HYDROGEOLOGY OF THE HELENA VALLEY-FILL AQUIFER SYSTEM, WEST-CENTRAL MONTANA

By David W. Briar and James P. Madison

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CONTENTS

ILLUSTRATIONS

TABLES

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
	Area	
acre	4,047	square meter
square foot (ft^2)	0.0929	square meter
square mile (mi^2)	2.59	square kilometer
	Volume	
acre-foot (acre-ft)	1,233	cubic meter
	Flow	
acre-foot per day (acre-ft/d)	1,233	cubic meter per day
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year
cubic foot per second (ft^3/s)	0.028317	cubic meter per second
cubic foot per second per mile [$(ft^3/s)/mi$]	0.0176	cubic meter per second per kilometer
gallon per day (gal/d)	0.003785	cubic meter per day
gallon per minute (gal/min)	0.06309	liter per second
inch per year (in/yr)	25.4	millimeter per year
	Gradient	
foot per foot (ft/ft)	1.0	meter per meter
	Hydraulic Conductivity	
foot per day [$(ft^3/d)/ft^2$ or ft/d]	0.3048	meter per day

Multiply	By	To obtain
	Transmissivity	
foot squared per day [((ft^3/d)/ft^2)ft or ft^2/d]	0.0929	meter squared per day
	Consumptive Use	
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year
inch per year (in/yr)	25.4	millimeter per year

Temperature can be converted to degrees Celsius (°C) or degrees Fahrenheit (°F) by the equations:

$$°C = 5/9\ (°F - 32)$$
$$°F = 9/5\ (°C) + 32$$

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 the United States and Canada, formerly called Sea Level Datum of 1929.

Abbreviated water-quality units used in this report:

- µg/L micrograms per liter
- µS/cm microsiemens per centimeter at 25 °C
- mg/L milligrams per liter

Acronyms used in this report:

- GIS Geographic Information System
- MCL Maximum Contaminant Level
- SMCL Secondary Maximum Contaminant Level

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ABSTRACT

The valley-fill aquifer system underlying the Helena Valley in west-central Montana is the sole source of domestic water supply for about 13,000 residents. Quaternary valley fill in the study area forms a gently sloping alluvial plain about 8 miles square. Surface water enters the valley principally from Prickly Pear, Tenmile, Sevenmile, and Silver Creeks and from flow in irrigation canals that has been diverted from the Missouri River. The principal surface- and ground-water discharge point is Lake Helena.

The Helena Valley is bounded by folded and fractured sedimentary, metamorphic, and igneous bedrock of Precambrian to Cretaceous age and is underlain by an estimated 6,000 feet of valley fill. This valley fill is composed primarily of fine- and coarse-grained Tertiary sediments unconformably overlain by about 100 feet of Quaternary alluvium. The upper few-hundred feet of valley fill is composed of complexly stratified lenses of cobbles, gravel, sand, silt, and clay. Lateral discontinuity of fine-grained layers allows hydraulic interconnection of water-yielding zones, which function as one complex aquifer system.

Horizontal hydraulic conductivity of water-yielding zones in the valley fill is about 200 feet per day. Vertical hydraulic conductivity is 1-3 orders of magnitude less.

The potentiometric surface of near-surface valley fill depicts flow from the south, west, and north margins of the valley toward Lake Helena. Flow is sub-parallel to sediments on the east side of the study area. Seasonal fluctuations in water level do not significantly alter the shape of the potentiometric contours.

Recharge is through infiltration of streamflow, leakage from irrigation canals, infiltration of excess irrigation water, and inflow from fractures in bedrock. Discharge is through leakage to streams and drains, upward leakage to Lake Helena, and withdrawals from wells.

Coarse-grained, near-surface deposits could allow rapid infiltration of surface contaminants. The aquifer system is most susceptible to potential contamination where the hydraulic gradient is downward and vertical permeability allows downward flow.

Results of analyses of water samples from wells completed in the valley fill indicate calcium bicarbonate type water having a median dissolved-solids concentration of 286 milligrams per liter. Major-ion concentrations increase slightly downflow in the aquifer system. None of the water samples analyzed for volatile compounds, semi-volatile compounds, or pesticides indicate significant contamination by organic compounds in the aquifer system.

INTRODUCTION

The Helena Valley is located in west-central Montana north and east of the city of Helena (fig. 1). The valley-fill aquifer system underlying the valley is the sole source of domestic water supply for about 13,000 residents (W.I. Selser, Lewis and Clark City-County Health Department, oral commun., 1991), and almost 60 percent of the domestic and public-supply wells used by these residents are less than 70 ft deep. Continued population growth will result in additional contaminant load to

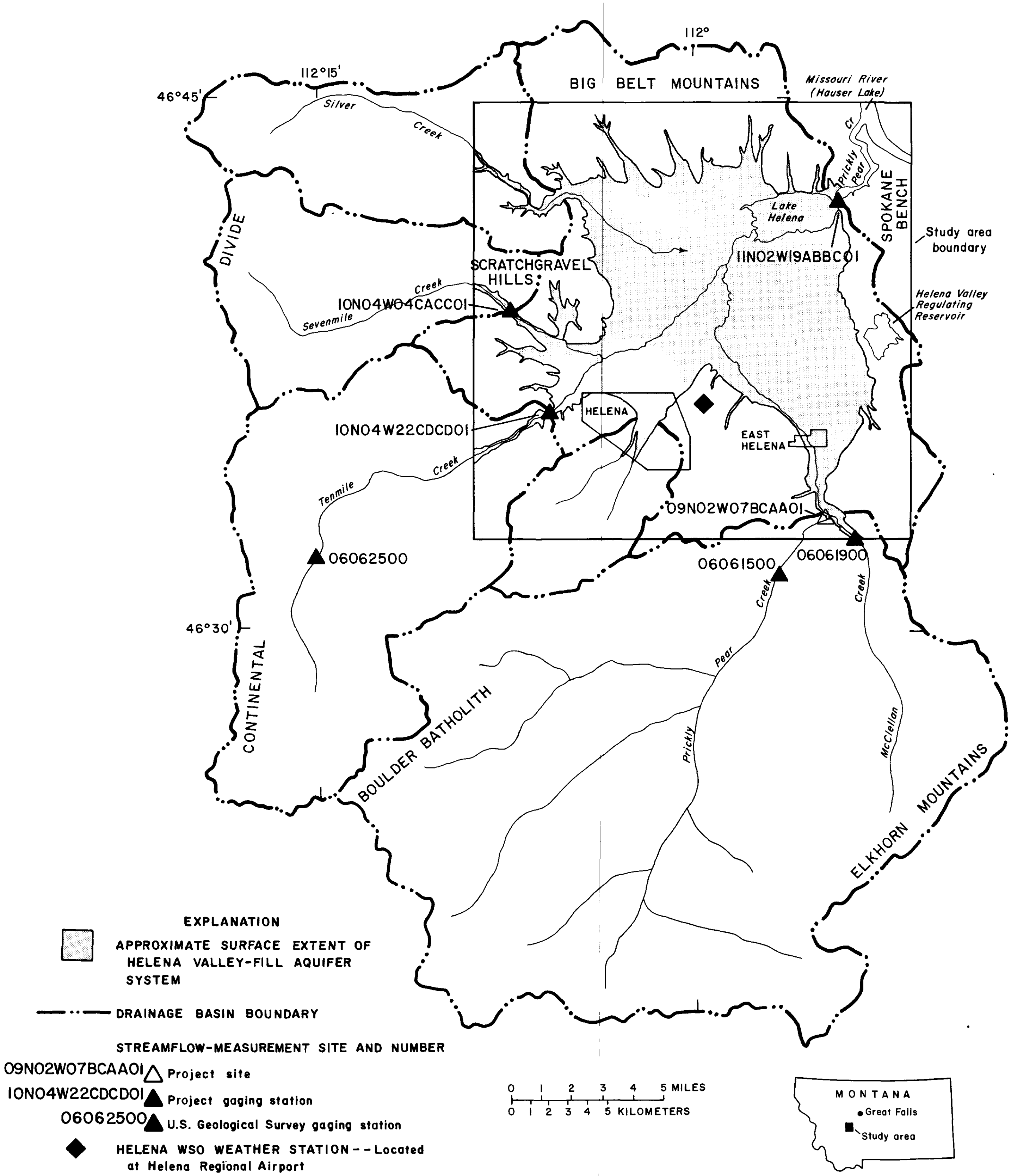


Figure 1.--Location of study area and selected streamflow-measurement sites.

the shallow parts of the aquifer system from increased septic-tank density, industrial-waste discharge, landfills, accidental spills, and other effects of human activity. Although deeper parts of the aquifer system are potential sources of water for additional irrigation, industrial, and municipal supply, increased pumping from deeper zones could alter flow paths and cause downward migration of near-surface contaminants.

From July 1989 through July 1991, the U.S. Geological Survey, in cooperation with the Lewis and Clark City-County Health Department, conducted a study of the aquifer system beneath the Helena Valley. The study was designed to expand knowledge of the ground-water system through a systematic program of data collection, research, and analysis. The results of the study will be useful to the development of a comprehensive management program for the use and protection of the ground-water resources of the Helena Valley.

Purpose and Scope

This report, which presents the study results, describes the hydrogeology of the valley-fill aquifer system. Specific objectives were to:

1. Describe the geometry and the hydraulic characteristics of the aquifer system.

2. Define the potentiometric surface and the direction of ground-water flow.

3. Locate and quantify sources of ground-water recharge and discharge including surface- and ground-water interactions.

4. Characterize the water quality in terms of susceptibility of the aquifer system to contamination and in terms of concentrations, distribution, and sources of major ions, trace elements, and organic compounds.

To determine the geometry and stratigraphy of the valley-fill aquifer system, and to identify any spatial trends in the data, well-completion reports on file with the State of Montana were entered into a GIS. About 1,400 drillers' logs were collected for the study area. In addition, the U.S. Geological Survey and the Montana Bureau of Mines and Geology augered 23 test holes in the valley fill. The augered test holes were cased with 2- or 4-in. diameter polyvinylchloride pipe and 5 to 10 ft of screen. Thirty wells, some existing prior to this study and some augered and cased during this study, formed "nested sites." Nested sites consisted of one shallow well and one or more deeper wells at the same general location.

To determine the hydraulic characteristics of the aquifer system, constant-discharge aquifer tests were conducted at seven sites. The results were analyzed using various techniques.

An 84-well monitoring network was established for the measurement of water levels in the aquifer system. Four of these wells were equipped with continuous water-level recorders.

Continuous-record streamflow-gaging stations were established at three sites in the study area. In addition, streamflow was measured periodically at 14 other stream sites in the study area. The resulting data were used to determine surface-water inflow to and outflow from the study area.

A digital three-dimensional ground-water flow model was developed for the study area. The purpose of the model was to test the conceptualization and validity of the water budget of steady-state flow in the valley-fill aquifer system.

Water samples were collected from 93 wells and analyzed onsite for nitrate concentration; specific conductance and pH were measured onsite at these and an additional 18 wells during the study. Samples were collected from 47 wells for laboratory analysis of major-ion and trace-element concentrations. Also, water samples from 39 wells and 1 open drain were analyzed for volatile organic compounds, semi-volatile organic compounds, and (or) pesticides.

Data from well inventories, streamflow-gaging stations, and water-level and water-quality monitoring networks were entered into a computerized data base to supplement data collected during previous studies. That data base can be used as the basis for establishing long-term water-level and water-quality monitoring networks and for identifying and assessing future changes in the physical and chemical aspects of the aquifer system.

Previous Investigations

The geology of the Helena Mining District and the northern part of the Boulder batholith was described by Knopf (1913, 1963). Pardee and Schrader (1933) reported on the metalliferous deposits of the Helena mining area. The seismicity and faulting of the Helena area were described by Freidline and others (1976), Reynolds (1979), Schmidt (1977, 1986), Stickney (1978, 1987), and Stickney and Bartholomew (1987). Lorenz and Swenson (1951) first described the water resources of the Helena Valley. The ground-water quality beneath the valley was described by Wilke and Coffin (1973). Depth to the water table and area inundated by the June 1975 flood were investigated by Wilke and Johnson (1978). Moreland and Leonard (1980) evaluated the shallow aquifers beneath the valley.

Location Numbering System

The location of wells, test holes, and streamflow-measurement sites is designated by a location number, which is based on the rectangular system for the subdivision of public lands (fig. 2). The number consists of as many as 14 characters and is assigned according to the location of the site within a given township, range, and section. The first three characters specify the township and its position north (N) of the Montana Base Line. The next three characters specify the range and its position west (W) of the Montana Principal Meridian. The next two characters indicate the section. The next three or four characters indicate the position of the site within the section. The first letter denotes the quarter section (160-acre tract); the second, the quarter-quarter section (40-acre tract); the third, the quarter-quarter-quarter section (10-acre tract); and the fourth, the quarter-quarter-quarter-quarter section (2 1/2-acre tract). The subdivisions of the section are numbered A, B, C, and D in a counterclockwise direction beginning in the northeast quadrant. The last two characters form a sequence number that is assigned on the basis of order of inventory within that tract. For example, the location number 11N03W21BBAA01 represents the first well inventoried in the NE1/4 NE1/4 NW1/4 NW1/4 sec. 21, T. 11 N., R. 3 W.

Acknowledgments

The authors wish to thank various people for their assistance in conducting this investigation. Specifically, we appreciate the contribution of Will I. Selser, Director of the Environmental Health Division, Lewis and Clark City-County Health Department, for his valuable contribution of time and knowledge of the Helena Valley. In addition, we wish to acknowledge the contributions of two graduate students from the Montana College of Mineral Science and Technology: Vivian M. Drake, who conducted much of the water-quality sampling for the project and investigated the distribution of nitrate in the study area, and David J. White, who assisted in the design and implementation of test drilling and aquifer testing and interpreted the aquifer-test results. We also wish to thank personnel of the Montana Department of Agriculture, Agricultural Biological Sciences Division, for coordinating their sampling efforts for pesticides with the needs of this project. Finally, we wish to acknowledge the cooperation of the many landowners who provided access to their land and contributed valuable information about the occurrence and use of water resources in the Helena Valley.

GEOGRAPHY

The Helena Valley is an intermontane basin in the north-central part of the Northern Rocky Mountains physiographic province. The Continental Divide, which

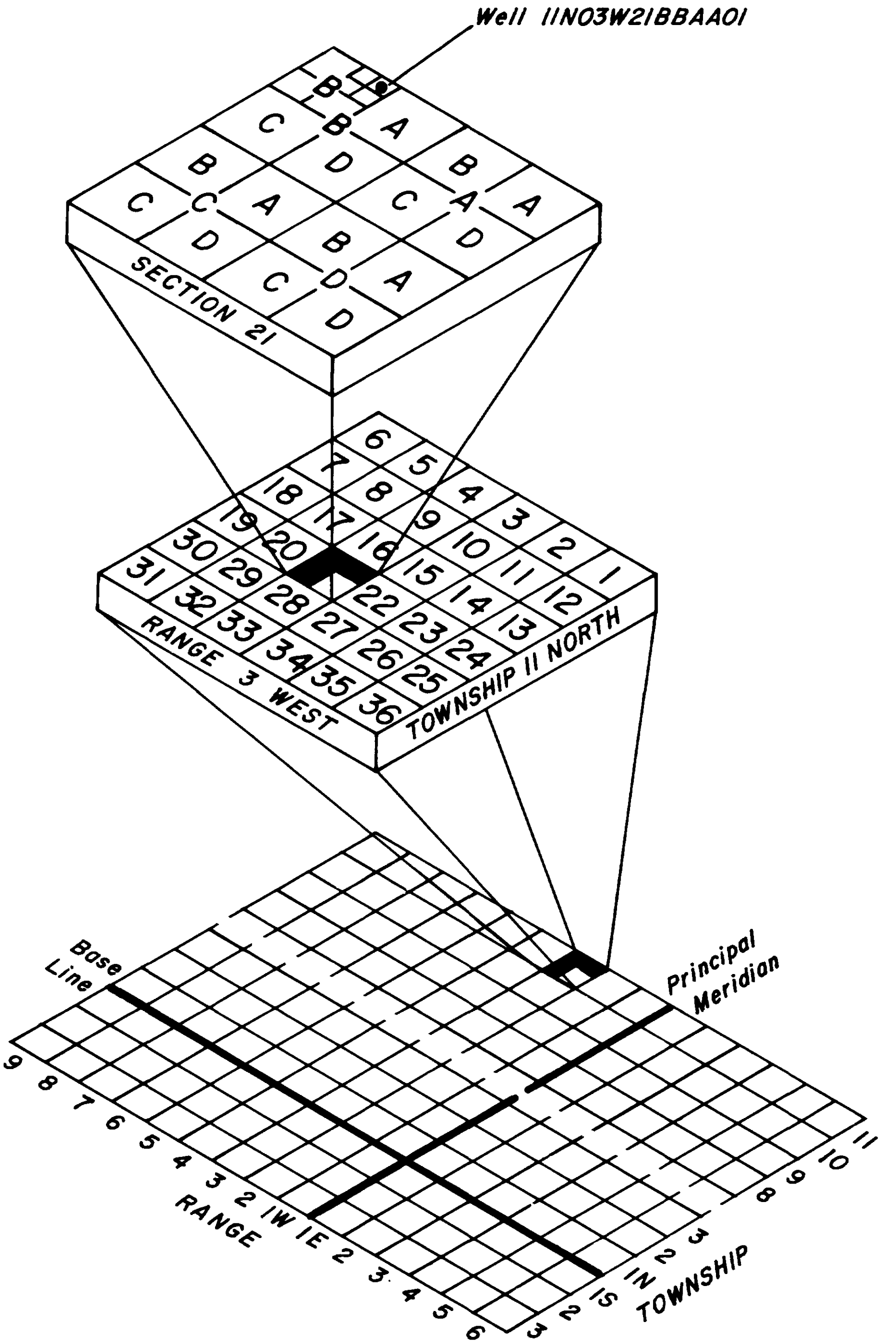


Figure 2.--Location numbering system.

separates the Missouri and Columbia River drainages, is located about 15 mi west of the valley.

Physiography

Quaternary valley fill forms a gently sloping alluvial plain in the Helena Valley that measures about 8 mi square. The alluvial plain is bounded by pediments and alluvial fans that descend from the Elkhorn Mountains and Boulder batholith to the south, the Scratchgravel Hills to the west, and the Big Belt Mountains to the north (fig. 1). A line of low, rolling hills composed of poorly consolidated fine-grained sediments forms the Spokane Bench on the east. The lowest altitude of the Helena Valley is 3,650 ft at Lake Helena near the northeast corner of the basin. Lake Helena, formed by backwater from Hauser Lake on the Missouri River, is the primary discharge point for surface and ground water from the basin. The highest altitude of valley fill is about 4,000 ft along the south and west margins of the valley.

Climate

The Helena Valley has a semiarid climate that is typical of areas in Montana east of the Continental Divide. Average annual precipitation is 11.37 in. at the Helena WSO weather station (National Oceanic and Atmospheric Administration, 1982a), which is located at the Helena Regional Airport in the south-central part of the valley (fig. 1). Precipitation at high altitudes of the drainage basins tributary to the Helena Valley can exceed 30 in/yr (fig. 3). May and June typically have the greatest monthly precipitation and combined account for about one-third of the annual precipitation. Average annual free-water-surface evaporation at the Helena WSO weather station is about 35.5 in. (National Oceanic and Atmospheric Administration, 1982c), which is three times the average annual precipitation. Daily air temperatures have an annual range from about -35 to 100 °F. Mean monthly air temperature and precipitation at the Helena WSO weather station are shown in figure 4.

Streamflow

Four principal streams flow into the Helena Valley: Prickly Pear, Tenmile, Sevenmile, and Silver Creeks (fig. 1). The largest of these streams is Prickly Pear Creek, which, with its tributary McClellan Creek, drains about 241 mi^2 of the Boulder batholith and Elkhorn Mountains to the south. Monthly mean flow for Prickly Pear Creek for April 1990 through March 1991 was determined at project site 09N02W07BCAA01 by statistical correlation using techniques described by Parrett and others (1989). Daily mean flows at the gaging station on McClellan Creek (06061900), just upstream from the project site, for the period April 1990 through September 1990 were added to concurrent daily mean flows at the long-term gaging station on Prickly Pear Creek (06061500), about 3 mi upstream from the project site, and the sums were correlated with the daily mean flows at the long-term gaging station. The resultant equation relating flow at the project site on Prickly Pear Creek to flow at the long-term gaging station was used to calculate monthly mean flow at the project site from monthly mean flow at the long-term gaging station. Annual mean flow for April 1990 through March 1991 at the project site was determined to be 33,600 acre-ft by summing the monthly flow volumes (table 1). At the long-term gaging station on Prickly Pear Creek, the annual flow for April 1990 through March 1991 was about 70 percent of the long-term mean annual flow based on 54 years of record. Similarly, the April 1990 through March 1991 annual flow at the project site is presumed to be about 70 percent of the long-term mean annual flow (48,000 acre-ft).

The second largest stream, Tenmile Creek, has a drainage area of about 98 mi^2, at project gaging station 10N04W22CDCD01. Monthly mean flow at the project gaging station was determined from the flow record for April 1990 through October 1990 and for March 1991. For the remaining months from April 1990 to March 1991, the project gaging station was not in operation, and monthly mean flows were determined by correlation. In this instance, all available daily mean flows for the project gaging stations were correlated (Parrett and others, 1989) with concurrent daily mean flows at the long-term gaging station on Tenmile Creek (06062500) near the headwaters of the drainage. The resultant equation was used to calculate monthly mean flow at the project station for November 1990 through February 1991. Annual mean flow for April 1990 through March 1991 at the project gaging station was determined to be 16,400 acre-ft by summing the monthly mean flows (table 1). At the long-term gaging station, the annual mean flow for April 1990 through March 1991 was about 88 percent of the long-term mean annual flow based on 75 years of record. The annual mean flow for April 1990 through March 1991 at the project gaging station is also presumed to be about 88 percent of the long-term mean annual flow (18,600 acre-ft).

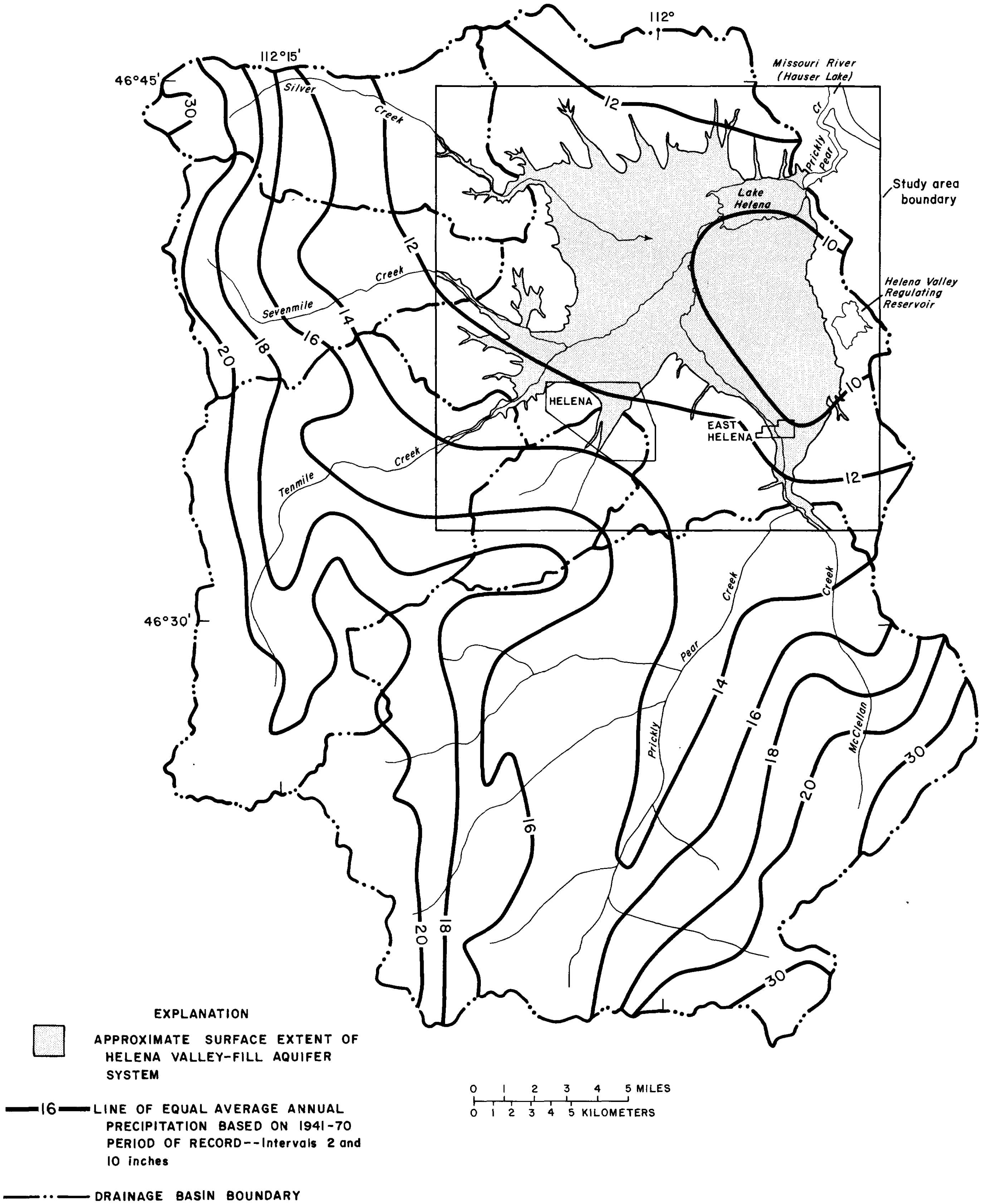


Figure 3.--Average annual precipitation in drainage basins tributary to the Helena Valley. Data from U.S. Soil Conservation Service (1977).

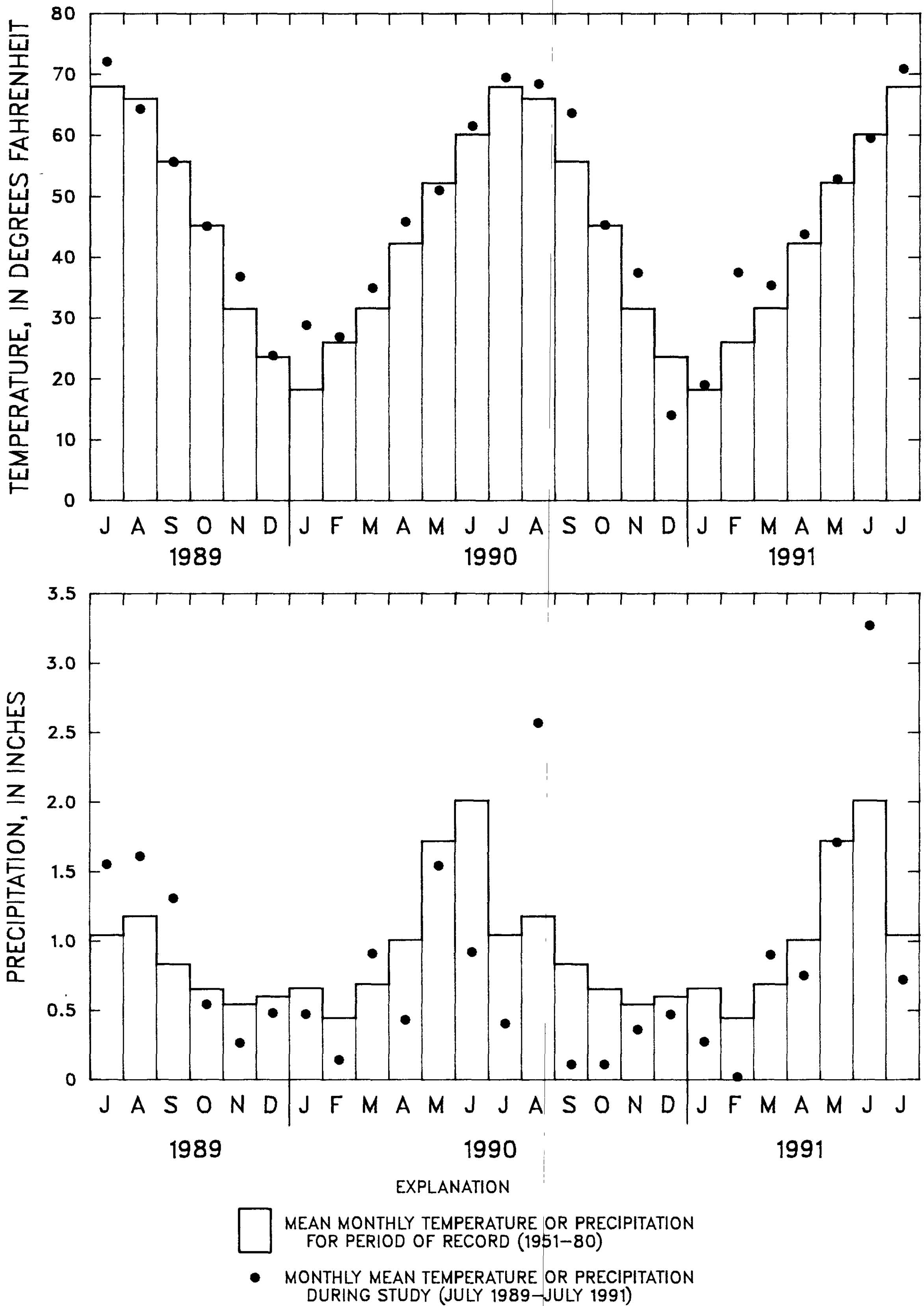


Figure 4.--Monthly air temperature and precipitation for the study period and the period of record at Helena. Data from National Oceanic and Atmospheric Administration (1982a).

Table 1.--*Estimated monthly mean and annual mean streamflow*[1] *for April 1990 through March 1991*

Creek	Location number of streamflow-measurement site	Streamflow, in acre-feet												
		Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Annual (rounded)
Prickly Pear	09N02W07BCAA01	4,800	7,350	7,130	2,600	2,330	1,550	1,490	1,460	1,110	970	1,240	1,530	33,600
Tenmile	10N04W22CDCD01	4,150	4,760	3,940	680	640	260	250	350	340	340	320	330	16,400
Sevenmile	10N04W04CACC01	430	740	920	430	220	120	280	210	210	210	190	310	4,300
Silver	11N04W21ADAD01	140	420	440	200	97	70	66	51	44	36	33	53	1,600
Total (rounded)		9,520	13,300	12,400	3,910	3,290	2,000	2,090	2,070	1,700	1,560	1,780	2,220	56,000

[1] Calculations by James A. Hull, Helena office, U.S. Geological Survey.

On the west side of the study area, Sevenmile Creek drains about 47 mi^2 at the project gaging station (10N04W04CACC01). Monthly mean flow for April 1990 through October 1990 and for March 1991 was determined from project-station records. As was true for Tenmile Creek, monthly mean flows for November 1990 through February 1991 were determined by correlation of all available daily mean flows at the project gaging station with concurrent daily mean flows at the long-term gaging station on Tenmile Creek (06062500). The annual mean flow of Sevenmile Creek for April 1990 through March 1991 at the project gaging station was determined to be 4,300 acre-ft (table 1). On the basis of data from the long-term gaging station on Tenmile Creek, the annual mean flow was presumed to be 88 percent of the long-term mean annual flow (4,900 acre-ft).

Equations developed by Parrett and others (1989) relating long-term mean monthly flow to channel width were used to calculate long-term mean monthly flow for Silver Creek near where it enters the area of the valley-fill aquifer. Because data from long-term gages on Prickly Pear Creek and Tenmile Creek indicated that the annual mean flow for April 1990 through March 1991 was about 70 percent and 88 percent, respectively, of the long-term mean annual flow, the annual mean flow for Silver Creek for the same period was presumed to be about 80 percent of the long term mean annual flow. Consequently, each calculated long-term mean monthly flow for Silver Creek was multiplied by 0.80 to provide estimates of the monthly mean flows for April 1990 through March 1991. The estimated annual mean flow for this period for Silver Creek was 1,600 acre-ft (table 1).

Intermittent streamflow in the gulches just south of Helena and ephemeral runoff from hillsides adjacent to the valley fill also supply surface water to the valley. Intermittent streamflow in the gulches south of Helena is captured by infiltration galleries and is pumped to tank reservoirs of the Helena water-supply system. Ephemeral runoff from hillsides adjacent to the valley fill supplies only a minor quantity of flow, mostly during periods of substantial precipitation.

In addition to natural streamflow to the valley, water from the Missouri River is diverted to the Helena Valley Regulating Reservoir and then released to an extensive network of irrigation canals. These irrigation canals distribute water to most of the central part of the valley. On average, 63,100 acre-ft of irrigation water is diverted into the Helena Valley from the Missouri River during the irrigation season (J.A. Foster, Helena Valley Irrigation District, written commun., 1991).

HYDROGEOLOGY

Ground-water flow in the Helena Valley is strongly controlled by the orientation and hydraulic character of the geologic units in the area. The geology of the Helena area can best be understood from the context of the structural and depositional history of the northern Rocky Mountains region.

General Geology

The Helena Valley is a topographic and structural intermontane basin surrounded and underlain by folded and fractured sedimentary, metamorphic, and igneous rocks of Precambrian to Cretaceous age. The geology has been described in detail in reports by Knopf (1913), Lorenz and Swenson (1951), Knopf (1963), and Schmidt (1977, 1986).

The Helena basin probably originated from a broad regional basin that began to form about 50 million years ago during the Eocene Epoch when east-west extensional tectonic movement began to pull apart the mountains formed during Late Cretaceous and early Tertiary time (Fields and others, 1985). As a result of regional extension, the bedrock floor of the regional basin began to drop along steeply dipping normal faults. About 16 million years ago, during middle Miocene time, renewed faulting and basin subsidence divided the regional basin into several smaller basins, one of which is the present-day Helena basin (Fields and others, 1985, p. 12). The rate of subsidence has varied throughout development of the Helena basin and to some degree is still proceeding. Gravity-survey data (Noble and others, 1982) indicate that the bedrock floor of the Helena basin is about 6,000 ft beneath land surface near Lake Helena and rapidly becomes shallower to the southwest, thus defining a northwest-trending half-graben structure.

The character of the thick sequence of layered valley fill that underlies the Helena Valley is closely related to the geologic evolution of the Helena basin. Although little information is available regarding the stratigraphy of valley fill in the deeper parts of the basin, the depositional history interpreted in other intermontane basins in western Montana is probably representative of the Helena basin as well. On this basis, the oldest unconsolidated deposits of the Helena Valley unconformably overlie bedrock at the base of the valley-fill sequence. These deposits are probably composed of a relatively thin section of coarse conglomerate and fanglomerate sediments deposited during the initial development of the ancestral regional basin. Unconformably overlying the coarse basal layer is a thick sequence of predominantly fine-grained lacustrine ash and volcaniclastic sediments with local lenses of gravel and coarse-grained alluvial-fan deposits adjacent to the basin margins. These fine-grained sediments were deposited in the ancestral regional basin and are probably equivalent to the Miocene Renova Formation of the Bozeman Group. The depth of the top of these fine-grained sediments in the central part of the present-day valley-fill sequence is unknown. However, the fine-grained sediments comprising most of the Spokane Bench may represent the upper part of these Renova-equivalent deposits.

As renewed faulting during the Miocene created the Helena basin from the ancestral regional basin, fine-grained sediments were eroded, folded, and tilted before being buried by a thick sequence of locally derived fine- to coarse-grained sediment that was transported into the basin. These overlying Miocene sediments are probably equivalent to the Sixmile Creek Formation of the Bozeman Group. Sixmile Creek sediments typically include locally coarse fan and debris-flow deposits, ephemeral-stream deposits, and lacustrine clay and siltstone. These coarse-grained sediments are exposed in some locations along the Spokane Bench and probably lie about 100 ft beneath the surface of the Helena Valley.

The present valley floor began to form about 5 million years ago during the Pliocene Epoch as extensive pediments developed along the south, west, and north sides of the valley. The pediment-building processes eroded bedrock along the mountain front and deposited thick wedges of gravel along the toe of the pediments. Finally, Quaternary to Holocene streams deposited channel-fill and alluvial-plain sediments across the gently sloping surface of the central valley. These stratified Quaternary alluvial deposits are composed of a gradational sequence of cobbles, gravel, sand, silt, and clay.

Pleistocene glaciation also affected the Helena Valley. Alpine glaciation in the headwaters of Prickly Pear and Tenmile Creeks (Ruppel, 1962) increased the coarse sediment load of the creeks tributary to the valley and may have enhanced the transport of coarse sediment into and across the valley through increased stream discharge during spring melting and draining of ice-dammed glacial lakes.

Continental glaciation near Great Falls, Mont., dammed the ancestral Missouri River and created Glacial Lake Great Falls, which repeatedly flooded the Helena Valley. This flooding interrupted the transport of coarse stream sediment into and across the valley and left a blanket of silt. No evidence is known that glacial ice has occupied the Helena Valley.

The surficial geology of the study area is shown in figure 5. The generalized geologic units and their water-yielding properties are described in table 2.

Aquifer Geometry and Hydraulic Characteristics

The upper few-hundred feet of the Helena valley-fill aquifer system can best be described as a sequence of complexly stratified lenses of cobbles, gravel, and sand with abundant intercalated silt and clay. This near-surface stratigraphic sequence grades from predominantly cobbles, gravel, and coarse sand where tributary streams enter along the south and west margins of the valley to predominantly sand, silt, and clay near Lake Helena. Drillers' logs indicate that the upper few-hundred feet of the valley fill contains as much as 30 to 70 percent intercalated silt and clay, but Moreland and Leonard (1980) showed that individual fine-grained layers are not laterally continuous across the valley. The lateral discontinuity of the many fine-grained layers allows hydraulic interconnection of the coarse-grained water-yielding zones, which therefore function as one complex aquifer system. Most wells that withdraw water from the valley fill are completed in the upper few-hundred feet. Supplies of water in valley fill are adequate for domestic use virtually everywhere in the valley.

Wells completed in the valley fill at depths greater than about 100 ft probably have been drilled through Quaternary sediments and are completed in the top part of the Tertiary section (Schmidt, 1986, p. 7). However, this relation is speculative, because the Quaternary/Tertiary contact beneath the central valley probably ranges in depth throughout the area and is not easily identifiable in drillers' logs or bore-hole geophysical logs (Moreland and Leonard, 1980). The lack of a well-defined contact probably is due to the fact that both the Quaternary sediments and the upper part of the Tertiary sediments in the central valley were deposited under similar depositional controls; hence, they have a similar hydrogeologic character.

The hydrogeologic character of the valley fill below a depth of a few hundred feet is not well known, because the abundance of water in the shallow parts of the aquifer system has generally made deeper drilling unnecessary. Therefore, interpretation of the factors controlling the depositional history and hydraulic character of the Tertiary sediments becomes increasingly speculative with depth. For example, the depth and character of the contact between the coarse-grained sediments similar to the Sixmile Creek Formation and the underlying fine-grained sediments similar to the Renova Formation, which likely occur in the valley-fill sequence beneath the central valley, are unknown.

Variation of particle size in the valley fill indicates a wide range in permeability of valley-fill deposits. Possible values of hydraulic conductivity for valley fill range from about 10^{-3} ft/d for clay to about 10^{4} ft/d for coarse gravel (Heath, 1983, p. 13). In this study, hydraulic properties of the valley fill were estimated by aquifer tests conducted at seven sites (pl. 1). The method of aquifer testing chosen for this study involves pumping a well at a constant discharge and plotting the resulting drawdown of water level in the pumping and nearby observation wells as a function of the time after pumping started. The resulting time-drawdown plots are then analyzed by matching with type curves based on modifications of the original Theis nonequilibrium equation (Theis, 1935). The Theis solution is valid for the following conditions:

1. The aquifer is homogeneous and isotropic; that is, the formation is uniform in character and the hydraulic conductivity is the same in all directions.

2. The aquifer is uniform in thickness and effectively infinite in lateral extent.

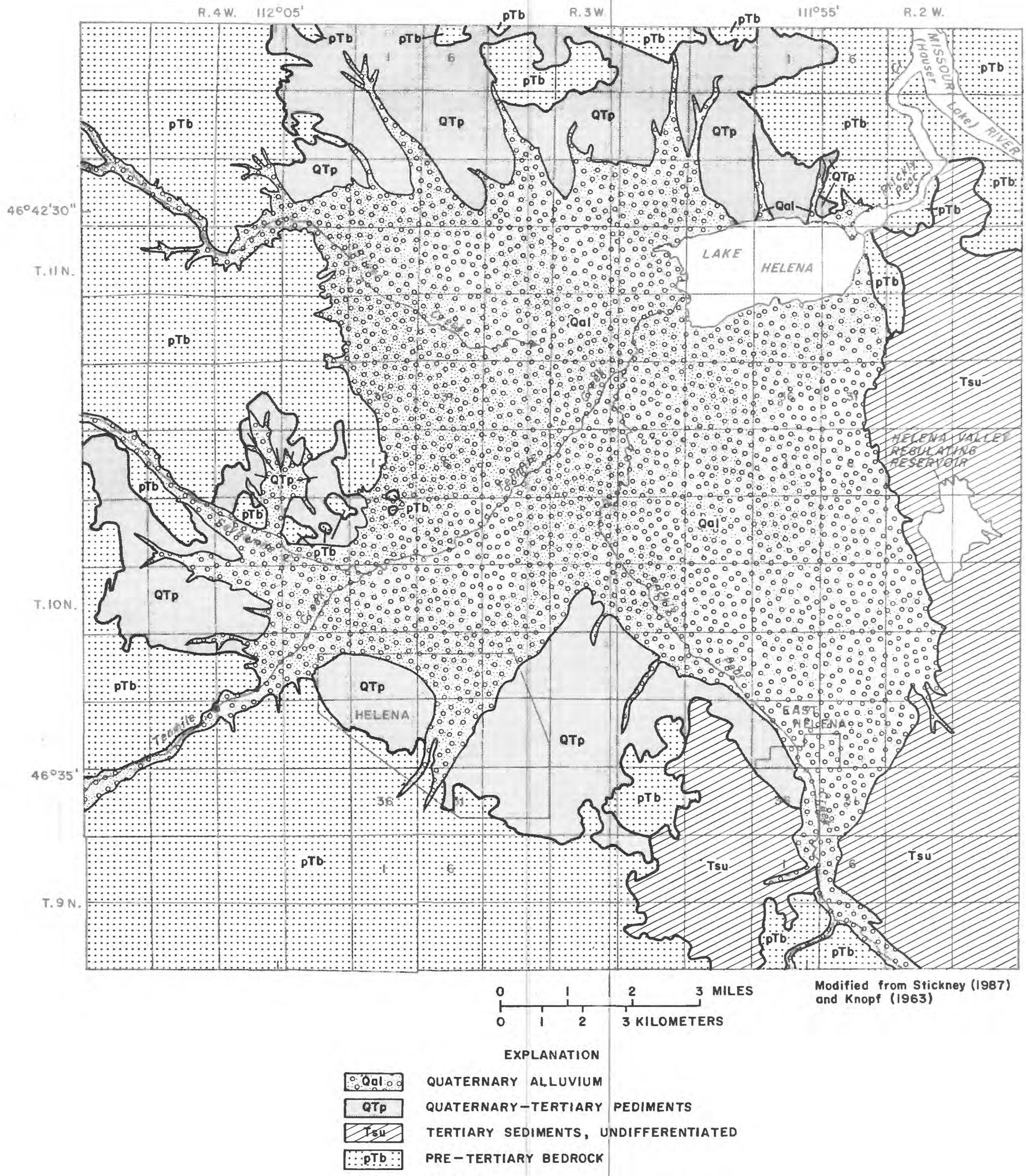


Figure 5.--Generalized surficial geology.

Table 2.--*Generalized geologic units and water-yielding properties*
[gal/min, gallons per minute]

Erathem	System	Series	Formation	Approximate thickness (feet)	General character	Water-yielding properties
Cenozoic	Quaternary	Holocene, Pleistocene	Alluvium (Qal)	0-100	Unconsolidated stream-channel, alluvial-plain, terrace, and fan deposits. Along the southern and western margins of the valley, deposits are coarse, moderately sorted, and well-rounded to subrounded cobbles, gravel, and sand intercalated with silt and clay. Material becomes better sorted and more fine grained near Lake Helena.	Deposits yield abundant water to wells at all locations in the valley. Yields are commonly 20 to 300 gal/min.
Cenozoic	Quaternary, Tertiary	Pleistocene	Pediments (QTp)	0-50	Light-brown, poorly sorted, unstratified gravel, sand, and silt lag deposits unconformably overlying eroded Tertiary sediments and pre-Tertiary bedrock. Subrounded to sub-angular, pebble-to-cobble gravel clasts reflect local bedrock lithologies. Along the toe of the mapped pediments, deposits may represent thick sequences of Tertiary-Quaternary deposition in front of the pediment erosional surface.	Thin lag deposits are generally not an aquifer except along the toe of the pediments where thick deposits are hydraulically connected to the adjacent Quaternary alluvium and provide abundant water to wells. Yields are commonly 2 to 100 gal/min.
Cenozoic	Tertiary	Pliocene to Eocene(?)	Sediments (undifferentiated) (Tsu)	0-6,000	Moderately well indurated, poorly sorted, tan-to-brown, micaceous sandy siltstone with laterally discontinuous sandy-pebble and cobble-gravel interbeds and lenses. Includes both Renova- and Sixmile-Creek equivalent sediments. Previous authors have referred to exposed Tertiary sediments as "lake beds" owing to the fine-grained nature of most of the deposits. The upper part of the unmapped sediments underlying Quaternary alluvium in the central valley represents either a different facies or stratigraphic horizon; they are indistinguishable from Quaternary alluvium in drillers' logs.	Sediments generally yield small quantities of water to wells owing to the small permeability of the fine-grained material and the discontinuous nature of the permeable interbeds and lenses. The upper parts of sediments underlying Quaternary alluvium in the central valley supply abundant water to wells. Yields are commonly 2 to 15 gal/min but may exceed 100 gal/min at places.
pre-Tertiary	pre-Tertiary	pre-Tertiary	Bedrock (pTb)	--	Cretaceous to Precambrian sedimentary rocks and Cretaceous plutonic and volcanic rocks surrounding the valley.	Permeability is mainly secondary, with wells obtaining variable quantities of water from fractures. Unit supplies significant sub-surface recharge to the valley fill. Yields are commonly 5 to 15 gal/min.

(Modified from Stickney, 1987)

3. The pumped well fully penetrates and is open to the entire thickness of the aquifer.

4. All water removed from the aquifer comes from storage; that is, the aquifer receives no recharge during the test.

5. The water removed from aquifer storage is released instantaneously.

6. The water table or potentiometric surface has no slope.

7. The pumped well is 100 percent efficient.

Aquifer tests need not perfectly satisfy all these conditions to provide at least a qualified estimate of aquifer hydraulic properties; however, aquifer-test sites in the Helena Valley commonly do not satisfy most of the conditions. The results of the seven aquifer tests conducted as part of this study were affected by many of the same problems experienced by previous investigators. The inhomogeneity, anisotropy, and limited lateral extent of the valley fill clearly do not satisfy conditions 1 and 2. In addition, the tested wells could not fully penetrate the entire aquifer system. The resulting plots of time versus drawdown show ample evidence of delayed leakage of water into the tested interval, which thereby does not satisfy conditions 3, 4, and 5 (fig. 6).

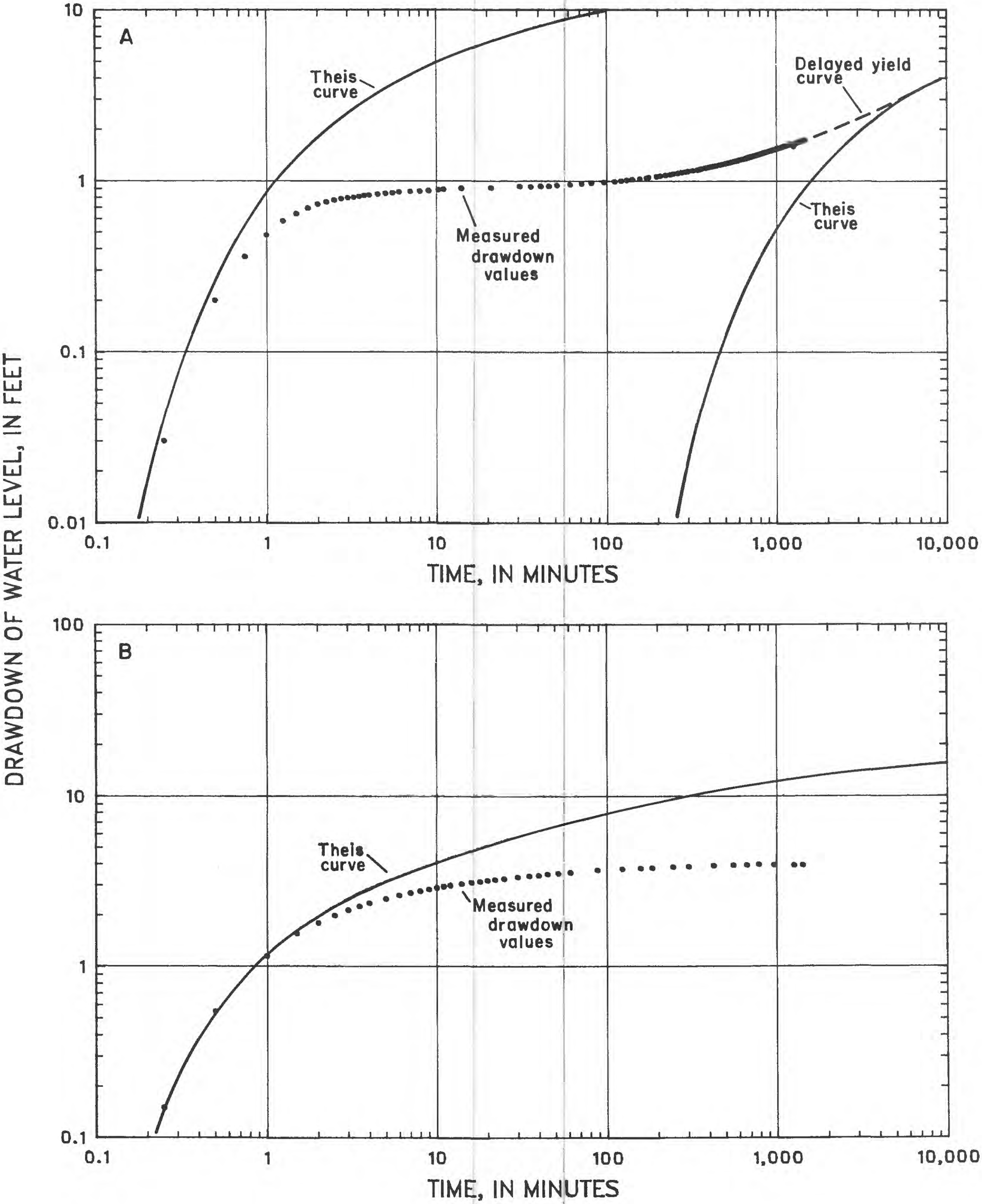


Figure 6.--Typical drawdown curves for aquifer tests conducted on wells completed in the valley-fill aquifer system. A, Delayed-yield response; B, Leaky-confined response.

