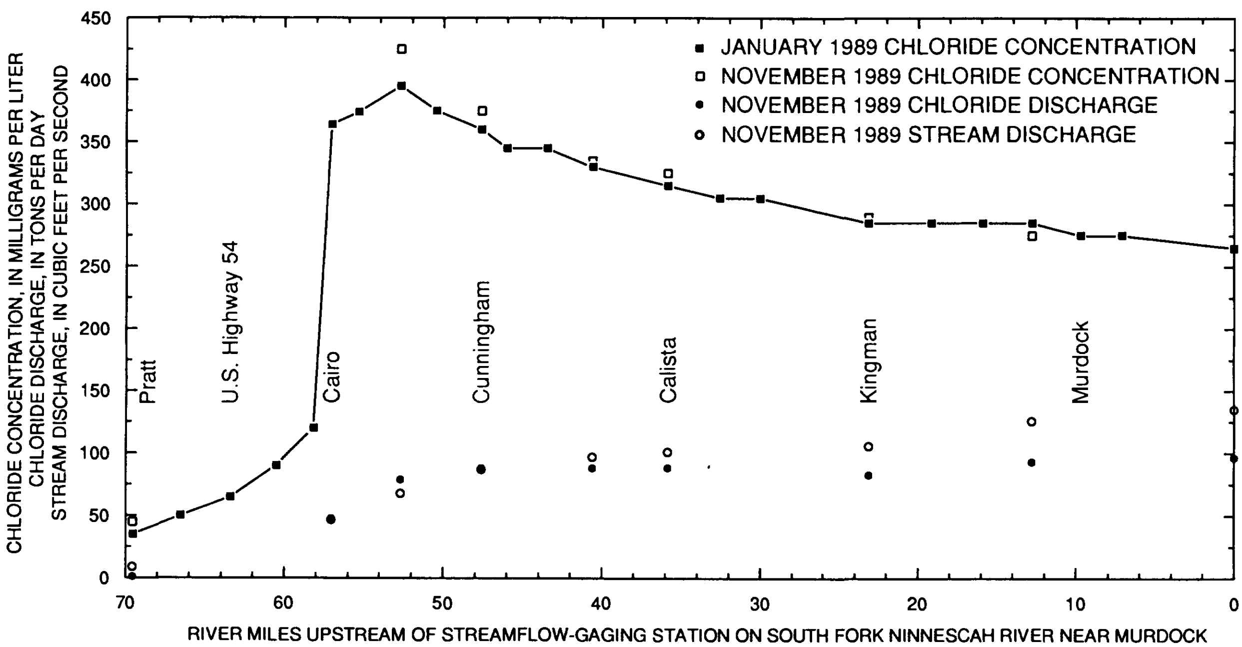


Figure 16. Chloride concentrations, chloride discharges, and stream discharges for South Fork Ninnescah River from Pratt to near Murdock, January and November 1989.

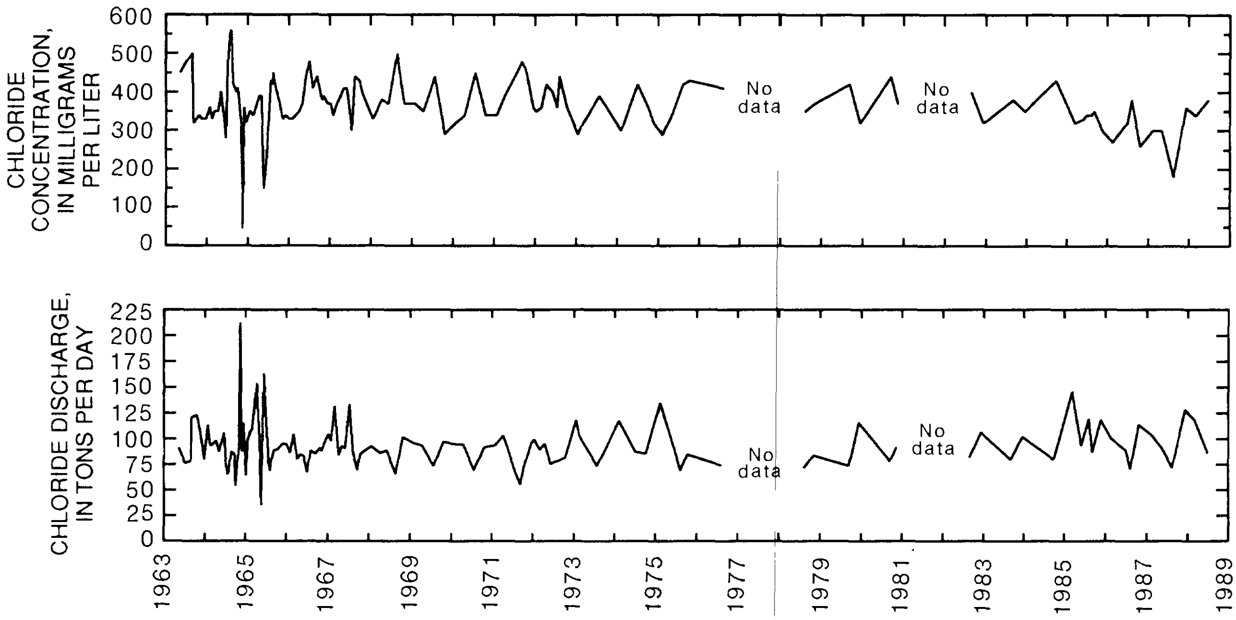


Figure 17. Chloride concentrations and discharges for South Fork Ninnescah River near Calista, 1963-88.

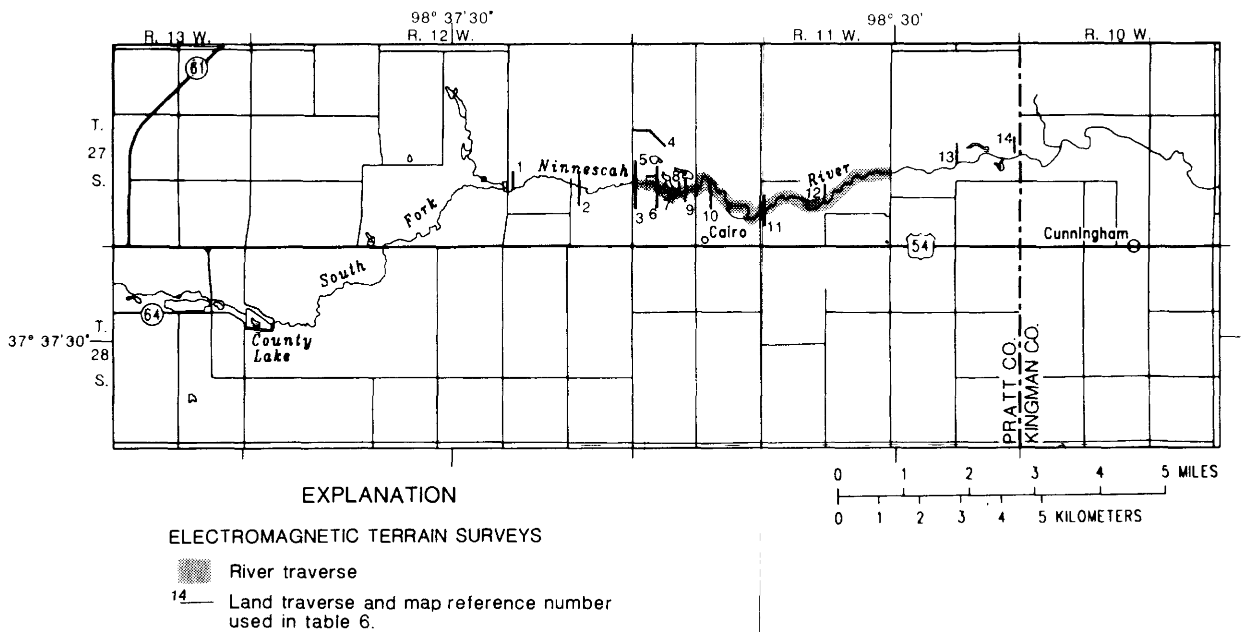


Figure 18. Location of electromagnetic ground-conductivity traverses beneath and adjacent to South Fork Ninnescah River.

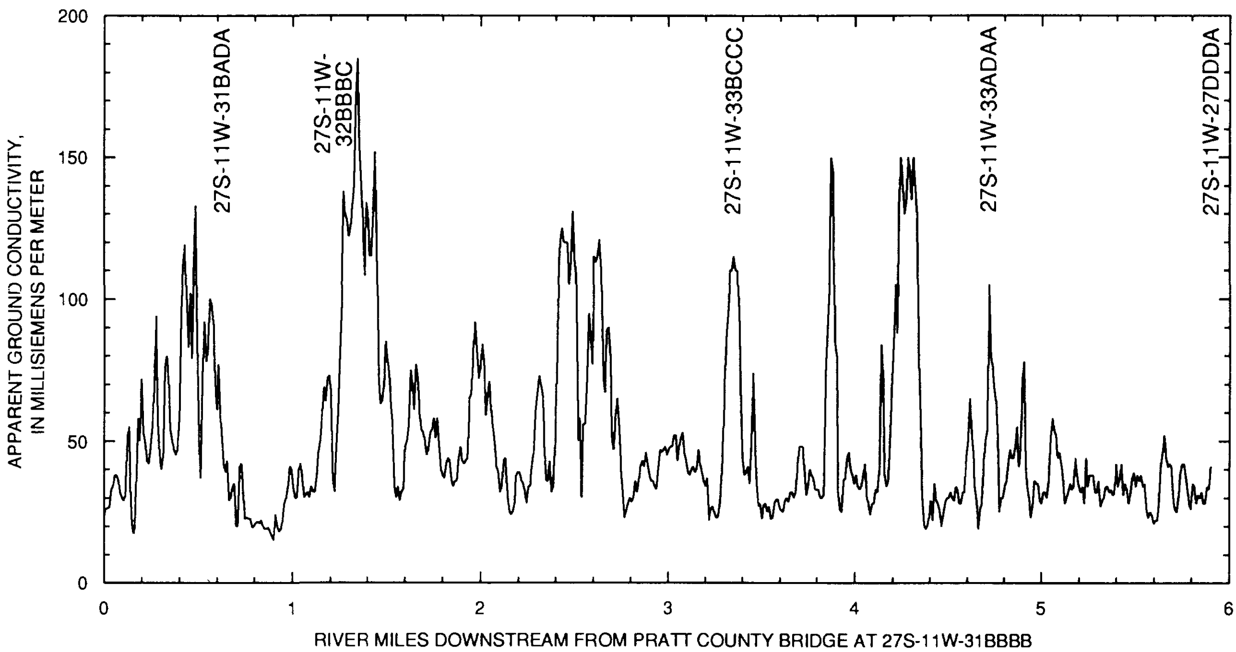


Figure 19. Apparent ground conductivity beneath South Fork Ninnescah River downstream from Pratt County bridge at 27S-11W-31BBBB.

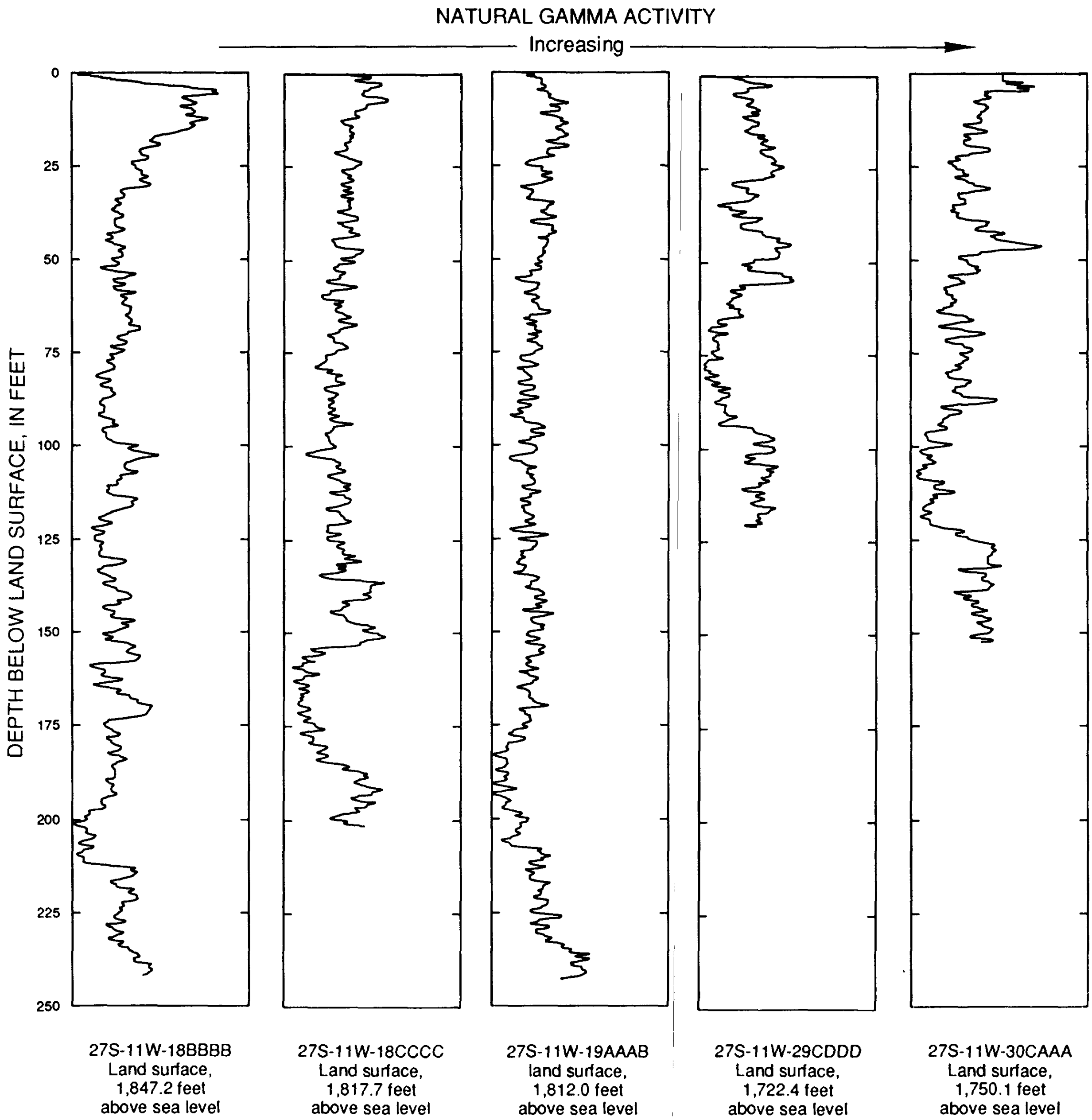


Figure 20. Natural gamma logs from wells drilled by U.S. Bureau of Reclamation.

