HYDROLOGY OF THE PROSPECTOR SQUARE AREA, SUMMIT COUNTY, UTAH

By J. L. Mason

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DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS AND RELATED INFORMATION

For readers who prefer to use metric (International System) units, conversion factors for inch-pound units used in this report are listed below:

Multiply inch-pound unit	By	To obtain metric unit
acre	0.4047	hectare
acre-foot per acre	0.003	cubic hectometer per hectare
cubic foot per second	0.0283	cubic meter per second
cubic yard	0.7646	cubic meter
foot	0.3048	meter
foot per day	0.3048	meter per day
foot squared per day	0.0929	meter squared per day
gallon per minute	0.0631	liter per second
inch	25.4	millimeter
inch per year	25.4	millimeter per year
mile	1.609	kilometer
square mile	2.59	square kilometer

Chemical concentration is given in milligrams per liter or micrograms per liter. Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to 1 milligram per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

Water temperature is given in degrees Celsius, which can be converted to degrees Farenheit by the following equation:

$$\text{Farenheit} = 1.8\ (\text{Celsius}) + 32.$$

Specific conductance is reported in microsiemens per centimeter at 25 degrees Celsius (µS/cm).

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

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ABSTRACT

The Silver Creek tailings site is in Prospector Square, a commercial development and residential community in Summit County, Utah. This study assessed the extent of metal contamination and the movement of ground water in the unconsolidated valley-fill and consolidated-rock aquifers underlying the tailings.

The unconsolidated valley fill is a poorly sorted mixture of clay, silt, sand, and gravel, with intermittent layers of clay. The hydraulic conductivity, estimated on the basis of slug tests, ranged from 1 to 14 feet per day. An aquifer-interference test indicated that water in the valley fill did not move toward the pumped municipal well completed in the consolidated-rock aquifer.

Concentrations of dissolved and suspended cadmium, manganese, and zinc were greater than background only in surface water downstream from the tailings site during low-flow conditions. Concentrations of suspended iron and lead were greater than background concentrations upstream from the tailings site, but concentrations decreased progressively downstream and during later sampling when flow conditions were different.

Concentrations of dissolved cadmium, managanese, and zinc were greater than background concentrations in water from six wells and a drain. Dissolved arsenic and lead were detected in water from a well downgradient from Prospector Square, but these constituents were not detected in water from any of the other wells.

Concentrations of all selected metals detected in stream-sediment samples, were detected in similar concentrations in tailings samples. Concentrations of metals in surface and ground water could increase if the pH of the water decreases substantially from the present (1988) values of about 7 (neutral).

INTRODUCTION

The study area (fig. 1) that includes the Silver Creek tailings site, which is in the Prospector Square area of Park City (fig. 2), is about 30 miles east of Salt Lake City, Utah. Prospector Square is a commercial development and residential community that has been built over mill tailings. The tailings generally extend from Bonanza Drive on the west to where Silver Creek enters a narrow canyon on the east, and from Silver Creek on the south to State Highway 248 on the north (figs. 2 and 3). The tailings were reworked during the 1940's, resulting in localized deposits that vary in thickness from a few inches to several feet. Within the original tailings-pond area, the tailings are not continuous. Most of the tailings have been covered with a 10-inch cap of soil through the actions of a Park City Special Improvement District. However, in some areas, the tailings are exposed.