Modifications of the Theis solution that account for delayed yield of water by gravity draining in unconfined aquifers (Boulton, 1963) and for leakage of water across leaky confining beds (Cooper, 1963) were applied to the aquifer-test data from the seven sites. These modified solutions do not require that conditions 4 and 5 be satisfied. However, estimates of transmissivity for multiple observation wells at individual test sites commonly varied by a factor of 10 or more, indicating that too many of the above stated conditions had been violated. As a result, the hydraulic parameters calculated from the test data are only rough approximations.

On the basis of the aquifer-test data and a general understanding of the hydrogeology, two observations can be made regarding the hydraulic character of the valley-fill aquifer system. First, deviations of time-drawdown data from the Theis type curve corroborate the interpretation of the hydrogeology by confirming that the clay layers in the valley fill are not laterally continuous boundaries to flow but instead are localized lenses dividing complexly interconnected water-yielding zones that function as a single aquifer system. Early time data for some of the tests did fit the Theis type curve, which indicates that the clay layers bounding the water-yielding zones are extensive enough to limit vertical flow until the expanding cone of depression intercepts a window in the clay layer. At that time, the rate of drawdown decreases, owing to vertical leakage from above or below the tested interval.

Second, Theis analysis of early time data and modified solutions for delayed-yield and leaky-confined conditions indicate that the transmissivity value of 10,000 ft^2/d estimated by Moreland and Leonard (1980) is probably reasonable for the effective transmissivity of water-yielding zones beneath the valley. This estimated transmissivity, however, is not the transmissivity of the entire thickness of water-yielding material that composes the aquifer system. Although the numerous clay layers are not continuous enough to hydraulically isolate water-yielding zones in the valley fill, they can decrease the composite vertical hydraulic conductivity of the aquifer system by as much as 1-3 orders of magnitude compared to the horizontal direction. The small vertical hydraulic conductivity of the clay layers essentially limits the thickness of water-yielding material that is subjected to the hydraulic stress caused by pumping during an aquifer test. Assuming that the average thickness of the aquifer system that is stressed by the pumping is 50 ft, the effective horizontal hydraulic conductivity of the water-yielding zones would be about 200 ft/d.

Potentiometric Surface and Direction of Ground-Water Flow

Water levels were measured monthly and semi-monthly in most of the 84 wells of the monitoring network (tables 8-9 in the Supplemental Data section at the back of the report, pl. 1). Water levels generally were lowest in spring, rose during the irrigation season, and then fell throughout the fall and winter. The altitude of all monitoring wells was determined to within ± 0.3 ft by leveling from points of known altitude. Fifteen sites have both a shallow (19-150 ft) and a deeper (55-250 ft) well (nested site) to allow measurement of the vertical component of hydraulic gradient in the aquifer system. The relative altitude of wells at nested sites was determined to within ± 0.01 ft.

The potentiometric surface in the upper 25 ft of saturated valley fill and the surrounding bedrock was determined from water levels measured during March and April 1991 (pl. 1). Only wells completed in the upper 25 ft of saturated valley fill were included for contouring, because vertical hydraulic gradients in the aquifer system result in hydraulic heads that differ for wells completed at different depths. Horizontal ground-water flow is perpendicular to the potentiometric contours and downgradient. Thus, flow in the valley-fill aquifer system is generally from the south, west, and north margins of the valley toward Lake Helena, with flow sub-parallel to the boundary of the fine-grained Tertiary sediments of the Spokane Bench on the east side of the study area. Seasonal fluctuations in water level (table 9) do not significantly alter the shape of the potentiometric contours or the direction of horizontal flow beneath the valley.

The vertical component of hydraulic gradient in the valley-fill aquifer system was determined at 15 locations by dividing the difference in water-level altitude in wells at nested sites by the difference in the depth of open interval of the wells. Vertical gradients in an aquifer identify a potential for ground water to move vertically as well as horizontally. On the basis of measured vertical hydraulic gradients, the Helena Valley can be divided into two areas (fig. 7)--an area within about 4 mi of Lake Helena, which displays an upward gradient, and the rest of the valley, which displays a downward gradient. Water in the aquifer has a downward flow component in areas with a downward hydraulic gradient and an upward flow component in areas with an upward hydraulic gradient. Where the vertical permeability of the valley fill is sufficient, vertical flow can be significant.

Ground-Water Recharge and Discharge

Recharge to and discharge from the Helena valley-fill aquifer system can be derived from the following equation:

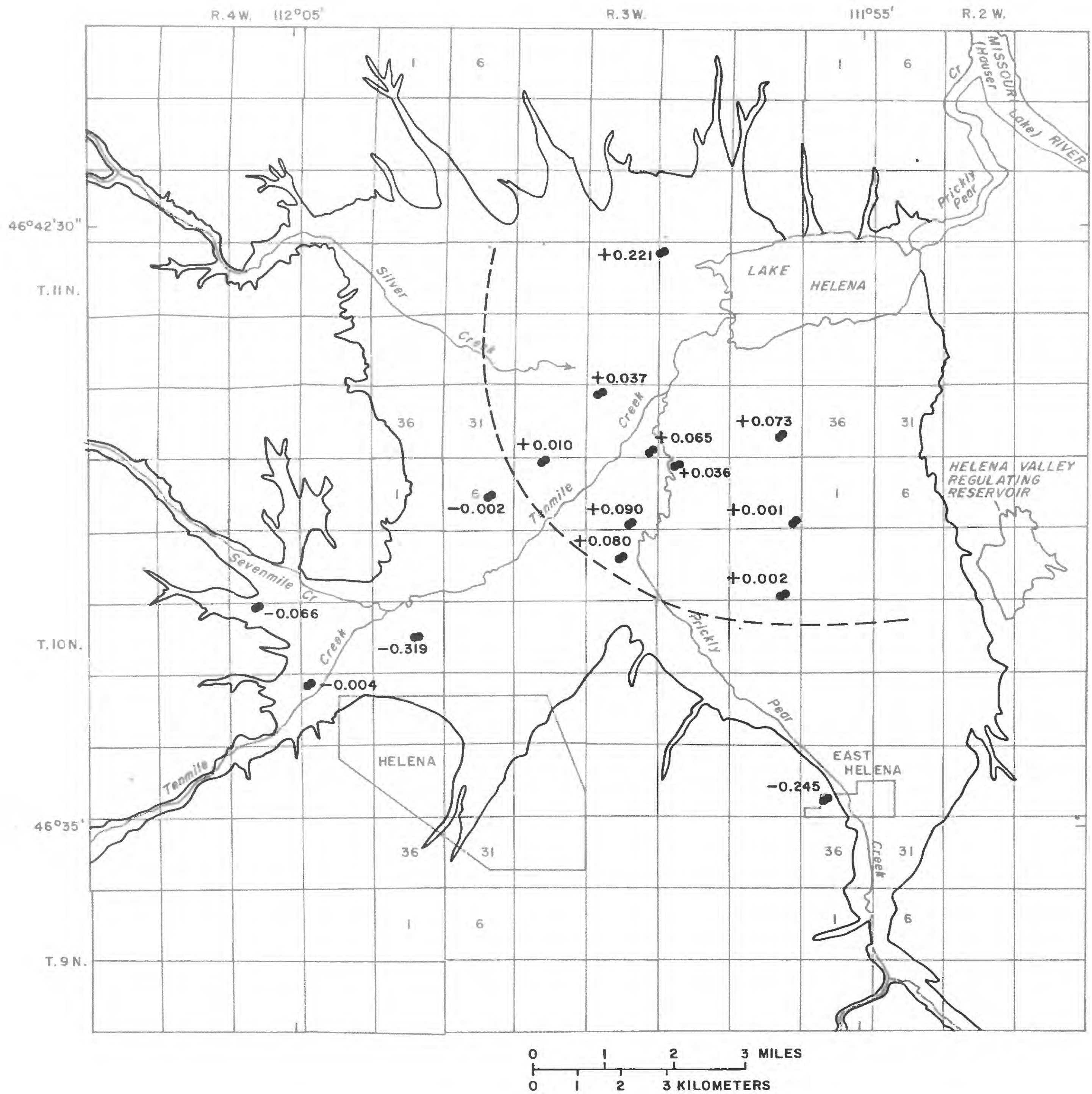
$$LS\_in + LC\_in + IF\_in + PN\_in + BR\_in = SD\_out + LH\_out + WL\_out \qquad (1)$$

where:

LS_in = Recharge from infiltration of streamflow,
LC_in = Recharge from infiltration of water in irrigation canals,
IF_in = Recharge from infiltration of excess water applied to irrigated fields (applied irrigation water plus precipitation on irrigated fields minus evapotranspiration),
PN_in = Recharge from infiltration of precipitation on non-irrigated areas (precipitation minus evaporation during the non-growing season; precipitation minus evapotranspiration during the growing season),
BR_in = Recharge from inflow from bedrock,
SD_out = Discharge through leakage to streams and drains,
LH_out = Discharge through upward leakage to Lake Helena, and
WL_out = Discharge through withdrawals from wells.

Recharge to the Helena valley-fill aquifer system is through infiltration of streamflow, irrigation water, and precipitation, and inflow from fractures in the surrounding and underlying bedrock. Recharge from infiltration of streamflow (LS_in) was estimated from low-flow investigations conducted on March 20 and October 25, 1990 (table 3 , fig. 8). The data indicate that Prickly Pear Creek loses about 6-10 ft^3/s to the aquifer system between measurement sites 10N03W25DBDC01 and 10N03W10CCCB01. Tenmile Creek loses about 8-11 ft^3/s to the aquifer system between the confluence of Sevenmile Creek and measurement site 11N03W33CDDD01. The apparent anomaly of Tenmile Creek losing flow near measurement site 11N03W33CDDD01 and Prickly Pear Creek gaining flow only 0.7 mi to the east is reflected in the potentiometric surface shown on plate 1. Sevenmile Creek does not lose or gain a significant quantity of flow between measurement site 10N04W04CACC01 and its mouth at Tenmile Creek. Silver Creek discharge was measured at 1.81 ft^3/s on March 20, 1990. Silver Creek loses all its flow to the valley fill not far from where the stream enters the valley.

Although the March and October discharge measurements indicate a seasonal variation in LS_in, the measurements are too infrequent to properly identify the magnitude and timing of the yearly variation. Therefore, potential streamflow losses to the aquifer system were calculated as being constant throughout the year with a magnitude equal to the average of the March and October losses. On this basis, potential streamflow losses to the aquifer system are about 8 ft^3/s for Prickly Pear Creek, 9 ft^3/s for Tenmile Creek, 0 ft^3/s for Sevenmile Creek, and 1.5 ft^3/s for Silver Creek. Actual streamflow losses probably are less, because natural low-flow conditions and irrigation diversions downstream from project gaging stations limit the streamflow available for aquifer-system recharge during some months. Thus, for the data presented, recharge from infiltration of streamflow is estimatd to be about 12,900 acre-ft/yr.



EXPLANATION

——— LINE OF APPROXIMATE SURFACE EXTENT OF HELENA VALLEY-FILL AQUIFER SYSTEM

— — — APPROXIMATE BOUNDARY BETWEEN AREAS WITH UPWARD AND DOWNWARD GRADIENT

+0.221 ● WELLS AT NESTED SITE AND MAGNITUDE OF VERTICAL HYDRAULIC GRADIENT, IN FOOT PER FOOT (+, upward gradient ; —, downward gradient)

Figure 7.--Areas of upward and downward vertical hydraulic gradients and location of wells at nested sites.

Table 3.--*Results of low-flow investigations*

[ft^3/s, cubic feet per second; μS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data]

Creek	Location number of streamflow-measurement site	March 20, 1990 Discharge (ft^3/s)	March 20, 1990 Specific conductance (μS/cm)	October 25, 1990 Discharge (ft^3/s)	October 25, 1990 Specific conductance (μS/cm)
Prickly Pear	09N02W07BCAA01	51.0	231	26.7	263
	10N03W25DBDC01	54.7	239	27.6	270
	10N03W22AABA01	49.4	238	17.3	269
	10N03W10CCCB01	48.9	243	18.0	286
	11N03W34CCDC01	54.1	374	30.3	441
	11N03W27BDAA01	--	--	32.1	425
Tenmile	10N04W22CDCD01	13.0	242	4.97	342
	10N04W23BABD01	10.6	240	3.19	344
	10N04W14ADAD01	13.7	269	5.69	398
	10N04W12DDCC01	16.5	343	9.67	476
	10N03W05CDAD01	13.6	367	3.82	503
	11N03W33CDDD01	11.2	374	0.0	--
Sevenmile	10N04W04CACC01	5.00	438	4.59	468
	10N04W11CBBC01	4.63	441	3.99	479
	10N04W13BBBD01	5.22	502	4.93	560
Silver	11N04W21ADAD01	1.81	735	--	--

To estimate recharge from leaky irrigation canals (LC_in), a low-flow investigation of a 15.5-mi section of the Helena Valley Irrigation District main canal was conducted on April 12, 1991--12 days after the canal was first filled for the season. The main canal, identified as Helena Valley canal on plate 1, flows from the Helena Valley Regulating Reservoir clockwise around the valley and enters the northeast end of Lake Helena. The main canal was nearly full and none of the distributary canals between the measurement sites were diverting flow during the 12 days. Discharge measurements indicate that the main canal loses an average of about 0.63 (ft^3/s)/mi throughout the measured section. Assuming that this estimate is representative of canal leakage and that the smaller distributary canals on average have one-third the wetted perimeter and therefore one-third the rate of leakage of the main canal, leakage from the entire 68-mi irrigation system is estimated to be about 7,060 acre-ft from mid-April through early October.

Recharge to the aquifer system from infiltration of excess water applied to irrigated fields (IF_in) during the irrigation season was estimated from the following equation:

$$IF\_in = tv + p - ETa \qquad (2)$$

where:

IF_in = Infiltration of excess water from irrigated fields,
tv = Total volume of irrigation water applied to fields,
p = Precipitation on irrigated acres during irrigation season, and
ETa = Evapotranspiration by alfalfa from irrigated acres during irrigation season in the Helena Valley.

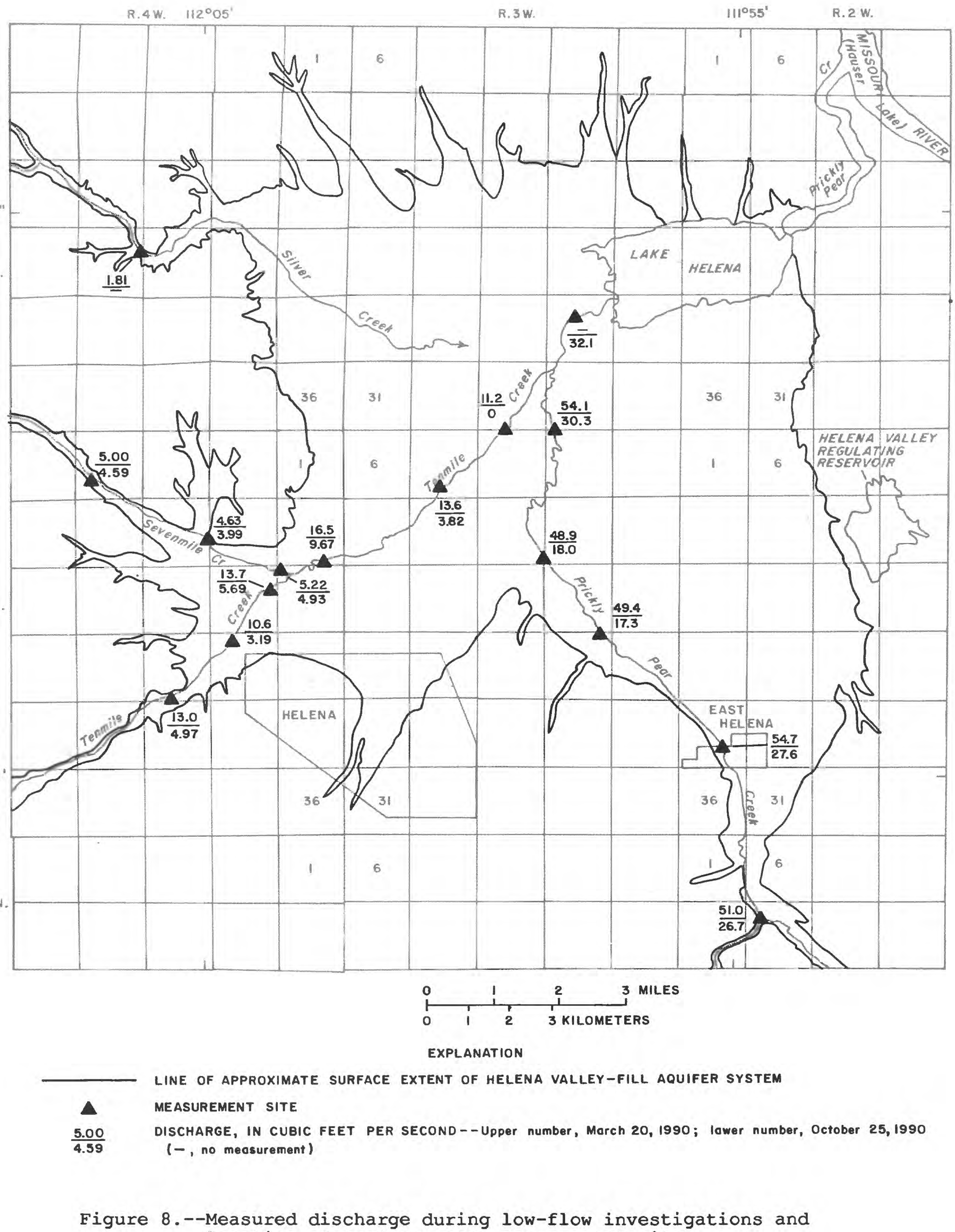


Figure 8.--Measured discharge during low-flow investigations and location of surface-water measurement sites.

Equation 2 is based on the assumption that recharge to the aquifer system occurs when the volume of irrigation water applied to fields plus precipitation exceeds evapotranspiration.

The total volume of irrigation water applied to fields is obtained from three sources: the Helena Valley Irrigation District, stream diversions, and irrigation-well withdrawals. The volume of water applied to fields from the Helena Valley Irrigation District canal system during 1990 is estimated to be about 41,300 acre-ft. This value was obtained from the total volume of water released to the canal system from the Helena Valley Regulating Reservoir (63,100 acre-ft) minus the estimated quantity of water that leaks from the canals (LC_in) (7,060 acre-ft) minus the quantity of excess water that is spilled directly into Lake Helena at the end of the canal system (about 14,700 acre-ft). The total volume of water applied to fields from diversions along Prickly Pear, Tenmile, and Sevenmile Creeks during 1990 is estimated to be about 13,200 acre-ft (A.J. Smith, Water Commissioner, Tenmile and Sevenmile Creeks, written commun., 1991; Bill Wegner, Water Commissioner, Prickly Pear Creek, written commun., 1991). Using onsite well inventories, estimated irrigated acreage, and an assumed application rate equal to that in areas irrigated from canals, the total volume of applied water obtained from irrigation wells during 1990 is estimated to be about 2,480 acre-ft. Therefore, the total volume of irrigation water applied to fields from all sources during 1990 is estimated to be about 57,000 acre-ft. This quantity is probably representative of the normal application of irrigation water in the study area.

Precipitation on irrigated acres during the 1990 irrigation season is estimated to be about 8,920 acre-ft using the monthly precipitation data shown in figure 4 and an estimated irrigated area of 17,600 acres. This quantity represents about 72 percent of the normal precipitation for the period.

Monthly evapotranspiration by the principal irrigated crop, alfalfa, during 1990 was estimated using techniques described by U.S. Soil Conservation Service Engineering Division (1970). The 1990 growing season began in April and ended on October 5 when freezing temperatures ended evapotranspiration for the year. On the basis of these monthly evapotranspiration rates and an irrigated area of 17,600 acres, the total evapotranspiration by alfalfa from irrigated acres during 1990 is estimated to be about 38,900 acre-ft. This is probably a reasonable estimate of the normal evapotranspiration from irrigated areas in the valley.

Using the quantities presented, recharge from infiltration of excess applied irrigation water during 1990 is estimated from equation 2. The total is about 27,000 acre-ft.

Recharge to the valley-fill aquifer system from infiltration of precipitation is dependent upon the season and area of the precipitation. From early October through March when plants are not transpiring, normal precipitation in the Helena Valley is about 3.58 in. (National Oceanic and Atmospheric Administration, 1982a) and normal free-water-surface evaporation is 7.13 in. (National Oceanic and Atmospheric Administration, 1982b,c). Actual precipitation during this period in 1990-91 was only 2.13 in. Hence, the aquifer system probably received little recharge directly from precipitation during this period.

Recharge from precipitation during the summer growing season is dependent upon whether the precipitation falls on irrigated or non-irrigated areas of the valley. Precipitation falling on irrigated areas during the summer growing season does not have a soil-moisture deficit to overcome; hence, it is added to the volume of irrigation water applied. Precipitation falling on irrigated areas during the summer growing season is accounted for as infiltration from excess water applied to irrigated fields (IF_in) in equation 1.

Precipitation falling on non-irrigated areas has to overcome a soil-moisture deficit. Normal precipitation in the Helena Valley for the summer growing season is 7.79 in. (National Oceanic and Atmospheric Administration, 1982a). Actual precipitation for the 1990 growing season was about 6 in. A reasonable estimate for potential evapotranspiration in non-irrigated areas of the Helena Valley is probably about one-half to three-quarters that for pasture grasses (U.S. Soil Conservation Service, no date) or 11 to 16 in. for the same period. Therefore, except for infrequent periods of sustained precipitation large enough to overcome the natural soil-moisture deficit in those areas, the aquifer system probably receives little recharge directly from precipitation (PN_in) in the non-irrigated areas of the valley.

Even if infrequent periods of sustained precipitation contribute some recharge to the aquifer system, the quantity is probably a relatively small part of the total recharge to the system. For example, GIS analysis indicates that the surface extent of non-irrigated valley fill is about 26,400 acres. If precipitation were sufficiently sustained to overcome the soil-moisture deficit and contribute 1 in. of recharge over the area, the total recharge would be 2,200 acre-ft or about 2.5 percent of the estimated total annual recharge to the aquifer system. If the same recharge event occurred over the entire surface extent of the valley fill (44,000 acres) during the non-growing season, the resulting recharge would be 3,670 acre-ft or about 4 percent of the estimated total annual recharge to the aquifer system.

The direction of ground-water flow and mass-balance analysis indicate that recharge through inflow from fractures in the surrounding pre-Tertiary bedrock (BR_in) is a significant part of the total recharge entering the valley-fill aquifer system. However, flow from bedrock is almost impossible to measure directly, and hence must be deduced from less direct analysis. Evidence for the hydraulic potential to move water from bedrock into the valley fill is given on plate 1, which shows a relatively steep hydraulic gradient in the potentiometric contours and a direction of flow in the valley fill away from the pre-Tertiary bedrock along the south, west, and north margins of the basin. In contrast, potentiometric contours provide evidence that the direction of flow in the valley fill is sub-parallel to the Spokane Bench on the east boundary of the study area. Thus, little recharge enters the valley fill from the Tertiary sediments (Tsu, fig. 5) in that area. Evidence for permeability of the mountain mass consists of the many pre-Tertiary bedrock wells that generally produce adequate supplies of water for domestic use along the south, west, and north margins of the valley. On the basis of Darcy's equation and an assumed average hydraulic gradient from pre-Tertiary bedrock into the valley fill of 0.05 ft/ft estimated from plate 1, an effective bedrock hydraulic conductivity of 1 ft/d, and an area of the top 300 ft of pre-Tertiary bedrock/valley-fill contact of 9.5×10^7 ft^2 determined from figure 5, estimated recharge to the valley-fill aquifer system from bedrock is about 39,800 acre-ft/yr.

Evidence of storage in the bedrock flow system adequate to supply sustained recharge to the valley-fill aquifer also can be inferred from a mass balance analysis of tributary basins. GIS analysis of lines of equal precipitation in the Prickly Pear drainage basin indicates that about 235,000 acre-ft of precipitation falls in the drainage annually. In contrast, the estimated long-term mean annual flow of Prickly Pear Creek at project site 09N02W07BCAA01 is only 48,000 acre-ft. Whereas most of the difference between precipitation input and surface-water outflow is due to evapotranspiration and other consumptive uses in the Prickly Pear drainage basin, some of the difference is due to precipitation that infiltrates the bedrock flow system. Quantifying fracture-flow in the mountain mass is beyond the scope of this study; however, precipitation recharge to the bedrock flow system in drainage basins tributary to the Helena Valley probably can be reasonably assumed to be more than adequate to maintain bedrock recharge to the valley-fill aquifer system.

Discharge from the Helena valley-fill aquifer system is through evapotranspiration; leakage to streams, drains, and Lake Helena; and withdrawals from wells. Discharge through evapotranspiration has been accounted for in estimates of recharge from excess irrigation water and infiltration of precipitation. Discharge through leakage of ground water to streams is documented in table 3 and figure 8. Of the four streams in the valley, only the downstream reaches of Prickly Pear Creek gain flow from aquifer-system discharge. The streamflow data for Prickly Pear Creek (table 3) exclude 4.3 ft^3/s of treated municipal wastewater entering the creek downstream from site 10N03W10CCCB01. In addition, the increase in streamflow of about 15 ft^3/s measured on October 25, 1990, from measurement site 10N03W22AABA01 to measurement site 11N03W27BDAA01 is partly due to inflow from several open drains tributary to the stream.

The drains tributary to Prickly Pear Creek are part of a 41-mi network of open and buried drains designed to decrease waterlogging of fields in the downgradient areas of the Helena Valley by collecting shallow ground water and channeling it into Lake Helena. Combined discharge of the three principal drains entering the lake was about 43 ft^3/s in October 1990 when well hydrographs show that ground-water levels were still relatively high and about 31 ft^3/s in February 1991 when ground-water levels had declined. Assuming that the seasonal change in leakage to Prickly Pear Creek is proportional to the observed seasonal change in discharge to the three principal drains entering Lake Helena, the average aquifer-system discharge to streams and drains (SD_out) is estimated to be about 50 ft^3/s or 36,200 acre-ft/yr.

Discharge from the aquifer also occurs through direct upward leakage into Lake Helena (LH_out). Upward leakage from the aquifer system through the bed of the 3.2-mi^2 lake was estimated by two methods: Darcy's equation to estimate ground-water flow through the bed of the lake and a potentially more accurate mass-balance analysis based on measurements of inflow to and outflow from the lake. Assuming an estimated hydraulic conductivity of 1 ft/d for the lake bed, an average vertical hydraulic gradient of 0.07 ft/ft determined from nested-pair wells near the lake, and a surface area of 9.0×10^7 ft^2 for the lake bed, upward leakage from the aquifer system directly to Lake Helena would be about 53,000 acre-ft/yr.

Estimated upward leakage to Lake Helena from a mass-balance analysis was based on the assumption that inflow to the lake has essentially three components: tributary-basin surface water entering as flow in Prickly Pear Creek, aquifer-system leakage entering as surface flow in Prickly Pear Creek and drains, and upward leakage directly to the lake. Because outflow from Lake Helena into Hauser Lake was measured (project gaging station 11N02W19ABBC01 shown in fig. 1), the only unknown factor in the mass-balance equation is upward leakage to the lake. On the basis of October 25, 1990, measurements of outflow from Lake Helena (148 ft^3/s), inflow from Prickly Pear Creek (32.1 plus 4.3 ft^3/s of treated wastewater from the City of Helena), and inflow from the three principal drains (43 ft^3/s), upward leakage from the aquifer into Lake Helena is estimated to be a relatively constant 69 ft^3/s or 50,000 acre-ft/yr. This estimate is in general agreement with that obtained from analysis using Darcy's equation.

Discharge from the valley-fill aquifer system through withdrawals from domestic, public-supply, and irrigation wells (WL_out) accounts for a relatively minor part of the total discharge from the system. Well-completion reports on file with the State of Montana list about 2,440 wells as being completed in areas identified as Quaternary alluvium (Qal) and along the toe of the Quaternary-Tertiary pediments (QTp) shown in figure 5. This number probably underrepresents the actual number of wells completed in the valley fill. Of the 2,225 wells in the data base that have water-use information, 87 percent are used for domestic supply. Of the 1,840 domestic wells in the data base that have depth information, almost 60 percent have been completed at depths of less than 70 ft (fig. 9). Domestic wastewater from essentially all households supplied by these wells is disposed on-site through private septic systems that are hydraulically connected to the upper part of the valley-fill aquifer system. Estimated average withdrawal for domestic use is 138 gal/d per person, with 87 gal/d or 63 percent being returned to the shallow ground-water system through septic systems (Montana Department of Natural Resources and Conservation, 1986). Considering that 13,000 Helena Valley residents are served by private water supplies, total withdrawal from the aquifer system for domestic use is about 5.5 acre-ft/d, with about 3.5 acre-ft/d being returned to the upper part of the aquifer through septic-system discharge. Although the consumptive use is small--about 2 acre-ft/d or 730 acre-ft/yr--the cycling of water from deeper to shallower parts of the aquifer has the potential to create localized downward hydraulic gradients that could induce downward flow in the aquifer.

Of the 2,440 wells listed in the State data base, 37 are used for public supply. Most public-supply wells provide water to small housing developments and their discharge has been included in the estimate of consumptive use for domestic supply. The water system for the City of East Helena withdraws about 70 acre-ft/yr from four public-supply wells in the valley fill (E.F. Murgel, City of East Helena Public Works Department, written commun., 1991). The City of East Helena wastewater treatment facility discharges to surface flow; therefore, all water withdrawn from the four wells is considered to be consumptive use. The City of Helena water-supply system does not presently (1991) withdraw water from wells in the valley.

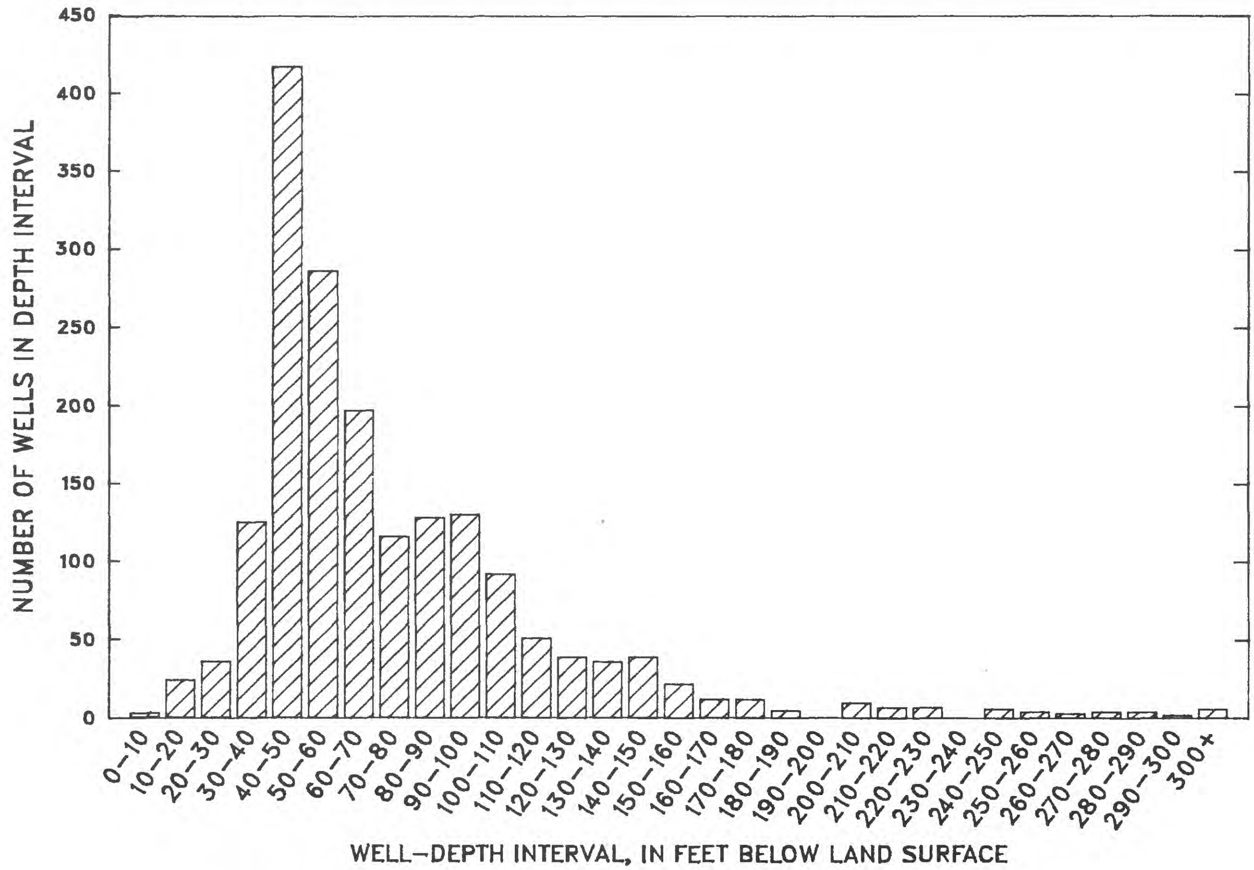


Figure 9.--Depth of domestic and public-supply wells completed in valley fill.

Because of the abundance of surface water in the Helena Valley, relatively few wells are used for large-scale irrigation. Of the estimated 2,480 acre-ft/yr withdrawn from irrigation wells, 1,170 acre-ft/yr is returned to the aquifer system through infiltration of excess water applied to irrigated fields and has been accounted for in equation 2. Net discharge from the valley-fill aquifer system to domestic, public-supply, and irrigation wells is about 2,110 acre-ft/yr.

The estimated components of monthly recharge to and discharge from the Helena valley-fill aquifer system are summarized in the water budget presented in table 4. Although many of the components are based to varying degrees on data from only 1 year (1990), the water budget presented is considered to be reasonably representative of long-term conditions in the aquifer. Total monthly recharge to and discharge from the aquifer are shown in figure 10. The difference between the total monthly recharge to and discharge from the aquifer is reflected in aquifer storage. For example, the shaded area between the recharge and discharge curves in figure 10 for May through August represents the volume of water that is entering aquifer storage as hydraulic heads in the aquifer rise during those months. Conversely, the shaded area between the discharge and recharge curves for September through April represents the volume of water leaving storage in the aquifer as hydraulic heads in the aquifer fall during those months.

Table 4.--*Estimated water budget for the valley-fill aquifer system*

	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Annual (rounded)
	Acre-feet												
Recharge													
LS_in	1,100	1,140	1,100	1,140	1,140	920	1,090	1,060	1,090	1,080	980	1,100	12,900
LC_in	270	1,410	1,370	1,410	1,410	1,140	46	0	0	0	0	0	7,060
IF_in	-480	8,970	9,070	10,600	3,180	-4,230	-76	0	0	0	0	0	27,000
PN_in	0	0	0	0	0	0	0	0	0	0	0	0	0
BR_in	3,270	3,380	3,270	3,380	3,380	3,270	3,380	3,270	3,380	3,380	3,050	3,380	39,800
Total (rounded)	4,160	14,900	14,800	16,500	9,110	1,110	4,440	4,330	4,470	4,460	4,030	4,480	86,800
Discharge													
SD_out	2,980	3,070	2,980	3,070	3,070	2,980	3,070	2,980	3,070	3,070	2,780	3,070	36,200
LH_out	4,110	4,250	4,110	4,250	4,250	4,110	4,250	4,110	4,250	4,250	3,840	4,250	50,000
WL_out	72	282	427	634	225	69	68	66	68	68	61	68	2,110
Total (rounded)	7,160	7,600	7,520	7,950	7,540	7,160	7,390	7,160	7,390	7,390	6,680	7,400	88,300

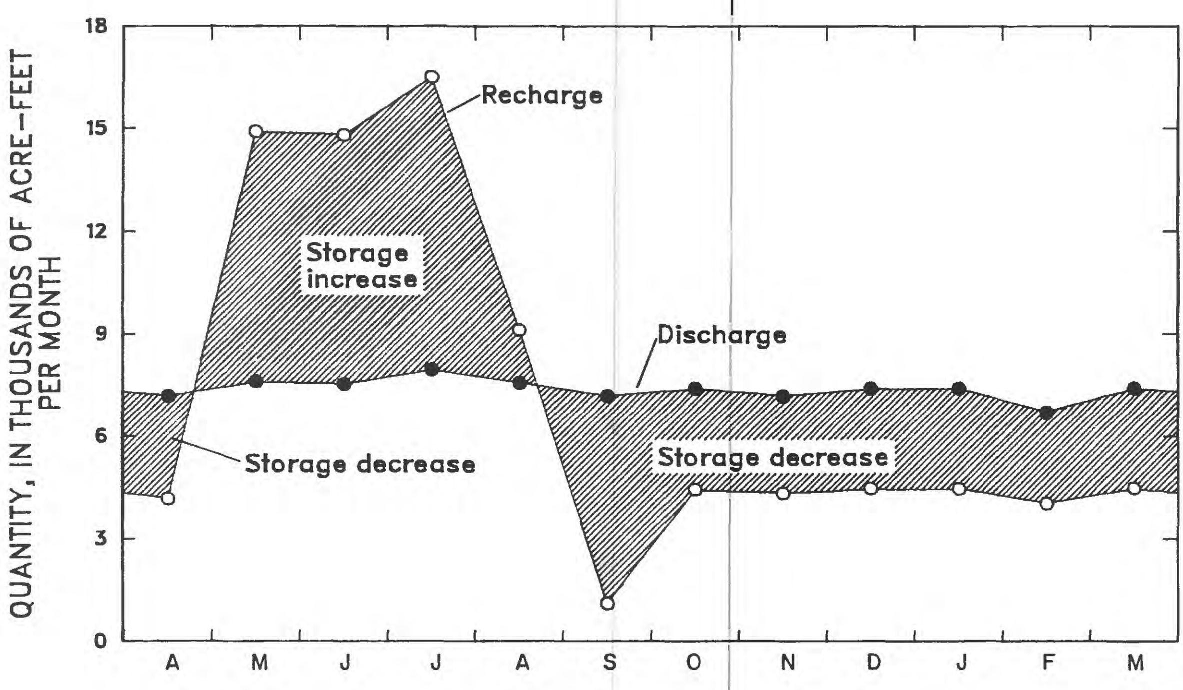


Figure 10.--Estimated monthly recharge to and discharge from the valley-fill aquifer system.

Conceptualization and Simulation of Ground-Water Flow System

Using the preceding analyses and data, the valley-fill aquifer system can be conceptualized. The conceptual model of steady-state flow in the aquifer system is largely constrained by the hydrogeology and distribution of recharge and discharge in the basin. Owing largely to the fact that inflow from pre-Tertiary bedrock is the principal source of recharge, the direction of flow in the aquifer system generally is from the south, west, and north margins of the basin toward Lake Helena. The predominantly fine-grained sediments of the Spokane Bench effectively form a no-flow boundary along the east side of the aquifer. Particle-size distribution in the near-surface valley fill strongly implies that the mean hydraulic conductivity of the system is largest near the mouths of tributary streams and smallest near Lake Helena. On the basis of qualified interpretation of aquifer-test data, particle-size distribution, and percentage of clay reported in drillers' logs, the estimated effective horizontal hydraulic conductivity of the near-surface valley fill probably ranges from about 100 ft/d near Lake Helena to about 200 ft/d near the mouths of tributary streams. The effective horizontal hydraulic conductivity is probably greatest near the land surface and decreases with depth.

The complex stratification of coarse- and fine-grained sediments in the near-surface valley fill impedes but does not prohibit the vertical movement of ground water in the system. The effective vertical hydraulic conductivity is estimated to be on average about two orders of magnitude smaller than the horizontal hydraulic conductivity in the valley fill.

Vertical flow through the deeper parts of the aquifer system is implied by the unique set of hydraulic conditions near Lake Helena--convergence of flow in conjunction with a decrease in horizontal hydraulic conductivity and gradient. These conditions can occur only if water is removed from the flow system or if the transmissivity of the flow system increases owing to an increase in thickness of the aquifer system. Even though discharge to streams and drains removes some water from the aquifer system near Lake Helena, the thickness of the aquifer system probably increases as well.

A three-dimensional, finite-difference ground-water flow model (McDonald and Harbaugh, 1988) was configured to appraise the validity of the conceptual model of steady-state flow and water budget for the valley-fill aquifer system during March. Use of the flow model is based on several simplifying assumptions:

1. Ground-water flow is completely described by Darcy's Law.

2. Within any active model cell, the volume of aquifer represented is homogeneous and horizontally isotropic.

3. Recharge and discharge at a model-grid node are constant over the entire cell.

4. The potentiometric surface in the modeled area was at quasi-equilibrium conditions during late March 1991.

The modeled area was subdivided into a three-layer finite-difference grid having 24 columns and 24 rows with nodes located at the center of each 1/2-mi-square block (2,640 ft each side). The grid was oriented north-south and was approximately centered over the valley. Layer 1 was configured as unconfined, was 35 ft thick, and had an altitude of its top equal to the mean altitude of the interpreted potentiometric surface. The distribution and magnitude of horizontal hydraulic conductivity (Kh) for layer 1 are shown in figure 11. The vertical hydraulic conductivity (Kv) for layer 1 was modeled as a uniform 1.3 ft/d--two orders of magnitude smaller than the maximum Kh for the layer. Layer 2 was configured as semi-confined and 75 ft thick. Except for the four cells noted in figure 11, layer 2 directly underlies layer 1. The magnitude of Kh and Kv for layer 2 were assigned as one-half those for layer 1. Layer 3 was configured as semi-confined with a minimum thickness of 180 ft along the southern, western, and northernmost active cells in the layer and a maximum thickness of 1,000 ft in the northeastern part of the basin (fig. 12). The magnitudes of Kh and Kv for layer 3 were assumed to be uniformly 40 and 0.4 ft/d, respectively.

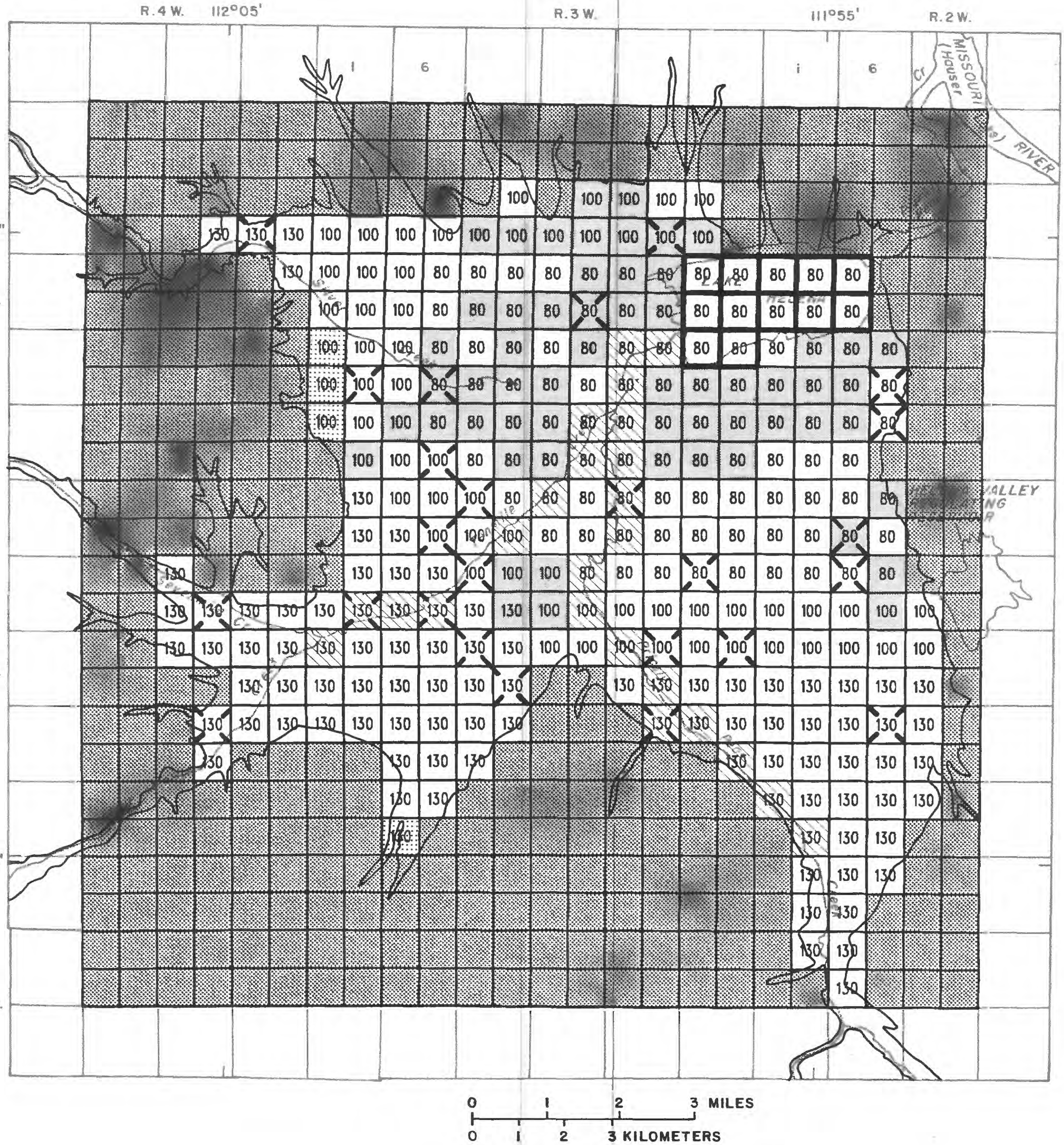


Figure 11.--Finite-difference grid, nodes, and distribution and magnitude of hydraulic conductivity for layers 1 and 2 in the ground-water flow model. Explanation for figure 11 on facing page.

EXPLANATION FOR FIGURE 11

LAYER 1

INACTIVE CELL

ACTIVE CELL

ACTIVE CELL USED TO CALIBRATE HYDRAULIC HEAD

ACTIVE CELL--CONSTANT HYDRAULIC HEAD

ACTIVE CELL--SPECIFIED FLOW SIMULATING LEAKAGE TO AND FROM STREAMS

ACTIVE CELL--DRAIN

80 HORIZONTAL HYDRAULIC CONDUCTIVITY, IN FEET PER DAY

LAYER 2

INACTIVE CELL

ACTIVE CELL

80 DOUBLE THE HORIZONTAL HYDRAULIC CONDUCTIVITY, IN FEET PER DAY

LINE OF APPROXIMATE SURFACE EXTENT OF HELENA VALLEY-FILL AQUIFER SYSTEM

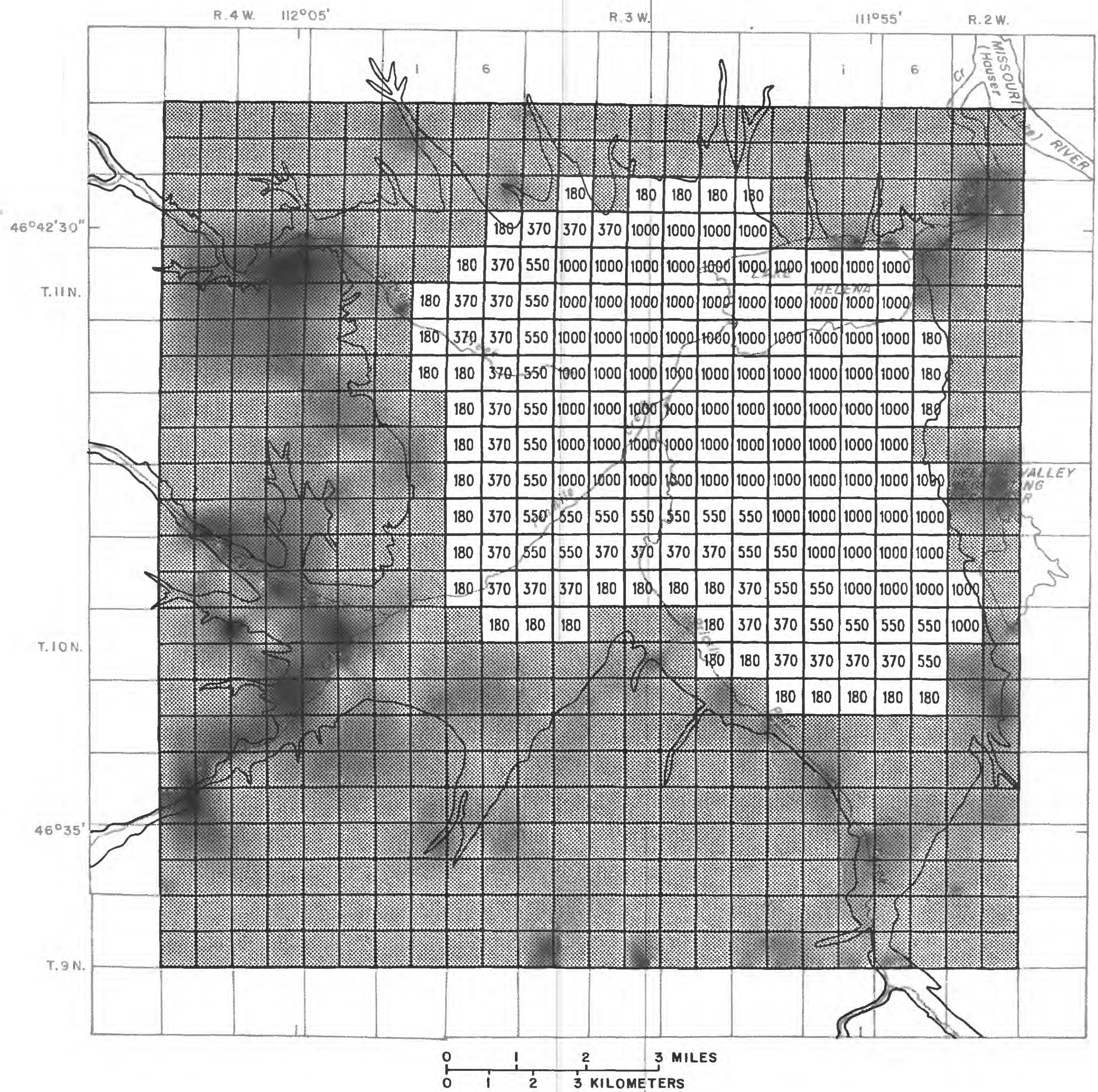
Inactive model cells along the east side of all three model layers identify the no-flow boundary formed by the fine-grained Tertiary sediments of the Spokane Bench. Recharge through inflow from pre-Tertiary bedrock (BR_in) was simulated with specified-flow nodes along the southern, western, and northernmost active cells in all three model layers. The estimated 3,380 acre-ft of recharge from bedrock for March (table 4) was proportioned to these cells on the basis of the estimated area of bedrock-valley fill contact and the location of the cell in the flow system. Recharge from infiltration of streamflow (LS_in) and discharge to streams (part of SD_out) were simulated by specified-flow nodes in layer 1 at the location and magnitude identified during low-flow investigations.