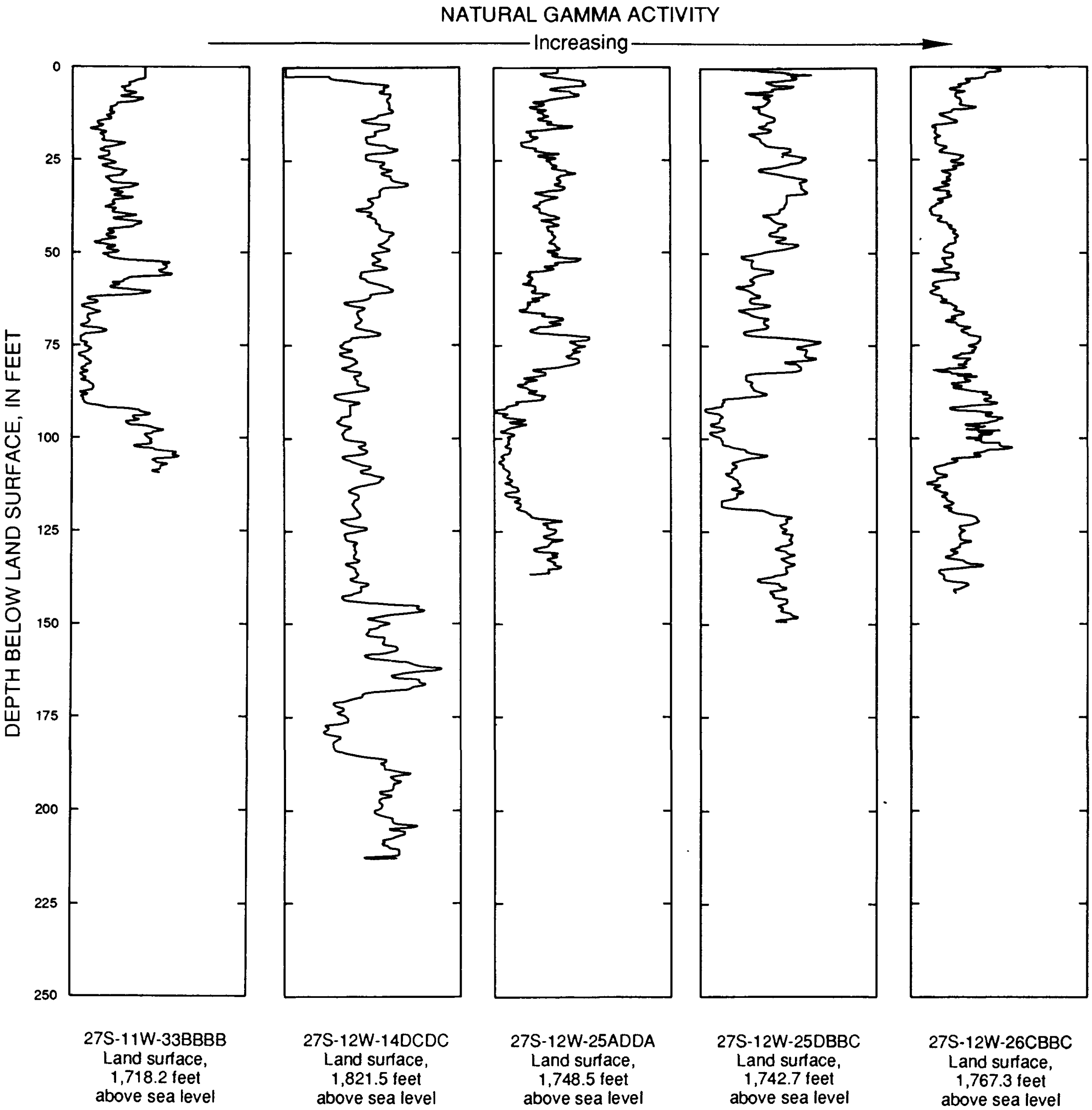


Figure 20. Natural gamma logs from wells drilled by U.S. Bureau of Reclamation--Continued.

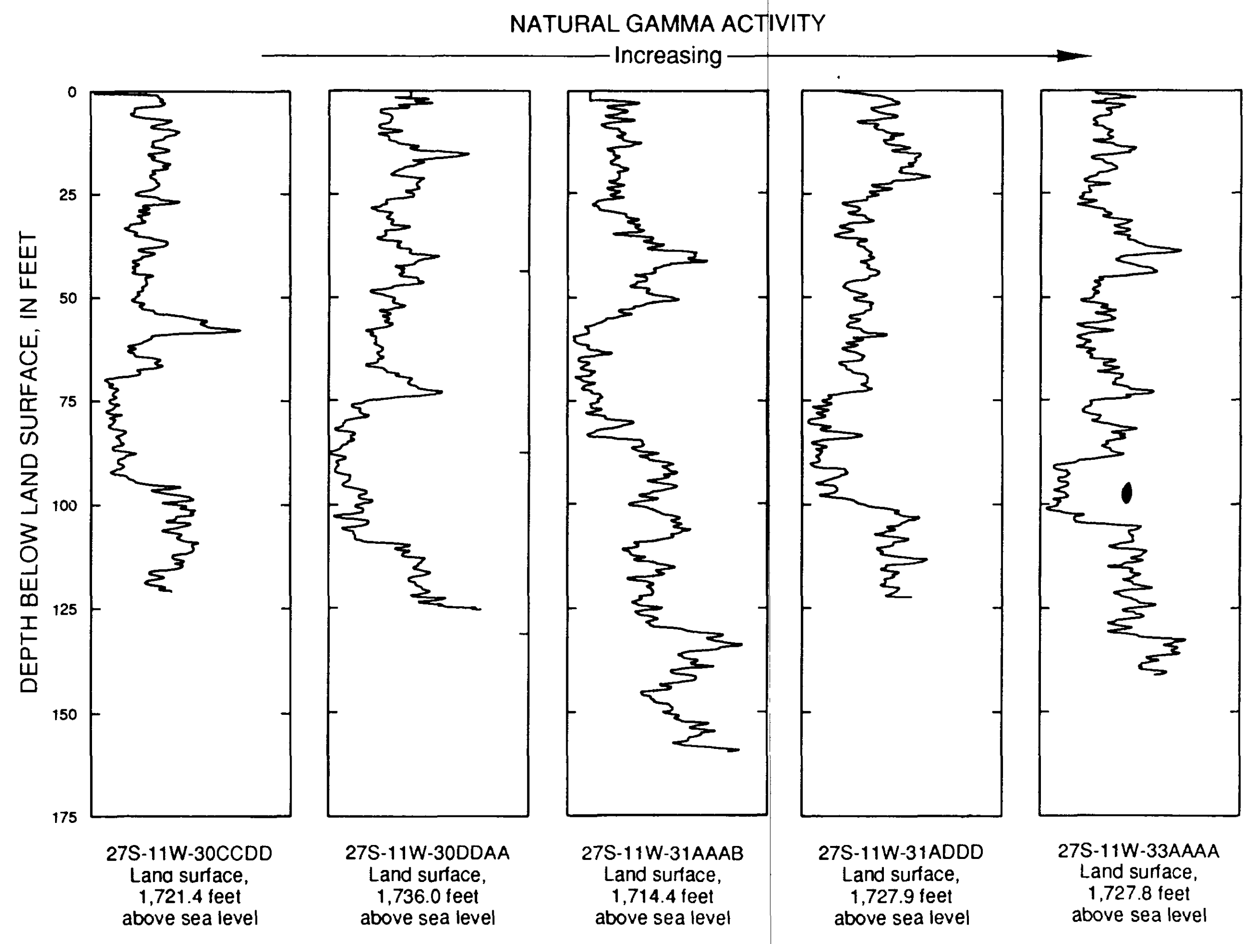


Figure 20. Natural gamma logs from wells drilled by U.S. Bureau of Reclamation--Continued.

Table 1. *Altitude of land surface and water levels in selected wells completed in alluvial and Permian aquifers, January-April 1990.*

[+, indicates height of water level above land surface; --, indicates no information]

Well number	Date of measurement (month-day-year)	Depth to water below land surface (feet)	Depth of well (feet)	Altitude of land surface (feet above sea level)	Altitude of water level (feet above sea level)
Wells completed in alluvial aquifer (fig. 5)					
26S-10W-31CCCB3	1-11-90	20.37	71	1,759.4	1,739.03
26S-12W-34CDC	1-16-90	32.77	--	1,885.8	1,853.03
26S-12W-36ADDA3	1-15-90	25.25	85	1,844.0	1,818.75
27S-10W-03DDD	1-16-90	53.13	--	1,747.1	1,693.97
27S-10W-16DADA	4-11-90	63.80	--	1,750.7	1,686.90
27S-10W-17AADD	4-11-90	79.92	--	1,778.4	1,698.48
27S-10W-17DDD	1-16-90	64.13	--	1,758.2	1,694.07
27S-10W-19BBBB	3-08-90	33.72	--	1,740.4	1,706.68
27S-10W-19DABD	3-15-90	67.87	137	1,759.9	1,692.03
27S-10W-20CADC	3-15-90	4.22	75	1,689.5	1,685.28
27S-10W-30ABDC	4-11-90	+ .91	--	1,666.8	1,667.71
27S-10W-30BBDA	4-11-90	18.64	--	1,698.8	1,680.16
27S-10W-31BBBB	4-11-90	7.64	90	1,680.9	1,673.26
27S-10W-31CBBB	3-15-90	19.04	95	1,706.2	1,687.16
27S-11W-08BDDD	3-08-90	37.20	--	1,813.4	1,776.20
27S-11W-10CCAA	4-10-90	51.76	--	1,806.3	1,754.54
27S-11W-12CBC	1-16-90	47.27	--	1,779.5	1,732.23
27S-11W-14CDBC	3-08-90	62.70	--	1,788.6	1,725.90
27S-11W-15BBDD	4-10-90	53.99	--	1,802.4	1,748.41
27S-11W-16AABC	4-10-90	55.74	--	1,810.0	1,754.26
27S-11W-19ACAC	3-01-90	78.82	146	1,831.8	1,752.98
27S-11W-19BAAC	3-01-90	89.10	112	1,851.0	1,761.90
27S-11W-21BADC	3-08-90	70.65	--	1,815.8	1,745.15
27S-11W-22CCAA	3-08-90	38.10	--	1,760.5	1,722.40
27S-11W-22DDBB	3-08-90	34.41	--	1,752.0	1,717.59
27S-11W-25AAAA	3-08-90	36.88	--	1,725.8	1,688.92
27S-11W-25BBBB	3-08-90	14.65	--	1,714.3	1,699.65
27S-11W-25DAAD2	3-01-90	1.51	30	1,664.8	1,663.29
27S-11W-26CBBB	3-08-90	40.05	--	1,731.5	1,691.45
27S-11W-27ACBA	3-08-90	49.39	--	1,760.0	1,710.61
27S-11W-27BBBC	3-01-90	29.82	117	1,754.0	1,724.18
27S-11W-27DBCB	3-08-90	11.09	--	1,709.1	1,698.01
27S-11W-27DBDB	3-08-90	41.79	--	1,738.1	1,696.31
27S-11W-28AABD	3-01-90	12.06	54	1,735.5	1,723.44
27S-11W-29CDDD3	3-01-90	9.31	41	1,722.0	1,712.69
27S-11W-30ADDD	3-01-90	17.44	79	1,745.8	1,728.36
27S-11W-30CAAA3	3-01-90	19.01	78	1,749.8	1,730.79
27S-11W-30CCDD3	3-01-90	5.14	--	1,721.8	1,716.66
27S-11W-30DDAA3	3-01-90	14.95	66	1,736.9	1,719.95
27S-11W-31AAAB4	3-02-90	1.85	37	1,714.8	1,712.95
27S-11W-31ADDD3	3-01-90	7.08	56	1,727.9	1,720.82
27S-11W-31BAAA2	3-02-90	+ .54	39	1,716.4	1,716.94
27S-11W-31BCCB	3-02-90	.90	29	1,694.8	1,693.90
27S-11W-31DAA	1-16-90	5.74	--	1,725.5	1,719.76
27S-11W-33AAAA3	3-01-90	24.50	--	1,728.0	1,703.50
27S-11W-33BBBB3	3-01-90	11.59	52	1,718.4	1,706.81
27S-11W-33BCCB2	3-01-90	.90	29	1,694.8	1,693.90
27S-11W-34AABC	3-08-90	2.87	--	1,690.6	1,687.73
27S-11W-34DDDA	4-11-90	16.98	--	1,727.6	1,710.62
27S-11W-35ABBC	3-15-90	6.30	58	1,692.5	1,686.20