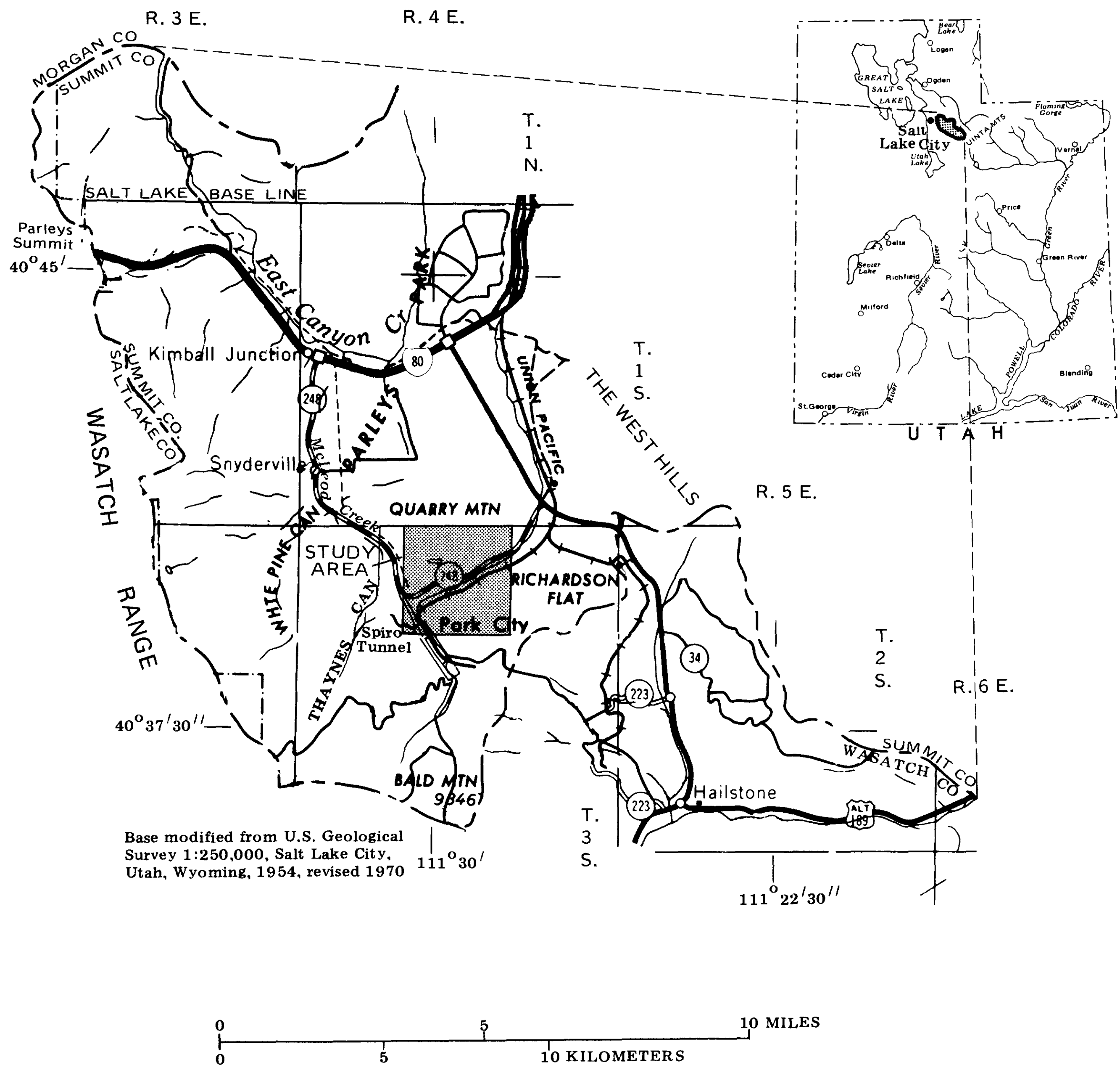


Figure 1.--Location of study area and vicinity.