Discharge to Lake Helena (LH_out) was simulated by constant-head nodes in layer 1 representing the relatively constant stage of the lake. Discharge to drains (part of SD_out) in the downgradient areas of the valley was simulated by drain nodes in layer 1 with the altitude and hydraulic conductance of the canal bed at each node estimated from onsite inspection. Discharge to wells (WL_out) was not simulated owing to the relatively small volume of this component.

The model was calibrated to hydraulic heads that were calculated at the center of 25 model nodes by linear interpolation between measured hydraulic heads in the aquifer system. These cells are identified in figure 11. Calibration of hydraulic head with a root-mean-square error of less than 10 ft was achieved with the model configuration described and the distribution of estimated recharge for March that is given in table 4.

The simulation of steady-state flow generally confirms the validity of the conceptual model and water budget for the valley-fill aquifer system. Model simulations indicate that the mean horizontal hydraulic conductivity of the valley fill probably is similar to the hydraulic conductivity estimated from aquifer tests, particle-size distribution, and percentage of clay reported in drillers' logs.

Model simulations also confirm that the convergence of flow in conjunction with the decrease in horizontal hydraulic conductivity and gradient near Lake Helena can most reasonably be attributed to an increase in aquifer-system thickness. Simulations indicate that discharge to streams and drains alone is not sufficient to lower hydraulic heads near the lake to measured values. The increase in thickness of the aquifer system in the area allows more water to flow under and eventually



EXPLANATION

INACTIVE CELL

180 ACTIVE CELL--Numeral is layer thickness, in feet

LINE OF APPROXIMATE SURFACE EXTENT OF HELENA VALLEY-FILL AQUIFER SYSTEM

Figure 12.--Finite-difference grid and thickness for layer 3 in the ground-water flow model.

through the bed of Lake Helena and confirms the prevalence of vertical flow in the aquifer system.

Finally, model simulations confirm that the components and quantities of natural recharge and discharge identified in this study are reasonably accurate. A more comprehensive model capable of simulating transient-flow conditions induced by irrigation, seasonal fluctuations in precipitation and streamflow, and changes in aquifer storage probably could more completely test the interpreted water budget for the basin. However, the steady-state model used was sufficiently constrained to confirm the general quantity and distribution of recharge and discharge, and to indicate that inflow from pre-Tertiary bedrock is the principal source of natural recharge to the aquifer system.

Ground-Water Quality

Ground-water quality in the Helena Valley is an increasing concern, owing to continued development in the watershed. Protecting the quality of the ground-water resource necessitates identifying those areas of the aquifer system that are susceptible to contamination.

Susceptibility of Aquifer System to Contamination

Water contamination can include any chemical, physical, or biological constituent, compound, or characteristic that is considered to be undesirable for an intended use of the water. Dissolved contaminants generally are transported in the direction of ground-water flow. However, contaminants that do not dissolve in water can move in directions that differ from the direction of ground-water flow. For example, compounds that are more dense than water can move downward through the aquifer, even in areas where the vertical component of hydraulic gradient and vertical component of flow are upward. Compounds that are less dense than water can mound on the ground-water surface and move in directions other than the direction of flow. The contaminants considered in this study generally include only dissolved chemical constituents or compounds.

The Helena valley-fill aquifer system is relatively susceptible to potential contamination from surface or near-surface sources, because its coarse-grained character in much of the valley could allow contaminants, if present, to readily infiltrate. The parts of the aquifer system most susceptible to potential contamination are those where the hydraulic gradient has a natural or induced downward component and the vertical permeability is sufficient to allow adequate downward flow. These conditions generally exist in the southern and western parts of the aquifer system as identified by the vertical downward component of hydraulic gradient (fig. 7). In addition, localized downward gradients can be induced or increased around pumping wells. Although the small vertical permeability of interstratified clay layers in the valley fill limits downward flow, flow-system analysis indicates that vertical flow occurs over large areas of the aquifer system.

Documented sources of contamination to the aquifer system include septic systems, sewage lagoons, landfills, fuel from surface spills and leaking underground storage tanks and pipe lines, and industrial accidents. Other potential sources of contamination include urban storm-water runoff, effluent from municipal waste water disposal, dry sumps, and agricultural chemicals. Most of the documented and potential sources of contamination to the aquifer system are point specific and only affect relatively localized areas. This study focused on characterizing the overall water quality in the aquifer system and did not address known point-source water-quality problems.

Major Ions and Trace Elements

Water samples were collected during this study according to guidelines described by Knapton (1985) and submitted for laboratory analysis. Major-ion concentrations in water samples collected during this and previous studies are presented in table 10 in the Supplemental Data section at the back of the report. On the basis of these data, water in wells completed in the valley-fill aquifer system generally is a calcium bicarbonate type. This water type probably results from the dissolution of calcium-carbonate rocks present in the valley-fill sediments. Water-quality diagrams of major-ion concentrations for selected samples are shown in figure 13. Dissolved-solids concentrations in water samples collected during this study (July 1989-July 1991) range from 85 mg/L (well 09N02W07ACDD01) to 1,250 mg/L (well 11N03W22BBCB02), and have a median value of 286 mg/L. The U.S. Environmental Protection Agency Secondary Drinking-Water Regulations[1] specify an SMCL of 500 mg/L for dissolved solids in public drinking-water supplies.

Major-ion concentrations of ground water were smallest along losing reaches of Prickly Pear and Tenmile Creeks, possibly indicating the effect of inflow of less mineralized surface water, and along the west, south, and southeast margins of the valley. Major-ion concentrations generally increase slightly downflow in the valley-fill aquifer system.

For example, table 10 denotes a general increase in constituent concentrations along the generalized flow path from well 10N04W23BBCB02 near the point where Tenmile Creek enters the valley to wells 10N03W05CCDD01 and 11N03W33DDDC02, which are successively farther downflow. Results of analyses of water samples collected during this study indicate an increase in the concentration of calcium from 26 to 49 to 64 mg/L, bicarbonate from 116 to 174 to 238 mg/L, and sulfate from 24 to 49 to 56 mg/L along the flow path. The concentrations of sodium and chloride also increased downflow. The increase in major-ion concentrations downflow is probably from dissolution as aquifer water moves through the valley sediments. Effects of human activity such as urban runoff, sewage disposal, and fertilizer application may also increase major-ion concentrations.

With few exceptions, water in nested-pair wells sampled during this study had little change in major-ion concentration with depth. The cause of the large dissolved-solids concentration in the sodium sulfate water in shallow well 11N03W22BBCB02 and the calcium sulfate water in shallow well 10N03W25CDBA02 is unknown.

The suitability of water for irrigation is determined primarily by sodium content. Large concentrations of dissolved sodium in water can cause accumulations of sodium in the soil and a breakdown of granular soil structure. A measure of the probability of damage to soil structure from applied irrigation water is the sodium-adsorption ratio (SAR), which is defined as:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}} \qquad (3)$$

where ion concentrations are expressed in milliequivalents per liter (U.S. Salinity Laboratory Staff, 1954). Waters with an SAR value of 10 or less generally are suitable for all but sodium-sensitive plants (McKee and Wolf, 1971, p. 110). Water in all wells sampled in the Helena Valley had SAR values of 5 or less, which indicates water that is suitable for irrigation as far as sodium content is concerned.

[1] Secondary Drinking-Water Regulations are established for contaminants that can adversely affect the odor or appearance of water and result in discontinuation of use of the water. These regulations specify Secondary Maximum Contaminant Levels (SMCL's), which are esthetically based and nonenforceable (U.S. Environmental Protection Agency, 1991b).

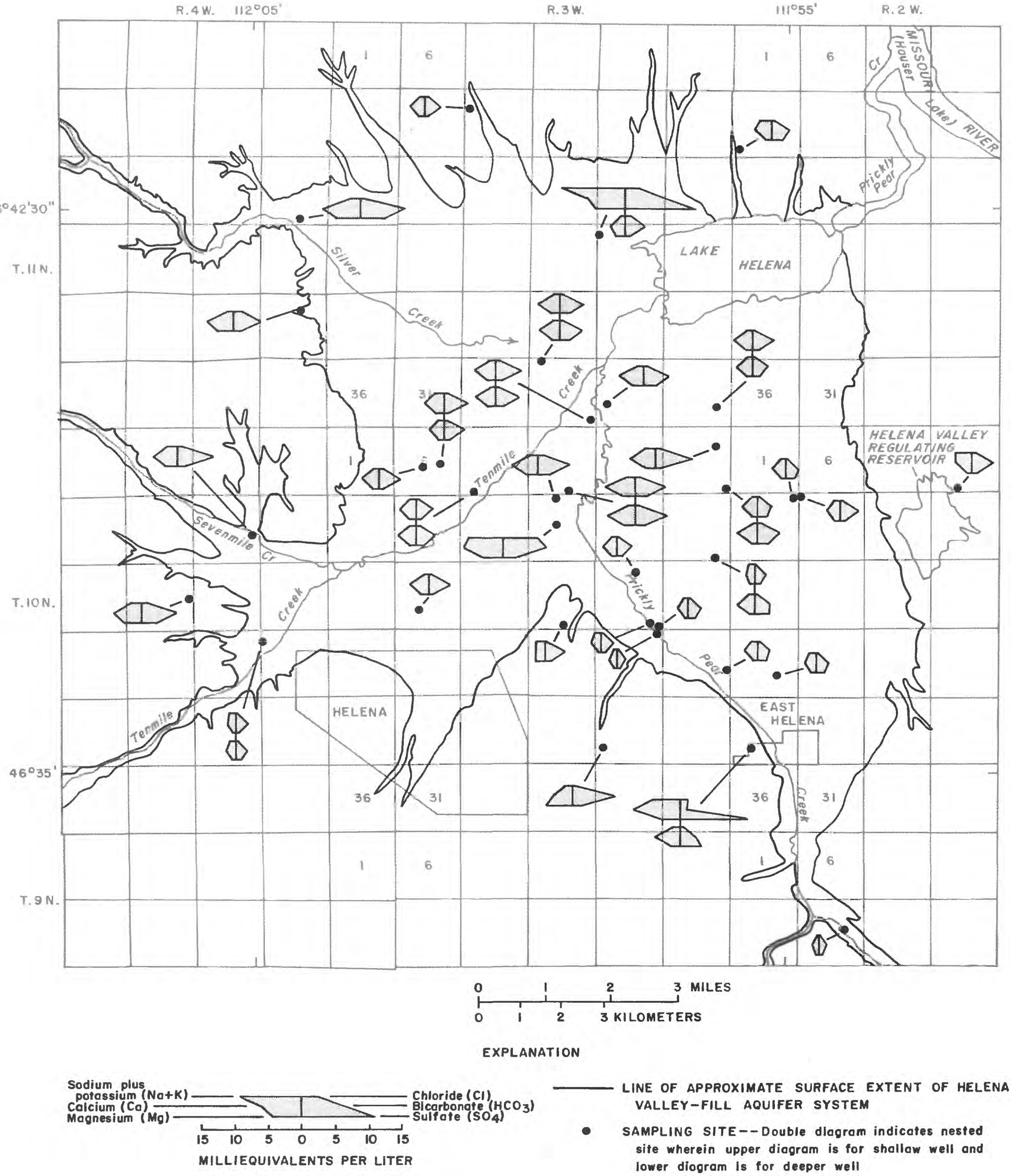


Figure 13.--Water-quality diagrams for water samples collected in 1990 from selected wells.

The concentration of nitrate can be used as an indicator of the effects of human activities on water quality. Except in rare instances, nitrate is not available as a soluble compound from rocks and minerals. Nitrate concentrations that exceed background levels commonly are due to human activities such as sewage disposal and fertilizer application.

Large concentrations of nitrate in ground water can cause concern. Studies have shown that infants can be seriously and occasionally fatally poisoned by continual ingestion of well water containing more than 10 mg/L of nitrate (expressed as elemental nitrogen) (National Academy of Sciences and National Academy of Engineering, 1974). The U.S. Environmental Protection Agency Primary Drinking-Water Regulations[2] specify an MCL of 10 mg/L for nitrate (as nitrogen) in public drinking-water supplies. Large concentrations of nitrate also can be indicative of other undesirable components, which may include fertilizers, pesticides, or pathogenic bacteria and viruses from sewage.

The location of 93 sampled wells and the corresponding nitrate concentrations determined by onsite analysis of samples collected during this study are shown in figure 14. The onsite analyses were conducted with a portable colorimeter using a modification of the cadmium-reduction method (Franson, 1989). Many of the sampled wells are at nested sites; samples from different depths in these wells indicate no consistent pattern with respect to vertical distribution of nitrate in the aquifer system. Also shown in figure 14 is the density of private septic systems per section in the study area. Despite the ambiguity in interpreting the distribution of nitrate in the valley-fill aquifer system, some degree of correlation appears to exist between areas having the largest concentrations of nitrate in water samples and areas having the largest density of private septic systems.

The median nitrate concentration determined by onsite analysis of samples collected during this study is 1.1 mg/L. Eighty-one of the samples also were analyzed by a laboratory. The median difference between nitrate concentrations determined by onsite analysis and laboratory analysis is 0.34 mg/L.

Trace-element concentrations determined by laboratory analysis of water samples collected during this and previous studies are presented in table 11 in the Supplemental Data section at the back of the report. Trace-constituent concentrations in all wells sampled during this study were smaller than the MCL's. However, the large concentrations of aluminum (3,300 µg/L) and iron (5,000 µg/L) in water from well 10N03W09BAA01 are larger than the SMCL's and may result from the dissolution of colloidal material that passed through the sampling filter during sample preparation. The well, which is completed in fine-grained sediment, was drilled to monitor potential leakage of a nearby sewage lagoon and produces murky water. The well is not used for drinking-water supply. The reason for the anomalously large concentrations of iron in wells 10N03W01DBCC02, 10N04W10DDDA01, and 11N04W25DDDD01 during part of 1979 is unknown.

Seven wells sampled during this study have water-quality analyses that date back at least 10 years; one of those was sampled 19 years ago. Analyses of current (1990) water samples from these seven wells indicate no significant increase in constituent concentrations during the period of record.

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[2]National Primary Drinking-Water Regulations are established for contaminants, which, if present in drinking water, may cause adverse human health effects. Either a Maximum Contaminant Level (MCL) or a treatment technique is specified by these regulations for regulated contaminants. MCL's are health-based and enforceable (U.S. Environmental Protection Agency, 1991a).

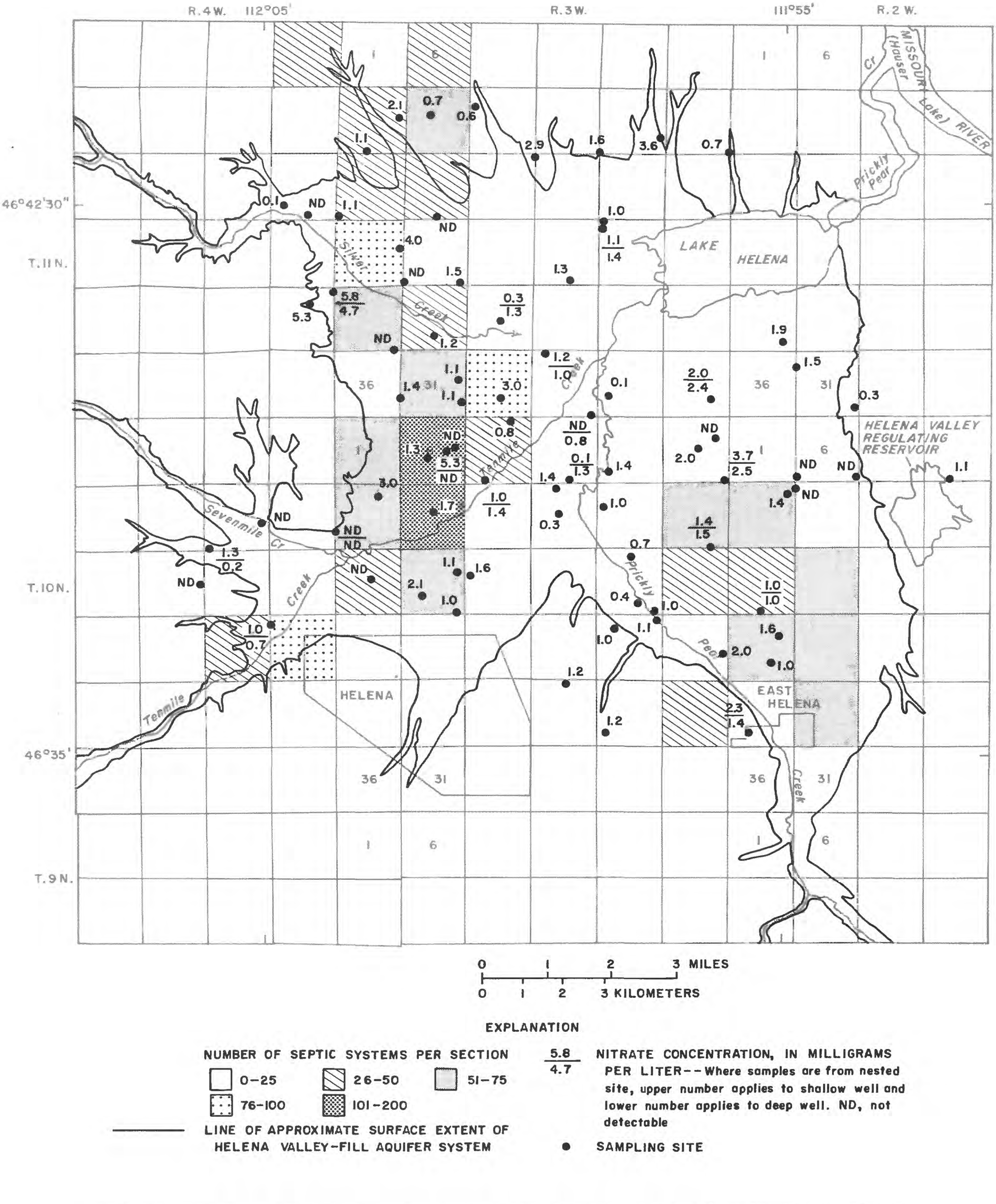

Figure 14.--Onsite determination of nitrate concentration in water from selected wells and density of private septic systems.

Organic Compounds

To determine if organic compounds have entered the valley-fill aquifer system, water samples from 39 selected wells and 1 open drain not associated with known point-sources of contaminants were analyzed for volatile organic compounds, semi-volatile organic compounds, and pesticides. Specific compounds, minimum reporting levels for the analytical methods used, and analyzing laboratories are listed in tables 12-14 in the Supplemental Data section at the back of the report. The results of analyses are given in tables 5, 6, and 7.

Only a few volatile organic compounds were detected in the water samples analyzed. Chloroform and bromodichloromethane were detected in water samples from three wells and one well, respectively, in concentrations slightly exceeding minimum reporting levels (table 5). Chloroform and bromodichloromethane can be created by the process of water chlorination (Howard, 1990) and are commonly found in small concentrations in the City of Helena water supply (W.I. Selser, Lewis and Clark City-County Health Department, oral commun., 1991). Other volatile organic compounds (cis-1,2-dichloroethene and trichloroethene) were also detected in very small concentrations in water samples from two wells. The concentrations detected did not exceed the MCL's for the respective compounds. The compound cis-1,2-dichloroethene commonly is used as a solvent and extractant (Howard, 1990), and the compound trichloroethene commonly is used as a solvent and dry-cleaning agent (Lucius and others, 1990). The concentrations of compounds detected could represent actual water quality in the aquifer. However, the source of chloroform in the water sample from 10N03W04DCCD04 (table 5) could be the distilled water used to clean and rinse the portable sampling equipment prior to sampling. In addition, the small concentrations of any of the volatile organic compounds detected could have been introduced from the plumbing system at the sampling site, from the containers used to collect the samples, or as part of the analytical process. One semi-volatile organic compound was detected in three water samples from wells (table 6). The compound, bis(2-ethylhexyl)phthalate, commonly is used as a plasticizer in manufacturing and is almost insoluble in water under normal conditions. The detected concentrations of the compound in the samples could represent actual water quality in the aquifer. However, because no likely source of the compound is known to exist near the sampling sites and the compound is almost insoluble in water, the detected concentrations very likely were introduced from the plumbing system at the sampling site, from the containers used to collect the samples, or as part of the analytical process.

One pesticide was detected in 1 of 15 water samples analyzed for a variety of pesticides (table 7). The 0.44-μg/L concentration of 2,4-D detected in a sample from shallow well 11N03W15DCDD01 is substantially smaller than the 70-μg/L MCL. A subsequent sample of water from the site contained no detectable pesticides.

Table 5.--*Results of analyses for volatile organic compounds in water samples collected January through June 1991*

[Equipment: E, existing plumbing system at site; G, grab sample; S, portable submersible sampling pump and hose. Sample type: D, duplicate; F, field; P, primary; T, trip blank. Laboratory: A, Energy Laboratories, Inc., Billings, Mont.; B, Chemistry Laboratory Bureau, Montana Department of Health and Environmental Sciences, Helena, Mont. Compound: N, none. Abbreviation: µg/L, micrograms per liter. Symbol: --, concentration less than minimum reporting level or not applicable]

Location number	Sample collection date	Equipment used to obtain sample	Sample type	Laboratory	Compound with concentration exceeding minimum reporting level	Concentration (µg/L)
			Primary and duplicate samples			
10N02W18DDCD01	01-14-91	E	P	A	N	--
	01-14-91	E	D	A	N	--
	06-17-91	E	P	B	N	--
	06-17-91	E	D	B	N	--
10N02W30DBCC01	01-16-91	E	P	A	N	--
	06-17-91	E	P	B	N	--
10N03W02DDDD03	01-18-91	S	P	A	N	--
10N03W04DCCD02	01-24-91	S	P	A	N	--
10N03W04DCCD04	06-18-91	S	P	B	Chloroform	0.6
10N03W15ABCA03	01-23-91	S	P	A	N	--
	06-18-91	S	P	B	N	--
10N03W16DCCC02	06-26-91	E	P	B	N	--
	06-26-91	E	D	B	N	--
10N03W17ABAA01	01-22-91	E	P	A	N	--
	06-17-91	E	P	B	cis-1,2-Dichloroethene	1.0
10N03W17DCDD01	01-14-91	E	P	A	N	--
10N03W18AAAB01	01-14-91	E	P	A	N	--
	06-17-91	E	P	B	N	--
	06-17-91	E	D	B	N	--
10N03W18BABC01	06-26-91	E	P	B	N	--
10N03W19BDDD01	06-17-91	E	P	B	N	--
10N03W20CAAC01	06-17-91	E	P	B	Chloroform	4.1
10N03W23ABAA01	01-22-91	E	P	A	N	--
	06-17-91	E	P	B	N	--
10N03W23BBB 01	06-26-91	E	P	B	N	--
	06-26-91	E	D	B	N	--
10N03W27CCAB01	01-16-91	E	P	A	N	--
	06-17-91	E	P	B	N	--
10N03W29BCAD01	06-17-91	E	P	B	N	--
10N03W30DAAD01	06-17-91	E	P	B	Chloroform	3.6
					Bromodichloromethane	.9
10N04W13ACCD01	01-23-91	S	P	A	N	--
	01-23-91	S	D	A	N	--
10N04W14BCCC01	06-26-91	E	P	B	Trichloroethene	.8
10N04W15DBB 01	06-18-91	E	P	B	N	--
10N04W23BBCB02	01-18-91	S	P	A	N	--
	06-18-91	S	P	B	N	--
11N02W31BCCB01	01-22-91	E	P	A	N	--
11N03W07BDBB01	06-17-91	E	P	B	N	--
11N03W17CCCD01	01-18-91	E	P	A	N	--
11N03W30DBCA01	01-14-91	E	P	A	N	--
11N03W32BAAC01[1]	06-26-91	G	P	B	N	--
11N03W33BBAA01	01-16-91	S	P	A	N	--
11N03W33BBAA02	01-16-91	S	P	A	N	--
	06-26-91	S	P	B	N	--
11N03W35DACC01	06-26-91	S	P	B	N	--
11N04W12ADDA01	06-17-91	E	P	B	N	--
11N04W24ADDA01	06-17-91	E	P	B	N	--
			Field[2] and trip[3] blanks			
10N04W23BBCB02	06-18-91	--	F	B	Chloroform	7.1
					1,1,1-Trichloroethane	2.7
11N03W33BBAA02	01-16-91	--	F	A	Chloroform	8.0
	06-26-91	--	F	B	Benzene	2.9
					Chloroform	9.7
					Ethylbenzene	.5
					Tetrachloroethene	.5
					Toluene	2.1
					1,1,1-Trichloroethane	2.3
					1,2,4-Trimethylbenzene	.7
					m + p - Xylene	2.6
					o - Xylene	.6
--	06-17-91	--	T	B	N	--
--	06-18-91	--	T	B	N	--
--	06-27-91	--	T	B	N	--

[1] Sample obtained from open drain.
[2] A blank solution consisting of the water from the final rinse of the portable pump and hose that were used, where indicated, to obtain the water sample from the aquifer.
[3] A blank solution that is put in the same type of bottle used for an environmental sample and stored adjacent to an environmental sample and kept with the set of sample bottles both before and after sample collection.

Table 6.--*Results of analyses for semi-volatile organic compounds in water samples collected January through June 1991*

[Equipment: E, existing plumbing system at site; S, portable submersible sampling pump and hose. Sample type: D, duplicate; P, primary. Laboratory: A, Energy Laboratories, Inc., Billings, Mont.; B, Chemistry Laboratory Bureau, Montana Department of Health and Environmental Sciences, Helena, Mont. Compound: N, none. Abbreviation: µg/L, micrograms per liter. Symbol: --, concentration less than minimum reporting level]

Location number	Sample collection date	Equipment used to obtain sample	Sample type	Laboratory	Compound with concentration exceeding minimum reporting level	Concentration (µg/L)
10N03W04DCCD02	01-24-91	S	P	A	N	--
	01-24-91	S	D	A	N	--
10N03W18BABC01	06-26-91	E	P	B	N	--
10N03W20CAAC01	06-17-91	E	P	B	bis(2-Ethylhexyl)phthalate	389
10N03W23ABAA01	01-22-91	E	P	A	N	--
10N03W23BBB 01	06-26-91	E	P	B	N	--
	06-26-91	E	D	B	N	--
10N03W29BCAD01	06-17-91	E	P	B	bis(2-Ethylhexyl)phthalate	486
10N04W23BBCB02	01-18-91	S	P	A	N	--
11N03W17CCCD01	01-18-91	E	P	A	N	--
11N04W14CCDD01	01-23-91	E	P	A	N	--
11N04W24ADDA01	06-17-91	E	P	B	bis(2-Ethylhexyl)phthalate	607

Table 7.--*Results of analyses for pesticides in water samples collected June through July 1991*

[Data from Montana Department of Agriculture, Helena, Mont. Analyses by Laboratory Bureau, Agricultural and Biological Sciences Division, Montana Department of Agriculture, Bozeman, Mont. Equipment: B, teflon bailer; E, existing plumbing system at site; G, grab sample; S, portable submersible sampling pump and hose. Compound: N, none. Abbreviation: µg/L, micrograms per liter. Symbol: --, concentration less than minimum reporting level]

Location number	Sample collection date	Equipment used to obtain sample	Compound with concentration exceeding minimum reporting level	Concentration (µg/L)
10N02W04CDDC01	07-23-91	E	N	--
10N02W18DDCD01	07-23-91	E	N	--
10N03W07DCBB01	07-23-91	E	N	--
10N03W11ABBB01	07-23-91	B	N	--
10N03W18BABC01	07-23-91	E	N	--
10N03W18CADA01	07-23-91	E	N	--
10N03W20CAAC01	06-17-91	E	N	--
10N03W23BBB 01	06-26-91	E	N	--
10N04W14BCCC01	06-26-91	E	N	--
11N02W31ACDD01	06-26-91	E	N	--
11N03W15DCDD01[1]	07-23-91	B	2,4-D	0.44
11N03W17DDDD01	07-23-91	E	N	--
11N03W32BAAC01[2]	06-26-91	G	N	--
11N03W33BBAA02	06-26-91	S	N	--
11N03W35DACC01	06-26-91	S	N	--

[1] A subsequent sample collected at the site by the Montana Department of Agriculture contained no pesticides.
[2] Sample obtained from open drain.

SUMMARY AND CONCLUSIONS

The Helena Valley is located in west-central Montana north and east of the city of Helena. The valley-fill aquifer system underlying the valley is the sole source of domestic water supply for about 13,000 residents. A 2-year study was conducted to describe the geometry, hydraulic characteristics, potentiometric surface, direction of flow, sources of recharge and discharge, susceptibility to contamination, and water quality of that valley-fill aquifer system.

Quaternary valley fill beneath the Helena Valley forms a gently sloping alluvial plain, about 8 mi square, bounded by pediments and alluvial fans that have descended from the adjacent mountains. Four principal streams flow into the valley along its south and west margins: Prickly Pear, Tenmile, Sevenmile, and Silver Creeks. In addition, water from the Missouri River is diverted to the valley for irrigation. The principal surface- and ground-water discharge point from the valley is Lake Helena in the northeast corner of the basin.

The Helena Valley is a topographic and structural intermontane basin bounded by folded and fractured sedimentary, metamorphic, and igneous rocks of Precambrian to Cretaceous age. The estimated 6,000 ft of valley fill is composed primarily of a thick section of fine-grained Tertiary lacustrine ash and volcaniclastic sediments with localized lenses of gravel. Unconformably overlying these deposits is a thinner section of locally derived fine-to-coarse-grained Tertiary sediments that grade into Quaternary alluvium in the upper 100 ft of the valley fill.

The upper few-hundred feet of the valley fill can best be described as a sequence of complexly stratified lenses of cobbles, gravel, and sand with 30-70 percent of the section composed of intercalated silt and clay. Lateral discontinuity of the many fine-grained layers allows hydraulic interconnection of the coarse-grained water-yielding zones, which therefore function as one complex aquifer system. Little information is available regarding the hydrogeologic character of the valley fill below a depth of a few hundred feet, because abundant water in the shallow parts of the aquifer system has generally made deeper drilling unnecessary.

Analysis of data from aquifer tests was inconclusive, owing to the complexity of the valley-fill stratigraphy, which is not representative of the hydrologic conditions upon which solution techniques are based. However, qualified analysis of the data indicates that a transmissivity of about 10,000 ft^2/d probably is a reasonable estimate for water-yielding zones in the valley fill. Assuming that the average thickness of water-yielding material stressed by the pumping is 50 ft, the effective hydraulic conductivity of the water-yielding zones is about 200 ft/d. On the basis of the interpreted hydrogeology, the effective vertical hydraulic conductivity of the aquifer system is probably 1-3 orders of magnitude smaller than that in the horizontal direction.

The potentiometric surface in the upper 25 ft of saturated valley fill depicts horizontal ground-water flow from the south, west, and north margins of the valley toward Lake Helena and flow sub-parallel to the fine-grained Tertiary sediments of the Spokane Bench on the east side of the study area. Seasonal fluctuations in water level do not significantly alter the shape of the potentiometric contours or the direction of horizontal flow in the aquifer system. The potential for vertical flow in the aquifer system was determined from measured vertical components of the hydraulic gradient. The vertical components indicate that the Helena Valley can be divided into two areas--an area within about 4 mi of Lake Helena, which displays an upward gradient, and the rest of the valley, which displays a downward gradient. Where the vertical permeability is sufficient, vertical flow in the aquifer system can be significant.

Recharge to the Helena valley-fill aquifer system is through infiltration of streamflow (12,900 acre-ft/yr), leakage from irrigation canals (7,060 acre-ft/yr), infiltration of excess water applied to irrigated fields (27,000 acre-ft/yr), and inflow from fractures in the surrounding bedrock (39,800 acre-ft/yr). Evaporation and transpiration from non-irrigated parts of the valley exceed precipitation;

therefore, recharge from precipitation occurs only in response to infrequent periods of sustained precipitation or as part of excess water applied to irrigated fields.

Discharge from the aquifer system is through leakage to streams and drains (36,200 acre-ft/yr), upward leakage to Lake Helena (50,000 acre-ft/yr), and withdrawals by wells (2,110 acre-ft/yr). Discharge from evapotranspiration is accounted for in calculations of recharge from excess water applied to irrigated fields and precipitation. The difference between total monthly recharge to and discharge from the aquifer system is accounted for by changes in aquifer storage. Simulation of steady-state flow in the aquifer system during March generally confirmed the validity of the conceptual model of flow and water budget for the valley-fill aquifer system. Model simulations indicate that the mean horizontal hydraulic conductivity of the valley fill is in general agreement with the hydraulic conductivity estimated from aquifer tests, particle-size distribution, and percentage of clay reported in drillers' logs. Model simulations also confirm an increase in thickness of the aquifer system and prevalence of vertical flow near Lake Helena and that the conceptualized components and quantities of natural recharge to and discharge from the aquifer system are probably reasonable estimates.

The aquifer system is relatively susceptible to potential contamination from surface or near-surface sources, because the coarse-grained character of the near-surface valley fill could readily allow infiltration. Parts of the aquifer system most susceptible to potential contamination are those where the hydraulic gradient has a natural or induced downward component and the vertical permeability is sufficient to allow downward flow. These conditions generally exist in the southern and western parts of the aquifer system. In addition, localized downward gradients can be induced or increased around pumping wells.

Analysis of water samples collected during this study indicate that water in wells completed in the valley-fill aquifer system generally is a calcium bicarbonate type, probably owing to dissolution of calcium-carbonate rocks in the valley fill. Dissolved-solids concentrations ranged from 85 to 1,250 mg/L with a median value of 286 mg/L. Major-ion concentrations, which were smallest along the west, south, and southeast margins of the valley and along losing reaches of Prickly Pear and Tenmile Creeks, increase slightly downflow in the aquifer system. Water in all wells in the valley has SAR values of 5 or less, which indicates water that is suitable for irrigation as far as sodium content is concerned. The median nitrate concentration determined onsite is 1.1 mg/L. Despite an apparently anomalous distribution of nitrate in the valley-fill aquifer system, some degree of correlation seems to exist between areas having the largest concentration of nitrate in water samples and areas having the largest density of private septic systems. Analysis of historical water-quality records indicates no significant increase in constituent concentrations during the period of record (1971-90).

Analysis for organic compounds in water samples from 39 wells and 1 open drain indicates the occurrence of small concentrations (0.6 to 4.1 µg/L) of several volatile organic compounds, which may have resulted from equipment contamination during sample collection and handling or as part of the analytical process. One semi-volatile organic compound was detected in water samples from three domestic wells. The compound is used as a plasticizer in manufacturing and is almost insoluble in water; therefore, the small concentrations detected very likely were introduced by the sampling equipment, sample containers, or as part of the analytical process. A very small concentration of pesticide (0.44 µg/L of 2,4-D) was detected in one water sample but a subsequent sample at the site had no detectable pesticide.

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SUPPLEMENTAL DATA

Table 8.--*Records of wells*

Location number--numbering system described in text.

Altitude of land surface--reported in feet above sea level.

Geologic unit--Qal, Quaternary alluvium; Tsu, Tertiary sediments undifferentiated (queried where upper contact is uncertain); pTb, pre-Tertiary bedrock.

Depth of well--reported in feet below land surface.

Primary use of water--C, commercial; H, domestic; I, irrigation; P, public supply; S, stock; U, unused; Z, other.

Water level--reported in feet below or above (+) land surface.

Temperature--reported in degrees Celsius; onsite measurement.

Specific conductance--reported in microsiemens per centimeter at 25 °C; onsite measurement.

pH--onsite measurement.

Nitrate, as nitrogen--reported in milligrams per liter; onsite measurement.

Abbreviations--in., inch; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter.

Symbols: - or --, no data; ND, not detectable.

Table 8.--*Records of wells*--Continued

Location number	Altitude of land surface (feet)	Geologic unit	Depth of well (feet)	Diameter of casing (in.)	Date well constructed	Primary use of water	Water level (feet)	Date water level measured	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Nitrate (mg/L)	Date water-quality parameter measured
09N02W06BCCA01	3,965	Qal	--	--	--	H	--	--	11.0	429	7.9	--	06-22-83
09N02W07ACDD01	4,030	Qal	--	--	--	-	--	--	8.0	190	5.8	--	05-29-90
09N03W01ABAA01	3,950	Qal	22	48.0	--	U	12.10	06-22-83	--	--	--	--	--
09N03W01ABAB01	3,950	Tsu	105	6.0	01-01-71	P	--	--	8.5	495	7.1	--	11-18-80
09N03W02CDBA01	4,200	Tsu	400	6.0	--	H	149.61	06-22-83	13.5	409	7.5	--	06-22-83
09N03W12ADBA01	4,343	pTb	--	6.0	01-01-66	U	--	--	--	--	--	--	--
10N02W04CDDC01	3,824	Tsu	120	6.0	03-14-85	H	55.0	03-14-85	11.0	505	7.8	1.1	11-06-90
10N02W06CBCC01	3,707	Qal	24	1.5	01-01-78	U	9.00	12-05-78	20.0	410	--	--	08-18-88
10N02W06CCCC01	3,717	Qal	35	--	--	H	--	--	13.5	305	--	--	07-26-88
									13.0	380	7.5	ND	10-03-90
10N02W06DCDD01	3,716	Qal	--	--	--	H	8.30	06-30-88	9.0	790	--	--	06-30-88
10N02W06DDB 01	3,720	Qal	21	1.5	--	U	7.90	12-06-78	--	--	--	--	--
10N02W06DDBC01	3,715	Qal	24	1.5	01-01-78	U	7.90	12-06-78	14.0	460	--	--	08-19-88
10N02W06DDDA01	3,720	Qal	--	--	--	H	--	--	12.0	422	7.6	ND	11-07-90
10N02W07BAA 01	3,714	Qal	38	6.0	--	H	5.6	07-29-71	17.0	398	--	--	08-31-71
10N02W07BAAB01	3,717	Qal	--	--	--	H	8.29	07-21-88	10.0	530	--	--	07-21-88
10N02W07BBBB01	3,717	Qal	24	1.5	01-01-78	U	11.20	12-05-78	18.5	400	--	--	08-17-88
									17.0	390	6.6	ND	08-17-90
10N02W18AADA01	3,744	Qal	--	--	--	H	--	--	13.0	330	--	--	08-02-88
10N02W18BCCC01	3,775	Qal	--	6.0	--	H	46.10	06-17-83	9.5	364	7.2	--	06-17-83
10N02W18BDBC01	3,765	Tsu(?)	120	8.0	--	H	40.87	06-17-83	11.0	395	7.1	--	06-17-83
10N02W18CAAA01	3,775	Qal	100	6.0	--	H	39.30	06-15-83	11.5	438	7.2	--	06-15-83
10N02W18DDCD01	3,784	Tsu	70	6.6	02-27-79	H	53.12	06-11-81	10.0	400	7.6	--	06-11-81
									9.5	420	7.5	--	06-14-83
10N02W19AAD 01	3,794	Qal	74	6.0	--	H	39.4	07-29-71	14.5	390	--	--	09-01-71
10N02W19ABCB01	3,795	Qal	94	--	08-02-88	H	58.65	08-02-88	12.0	320	--	--	08-02-88
10N02W19ACAB01	3,798	Qal	91	6.0	--	H	63.11	06-14-83	12.0	410	7.4	--	06-14-83
10N02W19BBBB01	3,793	Qal	93	6.0	--	H	61.75	06-14-83	11.0	400	7.2	--	06-14-83
									12.0	370	--	--	07-11-88
10N02W20BAAC01	3,790	Qal	100	--	--	H	--	--	--	--	--	--	--
10N02W29BCC 01	3,861	Qal	80	6.0	--	-	32.9	08-03-71	14.0	733	--	--	09-01-71
10N02W29BCCD01	3,861	Qal	50	48.0	--	U	--	--	--	--	--	--	--
10N02W29CBDA01	3,898	Tsu	--	--	--	P	--	--	11.0	531	7.2	--	10-20-83
10N02W29CBDD01	3,895	Tsu	--	10.0	--	P	--	--	13.0	370	7.8	--	06-15-83
10N02W29CCAA01	3,885	Tsu	--	--	--	H	--	--	11.0	545	--	--	05-01-89
10N02W29CCAA02	3,885	Tsu	--	--	--	H	--	--	7.0	550	--	--	05-01-89
10N02W29CCAA03	3,900	--	130	6.0	--	H	119.75	06-01-89	--	--	--	--	--
10N02W29CCDA01	3,929	Tsu	190	6.0	--	H	98.07	06-15-83	11.0	1,100	7.7	--	06-15-83
10N02W30BBBD01	3,842	Tsu(?)	150	11.0	--	P	53.54	06-14-83	10.0	377	7.1	--	06-14-83
									11.5	200	--	--	08-02-88
10N02W30CDCA01	3,882	Tsu(?)	130	6.6	--	H	75.88	06-20-83	11.5	371	7.3	--	06-20-83
10N02W30CDCA02	3,883	Tsu(?)	144	6.0	--	P	--	--	--	--	--	--	--
10N02W30CDDA01	3,885	Tsu(?)	145	6.0	05-10-77	H	56.50	06-20-83	11.0	520	7.3	--	06-20-83
10N02W30DBAC01	3,865	Tsu(?)	180	--	--	H	--	--	11.0	405	--	--	05-01-89
10N02W30DBBA01	3,864	Tsu	155	--	08-23-88	H	--	--	11.5	420	--	--	08-23-88
10N02W30DBBB01	3,870	Tsu(?)	127	6.0	02-25-76	H	64.03	06-17-83	11.0	371	7.4	--	06-17-83
10N02W30DBCC01	3,864	Qal	40	--	--	H	--	--	11.5	520	--	--	05-01-89
10N02W30DBDA01	3,866	Qal	98	--	--	H	76.75	05-04-89	10.0	680	--	--	05-04-89
10N02W30DCBD01	3,878	Qal	--	--	--	H	--	--	11.0	460	--	--	05-01-89
10N02W31ABA 01	3,897	Qal	--	6.0	--	H	--	--	15.0	--	--	--	09-10-71
10N02W31ABAA01	3,890	Tsu(?)	157	6.0	--	H	58.37	06-20-83	11.5	502	7.3	--	06-20-83
10N02W32AADA01	3,960	Tsu	97	6.0	--	H	84.68	06-21-83	11.0	578	7.7	--	06-21-83
10N03W02ACC 01	3,700	Qal	49	6.0	11-06-82	H	4.51	11-06-90	9.0	402	7.3	2.0	11-06-90
10N03W02ADB 01	3,695	Qal	20	6.0	04-13-90	U	4.55	09-05-90	14.5	620	7.0	ND	09-05-90
10N03W02BCDD01	3,700	Qal	--	--	--	H	--	--	9.5	300	--	--	07-25-88
10N03W02BDD 01	3,696	Qal	40	6.0	--	-	4.0	08-04-71	12.0	402	--	--	08-31-71
10N03W02DDDD01	3,720	Tsu(?)	123	8.0	- -86	I	11.34	08-16-90	11.5	377	7.1	2.5	08-15-90
10N03W02DDDD02	3,720	Tsu(?)	104	2.0	07-13-90	U	11.90	07-27-90	--	--	--	--	--
10N03W02DDDD03	3,720	Qal	25	2.0	07-13-90	U	10.15	07-27-90	12.0	480	7.1	3.7	08-14-90
10N03W03BABB01	3,685	Tsu(?)	119	--	08-17-88	H	--	--	10.5	340	--	--	08-17-88
10N03W03BACB01	3,684	Qal	65	1.5	09-01-78	U	.57	09-26-78	10.0	--	--	--	09-26-78
									8.5	180	9.8	--	06-09-81
									9.0	385	--	--	08-17-88
10N03W03BACB02	3,683	Qal	24	1.5	09-01-78	U	3.51	09-26-78	11.0	420	--	--	09-26-78
									8.5	590	--	--	08-17-88
10N03W03BCDA01	3,692	Qal	--	--	--	H	--	--	9.5	375	--	--	07-12-88
10N03W03BDBB01	3,690	Qal	20	--	07-13-88	H	--	--	9.0	330	--	--	07-13-88
10N03W03CAB 01	3,693	Qal	44	6.0	--	H	4.8	07-30-71	20.5	386	7.7	--	08-17-71
10N03W03CABC01	3,696	Qal	--	--	--	H	--	--	7.5	330	--	--	07-15-88
10N03W03CAC 01	3,693	Qal	50	6.0	01-01-62	S	4.1	07-30-71	13.5	372	--	--	08-31-71

Location number	Altitude of land surface (feet)	Geologic unit	Depth of well (feet)	Diameter of casing (in.)	Date well constructed	Primary use of water	Water level (feet)	Date water level measured	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Nitrate (mg/L)	Date water-quality parameter measured
10N03W03CCA 01	3,700	Qal	32	6.3	04-07-80	H	3.55	11-07-90	8.0	370	7.6	1.4	11-07-90
10N03W04ABBB01	3,691	Qal	--	--	--	H	--	--	9.5	335	--	--	07-18-88
10N03W04DCCD01	3,704	Qal	55	4.0	07-17-90	U	2.22	07-26-90	9.5	462	7.5	1.3	08-07-90
10N03W04DCCD02	3,704	Qal	25	4.0	07-18-90	U	5.21	07-26-90	8.5	641	7.5	.1	08-07-90
10N03W04DCCD03	3,703	Qal	22	2.0	07-17-90	U	5.17	07-26-90	--	--	--	--	--
10N03W04DCCD04	3,703	Qal	22	2.0	07-19-90	U	4.99	07-26-90	--	--	--	--	--
10N03W05ABA 01	3,710	Qal	42	8.0	01-01-22	H	4.8	07-01-71	15.5	418	7.6	--	08-17-71
10N03W05ABAA01	3,708	Qal	--	--	--	H	--	--	9.5	385	--	--	07-26-88
									9.5	470	7.8	.8	09-25-90
10N03W05BAAA01	3,714	Qal	64	1.5	09-01-78	U	8.00	07-23-79	10.0	--	--	--	09-26-78
									10.5	550	--	--	08-17-88
10N03W05BAAB01	3,715	Qal	28	1.5	09-01-78	U	8.89	09-26-78	10.0	312	--	--	09-26-78
									10.5	575	--	--	08-17-88
10N03W05CCDC01	3,750	Qal	45	--	--	H	--	--	10.0	440	--	--	06-22-88
10N03W05CCDD01	3,743	Qal	23	1.5	09-01-78	U	5.00	11-28-78	11.5	425	7.3	1.0	08-15-90
10N03W05CCDD02	3,745	Qal	48	6.0	- -35	H	12.94	08-15-90	9.0	425	7.4	1.4	08-15-90
10N03W06AADA01	3,734	Qal	89	--	--	H	--	--	10.0	580	--	--	06-21-88
10N03W06ABBC01	3,735	Qal	62	1.5	09-01-78	U	17.70	11-30-78	11.5	590	--	--	08-19-88
10N03W06ACD 01	3,740	Qal	48	6.0	--	H	16.2	07-14-71	17.5	487	7.3	--	08-18-71
10N03W06ACDC01	3,749	Qal	55	--	--	H	--	--	10.5	489	--	--	06-21-88
10N03W06ADCD01	3,745	Qal	34	--	--	H	14.79	09-25-90	10.5	472	7.5	ND	09-25-90
10N03W06BCC 01	3,755	Qal	--	6.0	--	H	19.6	07-14-71	14.5	325	--	--	08-23-71
10N03W06CAA 01	3,752	Qal	45	6.0	--	H	19.1	07-14-71	18.5	552	--	--	08-23-71
10N03W06CAAD01	3,758	Qal	40	6.0	10-02-62	H	20.59	07-11-90	10.0	455	7.4	1.3	07-11-90
10N03W06CABB01	3,760	Qal	45	--	--	H	--	--	10.0	470	--	--	07-21-88
10N03W06CDC 01	3,766	Qal	65	6.0	--	H	10.4	07-14-71	13.0	470	--	--	08-23-71
10N03W06DBAA01	3,747	Qal	34	1.5	09-01-78	U	16.36	09-26-78	11.5	420	--	--	11-01-78
									11.0	575	--	--	08-16-88
									8.0	540	7.0	5.3	11-03-90
10N03W06DBAA02	3,747	Qal	62	1.5	09-01-78	U	16.34	09-26-78	11.0	--	--	--	09-26-78
									10.5	430	--	--	08-16-88
									9.0	407	6.9	ND	11-03-90
10N03W06DCA 01	--	Qal	--	--	--	H	--	--	15.0	477	--	--	08-23-71
10N03W06DDCD01	3,758	Qal	46	--	--	H	--	--	9.5	455	--	--	06-21-88
10N03W07AAA 01	3,752	Qal	40	6.0	01-01-70	H	8.3	07-16-71	13.0	488	--	--	08-23-71
10N03W07AAAA01	3,751	Qal	--	6.0	--	U	16.51	04-12-90	--	--	--	--	--
10N03W07AAAC01	3,759	Qal	--	--	--	H	15.01	07-11-88	10.5	430	--	--	07-11-88
10N03W07ABB 01	3,762	Qal	42	6.0	--	H	9.2	07-01-71	19.0	478	7.4	--	08-18-71
10N03W07ABBD01	3,767	Qal	--	--	--	H	--	--	11.0	330	--	--	07-15-88
10N03W07ACCB01	3,778	Qal	89	6.0	--	H	10.74	07-12-90	9.0	310	--	--	07-18-88
									10.5	445	7.1	1.7	07-12-90
10N03W07ADAB01	3,767	Qal	44	--	--	H	--	--	9.0	325	--	--	07-25-88
10N03W07ADD 02	3,763	Qal	40	6.0	--	H	11.4	07-16-71	14.0	507	--	--	08-24-71
10N03W07BAAA01	3,768	Qal	--	--	--	H	--	--	10.0	435	--	--	06-21-88
10N03W07DBC 01	3,782	Qal	32	6.0	--	H	6.4	07-01-71	10.5	446	--	--	08-23-71
10N03W07DCBB01	3,787	Qal	40	--	--	H	--	--	8.0	400	--	--	07-12-88
10N03W07DDC 01	3,785	Qal	65	6.0	--	H	20.9	07-16-71	14.0	708	--	--	08-24-71
10N03W08ADCB01	3,717	Qal	50	--	--	H	--	--	10.0	695	--	--	06-22-88
10N03W08BBA 01	3,748	Qal	60	6.0	--	H	9.6	07-19-71	18.5	409	--	--	08-24-71
10N03W08CBAD01	3,764	Qal	52	--	--	H	12.79	06-27-88	9.0	200	--	--	06-27-88
10N03W08CBCC01	3,767	Qal	23	1.5	09-01-78	U	3.50	09-12-78	12.5	130	--	--	11-01-78
									11.0	465	--	--	08-16-88
10N03W08CCCD01	3,782	Qal	--	--	--	H	--	--	10.0	778	--	--	06-23-88
10N03W08CCDD01	3,775	Qal	--	--	07-20-88	H	--	--	10.0	625	--	--	07-20-88
10N03W08CDAC01	3,764	Qal	--	--	--	H	--	--	12.0	465	--	--	07-15-88
10N03W08CDCC01	3,776	Qal	--	--	07-20-88	H	--	--	9.0	540	--	--	07-20-88
10N03W08CDD 01	3,761	Qal	52	6.0	01-01-67	H	21.3	07-19-71	12.0	607	--	--	08-24-71
10N03W08CDDB01	3,769	Qal	--	--	--	H	--	--	11.0	575	--	--	06-22-88
10N03W08CDDC01	3,782	Qal	62	--	--	H	--	--	9.5	658	--	--	06-23-88
10N03W08CDDC02	3,771	Qal	49	--	--	H	20.64	06-27-88	10.0	705	--	--	06-27-88
10N03W08DACB01	3,745	Qal	--	--	--	H	--	--	10.5	797	--	--	06-22-88
10N03W09ACCC01	3,713	Qal	64	1.5	09-01-78	U	2.02	08-31-79	13.0	520	--	--	08-16-88
10N03W09ACCC02	3,713	Qal	22	1.5	09-01-78	U	4.22	08-31-79	12.5	650	--	--	08-16-88
10N03W09BAA 01	3,710	Qal	17	4.0	03-28-90	U	5.68	09-05-90	12.5	675	7.0	1.4	09-05-90
10N03W09BBBA01	3,722	Qal	--	--	08-23-88	H	--	--	10.0	555	--	--	08-23-88
10N03W09BCCB01	3,729	Qal	--	--	08-23-88	H	--	--	12.0	695	--	--	08-23-88
10N03W09BDD 01	3,715	Qal	16	6.0	03-28-90	U	7.28	09-05-90	12.0	1,390	7.1	.3	09-05-90
10N03W09DAD 01	3,716	Qal	8	48.0	01-01-62	I	3.8	07-29-71	--	--	--	--	--
10N03W10BCBB01	3,707	Qal	57	6.3	05-19-77	H	1.50	11-07-90	10.0	228	7.9	1.0	11-07-90
10N03W11AAA 01	3,719	Qal	35	6.0	--	H	10.2	07-29-71	12.5	361	--	--	09-01-71