Table 1. *Altitude of land surface and water levels in selected wells completed in alluvial and Permian aquifers, January-April 1990*--Continued

Well number	Date of measurement (month-day-year)	Depth to water below land surface (feet)	Depth of well (feet)	Altitude of land surface (feet above sea level)	Altitude of water level (feet above sea level)
Wells completed in alluvial aquifer (fig. 5)--Continued					
27S-11W-35ADCC	3-08-90	15.78	--	1,708.8	1,693.02
27S-11W-35DADA	4-11-90	25.16	--	1,716.5	1,691.34
27S-11W-36ABAD	3-15-90	7.26	83	1,684.8	1,677.54
27S-11W-36BBBA	4-11-90	3.54	--	1,679.8	1,676.26
27S-11W-36BDDC	3-08-90	8.79	--	1,696.0	1,687.21
27S-11W-36DCAA	3-15-90	16.90	100	1,707.6	1,690.70
27S-12W-06BABA3	4-10-90	25.24	90	1,893.4	1,868.16
27S-12W-08ADDA	4-10-90	7.58	--	1,850.4	1,842.82
27S-12W-09ABBB	4-10-90	25.69	--	1,863.0	1,837.31
27S-12W-12DAA	1-16-90	55.03	--	1,838.1	1,783.07
27S-12W-14BBAD	3-01-90	45.18	117	1,838.3	1,793.12
27S-12W-14DCCB	3-01-90	67.95	--	1,844.3	1,776.35
27S-12W-16BCCC	3-08-90	44.40	--	1,858.2	1,813.80
27S-12W-16BCDD	4-10-90	41.91	--	1,851.9	1,809.99
27S-12W-21ACCA	4-10-90	43.83	--	1,838.7	1,794.87
27S-12W-25ADDA3	3-01-90	12.16	70	1,748.4	1,736.24
27S-12W-25CABC	3-01-90	9.62	92	1,750.0	1,740.38
27S-12W-25DBBC3	3-01-90	8.91	70	1,742.6	1,733.69
27S-12W-29ADAB	4-10-90	3.40	73	1,793.0	1,789.60
27S-12W-33CBAB	1-16-90	3.34	--	1,777.9	1,774.56
27S-12W-35AAAA3	4-19-90	.97	51	1,733.9	1,732.95
27S-13W-13DDC	1-16-90	57.18	--	1,897.0	1,839.82
28S-10W-16BCB	1-16-90	50.48	--	1,753.5	1,703.02
28S-11W-01AAAD3	1-23-90	30.57	57	1,725.0	1,694.43
28S-11W-01ABDA	4-11-90	28.10	--	1,728.1	1,700.00
28S-11W-02ABDB	4-11-90	26.64	--	1,746.4	1,719.76
28S-11W-02BCBA	3-15-90	16.00	70	1,734.8	1,718.80
28S-11W-02DDAA	3-15-90	31.29	119	1,746.7	1,715.41
28S-11W-03AABB	3-08-90	24.80	--	1,733.3	1,708.50
28S-11W-03ACDB	4-11-90	38.32	--	1,750.0	1,711.68
28S-11W-03DCDD	4-11-90	37.61	--	1,759.5	1,721.89
28S-11W-04BABB	3-08-90	11.20	--	1,723.5	1,712.30
28S-11W-04CCBC	3-08-90	41.11	--	1,775.9	1,734.79
28S-11W-07DAB	1-08-90	54.88	--	1,806.0	1,751.12
28S-11W-07DDAD	3-08-90	27.82	--	1,782.0	1,754.18
28S-11W-08CBBB	3-08-90	35.87	--	1,786.2	1,750.33
28S-11W-11BCCB	4-11-90	48.15	--	1,774.6	1,726.45
28S-11W-11DBAC	4-11-90	57.60	--	1,768.8	1,711.20
28S-11W-12ABAB	4-11-90	40.36	--	1,754.6	1,714.24
28S-11W-12ACC	1-16-90	35.97	--	1,756.1	1,720.13
28S-11W-18BACC	3-08-90	35.35	--	1,798.0	1,762.65
28S-11W-20CACC	1-16-90	69.94	--	1,839.9	1,769.96
28S-11W-20DDBB	3-08-90	68.87	--	1,834.5	1,765.63
28S-11W-21BCD	3-08-90	61.46	--	1,821.3	1,759.84
28S-11W-23DAC	1-08-90	12.25	--	1,756.2	1,743.95
28S-11W-24BBDD	3-08-90	21.70	--	1,756.8	1,735.10
28S-12W-02CBBC	4-10-90	25.41	--	1,789.1	1,763.89
28S-12W-04BBAB	4-10-90	9.94	--	1,774.7	1,764.76
28S-12W-10DDCA	4-10-90	50.79	--	1,828.2	1,777.41
28S-12W-12AACC	3-08-90	50.97	--	1,808.5	1,757.53
28S-12W-12DCBB	3-08-90	58.27	--	1,825.5	1,767.23
28S-12W-13DAAD	3-08-90	60.17	--	1,826.4	1,766.23
28S-12W-21BADD	1-16-90	81.56	--	1,878.2	1,796.64
28S-12W-34CCC	1-16-90	100.50	--	1,905.4	1,804.90
28S-13W-01CBAA3	1-15-90	13.30	103	1,825.0	1,811.70

Table 1. *Altitude of land surface and water levels in selected wells completed in alluvial and Permian aquifers, January-April 1990*--Continued

Well number	Date of measurement (month-day-year)	Depth to water below land surface (feet)	Depth of well (feet)	Altitude of land surface (feet above sea level)	Altitude of water level (feet above sea level)
Wells completed in alluvial aquifer (fig. 5)--Continued					
28S-13W-02DDC	1-16-90	13.09	--	1,831.4	1,818.31
28S-13W-26DCB	1-16-90	89.64	--	1,928.2	1,838.56
29S-11W-01DADA3	1-18-90	44.88	85	1,795.3	1,750.42
29S-11W-06AAAB3	1-18-90	43.69	78	1,828.7	1,785.01
29S-13W-12ABBA3	1-22-90	69.52	82	1,906.3	1,836.78
Wells completed near base of alluvial aquifer (fig. 6)					
26S-10W-31CCCB2	1-11-90	24.32	155	1,759.6	1,735.28
26S-12W-36ADDA2	1-15-90	30.04	192	1,843.7	1,813.66
27S-11W-18BBBB2	3-01-90	73.79	212	1,847.0	1,773.21
27S-11W-18CCCC2	3-01-90	58.01	183	1,817.3	1,759.29
27S-11W-19AAAB2	3-01-90	56.12	205	1,811.7	1,755.58
27S-11W-29CDDD2	3-01-90	8.48	92	1,722.3	1,713.82
27S-11W-30CAAA2	3-01-90	20.24	120	1,749.8	1,729.56
27S-11W-30CCDD2	3-01-90	+3.40	93	1,721.5	1,725.48
27S-11W-30DDAA2	3-01-90	15.83	108	1,736.5	1,720.65
27S-11W-31AAAB3	3-02-90	.06	84	1,714.6	1,714.54
27S-11W-31ADDD2	3-01-90	7.41	97	1,728.1	1,720.69
27S-11W-31BAAA	3-02-90	5.58	91	1,716.9	1,711.30
27S-11W-33AAAA2	3-01-90	27.30	105	1,727.4	1,700.10
27S-11W-33BBBB2	3-01-90	12.02	90	1,718.1	1,706.08
27S-11W-33BCCB	3-02-90	+3.16	--	1,694.7	1,691.54
27S-12W-06BABA2	4-10-90	27.02	196	1,892.9	1,865.88
27S-12W-14DCDC2	3-01-90	50.52	182	1,821.3	1,770.78
27S-12W-25ADDA2	3-01-90	11.13	120	1,748.2	1,737.07
27S-12W-25DBBC2	3-01-90	8.64	118	1,742.8	1,734.16
27S-12W-26CBBC2	3-01-90	10.17	120	1,767.3	1,757.13
27S-12W-35AAAA2	4-19-90	+4.40	89	1,736.6	1,741.00
28S-11W-01AAAD2	1-23-90	31.47	116	1,725.0	1,693.53
28S-13W-01CBAA2	1-15-90	18.09	157	1,824.7	1,806.61
29S-11W-01DADA2	1-18-90	45.86	150	1,795.5	1,749.64
29S-11W-06AAAB2	1-18-90	43.72	164	1,828.8	1,785.08
29S-13W-12ABBA2	1-22-90	70.04	158	1,905.9	1,835.86
Wells completed in top of Permian aquifer (fig. 7)					
26S-10W-31CCCB	1-11-90	25.29	173	1,759.7	1,734.41
26S-12W-36ADDA	1-15-90	30.60	209	1,843.6	1,813.00
27S-11W-30CAAA	3-01-90	20.74	154	1,750.1	1,729.36
27S-11W-30CCDD	3-01-90	+8.46	124	1,721.4	1,729.86
27S-11W-30DDAA	3-01-90	14.51	127	1,736.0	1,721.49
27S-11W-31AAAB2	3-02-90	+1.32	103	1,714.5	1,715.82
27S-11W-31ADDD	3-01-90	1.81	124	1,727.9	1,726.09
27S-11W-33AAAA	3-01-90	22.33	143	1,727.8	1,705.47
27S-11W-33BBBB	3-01-90	12.00	111	1,718.2	1,706.20
27S-11W-18BBBB	3-01-90	73.63	244	1,847.2	1,773.57
27S-11W-18CCCC	3-01-90	59.50	203	1,817.7	1,758.20
27S-11W-19AAAB	3-01-90	57.94	235	1,812.0	1,754.06
27S-11W-29CDDD	3-01-90	6.53	125	1,722.4	1,715.87
27S-12W-14DCDC	3-01-90	51.09	214	1,821.5	1,770.41
27S-12W-35AAAA	4-19-90	+9.21	116	1,737.1	1,746.31
27S-12W-25ADDA	3-01-90	14.67	147	1,748.5	1,733.83
27S-12W-25DBBC	3-01-90	6.86	155	1,742.7	1,735.84
27S-12W-06BABA	4-10-90	29.14	215	1,892.3	1,863.16
27S-12W-26CBBC	3-01-90	10.57	144	1,767.4	1,756.83
28S-11W-01AAAD	1-23-90	26.79	135	1,725.0	1,698.21
28S-13W-01CBAA	1-15-90	19.10	178	1,824.5	1,805.40
29S-11W-01DADA	1-18-90	45.95	192	1,795.5	1,749.55
29S-11W-06AAAB	1-18-90	48.72	195	1,828.6	1,779.88
29S-13W-12ABBA	1-22-90	75.84	188	1,905.2	1,829.36

Table 2. *Altitude of top of the Permian bedrock determined at selected water wells and test holes.*