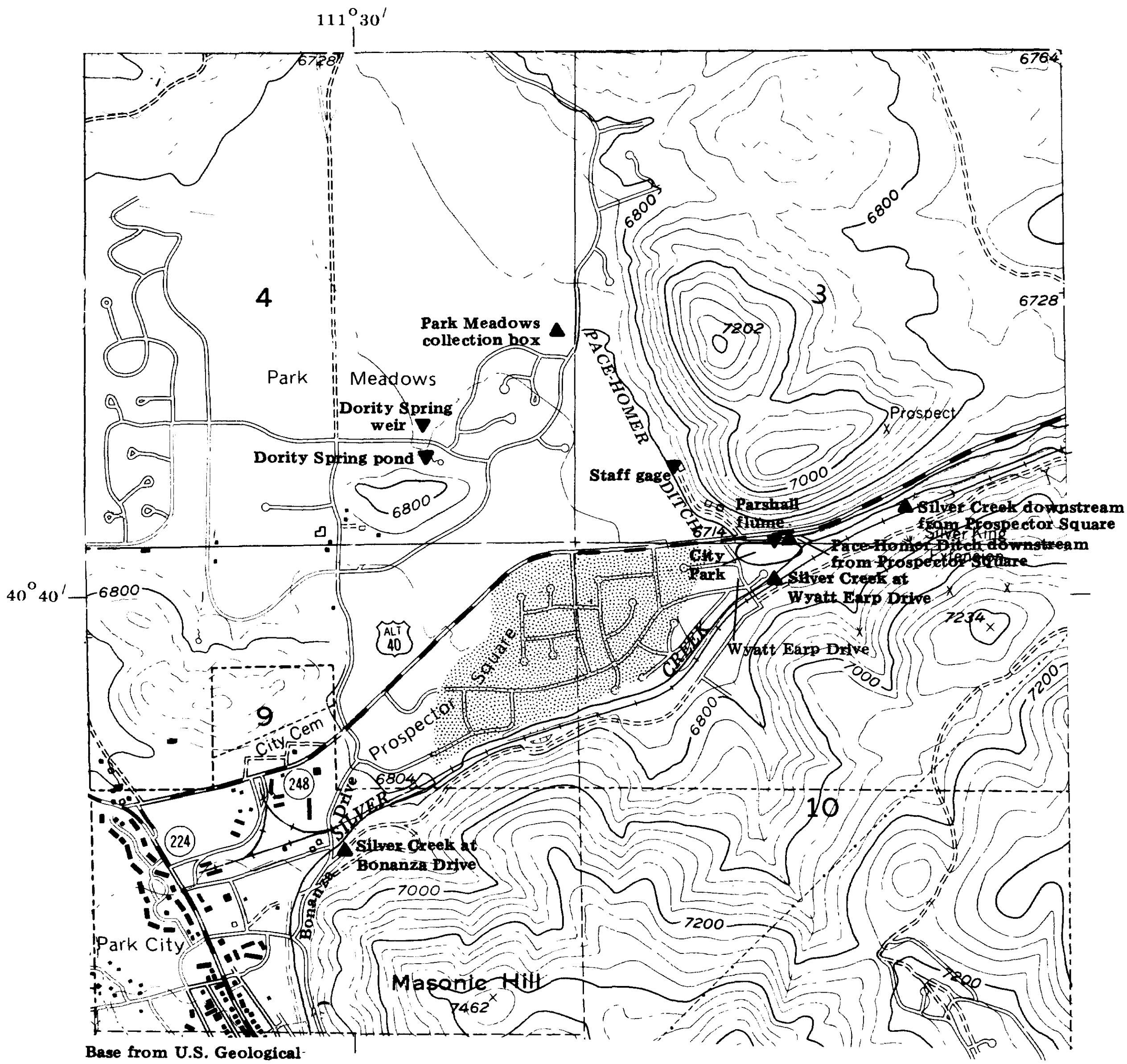
EXPLANATION

PRINCIPAL AREA OF TAILINGS--As shown on U.S. Geological Survey Park City East, 1:24,000, 1955

SURFACE-WATER SITES

Silver Creek at Bonanza Drive ▲ Water-quality data-collection site and identifier

Staff gage ▼ Aquifer-interference-test data-collection site and identifier



Base from U.S. Geological Survey Park City West, 1:24,000, 1955, revised 1975 and Park City East, 1:24,000, 1955

0 ¼ ½ ¾ 1 MILE

0 ¼ ½ ¾ 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DATUM IS SEA LEVEL

Figure 2.--Location of surface-water sites.

EXPLANATION

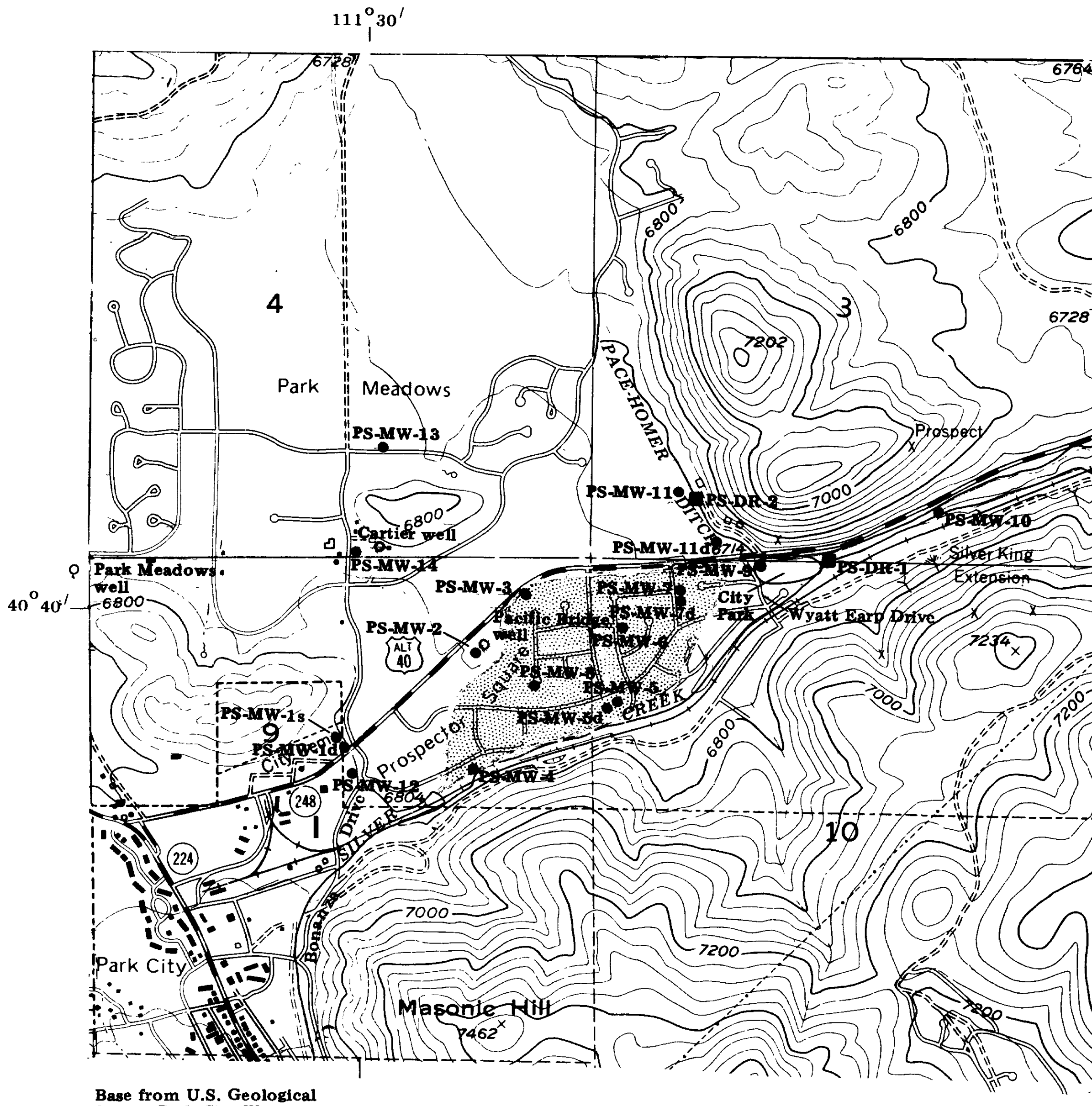
PRINCIPAL AREA OF TAILINGS--As shown on U.S. Geological Survey Park City East, 1:24,000, 1955