Table 8.--*Records of wells*--Continued

Location number	Altitude of land surface (feet)	Geologic unit	Depth of well (feet)	Diameter of casing (in.)	Date well constructed	Primary use of water	Water level (feet)	Date water level measured	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Nitrate (mg/L)	Date water-quality parameter measured
10N03W11ABBB01	3,717	Qal	24	1.5	01-01-78	U	6.99	09-26-78	15.0	450	--	--	09-26-78
									14.5	280	--	--	08-10-88
10N03W11ACCC01	3,732	Qal	--	--	07-26-88	H	--	--	10.5	255	--	--	07-26-88
10N03W11CBAA01	3,730	Qal	23	1.5	01-01-78	U	6.56	11-11-78	15.0	370	--	--	09-26-78
10N03W11CCA 01	3,740	Qal	40	6.0	--	P	6.6	07-29-71	21.5	317	--	--	08-31-71
10N03W11CCCA01	3,743	Qal	60	--	08-01-88	H	16.95	08-01-88	11.5	--	--	--	08-01-88
									--	240	--	--	08-14-88
10N03W11DAA 01	3,740	Qal	46	6.0	--	H	20.3	08-03-71	14.5	318	--	--	09-01-71
10N03W11DBAA01	3,736	Qal	--	--	07-26-88	H	--	--	10.0	325	--	--	07-26-88
10N03W11DBD 01	3,744	Qal	46	6.0	01-01-18	H	10.7	08-04-71	15.0	364	7.5	--	08-16-71
10N03W11DDCC01	3,752	Qal	40	1.5	09-01-78	U	19.00	12-07-78	15.0	262	7.6	1.4	08-10-90
10N03W11DDCC02	3,753	Qal	78	2.0	06-07-90	U	21.56	06-11-90	10.5	415	7.1	1.5	08-09-90
10N03W11DDDC01	3,757	Qal	--	--	--	H	--	--	10.0	320	--	--	08-01-88
10N03W12AAA 01	3,720	Qal	35	6.0	--	H	6.7	07-29-71	15.5	315	--	--	08-31-71
10N03W12AAAD01	3,715	Qal	55	--	--	H	8.60	08-17-90	12.0	330	6.9	1.4	08-17-90
10N03W12ADAD01	3,730	Qal	--	--	--	H	--	--	11.0	350	--	--	07-07-88
10N03W12BABB01	3,721	Qal	--	--	--	H	12.68	06-30-88	10.0	410	--	--	06-30-88
10N03W12CBAB01	3,739	Qal	--	--	08-01-88	H	--	--	10.0	370	--	--	08-01-88
10N03W12CDCB01	3,746	Qal	--	--	07-25-88	H	--	--	10.5	260	--	--	07-25-88
10N03W13BADD01	3,766	Tsu(?)	185	--	--	U	47.33	04-12-90	--	--	--	--	--
10N03W13BBCC01	3,765	Qal	90	6.0	06-01-76	H	38.85	06-16-83	10.5	307	7.0	--	06-16-83
10N03W13BCCD01	3,770	Qal	80	--	07-14-88	H	--	--	10.5	270	--	--	07-14-88
10N03W13BCDC01	3,772	Qal	--	--	08-18-88	H	--	--	10.5	370	--	--	08-18-88
10N03W13CBBA01	3,772	Qal	--	--	08-18-88	H	--	--	--	305	--	--	08-18-88
									10.5	--	--	--	08-19-88
10N03W13CBBB01	3,773	Qal	--	--	--	H	--	--	11.0	310	--	--	07-12-88
10N03W13CBBD01	3,780	Qal	100	6.0	10-01-71	H	33.88	06-16-83	10.0	368	6.9	--	06-16-83
10N03W13CDD 01	3,794	Qal	64	6.0	--	H	37.8	07-29-71	15.0	299	--	--	09-01-71
10N03W13CDDB01	3,790	Qal	56	6.0	08-01-69	H	39.97	06-20-83	10.0	395	7.0	--	06-20-83
10N03W13DCCC01	3,793	Qal	--	--	--	H	38.66	07-26-88	10.0	275	--	--	07-26-88
									9.5	345	7.5	1.0	11-06-90
10N03W13DCCC02	3,793	Tsu(?)	105	--	--	H	54.07	11-06-90	9.5	315	7.3	1.0	11-06-90
10N03W13DDCD01	3,790	Qal	--	6.0	--	H	61.13	06-16-83	9.5	375	6.9	--	06-16-83
10N03W14ADD 01	3,773	Qal	61	6.0	--	H	22.1	08-03-71	15.5	291	--	--	09-01-71
10N03W14BDAC01	3,760	Qal	55	6.0	--	H	18.96	06-21-83	9.5	338	7.1	--	06-21-83
10N03W14CACA01	3,770	Qal	80	--	07-14-88	H	21.50	07-14-88	9.5	270	--	--	07-14-88
10N03W14CACC01	3,780	Qal	--	6.0	--	H	21.45	06-21-83	11.0	338	7.0	--	06-21-83
10N03W14DBBC01	3,766	Qal	96	--	08-18-88	H	25.33	08-18-88	10.5	335	--	--	08-19-88
10N03W14DDDD01	3,796	Tsu(?)	180	--	--	P	41.12	05-12-83	9.5	327	7.3	--	06-21-83
10N03W15ABAA01	3,738	Qal	--	--	--	H	--	--	11.0	270	--	--	07-15-88
10N03W15ABCA01	3,740	Qal	39	8.0	11-14-80	I	4.11	08-01-90	10.0	340	7.3	.7	08-02-90
10N03W15ABCA02	3,740	Qal	36	2.0	07-16-90	U	5.42	08-01-90	--	--	--	--	--
10N03W15ABCA03	3,740	Qal	38	2.0	07-16-90	U	4.40	08-01-90	--	--	--	--	--
10N03W15BAD 01	3,730	Qal	79	6.0	--	H	7.4	07-29-71	14.5	303	7.5	--	08-17-71
10N03W15BCBA01	3,734	Qal	25	1.5	09-01-78	U	1.75	09-26-78	9.0	580	--	--	09-26-78
									10.5	440	--	--	08-10-88
10N03W15BDBD01	3,735	Qal	--	--	--	H	--	--	9.0	360	--	--	07-20-88
10N03W15DDCA01	3,769	Tsu(?)	326	8.0	11-13-87	U	9.97	03-12-90	12.5	250	7.6	.4	08-13-90
10N03W15DDDD01	3,765	Qal	95	6.0	- -78	-	13.57	08-14-90	8.0	285	7.3	1.0	08-14-90
10N03W15DDDD02	3,765	Qal	--	--	11-05-81	U	6.13	11-05-81	--	--	--	--	--
10N03W15DDDD03	3,765	Qal	--	--	--	U	8.55	11-05-81	--	--	--	--	--
10N03W16CCDC01	3,800	Qal	44	1.5	09-01-78	U	36.48	08-31-79	--	--	--	--	--
10N03W16DBAD01	3,756	Qal	44	1.5	09-01-78	U	8.19	09-26-78	11.0	--	--	--	09-25-78
									11.0	565	--	--	08-10-88
10N03W16DCA 01	3,768	Qal	60	6.0	--	H	14.4	07-30-71	16.0	669	7.8	--	08-17-71
10N03W16DCBA01	3,757	Qal	--	--	--	H	--	--	11.0	460	--	--	07-06-88
10N03W16DCCB01	3,781	Qal	80	--	--	H	25.92	07-12-88	12.0	455	--	--	07-12-88
10N03W16DCCC01	3,790	Qal	--	--	08-23-88	H	--	--	12.5	380	--	--	08-23-88
10N03W16DCCC02	3,780	Qal	75	--	--	H	27.7	08-13-90	13.0	425	8.0	--	08-13-90
10N03W17ABA 01	3,761	Qal	60	6.0	--	H	10.6	07-21-71	15.5	630	7.5	--	08-17-71
10N03W17ABAA01	3,760	Qal	51	--	- -66	H	23.68	01-22-91	10.5	470	7.5	--	01-22-91
10N03W17ABBB01	3,772	Qal	28	1.5	09-01-78	U	22.07	12-28-78	14.0	365	--	--	08-11-88
10N03W17ACAD01	3,775	Qal	28	1.5	09-01-78	U	14.10	12-06-78	--	--	--	--	--
10N03W17ACCC01	3,785	Qal	32	1.5	09-01-78	U	26.09	12-28-78	13.0	405	--	--	08-11-88
10N03W17ACCC02	3,785	Qal	44	1.5	09-01-78	U	26.02	12-20-78	11.5	425	--	--	08-11-88
10N03W17BABA01	3,779	Qal	--	--	07-18-88	H	27.46	07-18-88	8.5	550	--	--	07-18-88
10N03W17BCCA01	3,799	Tsu(?)	120	--	--	I	--	--	7.0	670	7.9	1.6	10-03-90
10N03W17CCCC01	3,837	Tsu(?)	120	6.0	03-05-87	U	2.24	05-01-90	--	--	--	--	--
10N03W17DCDD01	3,818	Tsu(?)	106	36.0	--	H	51.13	01-14-91	11.0	610	7.7	--	01-14-91
10N03W17DDAD01	3,796	Qal	43	1.5	09-01-78	U	33.63	12-28-78	14.0	335	--	--	08-12-88

Location number	Altitude of land surface (feet)	Geologic unit	Depth of well (feet)	Diameter of casing (in.)	Date well constructed	Primary use of water	Water level (feet)	Date water level measured	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Nitrate (mg/L)	Date water-quality parameter measured
10N03W17DDAD02	3,795	Qal	25	1.5	09-01-78	U	--	--	--	--	--	--	--
10N03W18AAAB01	3,783	Qal	55	--	--	H	24.12	06-23-88	10.0	636	--	--	06-23-88
10N03W18ADA 01	3,800	Qal	59	6.0	01-01-61	H	36.3	07-01-71	--	--	--	--	--
10N03W18ADA 02	3,800	Qal	41	6.0	--	H	37.2	07-01-71	9.5	636	--	--	08-24-71
10N03W18ADAC02	3,795	Qal	65	--	--	H	42.40	09-26-90	7.5	820	8.8	1.1	09-26-90
10N03W18ADB 01	3,808	Qal	90	6.0	--	H	41.7	07-16-71	7.5	605	7.6	--	08-17-71
10N03W18ADBC01	3,808	Qal	--	--	--	H	--	--	6.0	490	--	--	07-21-88
10N03W18ADDD01	3,810	Qal	--	--	--	H	--	--	8.0	640	--	--	07-07-88
10N03W18BAA 01	3,799	Qal	52	6.0	--	H	18.6	07-01-71	14.5	708	--	--	08-23-71
10N03W18BABC01	3,800	Qal	46	6.0	01-01-72	H	15.53	06-26-91	8.5	650	7.1	--	06-26-91
10N03W18CACD01	3,845	Tsu(?)	122	6.0	09-06-79	U	15.24	08-23-90	10.0	440	7.8	2.1	08-16-90
10N03W18CADA01	3,806	Qal	--	--	07-28-88	H	--	--	9.0	680	--	--	07-28-88
10N03W18CCC 01	3,860	Qal	53	6.0	--	H	39.6	07-19-71	20.5	1,060	--	--	08-23-71
10N03W18CDD 01	3,850	Qal	86	6.0	--	H	13.5	07-19-71	20.0	649	--	--	08-23-71
10N03W18DDD 01	3,843	Qal	66	6.0	--	H	27.2	07-19-71	15.5	618	--	--	08-23-71
10N03W18DDDC01	3,789	Qal	70	--	--	H	45.8	10-03-90	13.0	408	7.6	1.0	10-03-90
10N03W19ACC 01	3,912	Qal	23	48.0	--	I	9.4	07-28-71	11.0	568	7.5	--	08-18-71
10N03W19BDDD01	3,920	Tsu(?)	125	6.0	01-01-84	H	38.93	06-17-91	9.2	695	7.3	--	06-17-91
10N03W20CAAC01	3,820	Qal	100	6.0	01-01-88	I	47.43	06-17-91	10.5	1,380	7.2	--	06-17-91
10N03W22AAAA01	3,774	Qal	23	1.5	09-01-78	U	12.38	12-17-78	9.0	192	7.8	1.1	08-14-90
10N03W22AABB01	3,765	Qal	100	6.0	--	H	9.10	06-16-83	7.5	290	7.3	--	06-16-83
10N03W22BACC01	3,790	Qal	65	--	--	H	--	--	10.5	449	8.0	1.0	10-02-90
10N03W23ABAA01	3,790	Qal	--	--	07-14-88	H	--	--	11.5	193	--	--	07-14-88
10N03W23ABBB01	3,790	Qal	100	24.0	--	C	25.90	06-16-83	8.5	310	7.1	--	06-16-83
10N03W23BBB 01	3,775	Qal	40	6.0	01-01-55	H	13.4	07-29-71	12.0	235	--	--	09-01-71
10N03W23BBBB01	3,774	Qal	35	--	--	H	--	--	5.0	240	--	--	07-07-88
10N03W23DAAD01	3,816	Tsu(?)	180	6.0	--	U	35.82	04-17-90	10.0	325	7.2	2.0	08-09-90
10N03W24ACBB01	3,810	Qal	74	6.0	01-01-72	H	38.72	06-20-83	10.5	388	6.8	--	06-20-83
10N03W24ACCC01	3,820	Qal	--	6.0	--	H	39.14	06-20-83	10.5	363	7.1	--	06-20-83
10N03W24ACDA01	3,820	Qal	62	6.0	--	H	39.06	06-14-83	9.5	418	7.2	--	06-14-83
10N03W24ADB 01	3,812	Qal	70	--	--	H	41.9	10-02-90	10.0	395	6.8	1.6	10-02-90
10N03W24ADDB01	3,812	Qal	72	--	--	H	41.65	07-07-88	10.0	380	--	--	07-07-88
10N03W24BBBA01	3,798	Qal	65	--	--	H	--	--	10.5	340	--	--	07-11-88
10N03W24BBBC01	3,800	Qal	58	6.0	--	H	36.70	06-20-83	11.0	--	7.4	--	06-20-83
10N03W24BCBB01	3,810	Tsu(?)	144	--	--	P	47.70	06-01-80	9.0	325	7.1	--	06-21-83
10N03W24CBD 01	3,824	Qal	60	6.0	--	H	32.1	08-04-71	12.0	256	7.5	--	08-16-71
10N03W24CCAA01	3,825	Qal	76	6.0	--	H	33.92	06-21-83	9.5	280	7.0	--	06-21-83
10N03W24CCDA01	3,835	Qal	--	--	--	H	--	--	11.0	260	--	--	07-11-88
10N03W24DADB01	3,825	Qal	63	6.0	07-01-73	H	36.65	06-16-83	10.0	345	7.0	--	06-16-83
10N03W24DBD 01	3,825	Qal	67	6.0	03-27-90	U	47.81	09-05-90	11.0	349	7.0	1.0	09-05-90
10N03W25ACDC01	3,858	Qal	18	18.0	--	U	5.75	06-16-83	--	--	--	--	--
10N03W25ACDC02	3,858	Qal	84	6.0	03-30-69	H	16.84	06-16-83	9.0	281	7.2	--	06-16-83
10N03W25BBB 01	3,839	Qal	60	8.0	--	I	30.4	08-04-71	18.5	410	--	--	09-01-71
10N03W25BBCC01	3,840	Tsu	--	--	--	I	25.05	06-20-83	11.0	1,200	6.8	--	06-20-83
10N03W25CBBA01	3,860	Tsu	110	6.0	--	H	12.20	06-17-83	9.5	600	7.4	--	06-17-83
10N03W25CDBA01	3,871	Tsu	165	--	01-01-82	H	24.60	10-12-83	11.5	575	7.1	1.4	08-08-90
10N03W25CDBA02	3,872	Tsu	82	6.0	03-08-90	U	26.78	05-11-90	14.5	1,320	6.9	2.3	08-13-90
10N03W25CDBB01	3,878	Tsu	35	6.0	01-01-61	H	12.71	10-12-83	--	--	--	--	--
10N03W25CDBB02	3,876	Tsu	90	6.0	05-01-80	H	9.35	10-12-83	--	--	--	--	--
10N03W26CAAC01	3,918	Tsu	150	6.0	08-16-76	H	54.30	06-17-83	12.0	518	7.6	--	06-17-83
10N03W26CCCA01	3,950	Tsu	43	6.0	--	H	9.20	06-23-83	12.5	705	7.5	--	06-23-83
10N03W26DBBA01	3,900	Tsu	71	6.0	--	H	37.60	06-17-83	11.0	433	7.3	--	06-17-83
10N03W27CACB01	3,920	pTb	415	6.0	--	C	--	--	--	--	--	--	--
10N03W27CADB01	3,920	pTb	--	--	--	C	--	--	11.0	605	7.8	--	06-21-83
10N03W27CCAB01	3,948	Tsu	110	6.0	08-25-81	H	24.50	06-11-90	11.5	750	7.4	1.2	08-16-90
10N03W27DDC 01	3,980	Tsu	43	12.0	--	U	27.9	08-04-71	--	--	--	--	--
10N03W28ABBB01	3,890	Tsu(?)	180	6.0	02-26-87	C	9.07	07-17-90	11.0	775	7.8	1.2	07-17-90
10N03W28DDAD01	3,960	Tsu	130	6.0	--	P	25.73	06-22-83	--	--	--	--	--
10N03W29BCAD01	3,980	Qal	42	6.0	01-01-87	I	16.57	06-17-91	9.8	2,500	7.4	--	06-17-91
10N03W30BBBC02	3,760	Qal	66	--	07-22-88	H	34.54	07-22-88	13.0	325	--	--	07-22-88
10N03W30DAAD01	4,040	Tsu(?)	106	6.0	01-01-86	I	--	--	11.9	1,080	7.5	--	06-18-91
10N03W31BDBD01	4,253	--	150	6.0	04-29-88	I	96.2	04-20-91	--	--	--	--	--
10N03W36ABAB01	3,885	Qal	--	--	--	Z	--	--	15.0	1,280	6.8	--	10-20-83
10N03W36ABBB01	3,885	Tsu	162	--	--	C	--	--	12.0	350	7.0	--	10-20-83
10N04W01AABB01	3,748	Qal	--	--	--	H	--	--	12.5	440	--	--	06-20-88
10N04W01CDCD01	3,865	pTb	85	--	01-01-70	C	34.79	10-17-80	11.0	383	8.2	--	10-17-80
10N04W01DAAB01	3,765	Qal	--	--	07-19-88	H	--	--	12.0	515	--	--	07-19-88
10N04W01DABC01	3,765	Qal	--	--	--	H	--	--	14.0	370	--	--	07-19-88
10N04W01DBAD01	3,779	Qal	--	--	07-19-88	H	--	--	12.5	390	--	--	07-19-88
10N04W01DCAD01	3,795	pTb	95	6.0	08-31-73	P	45.00	08-31-73	12.0	550	8.0	--	10-14-80

Location number	Altitude of land surface (feet)	Geologic unit	Depth of well (feet)	Diameter of casing (in.)	Date well constructed	Primary use of water	Water level (feet)	Date water level measured	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Nitrate (mg/L)	Date water-quality parameter measured
10N04W01DCDA01	3,830	pTb	209	--	10-01-74	H	68.75	10-14-80	11.5	713	8.0	--	10-14-80
10N04W02CBAA01	4,049	pTb	110	6.0	08-08-76	H	25.37	11-14-76	11.0	450	7.6	--	05-31-90
10N04W03DADA01	4,050	Qal	87	--	--	U	31.66	10-25-88	--	--	--	--	--
10N04W10CCCD01	4,090	Qal	85	--	--	I	28.36	07-12-90	15.0	795	7.4	.2	07-12-90
10N04W10CCCD02	4,090	Qal	78	--	--	H	32.16	07-13-90	12.0	870	7.4	1.3	07-13-90
10N04W10DAAC01	3,930	Qal	16	6.0	08-30-90	U	11.07	09-05-90	10.5	640	7.3	ND	09-05-90
10N04W10DDDA01	3,914	Qal	23	1.5	09-15-78	U	3.73	09-26-78	12.5	138	--	--	09-26-78
10N04W12AABC01	3,800	Qal	--	--	--	-	--	--	9.0	765	--	--	06-28-88
10N04W12AACD02	3,800	Qal	--	--	09-29-89	-	--	--	--	--	--	--	--
10N04W12ABAA01	3,801	pTb	105	6.0	03-24-75	H	38.41	10-17-80	11.0	720	8.1	--	10-17-80
10N04W12ABDC01	3,805	pTb	110	--	01-01-74	H	--	--	10.0	681	7.7	--	10-15-80
									11.0	680	--	--	06-22-88
10N04W12ABDC02	3,820	Tsu	93	--	--	H	18.4	09-26-90	10.0	706	8.8	3.0	09-26-90
10N04W12ACBB01	3,820	pTb	400	6.0	02-22-79	H	20.00	02-22-79	11.5	625	7.7	--	10-15-80
10N04W12ACDA01	3,799	Qal	23	1.5	09-15-78	U	10.00	12-05-78	15.0	520	--	--	08-11-88
10N04W12BACD01	3,841	pTb	120	--	05-01-80	H	12.15	10-17-80	11.0	502	8.1	--	10-17-80
10N04W12BBAA01	3,885	pTb	30	6.0	07-31-73	H	3.83	10-14-80	10.5	530	7.9	--	10-14-80
10N04W12BBDB01	3,870	pTb	60	6.0	08-27-73	H	10.91	10-17-80	10.0	1,090	8.0	--	10-17-80
10N04W12CADB01	3,829	Qal	23	1.5	01-01-78	U	14.86	09-26-78	12.0	515	--	--	09-26-78
									10.5	535	--	--	08-11-88
10N04W12CBCC01	3,835	Tsu(?)	112	6.6	04-14-78	H	7.04	09-25-90	10.5	559	7.5	ND	09-25-90
10N04W12CBCC02	3,835	Qal	50	6.6	07-07-83	H	8.53	09-25-90	14.0	650	7.5	ND	09-25-90
10N04W12DAD 01	3,801	Qal	--	6.0	--	H	4.9	07-21-71	16.0	485	--	--	08-30-71
10N04W12DBCB01	3,822	Qal	--	--	--	H	--	--	10.0	680	--	--	06-20-88
10N04W13ABDD01	3,822	Qal	20	--	07-28-88	H	11.69	07-28-88	9.5	475	--	--	07-28-88
10N04W13ACCD01	3,831	Qal	19	6.0	09-30-74	U	8.03	05-01-90	8.0	460	7.5	--	01-23-91
10N04W13ACCD02	3,832	Qal	92	6.0	08-21-84	H	31.86	05-10-90	8.0	300	7.6	ND	11-07-90
10N04W13CBB 01	3,850	Qal	35	6.0	01-01-68	P	6.5	07-21-71	11.0	275	--	--	08-30-71
10N04W13DCAC01	3,856	Qal	100	--	07-27-88	H	27.60	07-28-88	10.0	1,320	--	--	07-28-88
10N04W13DCAD01	3,860	Qal	85	--	07-27-88	H	28.01	07-27-88	10.5	985	--	--	07-27-88
10N04W13DCAD02	3,860	Qal	50	--	--	H	--	--	9.5	1,260	--	--	05-10-89
10N04W13DCAD03	3,850	Qal	70	--	--	H	29.38	05-10-89	9.5	780	--	--	05-10-89
10N04W13DCCA01	3,850	Qal	80	--	--	H	25.15	05-09-89	10.0	630	--	--	05-09-89
10N04W13DCCB01	3,850	Qal	55	--	--	H	--	--	10.0	1,100	--	--	05-09-89
10N04W13DCDA01	3,860	Qal	50	--	--	H	--	--	9.5	1,175	--	--	05-10-89
10N04W13DCDB01	3,840	Qal	50	--	07-28-88	H	--	--	9.0	440	--	--	07-28-88
10N04W13DCDB01	3,850	Qal	--	--	--	H	--	--	9.5	1,020	--	--	05-09-89
10N04W13DCDB02	3,860	Qal	50	--	--	H	--	--	9.5	1,220	--	--	05-11-89
10N04W13DCDB03	3,860	Qal	100	--	--	I	--	--	10.0	1,000	--	--	05-11-89
10N04W13DCDC01	3,870	Qal	--	--	--	H	--	--	10.5	555	--	--	05-10-89
10N04W14BCCC01	3,910	Qal	34	6.0	01-01-80	I	--	--	10.0	680	7.5	--	06-26-91
10N04W14BBA 01	3,900	Qal	18	48.0	01-01-10	I	9.1	07-22-71	13.5	687	--	--	08-30-71
10N04W14BBAB01	3,898	Qal	--	--	08-23-88	H	--	--	10.5	780	--	--	08-23-88
10N04W15BAA 01	3,950	Qal	--	6.0	--	H	29.8	07-21-71	22.5	794	--	--	08-30-71
10N04W15BAAB01	3,949	pTb	150	10.0	11-16-83	I	35.11	04-18-90	--	--	--	--	--
10N04W15BABD02	3,953	pTb	250	10.0	11-16-83	I	41.50	04-18-90	--	--	--	--	--
10N04W15CCCC01	4,012	Tsu(?)	135	8.0	11-16-81	U	48.36	05-24-90	--	--	--	--	--
10N04W15DBB 01	3,933	pTb	38	6.0	01-01-59	H	16.2	07-21-71	16.0	1,290	7.5	--	08-18-71
10N04W15DBBB01	3,943	Qal	35	1.5	09-15-78	U	29.20	11-28-78	12.5	620	--	--	08-11-88
10N04W16DAAA01	4,000	pTb	100	6.0	--	I	49.46	10-31-90	10.0	749	7.4	ND	10-31-90
10N04W22ACAB01	3,957	Qal	28	--	08-15-88	H	--	--	12.5	460	--	--	08-15-88
10N04W22ACAB02	3,956	Qal	47	--	08-15-88	H	--	--	11.5	635	--	--	08-15-88
10N04W22ACAC01	3,656	Qal	30	--	08-15-88	H	--	--	11.5	405	--	--	08-15-88
10N04W23ABBC01	3,900	Qal	64	6.0	09-02-88	U	2.28	04-17-90	--	--	--	--	--
10N04W23BAAB01	3,915	Tsu(?)	500	6.0	--	U	6.79	04-17-90	--	--	--	--	--
10N04W23BAB 01	3,889	Qal	60	6.0	--	H	2.5	07-22-71	10.0	297	7.2	--	08-18-71
10N04W23BAC 02	3,898	Qal	38	6.0	01-01-46	H	7.5	07-22-71	12.0	294	--	--	08-30-71
10N04W23BBBB01	3,915	Qal	23	1.5	09-15-78	U	3.32	11-30-78	11.5	260	--	--	08-05-88
10N04W23BBCB01	3,919	Qal	60	6.0	- -87	U	4.32	06-12-90	10.0	315	7.0	.7	08-02-90
10N04W23BBCB02	3,919	Qal	28	2.0	06-05-90	U	3.99	06-21-90	10.5	249	7.1	1.0	08-02-90
10N04W25DBDC01	4,200	pTb	320	6.0	05-10-88	I	230.5	04-20-91	--	--	--	--	--
10N04W28ACAD01	4,040	Tsu(?)	105	12.0	10- -87	U	19.86	11-03-87	--	--	--	--	--
10N04W28ACAD02	4,040	pTb	261	--	- -80	U	19.8	11-03-87	--	--	--	--	--
11N02W30DCAD01	3,693	Qal	45	1.5	01-01-78	U	29.19	12-24-78	10.0	410	--	--	08-08-88
11N02W31ACAA01	3,700	Qal	44	1.5	01-01-78	U	27.95	12-27-78	13.0	330	--	--	08-08-88
11N02W31ACDD01	3,700	Qal	--	--	--	H	--	--	10.0	380	7.3	--	06-26-91
11N02W31BBCC01	3,669	Qal	43	6.0	06-24-77	H	2.75	07-16-90	11.5	372	6.8	1.5	07-16-90
11N02W31BCB 01	3,672	Qal	28	6.0	--	I	5.3	08-03-71	27.0	415	--	--	08-31-71
11N02W31BCBC01	3,674	Qal	--	--	08-02-88	H	--	--	9.5	340	--	--	08-02-88
11N02W31BCCB01	3,673	Qal	40	6.0	- -85	H	4.88	01-22-91	9.5	372	6.9	--	01-22-91

Table 8.--*Records of wells*--Continued

Location number	Altitude of land surface (feet)	Geologic unit	Depth of well (feet)	Diameter of casing (in.)	Date well constructed	Primary use of water	Water level (feet)	Date water level measured	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Nitrate (mg/L)	Date water-quality parameter measured
11N02W31DDAD01	3,770	Tsu	150	6.6	07-24-89	H	67.7	07-16-90	11.5	448	7.6	.3	07-16-90
11N02W32DDCD01	3,892	Tsu	396	6.0	12-02-76	H	155.44	06-20-91	--	--	--	--	--
11N03W07BCCD01	3,806	pTb	--	--	07-28-88	H	--	--	11.0	290	--	--	07-28-88
11N03W07BDBB01	3,885	pTb	110	--	--	H	56.2	07-26-90	11.5	349	7.6	.7	07-26-90
11N03W08BBBD01	3,925	pTb	208	6.0	- -82	H	50.58	10-31-90	13.0	380	7.6	.6	10-31-90
11N03W10CCCC01	3,805	pTb	97	--	--	H	--	--	13.5	722	7.8	1.6	07-25-90
11N03W10DADD01	3,810	pTb	--	--	--	H	111.76	07-25-90	13.5	880	7.8	3.6	07-25-90
11N03W12CCCC01	3,764	Tsu	159	10.0	08-23-88	P	--	--	12.5	486	7.4	.7	10-31-90
11N03W15CBCC01	3,697	Qal	16	.8	--	U	6.81	11-07-90	--	--	--	--	--
11N03W15DCDD01	3,666	Qal	24	1.5	09-15-78	U	4.38	01-03-79	11.0	271	--	--	10-31-78
									13.0	680	--	--	08-05-88
11N03W16BBBB01	3,785	pTb	125	--	--	H	50.81	07-25-90	11.5	582	7.6	2.9	07-25-90
11N03W17CCCD01	3,750	Qal	71	--	--	H	--	--	9.5	730	--	--	05-03-89
11N03W17DDDD01	3,719	Qal	--	--	--	H	5.73	06-29-88	9.0	620	--	--	06-29-88
11N03W18ADDA01	3,783	pTb	--	--	--	H	--	--	15.5	410	--	--	07-05-88
11N03W18BCCB01	3,814	Qal	90	--	--	H	--	--	11.0	440	--	--	06-28-88
11N03W18CCCC01	3,795	Qal	25	1.5	08-01-78	U	--	--	--	--	--	--	--
11N03W18DCCC01	3,777	Tsu(?)	150	--	--	H	34.52	06-28-88	13.0	405	--	--	06-28-88
									13.5	398	7.5	ND	07-25-90
11N03W18DCD 01	3,765	Qal	--	6.0	--	P	24.1	07-25-71	20.0	645	--	--	08-30-71
11N03W18DDDD01	3,757	pTb	--	--	--	H	--	--	10.0	640	--	--	07-05-88
11N03W19ADAA01	3,795	Qal	--	--	07-20-88	H	57.82	07-20-88	10.0	690	--	--	07-20-88
11N03W19CCCC01	3,767	Qal	65	6.0	--	H	39.11	09-26-90	11.0	455	--	--	06-29-88
									10.5	471	7.4	ND	09-26-90
11N03W19DBC 01	3,750	Qal	45	6.0	--	H	19.1	07-28-71	13.5	598	--	--	08-25-71
11N03W19DDAB01	3,739	Tsu(?)	125	--	--	H	--	--	11.5	510	--	--	07-05-88
11N03W19DDDC01	3,733	Qal	65	--	--	H	8.81	07-23-90	12.5	619	7.6	1.5	07-23-90
11N03W20BBBB01	3,751	Qal	23	1.5	09-01-78	U	18.48	05-15-79	17.0	425	--	--	09-26-78
									18.0	320	--	--	08-08-88
11N03W21BBAA01	3,690	Qal	46	1.5	09-15-78	U	3.36	09-26-78	11.0	--	--	--	09-26-78
									13.0	410	--	--	08-08-88
11N03W21DCC 01	3,678	Qal	48	48.0	--	I	2.7	07-30-71	18.0	550	7.4	--	08-17-71
11N03W21DCCA01	3,680	Qal	--	--	--	H	--	--	16.0	440	--	--	07-11-88
									10.0	475	7.9	1.3	10-03-90
11N03W21DDAD01	3,663	Qal	65	1.5	09-15-78	U	6.37	11-15-78	8.5	510	--	--	08-18-88
11N03W21DDAD02	3,665	Qal	23	1.5	09-15-78	U	5.50	09-26-78	11.0	120	--	--	09-26-78
11N03W22BBBA01	3,675	Qal	96	--	--	H	9.60	07-25-90	10.5	1,060	7.6	1.0	07-25-90
11N03W22BBCB01	3,672	Tsu(?)	195	6.0	10-30-78	U	+45.04	06-01-79	7.5	375	--	--	05-01-80
									10.0	375	--	--	08-12-88
									10.0	440	7.7	1.4	08-07-90
11N03W22BBCB02	3,670	Qal	48	2.0	06-04-90	U	9.06	06-12-90	10.0	1,790	7.5	1.1	08-07-90
11N03W22CBBC01	3,665	Qal	--	--	--	H	--	--	9.5	540	--	--	07-25-88
11N03W25DDBD01	3,664	Qal	--	--	--	H	--	--	9.5	420	--	--	06-30-88
									11.5	448	7.0	1.9	07-17-90
11N03W29ABB 01	3,707	Qal	--	6.0	--	H	2.3	07-28-71	10.5	685	--	--	08-25-71
11N03W29BABD01	3,710	Qal	50	--	--	H	15.77	05-05-89	9.0	570	--	--	05-05-89
11N03W29BAC 01	3,711	Qal	--	6.0	--	H	.7	07-01-71	11.0	607	--	--	08-25-71
11N03W29BACC01	3,710	Qal	--	--	--	H	--	--	9.5	555	--	--	05-09-89
11N03W29BBAC01	3,719	Qal	--	--	--	H	--	--	10.0	540	--	--	05-05-89
11N03W29BBBA01	3,722	Qal	--	--	--	H	--	--	10.0	545	--	--	05-05-89
11N03W29BBBD01	3,720	Qal	54	--	--	H	--	--	10.0	570	--	--	05-05-89
11N03W29BBDA01	3,710	Qal	--	--	--	H	--	--	13.0	550	--	--	07-12-88
11N03W29BBDC01	3,710	Qal	54	--	--	H	--	--	9.5	600	--	--	05-05-89
11N03W29BCBD01	3,712	Qal	--	--	--	H	--	--	11.5	590	--	--	05-09-89
11N03W29CCB 01	3,706	Qal	40	6.0	--	S	6.7	07-25-71	15.0	621	--	--	08-24-71
11N03W29DBBB01	3,798	Tsu(?)	150	--	--	S	--	--	14.0	718	7.1	1.3	11-05-90
11N03W29DBBB02	3,798	Qal	40	6.0	--	H	--	--	8.0	512	7.5	.3	11-06-90
11N03W30BAAA01	3,747	Qal	24	1.5	09-01-78	U	13.22	07-09-79	15.0	445	--	--	08-10-88
11N03W30BBBB01	3,770	Qal	--	--	07-19-88	H	36.92	07-19-88	13.0	330	--	--	07-19-88
11N03W30BBBC01	3,765	Tsu(?)	127	10.0	01-01-79	I	34.81	06-13-79	10.5	480	--	--	05-01-80
11N03W30CBBC01	3,750	Qal	--	--	--	H	--	--	11.0	685	--	--	06-29-88
11N03W30DAA 01	3,715	Qal	10	4.0	01-01-71	U	5.7	07-25-71	9.0	1,880	--	--	11-01-71
11N03W30DACA01	3,721	Qal	--	--	--	H	--	--	9.5	640	--	--	06-28-88
11N03W30DACC01	3,723	Qal	--	--	--	H	--	--	9.5	685	--	--	05-04-89
11N03W30DACC02	3,722	Qal	--	--	--	H	7.54	05-04-89	10.0	665	--	--	05-04-89
11N03W30DAD 01	3,714	Qal	52	6.0	--	H	2.3	07-25-71	12.0	625	7.4	--	08-18-71
11N03W30DADA01	3,710	Qal	44	1.5	09-01-78	U	4.23	12-27-78	--	--	--	--	--
11N03W30DADA02	3,715	Qal	25	1.5	09-01-78	U	7.95	12-27-78	11.0	520	--	--	08-05-88
11N03W30DBAB01	3,732	Qal	--	--	--	H	--	--	10.5	615	--	--	05-03-89
11N03W30DBAC01	3,728	Qal	40	--	--	H	--	--	9.5	680	--	--	05-03-89

Table 8.--*Records of wells*--Continued

Location number	Altitude of land surface (feet)	Geologic unit	Depth of well (feet)	Diameter of casing (in.)	Date well constructed	Primary use of water	Water level (feet)	Date water level measured	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Nitrate (mg/L)	Date water-quality parameter measured
11N03W30DBAD01	3,726	Qal	68	--	--	H	--	--	9.0	680	--	--	05-03-89
11N03W30DBCA01	3,728	Qal	35	--	--	H	14.46	05-03-89	9.0	720	--	--	05-03-89
11N03W30DBCC01	3,730	Qal	65	--	--	H	4.40	07-20-88	9.5	630	--	--	07-20-88
11N03W30DBCD01	3,727	Qal	--	--	--	H	--	--	9.0	750	--	--	05-04-89
11N03W30DBD 01	3,718	Qal	57	6.0	--	H	4.7	07-25-71	19.0	683	--	--	08-24-71
11N03W30DCAA01	3,725	Qal	60	--	--	H	--	--	9.0	750	--	--	05-04-89
11N03W30DCBB01	3,725	Qal	56	--	--	H	7.48	11-05-90	9.0	715	7.5	1.2	11-05-90
11N03W30DDAA01	3,717	Qal	--	--	--	H	3.96	06-27-88	11.0	640	--	--	06-27-88
11N03W31ADD 01	3,675	Tsu(?)	130	--	--	H	2.44	07-16-90	11.5	327	6.7	1.1	07-16-90
11N03W31BADD01	3,716	Tsu(?)	154	6.0	- -79	U	5.85	04-10-90	--	--	--	--	--
11N03W31BBDB01	3,717	Qal	79	16.0	- -78	U	6.69	04-10-90	--	--	--	--	--
11N03W31CBBC01	3,714	Qal	--	--	--	H	11.95	05-04-89	10.0	580	--	--	05-04-89
11N03W31CBCC01	3,732	Qal	20	--	--	S	--	--	9.0	508	7.4	1.4	11-05-90
11N03W31DABA01	3,711	Qal	24	1.5	09-01-78	U	4.45	09-26-78	15.0	649	--	--	09-26-78
									12.0	530	--	--	08-08-88
11N03W31DADD01	3,718	Qal	--	--	--	H	--	--	10.5	570	--	--	06-27-88
11N03W31DBC 01	3,722	Qal	55	6.0	--	H	13.9	07-25-71	15.5	593	--	--	08-24-71
11N03W31DCC 01	3,732	Qal	--	6.0	--	H	10.1	07-26-71	11.0	593	--	--	08-23-71
11N03W31DDA 01	3,720	Qal	--	6.0	--	H	8.9	07-25-71	--	--	--	--	--
11N03W31DDAA01	3,722	Qal	--	--	--	H	--	--	11.0	465	--	--	07-27-88
									10.0	579	7.6	1.1	09-26-90
11N03W31DDAA02	3,721	Qal	54	6.0	--	H	11.7	07-25-71	13.0	556	--	--	09-01-71
									11.0	465	--	--	07-27-88
									10.0	579	7.6	--	09-26-90
11N03W32AAA 01	3,685	Qal	54	6.0	--	H	.1	07-28-71	14.0	451	--	--	08-25-71
11N03W32ACC 01	3,703	Qal	9	1.0	--	U	8.8	07-08-71	--	--	--	--	--
11N03W32CABB01	3,708	Qal	--	--	--	H	--	--	10.0	565	--	--	06-28-88
11N03W32CACA01	3,710	Qal	--	--	--	H	--	--	10.0	560	--	--	05-02-89
11N03W32CBAB01	3,708	Qal	60	--	--	H	--	--	10.0	575	--	--	05-02-89
11N03W32CBB 01	3,713	Qal	30	6.0	--	H	4.3	07-23-71	15.0	554	--	--	08-24-71
11N03W32CBBA01	3,710	Qal	--	--	--	H	--	--	10.0	595	--	--	05-02-89
11N03W32CBCD01	3,718	Qal	--	--	--	H	11.95	05-02-89	9.5	620	--	--	05-02-89
11N03W32CBDC01	3,718	Qal	--	--	--	H	--	--	11.0	595	--	--	05-02-89
11N03W32CBDC02	3,718	Qal	--	--	--	H	--	--	9.5	595	--	--	05-02-89
11N03W32CBDC03	3,718	Qal	46	--	--	H	--	--	10.0	560	--	--	05-02-89
11N03W32CCAD01	3,718	Qal	60	--	07-27-88	H	--	--	10.5	490	--	--	07-27-88
11N03W32CCD 01	3,720	Qal	40	6.0	--	H	8.8	07-23-71	11.0	458	--	--	08-24-71
11N03W32DBCC01	3,707	Qal	38	--	01-01-51	H	--	--	9.5	540	6.9	3.0	11-05-90
11N03W32DCDB01	3,708	Qal	--	--	--	H	7.79	07-25-88	11.0	450	--	--	07-25-88
11N03W33BBAA01	3,678	Qal	60	2.0	07-09-90	U	3.58	08-17-90	--	--	--	--	--
11N03W33BBAA02	3,679	Qal	25	2.0	07-10-90	U	5.23	08-20-90	9.0	315	6.8	1.2	08-16-90
11N03W33BBAA03	3,678	Qal	55	4.0	07-18-90	-	3.68	08-20-90	9.0	411	7.1	1.0	08-16-90
11N03W33BBAA04	3,678	Qal	54	2.0	07-11-90	U	--	--	--	--	--	--	--
11N03W33DAC 01	3,679	Qal	25	6.0	--	H	8.2	07-30-71	18.5	434	7.3	--	08-17-71
11N03W33DDDC01	3,683	Qal	58	2.0	05-09-90	U	.43	05-25-90	10.0	360	7.3	.8	08-06-90
11N03W33DDDC02	3,682	Qal	29	4.0	05-08-90	U	2.48	05-25-90	8.0	366	7.3	ND	08-06-90
11N03W33DDDC03	3,685	Qal	28	2.0	07-19-90	U	4.02	08-22-90	--	--	--	--	--
11N03W33DDDC04	3,685	Qal	28	2.0	07-20-90	U	3.72	08-22-90	--	--	--	--	--
11N03W34CBD 01	3,680	Qal	17	6.0	08-30-90	U	7.26	09-05-90	12.5	575	7.3	.1	09-05-90
11N03W34CCAD01	3,681	Tsu(?)	246	--	--	H	--	--	17.0	290	--	--	07-11-88
11N03W35ACDC01	3,670	Tsu(?)	113	--	--	H	+1.5	07-25-88	9.5	310	--	--	07-25-88
11N03W35DACC01	3,678	Qal	29	4.0	05-16-90	U	6.86	05-25-90	9.0	897	7.2	2.0	08-06-90
11N03W35DCCC01	3,685	Qal	22	1.5	09-15-78	U	2.88	09-26-78	12.0	400	--	--	09-26-78
									13.5	350	--	--	08-10-88
11N03W35DDBB01	3,679	Tsu(?)	103	2.0	05-15-90	U	+2.17	05-25-90	11.0	900	7.2	2.4	08-06-90
11N03W36CCD 01	3,684	Qal	45	6.0	--	H	3.7	08-03-71	18.0	346	--	--	08-31-71
11N04W11ADAB01	3,975	pTb	90	6.0	- -79	H	54.70	07-18-88	10.5	320	--	--	07-18-88
11N04W12ADD 01	3,885	pTb	110	--	--	H	87.49	07-26-90	11.5	492	7.8	2.1	07-26-90
11N04W12ADDA01	3,880	Qal	80	6.0	01-01-85	H	58.44	06-17-91	10.6	380	7.7	--	06-17-91
11N04W12CCCB01	3,910	Tsu(?)	--	--	--	H	148.52	07-15-88	15.0	560	--	--	07-15-88
11N04W12CDDD01	3,890	pTb	176	6.0	11-16-73	H	119.62	07-19-90	15.0	1,010	7.8	1.1	07-19-90
11N04W13AAAD01	3,850	Qal	--	--	--	H	--	--	11.5	400	--	--	06-28-88
									12.0	409	7.6	1.1	07-23-90
11N04W13CCC 01	3,855	Qal	93	6.0	--	H	63.5	07-28-71	10.0	882	--	--	08-25-71
11N04W13CCCC01	3,859	Qal	92	--	--	H	--	--	9.5	900	--	--	07-05-88
11N04W13DDD 01	3,801	Qal	85	6.0	--	H	64.6	07-28-71	15.5	802	7.5	--	08-18-71
11N04W14CCAA01	3,915	Qal	92	--	--	H	8.93	07-19-90	10.0	775	7.7	.1	07-19-90
11N04W14CCDD01	3,920	pTb	97	6.0	- -71	H	10.70	01-23-91	4.0	945	7.7	--	01-23-91
11N04W14DCCA01	3,882	Tsu(?)	112	--	--	-	40.30	04-10-90	9.5	900	7.7	ND	08-10-90
11N04W24AACB01	3,808	Qal	--	--	--	H	--	--	11.5	710	--	--	07-19-88