Well number (fig. 9)	Altitude of top of bedrock (feet above sea level)	Well number (fig. 9)	Altitude of top of bedrock (feet above sea level)
26S-10W-31CCCB	1,608	26S-11W-32DDD	1,637
26S-11W-35CCCC	1,704	26S-12W-34CDCC	1,675
26S-12W-36ADDA	1,655	27S-10W-16DADA	1,581
27S-10W-17DDD	1,586	27S-10W-19CAC	1,595
27S-10W-19DCC	1,592	27S-10W-19DDD	1,597
27S-10W-20CADC	1,592	27S-10W-20DDD	1,598
27S-10W-29ABB	1,598	27S-10W-30ABD	1,600
27S-10W-30BCC	1,602	27S-10W-30CBC	1,602
27S-10W-30CDD	1,602	27S-10W-31ADB	1,616
27S-10W-31BBB	1,591	27S-10W-31CBC	1,607
27S-10W-31CCB	1,624	27S-10W-32BBB	1,611
27S-10W-33CBC	1,587	27S-11W-04DAA	1,646
27S-11W-04DDDB	1,646	27S-11W-05CC	1,633
27S-11W-06ACCA	1,648	27S-11W-07BBBD	1,645
27S-11W-08BDDD	1,609	27S-11W-12CBC	1,684
27S-11W-14DAA	1,629	27S-11W-17AAA	1,604
27S-11W-18BBBB	1,635	27S-11W-18CCCC	1,634
27S-11W-19AAAB	1,605	27S-11W-21ACB	1,634
27S-11W-21CBA	1,624	27S-11W-22ABBD	1,636
27S-11W-24ACD	1,591	27S-11W-24DDCC	1,592
27S-11W-25AAA	1,594	27S-11W-25AADD	1,586
27S-11W-25ABD	1,594	27S-11W-25BBB	1,612
27S-11W-25BCA	1,594	27S-11W-25C	1,595
27S-11W-25CC	1,595	27S-11W-26CBB	1,610
27S-11W-27BBB	1,642	27S-11W-28CCDB	1,632
27S-11W-29AAA	1,626	27S-11W-29CDDD	1,628
27S-11W-30CAAA	1,629	27S-11W-30CCC	1,617
27S-11W-30CCDD	1,627	27S-11W-30DDAA	1,627
27S-11W-31AAAB	1,630	27S-11W-31ADDD	1,629
27S-11W-32ABA	1,627	27S-11W-32DAAA	1,607
27S-11W-32DDD	1,624	27S-11W-33AAAA	1,623
27S-11W-33BBBB	1,626	27S-11W-34DDD	1,622
27S-11W-35ABB	1,601	27S-11W-35BBA	1,589
27S-11W-35CDC	1,614	27S-11W-35DADA	1,596
27S-11W-35DCA	1,591	27S-11W-36ABA	1,596
27S-11W-36BBB	1,594	27S-11W-36DBB	1,579
27S-11W-36DCA	1,580	27S-12W-01B	1,669
27S-12W-01BBB	1,676	27S-12W-05AAA	1,642
27S-12W-05ABBA	1,660	27S-12W-05BBB	1,685
27S-12W-06BABA	1,700	27S-12W-06BDA	1,731
27S-12W-06CDC	1,717	27S-12W-06DCCB	1,744
27S-12W-07CAC	1,745	27S-12W-07DBB	1,745
27S-12W-07DDB	1,742	27S-12W-08AAD	1,722
27S-12W-09AAA	1,727	27S-12W-09AC	1,741
27S-12W-09BAA	1,724	27S-12W-13ADD	1,633
27S-12W-14DCDC	1,640	27S-12W-15BBB	1,752
27S-12W-16BBAA	1,755	27S-12W-16CDC	1,735
27S-12W-16DCD	1,739	27S-12W-17BDDC	1,745
27S-12W-17DAD	1,753	27S-12W-18ABAB	1,742
27S-12W-18BBD	1,768	27S-12W-18BDD	1,748
27S-12W-18CAB	1,744	27S-12W-18CCB	1,746
27S-12W-18CCD	1,753	27S-12W-19BA	1,748
27S-12W-20BD	1,746	27S-12W-20DA	1,719
27S-12W-21ACCA	1,704	27S-12W-21BDB	1,722
27S-12W-21DCB	1,698	27S-12W-22CCAC	1,661
27S-12W-24CBB	1,635	27S-12W-24DCA	1,627
27S-12W-25ABB	1,633	27S-12W-25ADDA	1,628
27S-12W-25BDB	1,630	27S-12W-25DBBC	1,625
27S-12W-26CBBC	1,647	27S-12W-26DDA	1,613
27S-12W-28ABAA	1,661	27S-12W-28BAAC	1,695

Table 2. *Altitude of top of the Permian bedrock determined at selected water wells and test holes --Continued*

Well number (fig. 9)	Altitude of top of bedrock (feet above sea level)	Well number (fig. 9)	Altitude of top of bedrock (feet above sea level)
27S-12W-29ABDD	1,685	27S-12W-29CA	1,715
27S-12W-31BBCA	1,767	27S-12W-32AAD	1,660
27S-12W-32ABD	1,707	27S-12W-34DAB	1,640
27S-12W-35AAAA	1,627	27S-12W-35ACCD	1,617
27S-12W-35ADD	1,627	27S-12W-35DCAA	1,622
27S-12W-35DCB	1,635	27S-12W-36DAA	1,623
27S-13W-36CCAA	1,759	28S-10W-08CCD	1,600
28S-10W-19CCC	1,606	28S-10W-31BBB	1,601
28S-11W-01AAAD	1,597	28S-11W-01AAC	1,610
28S-11W-01BBDA	1,603	28S-11W-01BCCB	1,603
28S-11W-01BDD	1,612	28S-11W-02AAA	1,603
28S-11W-02ABDB	1,598	28S-11W-02DAA	1,616
28S-11W-02DCDC	1,630	28S-11W-02DDA	1,618
28S-11W-03ACD	1,610	28S-11W-03BABA	1,623
28S-11W-03DCD	1,616	28S-11W-04CCB	1,630
28S-11W-05DDD	1,632	28S-11W-06ADD	1,633
28S-11W-07AD	1,627	28S-11W-07DDAD	1,621
28S-11W-08CBBB	1,623	28S-11W-09ADD	1,628
28S-11W-10CCC	1,611	28S-11W-11BCCB	1,616
28S-11W-11DBAC	1,612	28S-11W-12ABAB	1,629
28S-11W-12BAA	1,597	28S-11W-12BBB	1,618
28S-11W-12BCC	1,611	28S-11W-14AAAC	1,612
28S-11W-18BACC	1,621	28S-11W-20AAA	1,624
28S-11W-20AAB	1,625	28S-11W-24AAA	1,603
28S-11W-24ADA	1,603	28S-11W-24DAA	1,603
28S-11W-25CDD	1,615	28S-11W-30AACC	1,619
28S-11W-33BBB	1,639	28S-11W-33CCB	1,650
28S-11W-34BBDD	1,630	28S-12W-02BCCA	1,639
28S-12W-06CBB	1,652	28S-12W-10BBB	1,642
28S-12W-14DCC	1,629	28S-12W-14DDD	1,625
28S-12W-15AAD	1,635	28S-12W-31AACC	1,694
28S-12W-32AAA	1,615	28S-12W-34DDBB	1,650
28S-13W-01CBAA	1,669	28S-13W-11CBB	1,748
28S-13W-13DBB	1,730	28S-13W-23DDBB	1,738
28S-13W-26CCAA	1,723	28S-13W-26DCB	1,727
28S-13W-35BBDD	1,736	29S-10W-09DDD	1,669
29S-11W-01DADA	1,619	29S-11W-06AAAB	1,654
29S-12W-02BBB	1,640	29S-13W-12ABBA	1,724
29S-13W-12CCCC	1,724		

Table 3. *Altitude of top of the Stone Corral Formation and thickness of salt in the Ninnescah Shale determined at selected oil-or-gas wells and test holes*

[--, indicates that Stone Corral Formation was not identified in that particular well or test hole]

Well number (figs. 10 and 11)	Altitude of top of Stone Corral Formation (feet above sea level)	Thickness of salt in Ninnescah Shale (feet)	Well number (figs. 10 and 11)	Altitude of top of Stone Corral Formation (feet above sea level)	Thickness of salt in Ninnescah Shale (feet)
26S-11W-32DD	--	0	26S-11W-35CCC	--	0
26S-11W-36DD	--	0	26S-11W-36DDD	--	0
26S-12W-34CDD	--	0	27S-10W-16AD	1,340	0
27S-10W-16DAA	--	0	27S-10W-19BBB	--	0
27S-10W-19CAC	--	0	27S-10W-19DAB	--	0
27S-10W-19DCC	--	0	27S-10W-19DDD	--	0
27S-10W-20CAA	--	0	27S-10W-20CC	1,376	0
27S-10W-20CDC	--	0	27S-10W-20CDD	--	0
27S-10W-20DDB	--	0	27S-10W-21AAA	1,339	0
27S-10W-29ABB	--	0	27S-10W-30ABD	--	0
27S-10W-30BCC	--	0	27S-10W-30CBC	--	0
27S-10W-30CDD	--	0	27S-10W-31BBB	--	0
27S-10W-31CBC	--	0	27S-10W-31CCB	--	0
27S-10W-32BBB	--	0	27S-10W-33DBB	--	0
27S-11W-04DAA	1,241	0	27S-11W-04DD	1,227	0
27S-11W-05CC	1,230	0	27S-11W-06AC	1,274	55
27S-11W-07BB	1,279	58	27S-11W-08ACC	--	0
27S-11W-08BDB	1,266	0	27S-11W-08BDD	--	0
27S-11W-12CBC	--	0	27S-11W-12DB	1,235	0
27S-11W-12DCA	1,245	0	27S-11W-14BBB	1,232	0
27S-11W-14DAA	1,240	0	27S-11W-17AAA	--	0
27S-11W-19BA	1,276	0	27S-11W-20ADD	1,276	45
27S-11W-20CAB	1,271	25	27S-11W-20CDB	1,271	60
27S-11W-20DCC	1,268		27S-11W-21ACB	1,267	30
27S-11W-21BAD	1,296	55	27S-11W-21BB	1,285	40
27S-11W-21BDD	1,271	25	27S-11W-22AB	1,255	0
27S-11W-21CBA	1,265	55	27S-11W-22CC	--	0
27S-11W-22CCCA	1,247	0	27S-11W-24AAD	--	0
27S-11W-24DCCA	1,319	0	27S-11W-24D	--	0
27S-11W-24DD	--	0	27S-11W-24DDCC	1,330	0
27S-11W-25AAA	--	0	27S-11W-25AAD	--	0
27S-11W-25ABD	--	0	27S-11W-25BBB	--	0
27S-11W-25BCA	--	0	27S-11W-25C	--	0
27S-11W-25CC	--	0	27S-11W-26CABA	1,193	0
27S-11W-26CBB	--	0	27S-11W-27BBB	1,274	10
27S-11W-28AA	1,273	14	27S-11W-28BAB	--	45
27S-11W-28CC	--	50	27S-11W-29AAA	--	0
27S-11W-29BAC	1,285	46	27S-11W-30CCC	--	0
27S-11W-32ABA	--	0	27S-11W-32DAA	--	0
27S-11W-32DDD	--	0	27S-11W-33BBB	--	0
27S-11W-34DDC	1,297	0	27S-11W-34DDD	--	0
27S-11W-35ADB	--	0	27S-11W-35BBA	--	0
27S-11W-35BD	--	0	27S-11W-35CBA	--	0
27S-11W-35CDC	--	0	27S-11W-35DAA	--	0
27S-11W-35DCA	1,295	0	27S-11W-36A	--	0
27S-11W-36ABA	--	0	27S-11W-36ABB	--	0
27S-11W-36BAA	--	0	27S-11W-36BDA	1,307	0
27S-11W-36CAC	--	0	27S-11W-36DCA	--	0
27S-12W-01B	1,254	10	27S-12W-01BBB	1,414	60
27S-12W-02AAA	1,229	0	27S-12W-03BAC	1,224	0
27S-12W-03BDA	1,223	30	27S-12W-03BDDA	1,218	20
27S-12W-03CBAB	1,236	55	27S-12W-03CBD	1,235	65
27S-12W-03CDA	1,250	60	27S-12W-04DCC	1,213	40
27S-12W-04DDD	1,229	50	27S-12W-05AB	--	0
27S-12W-05BBB	--	0	27S-12W-05CAB	--	50
27S-12W-05AAA	--	0	27S-12W-05DBB	1,219	50
27S-12W-06BAAB	--	0	27S-12W-06BBA	--	0
27S-12W-06BDCB	1,163	10	27S-12W-06CBA	--	0
27S-12W-06CDC	--	60	27S-12W-06DC	--	15
27S-12W-07ABB	1,217	60	27S-12W-07BDA	1,216	65

Table 3. *Altitude of top of the Stone Corral Formation and thickness of salt in the Ninnescah Shale determined at selected oil-or-gas wells and test holes*--Continued