GROUND-WATER SITES

Cartier well ○ Observation well and identifier--All observation wells also used as data-collection sites during aquifer-interference test

PS-MW-2 ● Monitoring well and number--All monitoring wells (except well PS-MW-5d) also used as data-collection sites during aquifer-interference test

PS-DR-2 ■ Drain and number



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CONTOUR INTERVAL 40 FEET
DATUM IS SEA LEVEL

Figure 3.--Location of ground-water sites.

Through a drilling and sampling program, the Utah Geological and Mineral Survey identified large concentrations of metals in tailings and soil samples (Gill and Lund, 1984, p. 27). The Utah Department of Health sampled soils to a depth of 12 inches; chemical analyses of these samples confirmed the large concentrations of metals detected earlier in samples collected by the Utah Geological and Mineral Survey. Chemical analyses of surface-water samples collected by the Utah Geological and Mineral Survey upstream and downstream from the tailings area indicated that the concentration of lead was much greater in downstream sample than in the upstream sample. Although concentrations of the metals in tailings, soil, and water samples were greater than background concentrations, the extent of possible contamination in the hydrologic environment and the potential hazard to persons working or residing in Prospector Square is unknown.

Purpose and Scope

This report describes the methods and results of a study to characterize the tailings, surface-water system, stream sediment, and ground-water system in the vicinity of the Silver Creek tailings site in the Prospector Square area. The report also describes the lithology and estimated hydraulic conductivity of the unconsolidated valley fill underlying the tailings area, and the degree of hydraulic connection between the unconsolidated valley-fill and consolidated-rock aquifers. The results of the data collection and analyses were used by the Utah Department of Health and the U.S. Environmental Protection Agency to determine if selected constituents are being released from the tailings to Silver Creek and to the unconsolidated valley-fill and consolidated-rock aquifers underlying the study area.

Methods

Tailings characterization included chemical analysis of samples collected during the test drilling. In addition, the volume of the tailings was estimated.

Surface-water and stream-sediment characterization involved collection of data such as discharge, specific conductance, pH, temperature, alkalinity, and necessary water and sediment samples at each of the five sampling sites. Four sampling sites were located upstream and downstream from the Silver Creek tailings site on Silver Creek and on the Pace-Homer Ditch (fig. 2). The fifth sampling site was located on Silver Creek downstream from the point where water from the Pace-Homer Ditch could be diverted into Silver Creek. Data collected at the five sampling sites were used to determine if water from the tailings site is causing degradation of water in Silver Creek and if sediment is transporting metals from the tailings site.

Characterization of the ground-water system included determination of the lithology of the aquifers; recharge, movement and discharge of ground water; seasonal water-level fluctuations; hydraulic properties of the aquifers; the degree of hydraulic connection between the unconsolidated valley-fill and consolidated-rock aquifers using an aquifer-interference test; and quality of ground water. To accomplish these tasks, 18 monitoring wells (identified by PS-MW numbers) were completed in the unconsolidated valley fill (fig. 3) during two phases of drilling. During the first phase of drilling, 13 monitoring wells (wells PS-MW-1s and PS-MW-1d through PS-MW-12) were completed upgradient, within, and downgradient from the Silver Creek tailings site. Two of the three upgradient monitoring wells (PS-MW-1d and PS-MW-12) were completed near the base of the unconsolidated valley fill to determine the quality of ground water at depth. All other monitoring wells were completed at least 12 feet below the water table. Two downgradient monitoring wells were necessary to insure proper sampling of downgradient conditions. One monitoring well (PS-MW-10) was drilled adjacent to Silver Creek down gradient from Prospector Square and the second well (PS-MW-11) was drilled adjacent to the Pace-Homer Ditch.