Table 8.--*Records of wells*--Continued

Location number	Altitude of land surface (feet)	Geologic unit	Depth of well (feet)	Diameter of casing (in.)	Date well constructed	Primary use of water	Water level (feet)	Date water level measured	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Nitrate (mg/L)	Date water-quality parameter measured
11N04W24ADDA01	3,790	Qal	--	--	07-27-88	H	--	--	10.0	770	--	--	07-27-88
11N04W24ADDA02	3,790	Qal	87	--	--	H	59.01	07-23-90	12.0	895	7.6	4.0	07-23-90
11N04W24CBBD01	3,840	Qal	--	--	--	H	--	--	12.0	770	--	--	07-05-88
11N04W24DAA 01	3,788	Qal	90	6.0	--	H	59.1	07-28-71	11.0	842	--	--	08-25-71
11N04W24DCDB01	3,797	Qal	--	--	07-27-88	H	--	--	10.0	595	--	--	07-27-88
11N04W25AABD01	3,784	Qal	--	--	--	H	--	--	12.0	340	--	--	07-19-88
11N04W25AABD02	3,782	Qal	--	--	07-19-88	H	--	--	12.5	315	--	--	07-19-88
11N04W25ADDD01	3,750	Qal	23	1.5	09-01-78	U	10.54	12-27-78	--	--	--	--	--
11N04W25BAA 01	3,796	Qal	90	6.0	--	H	62.2	07-26-71	13.0	683	--	--	08-25-71
11N04W25BBBC01	3,890	pTb	103	--	--	I	73.17	07-12-90	13.5	950	7.2	5.8	07-12-90
11N04W25BBBC02	3,919	pTb	301	--	--	H	92.27	07-12-90	13.0	781	7.4	4.7	07-12-90
11N04W25BBBC03	3,919	pTb	167	--	--	U	93.84	07-13-90	13.0	781	7.5	--	07-12-90
11N04W25DAA 01	3,753	Qal	60	6.0	--	H	22.7	07-26-71	15.5	511	--	--	08-25-71
11N04W25DBCC01	3,808	Qal	--	--	--	H	--	--	12.0	570	--	--	06-29-88
11N04W25DCAD01	3,761	Qal	--	--	07-18-88	H	34.09	07-18-88	13.5	405	--	--	07-18-88
11N04W25DDC 01	3,750	Qal	74	6.0	--	H	27.0	07-26-71	13.0	525	--	--	08-30-71
11N04W25DDCC01	3,758	Qal	71	--	--	H	24.55	07-13-88	13.0	485	--	--	07-13-88
11N04W25DDDC01	3,735	Qal	60	--	--	H	12.17	11-05-90	11.0	555	7.3	ND	11-05-90
11N04W25DDDD01	3,733	Qal	20	1.0	09-01-78	U	9.08	12-27-78	20.0	400	--	--	08-22-88
11N04W26ACAB01	4,100	pTb	--	--	--	H	66.77	10-31-90	11.5	672	7.7	5.3	10-31-90
11N04W36BAA 01	3,800	Tsu(?)	110	6.0	--	H	72.1	07-26-71	14.0	379	--	--	08-30-71

Table 9.--*Records of water levels in monitoring wells*

[Water level--in feet below or above (+) land surface. MS, conditions of measurement. First column (M) is method of measurement--B, recorder; D, dry; F, flowing; H, calibrated pressure gage; S, steel tape; T, electric tape. Second column (S) is site status--P, pumping]

10N02W06CBCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	5.86		FEB 05, 1990	10.93	S	JUL 05, 1990	5.70	S	FEB 06, 1991	10.85	S
30	7.00	S	APR 06	12.03	S	27	4.12	S	MAR 14	11.53	S
NOV 06	7.10	S	27	12.28	S	AUG 20	4.06	S	APR 13	12.07	S
MAY 25, 1982	8.99	S	MAY 10	12.45	S	SEP 12	6.25	S	MAY 17	11.86	S
NOV 15, 1983	8.79	S	25	8.32	S	OCT 10	7.00	S	30	9.92	S
AUG 17, 1988	5.67	S	JUN 08	7.78	S	NOV 07	8.18	S	JUN 13	5.47	S
18	6.17	S	21	7.06	S	DEC 10	9.23	S			

HIGHEST 4.06 AUG 20, 1990
LOWEST 12.45 MAY 10, 1990

10N02W07BBBB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	9.84		APR 06, 1990	15.92	S	JUL 27, 1990	7.10	S	MAR 14, 1991	15.30	S
30	9.34	S	27	16.33	S	AUG 20	7.03	S	APR 13	15.18	S
NOV 06	9.68	S	MAY 10	15.86	S	SEP 12	9.16	S	MAY 17	12.47	S
MAY 25, 1982	12.89	S	25	13.63	S	OCT 10	9.98	S	JUN 13	10.60	S
NOV 15, 1983	11.65	S	JUN 08	10.68	S	NOV 07	11.19	S			
AUG 17, 1988	8.02	S	21	10.29	S	DEC 10	12.37	S			
FEB 05, 1990	14.27		JUL 05	8.57	S	FEB 06, 1991	14.34	S			

HIGHEST 7.03 AUG 20, 1990
LOWEST 16.33 APR 27, 1990

10N02W18DDCD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 11, 1981	53.12	S	SEP 01, 1989	45.36	S	JUL 05, 1990			MAR 14, 1991	55.70	S
JUN 14, 1983	52.23	S	JAN 09, 1990	52.49	S	AUG 20	44.93	S	APR 13	57.17	S
OCT 11, 1984	45.48	S	APR 06	56.79	S	SEP 12	45.23	S	MAY 17	58.35	S
SEP 26, 1985	46.76	S	MAY 11	57.30	S	OCT 10	46.02	S	30	58.05	S
SEP 23, 1986	45.01	S	25	58.32	S	DEC 10	50.36	S	JUN 13	56.35	S
SEP 30, 1987	47.09	S	JUN 11	55.51	S	JAN 14, 1991	52.57	S			
DEC 20, 1988	51.05	S	22	53.25	S	FEB 06	53.90	S			

HIGHEST 44.93 AUG 20, 1990
LOWEST 58.35 MAY 17, 1991

10N02W29CCAA03

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 01, 1989	119.75	T	OCT 19, 1989	121.22	T	JUL 05, 1990	122.02	T	OCT 18, 1990	122.40	T
08	120.08	T	NOV 16	120.35	T	12	122.82	T	NOV 09	121.85	T
15	120.24	T	DEC 08	120.38	T	19	123.38	T	21	121.94	T
22	120.50	T	JAN 05, 1990	120.37	T	26	123.49	T	DEC 06	121.59	T
29	121.04	T	FEB 01	119.99	T	AUG 02	123.58	T	26	121.11	T
JUL 06	121.64	T	MAR 01	119.79	T	10	124.00	T	JAN 10, 1991	121.20	T
13	121.98	T	APR 09	119.58	T	17	124.11	T	31	120.99	T
19	122.08	T	23	119.43	T	21	123.73	T	FEB 21	120.92	T
27	122.23	T	MAY 17	119.74	T	23	123.56	T	MAR 07	120.77	T
AUG 03	122.27	T	30	119.87	T	30	123.24	T	21	120.70	T
10	122.60	T	JUN 04	119.99	T	SEP 07	123.14	T	APR 04	120.59	T
24	122.70	T	08	120.24	T	13	123.46	T	18	120.78	T
SEP 07	122.00	T	14	120.52	T	20	123.53	T	MAY 02	120.90	T
22	121.63	T	22	120.88	T	27	123.53	T	16	121.14	T
OCT 06	121.56	T	28	121.53	T	OCT 04	123.27	T			

HIGHEST 119.75 JUN 01, 1989
LOWEST 124.11 AUG 17, 1990

Table 9.--*Records of water levels in monitoring wells*--Continued

10N03W02DDDD02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUL 27, 1990	11.90	S	OCT 10, 1990	11.61	S	FEB 06, 1991	17.17	S	MAY 17, 1991	19.26	S
AUG 20	11.11	S	NOV 08	13.18	S	MAR 14	18.27	S	30	20.44	S
SEP 12	11.85	S	DEC 10	14.73	S	APR 13	18.27	S	JUN 13	15.40	S

HIGHEST 11.11 AUG 20, 1990
LOWEST 20.44 MAY 30, 1991

10N03W02DDDD03

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUL 27, 1990	10.15		OCT 10, 1990	10.90		FEB 06, 1991	17.08		MAY 17, 1991	18.75	
AUG 20	9.86		NOV 08	12.70		MAR 14	18.28		30	15.37	
SEP 12	10.73		DEC 10	14.47		APR 13	19.09		JUN 13	13.20	

HIGHEST 9.86 AUG 20, 1990
LOWEST 19.09 APR 13, 1991

10N03W03BACB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	.01	S	SEP 30, 1987	2.5	S	MAY 25, 1990	2.34	S	NOV 08, 1990	2.98	S
30	1.77	S	AUG 16, 1988	2.55	S	JUN 08	1.98	S	DEC 12	3.08	S
NOV 05	2.31	S	17	2.71	S	21	2.18	S	FEB 06, 1991	3.44	S
MAY 25, 1982	2.04	S	SEP 01, 1989	2.65	S	JUL 05	2.73	S	MAR 14	3.32	S
NOV 15, 1983	2.30	S	JAN 08, 1990	3.10	S	27	2.56	S	APR 13	3.13	S
OCT 11, 1984	2.63	S	09	3.10	S	AUG 20	2.66	S	MAY 17	2.56	S
SEP 26, 1985	2.69	S	APR 06	2.87	S	SEP 12	2.85	S	30	2.24	S
SEP 23, 1986	1.85	S	MAY 10	2.83	S	OCT 09	3.05	S	JUN 13	2.12	S

HIGHEST .01 JUN 02, 1981
LOWEST 3.44 FEB 06, 1991

10N03W03BACB02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	1.16		AUG 17, 1988	4.01	S	JUL 27, 1990	3.63	S	FEB 06, 1991	4.28	S
30	2.90	S	MAY 10, 1990	3.38	S	AUG 20	3.69	S	MAR 14	4.12	S
NOV 05	3.70	S	24	3.24	S	SEP 12	3.77	S	APR 13	3.90	S
MAY 25, 1982	2.90	S	JUN 08	2.63	S	OCT 09	4.07	S	MAY 17	3.21	S
NOV 15, 1983	3.85	S	21	2.84	S	NOV 08	3.95	S	30	3.02	S
AUG 16, 1988	3.75	S	JUL 05	3.64	S	DEC 12	4.00	S	JUN 13	2.77	S

HIGHEST 1.16 JUN 02, 1981
LOWEST 4.28 FEB 06, 1991

10N03W04DCCD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUL 26, 1990	2.17	S	OCT 09, 1990	2.52	S	FEB 06, 1991	3.10	S	JUN 13, 1991	1.62	S
AUG 20	2.30	S	NOV 08	2.68	S	MAR 14	2.94	S	MAY 17	1.60	S
SEP 12	2.36	S	DEC 12	2.58	S	APR 13	2.44	S	30	1.60	S

HIGHEST 1.60 MAY 17, 1991 MAY 30, 1991
LOWEST 3.10 FEB 06, 1991

10N03W04DCCD02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUL 26, 1990	5.21	S	NOV 08, 1990	5.35	S	MAR 14, 1991	5.57	S	JUN 13, 1991	4.88	S
AUG 21	5.13	S	DEC 12	5.30	S	APR 13	5.25	S			
SEP 12	5.19	S	JAN 24, 1991	5.57	S	MAY 17	4.76	S			
OCT 09	5.26	S	FEB 06	5.60	S	30	4.76	S			

HIGHEST 4.76 MAY 17, 1991 MAY 30, 1991
LOWEST 5.60 FEB 06, 1991

10N03W05BAAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	4.71		JAN 19, 1990	10.18	S	JUL 05, 1990	9.62	S	FEB 06, 1991	12.42	S
30	5.71	S	APR 05	10.95	S	27	9.89	S	MAR 14	11.42	S
NOV 05	8.33	S	27	10.99	S	AUG 20	9.94	S	APR 13	12.23	S
MAY 25, 1982	8.79	S	MAY 10	10.74	S	SEP 12	9.97	S	MAY 17	10.70	S
NOV 15, 1983	9.20	S	25	9.94	S	OCT 09	10.50	S	30	10.05	S
AUG 16, 1988	9.81	S	JUN 08	9.73	S	NOV 08	10.55	S	JUN 13	9.38	S
17	10.18	S	21	9.48	S	DEC 12	10.47	S			

HIGHEST 4.71 JUN 02, 1981
LOWEST 12.42 FEB 06, 1991

10N03W05BAAB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	3.54		JAN 18, 1990	10.20	S	JUL 05, 1990	9.20	S	FEB 06, 1991	11.34	S
30	5.35	S	APR 05	10.86	S	27	9.74	S	MAR 14	11.47	S
NOV 05	8.34	S	27	10.98	S	AUG 20	9.64	S	APR 13	11.27	S
MAY 25, 1982	8.82	S	MAY 10	10.60	S	SEP 12	9.78	S	MAY 17	10.49	S
NOV 15, 1983	9.29	S	25	9.56	S	OCT 09	9.32	S	30	9.82	S
AUG 16, 1988	9.39	S	JUN 08	9.26	S	NOV 08	10.65	S	JUN 13	8.87	S
17	9.76	S	21	8.96	S	DEC 12	10.55	S			

HIGHEST 3.54 JUN 02, 1981
LOWEST 11.47 MAR 14, 1991

10N03W05CCDD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	1.98	S	SEP 30, 1987	10.25	S	MAY 25, 1990	10.59	S	NOV 08, 1990	10.02	S
30	4.57	S	AUG 15, 1988	12.36	S	JUN 08	9.88	S	DEC 12	10.06	S
NOV 05	6.86	S	16	12.37	S	21	10.04	S	FEB 06, 1991	11.74	S
MAY 25, 1982	7.44	S	SEP 01, 1989	8.49	S	JUL 05	10.76	S	MAR 14	10.32	S
NOV 15, 1983	8.35	S	JAN 08, 1990	8.53	S	27	10.96	S	APR 13	10.72	S
OCT 11, 1984	8.02	S	APR 05	11.40	S	AUG 21	12.16	S	MAY 17	10.55	S
SEP 26, 1985	10.11	S	27	10.34	S	SEP 12	10.30	S	30	9.31	S
SEP 22, 1986	7.65	S	MAY 10	10.22	S	OCT 09	11.54		JUN 13	9.27	S

HIGHEST 1.98 JUN 02, 1981
LOWEST 12.37 AUG 16, 1988

10N03W06ABBC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	9.10		NOV 05, 1981	14.88	S	NOV 15, 1983	16.18	S	AUG 19, 1988	17.87	S
30	10.85	S	MAY 25, 1982	17.38	S	AUG 18, 1988	19.01	S			

HIGHEST 9.10 JUN 02, 1981
LOWEST 19.01 AUG 18, 1988

10N03W06DBAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	5.17		APR 05, 1990	21.92	S	JUL 27, 1990	20.85	S	MAR 14, 1991	22.23	S
30	9.22	S	27	22.52	S	AUG 21	20.20	S	APR 13	22.68	S
NOV 05	14.97	S	MAY 10	22.76	S	SEP 12	19.39	S	MAY 17	23.15	S
MAY 25, 1982	19.01	S	25	22.74	S	OCT 09	19.35	S	30	22.84	S
NOV 15, 1983	16.98	S	JUN 08	22.39	S	NOV 08	19.43	S	JUN 13	22.24	S
AUG 16, 1988	19.67	S	21	21.78	S	DEC 12	20.08	S			
JAN 18, 1990	19.79		JUL 05	21.35	S	FEB 06, 1991	21.59	S			

HIGHEST 5.17 JUN 02, 1981
LOWEST 23.15 MAY 17, 1991

10N03W06DBAA02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	4.65		JAN 18, 1990	19.62	S	JUL 05, 1990	21.16	S	FEB 06, 1991	21.45	S
30	9.18	S	APR 05	21.75	S	27	20.61	S	MAR 14	22.06	S
NOV 05	14.89	S	27	22.33	S	AUG 21	19.93	S	APR 13	22.87	S
MAY 25, 1982	18.81	S	MAY 10	22.62	S	SEP 12	19.29	S	MAY 17	23.01	S
NOV 15, 1983	16.84	S	25	22.52	S	OCT 09	19.23	S	30	22.40	S
AUG 15, 1988	19.56	S	JUN 08	22.16	S	NOV 08	19.31	S	JUN 13	22.01	S
16	19.49	S	21	21.59	S	DEC 12	19.94	S			

HIGHEST 4.65 JUN 02, 1981
LOWEST 23.01 MAY 17, 1991

10N03W07AAAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 12, 1990	16.51	S	JUN 21, 1990	15.60	S	OCT 09, 1990	15.25	S	APR 13, 1991	16.32	S
27	16.40	S	JUL 05	15.71	S	NOV 08	14.50	S	MAY 17	16.84	S
MAY 10	16.22	S	27	15.93	S	DEC 12	14.89	S	JUN 13	16.84	S
25	16.27	S	AUG 21	14.84	S	FEB 06, 1991	15.96	S			
JUN 08	15.78	S	SEP 12	14.94	S	MAR 14	15.61	S			

HIGHEST 14.50 NOV 08, 1990
LOWEST 16.84 MAY 17, 1991 JUN 13, 1991

10N03W08CBCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	9.37		JAN 19, 1990	13.74	S	JUL 05, 1990	14.93	S	FEB 06, 1991	14.29	S
30	9.78	S	APR 05	16.04	S	27	14.78	S	MAR 14	15.48	S
NOV 05	9.84	S	27	15.94	S	AUG 21	14.84	S	APR 13	16.38	S
MAY 25, 1982	11.27	S	MAY 10	15.94	S	SEP 12	13.31	S	MAY 17	16.71	S
NOV 15, 1983	10.64	S	25	15.93	S	OCT 09	13.58	S	30	15.84	S
AUG 15, 1988	14.04	S	JUN 08	15.35	S	NOV 08	13.97	S	JUN 13	14.55	S
16	13.98	S	21	14.92	S	DEC 12	14.77	S			

HIGHEST 9.37 JUN 02, 1981
LOWEST 16.71 MAY 17, 1991

10N03W09ACCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	1.49	S	SEP 22, 1986	1.37	S	APR 27, 1990	2.22	S	NOV 08, 1990	3.53	S
JUL 01	2.07	S	SEP 30, 1987	2.46	S	MAY 10	2.40	S	DEC 12	2.57	S
NOV 06	2.31	S	AUG 15, 1988	2.39	S	25	1.97	S	FEB 06, 1991	2.82	S
MAY 25, 1982	2.37	S	16	2.46	S	JUN 21	1.91	S	MAY 17	2.10	S
NOV 15, 1983	2.30	S	SEP 01, 1989	2.00	S	JUL 26	2.30	S	30	1.54	S
OCT 11, 1984	2.30	S	JAN 09, 1990	2.40	S	SEP 12	2.06	S	JUN 13	1.86	S
SEP 26, 1985	1.80	S	APR 05	2.28		OCT 09	2.60	S			

HIGHEST 1.37 SEP 22, 1986
LOWEST 3.53 NOV 08, 1990

10N03W09ACCC02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	3.63		AUG 10, 1988	4.19	S	JUL 26, 1990	4.31	S	FEB 06, 1991	4.68	S
JUL 01	3.87	S	16	4.70	S	SEP 12	4.07	S	MAY 17	4.05	S
NOV 06	4.08	S	MAY 10, 1990	4.26	S	OCT 09	4.51	S	JUN 13	3.86	S
MAY 25, 1982	4.11	S	25	3.90	S	NOV 08	4.49	S			
NOV 15, 1983	4.09	S	JUN 21	3.87	S	DEC 12	4.52	S			

HIGHEST 3.63 JUN 02, 1981
LOWEST 4.70 AUG 16, 1988

Table 9.--*Records of water levels in monitoring wells*--Continued

10N03W11ABBB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	8.81		APR 06, 1990	14.81	S	JUL 27, 1990	4.10	S	MAR 14, 1991	14.30	S
30	2.67	S	MAY 10	14.02	S	AUG 20	5.23	S	APR 13	15.03	S
NOV 05	8.20	S	25	7.86	S	SEP 12	5.83	S	MAY 17	14.95	S
MAY 25, 1982	13.36	S	27	14.98	S	OCT 10	4.61	S	30	13.42	S
NOV 15, 1983	10.00	S	JUN 08	6.92	S	NOV 08	8.18	S	JUN 13	6.72	S
AUG 10, 1988	6.84	S	21	4.00	S	DEC 10	10.26	S			
FEB 05, 1990	13.06		JUL 05	4.67	S	FEB 06, 1991	13.08	S			

HIGHEST 2.67 JUN 30, 1981
LOWEST 15.03 APR 13, 1991

10N03W11DDCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	8.31	S	SEP 30, 1987	17.16	S	MAY 25, 1990	19.21	S	NOV 07, 1990	18.39	S
30	12.16	S	AUG 09, 1988	23.35	S	JUN 11	20.68	S	DEC 10	21.23	S
NOV 06	16.39	S	DEC 20	23.81	S	21	21.03	S	FEB 06, 1991	25.03	S
MAY 25, 1982	24.98	S	SEP 01, 1989	16.38	S	JUL 05	18.97	S	MAR 14	26.32	S
NOV 15, 1983	19.54	S	JAN 09, 1990	22.13	S	27	13.36	S	APR 13	27.17	S
OCT 11, 1984	19.45	S	APR 06	25.91	S	AUG 20	13.36	S	MAY 17	26.12	S
SEP 26, 1985	19.26	S	27	26.74	S	SEP 12	13.36	S	30	24.77	S
SEP 23, 1986	17.40	S	MAY 10	21.64	S	OCT 10	17.70	S	JUN 13	24.12	S

HIGHEST 8.31 JUN 02, 1981
LOWEST 27.17 APR 13, 1991

10N03W11DDCC02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 11, 1990	21.56	S	AUG 20, 1990	15.07	S	DEC 10, 1990	21.10	S	MAY 17, 1991	26.40	S
21	21.43	S	SEP 12	17.99	S	FEB 06, 1991	24.73	S	30	24.93	S
JUL 05	20.53	S	OCT 10	17.81	S	MAR 14	25.97	S	JUN 13	24.45	S
27	17.07	S	NOV 07	18.50	S	APR 13	26.86	S			

HIGHEST 15.07 AUG 20, 1990
LOWEST 26.86 APR 13, 1991

10N03W13BADD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 12, 1990	47.33	S	JUN 11, 1990	44.66	S	SEP 12, 1990	39.56	S	MAR 14, 1991	46.72	S
20	47.64	S	21	43.87	S	OCT 10	39.20	S	APR 13	47.80	S
27	47.92	S	JUL 05	42.77	S	NOV 07	40.24	S	MAY 17	48.50	S
MAY 10	49.07	S	27	41.12	S	DEC 10	42.04	S	30	47.53	S
25	46.29	S	AUG 20	39.60	S	FEB 06, 1991	45.22	S	JUN 13	46.67	S

HIGHEST 39.20 OCT 10, 1990
LOWEST 49.07 MAY 10, 1990

10N03W15BCBA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 03, 1981	+.03		FEB 05, 1990	2.16	S	JUL 05, 1990	2.20	S	FEB 06, 1991	2.21	S
30	1.54	S	APR 06	1.56	S	27	2.30	S	MAR 14	2.00	S
NOV 06	1.35	S	27	1.52	S	AUG 20	2.09	S	APR 13	1.84	S
MAY 25, 1982	1.47	S	MAY 10	2.02	S	SEP 12	2.00	S	MAY 17	1.87	S
NOV 15, 1983	1.69	S	25	1.55	S	OCT 10	2.24	S	30	1.78	S
AUG 09, 1988	2.30	S	JUN 08	1.70	S	NOV 08	1.88	S	JUN 13	1.77	S
10	2.25	S	21	1.88	S	DEC 10	2.04	S			

HIGHEST +.03 JUN 03, 1981
LOWEST 2.30 AUG 09, 1988 JUL 27, 1990

10N03W15DDCA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAR 12, 1990	9.97	S	JUN 01, 1990	8.20	B	OCT 01, 1990	6.91	B	FEB 01, 1991	9.93	B
13	9.98	B	JUL 01	6.52	B	NOV 01	7.72	B	MAR 01	10.13	B
APR 01	10.61	B	AUG 01	5.80	B	DEC 01	9.43	B	APR 01	11.61	B
MAY 01	11.07	B	SEP 01	5.62	B	JAN 01, 1991	10.43	B	MAY 01	12.70	B

HIGHEST 5.62 SEP 01, 1990
LOWEST 12.70 MAY 01, 1991

10N03W16DBAD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 03, 1981	11.10		FEB 05, 1990	11.65	S	JUL 05, 1990	8.92	S	FEB 06, 1991	11.83	S
30	10.97	S	APR 06	12.18	S	27	6.79	S	MAR 14	12.13	S
NOV 05	9.32	S	27	11.82	S	AUG 20	7.91	S	APR 13	12.40	S
MAY 25, 1982	12.06	S	MAY 10	12.71	S	SEP 12	8.62	S	MAY 17	12.45	S
NOV 15, 1983	9.61	S	25	12.51	S	OCT 10	9.29	S	30	10.08	S
AUG 08, 1988	7.84	S	JUN 08	9.60	S	NOV 08	9.82	S	JUN 13	8.96	S
10	7.89	S	21	8.43	S	DEC 10	10.55	S			

HIGHEST 6.79 JUL 27, 1990
LOWEST 12.71 MAY 10, 1990

10N03W17ABBB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	21.56		FEB 05, 1990	24.67	S	JUL 05, 1990	22.87	S	FEB 06, 1991	25.65	S
30	20.64	S	APR 05	25.89	S	27	19.30	S	MAR 14	26.02	S
NOV 05	19.51	S	27	26.36	S	AUG 21	19.89	S	APR 13	26.47	S
MAY 25, 1982	22.03	S	MAY 10	26.65	S	SEP 12	21.31	S	MAY 17	25.49	S
NOV 15, 1983	20.49	S	25	25.29	S	OCT 09	22.36	S	30	24.22	S
AUG 08, 1988	22.75	S	JUN 08	23.50	S	NOV 08	23.59	S	JUN 13	22.96	S
11	22.19	S	21	22.51	S	DEC 12	24.48	S			

HIGHEST 19.30 JUL 27, 1990
LOWEST 26.65 MAY 10, 1990

10N03W17ACAD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	21.35		SEP 22, 1986	15.90	S	APR 05, 1990	--	D	NOV 08, 1990	20.00	S
JUL 01	--	D	SEP 30, 1987	16.32	S	MAY 01	--	D	DEC 12	--	D
NOV 06	16.27	S	AUG 09, 1988	18.10	S	JUL 05	20.05	S	MAY 17, 1991	--	D
MAY 25, 1982	--	D	11	17.10	S	26	19.30	S	30	--	D
NOV 15, 1983	--	D	SEP 01, 1989	17.46	S	AUG 21	17.82	S	JUN 13	--	D
NOV 02, 1984	17.12	S	JAN 08, 1990	--	D	SEP 12	17.90	S			
SEP 26, 1985	15.85	S	FEB 05	--	D	OCT 09	19.08	S			

HIGHEST 15.85 SEP 26, 1985
LOWEST 21.35 JUN 02, 1981

10N03W17ACCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	27.12		APR 05, 1990	--	D	JUL 26, 1990	25.88	S	MAR 14, 1991	--	D
JUL 01	25.89	S	MAY 01	--	D	AUG 21	24.92	S	APR 13	--	D
NOV 06	22.33	S	10	--	D	SEP 12	24.87	S	MAY 17	--	D
MAY 25, 1982	27.72	S	25	--	D	OCT 09	25.88	S	30	30.02	S
NOV 15, 1983	24.20	S	JUN 08	30.36	S	NOV 08	27.66	S	JUN 13	--	D
AUG 09, 1988	25.59	S	21	28.49	S	DEC 12	29.31	S			
FEB 05, 1990	--	D	JUL 05	27.12	S	FEB 06, 1991	--	D			

HIGHEST 22.33 NOV 06, 1981
LOWEST 30.36 JUN 08, 1990

10N03W17ACCC02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	27.04		FEB 05, 1990	30.60	S	JUL 05, 1990	26.98	S	FEB 06, 1991	31.46	S
JUL 01	25.77	S	APR 05	32.34	S	26	25.81	S	MAR 14	32.56	S
NOV 06	22.27	S	MAY 01	32.94	S	AUG 21	24.83	S	APR 13	33.26	S
MAY 25, 1982	27.63	S	10	33.00	S	SEP 12	24.81	S	MAY 17	31.45	S
NOV 15, 1983	24.15	S	25	32.30	S	OCT 09	25.83	S	30	30.36	S
AUG 09, 1988	25.56	S	JUN 08	30.13	S	NOV 08	27.63	S	JUN 13	29.05	S
11	25.09	S	21	28.33	S	DEC 12	29.26	S			

HIGHEST 22.27 NOV 06, 1981
LOWEST 33.26 APR 13, 1991

10N03W17CCCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 10, 1990	2.32	S	JUL 27, 1990	2.89	S	DEC 12, 1990	2.88	S	MAY 30, 1991	1.76	S
25	1.81	S	AUG 21	2.26	S	FEB 06, 1991	2.76	S	JUN 13	1.40	S
JUN 08	2.09	S	SEP 12	2.28	S	MAR 14	2.68	S			
21	2.03	S	OCT 09	2.60	S	APR 13	2.34	S			
JUL 05	2.43	S	NOV 08	2.60	S	MAY 17	2.09	S			

HIGHEST 1.40 JUN 13, 1991
LOWEST 2.89 JUL 27, 1990

10N03W17DDAD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	33.59		APR 05, 1990	40.68	S	JUL 26, 1990	26.25	S	MAR 14, 1991	41.03	S
JUL 01	31.17	S	MAY 01	41.64	S	AUG 21	24.98	S	APR 13	41.45	S
NOV 06	27.70	S	10	41.42	S	SEP 12	26.57	S	MAY 17	39.34	S
MAY 29, 1982	36.44	S	25	39.96	S	OCT 09	29.90	S	30	35.29	S
NOV 15, 1983	29.83	S	JUN 08	35.68	S	NOV 08	33.46	S	JUN 13	30.75	S
AUG 08, 1988	20.96	S	21	31.17	S	DEC 12	36.15	S			
FEB 05, 1990	38.33		JUL 05	27.41	S	FEB 06, 1991	39.52	S			

HIGHEST 20.96 AUG 08, 1988
LOWEST 41.64 MAY 01, 1990

10N03W17DDAD02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	--	D	FEB 05, 1990	--	D	JUL 05, 1990	--	D	FEB 06, 1991	--	D
30	--	D	APR 05	--	D	26	--	D	MAR 14	--	D
NOV 06	--	D	MAY 01	--	D	AUG 21	--	D	APR 13	--	D
MAY 25, 1982	--	D	10	--	D	SEP 12	--	D	MAY 17	--	D
NOV 15, 1983	--	D	25	--	D	OCT 09	--	D	30	--	D
AUG 09, 1988	--	D	JUN 08	--	D	NOV 08	--	D	JUN 13	--	D
12	24.21	S	21	--	D	DEC 12	--	D			

HIGHEST 24.21 AUG 12, 1988
LOWEST 24.21 AUG 12, 1988

10N03W18CACD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
AUG 24, 1990	15.12	B	DEC 01, 1990	12.20	B	MAR 01, 1991	11.35	B			
SEP 01	14.24	B	JAN 01, 1991	11.86	B	APR 01	11.30	B			
NOV 01	12.72	B	FEB 01	11.60	B	MAY 01	11.31	B			

HIGHEST 11.30 APR 01, 1991
LOWEST 15.12 AUG 24, 1990

10N03W22AAAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	5.57		SEP 30, 1987	10.62	S	MAY 25, 1990	14.32	S	NOV 07, 1990	12.89	S
30	6.11	S	AUG 08, 1988	15.80	S	JUN 08	13.26	S	DEC 10	14.88	S
NOV 06	7.58	S	10	15.95	S	21	12.87	S	FEB 06, 1991	10.65	S
MAY 25, 1982	10.57	S	SEP 01, 1989	8.07	S	JUL 05	12.31	S	MAR 14	13.23	S
NOV 15, 1983	11.24	S	JAN 09, 1990	10.24	S	27	13.13	S	APR 13	15.65	S
MAR 29, 1985	14.60	S	APR 05	13.56	S	AUG 20	13.03	S	MAY 17	17.87	S
SEP 26	17.38	S	27	13.48	S	SEP 12	11.59	S	30	14.48	S
SEP 23, 1986	8.27	S	MAY 10	14.55	S	OCT 10	13.26	S	JUN 13	13.08	S

HIGHEST 5.57 JUN 02, 1981
LOWEST 17.87 MAY 17, 1991

10N03W23DAAD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 17, 1990	35.82		MAY 24, 1990	39.53	B	SEP 01, 1990	33.95	B	MAR 09, 1991	44.58	B
20	35.93		JUN 01	37.64	B	OCT 01	35.72	B	APR 01	45.87	B
27	42.59		11	36.58	S	NOV 01	37.90	B	MAY 01	46.62	B
MAY 10	42.11		JUL 01	35.31	B	07	38.22	S			
23	39.70		AUG 01	34.39	B	DEC 01	40.31	B			

HIGHEST 33.95 SEP 01, 1990
LOWEST 46.62 MAY 01, 1991

10N03W25CDBA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 11, 1990	37.30	S	SEP 12, 1990	--	P	FEB 06, 1991	41.30	S	MAY 30, 1991	40.40	S
JUL 05	36.85	S	OCT 10	38.62	S	MAR 14	47.86	S	JUN 13	38.61	S
27	37.30	S	NOV 07	40.76	S	APR 13	45.08	S			
AUG 20	37.02	S	DEC 10	43.59	S	MAY 17	44.60	S			

HIGHEST 36.85 JUL 05, 1990
LOWEST 47.86 MAR 14, 1991

10N03W25CDBA02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 11, 1990	26.78	S	JUL 27, 1990	27.76	S	DEC 10, 1990	24.27	S	MAY 30, 1991	28.52	S
25	26.91	S	AUG 20	19.26	S	FEB 06, 1991	27.31	S	JUN 13	24.93	S
JUN 11	26.77	S	SEP 12	17.90	S	MAR 14	27.94	S			
22	25.59	S	OCT 10	19.22	S	APR 13	28.75	S			
JUL 05	23.91	S	NOV 07	21.72	S	MAY 17	29.39	S			

HIGHEST 17.90 SEP 12, 1990
LOWEST 29.39 MAY 17, 1991

10N03W27CCAB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 11, 1990	24.50	S	AUG 20, 1990	26.68	S	DEC 10, 1990	25.76	S	MAY 17, 1991	24.15	S
22	24.83	S	SEP 12	26.42	S	JAN 16, 1991	25.90	S	30	23.40	S
JUL 05	28.57	S	OCT 10	26.00	S	FEB 06	24.35	S	JUN 13	24.40	S
27	26.45		NOV 08	25.50	S	MAR 14	23.26	S			

HIGHEST 23.26 MAR 14, 1991
LOWEST 28.57 JUL 05, 1990

10N03W31BDBD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 20, 1991	96.2	T									

HIGHEST 96.2 APR 20, 1991
LOWEST 96.2 APR 20, 1991

10N04W01DCAD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAR 14, 1991	52.53	S	APR 13, 1991	51.48	S						

HIGHEST 51.48 APR 13, 1991
LOWEST 52.53 MAR 14, 1991

10N04W02CBAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
FEB 03, 1980	26.88	S	APR 24, 1982	22.70	S	MAR 31, 1985	32.19	S	OCT 11, 1988	37.37	S
MAR 08	27.48	S	MAY 23	22.61	S	MAY 19	33.21	S	DEC 05	36.87	S
APR 13	27.94	S	JUL 27	22.64	S	JUL 04	34.97	S	JAN 04, 1989	37.02	S
MAY 04	28.48	S	SEP 25	24.15	S	26	36.29	S	MAR 15	35.56	S
JUN 01	27.12	S	DEC 03	25.09	S	27	35.55	S	MAY 01	34.52	S
28	25.21	S	JAN 16, 1983	25.69	S	SEP 28	34.19	S	JUN 06	34.34	S
JUL 27	23.94	S	FEB 19	26.20	S	DEC 26	34.18	S	NOV 03	32.85	S
AUG 30	23.38	S	APR 16	26.94	S	MAR 09, 1986	33.00	S	DEC 06	32.94	S
OCT 19	23.10	S	MAY 10	27.46	S	MAY 25	30.30	S	JAN 05, 1990	33.26	S
NOV 30	23.36	S	JUN 02	27.84	S	JUL 13	29.47	S	FEB 12	33.64	S
JAN 24, 1981	24.20	S	18	27.89	S	SEP 28	29.68	S	MAR 20	34.09	S
MAR 07	25.05	S	JUL 11	27.55	S	NOV 16	30.03	S	MAY 16	34.51	S
APR 19	25.95	S	AUG 07	28.29	S	FEB 01, 1987	30.80	S	JUL 07	33.30	S
MAY 23	23.66	S	SEP 25	27.74	S	APR 26	31.90	S	AUG 19	35.03	S
30	18.46	S	OCT 30	27.78	S	JUL 03	34.00	S	SEP 22	33.98	S
JUN 21	12.18	S	JAN 01, 1984	28.48	S	25	33.53	S	DEC 06	34.56	S
AUG 08	13.35	S	FEB 19	28.93	S	OCT 12	34.31	S	JAN 11, 1991	34.93	S
SEP 12	15.59	S	APR 21	29.58	S	DEC 15	34.10	S	FEB 07	35.26	S
OCT 03	17.09	S	MAY 27	30.29	S	MAR 29, 1988	34.92	S	MAR 15	35.63	S
NOV 11	18.95	S	JUL 01	30.98	S	MAY 17	35.76	S	APR 19	35.86	S
DEC 24	20.72	S	SEP 09	31.35	S	JUN 17	36.75	S	MAY 16	36.73	S
FEB 15, 1982	22.49	S	NOV 11	31.40	S	JUL 17	37.85	S	JUN 26	36.45	S
MAR 28	22.85	S	JAN 26, 1985	31.87	S	SEP 01	38.09	S			

HIGHEST 12.18 JUN 21, 1981
LOWEST 38.09 SEP 01, 1988

10N04W10DDDA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	2.26		SEP 30, 1987	5.73	S	MAY 24, 1990	3.21	S	NOV 08, 1990	8.12	S
30	4.41	S	AUG 05, 1988	7.81	S	JUN 08	3.28	S	DEC 10	8.09	S
NOV 06	5.79	S	DEC 20	8.55	S	21	3.92	S	FEB 06, 1991	7.76	S
MAY 25, 1982	4.95	S	AUG 31, 1989	5.23	S	JUL 05	1.86	S	MAR 14	7.53	S
NOV 15, 1983	4.78	S	JAN 08, 1990	5.23	S	26	5.30	S	APR 13	7.32	S
OCT 11, 1984	4.68	S	APR 05	6.69	S	AUG 21	6.67	S	MAY 17	7.18	S
SEP 24, 1985	3.69	S	27	6.52	S	SEP 12	6.61	S	30	3.93	S
SEP 22, 1986	2.35	S	MAY 18	3.58	S	OCT 09	7.67	S	JUN 13	3.11	S

HIGHEST 1.86 JUL 05, 1990
LOWEST 8.55 DEC 20, 1988

10N04W12ACDA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	2.90		JAN 18, 1990	10.21	S	JUL 05, 1990	6.83	S	FEB 06, 1991	10.52	S
30	4.49	S	APR 05	13.00	S	27	8.18	S	MAR 14	11.35	S
NOV 05	7.13	S	27	12.89	S	AUG 21	8.18	S	APR 13	12.19	S
MAY 25, 1982	9.07		MAY 10	11.62	S	SEP 12	7.33	S	MAY 17	11.70	S
NOV 15, 1983	8.26	S	24	10.46	S	OCT 09	7.88	S	30	10.43	S
AUG 05, 1988	9.27	S	JUN 08	9.34	S	NOV 08	8.23	S	JUN 13	9.16	S
11	9.48	S	21	8.32	S	DEC 13	9.30	S			

HIGHEST 2.90 JUN 02, 1981
LOWEST 13.00 APR 05, 1990

10N04W12CADB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	10.22	S	JAN 19, 1990	16.99	S	JUL 05, 1990	12.62	S	FEB 06, 1991	16.72	S
30	11.45	S	APR 05	18.66	S	27	12.89	S	MAR 14	17.52	S
NOV 05	14.17	S	27	18.18	S	AUG 21	13.05	S	APR 13	17.93	S
MAY 25, 1982	15.48	S	MAY 10	17.18	S	SEP 12	12.17	S	MAY 17	16.55	S
NOV 15, 1983	15.40	S	24	15.38	S	OCT 09	13.28	S	30	14.82	S
AUG 05, 1988	16.10	S	JUN 08	13.50	S	NOV 08	14.67	S	JUN 13	3.09	S
11	16.21	S	21	12.65	S	DEC 13	15.93	S			

HIGHEST 3.09 JUN 13, 1991
LOWEST 18.66 APR 05, 1990

10N04W13ACCD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 01, 1990	8.03	S	JUL 05, 1990	6.23	S	NOV 08, 1990	9.09	S	APR 13, 1991	8.32	S
10	5.41	S	27	8.09	S	DEC 13	9.41	S	MAY 17	6.21	S
24	3.32	S	AUG 21	9.63	S	JAN 23, 1991	9.26	S	30	2.31	S
JUN 08	2.54	S	SEP 12	9.45	S	FEB 06	9.15	S	JUN 13	4.03	S
21	3.99	S	OCT 09	9.01	S	MAR 14	8.42	S			

HIGHEST 2.31 MAY 30, 1991
LOWEST 9.63 AUG 21, 1990

10N04W13ACCD02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 10, 1990	31.86	S	JUL 27, 1990	37.56	S	DEC 13, 1990	32.14	S	MAY 30, 1991	31.73	S
24	30.43	S	AUG 21	37.61	S	FEB 06, 1991	32.35	S	JUN 13	32.50	S
JUN 08	29.79	S	SEP 12	36.11	S	MAR 14	32.35	S			
21	31.76	S	OCT 09	35.22	S	APR 13	31.32	S			
JUL 05	33.88	S	NOV 08	33.90	S	MAY 17	31.85	S			

HIGHEST 29.79 JUN 08, 1990
LOWEST 37.61 AUG 21, 1990

10N04W15BAAB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 18, 1990	25.11	S	JUN 21, 1990	24.96	S	OCT 09, 1990	26.02	S	APR 13, 1991	26.11	S
27	25.27	S	JUL 05	24.50	S	NOV 08	25.83	S	MAY 17	26.66	S
MAY 10	25.56	S	26	27.01	S	DEC 10	25.93	S	30	26.36	S
24	25.95	S	AUG 21	27.65	S	FEB 06, 1991	26.45	S	JUN 13	26.36	S
JUN 08	25.21	S	SEP 12	26.21	S	MAR 14	26.07	S			

HIGHEST 24.50 JUL 05, 1990
LOWEST 27.65 AUG 21, 1990

10N04W15BABD02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 18, 1990	31.50	S	JUL 26, 1990	31.08	S	NOV 08, 1990	31.37	S	APR 13, 1991	32.89	S
27	31.75	S	AUG 21	30.88	S	DEC 10	31.86	S	JUN 13	33.38	S
MAY 10	31.33	S	SEP 12	30.37	S	FEB 06, 1991	32.70	S			
24	34.26	S	OCT 09	30.88	S	MAR 14	32.80	S			

HIGHEST 30.37 SEP 12, 1990
LOWEST 34.26 MAY 24, 1990

10N04W15CCCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 24, 1990	48.36	S	JUL 25, 1990	48.87	S	NOV 08, 1990	50.40	S	APR 13, 1991	52.98	S
JUN 08	48.63	S	AUG 21	49.05	S	DEC 10	50.95	S	MAY 17	53.20	S
21	48.70	S	SEP 12	49.51	S	FEB 06, 1991	52.04	S	30	53.15	S
JUL 05	48.69	S	OCT 09	49.95	S	MAR 14	52.53	S	JUN 13	53.05	S

HIGHEST 48.36 MAY 24, 1990
LOWEST 53.20 MAY 17, 1991

10N04W15DBBB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	21.53	S	AUG 11, 1988	23.42	S	JUL 05, 1990	19.66	S	DEC 10, 1990	30.33	S
30	23.10	S	APR 05, 1990	--	D	26	24.96	S	MAR 14, 1991	--	D
NOV 05	25.18	S	27	--	D	AUG 21	16.90	S	APR 13	--	D
MAY 25, 1982	19.60	S	MAY 10	--	D	SEP 12	22.16	S	MAY 17	--	D
NOV 15, 1983	25.50	S	24	--	D	OCT 09	25.78	S	30	--	D
AUG 05, 1988	22.65	S	JUN 21	22.19	S	NOV 08	28.38	S	JUN 13	21.38	S

HIGHEST 16.90 AUG 21, 1990
LOWEST 30.33 DEC 10, 1990

10N04W23ABBC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 17, 1990	2.28	S	JUN 08, 1990	2.40	S	OCT 09, 1990	3.37	S	APR 13, 1991	1.98	S
27	2.37	S	21	2.45	S	NOV 08	2.74	S	MAY 17	2.25	S
MAY 10	2.49	S	JUL 26	3.43	S	DEC 10	2.39	S	30	2.14	S
23	2.74	S	AUG 21	3.78	S	FEB 06, 1991	2.03	S	JUN 13	2.20	S
24	1.57	S	SEP 12	3.65	S	MAR 14	2.00	S			

HIGHEST 1.57 MAY 24, 1990
LOWEST 3.78 AUG 21, 1990

10N04W23BBBB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	2.72	S	APR 27, 1990	7.10	S	AUG 21, 1990	4.48	S	APR 13, 1991	5.76	S
30	3.58	S	MAY 10	4.14	S	SEP 12	4.19	S	MAY 17	4.05	S
NOV 05	3.91	S	24	2.45	S	OCT 09	4.36	S	30	3.65	S
MAY 25, 1982	4.79	S	JUN 08	2.96	S	NOV 08	4.57	S	JUN 13	3.95	S
NOV 15, 1983	4.57	S	21	3.09	S	DEC 10	4.98	S			
AUG 05, 1988	4.71	S	JUL 05	3.78	S	FEB 06, 1991	5.38	S			
APR 05, 1990	7.19	S	26	3.51	S	MAR 14	5.45	S			

HIGHEST 2.45 MAY 24, 1990
LOWEST 7.19 APR 05, 1990

10N04W23BBCB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 12, 1990	4.32	S	AUG 21, 1990	6.41	S	DEC 10, 1990	6.88	S	MAY 17, 1991	5.80	S
21	3.93	S	SEP 12	5.71	S	FEB 06, 1991	7.31	S	30	5.36	S
JUL 05	5.13	S	OCT 09	5.99	S	MAR 14	7.50	S	JUN 13	5.52	S
26	4.92	S	NOV 08	6.33	S	APR 13	7.94	S			

HIGHEST 3.93 JUN 21, 1990
LOWEST 7.94 APR 13, 1991

10N04W23BBCB02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 21, 1990	3.99	S	SEP 12, 1990	5.78	S	JAN 18, 1991	7.24	S	MAY 17, 1991	5.89	S
JUL 05	5.22	S	OCT 09	6.07	S	FEB 06	7.39	S	30	5.44	S
26	4.98	S	NOV 08	6.46	S	MAR 14	7.60	S	JUN 13	5.52	S
AUG 21	6.56	S	DEC 10	6.96	S	APR 13	8.04	S			

HIGHEST 3.99 JUN 21, 1990
LOWEST 8.04 APR 13, 1991

10N04W25DBDC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 20, 1991	230.5	T									

HIGHEST 230.5 APR 20, 1991
LOWEST 230.5 APR 20, 1991

11N02W30DCAD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	28.21		APR 06, 1990	29.02	S	JUL 26, 1990	23.20	S	MAR 14, 1991	28.61	S
30	27.34	S	27	29.04	S	AUG 20	22.19	S	APR 13	28.81	S
NOV 06	26.68	S	MAY 10	29.15	S	SEP 12	24.08	S	MAY 17	27.20	S
MAY 25, 1982	26.45	S	25	26.10	S	OCT 10	25.51	S	30	26.19	S
NOV 15, 1983	27.12	S	JUN 08	25.12	S	NOV 07	25.64	S	JUN 13	26.40	S
AUG 05, 1988	19.82	S	21	24.94	S	DEC 10	26.82	S			
08	20.16	S	JUL 05	23.39	S	FEB 06, 1991	28.16	S			

HIGHEST 19.82 AUG 05, 1988
LOWEST 29.15 MAY 10, 1990

11N02W31ACAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	28.91		FEB 05, 1990	30.23	S	JUL 05, 1990	24.29	S	FEB 06, 1991	30.02	S
30	28.16	S	APR 06	30.64	S	26	21.73	S	MAR 14	30.39	S
NOV 06	28.30	S	27	30.73	S	AUG 20	22.72	S	APR 13	30.61	S
MAY 25, 1982	28.58	S	MAY 10	30.81	S	SEP 12	25.84	S	MAY 17	30.59	S
NOV 15, 1983	29.10	S	25	27.22	S	OCT 10	25.79	S	30	28.80	S
AUG 04, 1988	22.47	S	JUN 08	24.04	S	NOV 07	27.52	S	JUN 13	25.56	S
08	21.98	S	21	23.91	S	DEC 10	28.89	S			

HIGHEST 21.73 JUL 26, 1990
LOWEST 30.81 MAY 10, 1990

11N02W32DDCD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 06, 1991	155.44	S									

HIGHEST 155.44 JUN 06, 1991
LOWEST 155.44 JUN 06, 1991

11N03W08BBBD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
OCT 31, 1990	50.58	S	FEB 21, 1991	49.83	S	MAR 14, 1991	49.69	S	APR 13, 1991	49.54	S

HIGHEST 49.54 APR 13, 1991
LOWEST 50.58 OCT 31, 1990

11N03W12CCCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAR 14, 1991	77.10	S	APR 13, 1991	77.94	S						

HIGHEST 77.10 MAR 14, 1991
LOWEST 77.94 APR 13, 1991

11N03W15CBCC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
NOV 7, 1990	6.81	S	FEB 6, 1991	6.99	S	APR 13, 1991	6.96	S	JUN 13, 1991	7.10	S
DEC 13, 1990	6.77	S	MAR 14, 1991	6.96	S	MAY 17, 1991	6.95	S			

HIGHEST 6.77 DEC 13, 1990
LOWEST 7.10 JUN 13, 1991

Table 9.--*Records of water levels in monitoring wells*--Continued

11N03W15DCDD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	2.28	S	JAN 19, 1990	6.28	S	JUL 25, 1990	5.99	S	FEB 06, 1991	6.66	S
30	5.01	S	APR 06	6.68	S	26	5.99	S	MAR 14	6.64	S
NOV 05	6.43	S	27	6.73	S	AUG 20	6.19	S	APR 13	6.67	S
MAY 25, 1982	6.74	S	MAY 10	6.75	S	SEP 12	5.86	S	MAY 17	6.05	S
NOV 15, 1983	5.09	S	25	6.56	S	OCT 10	6.40	S	30	6.05	S
AUG 04, 1988	3.03	S	JUN 08	6.29	S	NOV 08	6.31	S	JUN 13	5.78	S
05	3.24	S	21	5.71	S	DEC 13	6.37	S			