Well number (figs. 10 and 11)	Altitude of top of Stone Corral Formation (feet above sea level)	Thickness of salt in Ninnescah Shale (feet)	Well number (figs. 10 and 11)	Altitude of top of Stone Corral Formation (feet above sea level)	Thickness of salt in Ninnescah Shale (feet)
27S-12W-07BDC	1,216	60	27S-12W-07CAC	1,238	60
27S-12W-07CBC	1,215	60	27S-12W-07DACA	--	55
27S-12W-07DBB	1,221	55	27S-12W-07DDB	--	65
27S-12W-08AAD	1,198	25	27S-12W-08ABB	1,233	60
27S-12W-08DAD	1,178	0	27S-12W-09AAA	--	0
27S-12W-09BAA	1,199	0	27S-12W-09BCA	1,181	0
27S-12W-09BCB	1,180	0	27S-12W-09BCC	1,167	0
27S-12W-09BCCD	1,185	0	27S-12W-10ABB	1,235	0
27S-12W-13ADD	--	0	27S-12W-13BBB	--	50
27S-12W-14DCC	1,230	0	27S-12W-15BBB	--	0
27S-12W-15CAB	1,245	50	27S-12W-16BBAA	1,183	0
27S-12W-16CDC	1,245	60	27S-12W-16DCD	1,246	55
27S-12W-17BBC	1,227	60	27S-12W-17BCA	1,235	60
27S-12W-17BCC	1,225	65	27S-12W-17BDC	1,233	74
27S-12W-17BDDA	1,230	60	27S-12W-17CAA	1,233	55
27S-12W-17CAC	1,236	50	27S-12W-17CBA	1,239	55
27S-12W-17CBDA	1,236	67	27S-12W-17CCA	1,235	50
27S-12W-18ABAD	1,227	65	27S-12W-18BAB	--	67
27S-12W-18BBD	1,233	70	27S-12W-18BDCA	1,239	60
27S-12W-18BDD	1,238	73	27S-12W-18CAB	1,239	65
27S-12W-18CAC	1,222	55	27S-12W-18CBB	1,223	40
27S-12W-18CBD	1,227	40	27S-12W-18CCB	1,228	70
27S-12W-18CCD	1,238	75	27S-12W-18DAD	1,232	63
27S-12W-19ABB	1,219	60	27S-12W-19ADC	1,223	65
27S-12W-19BAA	1,217	50	27S-12W-19BB	1,214	70
27S-12W-19BBA	1,227	50	27S-12W-19BBC	1,223	50
27S-12W-19BBD	1,182	60	27S-12W-19BCA	1,213	50
27S-12W-19BDB	1,177	50	27S-12W-19BDC	1,177	0
27S-12W-19CAB	1,236	50	27S-12W-19CBA	1,203	40
27S-12W-19CBB	1,212	40	27S-12W-20BD	1,231	65
27S-12W-20DA	1,198	0	27S-12W-21AC	1,244	45
27S-12W-21BDB	1,217	0	27S-12W-21DCB	--	50
27S-12W-22CC	1,241	45	27S-12W-23BCBA	1,242	50
27S-12W-23CC	1,232	0	27S-12W-24CBB	1,240	20
27S-12W-24DCA	1,261	40	27S-12W-25ABB	1,268	55
27S-12W-25ACC	1,253	20	27S-12W-25BDB	--	40
27S-12W-25BDDA	1,257	30	27S-12W-25CAA	1,258	40
27S-12W-25CAC	1,255	0	27S-12W-25DBBD	1,251	30
27S-12W-26DDA	--	0	27S-12W-28ABAA	1,236	45
27S-12W-28BA	1,239	40	27S-12W-28CAB	1,205	0
27S-12W-29ABDD	1,236	35	27S-12W-29BBB	1,223	58
27S-12W-29DD	1,227	60	27S-12W-30AAB	1,220	70
27S-12W-30BBB	1,215	40	27S-12W-30BCB	1,224	45
27S-12W-30BCCD	1,229	40	27S-12W-30CBB	1,226	60
27S-12W-30CCB	1,227	75	27S-12W-31AAD	1,125	30
27S-12W-31BBB	1,199	35	27S-12W-31BC	1,207	50
27S-12W-32AAD	--	60	27S-12W-32ABD	1,222	50
27S-12W-33BB	1,219	45	27S-12W-33BC	1,204	25
27S-12W-34DAB	1,230	30	27S-12W-35AAAA	--	0
27S-12W-35ACCD	1,247	50	27S-12W-35ADD	1,240	45
27S-12W-35BDD	1,225	15	27S-12W-35DCB	1,240	58
27S-12W-35D	--	46	27S-12W-35DDBB	1,240	46
27S-12W-36BBCD	1,248	40	27S-12W-36DAA	--	0
27S-13W-01A	1,166	0	27S-13W-01AAB	1,170	0
27S-13W-01BAA	1,167	0	27S-13W-01BAB	1,161	0
27S-13W-02AAA	1,165	0	27S-13W-02CADD	1,170	0
27S-13W-02DBC	1,168	0	27S-13W-02DCB	1,150	0
27S-13W-02DCC	1,222	55	27S-13W-11AABB	1,215	60
27S-13W-11AAC	1,219	55	27S-13W-11ABB	1,225	55
27S-13W-11ABDB	1,212	50	27S-13W-11BA	1,157	0

Table 3. *Altitude of top of the Stone Corral Formation and thickness of salt in the Ninnescah Shale determined at selected oil-or-gas wells and test holes*--Continued

Well number (figs. 10 and 11)	Altitude of top of Stone Corral Formation (feet above sea level)	Thickness of salt in Ninnescah Shale (feet)	Well number (figs. 10 and 11)	Altitude of top of Stone Corral Formation (feet above sea level)	Thickness of salt in Ninnescah Shale (feet)
27S-13W-11CC	1,196	70	27S-13W-11DC	1,182	75
27S-13W-12CCA	1,225	25	27S-13W-12CDB	1,185	35
27S-13W-12DCC	1,209	50	27S-13W-13DAA	1,233	40
27S-13W-13DAC	1,224	25	27S-13W-13DDC	1,240	30
27S-13W-14BAC	1,208	65	27S-13W-14BDD	1,210	65
27S-13W-24AAA	1,248	65	27S-13W-24AAD	1,231	60
27S-13W-24CBC	1,219	70	27S-13W-24DBD	1,231	65
27S-13W-25AAD	1,212	65	27S-13W-25ADD	1,226	65
27S-13W-25DAD	1,226	70	27S-13W-25DC	1,228	60
27S-13W-26CD	1,202	70	27S-13W-35CDD	1,107	25
27S-13W-35DC	1,195	45	27S-13W-36AAD	1,215	50
28S-10W-07DCC	1,278	0	28S-10W-16CC	1,266	0
28S-10W-19CC	--	0	28S-10W-19CCC	--	0
28S-10W-30CCB	1,233	0	28S-10W-31BBDC	1,236	0
28S-10W-31DBB	1,240	0	28S-10W-33CCC	1,233	0
28S-11W-01AAAD	--	0	28S-11W-01BBA	--	0
28S-11W-01BCC	--	0	28S-11W-01BDD	--	0
28S-11W-02AAA	1,308	0	28S-11W-02ABB	--	0
28S-11W-02BAA	--	0	28S-11W-02BCB	--	0
28S-11W-02CDD	1,298	0	28S-11W-02DAA	--	0
28S-11W-02DCD	--	0	28S-11W-03ACD	--	0
28S-11W-03DCD	--	0	28S-11W-04CCC	--	0
28S-11W-05DDD	--	0	28S-11W-06ADD	1,220	0
28S-11W-07AD	1,260	0	28S-11W-08CBB	--	0
28S-11W-09AA	1,297	0	28S-11W-10CCC	--	0
28S-11W-11CAA	1,293	0	28S-11W-12AAC	--	0
28S-11W-12BAA	--	0	28S-11W-12BBB	--	0
28S-11W-12CDD	1,296	0	28S-11W-16CAAA	--	0
28S-11W-16CC	--	0	28S-11W-18BBD	1,240	0
28S-11W-20AAA	--	0	28S-11W-20AAB	1,242	0
28S-11W-20DDD	1,242	0	28S-11W-22DC	1,239	0
28S-11W-24AAA	--	0	28S-11W-24ADA	--	0
28S-11W-24DAA	--	0	28S-11W-24DBDD	1,199	0
28S-11W-24DDBB	--	0	28S-11W-25BAA	1,235	0
28S-11W-25CCC	1,218	0	28S-11W-25CDD	1,219	0
28S-11W-25DCD	--	0	28S-11W-26BB	1,235	0
28S-11W-27ABB	1,232	0	28S-11W-27BD	1,229	0
28S-11W-28CB	1,216	0	28S-11W-29CDD	1,213	0
28S-11W-30DA	1,207	0	28S-11W-31BDD	1,184	0
28S-11W-31CDD	1,195	0	28S-11W-31DAA	1,197	0
28S-11W-32BACD	1,210	0	28S-11W-32DBDA	1,218	0
28S-11W-33AA	1,207	0	28S-11W-33BBB	--	0
28S-11W-33CCB	--	0	28S-11W-33DB	1,205	0
28S-11W-34ACC	1,205	0	28S-11W-34BDCB	1,205	0
28S-11W-35ACC	1 213	0	28S-11W-35BC	1,208	0
28S-11W-35CCBA	1,205	0	28S-11W-35DA	1,208	0
28S-11W-36ACA	1,213	0	28S-11W-36CBDA	1,218	0
28S-11W-36DBBA	1,213	0	28S-12W-02BC	1,211	0
28S-12W-03ACC	1,222	0	28S-12W-03ADCD	1,193	0
28S-12W-03DAD	1,209	0	28S-12W-05DBD	1,217	35
28S-12W-06CBB	--	0	28S-12W-06DAB	1,200	0
28S-12W-07DC	1,175	0	28S-12W-07DD	1,184	0
28S-12W-08AC	1,184	0	28S-12W-10BAA	1,208	0
28S-12W-10BBB	--	0	28S-12W-11CCC	1,210	0
28S-12W-13CAA	1,259	0	28S-12W-14DCC	1,234	0
28S-12W-14DDD	--	0	28S-12W-15AAD	1,224	0
28S-12W-15ACD	1,192	0	28S-12W-17AB	1,203	0
28S-12W-17CC	1,183	0	28S-12W-17DBCD	1,207	0
28S-12W-18AC	1,212	45	28S-12W-18CAAD	1,211	40
28S-12W-18CDD	1,207	0	28S-12W-18DA	1,183	0
28S-12W-19ABDA	1,175	0	28S-12W-20ACC	1,193	0

Table 3. *Altitude of top of the Stone Corral Formation and thickness of salt in the Ninnescah Shale determined at selected oil-or-gas wells and test holes*--Continued

Well number (figs. 10 and 11)	Altitude of top of Stone Corral Formation (feet above sea level)	Thickness of salt in Ninnescah Shale (feet)	Well number (figs. 10 and 11)	Altitude of top of Stone Corral Formation (feet above sea level)	Thickness of salt in Ninnescah Shale (feet)
28S-12W-21BCA	1,200	0	28S-12W-21CDA	1,192	0
28S-12W-21DB	1,218	0	28S-12W-21DCBD	1,221	0
28S-12W-23BAB	1,239	0	28S-12W-23BABC	1,271	0
28S-12W-23BBA	1,240	0	28S-12W-23BBB	1,232	0
28S-12W-23BCB	1,243	0	28S-12W-23CAC	1,238	0
28S-12W-23CBC	1,235	0	28S-12W-23CCA	1,227	0
28S-12W-23CCAD	1,224	0	28S-12W-23CD	1,215	0
28S-12W-23CDA	1,235	0	28S-12W-23DBC	1,238	0
28S-12W-24DBBB	1,254	0	28S-12W-26DC	1,186	0
28S-12W-27AABD	1,223	0	28S-12W-27BAC	1,214	0
28S-12W-27DAA	1,242	0	28S-12W-27DBA	1,208	0
28S-12W-28ABB	1,209	0	28S-12W-28AC	1,213	0
28S-12W-28BBB	1,203	0	28S-12W-28CDD	1,192	0
28S-12W-31ADD	1,260	0	28S-12W-31BBC	1,147	0
28S-12W-32AAA	--	0	28S-12W-33CA	1,192	0
28S-12W-33DAB	1,200	0	28S-12W-33DD	1,215	0
28S-12W-34CC	1,186	0	28S-12W-35AB	1,197	0
28S-12W-35DA	1,193	0	28S-12W-36CC	1,195	0
28S-13W-01BB	1,175	35	28S-13W-01CBAA	--	0
28S-13W-02BDC	1,189	70	28S-13W-12ABD	1,138	0
28S-13W-12CDA	1,203	50	28S-13W-13ACC	1,284	50
28S-13W-13C	1,213	50	28S-13W-13DBB	1,226	45
28S-13W-14ADD	1,191	45	28S-13W-14BAA	1,198	55
28S-13W-23CAC	1,183	45	28S-13W-23CCC	1,200	35
28S-13W-23CDC	1,203	35	28S-13W-23DCB	1,210	35
28S-13W-26ADD	1,189	0	28S-13W-26BAC	1,212	50
28S-13W-26BBA	1,218	60	28S-13W-26BBC	1,206	70
28S-13W-26DCB	--	0	28S-13W-35CA	1,151	0
28S-13W-35CD	1,024	0	28S-13W-35DABD	1,133	0
28S-13W-35DC	1,129	0	29S-10W-09DDD	--	0
29S-11W-01DADA	--	0	29S-11W-06AAAB	--	0
29S-11W-11CCC	--	0	29S-11W-12DDD	--	0
29S-12W-02BBB	--	0	29S-13W-12ABB	--	0

Table 4. *Specific conductance and chloride concentrations in samples collected from selected water wells completed in the alluvial and Permian aquifers, 1982-89*

[--, indicates no information]