The second phase of drilling, which involved the completion of five monitoring wells (wells PS-MW-5d, PS-MW-7d, PS-MW-11d, PS-MW-13, PS-MW-14) at or near the base of the unconsolidated valley fill, was necessary to determine the lithology and quality of water at depth below the tailings and to determine the effects of the aquifer-interference test on ground water in the unconsolidated valley fill. Slug tests were performed on 16 of the 18 monitoring wells to estimate the horizontal hydraulic conductivity of the unconsolidated valley fill. Ground-water samples were collected on 4 separate occassions from 16 of the 18 monitoring wells and from 2 drains to assess the quality of water beneath the Silver Creek tailings site. By sampling four times, changes in the quality of water due to seasonal water-level fluctuations were determined.

Well and Drain Numbering System

The system of numbering wells and drains in Utah (fig. 4) is based on the cadastral land-survey system of the U.S. Government. The number, in addition to designating the well or drain, describes the location of the well or drain in the land net. By the land-survey system, the State is divided into four quadrants by the Salt Lake base line and meridian; these quadrants are designated by the uppercase letters A, B, C, D, indicating the northeast, northwest, southwest, and southeast quadrants, respectively. Numbers designating the township and range (in that order) follow the quadrant letter, and all three are enclosed in parentheses. The number after the parentheses indicates the section and is followed by three letters indicating the quarter section, quarter-quarter section, and quarter-quarter-quarter section--generally 10 acres[1]; the letters a, b, c, and d indicate, respectively, the northeast, northwest, southwest, and southeast quarters of each subdivision. The number after the letters is a serial number of a well within the 10-acre tract.

Physiography

The Prospector Square study area is located in the Park City area (fig. 1), which is in the Middle Rocky Mountains physiographic province (Fenneman, 1931). Altitudes range from about 6,700 feet on the valley floor to about 10,000 feet in the adjacent Wasatch Range west of Park City. The Park City area is divided by a slight topographic high which results in two separate