HIGHEST 2.28 JUN 02, 1981
LOWEST 6.75 MAY 10, 1990

11N03W20BBBB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	19.33		AUG 08, 1988	15.19	S	JUL 05, 1990	16.72	S	DEC 12, 1990	--	D
30	20.37	S	JAN 18, 1990	--	D	27	16.79	S	MAR 14, 1991	--	D
NOV 05	17.61	S	APR 05	--	D	AUG 21	17.03	S	APR 13	--	D
MAY 25, 1982	17.37	S	27	--	D	SEP 12	17.16	S	MAY 17	20.90	S
NOV 15, 1983	19.25	S	MAY 10	21.13	S	OCT 09	19.58	S	30	20.30	S
AUG 04, 1988	14.58	S	24	21.20	S	NOV 07	--	D	JUN 13	18.85	S

HIGHEST 14.58 AUG 04, 1988
LOWEST 21.20 MAY 24, 1990

11N03W21BBAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
SEP 26, 1978	3.36	S	MAR 23, 1979	2.81	S	JUL 20, 1979	1.90	S	AUG 04, 1988	1.67	S
DEC 27	3.66	S	26	2.82	S	AUG 13	1.75	S	08	2.47	S
29	3.76	S	28	2.87	S	30	2.62	S	NOV 08, 1990	3.24	S
FEB 02, 1979	4.35	S	APR 04	2.90	S	SEP 13	3.46	S	DEC 13	3.13	S
20	4.02	S	10	3.38	S	JUN 02, 1981	1.81	S	FEB 06, 1991	3.37	S
27	4.04	S	MAY 15	3.45	S	30	.66	S	MAR 14	2.71	S
MAR 05	3.97	S	25	3.14	S	NOV 05, 1981	2.70	S	APR 13	2.59	S
08	3.28	S	JUN 10	3.19	S	MAY 25, 1982	1.22	S	MAY 17	1.78	S
MAR 14	2.91	S	JUL 09	1.86	S	NOV 15, 1983	2.81	S	JUN 13	2.05	S

HIGHEST .66 JUN 30, 1981
LOWEST 4.35 FEB 02, 1979

11N03W21DDAD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	5.35		JAN 19, 1990	6.68	S	JUL 26, 1990	5.04	S	MAR 14, 1991	6.55	S
30	6.14	S	APR 06	6.30	S	AUG 20	4.91	S	APR 13	6.14	S
NOV 05	6.29	S	27	6.42	S	SEP 12	5.56	S	MAY 17	5.95	S
MAY 25, 1982	6.23	S	MAY 10	6.01	S	OCT 10	6.09	S	30	5.37	S
NOV 15, 1983	6.45	S	25	5.50	S	NOV 08	6.26	S	JUN 13	5.12	S
AUG 17, 1988	6.61	S	JUN 08	5.54	S	DEC 12	6.54	S			
18	6.06	S	21	5.25	S	FEB 06, 1991	6.83	S			

HIGHEST 4.91 AUG 20, 1990
LOWEST 6.83 FEB 06, 1991

11N03W22BBCB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
OCT 11, 1984	+54.57	H	AUG 20, 1990	+50.34	H	DEC 12, 1990	+47.11	H	MAY 17, 1991	+43.42	H
JUN 12, 1990	+42.92	H	SEP 14	+52.01	H	FEB 06, 1991	+44.46	H	30	+44.00	H
JUL 05	+48.61	H	OCT 10	+51.78	H	MAR 14	+42.36	H	JUN 13	+39.98	H
26	+49.07	H	NOV 07,	+49.53	H	APR 13	+44.46	H			

HIGHEST +54.57 OCT 11, 1984
LOWEST +39.98 JUN 13, 1991

Table 9.--*Records of water levels in monitoring wells*--Continued

11N03W22BBCB02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 11, 1990	8.52	S	JUL 26, 1990	9.79	S	NOV 07, 1990	10.34	S	APR 13, 1991	9.36	S
12	8.56	S	AUG 20	9.78	S	DEC 13	10.24	S	MAY 17	8.66	S
21	8.68	S	SEP 12	9.76	S	FEB 06, 1991	10.40	S	30	8.64	S
JUL 05	9.28	S	OCT 10	10.36	S	MAR 14	9.93	S	JUN 13	8.69	S

HIGHEST 8.52 JUN 11, 1990
LOWEST 10.40 FEB 06, 1991

11N03W30BAAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	20.40		AUG 10, 1988	15.6	S	JUN 21, 1990	--	D	DEC 12, 1990	--	D
30	17.59	S	APR 05, 1990	--	D	JUL 27	19.38	S	MAR 14, 1991	--	D
NOV 05	17.04	S	27	--	D	AUG 21	18.14	S	APR 13	--	D
MAY 25, 1982	19.37	S	MAY 10	--	D	SEP 12	19.04	S	MAY 17	--	D
NOV 15, 1983	19.14	S	24	20.01	S	OCT 09	20.72	S	30	--	D
AUG 04, 1988	14.27	S	JUN 08	--	D	NOV 08	--	D	JUN 13	--	D

HIGHEST 14.27 AUG 04, 1988
LOWEST 20.72 OCT 09, 1990

11N03W30DADA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	+.54	S	SEP 30, 1987	.01	S	JUN 08, 1990	3.44	S	DEC 13, 1990	3.39	S
30	.80	S	AUG 03, 1988	.45	S	21	2.50	S	FEB 06, 1991	4.26	S
NOV 05	.18	S	SEP 01, 1989	1.05	S	JUL 05	2.32	S	MAR 14	4.69	S
MAY 25, 1982	2.04	S	JAN 08, 1990	4.13	S	27	1.66	S	APR 13	4.96	S
NOV 15, 1983	.97	S	APR 05	5.05	S	AUG 21	.99	S	MAY 17	4.97	S
OCT 11, 1984	.10	S	27	5.28	S	SEP 12	1.05	S	30	4.80	S
SEP 26, 1985	.66	S	MAY 10	6.23	S	OCT 09	1.72	S	JUN 13	4.34	S
SEP 22, 1986	.32	S	25	4.69	S	NOV 08	2.63	S			

HIGHEST +.54 JUN 02, 1981
LOWEST 6.23 MAY 10, 1990

11N03W31BADD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 10, 1990	5.85	S	JUN 08, 1990	5.91	S	SEP 12, 1990	4.46	S	APR 13, 1991	5.51	S
27	7.17	S	21	5.55	S	OCT 09	4.77	S	MAY 30	6.37	S
MAY 10	8.32	S	JUL 05	5.20	S	DEC 13	5.51	S	JUN 13	5.30	S

HIGHEST 4.46 SEP 12, 1990
LOWEST 8.32 MAY 10, 1990

11N03W31BBDB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 10, 1990	6.69	S	JUN 08, 1990	5.04	S	AUG 21, 1990	3.66	S	APR 13, 1991	6.76	S
27	6.90	S	21	4.97	S	SEP 12	4.07	S	MAY 17	5.98	S
MAY 10	7.02	S	JUL 05	4.49	S	OCT 09	4.63	S	30	5.55	S
24	5.90	S	27	2.37	S	DEC 13	4.20	S	JUN 13	4.20	S

HIGHEST 2.37 JUL 27, 1990
LOWEST 7.02 MAY 10, 1990

11N03W31DABA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	1.47		APR 05, 1990	6.53	S	JUL 05, 1990	6.42	S	DEC 12, 1990	5.90	S
NOV 12	3.63	S	27	6.75	S	27	6.23	S	FEB 06, 1991	6.32	S
MAY 25, 1982	4.97	S	MAY 10	6.94	S	AUG 21	5.96	S	MAR 14	6.68	S
NOV 15, 1983	4.21	S	25	6.83	S	SEP 12	5.81	S	APR 13	6.90	S
AUG 03, 1988	5.81	S	JUN 08	6.57	S	OCT 09	5.90	S	MAY 17	6.88	S
08	5.86	S	21	6.21	S	NOV 08	5.83	S	JUN 13	6.50	S

HIGHEST 1.47 JUN 02, 1981
LOWEST 6.94 MAY 10, 1990

11N03W33BBAA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
AUG 17, 1990	3.58	S	NOV 08, 1990	3.84	S	MAR 14, 1991	4.03	S	MAY 30, 1991	3.00	S
SEP 12	3.61	S	DEC 12	3.98	S	APR 13	3.90	S	JUN 13	3.10	S
OCT 09	3.92	S	JAN 16, 1991	4.03	S	MAY 17	3.35	S			

HIGHEST 2.61 SEP 12, 1990
LOWEST 4.03 JAN 16, 1991 MAR 14, 1991

11N03W33BBAA02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
AUG 20, 1990	5.23	S	NOV 08, 1990	5.48	S	FEB 06, 1991	5.62	S	MAY 17, 1991	4.45	S
SEP 12	5.32	S	DEC 12	5.48	S	MAR 14	5.56	S	30	4.57	S
OCT 09	5.62	S	JAN 16, 1991	5.58	S	APR 13	5.41	S	JUN 13	3.33	S

HIGHEST 3.33 JUN 13, 1991
LOWEST 5.62 OCT 09, 1990 FEB 06, 1991

11N03W33DDDC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 25, 1990	.53	S	JUL 27, 1990	.10	S	NOV 08, 1990	1.22	S	APR 13, 1991	1.10	S
JUN 08	.46	S	AUG 20	.99	S	DEC 12	1.20	S	MAY 17	.70	S
21	.16	S	SEP 12	1.05	S	FEB 06, 1991	1.55	S	30	1.60	S
JUL 05	.79	S	OCT 09	1.22	S	MAR 14	1.27	S	JUN 13	.71	S

HIGHEST .10 JUL 27, 1990
LOWEST 1.60 MAY 30, 1991

11N03W33DDDC02

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 25, 1990	2.48	S	JUL 27, 1990	2.55	S	NOV 08, 1990	2.86	S	APR 13, 1991	2.67	S
JUN 08	2.63	S	AUG 20	2.90	S	DEC 12	2.80	S	MAY 17	2.65	S
21	2.34	S	SEP 12	2.93	S	FEB 06, 1991	2.93	S	30	1.33	S
JUL 05	2.86	S	OCT 09	2.93	S	MAR 14	2.78	S	JUN 13	2.06	S

HIGHEST 1.33 MAY 30, 1991
LOWEST 2.93 SEP 12, 1990 OCT 09, 1990 FEB 06, 1991

11N03W35DACC01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 25, 1990	2.16	S	JUL 27, 1990	1.60	S	NOV 08, 1990	2.78	S	APR 13, 1991	3.48	S
JUN 08	2.23	S	AUG 20	.91	S	DEC 10	3.11	S	MAY 17	2.28	S
21	2.17	S	SEP 12	2.40	S	FEB 06, 1991	3.61	S	30	2.73	S
JUL 05	1.60	S	OCT 10	2.00	S	MAR 14	3.60	S	JUN 13	2.06	S

HIGHEST .91 AUG 20, 1990
LOWEST 3.61 FEB 06, 1991

11N03W35DDBB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
MAY 25, 1990	+2.17	S	JUL 27, 1990	--	F	NOV 08, 1990	+2.55	S	APR 13, 1991	+.49	S
JUN 08	+2.49	S	AUG 20	--	F	DEC 12	+2.02	S	MAY 17	+1.07	S
21	+2.87	S	SEP 12	+3.14	S	FEB 06, 1991	+1.10	S	30	+2.00	S
JUL 05	--	F	OCT 10	+3.35	S	MAR 14	+.96	S	JUN 13	+3.05	S

HIGHEST +3.35 OCT 10, 1990
LOWEST +.49 APR 13, 1991

11N04W11ADAB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUL 18, 1988	54.70	S	FEB 21, 1991	59.30	S	MAR 14, 1991	59.20	S	APR 13, 1991	59.14	S

HIGHEST 54.70 JUL 18, 1988
LOWEST 59.30 FEB 21, 1991

11N04W14DCCA01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
APR 10, 1990	40.30	S	JUN 01, 1990	37.64	B	NOV 01, 1990	38.24	B	MAY 01, 1991	40.58	B
20	40.30	S	22	33.92	S	DEC 01	37.37	B	17	41.11	S
27	40.93	S	JUL 01	33.71	B	JAN 01, 1991	38.58	B	JUN 13	41.11	
MAY 10	40.42	S	AUG 01	33.14	B	FEB 01	40.65	B			
23	39.01	S	SEP 01	34.83	B	MAR 01	39.77	B			
MAY 24	38.95	B	OCT 01	36.50	B	APR 01	40.15	B			

HIGHEST 33.14 AUG 01, 1990
LOWEST 41.11 MAY 17, 1991 JUN 13, 1991

11N04W25DDDD01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
JUN 02, 1981	8.70		APR 09, 1990	15.08	S	JUL 27, 1990	3.57	S	MAR 14, 1991	13.81	S
30	4.41	S	27	15.46	S	AUG 21	4.90	S	APR 13	14.63	S
NOV 05	5.39	S	MAY 10	15.60	S	SEP 12	7.25	S	MAY 17	11.28	S
MAY 25, 1982	5.63	S	24	11.98	S	OCT 09	8.67	S	30	11.61	S
NOV 15, 1983	6.17	S	JUN 08	9.54	S	NOV 07	9.76	S	JUN 13	6.09	S
AUG 22, 1988	5.68	S	21	8.45	S	DEC 13	8.80	S			
JAN 18, 1990	13.18	S	JUL 05	7.56	S	FEB 06, 1991	12.82	S			

HIGHEST 3.57 JUL 27, 1990
LOWEST 15.60 MAY 10, 1990

11N04W26ACAB01

DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS	DATE	WATER LEVEL	MS
OCT 31, 1990	66.77	S	JUN 20, 1991	66.42	S						

HIGHEST 66.42 JUN 20, 1991
LOWEST 66.77 OCT 31, 1990

Table 10.--*Physical properties and major-ion concentrations of water from wells*

[Analyses by Montana Bureau of Mines and Geology in accordance with methods defined by Fishman and Friedman (1989). Geologic unit: Qal, Quaternary alluvium; Tsu, Tertiary sediments undifferentiated (queried where upper contact is uncertain; pTb, pre-Tertiary bedrock. Depth of well reported in feet below land surface. Bicarbonate was determined by fixed endpoint titration in the laboratory (fet-lab) or by incremental titration onsite (it-fld). Abbreviations: °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter. Symbols: <, less than; --, no data or not applicable; ND, not detectable]

Location number	Geo-logic unit	Depth of well (feet)	Date	Onsite temper-ature, water (°C)	Onsite spe-cific con-duct-ance (µS/cm)	Onsite pH (stand-ard units)	Hard-ness, total (mg/L as $CaCO_3$)	Alka-linity (it-fld) (mg/L as $CaCO_3$)	Solids, sum of consti-tuents, dis-solved (mg/L)	Calcium, dis-solved (mg/L as Ca)	Magne-sium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
09N02W07ACDD01	Qal	--	05-24-89	6.0	170	7.0	70	47	102	20	4.8	4.0
			06-21-89	--	--	7.2	80	61	114	23	5.5	4.2
			08-22-89	12.0	197	7.4	99	82	140	28	6.9	5.1
			09-27-89	11.0	177	7.0	73	61	116	21	5.0	5.2
			04-18-90	5.0	153	6.6	53	38	90	15	3.8	4.1
			04-25-90	5.5	139	6.7	49	38	85	13	3.9	3.6
			05-29-90	8.0	190	5.8	69	--	--	19	5.2	3.9
			06-04-90	8.0	159	6.9	71	52	100	20	5.1	4.0
09N03W01ABAB01	Tsu	105	11-18-80	8.5	495	7.1	200	--	305	59	13	25
10N02W04CDDC01	Tsu	120	11-06-90	11.0	505	7.8	150	171	354	47	7.3	47
10N02W06CBCC01	Qal	24	11-14-78	--	384	--	150	--	240	45	10	21
			12-26-78	11.0	--	--	140	--	184	39	11	22
			04-11-79	7.0	400	--	160	--	236	45	11	18
			06-26-79	--	380	--	--	--	--	--	--	--
10N02W06CCCC01	Qal	35	10-03-90	13.0	380	7.5	--	--	--	--	--	--
10N02W06DCDD01	Qal	--	06-30-88	9.0	790	--	--	--	--	--	--	--
10N02W06DDB 01	Qal	21	01-16-79	3.5	610	--	220	--	388	63	16	48
10N02W06DDBC01	Qal	24	11-14-78	10.0	579	--	200	--	359	58	14	45
			01-16-79	3.5	--	--	210	--	382	61	14	46
			04-12-79	8.0	620	--	220	--	372	64	15	42
			06-27-79	--	610	--	--	--	--	--	--	--
10N02W06DDDA01	Qal	--	11-07-90	12.0	422	7.6	--	--	--	--	--	--
10N02W07BAA 01	Qal	38	08-31-71	17.0	398	--	--	--	--	--	--	--
10N02W07BBBB01	Qal	24	11-14-78	--	--	--	130	--	248	37	8.8	21
			12-26-78	13.0	--	--	160	--	242	45	11	20
			04-11-79	9.0	386	--	150	--	238	44	10	18
			06-27-79	--	411	--	--	--	--	--	--	--
			08-17-90	17.0	390	6.6	150	142	237	41	12	22
10N02W18AADA01	Qal	--	08-02-88	13.0	330	--	--	--	--	--	--	--
10N02W18DDCD01	Tsu	70	06-11-81	10.0	400	7.6	150	--	241	45	9.4	27
10N02W19AAD 01	Qal	74	09-01-71	14.5	390	--	--	--	--	--	--	--
			09-09-71	14.0	--	--	--	--	--	--	--	--
10N02W29BCC 01	Qal	80	09-01-71	14.0	733	--	--	--	--	--	--	--
			09-10-71	14.5	--	--	--	--	--	--	--	--
10N02W29CCAA01	Tsu	--	05-01-89	11.0	545	--	--	--	--	--	--	--
10N02W29CCAA02	Tsu	--	05-01-89	7.0	550	--	--	--	--	--	--	--
10N02W30DBAC01	Tsu(?)	180	05-01-89	11.0	405	--	--	--	--	--	--	--
10N02W30DBCC01	Qal	40	05-01-89	11.5	520	--	--	--	--	--	--	--
10N02W30DBDA01	Qal	98	05-04-89	10.0	680	--	--	--	--	--	--	--
10N02W30DCBD01	Qal	--	05-01-89	11.0	460	--	--	--	--	--	--	--
10N02W31ABA 01	Qal	--	09-10-71	15.0	--	--	--	--	--	--	--	--
10N03W02ACC 01	Qal	49	11-06-90	9.0	402	7.3	--	--	--	--	--	--
10N03W02ADB 01	Qal	20	09-05-90	14.5	620	7.0	270	278	399	79	17	36
10N03W02BDD 01	Qal	40	08-31-71	12.0	402	--	--	--	--	--	--	--
10N03W02DDDD01	Tsu(?)	123	08-15-90	11.5	377	7.1	160	111	248	47	10	14
10N03W02DDDD03	Qal	25	08-14-90	12.0	480	7.1	210	162	303	62	14	14
10N03W03BACB01	Qal	65	04-16-79	8.5	375	--	160	--	230	42	13	15
			06-26-79	--	370	--	--	--	--	--	--	--
			06-09-81	8.5	180	9.8	52	--	105	6.3	8.7	15
10N03W03BACB02	Qal	24	10-18-78	--	--	--	--	--	--	--	--	--
			01-17-79	4.5	--	--	200	--	275	55	14	16
			04-13-79	8.0	460	--	200	--	287	55	14	16
			06-26-79	--	470	--	--	--	--	--	--	--
			06-09-81	9.5	460	7.8	200	--	286	58	13	16
10N03W03BCDA01	Qal	--	07-12-88	9.5	375	--	--	--	--	--	--	--
10N03W03CAB 01	Qal	44	08-17-71	20.5	386	7.7	170	--	264	48	12	15
10N03W03CAC 01	Qal	50	08-31-71	13.5	372	--	--	--	--	--	--	--
10N03W03CCA 01	Qal	32	11-07-90	8.0	370	7.6	--	--	--	--	--	--
10N03W04DCCD01	Qal	55	08-07-90	9.5	462	7.5	300	239	400	89	20	18
10N03W04DCCD02	Qal	25	08-07-90	8.5	641	7.5	300	244	403	86	20	22

Date	Sodium ad-sorp-tion ratio	Potas-sium, dis-solved (mg/L as K)	Bicar-bonate (fet-lab) (mg/L as HCO_3)	Bicar-bonate (it-fld) (mg/L as HCO_3)	Sul-fate, dis-solved (mg/L as SO_4)	Chlo-ride, dis-solved (mg/L as Cl)	Fluo-ride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Nitro-gen, nitrate, dis-solved (mg/L as N)	Phos-phorus, dis-solved (mg/L as P)	Location number
05-24-89	0.2	1.6	--	57	25	1.0	0.1	17	--	0.01	09N02W07ACDD01
06-21-89	.2	1.5	--	74	24	.90	.2	18	--	.02	
08-22-89	.2	1.9	--	101	25	3.8	.1	19	--	<.01	
09-27-89	.3	1.8	--	74	24	2.0	.1	19	--	<.01	
04-18-90	.2	1.4	--	47	21	1.0	.1	17	--	.01	
04-25-90	.2	1.3	--	46	21	1.6	.1	15	--	<.01	
05-29-90	.2	1.4	--	--	20	--	.2	17	--	<.01	
06-04-90	.2	1.4	--	63	20	.40	.1	17	--	.01	
11-18-80	.8	5.0	210	--	62	11	.7	26	--	--	09N03W01ABAB01
11-06-90	2	10	210	208	48	22	.5	61	.65	<.10	10N02W04CDDC01
11-14-78	.7	4.0	180	--	38	9.4	.8	22	.23	--	10N02W06CBCC01
12-26-78	.8	4.0	93	--	39	10	.7	5.7	1.2	--	
04-11-79	.6	3.0	170	--	41	9.9	.6	20	.77	--	
06-26-79	--	--	170	--	--	--	--	--	.11	--	
10-03-90	--	--	--	--	40	12	--	--	.35	--	10N02W06CCCC01
06-30-88	--	--	--	--	--	19	--	--	5.8	--	10N02W06DCDD01
01-16-79	1	7.9	--	--	58	21	.6	24	--	.06	10N02W06DDB 01
11-14-78	1	7.0	250	--	66	25	.8	11	.71	--	10N02W06DDBC01
01-16-79	1	8.0	290	--	61	19	.6	12	2.9	--	
04-12-79	1	5.0	290	--	54	23	.4	18	1.0	--	
06-27-79	--	--	310	--	--	--	--	--	.35	--	
11-07-90	--	--	--	--	40	15	--	--	.43	--	10N02W06DDDA01
08-31-71	--	--	--	--	--	9.5	--	--	1.9	.07	10N02W07BAA 01
11-14-78	.8	4.0	260	--	37	10	.9	--	.34	--	10N02W07BBBB01
12-26-78	.7	4.0	180	--	40	9.4	.8	21	.37	--	
04-11-79	.6	3.0	170	--	37	20	.7	19	.52	--	
06-27-79	--	--	180	--	--	--	--	--	.10	--	
08-17-90	.8	3.8	170	173	37	12	1.1	21	.10	<.10	
08-02-88	--	--	--	--	--	11	--	--	--	--	10N02W18AADA01
06-11-81	1	3.0	170	--	47	10	.4	15	--	--	10N02W18DDCD01
09-01-71	--	--	--	--	--	8.0	--	--	1.2	.09	10N02W19AAD 01
09-09-71	--	--	--	--	--	--	--	--	--	--	
09-01-71	--	--	--	--	--	29	--	--	1.8	.08	10N02W29BCC 01
09-10-71	--	--	--	--	--	--	--	--	--	--	
05-01-89	--	--	--	--	--	15	--	--	1.4	--	10N02W29CCAA01
05-01-89	--	--	--	--	--	15	--	--	1.4	--	10N02W29CCAA02
05-01-89	--	--	--	--	--	13	--	--	2.1	--	10N02W30DBAC01
05-01-89	--	--	--	--	--	20	--	--	2.9	--	10N02W30DBCC01
05-04-89	--	--	--	--	--	18	--	--	8.6	--	10N02W30DBDA01
05-01-89	--	--	--	--	--	11	--	--	3.3	--	10N02W30DCBD01
09-10-71	--	--	--	--	--	--	--	--	--	--	10N02W31ABA 01
11-06-90	--	--	--	--	49	4.9	--	--	1.9	--	10N03W02ACC 01
09-05-90	.9	5.7	350	339	34	23	.4	32	.07	<.10	10N03W02ADB 01
08-31-71	--	--	--	--	--	3.9	--	--	2.7	.09	10N03W02BDD 01
08-15-90	.5	3.1	130	135	75	5.2	.2	22	1.8	<.10	10N03W02DDDD01
08-14-90	.4	3.5	170	197	78	9.6	.2	21	3.3	<.10	10N03W02DDDD03
04-16-79	.5	3.0	150	--	62	.80	.2	18	.56	--	10N03W03BACB01
06-26-79	--	--	150	--	--	--	--	--	.69	--	
06-09-81	.9	3.0	35	--	45	3.8	.2	.10	--	--	
10-18-78	--	--	210	--	--	--	--	--	.86	--	10N03W03BACB02
01-17-79	.5	3.0	200	--	65	3.5	.2	16	.28	--	
04-13-79	.5	3.0	200	--	65	2.8	.2	25	1.8	--	
06-26-79	--	--	210	--	--	--	--	--	1.4	--	
06-09-81	.5	2.0	200	--	70	3.0	.2	25	--	--	
07-12-88	--	--	--	--	--	4.1	--	--	--	--	10N03W03BCDA01
08-17-71	.5	3.2	--	--	64	2.1	.3	27	--	.09	10N03W03CAB 01
08-31-71	--	--	--	--	--	2.3	--	--	1.4	.08	10N03W03CAC 01
11-07-90	--	--	--	--	59	4.3	--	--	1.0	--	10N03W03CCA 01
08-07-90	.4	3.4	280	292	82	16	.2	30	1.3	<.10	10N03W04DCCD01
08-07-90	.5	3.4	290	298	78	19	.2	28	1.2	<.10	10N03W04DCCD02

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Location number	Geologic unit	Depth of well (feet)	Date	Onsite temperature, water (°C)	Onsite specific conductance (µS/cm)	Onsite pH (standard units)	Hardness, total (mg/L as $CaCO_3$)	Alkalinity (it-fld) (mg/L as $CaCO_3$)	Solids, sum of constituents, dissolved (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)
10N03W05ABA 01	Qal	42	08-17-71	15.5	418	7.6	200	--	280	61	12	18
			12-18-72	13.0	435	--	--	--	--	--	--	--
			06-04-81	9.5	480	7.4	210	--	284	61	13	17
10N03W05ABAA01	Qal	--	09-25-90	9.5	470	7.8	--	--	--	--	--	--
10N03W05BAAA01	Qal	64	01-09-79	8.0	--	--	130	--	194	33	12	14
			04-11-79	8.0	336	--	120	--	182	27	13	15
			06-27-79	--	460	--	--	--	--	--	--	--
10N03W05BAAB01	Qal	28	10-17-78	--	--	--	200	--	282	58	14	16
			12-19-78	10.0	--	--	210	--	292	61	15	17
			05-14-79	--	475	--	230	--	320	67	16	20
			06-27-79	--	540	--	--	--	--	--	--	--
10N03W05CCDC01	Qal	45	06-22-88	10.0	440	--	--	--	--	--	--	--
10N03W05CCDD01	Qal	23	11-02-78	12.5	--	--	170	--	242	50	9.8	14
			01-10-79	7.0	--	--	170	--	249	51	10	15
			03-14-79	10.0	450	--	190	--	259	58	11	14
			04-12-79	9.0	435	--	180	--	258	53	11	15
			06-20-79	--	380	--	--	--	--	--	--	--
			08-15-90	11.5	425	7.3	160	142	243	49	10	16
			09-25-90	9.0	468	7.4	--	--	--	--	--	--
10N03W05CCDD02	Qal	48	08-15-90	9.0	425	7.4	190	150	275	54	13	18
10N03W06AADA01	Qal	89	06-21-88	10.0	580	--	--	--	--	--	--	--
10N03W06ABBC01	Qal	62	01-09-79	7.0	--	--	170	--	256	43	15	22
			04-11-79	9.0	505	--	230	--	294	61	18	20
			06-21-79	--	573	--	240	--	334	68	18	21
10N03W06ACD 01	Qal	48	08-18-71	17.5	487	7.3	220	--	308	62	15	21
			12-18-72	12.5	503	--	--	--	--	--	--	--
			11-06-78	14.0	475	--	--	--	--	--	--	--
			06-10-81	11.5	525	7.3	220	--	314	63	15	22
10N03W06ACDC01	Qal	55	06-21-88	10.5	489	--	--	--	--	--	--	--
10N03W06BCC 01	Qal	--	08-23-71	14.5	325	--	--	--	--	--	--	--
10N03W06CAA 01	Qal	45	08-23-71	18.5	552	--	--	--	--	--	--	--
10N03W06CAAD01	Qal	40	11-03-90	9.5	456	7.6	190	--	285	55	14	21
			07-11-90	10.0	455	7.4	--	167	--	--	--	--
10N03W06CDC 01	Qal	65	08-23-71	13.0	470	--	--	--	--	--	--	--
10N03W06DBAA01	Qal	34	11-02-78	11.5	--	--	300	--	422	84	21	28
			01-24-79	8.0	--	--	270	--	404	77	20	28
			04-24-79	9.5	670	--	300	--	412	82	22	28
			07-06-79	--	690	--	--	--	--	--	--	--
			11-03-90	8.0	540	7.0	210	190	330	60	15	31
10N03W06DBAA02	Qal	62	04-24-79	9.0	510	--	210	--	314	59	16	23
			07-06-79	--	522	--	--	--	--	--	--	--
			11-03-90	9.0	407	6.9	160	153	244	46	12	19
10N03W06DCA 01	Qal	--	08-23-71	15.0	477	--	--	--	--	--	--	--
10N03W06DDCD01	Qal	46	06-21-88	9.5	455	--	--	--	--	--	--	--
10N03W07AAA 01	Qal	40	08-23-71	13.0	488	--	--	--	--	--	--	--
10N03W07ABB 01	Qal	42	08-18-71	19.0	478	7.4	210	--	299	58	15	21
10N03W07ACCB01	Qal	89	07-12-90	10.5	445	7.1	--	--	--	--	--	--
10N03W07ADD 02	Qal	40	08-24-71	14.0	507	--	--	--	--	--	--	--
10N03W07BAAA01	Qal	--	06-21-88	10.0	435	--	--	--	--	--	--	--
10N03W07DBC 01	Qal	32	08-23-71	10.5	446	--	--	--	--	--	--	--
10N03W07DDC 01	Qal	65	08-24-71	14.0	708	--	--	--	--	--	--	--
10N03W08ADCB01	Qal	50	06-22-88	10.0	695	--	--	--	--	--	--	--
10N03W08BBA 01	Qal	60	08-24-71	18.5	409	--	--	--	--	--	--	--
			12-18-72	14.0	439	--	--	--	--	--	--	--
			11-06-78	10.0	425	--	--	--	--	--	--	--
10N03W08CBAD01	Qal	52	06-27-88	9.0	200	--	--	--	--	--	--	--
10N03W08CBCC01	Qal	23	11-01-78	12.5	130	--	200	--	286	55	15	19
			01-10-79	7.0	--	--	220	--	308	60	16	19
			04-11-79	5.5	502	--	210	--	299	59	16	19
			06-21-79	--	532	--	230	--	315	63	17	19
10N03W08CCCD01	Qal	--	06-23-88	10.0	778	--	--	--	--	--	--	--
10N03W08CDD 01	Qal	52	12-18-72	11.5	641	--	--	--	--	--	--	--
			11-06-78	10.0	635	--	--	--	--	--	--	--
			06-04-81	10.0	740	7.6	310	--	404	82	25	25
10N03W08CDDB01	Qal	--	06-22-88	11.0	575	--	--	--	--	--	--	--

Date	Sodium ad-sorp-tion ratio	Potas-sium, dis-solved (mg/L as K)	Bicar-bonate (fet-lab) (mg/L as HCO_3)	Bicar-bonate (it-fld) (mg/L as HCO_3)	Sul-fate, dis-solved (mg/L as SO_4)	Chlo-ride, dis-solved (mg/L as Cl)	Fluo-ride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Nitro-gen, nitrate, dis-solved (mg/L as N)	Phos-phorus, dis-solved (mg/L as P)	Location number
08-17-71	.6	2.9	--	--	45	6.8	.2	23	--	.10	10N03W05ABA 01
12-18-72	--	--	--	--	--	7.7	--	--	--	.04	
06-04-81	.5	3.0	220	--	49	10	.7	22	--	--	
09-25-90	--	--	--	--	52	11	--	--	.73	--	10N03W05ABAA01
01-09-79	.5	3.0	130	--	50	13	.3	1.9	.17	--	10N03W05BAAA01
04-11-79	.6	3.0	130	--	42	15	.2	1.8	.18	--	
06-27-79	--	--	190	--	--	--	--	--	3.2	--	
10-17-78	.5	3.0	190	--	55	18	.3	20	1.0	--	10N03W05BAAB01
12-19-78	.5	4.0	210	--	47	16	.3	21	1.5	--	
05-14-79	.6	3.0	220	--	60	18	.3	20	1.6	--	
06-27-79	--	--	230	--	--	--	--	--	2.7	--	
06-22-88	--	--	--	--	--	12	--	--	1.7	--	10N03W05CCDC01
11-02-78	.5	3.0	180	--	47	5.1	.3	19	.99	--	10N03W05CCDD01
01-10-79	.5	3.0	190	--	44	5.6	.3	22	.73	--	
03-14-79	.4	4.0	190	--	52	9.1	.3	14	.47	--	
04-12-79	.5	4.0	190	--	51	8.6	.3	19	.47	--	
06-20-79	--	--	180	--	--	--	--	--	.85	--	
08-15-90	.6	3.5	170	174	49	10	.4	19	.48	<.10	
09-25-90	--	--	--	--	59	16	--	--	1.4	--	
08-15-90	.6	2.8	180	183	55	16	.3	23	1.2	<.10	10N03W05CCDD02
06-21-88	--	--	--	--	--	17	--	--	2.6	--	10N03W06AADA01
01-09-79	.7	5.0	190	--	59	11	.5	3.2	.40	--	10N03W06ABBC01
04-11-79	.6	5.0	230	--	56	8.0	.4	12	<.02	--	
06-21-79	.6	4.0	270	--	60	8.0	.3	19	.48	--	
08-18-71	.6	3.1	--	--	58	6.4	.2	22	--	.05	10N03W06ACD 01
12-18-72	--	--	--	--	--	9.0	--	--	--	.02	
11-06-78	--	--	--	--	--	15	--	--	--	.02	
06-10-81	.6	2.0	230	--	67	9.6	.4	22	--	--	
06-21-88	--	--	--	--	--	7.1	--	--	.46	--	10N03W06ACDC01
08-23-71	--	--	--	--	--	3.4	--	--	.06	.01	10N03W06BCC 01
08-23-71	--	--	--	--	--	15	--	--	.53	.01	10N03W06CAA 01
11-03-90	.6	3.1	200	--	39	19	.4	21	3.4	.10	10N03W06CAAD01
07-11-90	--	--	--	204	--	15	--	--	1.5	--	
08-23-71	--	--	--	--	--	4.8	--	--	.41	.01	10N03W06CDC 01
11-02-78	.7	4.0	280	--	78	23	.3	17	5.5	--	10N03W06DBAA01
01-24-79	.7	4.0	270	--	79	25	.4	17	4.6	--	
04-24-79	.7	4.0	290	--	64	24	.2	20	5.6	--	
07-06-79	--	--	300	--	--	--	--	--	4.2	--	
11-03-90	.9	3.6	220	232	44	17	.3	21	6.1	<.10	
04-24-79	.7	5.0	240	--	63	9.9	.3	18	.44	--	10N03W06DBAA02
07-06-79	--	--	240	--	--	--	--	--	.53	--	
11-03-90	.7	2.9	180	187	39	8.6	.4	22	.81	<.10	
08-23-71	--	--	--	--	--	9.2	--	--	1.2	.02	10N03W06DCA 01
06-21-88	--	--	--	--	--	9.9	--	--	1.0	--	10N03W06DDCD01
08-23-71	--	--	--	--	--	7.9	--	--	1.5	.02	10N03W07AAA 01
08-18-71	.6	3.0	--	--	53	5.5	.2	22	--	.08	10N03W07ABB 01
07-12-90	--	--	--	--	--	8.9	--	--	.80	--	10N03W07ACCB01
08-24-71	--	--	--	--	--	10	--	--	.65	.02	10N03W07ADD 02
06-21-88	--	--	--	--	--	7.7	--	--	.65	--	10N03W07BAAA01
08-23-71	--	--	--	--	--	8.5	--	--	.16	.01	10N03W07DBC 01
08-24-71	--	--	--	--	--	26	--	--	1.9	.02	10N03W07DDC 01
06-22-88	--	--	--	--	--	28	--	--	1.8	--	10N03W08ADCB01
08-24-71	--	--	--	--	--	7.1	--	--	1.1	.02	10N03W08BBA 01
12-18-72	--	--	--	--	--	10	--	--	--	.02	
11-06-78	--	--	--	--	--	16	--	--	--	.01	
06-27-88	--	--	--	--	--	9.7	--	--	.97	--	10N03W08CBAD01
11-01-78	.6	4.0	200	--	53	12	.6	20	.98	--	10N03W08CBCC01
01-10-79	.6	3.0	230	--	60	11	.5	23	.43	--	
04-11-79	.6	3.0	220	--	59	11	.4	19	1.0	--	
06-21-79	.5	3.0	220	--	62	13	.4	21	2.0	--	
06-23-88	--	--	--	--	--	40	--	--	2.6	--	10N03W08CCCD01
12-18-72	--	--	--	--	--	22	--	--	--	.04	10N03W08CDD 01
11-06-78	--	--	--	--	--	33	--	--	--	.02	
06-04-81	.6	3.0	310	--	59	28	.3	29	--	--	
06-22-88	--	--	--	--	--	19	--	--	1.4	--	10N03W08CDDB01

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Location number	Geo-logic unit	Depth of well (feet)	Date	Onsite temper-ature, water (°C)	Onsite spe-cific con-duct-ance (µS/cm)	Onsite pH (stand-ard units)	Hard-ness, total (mg/L as $CaCO_3$)	Alka-linity (it-fld) (mg/L as $CaCO_3$)	Solids, sum of consti-tuents, dis-solved (mg/L)	Calcium, dis-solved (mg/L as Ca)	Magne-sium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
10N03W08CDDC01	Qal	62	06-23-88	9.5	658	--	--	--	--	--	--	--
10N03W08CDDC02	Qal	49	06-27-88	10.0	705	--	--	--	--	--	--	--
10N03W08DACB01	Qal	--	06-22-88	10.5	797	--	--	--	--	--	--	--
10N03W09ACCC01	Qal	64	11-02-78	--	--	--	90	--	121	27	5.5	5.3
			01-31-79	--	207	--	96	--	117	29	5.7	5.7
			04-23-79	6.0	210	--	79	--	110	19	7.6	8.3
			07-06-79	--	232	--	--	--	--	--	--	--
10N03W09ACCC02	Qal	22	11-02-78	--	559	--	260	--	385	70	20	20
			01-31-79	--	294	--	120	--	195	26	14	18
			04-23-79	6.0	686	--	290	--	387	78	23	22
			06-26-79	--	624	--	--	--	--	--	--	--
			06-10-81	11.0	610	7.7	280	--	385	76	22	22
10N03W09BAA 01	Qal	17	09-05-90	12.5	675	7.0	290	240	433	82	22	25
10N03W09BDD 01	Qal	16	09-05-90	12.0	1,390	7.1	440	334	789	120	36	110
			09-05-90[1]	--	--	--	430	--	773	120	35	110
10N03W09DAD 01	Qal	8	08-31-71	11.5	401	--	--	--	--	--	--	--
10N03W10BCBB01	Qal	57	11-07-90	10.0	288	7.9	--	--	--	--	--	--
10N03W11AAA 01	Qal	35	09-01-71	12.5	361	--	--	--	--	--	--	--
10N03W11ABBB01	Qal	24	10-18-78	--	--	--	--	--	--	--	--	--
			12-26-78	12.0	--	--	170	--	253	50	11	13
			03-14-79	11.0	360	--	160	--	231	47	11	12
			04-18-79	9.0	367	--	150	--	229	45	10	12
			06-29-79	--	250	--	--	--	--	--	--	--
10N03W11CBAA01	Qal	23	10-11-78	--	--	--	--	--	--	--	--	--
			01-19-79	9.0	--	--	160	--	227	44	11	10
			04-23-79	9.5	380	--	170	--	234	48	11	11
			07-06-79	--	330	--	--	--	--	--	--	--
10N03W11CCA 01	Qal	40	08-31-71	21.5	317	--	--	--	--	--	--	--
10N03W11DAA 01	Qal	46	09-01-71	14.5	318	--	--	--	--	--	--	--
10N03W11DBD 01	Qal	46	08-16-71	15.0	364	7.5	160	--	245	48	10	15
10N03W11DDCC01	Qal	40	01-19-79	9.0	--	--	140	--	266	42	9.4	13
			04-11-79	10.0	368	--	150	--	229	44	10	12
			04-12-79	10.0	390	--	160	--	236	48	9.9	13
			06-29-79	--	222	--	--	--	--	--	--	--
			06-09-81	11.5	220	7.8	100	--	161	30	6.4	9.1
			08-10-90	15.0	262	7.6	100	87	164	25	9.7	14
10N03W11DDCC02	Qal	78	08-09-90	10.5	415	7.1	180	112	286	54	12	16
10N03W12AAA 01	Qal	35	08-31-71	15.5	315	--	--	--	--	--	--	--
10N03W12AAAD01	Qal	55	08-17-90	12.0	330	6.9	140	93	226	40	9.2	15
10N03W12BABB01	Qal	--	06-30-88	10.0	410	--	--	--	--	--	--	--
10N03W13CBBB01	Qal	--	07-12-88	11.0	310	--	--	--	--	--	--	--
10N03W13CDD 01	Qal	64	09-01-71	15.0	299	--	--	--	--	--	--	--
10N03W13DCCC02	Tsu(?)	105	11-06-90	9.5	315	7.3	--	--	--	--	--	--
10N03W14ADD 01	Qal	61	09-01-71	15.5	291	--	--	--	--	--	--	--
10N03W15ABCA01	Qal	39	08-02-90	10.0	340	7.3	140	116	214	41	9.2	13
10N03W15BAD 01	Qal	79	08-17-71	14.5	303	7.5	120	--	205	35	8.0	15
10N03W15BCBA01	Qal	25	10-18-78	--	--	--	--	--	--	--	--	--
			01-17-79	5.0	--	--	330	--	454	91	24	21
			04-17-79	8.5	680	--	320	--	449	89	24	21
			06-29-79	--	568	--	--	--	--	--	--	--
			06-09-81	10.0	580	7.3	--	--	--	--	--	--
10N03W15DDCA01	Tsu(?)	326	08-13-90	12.5	250	7.6	98	97	207	29	6.4	15
			08-13-90[1]	--	--	--	98	--	205	29	6.4	15
			08-13-90[2]	--	--	--	99	--	211	29	6.4	16
10N03W15DDDD01	Qal	95	08-14-90	8.0	285	7.3	110	93	185	32	7.0	13
10N03W16CCDC01	Qal	44	09-05-79	25.0	790	--	380	--	444	98	32	31
10N03W16DBAD01	Qal	44	01-17-79	8.0	--	--	270	--	458	51	34	52
			03-13-79	10.0	640	--	270	--	447	49	35	53
			04-17-79	10.0	792	--	280	--	503	54	35	54
			07-02-79	--	719	--	--	--	--	--	--	--
10N03W16DCA 01	Qal	60	08-17-71	16.0	669	7.8	120	--	489	19	18	120
10N03W16DCBA01	Qal	--	07-06-88	11.0	460	--	--	--	--	--	--	--
10N03W16DCCC02	Qal	75	07-17-90	15.0	370	7.6	--	--	--	--	--	--
			08-13-90	13.0	425	8.0	150	162	263	29	18	29
10N03W17ABA 01	Qal	60	08-17-71	15.5	630	7.5	310	--	419	86	24	19

Footnotes at end of table.