Well number (fig. 12)	Date collected (month-day year)	Depth of well (feet)	Specific conductance (microsiemens per centimeter at 25 degrees Celsius)	Chloride concentration (milligrams per liter)
Wells completed in alluvial aquifer (fig. 12A)				
26S-10W-31CCCB3	10-30-84	71	451	10
26S-12W-36ADDA3	10-30-84	85	418	19
27S-10W-19BBBB		--	---	155
27S-10W-19DCCD	4-20-89	111	580	50
27S-10W-30ABDC	4-20-89	--	550	62
27S-10W-31BBBB	4-20-89	90	800	125
27S-10W-31CBBB	4-20-89	95	480	38
27S-11W-18CCAA	7-18-89	--	723	85
27S-11W-19ACAC	5-03-89	146	544	28
27S-11W-19BAAC	5-03-89	112	533	20
27S-11W-25DAAD2	10-19-89	30	912	140
27S-11W-26BCBB		--	---	135
27S-11W-29CDDD3	10-11-89	41	422	5
27S-11W-30ADDD	3-02-89	--	375	4
27S-11W-30CAAA3	10-04-89	78	834	105
27S-11W-30CBBD	5-10-89	--	1,037	230
27S-11W-30CCDD3	10-11-89	--	7,770	2,450
27S-11W-30DDAA3	10-04-89	66	550	50
27S-11W-31AAAB4	10-18-89	37	11,900	3,800
27S-11W-31AAAC2	10-18-89	29	32,000	11,300
27S-11W-31ADDD3	10-04-89	56	526	38
27S-11W-31BAAA2	3-01-90	39	6,630	2,000
27S-11W-32AABB	5-03-89	--	421	7
27S-11W-32AACD	6-23-89	--	402	4
27S-11W-32DAAA	5-04-89	--	916	155
27S-11W-33BBBB3	10-11-89	52	421	7
27S-11W-33BCCB2	3-08-90	29	10,600	3,200
27S-11W-35BACD	3-02-90	--	431	8
27S-11W-35BADC	3-02-90	--	461	12
27S-12W-06BABA3	10-30-84	90	495	30
27S-12W-14DCCB	5-03-89	--	624	105
27S-12W-21ACCA	5-03-89	--	1,140	205
27S-12W-25ADDA3	10-04-89	70	1,625	390
27S-12W-25CABC	4-20-89	92	590	95
27S-12W-25DBBC3	10-06-89	70	2,560	665

Table 4. *Specific conductance and chloride concentrations in samples collected from selected water wells completed in the alluvial and Permian aquifers, 1982-89*--Continued

Wells number (fig. 12)	Date collected (month-day year)	Depth of well (feet)	Specific conductance (microsiemens per centi-meter at 25 degrees Celsius)	Chloride concentration (milligrams per liter)
Wells completed in alluvial aquifer (fig. 12A)--Continued				
27S-12W-35AAAA3	11-23-82	51	2,270	560
28S-11W-01AAAD3	10-26-84	57	552	25
28S-11W-04BABB	4-05-89	--	514	35
28S-13W-01CBAA3	10-26-84	103	660	84
29S-11W-01DADA3	10-24-84	85	462	6
29S-11W-06AAAB3	10-24-84	78	470	9
29S-13W-12ABBA3	10-24-84	82	425	12
Wells completed near base of alluvial aquifer (fig. 12B)				
26S-10W-31CCCB2	3-08-83	155	2,670	689
26S-12W-36ADDA2	3-07-83	192	6,620	1,834
27S-11W-18BBBB2	6-06-89	212	25,200	8,500
27S-11W-18CCCC2	5-25-89	183	37,800	14,150
27S-11W-19AAAB2	5-25-89	205	18,400	6,850
27S-11W-25DAAD	10-19-89	64	855	145
27S-11W-29CDDD2	10-03-89	92	11,800	3,750
27S-11W-30CAAA2	10-04-89	120	32,100	11,550
27S-11W-30CCDD2	6-05-89	93	8,890	2,750
27S-11W-30DDAA2	5-02-89	108	16,990	5,750
27S-11W-31AAAB3	10-18-89	84	26,200	8,800
27S-11W-31AAAC	10-17-89	98	34,000	12,250
27S-11W-31ADDD2	6-06-89	97	529	85
27S-11W-31BAAA	3-01-90	91	22,700	7,900
27S-11W-33AAAA2	5-08-89	105	9,080	2,720
27S-11W-33BBBB2	5-04-89	90	15,390	5,150
27S-11W-33BCCB	3-08-90	--	18,890	6,400
27S-12W-06BABA2	3-07-83	196	46,600	16,850
27S-12W-14DCDC2	6-06-89	182	9,180	3,250
27S-12W-25DBBC2	5-05-89	118	10,330	3,150
27S-12W-26CBBC2	5-10-89	120	1,730	390
27S-12W-35AAAA2	11-23-82	89	3,830	1,064
28S-11W-01AAAD2	12-14-82	116	1,400	318
28S-13W-01CBAA2	4-26-83	157	14,200	4,470
29S-11W-01DADA2	12-09-82	150	477	14
29S-11W-06AAAB2	12-12-82	164	610	61
29S-13W-12ABBA2	4-26-83	158	470	35

Table 4. *Specific conductance and chloride concentrations in samples collected from selected water wells completed in the alluvial and Permian aquifers, 1982-89*--Continued

Wells number (fig. 12)	Date collected (month-day year)	Depth of well (feet)	Specific conductance (microsiemens per centimeter at 25 degrees Celsius)	Chloride concentration (milligrams per liter)
Wells completed in top of Permian aquifer (fig. 12C)				
26S-10W-31CCCB	12-23-82	173	21,400	6,750
26S-12W-36ADDA	3-07-83	209	6,910	1,908
27S-11W-18BBBB	6-06-89	244	33,900	11,900
27S-11W-18CCCC	5-25-89	203	62,200	26,200
27S-11W-19AAAB	5-25-89	235	33,800	12,600
27S-11W-29CDDD	10-03-89	125	45,600	16,950
27S-11W-30CAAA	5-03-89	154	39,900	14,450
27S-11W-30CCDD	5-30-89	124	50,100	18,500
27S-11W-30DDAA	5-02-89	127	39,800	14,900
27S-11W-31AAAB2	10-18-89	103	21,200	6,550
27S-11W-31ADDD	6-06-89	124	12,550	3,450
27S-11W-33AAAA	5-08-89	143	7,130	1,720
27S-11W-33BBBB	5-04-89	111	25,100	8,850
27S-12W-06BABA	5-26-83	215	56,800	21,800
27S-12W-14DCDC	6-06-89	214	7,890	2,450
27S-12W-25ADDA	5-04-89	147	75,800	28,100
27S-12W-25DBBC	6-06-89	155	83,100	24,000
27S-12W-26CBBC	5-10-89	144	3,830	1,045
27S-12W-35AAAA	11-23-82	116	84,800	32,700
28S-11W-01AAAD	5-15-84	135	2,100	465
28S-13W-01CBAA	5-26-83	178	15,500	4,900
29S-11W-01DADA	7-15-86	192	810	113
29S-11W-06AAAB	7-07-86	195	1,460	313
29S-13W-12ABBA	11-12-84	188	510	31

Table 5. *Specific conductance and chloride concentrations in water samples collected from streams, ponds, marshes, springs, the South Fork Ninnescah River, and from beneath streambed of river, 1988-89.*

[The South Fork of the Ninnescah River is referred to in the table as "river"]

Map reference number (fig. 13)	Site number	Date collected (month-day-year)	Specific conductance (microsiemens per centimeter at 25 degrees Celsius)	Chloride concentration (milligrams per liter)	Description of water sampling point or site
1	28S-12W-04BBBB	6-07-89	720	75	Three feet beneath streambed at center of river; 50 feet upstream from the U.S. Highway 54 bridge.
2	27S-12W-35BBCB	6-07-89	800	125	Three feet beneath streambed near left bank of river; 50 feet upstream from county bridge.
3	27S-12W-35AAAA	6-07-89	460	40	Three feet beneath streambed near left bank at abandoned county bridge.
4	27S-11W-31BBBB	12-01-88	836	135	Center of river 50 feet downstream from county bridge.
		6-07-89	470	95	Three feet beneath streambed near left bank; 50 feet downstream from county bridge.
5	27S-11W-31BBAA	12-01-88	892	144	Center of river 1/4 mile downstream from county bridge.
6	27S-11W-31BABD	12-01-88	924	155	Center of river 3/8 mile east of county bridge where meander scar intersects bank of the river.
7	27S-11W-31BADA	6-07-89	10,000	3,170	Three feet beneath streambed near left bank.
		6-07-89	770	105	Three feet beneath streambed near right bank.
8	27S-12W-25CCBB	6-6-89	643	55	Small pond on tributary to upper pond.
9	27S-12W-25DDCC	6-5-89	592	34	Do.
10	27S-12W-25AADA	11-30-88	1,119	214	Outflow from marsh on tributary to upper pond.
11	27S-11W-30CDAA	11-30-88	570	30	Flow between upper and middle ponds.
12	27S-11W-30DCCC	11-30-88	3,282	850	Flow (estimated 2 cubic feet per second) between middle and lower ponds.
13	27S-11W-31BAAB	11-30-88	12,074	3,849	Small west tributary to lower pond.
		10-25-89	17,800	5,850	Do.
14	27S-11W-31ABDA	11-30-88	3,597	1,014	Major outflow from lower pond.
15	27S-11W-31ABDD	12-01-88	939	159	Center of river 1/4 mile west of county bridge at north side of river meander.

Table 5. *Specific conductance and chloride concentrations in water samples collected from streams, ponds, marshes, springs, the South Fork Ninnescah River, and from beneath streambed of river, 1988-89*--Continued

Map reference number (fig. 13)	Site number	Date collected (month-day-year)	Specific conductance (microsiemens per centimeter at 25 degrees Celsius)	Chloride concentration (milligrams per liter)	Description of water sampling point or site
16	27S-11W-31AACA	12-01-88	5,198	1,514	Spring "A" on left bank of river; 600 feet upstream from county bridge.
	27S-11W-31AADB	12-01-88	20,114	6,749	Spring "B" on left bank of river; 50 feet downstream from spring "A."
17	27S-11W-31AAAD	12-01-88	965	174	Center of river 300 feet upstream from county bridge.
18	27S-11W-32BBBC	12-01-88	1,006	184	Center of river 100 feet downstream from county bridge.
		12-01-88	2,445	624	River near left bank; 100 feet downstream from county bridge.
	27S-11W-32BBBC	6-06-89	19,900	7,250	Three feet beneath streambed at center; 100 feet downstream from county bridge.
	27S-11W-32BBBC	6-06-89	22,800	7,400	Three feet beneath streambed near left bank; 100 feet downstream from county bridge.
	27S-11W-32BBBC	6-06-89	16,100	5,900	Three feet beneath streambed near right bank; 100 feet downstream from county bridge.
	27S-11W-32BBBC	6-06-89	23,000	7,400	Twelve feet beneath streambed near left bank; 100 feet downstream from county bridge.
19	27S-11W-32BBBD	12-01-88	1,023	204	Center of river upstream from salt-marsh outflow.
20	27S-11W-31AAAB	11-30-88	10,798	3,449	North fork of salt marsh.
		5-24-89	13,530	3,850	Do.
21	27S-11W-31AAAC	11-30-88	25,912	9,099	South fork of salt marsh.
		5-24-89	23,000	7,950	Do.
22	27S-11W-31AAAA	11-30-88	22,622	7,849	Salt marsh; shovel hole at confluence of north and south forks (water level = 1 foot).
23	27S-11W-32BBBB	12-01-88	11,341	3,750	Outflow from salt marsh to river.
24	27S-11W-29CCCD	12-01-88	1,041	194	Center of river downstream from salt-marsh outflow.
25	27S-11W-29CCCA	12-01-88	1,216	244	Outflow of pond on east side of county road.
26	27S-11W-32BACA	12-01-88	1,452	324	Center of river 1/2 mile downstream from county bridge.
27	27S-11W-32BDDD	11-30-88	638	74	Spring in small tributary on south side of river.
28	27S-11W-32ACCB	11-30-88	589	44	Total spring discharge to river from tributary on south side of river.
29	27S-11W-33BCCC	12-01-88	1,632	360	Center of river 50 feet downstream from county bridge.
		6-07-89	700	105	Three feet beneath streambed near left bank; 50 feet downstream from county bridge.