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

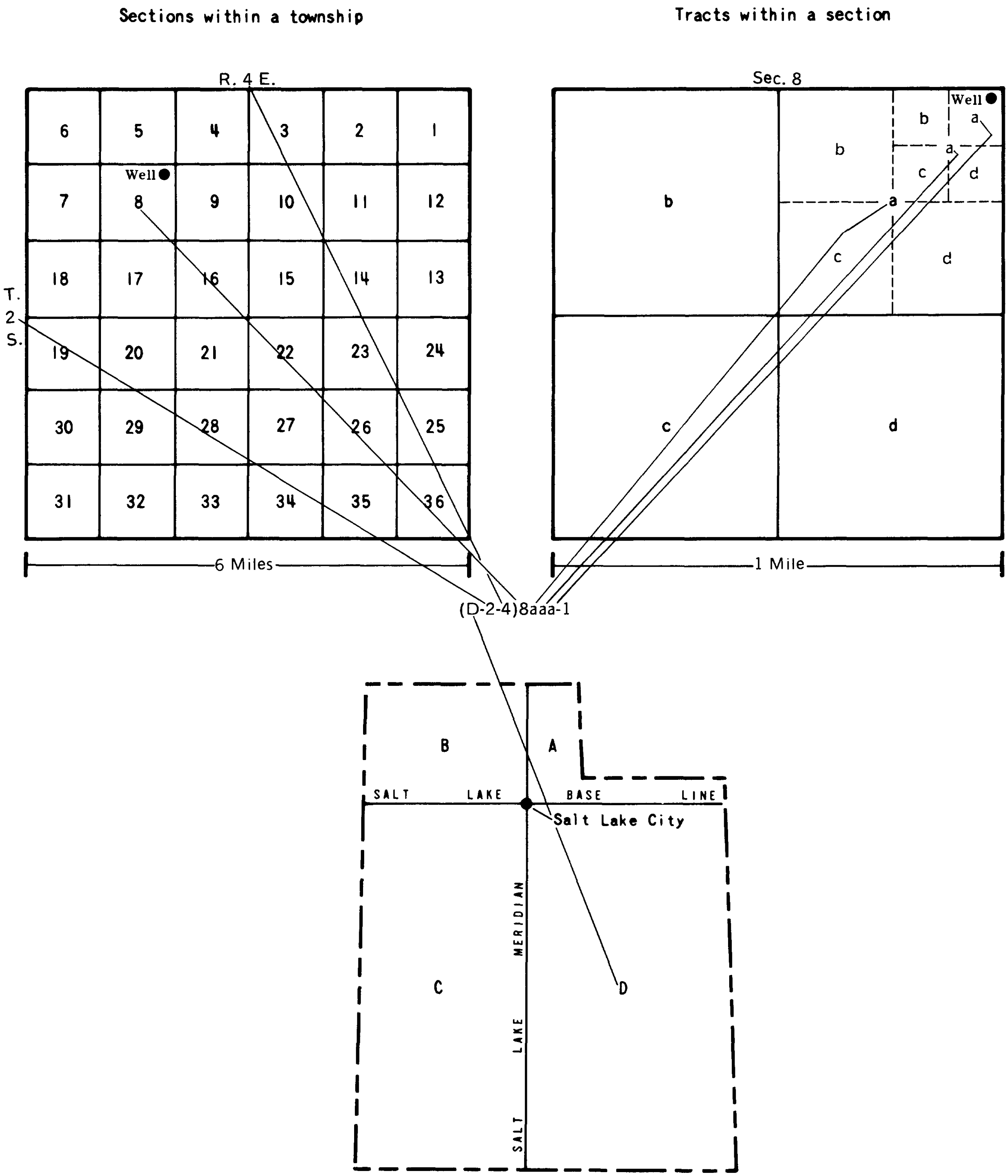


Figure 4.--Well- and drain-numbering system used in Utah.

drainages. Most of the Prospector Square study area is drained by Silver Creek, which flows northeastward; but, McLeod Creek, a northwestward flowing tributary of East Canyon Creek, drains some of the northwestern part of the area (fig. 1).

Geology

Consolidated rocks in the Prospector Square study area and in the surrounding mountains range in age from Pennsylvanian to Tertiary; the overlying unconsolidated valley fill is of Quaternary age (fig. 5). The consolidated rocks, which crop out or underlie the unconsolidated valley fill, are sedimentary rocks primarily consisting of quartzite, limestone, shale, and sandstone. The unconsolidated valley fill primarily consists of alluvial deposits.

The region surrounding the Prospector Square study area was structurally deformed in Late Cretaceous time; this deformation resulted in folding and faulting. As a result of folding, most of the consolidated rocks in the study area dip to the north and northwest at about 35 to 40 degrees (fig. 5). Most of the deformation is related to steep-angle thrust faults, which resulted in a complex geologic framework with extensive fracturing in most of the consolidated rocks. The differing resistance to deformation of each rock type resulted in fracture patterns; regional fracture patterns are not apparent. In limestone, such as the Thaynes Formation of lower Triassic age, the fractures have been enlarged by dissolution.

Acknowledgments

The Park City Municipal Corp. provided assistance through several phases of the study. Assistance included locating sites for drilling of wells, access to water during test drilling, plowing access roads during the winter, and access to observation wells.

HYDROLOGY

Tailings Characterization

Mill tailings were deposited in the Prospector Square area beginning in the early 1900's and continuing through the 1930's. Subsequently, in the 1940's, the mill tailings were reworked using an in-situ extraction process for the recovery of residual silver. The sporadic occurrence of the mill tailings as shown by test-drilling during this study is a direct result of the reworking process. Tailings were encountered in three of the nine monitoring wells completed in the immediate mill tailings area. Tailings from monitoring wells PS-MW-3 and PS-MW-5 appeared to have been reworked and had the appearance of well-sorted, fine- to medium-grained, brown sand. In contrast, the tailings from monitoring well PS-MW-9 did not appear to have been reworked based on the presence of sphalerite and various forms of pyrite. The thickness of each tailings interval encountered is listed in table 1. Chemical analyses from a total-metal extraction are listed in table 2 (Supplemental Data Section at back of report). Ecology and Environment, Inc., the Field Investigation Team contracted by the U.S. Environmental Protection Agency, has estimated the volume of mill tailings to be 46,740 cubic yards.

Surface Water and Stream Sediment

Sources of streamflow in the Prospector Square study area are rain or melting snow, direct ground-water discharge to the streams and drains, and spring discharge. Silver Creek, which flows along the southeastern margin of the unconsolidated valley fill, derives its flow from runoff in the mountains south of Park City. Silver Creek flows northeastward from the study area through a narrow canyon toward Richardson Flat (fig. 1).

Holmes and others (1986, p. 11) reported an estimated average annual flow of 0.8 cubic foot per second in the upstream reach of Silver Creek, south of Park City. The annual flow through the Prospector Square study area probably is not substantially greater because of the lack of inflow from other drainages or springs. South of Park City, flow in Silver Creek is greatest during spring runoff; flow usually ceases during the summer months.