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Date	Sodium ad-sorp-tion ratio	Potas-sium, dis-solved (mg/L as K)	Bicar-bonate (fet-lab) (mg/L as HCO_3)	Bicar-bonate (it-fld) (mg/L as HCO_3)	Sul-fate, dis-solved (mg/L as SO_4)	Chlo-ride, dis-solved (mg/L as Cl)	Fluo-ride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Nitro-gen, nitrate, dis-solved (mg/L as N)	Phos-phorus, dis-solved (mg/L as P)	Location number
06-23-88	--	--	--	--	--	21	--	--	4.0	--	10N03W08CDDC01
06-27-88	--	--	--	--	--	21	--	--	2.2	--	10N03W08CDDC02
06-22-88	--	--	--	--	--	25	--	--	2.5	--	10N03W08DACB01
11-02-78	.2	2.0	84	--	22	5.6	.3	2.5	2.1	--	10N03W09ACCC01
01-31-79	.3	3.0	82	--	26	6.2	.3	.90	.06	--	
04-23-79	.4	2.0	58	--	32	9.1	.3	.20	.03	--	
07-06-79	--	--	51	--	--	--	--	--	.11	--	
11-02-78	.5	3.0	250	--	70	15	.3	26	8.4	--	10N03W09ACCC02
01-31-79	.7	3.0	99	--	68	14	.2	2.1	.08	--	
04-23-79	.6	4.0	280	--	75	17	.3	29	.18	--	
06-26-79	--	--	280	--	--	--	--	--	1.7	--	
06-10-81	.6	3.0	280	--	77	19	.3	28	--	--	
09-05-90	.6	4.2	290	293	81	19	.2	44	1.1	<.10	10N03W09BAA 01
09-05-90	2	6.5	400	407	91	190	.4	35	.40	<.10	10N03W09BDD 01
09-05-90	2	6.2	390	--	84	190	.4	34	.38	<.10	
08-31-71	--	--	--	--	--	8.6	--	--	1.0	.07	10N03W09DAD 01
11-07-90	--	--	--	--	29	7.7	--	--	.38	--	10N03W10BCBB01
09-01-71	--	--	--	--	--	3.8	--	--	1.5	.08	10N03W11AAA 01
10-18-78	--	--	240	--	--	--	--	--	1.1	--	10N03W11ABBB01
12-26-78	.4	3.0	170	--	54	3.0	.3	27	1.4	--	
03-14-79	.4	4.0	150	--	50	2.6	.3	23	1.4	--	
04-18-79	.4	3.0	150	--	51	2.8	.3	23	1.9	--	
06-29-79	--	--	110	--	--	--	--	--	.69	--	
10-11-78	--	--	170	--	--	--	--	--	.34	--	10N03W11CBAA01
01-19-79	.3	3.0	140	--	54	3.8	.3	23	1.9	--	
04-23-79	.4	3.0	160	--	49	5.5	.2	22	1.2	--	
07-06-79	--	--	180	--	--	--	--	--	.12	--	
08-31-71	--	--	--	--	--	1.8	--	--	.49	.07	10N03W11CCA 01
09-01-71	--	--	--	--	--	2.3	--	--	.61	.08	10N03W11DAA 01
08-16-71	.5	3.2	--	--	57	3.0	.3	21	--	.09	10N03W11DBD 01
01-19-79	.5	4.0	150	--	50	8.0	.4	9.6	12	--	10N03W11DDCC01
04-11-79	.4	3.0	150	--	50	2.6	.3	24	2.1	--	
04-12-79	.4	3.0	160	--	51	5.9	.2	20	1.4	--	
06-29-79	--	--	96	--	--	--	--	--	.19	--	
06-09-81	.4	2.0	84	--	49	2.3	.3	21	--	--	
08-10-90	.6	4.0	100	107	43	7.5	.2	6.2	.51	<.10	
08-09-90	.5	3.2	130	137	100	6.3	.2	23	1.0	<.10	10N03W11DDCC02
08-31-71	--	--	--	--	--	7.8	--	--	.63	.07	10N03W12AAA 01
08-17-90	.6	3.1	120	114	65	6.5	.3	24	1.2	<.10	10N03W12AAAD01
06-30-88	--	--	--	--	--	5.2	--	--	3.7	--	10N03W12BABB01
07-12-88	--	--	--	--	--	3.8	--	--	--	--	10N03W13CBBB01
09-01-71	--	--	--	--	--	3.7	--	--	1.2	.06	10N03W13CDD 01
11-06-90	--	--	--	--	75	4.2	--	--	.73	--	10N03W13DCCC02
09-01-71	--	--	--	--	--	2.1	--	--	.58	.08	10N03W14ADD 01
08-02-90	.5	3.0	130	141	49	6.0	.6	22	.96	<.10	10N03W15ABCA01
08-17-71	.6	2.8	--	--	56	2.2	.4	22	--	.07	10N03W15BAD 01
10-18-78	--	--	270	--	--	--	--	--	.63	--	10N03W15BCBA01
01-17-79	.5	5.0	290	--	120	5.4	.3	36	1.5	--	
04-17-79	.5	5.0	300	--	120	6.1	.2	30	1.3	--	
06-29-79	--	--	280	--	--	--	--	--	1.6	--	
06-09-81	--	--	--	--	--	--	--	--	--	--	
08-13-90	.7	6.5	120	119	32	2.7	.4	57	.23	<.10	10N03W15DDCA01
08-13-90	.6	6.5	120	--	32	2.6	.4	57	.22	<.10	
08-13-90	.7	6.2	--	--	32	5.2	.2	56	--	--	
08-14-90	.5	2.8	110	114	49	3.1	.3	22	.61	<.10	10N03W15DDDD01
09-05-79	.7	5.0	320	--	45	59	.2	16	--	--	10N03W16CCDC01
01-17-79	1	6.0	200	--	130	52	.4	32	.28	--	10N03W16DBAD01
03-13-79	1	7.0	170	--	140	56	.3	20	.39	--	
04-17-79	1	7.0	210	--	150	60	.3	35	.90	--	
07-02-79	--	--	200	--	--	--	--	--	.99	--	
08-17-71	5	4.8	--	--	70	120	.6	41	--	.07	10N03W16DCA 01
07-06-88	--	--	--	--	--	20	--	--	.46	--	10N03W16DCBA01
07-17-90	--	--	--	--	--	14	--	--	.27	--	10N03W16DCCC02
08-13-90	1	3.6	180	198	44	15	1.0	35	.30	<.10	
08-17-71	.5	3.8	--	--	97	28	.4	28	--	.09	10N03W17ABA 01

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Location number	Geo-logic unit	Depth of well (feet)	Date	Onsite temper-ature, water (°C)	Onsite spe-cific con-duct-ance (µS/cm)	Onsite pH (stand-ard units)	Hard-ness, total (mg/L as $CaCO_3$)	Alka-linity (it-fld) (mg/L as $CaCO_3$)	Solids, sum of consti-tuents, dis-solved (mg/L)	Calcium, dis-solved (mg/L as Ca)	Magne-sium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
10N03W17ABBB01	Qal	28	02-06-79	15.0	684	--	310	--	422	88	21	31
			04-18-79	10.5	645	--	260	--	387	66	22	35
			07-02-79	--	650	--	--	--	--	--	--	--
10N03W17ACAD01	Qal	28	11-15-78	11.0	--	--	420	--	576	120	30	25
			04-11-79	11.0	1,610	--	820	--	1,120	230	59	44
			07-02-79	--	715	--	--	--	--	--	--	--
10N03W17ACCC01	Qal	32	01-30-79	7.0	--	--	200	--	293	57	14	16
			07-03-79	--	492	--	--	--	--	--	--	--
10N03W17ACCC02	Qal	44	01-25-79	10.0	492	--	210	--	294	58	16	20
			04-19-79	10.5	479	--	190	--	289	54	14	20
			07-03-79	--	502	--	--	--	--	--	--	--
10N03W17BCCA01	Tsu(?)	120	10-03-90	7.0	670	7.9	--	--	--	--	--	--
10N03W17DDAD01	Qal	43	01-30-79	10.0	1,060	--	480	--	603	120	43	31
			04-19-79	11.5	1,650	--	680	--	837	150	75	42
			07-05-79	--	367	--	--	--	--	--	--	--
10N03W18AAAB01	Qal	55	06-23-88	10.0	636	--	--	--	--	--	--	--
10N03W18ADA 01	Qal	59	08-24-71	9.5	636	--	--	--	--	--	--	--
			04-10-72	--	--	--	--	--	--	--	--	--
			12-18-72	11.0	792	--	--	--	--	--	--	--
			06-11-81	7.5	690	7.5	310	--	409	79	28	26
10N03W18ADA 02	Qal	41	11-06-78	8.0	740	--	--	--	--	--	--	--
			02-20-79	--	--	--	350	--	462	89	31	27
			06-10-81	7.5	710	7.7	320	--	407	81	29	25
10N03W18ADAC02	Qal	65	09-26-90	7.5	820	8.8	--	--	--	--	--	--
10N03W18ADB 01	Qal	90	08-17-71	7.5	605	7.6	290	--	376	75	25	23
10N03W18ADDD01	Qal	--	07-07-88	8.0	640	--	--	--	--	--	--	--
10N03W18BAA 01	Qal	52	08-23-71	14.5	708	--	--	--	--	--	--	--
			12-18-72	11.0	711	--	--	--	--	--	--	--
			11-06-78	12.0	615	--	--	--	--	--	--	--
			06-04-81	9.0	700	7.5	280	--	421	71	25	36
10N03W18CACD01	Tsu(?)	122	08-16-90	10.0	440	7.8	200	175	253	57	14	11
10N03W18CCC 01	Qal	53	08-23-71	20.5	1,060	--	--	--	--	--	--	--
10N03W18CDD 01	Qal	86	08-23-71	20.0	649	--	--	--	--	--	--	--
10N03W18DDD 01	Qal	66	08-23-71	15.5	618	--	--	--	--	--	--	--
10N03W18DDDC01	Qal	70	10-03-90	13.0	408	7.6	--	--	--	--	--	--
10N03W19ACC 01	Qal	23	08-18-71	11.0	568	7.5	280	--	350	77	22	15
10N03W22AAAA01	Qal	23	01-17-79	8.5	--	--	130	--	199	37	8.1	12
			04-23-79	5.5	310	--	130	--	193	39	7.7	11
			07-06-79	--	220	--	--	--	--	--	--	--
			08-14-90	9.0	192	7.8	77	65	127	23	4.9	9.9
10N03W22BACC01	Qal	65	10-02-90	10.5	449	8.0	--	--	--	--	--	--
10N03W23BBB 01	Qal	40	09-01-71	12.0	235	--	--	--	--	--	--	--
10N03W23BBBB01	Qal	35	07-07-88	5.0	240	--	--	--	--	--	--	--
10N03W23DAAD01	Tsu(?)	180	08-09-90	10.0	325	7.2	130	94	247	39	8.7	14
10N03W24ADB 01	Qal	70	10-02-90	10.0	395	6.8	--	--	--	--	--	--
10N03W24ADDB01	Qal	72	07-07-88	10.0	380	--	--	--	--	--	--	--
10N03W24CBD 01	Qal	60	08-16-71	12.0	256	7.5	100	--	178	30	6.7	12
			09-09-71	16.0	--	--	--	--	--	--	--	--
10N03W24DBD 01	Qal	67	09-05-90	11.0	349	7.0	110	95	209	31	7.9	19
10N03W25BBB 01	Qal	60	09-01-71	18.5	410	--	--	--	--	--	--	--
			09-10-71	16.0	--	--	--	--	--	--	--	--
10N03W25CDBA01	Tsu	165	08-08-90	11.5	575	7.1	260	122	421	76	17	21
10N03W25CDBA02	Tsu	82	08-13-90	14.5	1,320	6.9	490	49	927	140	34	94
10N03W27CCAB01	Tsu	110	08-16-90	11.5	750	7.4	350	338	406	59	48	17
10N03W27DDC 01	Tsu	43	09-09-71	17.0	--	--	--	--	--	--	--	--
10N03W28ABBB01	Tsu(?)	180	07-17-90	11.0	775	7.8	--	--	--	--	--	--
10N04W01AABB01	Qal	--	06-20-88	12.5	440	--	--	--	--	--	--	--
10N04W01DAAB01	Qal	--	07-19-88	12.0	515	--	--	--	--	--	--	--
10N04W01DCAD01	pTb	95	09-14-80	12.0	550	8.0	240	--	344	58	22	27
10N04W01DCDA01	pTb	209	09-14-80	11.5	713	8.0	290	--	423	65	31	39
10N04W02CBAA01	pTb	110	05-31-90	11.0	450	7.6	210	--	286	55	17	17
10N04W10CCCD01	Qal	85	07-12-90	15.0	795	7.4	--	--	--	--	--	--
10N04W10DAAC01	Qal	16	09-05-90	10.5	640	7.3	280	279	408	73	23	36
10N04W10DDDA01	Qal	23	01-10-79	6.0	--	--	390	--	528	97	36	24
			03-14-79	6.5	720	--	360	--	439	86	35	32

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Date	Sodium adsorption ratio	Potassium, dissolved (mg/L as K)	Bicarbonate (fet-lab) (mg/L as HCO_3)	Bicarbonate (it-fld) (mg/L as HCO_3)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Nitrogen, nitrate, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Location number
02-06-79	.8	6.0	330	--	71	25	.4	9.4	1.5	--	10N03W17ABBB01
04-18-79	1	4.0	320	--	51	14	.2	23	3.2	--	
07-02-79	--	--	330	--	--	--	--	--	4.2	--	
11-15-78	.5	4.0	320	--	120	35	.1	22	14	--	10N03W17ACAD01
04-11-79	.7	5.0	560	--	230	23	.1	25	52	--	
07-02-79	--	--	240	--	--	--	--	--	3.4	--	
01-30-79	.5	3.0	210	--	61	17	.2	17	.83	--	10N03W17ACCC01
07-03-79	--	--	200	--	--	--	--	--	1.3	--	
01-25-79	.6	4.0	200	--	53	24	.1	13	1.7	--	10N03W17ACCC02
04-19-79	.6	3.0	210	--	50	20	.1	18	1.4	--	
07-03-79	--	--	240	--	--	--	--	--	1.2	--	
10-03-90	--	--	--	--	--	22	--	--	1.8	--	10N03W17BCCA01
01-30-79	.6	6.0	320	--	30	200	.5	13	.31	--	10N03W17DDAD01
04-19-79	.7	3.0	280	--	16	390	.4	18	.21	--	
07-05-79	--	--	160	--	--	--	--	--	.05	--	
06-23-88	--	--	--	--	--	28	--	--	1.4	--	10N03W18AAAB01
08-24-71	--	--	--	--	--	24	--	--	6.3	.01	10N03W18ADA 01
04-10-72	--	--	--	--	--	--	--	--	4.8	--	
12-18-72	--	--	--	--	--	29	--	--	--	.05	
06-11-81	.6	3.0	320	--	71	22	.2	22	--	--	
11-06-78	--	--	--	--	--	25	--	--	--	.01	10N03W18ADA 02
02-20-79	.6	3.7	--	--	85	21	.2	22	--	.02	
06-10-81	.6	3.0	340	--	62	18	.2	22	--	--	
09-26-90	--	--	--	--	--	20	--	--	1.2	--	10N03W18ADAC02
08-17-71	.6	3.3	--	--	40	21	.2	24	--	--	10N03W18ADB 01
07-07-88	--	--	--	--	--	21	--	--	2.7	--	10N03W18ADDD01
08-23-71	--	--	--	--	--	25	--	--	1.3	.02	10N03W18BAA 01
12-18-72	--	--	--	--	--	22	--	--	--	.01	
11-06-78	--	--	--	--	--	25	--	--	--	.01	
06-04-81	.9	5.0	280	--	94	23	.6	29	--	--	
08-16-90	.3	3.1	210	213	35	10	.1	13	1.4	<.10	10N03W18CACD01
08-23-71	--	--	--	--	--	51	--	--	1.4	.01	10N03W18CCC 01
08-23-71	--	--	--	--	--	16	--	--	.42	.02	10N03W18CDD 01
08-23-71	--	--	--	--	--	18	--	--	.56	.02	10N03W18DDD 01
10-03-90	--	--	--	--	41	13	--	--	.59	--	10N03W18DDDC01
08-18-71	.4	2.1	--	--	51	27	ND	21	--	.07	10N03W19ACC 01
01-17-79	.5	3.0	110	--	62	3.1	.4	17	.36	--	10N03W22AAAA01
04-23-79	.4	3.0	110	--	60	2.5	.3	14	.38	--	
07-06-79	--	--	79	--	--	--	--	--	.19	--	
08-14-90	.5	2.6	82	80	26	1.7	.4	16	.44	<.10	
10-02-90	--	--	--	--	56	8.7	--	--	.82	--	10N03W22BACC01
09-01-71	--	--	--	--	--	1.4	--	--	.22	.07	10N03W23BBB 01
07-07-88	--	--	--	--	--	2.6	--	--	.46	--	10N03W23BBBB01
08-09-90	.5	4.8	120	114	67	4.5	.3	48	.56	.13	10N03W23DAAD01
10-02-90	--	--	--	--	84	6.3	--	--	1.4	--	10N03W24ADB 01
07-07-88	--	--	--	--	--	6.2	--	--	1.8	--	10N03W24ADDB01
08-16-71	.5	2.9	--	--	48	2.1	.5	22	--	.10	10N03W24CBD 01
09-09-71	--	--	--	--	--	--	--	--	--	--	
09-05-90	.8	2.6	110	115	60	4.7	.3	24	.84	<.10	10N03W24DBD 01
09-01-71	--	--	--	--	--	4.3	--	--	.94	.08	10N03W25BBB 01
09-10-71	--	--	--	--	--	--	--	--	--	--	
08-08-90	.6	5.1	140	148	160	18	.3	51	.28	<.10	10N03W25CDBA01
08-13-90	2	9.0	170	60	490	44	.2	26	1.1	<.10	10N03W25CDBA02
08-16-90	.4	6.7	370	412	63	11	.3	17	.73	<.10	10N03W27CCAB01
09-09-71	--	--	--	--	--	--	--	--	--	--	10N03W27DDC 01
07-17-90	--	--	--	--	--	32	--	--	1.1	--	10N03W28ABBB01
06-20-88	--	--	--	--	--	12	--	--	.56	--	10N04W01AABB01
07-19-88	--	--	--	--	--	13	--	--	--	--	10N04W01DAAB01
10-14-80	.8	3.0	250	--	50	27	.7	33	--	--	10N04W01DCAD01
10-14-80	1	4.0	310	--	59	36	.7	35	--	--	10N04W01DCDA01
05-31-90	.5	.88	180	--	57	6.9	.6	34	1.5	.10	10N04W02CBAA01
07-12-90	--	--	--	--	--	16	--	--	.07	--	10N04W10CCCD01
09-05-90	.9	3.4	340	341	65	11	.6	26	.07	<.10	10N04W10DAAC01
01-10-79	.5	6.0	380	--	120	15	.3	14	.72	--	10N04W10DDDA01
03-14-79	.7	6.0	320	--	96	12	.3	9.3	<.02	--	

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Location number	Geo-logic unit	Depth of well (feet)	Date	Onsite temper-ature, water (°C)	Onsite spe-cific con-duct-ance (µS/cm)	Onsite pH (stand-ard units)	Hard-ness, total (mg/L as $CaCO_3$)	Alka-linity (it-fld) (mg/L as $CaCO_3$)	Solids, sum of consti-tuents, dis-solved (mg/L)	Calcium, dis-solved (mg/L as Ca)	Magne-sium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
			04-12-79	3.5	776	--	350	--	453	85	34	28
			06-20-79	10.0	830	--	440	--	522	110	39	20
			06-09-81	8.0	820	7.3	--	--	--	--	--	--
10N04W12AABC01	Qal	--	06-28-88	9.0	765	--	--	--	--	--	--	--
10N04W12ABAA01	pTb	105	09-17-80	11.0	720	8.1	290	--	452	60	34	53
10N04W12ABDC01	pTb	110	09-15-80	10.0	681	7.7	280	--	427	63	29	46
			06-22-88	11.0	680	--	--	--	--	--	--	--
10N04W12ABDC02	Tsu	93	09-26-90	10.0	706	8.8	--	--	--	--	--	--
10N04W12ACBB01	pTb	400	09-15-80	11.5	625	7.7	260	--	395	58	27	39
10N04W12ACDA01	Qal	23	01-17-79	5.0	--	--	300	--	399	82	24	22
			03-15-79	9.0	640	--	290	--	375	79	23	20
			04-12-79	8.5	619	--	280	--	370	76	22	19
			06-20-79	12.0	631	--	300	--	373	78	25	19
10N04W12BACD01	pTb	120	09-17-80	11.0	502	8.1	220	--	317	52	22	27
10N04W12BBAA01	pTb	30	09-14-80	10.5	530	7.9	240	--	338	56	23	24
10N04W12BBDB01	pTb	60	09-17-80	10.0	1,090	8.0	470	--	734	110	47	61
10N04W12CADB01	Qal	23	01-24-79	9.0	--	--	300	--	363	80	24	15
			04-12-79	9.0	615	--	290	--	355	75	24	14
			06-20-79	11.5	589	--	320	--	396	88	24	15
10N04W12CBCC01	Tsu(?)	112	09-25-90	10.5	559	7.5	--	--	--	--	--	--
10N04W12CBCC02	Qal	50	09-25-90	14.0	650	7.5	--	--	--	--	--	--
10N04W12DAD 01	Qal	--	08-30-71	16.0	485	--	--	--	--	--	--	--
10N04W12DBCB01	Qal	--	06-20-88	10.0	680	--	--	--	--	--	--	--
10N04W13ACCD02	Qal	92	11-07-90	8.0	300	7.6	--	--	--	--	--	--
10N04W13CBB 01	Qal	35	08-30-71	11.0	275	--	--	--	--	--	--	--
10N04W13DCAD02	Qal	50	05-10-89	9.5	1,260	--	--	--	--	--	--	--
10N04W13DCAD03	Qal	70	05-10-89	9.5	780	--	--	--	--	--	--	--
10N04W13DCCA01	Qal	80	05-09-89	10.0	630	--	--	--	--	--	--	--
10N04W13DCCB01	Qal	55	05-09-89	10.0	110	--	--	--	--	--	--	--
10N04W13DCDA01	Qal	50	05-10-89	9.5	1,180	--	--	--	--	--	--	--
10N04W13DCDB01	Qal	--	05-09-89	9.5	1,020	--	--	--	--	--	--	--
10N04W13DCDB02	Qal	50	05-11-89	9.5	1,220	--	--	--	--	--	--	--
10N04W13DCDB03	Qal	100	05-11-89	10.0	1,000	--	--	--	--	--	--	--
10N04W13DCDC01	Qal	--	05-10-89	10.5	555	--	--	--	--	--	--	--
10N04W14BBA 01	Qal	18	08-30-71	13.5	687	--	--	--	--	--	--	--
10N04W15BAA 01	Qal	--	08-30-71	22.5	794	--	--	--	--	--	--	--
10N04W15DBB 01	pTb	38	08-18-71	16.0	1,290	7.5	520	--	889	98	66	83
10N04W15DBBB01	Qal	35	01-30-79	9.0	110	--	450	--	844	72	66	110
			04-19-79	10.5	1,360	--	470	--	908	79	67	110
			07-05-79	--	1,420	--	--	--	--	--	--	--
10N04W16DAAA01	pTb	100	10-31-90	10.0	749	7.4	350	266	494	86	32	31
10N04W23BAB 01	Qal	60	08-18-71	10.0	297	7.2	110	--	198	32	7.6	17
10N04W23BAC 02	Qal	38	08-30-71	12.0	294	--	--	--	--	--	--	--
10N04W23BBBB01	Qal	23	01-09-79	8.0	--	--	130	--	232	39	8.3	18
			03-13-79	17.0	240	--	120	--	201	35	7.7	16
			04-12-79	8.5	330	--	110	--	200	33	7.4	16
			06-19-79	11.0	357	--	130	--	217	37	8.3	17
10N04W23BBCB01	Qal	60	08-02-90	10.0	315	7.0	96	92	171	27	6.6	17
10N04W23BBCB02	Qal	28	08-02-90	10.5	249	7.1	88	95	176	26	5.8	16
11N02W30DCAD01	Qal	45	01-23-79	9.0	--	--	240	--	340	79	10	24
			04-20-79	11.0	570	--	260	--	370	84	12	26
			07-03-79	--	652	--	--	--	--	--	--	--
11N02W31ACAA01	Qal	44	01-23-79	9.5	--	--	190	--	293	50	17	21
			04-20-79	12.0	425	--	160	--	289	43	13	23
			07-03-79	--	511	--	--	--	--	--	--	--
11N02W31BBCC01	Qal	43	07-16-90	11.5	372	6.8	--	--	--	--	--	--
11N02W31BCB 01	Qal	28	08-31-71	27.0	415	--	--	--	--	--	--	--
11N02W31DDAD01	Tsu	150	07-16-90	11.5	448	7.6	--	--	--	--	--	--
11N03W07BDBB01	pTb	110	07-26-90	11.5	349	7.6	--	--	--	--	--	--
11N03W08BBBD01	pTb	208	10-31-90	13.0	380	7.6	160	131	232	45	12	16
11N03W12CCCC01	Tsu	159	10-31-90	12.5	486	7.4	180	142	367	50	12	33
11N03W15DCDD01	Qal	24	04-13-79	8.5	890	--	310	--	539	64	37	79
			06-26-79	--	870	--	--	--	--	--	--	--
11N03W16BBBB01	pTb	125	07-25-90	11.5	582	7.6	--	--	--	--	--	--
11N03W17CCCD01	Qal	71	05-03-89	9.5	730	--	--	--	--	--	--	--

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Date	Sodium ad-sorp-tion ratio	Potas-sium, dis-solved (mg/L as K)	Bicar-bonate (fet-lab) (mg/L as HCO_3)	Bicar-bonate (it-fld) (mg/L as HCO_3)	Sul-fate, dis-solved (mg/L as SO_4)	Chlo-ride, dis-solved (mg/L as Cl)	Fluo-ride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Nitro-gen, nitrate, dis-solved (mg/L as N)	Phos-phorus, dis-solved (mg/L as P)	Location number
04-12-79	.6	5.0	390	--	90	11	.3	7.1	.15	--	
06-20-79	.4	4.0	410	--	110	13	.2	22	.26	--	
06-09-81	--	--	--	--	--	--	--	--	--	--	
06-28-88	--	--	--	--	--	15	--	--	2.5	--	10N04W12AABC01
10-17-80	1	3.0	380	--	56	23	1.0	34	--	--	10N04W12ABAA01
10-15-80	1	3.0	350	--	70	9.9	.9	32	--	--	10N04W12ABDC01
06-22-88	--	--	--	--	--	14	--	--	3.3	--	
09-26-90	--	--	--	--	--	15	--	--	3.1	--	10N04W12ABDC02
10-15-80	1	2.0	320	--	69	8.1	1.0	32	--	--	10N04W12ACBB01
01-17-79	.5	4.0	330	--	65	7.2	.3	24	1.2	--	10N04W12ACDA01
03-15-79	.5	4.0	320	--	58	7.4	.3	22	.85	--	
04-12-79	.5	4.0	320	--	56	8.0	.3	22	1.1	--	
06-20-79	.5	4.0	320	--	57	7.0	.3	22	.65	--	
10-17-80	.8	2.0	250	--	53	8.8	1.0	28	--	--	10N04W12BACD01
10-14-80	.7	2.0	260	--	64	7.4	.8	32	--	--	10N04W12BBAA01
10-17-80	1	2.0	300	--	280	55	.7	29	--	--	10N04W12BBDB01
01-24-79	.4	6.0	330	--	50	7.6	.4	17	.02	--	10N04W12CADB01
04-12-79	.4	4.0	320	--	53	5.9	.3	20	.40	--	
06-20-79	.4	4.0	360	--	57	5.7	.3	21	.91	--	
09-25-90	--	--	--	--	36	4.9	--	--	.34	--	10N04W12CBCC01
09-25-90	--	--	--	--	44	11	--	--	.31	--	10N04W12CBCC02
08-30-71	--	--	--	--	--	5.9	--	--	.29	.06	10N04W12DAD 01
06-20-88	--	--	--	--	--	10	--	--	1.0	--	10N04W12DBCB01
11-07-90	--	--	--	--	28	5.4	--	--	.41	--	10N04W13ACCD02
08-30-71	--	--	--	--	--	3.7	--	--	.14	.06	10N04W13CBB 01
05-10-89	--	--	--	--	--	74	--	--	13	--	10N04W13DCAD02
05-10-89	--	--	--	--	--	39	--	--	3.8	--	10N04W13DCAD03
05-09-89	--	--	--	--	--	25	--	--	2.8	--	10N04W13DCCA01
05-09-89	--	--	--	--	--	61	--	--	4.9	--	10N04W13DCCB01
05-10-89	--	--	--	--	--	65	--	--	8.4	--	10N04W13DCDA01
05-09-89	--	--	--	--	--	55	--	--	7.3	--	10N04W13DCDB01
05-11-89	--	--	--	--	--	70	--	--	8.0	--	10N04W13DCDB02
05-11-89	--	--	--	--	--	68	--	--	4.7	--	10N04W13DCDB03
05-10-89	--	--	--	--	--	18	--	--	2.8	--	10N04W13DCDC01
08-30-71	--	--	--	--	--	5.9	--	--	.12	.06	10N04W14BBA 01
08-30-71	--	--	--	--	--	18	--	--	.46	.06	10N04W15BAA 01
08-18-71	2	6.8	--	--	370	110	.2	32	--	.05	10N04W15DBB 01
01-30-79	2	6.0	300	--	330	84	.4	24	.69	--	10N04W15DBBB01
04-19-79	2	6.0	290	--	350	120	.3	25	1.6	--	
07-05-79	--	--	240	--	--	--	--	--	1.6	--	
10-31-90	.7	10	340	325	110	17	.6	30	.62	<.10	10N04W16DAAA01
08-18-71	.7	2.3	--	--	40	3.0	.3	24	--	.26	10N04W23BAB 01
08-30-71	--	--	--	--	--	3.3	--	--	.05	.06	10N04W23BAC 02
01-09-79	.7	8.0	170	--	41	3.3	.7	26	.69	--	10N04W23BBBB01
03-13-79	.6	7.0	140	--	39	3.3	.6	21	.47	--	
04-12-79	.7	7.0	140	--	40	3.6	.6	22	.38	--	
06-19-79	.7	8.0	140	--	46	4.7	.6	23	.83	--	
08-02-90	.8	2.2	110	112	33	5.1	.7	23	.41	<.10	10N04W23BBCB01
08-02-90	.7	11	110	116	24	7.6	.8	26	1.2	.13	10N04W23BBCB02
01-23-79	.7	3.0	280	--	41	14	.5	29	.41	--	11N02W30DCAD01
04-20-79	.7	4.0	310	--	41	16	.3	29	1.1	--	
07-03-79	--	--	310	--	--	--	--	--	1.7	--	
01-23-79	.7	2.0	220	--	43	13	.5	33	1.2	--	11N02W31ACAA01
04-20-79	.8	4.0	210	--	40	14	.4	41	1.6	--	
07-03-79	--	--	240	--	--	--	--	--	.23	--	
07-16-90	--	--	--	--	--	8.7	--	--	1.0	--	11N02W31BBCC01
08-31-71	--	--	--	--	--	6.6	--	--	.02	.06	11N02W31BCB 01
07-16-90	--	--	--	--	--	13	--	--	.44	--	11N02W31DDAD01
07-26-90	--	--	--	--	--	8.0	--	--	.90	--	11N03W07BDBB01
10-31-90	.6	1.7	160	160	30	24	.3	17	1.2	.20	11N03W08BBBD01
10-31-90	1	7.6	170	173	88	18	.6	70	.77	<.10	11N03W12CCCC01
04-13-79	2	2.0	420	--	100	19	.4	24	1.4	--	11N03W15DCDD01
06-26-79	--	--	410	--	--	--	--	--	1.8	--	
07-25-90	--	--	--	--	--	33	--	--	1.2	--	11N03W16BBBB01
05-03-89	--	--	--	--	--	23	--	--	8.4	--	11N03W17CCCD01

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Location number	Geo-logic unit	Depth of well (feet)	Date	Onsite temper-ature, water (°C)	Onsite spe-cific con-duct-ance (µS/cm)	Onsite pH (stand-ard units)	Hard-ness, total (mg/L as $CaCO_3$)	Alka-linity (it-fld) (mg/L as $CaCO_3$)	Solids, sum of consti-tuents, dis-solved (mg/L)	Calcium, dis-solved (mg/L as Ca)	Magne-sium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
11N03W17DDDD01	Qal	--	06-29-88	9.0	620	--	--	--	--	--	--	--
11N03W18ADDA01	pTb	--	07-05-88	15.5	410	--	--	--	--	--	--	--
11N03W18BCCB01	Qal	90	06-28-88	11.0	440	--	--	--	--	--	--	--
11N03W18DCCC01	Tsu(?)	150	06-28-88	13.0	405	--	--	--	--	--	--	--
			07-25-90	13.5	398	7.5	--	--	--	--	--	--
11N03W18DCD 01	Qal	--	08-30-71	20.0	645	--	--	--	--	--	--	--
11N03W18DDDD01	pTb	--	07-05-88	10.0	640	--	--	--	--	--	--	--
11N03W19CCCC01	Qal	65	06-29-88	11.0	455	--	--	--	--	--	--	--
			09-26-90	10.5	471	7.4	--	--	--	--	--	--
11N03W19DBC 01	Qal	45	08-25-71	13.5	598	--	--	--	--	--	--	--
11N03W19DDAB01	Tsu(?)	125	07-05-88	11.5	510	--	--	--	--	--	--	--
11N03W19DDDC01	Qal	65	10-15-90	12.5	619	7.6	--	--	--	--	--	--
11N03W20BBBB01	Qal	23	10-18-78	17.0	--	--	170	--	247	48	11	21
			07-05-79	--	377	--	--	--	--	--	--	--
11N03W21BBAA01	Qal	46	01-17-79	5.0	--	--	140	--	192	33	14	16
			03-14-79	9.0	400	--	160	--	214	35	18	19
			04-13-79	9.0	397	--	160	--	211	35	17	18
			06-26-79	--	461	--	--	--	--	--	--	--
			06-09-81	10.0	230	9.1	--	--	--	--	--	--
11N03W21DCC 01	Qal	48	08-17-71	18.0	550	7.4	240	--	360	63	21	24
11N03W21DCCA01	Qal	--	10-03-90	10.0	475	7.9	--	--	--	--	--	--
11N03W21DDAD01	Qal	65	04-23-79	8.5	405	--	160	--	228	30	20	20
			07-06-79	--	500	--	--	--	--	--	--	--
11N03W21DDAD02	Qal	23	01-09-79	7.5	--	--	290	--	538	64	31	84
			03-15-79	10.0	920	--	300	--	528	67	31	77
			04-23-79	8.5	810	--	300	--	504	68	32	70
			07-06-79	--	830	--	--	--	--	--	--	--
11N03W22BBBA01	Qal	96	07-25-90	10.5	1,060	7.6	--	--	--	--	--	--
11N03W22BBCB01	Tsu(?)	195	08-07-90	10.0	440	7.7	190	151	265	46	19	17
11N03W22BBCB02	Qal	48	08-07-90	10.0	1,790	7.5	520	341	1,250	120	56	220
11N03W25DDBD01	Qal	--	06-30-88	9.5	420	--	--	--	--	--	--	--
11N03W29ABB 01	Qal	--	08-25-71	10.5	685	--	--	--	--	--	--	--
11N03W29BABD01	Qal	50	05-05-89	9.0	570	--	--	--	--	--	--	--
11N03W29BAC 01	Qal	--	08-25-71	11.0	607	--	--	--	--	--	--	--
11N03W29BACC01	Qal	--	05-09-89	9.5	555	--	--	--	--	--	--	--
11N03W29BBAC01	Qal	--	05-05-89	10.0	540	--	--	--	--	--	--	--
11N03W29BBBA01	Qal	--	05-05-89	10.0	545	--	--	--	--	--	--	--
11N03W29BBBD01	Qal	54	05-05-89	10.0	570	--	--	--	--	--	--	--
11N03W29BBDC01	Qal	54	05-05-89	9.5	600	--	--	--	--	--	--	--
11N03W29BCBD01	Qal	--	05-09-89	11.5	590	--	--	--	--	--	--	--
11N03W29CCB 01	Qal	40	08-24-71	15.0	621	--	--	--	--	--	--	--
11N03W29DBBB01	Tsu(?)	150	11-05-90	14.0	718	7.1	--	--	--	--	--	--
11N03W29DBBB02	Qal	40	11-06-90	8.0	512	7.5	--	--	--	--	--	--
11N03W30BAAA01	Qal	24	07-05-79	--	450	--	--	--	--	--	--	--
11N03W30CBBC01	Qal	--	06-29-88	11.0	685	--	--	--	--	--	--	--
11N03W30DAA 01	Qal	10	11-19-71	9.0	1,880	--	--	--	--	--	--	--
11N03W30DACA01	Qal	--	06-28-88	9.5	640	--	--	--	--	--	--	--
11N03W30DACC01	Qal	--	05-04-89	9.5	685	--	--	--	--	--	--	--
11N03W30DACC02	Qal	--	05-04-89	10.0	665	--	--	--	--	--	--	--
11N03W30DAD 01	Qal	52	08-18-71	12.0	625	7.4	290	402	402	76	25	30
11N03W30DADA01	Qal	44	11-14-78	8.0	--	--	160	221	221	36	17	16
			12-20-78	5.0	--	--	150	201	201	27	19	13
			04-13-79	7.5	322	--	120	168	168	20	16	12
			07-02-79	--	349	--	--	--	--	--	--	--
			06-09-81	9.5	120	9.8	64	95	95	5.8	12	11
11N03W30DADA02	Qal	25	11-14-78	8.0	--	--	270	369	369	69	24	24
			12-20-78	8.0	--	--	300	406	406	76	27	24
			03-13-79	17.0	250	--	310	414	414	78	27	27
			03-13-79	16.0	260	--	120	174	174	19	18	12
			04-13-79	8.0	692	--	300	419	419	76	27	28
			06-28-79	--	660	--	--	--	--	--	--	--
			06-09-81	8.0	650	7.6	280	373	373	72	25	25
11N03W30DBAB01	Qal	--	05-03-89	10.5	615	--	--	--	--	--	--	--
11N03W30DBAC01	Qal	40	05-03-89	9.5	680	--	--	--	--	--	--	--
11N03W30DBAD01	Qal	68	05-03-89	9.0	680	--	--	--	--	--	--	--
11N03W30DBCA01	Qal	35	05-03-89	9.0	720	--	--	--	--	--	--	--
11N03W30DBCD01	Qal	--	05-04-89	9.0	750	--	--	--	--	--	--	--
11N03W30DBD 01	Qal	57	08-24-71	19.0	683	--	--	--	--	--	--	--
			12-18-72	9.5	720	--	--	--	--	--	--	--
			06-10-81	10.0	700	7.5	320	425	425	82	28	25

Date	Sodium ad-sorp-tion ratio	Potas-sium, dis-solved (mg/L as K)	Bicar-bonate (fet-lab) (mg/L as HCO_3)	Bicar-bonate (it-fld) (mg/L as HCO_3)	Sul-fate, dis-solved (mg/L as SO_4)	Chlo-ride, dis-solved (mg/L as Cl)	Fluo-ride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Nitro-gen, nitrate, dis-solved (mg/L as N)	Phos-phorus, dis-solved (mg/L as P)	Location number
06-29-88	--	--	--	--	--	16	--	--	2.7	--	11N03W17DDDD01
07-05-88	--	--	--	--	--	12	--	--	.15	--	11N03W18ADDA01
06-28-88	--	--	--	--	--	18	--	--	3.1	--	11N03W18BCCB01
06-28-88	--	--	--	--	--	11	--	--	.21	--	11N03W18DCCC01
07-26-90	--	--	--	--	--	13	--	--	.17	--	
08-30-71	--	--	--	--	--	16	--	--	5.0	.07	11N03W18DCD 01
07-05-88	--	--	--	--	--	33	--	--	8.4	--	11N03W18DDDD01
06-29-88	--	--	--	--	--	13	--	--	.36	--	11N03W19CCCC01
09-26-90	--	--	--	--	57	14	--	--	.50	--	
08-25-71	--	--	--	--	--	11	--	--	1.7	.07	11N03W19DBC 01
07-05-88	--	--	--	--	--	11	--	--	.73	--	11N03W19DDAB01
10-15-90	--	--	--	--	--	12	--	--	1.9	--	11N03W19DDDC01
10-18-78	.7	3.0	190	--	37	7.9	1.1	23	.32	--	11N03W20BBBB01
07-05-79	--	--	180	--	--	--	--	--	.28	--	
01-17-79	.6	2.0	170	--	24	13	.2	3.5	.09	--	11N03W21BBAA01
03-14-79	.7	2.0	200	--	21	17	.2	1.7	.10	--	
04-13-79	.6	2.0	200	--	17	16	.2	3.0	.11	--	
06-26-79	--	--	220	--	--	--	--	--	1.1	--	
06-09-81	--	--	--	--	--	--	--	--	--	--	
08-17-71	.7	12	--	--	47	12	.9	31	--	.43	11N03W21DCC 01
10-03-90	--	--	--	--	26	31	--	--	1.3	--	11N03W21DCCA01
04-23-79	.7	3.0	190	--	43	15	<.1	2.7	.08	--	11N03W21DDAD01
07-06-79	--	--	240	--	--	--	--	--	1.6	--	
01-09-79	2	4.0	400	--	96	28	.2	21	2.7	--	11N03W21DDAD02
03-15-79	2	5.0	390	--	91	29	.2	19	3.0	--	
04-23-79	2	4.0	380	--	84	25	.2	21	2.9	--	
07-06-79	--	--	390	--	--	--	--	--	2.4	--	
07-25-90	--	--	--	--	--	35	--	--	1.3	--	11N03W22BBBA01
08-07-90	.5	1.9	180	185	36	30	.2	21	1.3	<.10	11N03W22BBCB01
08-07-90	4	1.3	410	416	540	77	.3	29	.87	<.10	11N03W22BBCB02
06-30-88	--	--	--	--	--	9.9	--	--	.73	--	11N03W25DDBD01
08-25-71	--	--	--	--	--	32	--	--	2.6	.07	11N03W29ABB 01
05-05-89	--	--	--	--	--	12	--	--	1.4	--	11N03W29BABD01
08-25-71	--	--	--	--	--	23	--	--	1.6	.05	11N03W29BAC 01
05-09-89	--	--	--	--	--	11	--	--	1.5	--	11N03W29BACC01
05-05-89	--	--	--	--	--	11	--	--	1.4	--	11N03W29BBAC01
05-05-89	--	--	--	--	--	11	--	--	1.4	--	11N03W29BBBA01
05-05-89	--	--	--	--	--	10	--	--	1.2	--	11N03W29BBBD01
05-05-89	--	--	--	--	--	11	--	--	2.0	--	11N03W29BBDC01
05-09-89	--	--	--	--	--	11	--	--	1.1	--	11N03W29BCBD01
08-24-71	--	--	--	--	--	16	--	--	2.5	.05	11N03W29CCB 01
11-05-90	--	--	--	--	110	20	--	--	1.1	--	11N03W29DBBB01
11-06-90	--	--	--	--	71	14	--	--	1.1	--	11N03W29DBBB02
07-05-79	--	--	230	--	--	--	--	--	.14	--	11N03W30BAAA01
06-29-88	--	--	--	--	--	24	--	--	3.4	--	11N03W30CBBC01
11-19-71	--	--	--	--	--	41	--	--	.03	.47	11N03W30DAA 01
06-28-88	--	--	--	--	--	11	--	--	2.0	--	11N03W30DACA01
05-04-89	--	--	--	--	--	12	--	--	1.6	--	11N03W30DACC01
05-04-89	--	--	--	--	--	11	--	--	1.8	--	11N03W30DACC02
08-18-71	.8	3.3	--	--	84	13	ND	17	--	.06	11N03W30DAD 01
11-14-78	.6	5.0	120	--	66	19	.3	.80	.47	--	11N03W30DADA01
12-20-78	.5	4.0	110	--	61	20	.2	1.2	.37	--	
04-13-79	.5	4.0	100	--	46	20	.2	.40	<.02	--	
07-02-79	--	--	160	--	--	--	--	--	.16	--	
06-09-81	.6	4.0	68	--	4.7	20	.2	.10	--	--	
11-14-78	.6	4.0	270	--	78	13	.2	17	1.6	--	11N03W30DADA02
12-20-78	.6	3.0	300	--	94	16	.2	15	.76	--	
03-13-79	.7	3.0	300	--	92	16	.1	15	1.6	--	
03-13-79	.5	5.0	80	--	56	22	.2	.40	.08	--	
04-13-79	.7	3.0	300	--	96	14	.2	18	2.0	--	
06-28-79	--	--	290	--	--	--	--	--	2.2	--	
06-09-81	.6	1.0	290	--	76	14	.2	17	--	--	
05-03-89	--	--	--	--	--	11	--	--	2.1	--	11N03W30DBAB01
05-03-89	--	--	--	--	--	11	--	--	2.4	--	11N03W30DBAC01
05-03-89	--	--	--	--	--	11	--	--	1.9	--	11N03W30DBAD01
05-03-89	--	--	--	--	--	11	--	--	1.4	--	11N03W30DBCA01
05-04-89	--	--	--	--	--	12	--	--	2.2	--	11N03W30DBCD01
08-24-71	--	--	--	--	--	17	--	--	1.5	.04	11N03W30DBD 01
12-18-72	--	--	--	--	--	20	--	--	--	.04	
06-10-81	.6	3.0	290	--	110	15	.2	19	--	--	

Table 10.--*Physical properties and major-ion concentrations of water from wells*--Continued

Location number	Geologic unit	Depth of well (feet)	Date	Onsite temperature, water (°C)	Onsite specific conductance (µS/cm)	Onsite pH (standard units)	Hardness, total (mg/L as $CaCO_3$)	Alkalinity (it-fld) (mg/L as $CaCO_3$)	Solids, sum of constituents, dissolved (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)
11N03W30DCAA01	Qal	60	05-04-89	9.0	750	--	--	--	--	--	--	--
11N03W30DCBB01	Qal	56	11-05-90	9.0	715	7.5	--	--	--	--	--	--
11N03W30DDAA01	Qal	--	06-27-88	11.0	640	--	--	--	--	--	--	--
11N03W31ADD 01	Tsu(?)	130	07-16-90	11.5	327	6.7	--	--	--	--	--	--
11N03W31DABA01	Qal	24	10-18-78	15.0	--	--	330	426	426	89	25	23
			01-11-79	7.0	--	--	310	428	428	86	24	21
			04-12-79	7.5	670	--	300	407	407	84	23	21
			06-26-79	--	669	--	--	--	--	--	--	--
			06-10-81	11.0	680	7.6	320	418	418	90	24	22
11N03W31DADD01	Qal	--	06-27-88	10.5	570	--	--	--	--	--	--	--
11N03W31DBC 01	Qal	55	08-24-71	15.5	593	--	--	--	--	--	--	--
11N03W31DCC 01	Qal	--	08-23-71	11.0	593	--	--	--	--	--	--	--
11N03W31DDA 01	Qal	--	11-06-78	10.0	540	--	--	--	--	--	--	--
11N03W31DDAA02	Qal	54	09-01-71	13.0	556	--	--	--	--	--	--	--
			09-09-71	18.0	--	--	--	--	--	--	--	--
			12-18-72	10.0	555	--	--	--	--	--	--	--
			06-04-81	10.0	570	7.5	260	--	345	75	18	19
			09-26-90	10.0	579	7.6	--	--	--	--	--	--
11N03W32AAA 01	Qal	54	08-25-71	14.0	451	--	--	--	--	--	--	--
11N03W32ACC 01	Qal	9	11-19-71	5.0	536	--	--	--	--	--	--	--
11N03W32CABB01	Qal	--	06-28-88	10.0	565	--	--	--	--	--	--	--
11N03W32CACA01	Qal	--	05-02-89	10.0	560	--	--	--	--	--	--	--
11N03W32CBAB01	Qal	60	05-02-89	10.0	575	--	--	--	--	--	--	--
11N03W32CBB 01	Qal	30	08-24-71	15.0	554	--	--	--	--	--	--	--
11N03W32CBBA01	Qal	--	05-02-89	10.0	595	--	--	--	--	--	--	--
11N03W32CBCD01	Qal	--	05-02-89	9.5	620	--	--	--	--	--	--	--
11N03W32CBDC01	Qal	--	05-02-89	11.0	595	--	--	--	--	--	--	--
11N03W32CBDC02	Qal	--	05-02-89	9.5	595	--	--	--	--	--	--	--
11N03W32CBDC03	Qal	46	05-02-89	10.0	560	--	--	--	--	--	--	--
11N03W32CCD 01	Qal	40	08-24-71	11.0	458	--	--	--	--	--	--	--
11N03W32DBCC01	Qal	38	11-05-90	9.5	540	6.9	--	--	--	--	--	--
11N03W33BBAA02	Qal	25	08-16-90	9.0	315	6.8	210	170	312	62	14	20
			08-16-90[1]	--	--	--	220	--	315	64	14	20
11N03W33BBAA03	Qal	55	08-16-90	9.0	411	7.1	230	175	309	66	15	13
11N03W33DAC 01	Qal	25	08-17-71	18.5	434	7.3	200	--	285	62	12	15
11N03W33DDDC01	Qal	58	08-06-90	10.0	360	7.3	210	179	292	61	14	16
11N03W33DDDC02	Qal	29	08-06-90	8.0	366	7.3	220	195	305	64	14	20
11N03W34CBD 01	Qal	17	09-05-90	12.5	575	7.3	260	199	382	76	18	22
11N03W35DACC01	Qal	29	08-06-90	9.0	897	7.2	190	165	276	58	12	16
11N03W35DCCC01	Qal	22	10-18-78	--	--	--	--	--	--	--	--	--
			12-26-78	--	412	--	190	--	267	55	12	14
			03-13-79	10.0	430	--	180	--	261	54	12	15
			04-13-79	11.5	430	--	180	--	265	54	12	15
			06-27-79	--	410	--	--	--	--	--	--	--
11N03W35DDBB01	Tsu(?)	103	08-06-90	11.0	900	7.2	160	125	244	47	10	15
11N03W36CCD 01	Qal	45	08-31-71	18.0	346	--	--	--	--	--	--	--
11N04W12CDDD01	pTb	176	07-19-90	15.0	1,010	7.8	--	--	--	--	--	--
11N04W13AAAD01	Qal	--	06-28-88	11.5	400	--	--	--	--	--	--	--
			07-23-90	12.0	409	7.6	--	--	--	--	--	--
11N04W13CCC 01	Qal	93	08-25-71	10.0	882	--	--	--	--	--	--	--
11N04W13CCCC01	Qal	92	07-05-88	9.5	900	--	--	--	--	--	--	--
11N04W13DDD 01	Qal	85	08-18-71	15.5	802	7.5	360	--	514	94	30	40
11N04W14CCAA01	Qal	92	07-19-90	10.0	775	7.7	--	--	--	--	--	--
11N04W14DCCA01	Tsu(?)	112	08-10-90	9.5	900	7.7	470	331	615	120	44	32
11N04W24ADDA02	Qal	87	07-23-90	12.0	895	7.6	--	--	--	--	--	--
11N04W24CBBD01	Qal	--	07-05-88	12.0	770	--	--	--	--	--	--	--
11N04W24DAA 01	Qal	90	08-25-71	11.0	842	--	--	--	--	--	--	--
11N04W25BAA 01	Qal	90	08-25-71	13.0	683	--	--	--	--	--	--	--
11N04W25BBBC01	pTb	103	07-12-90	13.5	950	7.2	--	--	--	--	--	--
11N04W25BBBC03	pTb	167	07-12-90	13.0	781	7.5	--	--	--	--	--	--
11N04W25DAA 01	Qal	60	08-25-71	15.5	511	--	--	--	--	--	--	--
11N04W25DBCC01	Qal	--	06-29-88	12.0	570	--	--	--	--	--	--	--
11N04W25DDC 01	Qal	74	08-30-71	13.0	525	--	--	--	--	--	--	--
11N04W25DDDC01	Qal	60	11-05-90	11.0	555	7.3	--	--	--	--	--	--
11N04W25DDDD01	Qal	20	02-28-79	--	491	--	210	--	335	43	25	26
			04-17-79	9.5	700	--	330	--	435	68	38	27
			07-03-79	--	520	--	--	--	--	--	--	--
11N04W26ACAB01	pTb	--	10-31-90	11.5	672	7.6	320	209	416	80	30	15
11N04W36BAA 01	Tsu(?)	110	08-30-71	14.0	379	--	--	--	--	--	--	--

[1]Duplicate sample.
[2]Triplicate sample, analysis by U.S. Geological Survey National Water-Quality Laboratory.