Table 5. *Specific conductance and chloride concentrations in water samples collected from streams, ponds, marshes, springs, the South Fork Ninnescah River, and from beneath streambed of river, 1988-89*--Continued

Map reference number (fig. 13)	Site number	Date collected (month-day-year)	Specific conductance (microsiemens per centimeter at 25 degrees Celsius)	Chloride concentration (milligrams per liter)	Description of water sampling point or site
30	27S-11W-33BCDB	6-07-89	4,600	290	Three feet beneath streambed near left bank 1/4 mile downstream from county bridge.
		6-07-89	8,700	570	Three feet beneath streambed near right bank 1/4 mile downstream from county bridge.
31	27S-11W-26CCCB	6-07-89	1,150	185	Three feet beneath streambed near right bank; 50 feet downstream from county bridge.
		6-07-89	2,000	455	Three feet beneath streambed near left bank; 50 feet downstream from county bridge.
32	27S-10W-30CBBC	6-07-89	825	120	Three feet beneath streambed near left bank; 50 feet downstream from county bridge.
33	27S-10W-29ADDD	6-07-89	690	95	Three feet beneath streambed at center; 50 feet upstream from county bridge.
		6-07-89	425	22	Three feet beneath streambed near left bank; 50 feet upstream from county bridge.
34	27S-10W-29ADDA	12-01-88	460	24	Marsh, 0.1 mile northwest of county bridge.
35	27S-10W-33AAAD	6-07-89	1,670	365	Three feet beneath streambed at center; 50 feet upstream from county bridge.
	27S-10W-33AAAD	6-07-89	1,560	355	Three feet beneath streambed near left bank; 50 feet upstream from county bridge.
	27S-10W-33AAAA	12-01-88	1,220	195	Marsh, 200 feet northwest of county bridge.

Table 6. *Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989*

[Ground conductivity in millisiemens per meter; data points are 131 feet apart, except between data points 1A and 1, which are 66 feet apart. The spacings between the coils of the electromagnetic survey instrument are 10, 20, and 40 meters (33, 66, and 131 feet). "hz" is the apparent ground conductivity in the vertical dipole. In the vertical dipole at large values of ground conductivity, the apparent conductivity is not linearly proportional to the true conductivity. In these cases for true ground conductivity in excess of approximately 700 millisiemens per meter, the apparent conductivity values become negative (McNeill, 1980). --, indicates no conductivity reading taken. Traverses are located in figure 18]

Traverse 1, south to north, started 33 feet north of river, 600 feet east of the county road in the E1/2 SW1/4 SW1/4, sec. 26 and NE1/4 NW1/4 NW1/4, sec. 35, T. 27 S., R. 12 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	20	21	28	30	--	--
1	19	18	27	27	47	56
2	21	18	25	23	45	43
3	19	22	26	24	43	46
4	18	21	23	22	40	40
5	17	21	23	24	39	41
6	15	17	22	26	39	42
7	18	16	22	25	38	45
8	20	18	24	21	39	40
9	19	15	22	24	37	39
10	18	14	21	20	36	38
11	21	15	24	19	38	40

Traverse 2 (north), south to north, started 33 feet north of river, 800 feet east of county road in the SE1/4 SW1/4 SW1/4, sec. 25 and NE1/4 NW1/4 NW1/4, sec. 36, T. 27 S., R. 12 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	22	29	39	60	--	--
1	17	25	34	47	70	91
2	17	18	29	38	62	64
3	16	20	29	36	58	71
4	18	24	28	31	57	65
5	16	20	27	31	54	54
6	19	23	27	33	54	58
7	20	27	28	27	52	58
8	22	25	28	28	52	55
9	18	17	25	24	50	60
10	23	20	27	28	50	48

Table 6. *Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989--Continued*

Traverse 2 (south), north to south, started 33 feet south of river, 800 feet east of county road in the NW1/4, sec. 36, T. 27 S., R. 12 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	31	41	52	56	--	--
1	22	32	46	62	81	80
2	19	18	35	61	69	68
3	29	33	41	48	65	60
4	40	14	37	24	52	59
5	36	14	38	9	44	31
6	25	21	27	23	42	48
7	29	22	30	25	42	53
8	42	-2	34	-50	41	-7
9	28	22	29	28	42	64
10	23	18	26	21	40	44
11	32	19	29	18	40	42
12	25	13	27	22	39	44
13	20	21	23	21	38	45

Traverse 3 (north), south to north, started 66 feet north of river, 100 feet east of the county-line road in the W1/2 W1/2 SW1/4, sec. 30 T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1	25	24	35	34	63	67
2	26	28	39	42	64	61
3	32	37	45	42	68	61
4	30	32	43	42	67	61
5	23	28	40	46	67	59
6	22	25	36	47	67	64
7	25	27	38	42	64	61
8	23	24	35	37	63	63
9	24	22	33	33	61	65
10	27	27	36	42	64	56
11	30	28	37	35	64	52

Table 6. *Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989--Continued*

Traverse 3 (south), north to south, started 66 feet south of river, 100 feet east of county road in the W1/2 W1/2 NW1/4, sec. 31, T. 27 S., R. 11 W.

Data point	Ground conductivity 10 meters hz	vt	20 meters hz	vt	40 meters hz	vt
1	26	30	42	56	68	65
2	25	34	41	48	58	42
3	11	16	23	38	52	67
4	14	16	22	24	44	38
5	15	17	21	25	41	46
6	34	26	32	23	44	36
7	39	32	39	27	50	45
8	41	29	40	33	50	39
9	--	--	35	34	48	48
10	--	--	34	27	47	42
11	--	--	31	27	45	40
12	--	--	30	26	42	40
13	--	--	27	27	43	45
14	--	--	29	24	43	42
15	--	--	30	25	41	43
16	--	--	36	21	41	37
17	--	--	34	22	42	37
18	--	--	32	26	42	41
19	--	--	33	25	42	41
20	--	--	36	24	42	38

Traverse 4, west to east, started 3/4 mile north of county bridge, 30 feet east of county road in the S1/2 NW1/4, sec. 30, T. 27 S., R. 11 W. Break in traverse at data point 9 to the southeast.

Data point	Ground conductivity 10 meters hz	vt	20 meters hz	vt	40 meters hz	vt
1	--	--	--	--	33	36
2	--	--	--	--	37	42
3	--	--	--	--	36	37
4	--	--	--	--	38	46
5	--	--	--	--	38	44
6	--	--	--	--	36	40
7	--	--	--	--	37	38
8	--	--	--	--	36	37
9	--	--	--	--	32	37
10	--	--	--	--	31	35
11	--	--	--	--	28	33
12	--	--	--	--	30	33
13	--	--	--	--	29	35
14	--	--	--	--	28	35
15	--	--	--	--	27	33
16	--	--	--	--	28	36
17	--	--	--	--	28	32
18	--	--	--	--	31	37
19	--	--	--	--	29	35
20	--	--	--	--	30	36
21	--	--	--	--	30	33
22	--	--	--	--	31	40
23	--	--	--	--	32	31
24	--	--	--	--	32	36
25	--	--	--	--	33	40
26	--	--	--	--	37	39

Table 6. *Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989--Continued*

Traverse 5, east to west, started at data point 6 on traverse 9 (north) in the S1/2 S1/2 SW1/4, sec. 30, T. 27 S., T. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1	105	--	132	--	150	--
2	105	--	120	--	130	--
3	60	--	80	--	105	--
4	49	--	63	--	90	--
5	38	--	54	--	84	--
6	32	--	51	--	83	--
7	32	--	52	--	84	--
8	30	--	48	--	80	--
9	26	--	42	--	74	--

Traverse 6 (north), south to north, started 33 north of river, 200 feet west of 1/2-mile section-line in the E1/2 SE1/4 SW1/4, sec.30 and E1/2 NE1/4 NW1/4, sec. 31, T. 27 S., T. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	72	46	76	28	--	--
1	89	64	84	23	76	40
2	115	75	110	53	100	44
3	130	63	142	65	125	31
4	115	63	149	72	150	38
5	120	63	140	72	140	70
6	115	66	135	59	140	74
7	103	56	135	94	148	62
8	105	55	128	60	139	50
9	80	59	103	78	125	95
10	82	67	100	72	118	62
11	62	59	82	70	105	90
12	44	50	69	60	98	82
13	56	42	69	51	96	70
14	84	51	90	51	100	65
15	90	56	97	70	108	74
16	98	34	90	54	104	68

Table 6. *Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989--Continued*

Traverse 6 (south), north to south, started 66 feet south of the river, 200 feet west of 1/2-mile section line in the E1/2 E1/2 NW1/4, sec. 31, T. 27 S., T. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1	16	18	24	27	44	58
2	20	21	27	31	43	46
3	26	22	30	31	43	44
4	31	29	34	30	46	41
5	36	27	39	28	48	42
6	38	29	39	31	45	40
7	37	30	38	30	44	39
8	35	31	35	26	42	37
9	26	25	30	32	40	40
10	25	23	29	28	38	39

Traverse 7, southeast to northwest, started 50 feet north of river, 20 feet west of 1/2-mile section line in the NE1/4 NW1/4, sec. 31, T. 27 S., T. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1	59	28	52	39	61	45
2	118	45	96	33	81	19
3	110	58	97	48	90	50
4	120	51	118	41	110	54
5	120	62	145	49	130	8
6	100	52	125	62	120	68
7	66	62	97	74	110	64
8	56	44	80	72	92	52

Traverse 8, south to north, 200 feet west of traverse 6, started 33 feet north of river in the SE1/4 SE1/4, sec. 30 and NE1/4 NE1/4, sec. 31, T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	44	49	66	57	--	--
1	50	40	76	76	94	70
2	52	46	80	63	110	94
3	56	53	82	78	120	118
4	57	52	93	68	125	62
5	63	62	98	82	122	54
6	57	52	81	54	110	88
7	47	43	68	62	100	100

Table 6. *Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989--Continued*

Traverse 9 (north), south to north, started 33 feet north of river, 600 feet west of county road in the SE1/4 SE1/4, sec. 30 and NE1/4 NE1/4, sec. 31, T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	110	58	110	58	--	--
1	135	73	150	40	118	-39
2	152	12	180	10	170	14
3	120	51	140	72	160	22
4	80	40	112	44	130	55
5	92	61	110	95	130	58
6	96	48	118	50	135	50
7	80	51	100	88	120	66

Traverse 9 (south), north to south, started 33 feet south of river, 600 feet west of county road in the NE1/4 NE1/4, sec. 31, T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	16	18	24	24	--	--
1	17	19	25	25	41	44
2	21	5	26	10	39	36
3	27	27	32	29	41	35
4	29	29	34	27	43	34
5	28	36	35	34	46	41

Traverse 10, north to south, started 33 feet south of river, 1,200 feet east of county road in the SW1/4, sec. 29, and NW1/4, sec. 32, T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	28	32	44	50	--	--
1	29	31	44	44	74	69
2	31	37	45	50	74	71
3	26	30	42	51	76	84
4	43	54	55	49	77	50
5	30	40	48	44	77	65
6	26	30	44	42	74	71
7	25	28	42	47	73	66
8	25	31	42	52	72	70
9	21	30	40	42	68	53
10	16	21	28	36	50	58
11	16	21	23	31	40	52
12	18	20	24	22	40	41

Table 6. *Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989--Continued*

Traverse 11 (north), south to north, started 33 feet north of river, 300 feet east of county road in the W1/2 W1/2 W1/2, sec. 33, T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	20	19	27	30	--	--
1	22	26	32	33	50	60
2	65	54	76	50	78	36
3	67	60	98	81	115	75
4	84	57	100	70	102	21
5	55	42	69	45	86	70
6	22	26	37	44	65	68
7	16	25	29	40	54	57
8	14	19	27	36	54	60
9	19	24	31	36	58	60
10	37	33	44	41	64	54
11	32	32	42	42	65	62

Traverse 11 (south), north to south, started 33 feet south of river, 300 feet east of county road in the W1/2 W1/2 W1/2, sec. 33, T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	26	19	28	17	--	--
1	34	27	32	16	34	21
2	42	21	38	16	37	29
3	41	30	40	22	36	23
4	34	28	34	28	34	29

Traverse 12, south to north, started 33 feet north of river, 100 feet west of section-line fence in the E1/2 NE1/4, sec. 33, T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1A	30	35	66	71	--	--
1	30	29	57	54	72	52
2	27	27	42	47	56	50
3	14	22	28	38	45	48
4	12	16	26	36	44	52
5	15	17	28	35	44	48
6	16	19	28	33	46	45
7	17	17	27	33	43	50
8	14	18	26	38	44	64

Table 6. *Apparent ground conductivity for electromagnetic traverses in the South Fork Ninnescah River valley near Cairo, 1989--Continued*

Traverse 13, south to north, started 66 feet north of river, 100 feet west of section-line fence in the E1/2 NE1/4 SE1/4, sec. 26, T. 27 S., R. 11 W.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1	15	22	25	34	44	50
2	13	19	23	28	46	48
3	12	15	24	28	45	54
4	14	18	27	32	51	50
5	15	18	29	33	54	58
6	14	17	27	34	54	59
7	15	16	27	32	56	56
8	17	17	30	34	59	60
9	17	17	28	35	53	53
10	16	19	26	31	47	44
11	20	17	26	24	44	50
12	18	17	25	27	44	44

Traverse 14, south to north, started 150 feet west of county road, 150 feet north of river in the E1/2 E1/2 E1/2, sec. 25, T.27 S., R. 11 W. East-west oil pipeline (2 inches in diameter) crosses traverse 1, 40 feet north of data point 2.