Water in the Pace-Homer Ditch (fig. 2) is derived primarily from ground-water sources west and southwest from the Park Meadows collection box. Water from Dority Spring and a series of ponds and drains converge at the Park Meadows collection box. The water exits the collection box through a culvert and flows eastward where it surfaces east of the road. At least two drains downstream from the Park Meadows collection box also discharge water into the ditch. The Pace-Homer Ditch probably receives some direct seepage of ground water from the unconsolidated valley fill before the ditch drains into Silver Creek, east of Prospector Square.

The flow in the Pace-Homer Ditch is measured at a 2-foot Parshall flume located upstream from the first diversion where water is allowed to enter Silver Creek. Data are collected at the flume during the summer months (May through September) and measurements of flow are compiled in annual reports for the Weber River Distribution System (Johnson, 1969-88). During years of normal precipitation, discharge in the ditch ranges from about 3 to 6 cubic feet per second; the long-term average discharge is about 4 cubic feet per second. Some water from the Spiro Tunnel (fig. 1), which usually flows into the East Canyon Creek drainage, may be diverted through ditches into the Pace-Homer Ditch to fulfill water obligations to downstream water users in the Silver Creek drainage.

Ground Water

Ground water in the Prospector Square study area occurs in both unconsolidated valley fill and consolidated rocks. Although ground water in the unconsolidated valley fill is not used for municipal and industrial purposes, ground water in the permeable consolidated rocks, such as the Thaynes Formation, is a primary source of municipal water. Records for observation and monitoring wells are presented in table 1, lithologic logs are presented in table 3, water levels are presented in table 4, and results of slug tests are presented in table 5 (Supplemental Data Section at back of report).