Date	Sodium ad-sorp-tion ratio	Potas-sium, dis-solved (mg/L as K)	Bicar-bonate (fet-lab) (mg/L as HCO_3)	Bicar-bonate (it-fld) (mg/L as HCO_3)	Sul-fate, dis-solved (mg/L as SO_4)	Chlo-ride, dis-solved (mg/L as Cl)	Fluo-ride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Nitro-gen, nitrate, dis-solved (mg/L as N)	Phos-phorus, dis-solved (mg/L as P)	Location number
05-04-89	--	--	--	--	--	12	--	--	2.3	--	11N03W30DCAA01
11-05-90	--	--	--	--	110	12	--	--	1.8	--	11N03W30DCBB01
06-27-88	--	--	--	--	--	11	--	--	2.4	--	11N03W30DDAA01
07-16-90	--	--	--	--	--	3.7	--	--	.90	--	11N03W31ADD 01
10-18-78	.6	4.0	310	--	92	14	.3	21	.90	--	11N03W31DABA01
01-11-79	.5	4.0	290	--	87	13	.2	22	5.9	--	
04-12-79	.5	3.0	300	--	83	13	.2	20	2.7	--	
06-26-79	--	--	300	--	--	--	--	--	3.5	--	
06-10-81	.5	4.0	300	--	85	23	.2	22	--	--	
06-27-88	--	--	--	--	--	9.1	--	--	1.3	--	11N03W31DADD01
08-24-71	--	--	--	--	--	7.0	--	--	.78	.06	11N03W31DBC 01
08-23-71	--	--	--	--	--	8.3	--	--	1.0	.02	11N03W31DCC 01
11-06-78	--	--	--	--	--	9.6	--	--	--	.02	11N03W31DDA 01
09-01-71	--	--	--	--	--	7.2	--	--	1.0	.09	11N03W31DDAA02
09-09-71	--	--	--	--	--	--	--	--	--	--	
12-18-72	--	--	--	--	--	10	--	--	--	.03	
06-04-81	.5	3.0	270	--	65	9.2	.3	23	--	--	
09-26-90	--	--	--	--	66	11	--	--	.91	--	
08-25-71	--	--	--	--	--	7.1	--	--	.89	.05	11N03W32AAA 01
11-19-71	--	--	--	--	--	12	--	--	2.0	.06	11N03W32ACC 01
06-28-88	--	--	--	--	--	8.9	--	--	.94	--	11N03W32CABB01
05-02-89	--	--	--	--	--	10	--	--	1.5	--	11N03W32CACA01
05-02-89	--	--	--	--	--	8.3	--	--	11	--	11N03W32CBAB01
08-24-71	--	--	--	--	--	6.9	--	--	.89	.05	11N03W32CBB 01
05-02-89	--	--	--	--	--	8.1	--	--	1.1	--	11N03W32CBBA01
05-02-89	--	--	--	--	--	19	--	--	2.6	--	11N03W32CBCD01
05-02-89	--	--	--	--	--	17	--	--	2.7	--	11N03W32CBDC01
05-02-89	--	--	--	--	--	16	--	--	2.8	--	11N03W32CBDC02
05-02-89	--	--	--	--	--	12	--	--	2.1	--	11N03W32CBDC03
08-24-71	--	--	--	--	--	8.1	--	--	1.6	.06	11N03W32CCD 01
11-05-90	--	--	--	--	76	18	--	--	2.7	--	11N03W32DBCC01
08-16-90	.6	2.8	190	207	79	13	.3	23	.58	.11	11N03W33BBAA02
08-16-90	.6	2.7	190	--	82	13	.3	23	.59	--	
08-16-90	.4	3.0	210	214	65	13	.2	25	.94	<.10	11N03W33BBAA03
08-17-71	.5	3.1	--	--	55	6.9	.3	24	--	.07	11N03W33DAC 01
08-06-90	.5	2.9	210	219	57	10	.2	25	.55	<.10	11N03W33DDDC01
08-06-90	.6	2.7	230	238	56	11	.3	22	.31	<.10	11N03W33DDDC02
09-05-90	.6	3.7	240	243	99	13	.3	28	.91	<.10	11N03W34CBD 01
08-06-90	.5	3.0	200	201	53	7.7	.2	23	1.4	<.10	11N03W35DACC01
10-18-78	--	--	180	--	--	--	--	--	1.0	--	11N03W35DCCC01
12-26-78	.4	3.0	190	--	52	7.0	.2	23	1.4	--	
03-13-79	.5	3.0	180	--	50	7.4	.2	22	.79	--	
04-13-79	.5	3.0	190	--	50	7.0	.2	22	1.8	--	
06-27-79	--	--	190	--	--	--	--	--	1.7	--	
08-06-90	.5	2.8	150	152	60	5.0	.2	22	1.9	<.10	11N03W35DDBB01
08-31-71	--	--	--	--	--	3.0	--	--	1.0	.07	11N03W36CCD 01
07-19-90	--	--	--	--	--	73	--	--	1.4	--	11N04W12CDDD01
06-28-88	--	--	--	--	--	8.2	--	--	.86	--	11N04W13AAAD01
07-23-90	--	--	--	--	--	9.9	--	--	.92	--	
08-25-71	--	--	--	--	--	17	--	--	.54	.07	11N04W13CCC 01
07-05-88	--	--	--	--	--	13	--	--	.55	--	11N04W13CCCC01
08-18-71	.9	2.9	--	--	150	46	ND	13	--	.02	11N04W13DDD 01
07-19-90	--	--	--	--	--	13	--	--	.37	--	11N04W14CCAA01
08-10-90	.7	4.6	390	403	190	13	.2	25	.47	<.10	11N04W14DCCA01
07-23-90	--	--	--	--	--	43	--	--	5.2	--	11N04W24ADDA02
07-05-88	--	--	--	--	--	8.0	--	--	.48	--	11N04W24CBBD01
08-25-71	--	--	--	--	--	19	--	--	1.6	.05	11N04W24DAA 01
08-25-71	--	--	--	--	--	92	--	--	4.1	.01	11N04W25BAA 01
07-12-90	--	--	--	--	--	78	--	--	6.2	--	11N04W25BBBC01
07-12-90	--	--	--	--	--	56	--	--	3.5	--	11N04W25BBBC03
08-25-71	--	--	--	--	--	19	--	--	.89	.04	11N04W25DAA 01
06-29-88	--	--	--	--	--	19	--	--	2.9	--	11N04W25DBCC01
08-30-71	--	--	--	--	--	11	--	--	.91	.07	11N04W25DDC 01
11-05-90	--	--	--	--	79	11	--	--	.86	--	11N04W25DDDC01
02-28-79	.8	4.0	160	--	78	20	.6	6.8	.14	--	11N04W25DDDD01
04-17-79	.7	2.0	350	--	84	14	.4	23	1.3	--	
07-03-79	--	--	260	--	--	--	--	--	.13	--	
10-31-90	.4	6.7	260	255	52	47	.2	26	6.7	.10	11N04W26ACAB01
08-30-71	--	--	--	--	--	6.4	--	--	1.0	.09	11N04W36BAA 01

Table 11.--*Trace-element concentrations of water from wells*

[Analyses by Montana Bureau of Mines and Geology in accordance with methods defined by Fishman and Friedman (1989). Geologic unit: Qal, Quaternary alluvium; Tsu, Tertiary sediments undifferentiated (queried where upper contact is uncertain); pTb, pre-Tertiary bedrock. Depth of well reported in feet below land surface. Abbreviations: µg/L, micrograms per liter. Symbols: <, less than; --, no data or not applicable; ND, not detectable]

Location number	Geo-logic unit	Depth of well (feet)	Date	Alumi-num, dis-solved (µg/L as Al)	Boron, dis-solved (µg/L as B)	Cadmium, dis-solved (µg/L as Cd)	Chro-mium, dis-solved (µg/L as Cr)	Copper, dis-solved (µg/L as Cu)	Iron, dis-solved (µg/L as Fe)	Lithium, dis-solved (µg/L as Li)
09N02W07ACDD01	Qal	--	05-24-89	--	<10	<1.0	<5	<10	7	4
			06-21-89	--	<10	<1.0	<5	<10	4	<4
			08-22-89	--	20	<1.0	<5	<10	11	5
			09-27-89	--	10	<1.0	<5	<10	<3	4
			04-18-90	--	<10	<1.0	<5	<10	9	<4
			04-25-90	--	10	1.0	<5	<10	30	<4
			05-29-90	--	<10	<1.0	<5	--	5	<4
			06-04-90	--	10	1.0	<5	<10	3	<4
09N03W01ABAB01	Tsu	105	11-18-80	<30	70	<2.0	<2	22	20	10
10N02W04CDDC01	Tsu	120	11-06-90	80	110	<5.0	<5	<4	4	15
10N02W06CBCC01	Qal	24	11-14-78	--	--	--	--	--	100	20
			12-26-78	--	--	--	--	--	1,200	20
			04-11-79	--	--	--	--	--	<10	20
10N02W06DDB 01	Qal	21	01-16-79	--	--	--	--	--	2,700	--
10N02W06DDBC01	Qal	24	11-14-78	--	--	--	--	--	860	20
			01-16-79	--	--	--	--	--	510	<10
			04-12-79	--	--	--	--	--	<10	<10
10N02W07BBBB01	Qal	24	12-26-78	--	--	--	--	--	310	<10
			04-11-79	--	--	--	--	--	20	<10
			08-17-90	100	110	<5.0	<5	<4	<4	54
10N02W18DDCD01	Qal	--	06-11-81	<30	50	<2.0	<2	<2	2	<2
10N02W19AAD 01	Qal	74	09-09-71	--	--	ND	ND	80	--	--
10N02W29BCC 01	Qal	80	09-10-71	--	--	ND	ND	14	--	--
10N02W31ABA 01	Qal	--	09-10-71	--	--	ND	ND	80	--	--
10N03W01DBCC01	Qal	22	04-16-79	--	--	--	--	--	20	<10
			06-21-79	--	--	--	--	--	50	<10
10N03W01DBCC02	Qal	67	11-15-78	--	--	--	--	--	20	<10
			01-11-79	--	--	--	--	--	9,800	20
			04-16-79	--	--	--	--	--	<10	<10
10N03W02ADB 01	Qal	20	09-05-90	<40	100	<5.0	<5	8	<4	20
10N03W02DDDD01	Tsu(?)	123	08-15-90	<40	<40	<5.0	<5	<4	<4	11
10N03W02DDDD03	Qal	25	08-14-90	150	50	<5.0	<5	<4	<4	12
10N03W03BACB01	Qal	65	04-16-79	--	--	--	--	--	20	<10
			06-09-81	--	--	--	--	--	<2	4
10N03W03BACB02	Qal	24	01-17-79	--	--	--	--	--	2,400	<10
			04-13-79	--	--	--	--	--	<10	<10
			06-09-81	--	--	--	--	--	40	10
10N03W03CAB 01	Qal	44	08-17-71	--	--	--	--	--	10	--
10N03W04DCCD01	Qal	55	08-07-90	170	<40	<5.0	<5	<4	<4	30
10N03W04DCCD02	Qal	25	08-07-90	50	<40	<5.0	<5	<4	<4	27
10N03W05ABA 01	Qal	42	08-17-71	--	--	--	--	--	10	--
			06-04-81	--	--	--	--	--	<2	7
10N03W05BAAA01	Qal	65	01-09-79	--	--	--	--	--	1,900	20
			04-11-79	--	--	--	--	--	<10	20
10N03W05BAAB01	Qal	28	10-17-78	--	--	--	--	--	110	20
			12-19-78	--	--	--	--	--	570	20
			05-14-79	--	--	--	--	--	20	20
10N03W05CCDD01	Qal	23	11-02-78	--	--	--	--	--	430	--
			01-10-79	--	--	--	--	--	1,400	20
			03-14-79	--	--	--	--	--	420	20
			04-12-79	--	--	--	--	--	<10	20
			08-15-90	60	50	7.0	<5	<4	73	20
10N03W05CCDD02	Qal	48	08-15-90	140	60	<5.0	<5	<4	<4	21
10N03W06ABBC01	Qal	62	01-09-79	--	--	--	--	--	990	30
			04-11-79	--	--	--	--	--	<10	20

Date	Manganese, dissolved (µg/L as Mn)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Titanium, dissolved (µg/L as Ti)	Vanadium, dissolved (µg/L as V)	Zinc, dissolved (µg/L as Zn)	Zirconium, dissolved (µg/L as Zr)	Location number
05-24-89	<1	<10	<10	1.0	100	--	<6	6	--	09N02W07ACDD01
06-21-89	<1	<10	<10	<1.0	100	--	<6	13	--	
08-22-89	<1	<10	10	<1.0	130	--	<6	9	--	
09-27-89	<1	<10	<10	<1.0	120	--	<6	3	--	
04-18-90	<1	<10	<10	<1.0	96	--	<6	<3	--	
04-25-90	5	<10	<10	2.0	84	--	<6	4	--	
05-29-90	<1	<10	<10	2.0	88	--	<6	18	--	
06-04-90	<1	<10	<10	5.0	91	--	<6	<3	--	
11-18-80	1	<20	<10	<2.0	320	6	<1	<4	<4	09N03W01ABAB01
11-06-90	<2	<40	<20	<4.0	340	5	16	19	<6	10N02W04CDDC01
11-14-78	60	--	--	--	--	--	--	--	--	10N02W06CBCC01
12-26-78	800	--	--	--	--	--	--	--	--	
04-11-79	300	--	--	--	--	--	--	--	--	
01-16-79	4,900	--	--	--	--	--	--	--	--	10N02W06DDB 01
11-14-78	5,000	--	--	--	--	--	--	--	--	10N02W06DDBC01
01-16-79	4,100	--	--	--	--	--	--	--	--	
04-12-79	3,700	--	--	--	--	--	--	--	--	
12-26-78	40	--	--	--	--	--	--	--	--	10N02W07BBBB01
04-11-79	20	--	--	--	--	--	--	--	--	
08-17-90	15	<40	<20	<4.0	280	5	<4	<6	<6	
06-11-81	3	70	<10	<2.0	320	<1	<1	10	<4	10N02W18DDCD01
09-09-71	--	--	ND	--	--	--	--	10	--	10N02W19AAD 01
09-10-71	--	--	2	--	--	--	--	--	--	10N02W29BCC 01
09-10-71	--	--	ND	--	--	--	--	--	--	10N02W31ABA 01
04-16-79	250	--	--	--	--	--	--	--	--	10N03W01DBCC01
06-21-79	40	--	--	--	--	--	--	--	--	
11-15-78	<10	--	--	--	--	--	--	--	--	10N03W01DBCC02
01-11-79	30	--	--	--	--	--	--	--	--	
04-16-79	30	--	--	--	--	--	--	--	--	
09-05-90	870	<40	<20	<4.0	580	10	<4	15	<6	10N03W02ADB 01
08-15-90	<2	<40	<20	<4.0	330	<4	<4	12	<6	10N03W02DDDD01
08-14-90	<2	<40	<20	<4.0	420	6	<4	<6	<6	10N03W02DDDD03
04-16-79	60	--	--	--	--	--	--	--	--	10N03W03BACB01
06-09-81	9	--	--	--	--	--	--	--	--	
01-17-79	150	--	--	--	--	--	--	--	--	10N03W03BACB02
04-13-79	20	--	--	--	--	--	--	--	--	
06-09-81	7	--	--	--	--	--	--	--	--	
08-17-71	10	--	--	--	--	--	--	--	--	10N03W03CAB 01
08-07-90	<2	<40	<20	<4.0	290	4	<4	<6	<6	10N03W04DCCD01
08-07-90	3	<40	<20	<4.0	290	<4	<4	<6	<6	10N03W04DCCD02
08-17-71	ND	--	--	--	--	--	--	--	--	10N03W05ABA 01
06-04-81	<1	--	--	--	--	--	--	--	--	
01-09-79	170	--	--	--	--	--	--	--	--	10N03W05BAAA01
04-11-79	80	--	--	--	--	--	--	--	--	
10-17-78	190	--	--	--	--	--	--	--	--	10N03W05BAAB01
12-19-78	130	--	--	--	--	--	--	--	--	
05-14-79	80	--	--	--	--	--	--	--	--	
11-02-78	90	--	--	--	--	--	--	--	--	10N03W05CCDD01
01-10-79	150	--	--	--	--	--	--	--	--	
03-14-79	210	--	--	--	--	--	--	--	--	
04-12-79	130	--	--	--	--	--	--	--	--	
08-15-90	200	<40	<20	<4.0	190	<4	<4	110	<6	
08-15-90	<2	<40	<20	<4.0	220	<4	<4	<6	<6	10N03W05CCDD02
01-09-79	640	--	--	--	--	--	--	--	--	10N03W06ABBC01
04-11-79	880	--	--	--	--	--	--	--	--	

Table 11.--*Trace-element concentrations of water from wells*--Continued

Location number	Geo-logic unit	Depth of well (feet)	Date	Alumi-num, dis-solved (µg/L as Al)	Boron, dis-solved (µg/L as B)	Cadmium, dis-solved (µg/L as Cd)	Chro-mium, dis-solved (µg/L as Cr)	Copper, dis-solved (µg/L as Cu)	Iron, dis-solved (µg/L as Fe)	Lithium, dis-solved (µg/L as Li)
			06-21-79	--	--	--	--	--	<10	20
10N03W06ACD 01	Qal	48	08-18-71	--	--	--	--	--	10	--
			06-10-81	--	--	--	--	--	<2	20
10N03W06CAAD01	Qal	40	11-03-90	100	60	<5.0	<5	<4	6	18
10N03W06DBAA01	Qal	34	11-02-78	--	--	--	--	--	4,200	--
			01-24-79	--	--	--	--	--	50	20
			04-24-79	--	--	--	--	--	<10	20
			11-03-90	100	<40	<5.0	<5	<4	11	18
10N03W06DBAA02	Qal	62	04-24-79	--	--	--	--	--	40	20
			11-03-90	<40	90	<5.0	<5	<4	140	22
10N03W07ABB 01	Qal	42	08-18-71	--	--	--	--	--	10	--
10N03W07BBBA01	Qal	24	11-14-78	--	--	--	--	--	100	20
			04-12-79	--	--	--	--	--	20	20
			06-20-79	--	--	--	--	--	<10	<10
10N03W08CBCC01	Qal	23	11-01-78	--	--	--	--	--	80	20
			01-10-79	--	--	--	--	--	600	20
			04-11-79	--	--	--	--	--	<10	<10
			06-21-79	--	--	--	--	--	30	<10
10N03W08CDD 01	Qal	52	06-04-81	--	--	--	--	--	<2	10
10N03W09ACCC01	Qal	64	11-02-78	--	--	--	--	--	170	<10
			01-31-79	--	--	--	--	--	<10	--
			04-23-79	--	--	--	--	--	<10	<10
10N03W09ACCC02	Qal	22	11-02-78	--	--	--	--	--	170	20
		--	01-31-79	--	--	--	--	--	50	<10
			04-23-79	--	--	--	--	--	<10	20
			06-10-81	--	--	--	--	--	330	10
10N03W09BAA 01	Qal	17	09-05-90	3,300	70	<5.0	<5	7	5,000	26
10N03W09BDD 01	Qal	16	09-05-90	40	140	6.0	<5	<4	240	41
			09-05-90[1]	<40	180	<5.0	<5	<4	280	39
10N03W11ABBB01	Qal	24	12-26-78	--	--	--	--	--	2,000	<10
			03-14-79	--	--	--	--	--	980	<10
			04-18-79	--	--	--	--	--	20	<10
10N03W11CBAA01	Qal	23	01-19-79	--	--	--	--	--	190	<10
			04-23-79	--	--	--	--	--	<10	<10
10N03W11DBD 01	Qal	46	08-16-71	--	--	--	--	--	10	--
10N03W11DDCC01	Qal	40	01-19-79	--	--	--	--	--	1,600	<10
			04-11-79	--	--	--	--	--	<10	<10
			04-12-79	--	--	--	--	--	<10	<10
			06-09-81	--	--	--	--	--	10	5
			08-10-90	160	<40	<5.0	<5	4	130	13
10N03W11DDCC02	Qal	78	08-09-90	110	<40	<5.0	<5	<4	<4	11
10N03W12AAAD01	Qal	55	08-17-90	100	<40	<5.0	<5	<4	10	14
10N03W15ABCA01	Qal	39	08-02-90	60	<40	<5.0	<5	<4	4	14
10N03W15BAD 01	Qal	79	08-17-71	--	--	--	--	--	10	--
10N03W15BCBA01	Qal	25	01-17-79	--	--	--	--	--	1,700	20
			04-17-79	--	--	--	--	--	20	20
10N03W15DDCA01	Tsu(?)	326	08-13-90	--	--	<1.0	<5	<10	88	11
			08-13-90	210	<40	<5.0	<5	<4	70	10
10N03W15DDDD01	Qal	95	08-14-90	220	<40	<5.0	<5	<4	94	15
10N03W16CCDC01	Qal	44	09-05-79	--	--	--	--	--	<10	<10
10N03W16DBAD01	Qal	--	01-17-79	--	--	--	--	--	1,000	<10
			03-13-79	--	--	--	--	--	790	<10
			04-17-79	--	--	--	--	--	20	<10
10N03W16DCA 01	Qal	60	08-17-71	--	--	--	--	--	20	--
10N03W16DCCC02	Qal	75	08-13-90	190	90	<5.0	<5	<4	<4	12
10N03W17ABA 01	Qal	60	08-17-71	--	--	--	--	--	10	--
10N03W17ABBB01	Qal	28	02-06-79	--	--	--	--	--	290	--
			04-18-79	--	--	--	--	--	<10	<10
10N03W17ACAD01	Qal	28	11-15-78	--	--	--	--	--	540	<10
			04-11-79	--	--	--	--	--	20	<10

Footnote is at end of table.

Table 11.--*Trace-element concentrations of water from wells*--Continued

Date	Manganese, dissolved (µg/L as Mn)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Titanium, dissolved (µg/L as Ti)	Vanadium, dissolved (µg/L as V)	Zinc, dissolved (µg/L as Zn)	Zirconium, dissolved (µg/L as Zr)	Location number
06-21-79	340	--	--	--	--	--	--	--	--	
08-18-71	ND	--	--	--	--	--	--	--	--	10N03W06ACD 01
06-10-81	<1	--	--	--	--	--	--	--	--	
11-03-90	<2	<40	<20	<4.0	210	9	4	<6	<6	10N03W06CAAD01
11-02-78	500	--	--	--	--	--	--	--	--	10N03W06DBAA01
01-24-79	760	--	--	--	--	--	--	--	--	
04-24-79	60	--	--	--	--	--	--	--	--	
11-03-90	88	<40	<20	<4.0	250	10	<4	<6	<6	
04-24-79	180	--	--	--	--	--	--	--	--	10N03W06DBAA02
11-03-90	39	<40	<20	<4.0	220	9	<4	<6	<6	
08-18-71	ND	--	--	--	--	--	--	--	--	10N03W07ABB 01
11-14-78	220	--	--	--	--	--	--	--	--	10N03W07BBBA01
04-12-79	20	--	--	--	--	--	--	--	--	
06-20-79	<10	--	--	--	--	--	--	--	--	
11-01-78	260	--	--	--	--	--	--	--	--	10N03W08CBCC01
01-10-79	180	--	--	--	--	--	--	--	--	
04-11-79	100	--	--	--	--	--	--	--	--	
06-21-79	20	--	--	--	--	--	--	--	--	
06-04-81	<1	--	--	--	--	--	--	--	--	10N03W08CDD 01
11-02-78	50	--	--	--	--	--	--	--	--	10N03W09ACCC01
01-31-79	20	--	--	--	--	--	--	--	--	
04-23-79	<10	--	--	--	--	--	--	--	--	
11-02-78	<10	--	--	--	--	--	--	--	--	10N03W09ACCC02
01-31-79	180	--	--	--	--	--	--	--	--	
04-23-79	<10	--	--	--	--	--	--	--	--	
06-10-81	14	--	--	--	--	--	--	--	--	
09-05-90	200	<40	<20	<4.0	260	170	15	25	<6	10N03W09BAA 01
09-05-90	410	<40	<20	<4.0	450	20	4	13	<6	10N03W09BDD 01
09-05-90	390	<40	<20	<4.0	450	17	<4	9	<6	
12-26-78	70	--	--	--	--	--	--	--	--	10N03W11ABBB01
03-14-79	40	--	--	--	--	--	--	--	--	
04-18-79	40	--	--	--	--	--	--	--	--	
01-19-79	30	--	--	--	--	--	--	--	--	10N03W11CBAA01
04-23-79	<10	--	--	--	--	--	--	--	--	
08-16-71	10	--	--	--	--	--	--	--	--	10N03W11DBD 01
01-19-79	810	--	--	--	--	--	--	--	--	10N03W11DDCC01
04-11-79	20	--	--	--	--	--	--	--	--	
04-12-79	70	--	--	--	--	--	--	--	--	
06-09-81	5	--	--	--	--	--	--	--	--	
08-10-90	260	<40	<20	<4.0	240	<4	<4	<6	<6	
08-09-90	19	<40	<20	<4.0	390	<4	<4	<6	<6	10N03W11DDCC02
08-17-90	<2	<40	<20	<4.0	290	7	<4	<6	<6	10N03W12AAAD01
08-02-90	<2	<40	<20	<4.0	280	<4	<4	<6	<6	10N03W15ABCA01
08-17-71	10	--	--	--	--	--	--	--	--	10N03W15BAD 01
01-17-79	40	--	--	--	--	--	--	--	--	10N03W15BCBA01
04-17-79	20	--	--	--	--	--	--	--	--	
08-13-90	14	<10	<10	<1.0	160	--	<6	<3	--	10N03W15DDCA01
08-13-90	13	<40	<20	<4.0	160	6	<4	<6	<6	
08-14-90	77	<40	<20	<4.0	210	<4	<4	<6	<6	10N03W15DDDD01
09-05-79	100	--	--	--	--	--	--	--	--	10N03W16CCDC01
01-17-79	200	--	--	--	--	--	--	--	--	10N03W16DBAD01
03-13-79	100	--	--	--	--	--	--	--	--	
04-17-79	40	--	--	--	--	--	--	--	--	
08-17-71	ND	--	--	--	--	--	--	--	--	10N03W16DCA 01
08-13-90	<2	<40	<20	<4.0	330	<4	12	<6	<6	10N03W16DCCC02
08-17-71	ND	--	--	--	--	--	--	--	--	10N03W17ABA 01
02-06-79	870	--	--	--	--	--	--	--	--	10N03W17ABBB01
04-18-79	180	--	--	--	--	--	--	--	--	
11-15-78	20	--	--	--	--	--	--	--	--	10N03W17ACAD01
04-11-79	70	--	--	--	--	--	--	--	--	

Table 11.--*Trace-element concentrations of water from wells*--Continued

Location number	Geo-logic unit	Depth of well (feet)	Date	Alumi-num, dis-solved (µg/L as Al)	Boron, dis-solved (µg/L as B)	Cadmium, dis-solved (µg/L as Cd)	Chro-mium, dis-solved (µg/L as Cr)	Copper, dis-solved (µg/L as Cu)	Iron, dis-solved (µg/L as Fe)	Lithium, dis-solved (µg/L as Li)
10N03W17ACCC01	Qal	32	01-30-79	--	--	--	--	--	20	<10
10N03W17ACCC02	Qal	44	01-25-79	--	--	--	--	--	370	--
			04-19-79	--	--	--	--	--	20	<10
10N03W17DDAD01	Qal	43	01-30-79	--	--	--	--	--	410	--
			04-19-79	--	--	--	--	--	<10	30
10N03W18ADA 01	Qal	59	06-11-81	--	--	--	--	--	<2	5
10N03W18ADA 02	Qal	41	02-20-79	--	--	--	--	--	20	--
			06-10-81	--	--	--	--	--	<2	4
10N03W18ADB 01	Qal	90	08-17-71	--	--	--	--	--	10	--
10N03W18BAA 01	Qal	52	06-04-81	--	--	--	--	--	<2	20
10N03W18CACD01	Tsu(?)	122	08-16-90	70	<40	<5.0	<5	<4	150	4
10N03W19ACC 01	Qal	23	08-18-71	--	--	--	--	--	10	--
10N03W22AAAA01	Qal	--	01-17-79	--	--	--	--	--	270	<10
			04-23-79	--	--	--	--	--	<10	<10
			08-14-90	150	<40	<5.0	<5	11	11	12
10N03W23DAAD01	Tsu(?)	180	08-09-90	190	40	<5.0	<5	<4	300	14
10N03W24CBD 01	Qal	60	08-16-71	--	--	--	--	--	10	--
			09-09-71	--	--	ND	ND	150	--	--
10N03W24DBD 01	Qal	67	09-05-90	40	50	<5.0	<5	<4	13	16
10N03W25BBB 01	Qal	60	09-10-71	--	--	ND	ND	44	--	--
10N03W25CDBA01	Tsu	165	08-08-90	<40	<40	<5.0	<5	<4	<4	18
			08-08-90[1]	<40	<50	<5.0	<5	<4	<4	18
10N03W25CDBA02	Tsu	82	08-13-90	130	250	<5.0	<5	<4	4,200	37
10N03W27CCAB01	Tsu	110	08-16-90	190	<40	<5.0	<5	<4	<4	10
10N03W27DDC 01	Tsu	43	09-09-71	--	--	ND	ND	54	--	--
10N04W01DCAD01	pTb	95	09-14-80	30	<20	<2.0	<2	11	<2	10
10N04W01DCDA01	pTb	209	09-14-80	250	<20	10	20	38	9	40
10N04W02CBAA01	pTb	110	05-31-90	<40	<40	6.0	<5	<4	<4	7
10N04W10DAAC01	Qal	16	09-05-90	<40	50	<5.0	<5	<4	<4	9
10N04W10DDDA01	Qal	23	01-10-79	--	--	--	--	--	24,000	20
			03-14-79	--	--	--	--	--	3,700	<10
			04-12-79	--	--	--	--	--	20	<10
			06-20-79	--	--	--	--	--	20	<10
10N04W12ABAA01	pTb	105	09-17-80	<30	160	<2.0	<2	10	<2	20
10N04W12ABDC01	pTb	110	09-15-80	30	<20	<2.0	<2	5	<2	10
10N04W12ACBB01	pTb	400	09-15-80	<30	<20	<2.0	<2	27	<2	10
10N04W12ACDA01	Qal	23	01-17-79	--	--	--	--	--	2,300	<10
			03-15-79	--	--	--	--	--	250	20
			04-12-79	--	--	--	--	--	20	<10
			06-20-79	--	--	--	--	--	<10	<10
10N04W12BACD01	pTb	120	09-17-80	<30	60	<2.0	<2	4	<2	10
10N04W12BBAA01	pTb	30	09-14-80	30	<20	<2.0	<2	5	<2	10
10N04W12BBDB01	pTb	60	09-17-80	<30	70	<2.0	<2	10	<2	20
10N04W12CADB01	Qal	23	01-24-79	--	--	--	--	--	40	<10
			04-12-79	--	--	--	--	--	20	<10
			06-20-79	--	--	--	--	--	40	<10
10N04W15DBB 01	pTb	38	08-18-71	--	--	--	--	--	10	--
10N04W15DBBB01	Qal	35	01-30-79	--	--	--	--	--	50	30
			04-19-79	--	--	--	--	--	<10	30
10N04W16DAAA01	pTb	100	10-31-90	<40	<40	<5.0	<5	<4	<4	15
10N04W23BAB 01	Qal	60	08-18-71	--	--	--	--	--	940	--
10N04W23BBBB01	Qal	23	01-09-79	--	--	--	--	--	710	40
			03-13-79	--	--	--	--	--	550	40
			04-12-79	--	--	--	--	--	30	40
			06-19-79	--	--	--	--	--	50	40
10N04W23BBCB01	Qal	60	08-02-90	70	60	<5.0	<5	<4	<4	26
10N04W23BBCB02	Qal	28	08-02-90	<40	60	<5.0	<5	<4	<4	29
11N02W30DCAD01	Qal	45	01-23-79	--	--	--	--	--	80	20
			04-20-79	--	--	--	--	--	<10	20
11N02W31ACAA01	Qal	44	01-23-79	--	--	--	--	--	310	20

Footnote is at end of table.

Table 11.--*Trace-element concentrations of water from wells*--Continued

Date	Manganese, dissolved (µg/L as Mn)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Titanium, dissolved (µg/L as Ti)	Vanadium, dissolved (µg/L as V)	Zinc, dissolved (µg/L as Zn)	Zirconium, dissolved (µg/L as Zr)	Location number
01-30-79	360	--	--	--	--	--	--	--	--	10N03W17ACCC01
01-25-79	140	--	--	--	--	--	--	--	--	10N03W17ACCC02
04-19-79	90	--	--	--	--	--	--	--	--	
01-30-79	800	--	--	--	--	--	--	--	--	10N03W17DDAD01
04-19-79	4,300	--	--	--	--	--	--	--	--	
06-11-81	<1	--	--	--	--	--	--	--	--	10N03W18ADA 01
02-20-79	<10	--	--	--	--	--	--	--	--	10N03W18ADA 02
06-10-81	<1	--	--	--	--	--	--	--	--	
08-17-71	ND	--	--	--	--	--	--	--	--	10N03W18ADB 01
06-04-81	<1	--	--	--	--	--	--	--	--	10N03W18BAA 01
08-16-90	250	<40	<20	<4.0	240	4	<4	<6	<6	10N03W18CACD01
08-18-71	10	--	--	--	--	--	--	--	--	10N03W19ACC 01
01-17-79	30	--	--	--	--	--	--	--	--	10N03W22AAAA01
04-23-79	<10	--	--	--	--	--	--	--	--	
08-14-90	38	<40	<20	<4.0	140	<4	<4	<6	<6	
08-09-90	240	<40	<20	<4.0	260	<4	<4	<6	<6	10N03W23DAAD01
08-16-71	ND	--	--	--	--	--	--	--	--	10N03W24CBD 01
09-09-71	--	--	ND	--	--	--	--	70	--	
09-05-90	10	<40	<20	<4.0	250	20	<4	12	<6	10N03W24DBD 01
09-10-71	--	--	ND	--	--	--	--	350	--	10N03W25BBB 01
08-08-90	<2	<40	<20	<4.0	510	<4	<4	<6	<6	10N03W25CDBA01
08-08-90	<2	<40	<20	<4.0	510	<4	<4	<6	<6	
08-13-90	2,300	<40	<20	<4.0	840	6	<4	<6	<6	10N03W25CDBA02
08-16-90	<2	<40	<20	<4.0	300	<4	<4	10	<6	10N03W27CCAB01
09-09-71	--	--	ND	--	--	--	--	60	--	10N03W27DDC 01
09-14-80	<1	<20	10	<2.0	520	6	9	10	<4	10N04W01DCAD01
09-14-80	3	<20	40	32	660	20	39	5	40	10N04W01DCDA01
05-31-90	<2	<40	<20	<4.0	420	8	11	33	<6	10N04W02CBAA01
09-05-90	<2	<40	<20	<4.0	230	10	<4	10	<6	10N04W10DAAC01
01-10-79	2,000	--	--	--	--	--	--	--	--	10N04W10DDDA01
03-14-79	1,100	--	--	--	--	--	--	--	--	
04-12-79	580	--	--	--	--	--	--	--	--	
06-20-79	920	--	--	--	--	--	--	--	--	
09-17-80	<1	20	<10	<2.0	710	7	6	<4	<4	10N04W12ABAA01
09-15-80	<1	<20	<10	<2.0	620	7	6	9	<4	10N04W12ABDC01
09-15-80	4	<20	<10	<2.0	650	9	11	640	<4	10N04W12ACBB01
01-17-79	350	--	--	--	--	--	--	--	--	10N04W12ACDA01
03-15-79	30	--	--	--	--	--	--	--	--	
04-12-79	<10	--	--	--	--	--	--	--	--	
06-20-79	40	--	--	--	--	--	--	--	--	
09-17-80	3	30	10	<2.0	540	4	6	9	<4	10N04W12BACD01
09-14-80	<1	<20	10	<2.0	550	9	12	<4	<4	10N04W12BBAA01
09-17-80	1	20	<10	<2.0	1,100	20	10	<4	<4	10N04W12BBDB01
01-24-79	230	--	--	--	--	--	--	--	--	10N04W12CADB01
04-12-79	30	--	--	--	--	--	--	--	--	
06-20-79	20	--	--	--	--	--	--	--	--	
08-18-71	ND	--	--	--	--	--	--	--	--	10N04W15DBB 01
01-30-79	580	--	--	--	--	--	--	--	--	10N04W15DBBB01
04-19-79	1,000	--	--	--	--	--	--	--	--	
10-31-90	<2	<40	<20	<4.0	610	10	4	<6	<6	10N04W16DAAA01
08-18-71	1,500	--	--	--	--	--	--	--	--	10N04W23BAB 01
01-09-79	390	--	--	--	--	--	--	--	--	10N04W23BBBB01
03-13-79	100	--	--	--	--	--	--	--	--	
04-12-79	160	--	--	--	--	--	--	--	--	
06-19-79	90	--	--	--	--	--	--	--	--	
08-02-90	<2	<40	<20	<4.0	180	<4	<4	37	<6	10N04W23BBCB01
08-02-90	3	<40	<20	<4.0	150	<4	<4	<6	<6	10N04W23BBCB02
01-23-79	220	--	--	--	--	--	--	--	--	11N02W30DCAD01
04-20-79	280	--	--	--	--	--	--	--	--	
01-23-79	100	--	--	--	--	--	--	--	--	11N02W31ACAA01

Table 11.--*Trace-element concentrations of water from wells*--Continued

Location number	Geo-logic unit	Depth of well (feet)	Date	Alumi-num, dis-solved (µg/L as Al)	Boron, dis-solved (µg/L as B)	Cadmium, dis-solved (µg/L as Cd)	Chro-mium, dis-solved (µg/L as Cr)	Copper, dis-solved (µg/L as Cu)	Iron, dis-solved (µg/L as Fe)	Lithium, dis-solved (µg/L as Li)
			04-20-79	--	--	--	--	--	20	20
11N03W08BBBD01	pTb	208	10-31-90	150	<40	<5.0	9	7	4	10
11N03W12CCCC01	Tsu	159	10-31-90	<40	50	<5.0	<5	<4	4	11
11N03W15CCBB01	Qal	23	01-10-79	--	--	--	--	--	2,100	<10
			03-14-79	--	--	--	--	--	1,700	20
			04-13-79	--	--	--	--	--	20	<10
11N03W15DCDD01	Qal	24	04-13-79	--	--	--	--	--	<10	20
11N03W20BBBB01	Qal	23	10-18-78	--	--	--	--	--	40	60
11N03W21BBAA01	Qal	46	01-17-79	--	--	--	--	--	1,900	<10
			03-14-79	--	--	--	--	--	1,000	<10
			04-13-79	--	--	--	--	--	<10	<10
11N03W21DCC 01	Qal	48	08-17-71	--	--	--	--	--	50	--
11N03W21DDAD01	Qal	65	04-23-79	--	--	--	--	--	<10	<10
11N03W21DDAD02	Qal	23	01-09-79	--	--	--	--	--	1,400	<10
			03-15-79	--	--	--	--	--	2,900	<10
			04-23-79	--	--	--	--	--	<10	<10
11N03W22BBCB01	Tsu(?)	195	08-07-90	110	50	<5.0	<5	<4	<4	8
11N03W22BBCB02	Qal	48	08-07-90	<40	90	<5.0	<5	5	<4	20
11N03W30DAD 01	Qal	52	08-18-71	--	--	--	--	--	10	--
11N03W30DADA01	Qal	44	11-14-78	--	--	--	--	--	20	<10
			12-20-78	--	--	--	--	--	200	<10
			04-13-79	--	--	--	--	--	<10	<10
			06-09-81	--	--	--	--	--	<2	2
11N03W30DADA02	Qal	25	11-14-78	--	--	--	--	--	40	<10
			12-20-78	--	--	--	--	--	<10	<10
			03-13-79	--	--	--	--	--	1,200	<10
			03-13-79	--	--	--	--	--	70	<10
			04-13-79	--	--	--	--	--	<10	<10
			06-09-81	--	--	--	--	--	50	4
11N03W30DBD 01	Qal	57	06-10-81	--	--	--	--	--	<2	7
11N03W31DABA01	Qal	24	10-18-78	--	--	--	--	--	370	30
			01-11-79	--	--	--	--	--	1,700	20
			04-12-79	--	--	--	--	--	<10	20
			06-10-81	--	--	--	--	--	260	10
11N03W31DDAA02	Qal	54	09-09-71	--	--	ND	ND	14	--	--
			06-04-81	--	--	--	--	--	<2	9
11N03W33BBAA02	Qal	25	08-16-90	<40	<40	<5.0	<5	<4	<4	18
			08-16-90[1]	130	<40	<5.0	<5	<4	<4	17
11N03W33BBAA03	Qal	55	08-16-90	110	<40	<5.0	<5	<4	5	17
11N03W33DAC 01	Qal	25	08-17-71	--	--	--	--	--	10	--
11N03W33DDDC01	Qal	58	08-06-90	<40	50	<5.0	<5	<4	67	21
11N03W33DDDC02	Qal	29	08-06-90	<40	<40	<5.0	<5	<4	14	20
11N03W34CBD 01	Qal	17	09-05-90	70	40	<5.0	<5	<4	<4	21
11N03W35DACC01	Qal	29	08-06-90	50	<40	<5.0	<5	<4	14	8
11N03W35DCCC01	Qal	22	12-26-78	--	--	--	--	--	880	<10
			03-13-79	--	--	--	--	--	5,600	<10
			04-13-79	--	--	--	--	--	<10	<10
11N03W35DDBB01	Tsu(?)	103	08-06-90	160	<40	<5.0	<5	<4	<4	8
11N04W13DDD 01	Qal	85	08-18-71	--	--	--	--	--	10	--
11N04W14DCCA01	Tsu(?)	112	08-10-90	190	50	<5.0	<5	<4	<4	16
11N04W25DDDD01	Qal	20	02-28-79	--	--	--	--	--	44,000	--
			04-17-79	--	--	--	--	--	<10	40
11N04W26ACAB01	pTb	--	10-31-90	110	50	<5.0	<5	<4	<4	17

[1] Duplicate sample.

Table 11.--*Trace-element concentrations of water from wells*--Continued

Date	Manganese, dissolved (µg/L as Mn)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Titanium, dissolved (µg/L as Ti)	Vanadium, dissolved (µg/L as V)	Zinc, dissolved (µg/L as Zn)	Zirconium, dissolved (µg/L as Zr)	Location number
04-20-79	150	--	--	--	--	--	--	--	--	
10-31-90	4	<40	<20	7.0	260	10	11	77	8	11N03W08BCBD01
10-31-90	<2	<40	<20	<4.0	340	7	8	7	<6	11N03W12CCCC01
01-10-79	210	--	--	--	--	--	--	--	--	11N03W15CCBB01
03-14-79	50	--	--	--	--	--	--	--	--	
04-13-79	30	--	--	--	--	--	--	--	--	
04-13-79	460	--	--	--	--	--	--	--	--	11N03W15DCDD01
10-18-78	150	--	--	--	--	--	--	--	--	11N03W20BBBB01
01-17-79	220	--	--	--	--	--	--	--	--	11N03W21BBAA01
03-14-79	90	--	--	--	--	--	--	--	--	
04-13-79	80	--	--	--	--	--	--	--	--	
08-17-71	650	--	--	--	--	--	--	--	--	11N03W21DCC 01
04-23-79	80	--	--	--	--	--	--	--	--	11N03W21DDAD01
01-09-79	240	--	--	--	--	--	--	--	--	11N03W21DDAD02
03-15-79	500	--	--	--	--	--	--	--	--	
04-23-79	140	--	--	--	--	--	--	--	--	
08-07-90	11	<40	<20	<4.0	320	<4	<4	<6	<6	11N03W22BBCB01
08-07-90	2	<40	<20	<4.0	660	<4	<4	<6	<6	11N03W22BBCB02
08-18-71	60	--	--	--	--	--	--	--	--	11N03W30DAD 01
11-14-78	160	--	--	--	--	--	--	--	--	11N03W30DADA01
12-20-78	100	--	--	--	--	--	--	--	--	
04-13-79	30	--	--	--	--	--	--	--	--	
06-09-81	9	--	--	--	--	--	--	--	--	
11-14-78	200	--	--	--	--	--	--	--	--	11N03W30DADA02
12-20-78	230	--	--	--	--	--	--	--	--	
03-13-79	130	--	--	--	--	--	--	--	--	
03-13-79	40	--	--	--	--	--	--	--	--	
04-13-79	40	--	--	--	--	--	--	--	--	
06-09-81	27	--	--	--	--	--	--	--	--	
06-10-81	<1	--	--	--	--	--	--	--	--	11N03W30DBD 01
10-18-78	570	--	--	--	--	--	--	--	--	11N03W31DABA01
01-11-79	100	--	--	--	--	--	--	--	--	
04-12-79	60	--	--	--	--	--	--	--	--	
06-10-81	19	--	--	--	--	--	--	--	--	
09-09-71	--	--	4	--	--	--	--	30	--	11N03W31DDAA02
06-04-81	<1	--	--	--	--	--	--	--	--	
08-16-90	6	<40	<20	<4.0	260	5	<4	<6	<6	11N03W33BBAA02
08-16-90	7	<40	<20	<4.0	260	8	<4	<6	<6	
08-16-90	2	<40	<20	<4.0	270	6	<4	<6	<6	11N03W33BBAA03
08-17-71	ND	--	--	--	--	--	--	--	--	11N03W33DAC 01
08-06-90	9	<40	<20	<4.0	230	<4	<4	<6	<6	11N03W33DDDC01
08-06-90	36	<40	<20	<4.0	250	<4	<4	<6	<6	11N03W33DDDC02
09-05-90	45	<40	<20	<4.0	310	20	14	8	<6	11N03W34CBD 01
08-06-90	<2	<40	<20	<4.0	370	<4	<4	<6	<6	11N03W35DACC01
12-26-78	20	--	--	--	--	--	--	--	--	11N03W35DCCC01
03-13-79	50	--	--	--	--	--	--	--	--	
04-13-79	20	--	--	--	--	--	--	--	--	
08-06-90	3	<40	<20	<4.0	310	<4	<4	<6	<6	11N03W35DDBB01
08-18-71	ND	--	--	--	--	--	--	--	--	11N04W13DDD 01
08-10-90	<2	<40	<20	<4.0	310	6	<4	<6	<6	11N04W14DCCA01
02-28-79	2,300	--	--	--	--	--	--	--	--	11N04W25DDDD01
04-17-79	640	--	--	--	--	--	--	--	--	
10-31-90	<2	<40	<20	<4.0	680	10	10	6	<6	11N04W26ACAB01

Table 12.--*Minimum reporting levels for analysis of volatile organic compounds in water samples*

[Laboratory A, Energy Laboratories, Inc., Billings, Mont.; Laboratory B, Chemistry Laboratory Bureau, Montana Department of Health and Environmental Sciences, Helena, Mont. Compounds analyzed using U.S. Environmental Protection Agency method 524.2. --, compound not analyzed by laboratory]

Compound	Minimum reporting level, in micrograms per liter		Compound	Minimum reporting level, in micrograms per liter	
	Laboratory A	Laboratory B		Laboratory A	Laboratory B
Benzene	0.5	0.5	1,3-Dichloropropane	1.0	0.5
Bromobenzene	1.0	.5	2,2-Dichloropropane	1.0	.5
Bromochloromethane	1.0	.5	1,1-Dichloropropene	1.0	.5
Bromodichloromethane	1.0	.5	cis-1,3-Dichloropropene	1.0	.5
Bromoform	1.0	.5	trans-1,3-Dichloropropene	1.0	.5
Bromomethane	1.0	.5	Ethylbenzene	1.0	.5
n-Butylbenzene	1.0	.5	Fluorotrichloromethane	--	.5
sec-Butylbenzene	1.0	.5	Hexachlorobutadiene	1.0	.5
tert-Butylbenzene	1.0	.5	Isopropylbenzene	1.0	.5
Carbon tetrachloride	.5	.5	p-Isopropyltoluene	1.0	.5
Chlorobenzene	1.0	.5	Methylene chloride	1.0	.5
Chlorodibromomethane	--	.5	Napthalene	1.0	.5
Chloroethane	1.0	.5	n-Propylbenzene	1.0	.5
Chloroform	1.0	.5	Styrene	1.0	.5
Chloromethane	1.0	.5	1,1,1,2-Tetrachloroethane	1.0	.5
2-Chlorotoluene	1.0	.5	1,1,2,2-Tetrachloroethane	1.0	.5
4-Chlorotoluene	1.0	.5	Tetrachloroethene	.5	.5
Dibromochloromethane	1.0	--	Toluene	1.0	.5
1,2-Dibromo-3-chloropropane	1.0	.5	1,2,3-Trichlorobenzene	1.0	.5
Dibromomethane	1.0	.5	1,2,4-Trichlorobenzene	1.0	.5
1,2-Dibromoethane	1.0	--	1,1,1-Trichloroethane	.5	.5
1,2-Dibromomethane	--	.5	1,1,2-Trichloroethane	1.0	.5
1,2-Dichlorobenzene	1.0	.5	Trichloroethene	.5	.5
1,3-Dichlorobenzene	1.0	.5	Trichlorofluoromethane	1.0	--
1,4-Dichlorobenzene	.5	.5	1,2,3-Trichloropropane	1.0	.5
Dichlorodifluoromethane	1.0	.5	1,2,4-Trimethylbenzene	1.0	.5
1,1-Dichloroethane	1.0	.5	1,3,5-Trimethylbenzene	1.0	.5
1,2-Dichloroethane	.5	.5	Vinyl chloride	.5	.5
1,1-Dichloroethene	.5	.5	Xylenes	1.0	--
cis-1,2-Dichloroethene	1.0	.5	m + p-Xylene	--	1.0
trans-1,2-Dichloroethene	1.0	.5	o-Xylene	--	.5
1,2-Dichloropropane	1.0	.5			

Table 13.--*Minimum reporting levels for analysis of semi-volatile organic compounds in water samples*

[Laboratory A, Energy Laboratories, Inc., Billings, Mont.; Laboratory B, Chemistry Laboratory Bureau, Montana Department of Health and Environmental Sciences, Helena, Mont. Compounds analyzed using U.S. Environmental Protection Agency method 8270 or 604. --, compound not analyzed by laboratory]

Compound	Minimum reporting level, in micrograms per liter		Compound	Minimum reporting level, in micrograms per liter	
	Laboratory A	Laboratory B		Laboratory A	Laboratory B
Acenaphthene	--	10	2,4-Dinitrophenol	10	50
Acenaphthylene	--	10	2,4-Dinitrotoluene	--	10
Anthracene	--	10	Di-n-octylphthalate	--	10
Benzo(a)anthracene	--	10	2,6-Dinitrotoluene	--	10
Benzo(a)pyrene	--	10	bis(2-Ethylhexyl)phthalate	--	10
Benzo(b)fluoranthene	--	10	Fluorathene	--	10
Benzo(g,h,i)perylene	--	10	Fluorene	--	10
Benzo(k)fluoranthene	--	10	Hexachlorobenzene	--	10
Benzoic acid	--	50	Hexachlorobutadiene	--	10
Benzyl alcohol	--	10	Hexachlorocyclopentadiene	--	10
4-Bromophenyl-phenylether	--	10	Hexachloroethane	--	10
Butylbenzylphthalate	--	10	Indeno (1,2,3-cd)pyrene	--	10
4-Chloroaniline	--	20	Isophorone	--	10
bis(2-Chloroethoxy)methane	--	10	2-Methylnaphthalene	--	10
bis(2-Chlorethyl)ether	--	10	2-Methlyphenol	--	10
bis(2-Chloroisopropyl)ether	--	10	4-Methlyphenol	--	10
4-Chloro-3-methylphenol	2.0	20	Napthalene	--	10
2-Chloronaphthalene	--	10	2-Nitroaniline	--	50
2-Chlorophenol	2.0	10	3-Nitroaniline	--	50
4-Chlorophenyl-phenylether	--	10	4-Nitroaniline	--	50
Chrysene	--	10	Nitrobenzene	--	10
Dibenz(a,h)anthracene	--	10	2-Nitrophenol	2.0	10
Dibenzofuran	--	10	4-Nitrophenol	10	50
1,2-Dichlorobenzene	--	20	N-Nitroso-di-n-propylamine	--	10
1,3-Dichlorobenzene	--	10	N-Nitrosodiphenylamine	--	10
1,4-Dichlorobenzene	--	10	Pentachlorophenol	10	50
3,3'-Dichlorobenzidine	--	20	Phenanthrene	--	10
2,4-Dichlorophenol	2.0	10	Phenol	2.0	10
Diethylphthalate	--	10	Pyrene	--	10
2,4-Dimethylphenol	2.0	50	1,2,4-Trichlorobenzene	--	10
Dimethylphthalate	--	10	2,4,5-Trichlorophenol	--	50
Di-n-butylphthalate	--	10	2,4,6-Trichlorophenol	2.0	10
4,6-Dinitro-2-methylphenol	10	50			

Table 14.--*Minimum reporting levels for analysis of pesticides in water samples*

[Analyses by Laboratory Bureau, Agricultural and Biological Sciences Division, Montana Department of Agriculture, Bozeman, Mont. Abbreviation: µg/L, micrograms per liter]

Compound	Minimum reporting level (µg/L)	Compound	Minimum reporting level (µg/L)
	Chlorinated-acid pesticides[1]		
Clopyralid	1.0	5-Hydroxy dicamba	0.040
Dicamba	.081	MCPA	2.0
Dinoseb	.40	PCP	.10
2,4-D	.20	Picloram	.14
2,4-DB	4.0	Silvex	.20
	Organophosphorus pesticides[2]		
Diazinon	.25	Malathion	.1
Ethyl parathion	.1	Methyl parathion	.1
	Thiocarbamate pesticides[2]		
Triallate	.5		

[1] Analyzed using U.S. Environmental Protection Agency method 3.
[2] Analyzed using U.S. Environmental Protection Agency method 1.

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