Data point	Ground conductivity					
	10 meters		20 meters		40 meters	
	hz	vt	hz	vt	hz	vt
1	18	18	28	36	48	100
2	12	-96	17	-70	40	-67
3	30	-30	18	-135	42	-26
4	31	19	40	32	62	185
5	32	38	15	-45	37	-100
6	22	21	31	30	60	72
7	30	33	40	75	38	-200
8	29	30	38	44	42	-300

Table 7. *Lithologic logs of wells drilled by U.S. Bureau of Reclamation*

[All altitudes are referenced to sea level and are reported to the nearest foot. Depth of well is report in feet below land surface]

27S-11W-18BBBB.--Drilled June 2, 1989.
Altitude of land surface, 1,847 feet.

	Thickness, in feet	Depth, in feet
Sand, tan, fine	3	3
Soil, gray-brown, tough	3	6
Clay, brown, silty, iron stains, somewhat sandy	16	22
Silty, tan, clayey	18	40
Sand, fine, grading to sand and gravel, coarse	18	58
Clay, tan	1	59
Sand and gravel, orange, arkosic and quartzose clay stringers in lower part	36	95
Sand, tan, fine	4	99
Clay, tan, silty/sandy, soft	18	117
Sand and gravel, orange, quartzose and arkosic, some ironstone	35	152
Clay, white-tan, sandy, soft	6	158
Sand and gravel, arkosic, quartzose, with clay lenses	7	165
Sand, tan, clay bound	9	174
Sand, tan, fine	24	198
Sand, tan, equigranular, with abundant ironstone	14	212
Shale, red, silty/sandy, with some siltstone/ sandstone; has some gray-green streaks and spots	32	244

27S-11W-18CCCC.--Drilled May 28, 1989.
Altitude of land surface, 1,818 feet.

	Thickness, in feet	Depth, in feet
Soil, clay, dark-brown, silty	3	3
Clay, light gray-green, silty	9	12
Silt and fine sand, orange	12	24
Sand, tan, fine-to-coarse, arkosic, with some small gravel	43	67
Sand, orange, medium-to-coarse, with some small gravel	37	104
Sand, tan, fine-to-medium, with clay zones	31	135
Clay, white, light-gray, silty, and fine sand	19	154
Sand, orange, medium-to-coarse, with some gravel, arkosic and quartzose; has abundant ironstone	30	184
Siltstone/sandstone, red, shaley	20	204

Table 7. *Lithologic logs of wells drilled by U.S. Bureau of Reclamation*--Continued

27S-11W-19AAAB.--Drilled May 21, 1989.
Altitude of land surface, 1,812 feet.

	Thickness, in feet	Depth, in feet
Soil, dark-brown, silty	7	7
Clay, brown, silty and sandy	16	23
Sand, with clay layers, tan, some clay bound sand, caliche zone at 35-36 feet	27	50
Sand, brown, fine-coarse	13	63
Clay, tan, sandy	2	65
Sand, tan, medium-to-coarse	10	75
Sand and gravel, coarse	17	92
Sand, tan, medium-to-coarse	43	135
Sand, tan, fine-to-medium, silty	45	180
Sand and gravel, orange, arkosic, quartzose, abundant ironstone below 200 feet	27	207
Clay, red and white, silty	3	210
Shale, red, silty/sandy	35	245

27S-11W-29CDDD.--Drilled June 7, 1989.
Altitude of land surface, 1,722 feet.

	Thickness, in feet	Depth, in feet
Soil, brown, very sandy	4	4
Clay, gray, silty, sandy, few sand zones	24	28
Sand and gravel, orange, with quartzose and arkose	17	45
Clay, tan, silty, tough	10	55
Sand and gravel, orange, with abundant dark-brown ironstone	39	94
Clay, tan, with caliche, tough, some cemented	3	97
Ironstone gravel, dark-brown, equigranular	2	99
Shale, red, sandy/silty, with some sandstone/siltstone; has gray-green streaks and spots	26	125

Table 7. *Lithologic logs of wells drilled by U.S. Bureau of Reclamation*--Continued

27S-11W-30CAAA.--Drilled April 28, 1989.
Altitude of land surface, 1,750 feet.

	Thickness, in feet	Depth, in feet
Soil, tan, brown, sandy	5	5
Sand, fine, tan, grading to sand and gravel, arkosic and quartzose, tan-pink	39	44
Clay, tan, silty	4	48
Sand and gravel, pink, quartzose and arkosic	39	87
Clay zone, tan	3	90
Sand and gravel, quartzose and arkosic, tan-pink; lots of ironstone, gravel below 110 feet	31	121
Shale, silty and sandy, red, weathered in upper part, grading to sandstone/siltstone, with a few thin gray-green streaks in lower part	34	155

27S-11W-30CCDD.--Drilled May 26, 1989.
Altitude of land surface, 1,721 feet.

	Thickness, in feet	Depth, in feet
Soil, dark-brown, sandy/silty	3	3
Sand and gravel, orange, medium-to-coarse, arkosic quartzose (pea size)	22	25
Clay, tan, silty	3	28
Sand, fine-to-coarse, some gravel, orange, arkosic	26	54
Clay, tan	16	70
Sand, tan, medium-to-coarse, ironstone in lower part	24	94
Siltstone/sandstone, red, with some gray-green streaks	30	124

Table 7. *Lithologic logs of wells drilled by U.S. Bureau of Reclamation*--Continued

27S-11W-30DDAA.--Drilled April 26, 1989.
Altitude of land surface, 1,736 feet.

	Thickness, in feet	Depth, in feet
Soil, clayey, with gray-tan sand	2	2
Sand and gravel, tan, composed of quartz, feldspar, and brown limestone	10	12
Clay, tan, stiff	7	19
Sand, tan, fine, clayey	7	26
Sand and gravel, tan	4	30
Clay, tan, sandy	4	34
Sand, tan, fine, clayey	3	37
Clay, tan, sandy	3	40
Sand and gravel, tan, quartzose and arkose	27	67
Clay, tan, sandy	6	73
Sand and gravel, fine-to-coarse, composed mostly of quartz, feldspar, and ironstone	36	109
Shale, red, silty	26	135

27S-11W-31AAAB.--Drilled May 11, 1989.
Altitude of land surface, 1,714 feet.

	Thickness, in feet	Depth, in feet
Soil, tan, very sandy; sand, orange, fine	4	4
Sand, orange, fine	4	8
Sand and gravel, orange, coarse, arkosic and quartzose	29	37
Silt, light-tan, clayey, grading to tan-yellow; clay, slick	12	49
Clay, tan, sticky	5	54
Silt and fine sand, tan, clayey	6	60
Sand and gravel, orange, arkosic and quartzose, with abundant ironstone gravel	24	84
Shale, red, silty and sandy, weathered to a pink clay in upper 3 to 4 feet; has a few gray-green streaks and specks	46	130
Shale, red, silty and sandy, clayey; has a few gray-green streaks and specks	15	145
Shale, red, silty and sandy, not as much clay as above; has a few gray-green streaks and specks	19	164

Table 7. *Lithologic logs of wells drilled by U.S. Bureau of Reclamation*--Continued

27S-11W-31ADDD.--Drilled May 29, 1989.
Altitude of land surface, 1,728 feet.

	Thickness, in feet	Depth, in feet
Soil, dark-brown, sandy and silty	3	3
Sand, light-brown, silty	9	12
Clay, gray, silty	12	24
Sand and gravel, orange, medium-to-coarse, quartzose and arkosic	12	36
Sand, tan, fine-to-medium, with silt	37	73
Sand, tan, medium-to-coarse, with abundant ironstone	26	99
Shale, red, silty, and siltstone, red	25	124

27S-11W-33AAAA.--Drilled May 5, 1989.
Altitude of land surface, 1,728 feet.

	Thickness, in feet	Depth, in feet
Soil, red-brown, very sandy	4	4
Sand, red-brown, clayey, with a few large gravels	3	7
Sand and gravel, orange, arkosic and quartzose	20	27
Clay, tan-white, tough, with sandy zones and a caliche layer at ± 39-40 feet	18	45
Sand, tan, fine, little clayey	20	65
Clay, tan, sandy and silty, most of cuttings in wash	24	89
Sand and gravel, arkosic and quartzose, with lots of ironstone gravel	16	105
Shale, silty/sandy, red, weathered in upper part	10	115
Sandstone/siltstone, red, firm, dry pieces; has gray-green streaks and specks, becoming shaley in lower part	30	145

Table 7. *Lithologic logs of wells drilled by U.S. Bureau of Reclamation*--Continued

27S-11W-33BBBB.--Drilled May 3, 1989.
Altitude of land surface, 1,718 feet.

	Thickness, in feet	Depth, in feet
Soil, tan-red brown, sandy	6	6
Sand and gravel, orange, arkosic and quartzose, some coarse	14	20
Clay, tan, soft	2	22
Sand, orange, fine-to-medium	18	40
Clay, tan, soft	3	43
Sand, orange, fine-to-medium (lots of fine sand)	10	53
Clay, tan, silty, firm	8	61
Sand, orange, fine-to-medium, arkosic and quartzose, abundant ironstone in lower part	31	92
Shale, silty and clayey, tan on top 2-3 feet, red below (weathered on top)	11	103
Siltstone/sandstone, mostly red, with some gray-green streaks and specks	11	114

27S-12W-14DCDC.--Drilled May 31, 1989.
Altitude of land surface, 1,822 feet.

	Thickness, in feet	Depth, in feet
Soil, brown, very sandy	3	3
Silt, tan, clayey	7	10
Clay, light tan-white, silty, with abundant caliche	22	32
Sand and gravel, orange, quartzose and arkosic	8	40
Clay, tan, light-tan, silty (mixes in drilling mud)	12	52
Caliche, white	3	55
Clay, tan, light-tan, silty	5	60
Silt and fine sand, tan	7	67
Sand, tan, fine	11	78
Sand and gravel, orange, with lots of ironstone	6	84
Sand, tan, fine	10	94
Sand and gravel, quartzose and arkosic, with some light-brown-colored ironstone. Material finer in lower part	48	142
Clay-tan, firm	3	145
Sand, tan, fine, clayey	12	157
Clay, light-tan to white	8	165
Sand and gravel, arkosic and quartzose, with lots of ironstone gravel	17	182
Shale, red, silty/sandy, with gray-green streaks and spots	16	198
Sandstone/siltstone, red, with gray-green streaks and spots	12	210
Shale, red, silty/sandy, with gray-green streaks and spots	4	214

Table 7. *Lithologic logs of wells drilled by U.S. Bureau of Reclamation*--Continued

<u>27S-12W-25ADDA</u>.--Drilled May 1, 1989.
Altitude of land surface, 1,748 feet.

	Thickness, in feet	Depth, in feet
Soil, brown, very sandy	5	5
Sand, tan, fine	4	9
Sand and gravel, arkosic, orange	6	15
Clay, red-brown, sandy	2	17
Sand and gravel, tan to orange, arkosic and quartzose	5	22
Clay, tan, sticky, some black clay, with sandy stringers below 36 feet	33	55
Sand and gravel, pink, arkosic and quartzose	16	71
Silt, tan, clayey	10	81
Sand and gravel, orange, quartzose and arkosic, clay bound above 100 feet, grading to clean sand and gravel, with lots of pieces of ironstone below that point	40	121
Sandstone, red, few shaley zones; has few thin gray-green streaks and spots	26	147

<u>27S-12W-25DBBC</u>.--Drilled June 5, 1989.
Altitude of land surface, 1,743 feet.

	Thickness, in feet	Depth, in feet
Soil, tan-brown, sandy	3	3
Clay, tan, silty and sandy	3	6
Sand, tan, fine	4	10
Sand and gravel, orange, arkosic and quartzose	8	18
Silt, gray, soft	3	21
Sand and gravel, orange, arkosic and quartzose	9	30
Clay, black, mucky, soft	7	37
Sand and gravel, coarse, arkosic and quartzose	8	45
Clay, tan, silty	6	51
Sand, fine, tan, with silt	23	74
Clay, tan, tough	13	87
Sand, orange, fine-to-medium, arkosic, quartzose; has lots of ironstone	16	103
Clay tan, silty, tough	3	106
Sand, orange, arkosic and quartzose, with lots of ironstone	12	118
Shale, red, silty/sandy, with gray-green streaks and specks. Below 135 feet, not much sample return, thus could be grading to sandstone/ siltstone	37	155

Table 7. *Lithologic logs of wells drilled by U.S. Bureau of Reclamation*--Continued

27S-12W-26CBBC.--Drilled May 8, 1989.
Altitude of land surface, 1,767 feet.

	Thickness, in feet	Depth, in feet
Soil, tan, brown, sandy	3	3
Sand, red-brown clayey, some large gravel	8	11
Sand and gravel, orange, arkosic and quartzose, fine-to-medium, some coarse; has some pieces of light-brown-colored ironstone. Below 70 feet, some clay zones in sand and gravel	76	87
Clay, tan, sandy, some tough gray clay	18	105
Sand and gravel, orange, with 3-4 feet of cemented morter bed above the shale	15	120
Shale, red, silty/sandy, grading to sandstone/ siltstone, shaley; has some gray-green streaks and spots, weathered in upper part	24	144

☆U.S. GOVERNMENT PRINTING OFFICE: 1991-556-929/40220