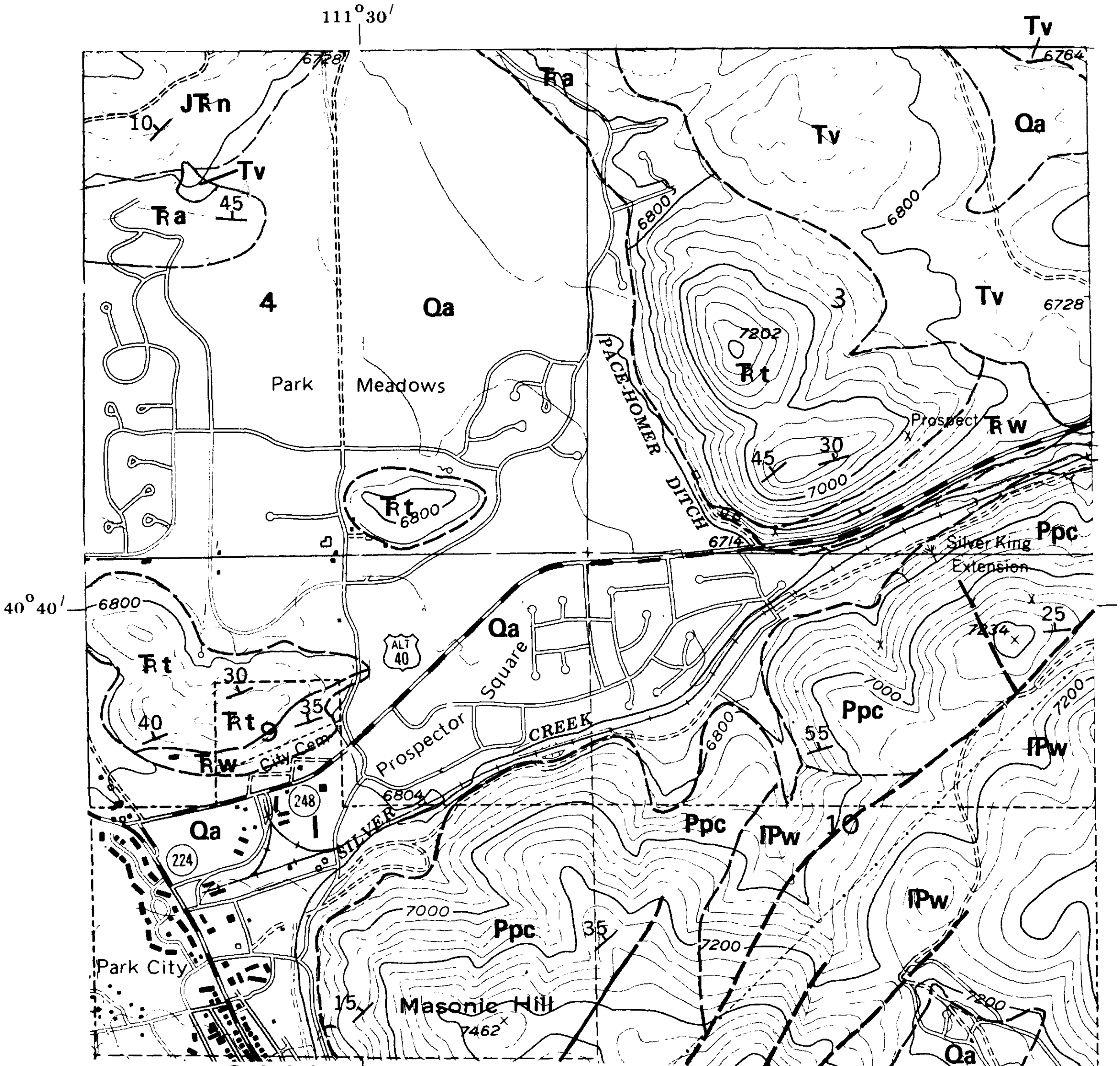
EXPLANATION

QUATERNARY	Qa	ALLUVIAL DEPOSITS--Poorly sorted mixture of material ranging in size from clay to boulders. Beds appear to be lenticular and discontinuous
TERTIARY	Tv	IGNEOUS ROCKS—Primarily extrusive igneous rocks, chiefly andesitic pyroclastics with some intercalated flow rocks
JURASSIC	JTRn	NUGGET SANDSTONE--Pale-orange, medium-grained, cross-bedded sandstone
TRIASSIC	TRa	ANKAREH FORMATION—Reddish-brown, reddish-purple, or bright-red shale, mudstone, and sandstone in upper and lower parts. White to pale-purple, coarse-grained to pebbly, massive, cross-bedded quartzite in middle part
	TRt	THAYNES FORMATION--Brown-stained, fine-grained limy sandstone and siltstone interbedded with olive-green to dull-red shale and gray, fine-grained, fossiliferous limestone
	TRw	WOODSIDE SHALE--Dark-red or purplish-red shale
PERMIAN	Ppc	PARK CITY FORMATION--Pale-gray-weathering fossiliferous and cherty limestone containing a medial phosphatic shale member
PENNSYLVANIAN	IPw	WEBER QUARTZITE--Pale-gray, tan-weathering quartzite and limy sandstone with some interbedded gray to white limestone and dolomite

——————— — — CONTACT--Dashed where approximately located

——————— — — HIGH-ANGLE FAULT--Dashed where approximately located

10 STRIKE AND DIP OF BEDS



Base from U.S. Geological Survey Park City West, 1:24,000, 1955, revised 1975 and Park City East, 1:24,000, 1955

0 1/4 1/2 3/4 1 MILE

0 1/4 1/2 3/4 1 KILOMETER

Geology modified from Crittenden and others (1966); and Broomfield and Crittenden (1971)

CONTOUR INTERVAL 40 FEET
DATUM IS SEA LEVEL

Figure 5.--Generalized geology.

Water in Unconsolidated Valley Fill

Water in the unconsolidated valley fill generally is unconfined but may be semiconfined at depth. The unconsolidated valley fill consists primarily of alluvium. The deposits generally are poorly sorted and consist of clay, silt, sand, gravel, cobbles, and boulders. Some local deposits of well-sorted, coarse-grained material are present near the Pace-Homer Ditch. The unconsolidated valley fill underlying the Silver Creek tailings site consists of a poorly sorted mixture of clay, silt, sand, and gravel, with intermittent lenses of clay.

The unconsolidated valley fill ranges in thickness from a few feet near the base of the hills and mountains to at least 260 feet at the Pacific Bridge well. The fill is probably less than 20 feet thick in the eastern part of the study area where Silver Creek flows out of the area to the northeast.

Recharge

Recharge to the unconsolidated valley fill is from: upward leakage from consolidated rocks; leakage from Silver Creek and other ditches; infiltration of precipitation; and seepage from excess irrigation water. Silver Creek is a primary source of recharge during the spring and summer months. Instantaneous discharge measurements (table 6 in Supplemental Data section at back of report) indicate streamflow losses of 15 to 25 percent of the flow in Silver Creek during normal to high flows and streamflow losses of virtually 100 percent of the flow during low flows. Holmes and others (1986, p. 14) estimated that annual recharge to the unconsolidated valley fill from precipitation and seepage from excess irrigation water was 1 acre-foot per acre.

Movement

In theory, the direction of ground-water flow in the unconsolidated valley fill should parallel the general slope and direction of flow in the major streams. However, in the Prospector Square study area, the water table in the shallow, unconsolidated valley fill, shown in figure 6, indicates movement of water away from Silver Creek in a northeasterly direction. In the eastern part of the study area, the general flow direction is more easterly, toward the Pace-Homer Ditch. Seasonal water-level fluctuations would not substantially change the configuration of the water table or the direction of flow.

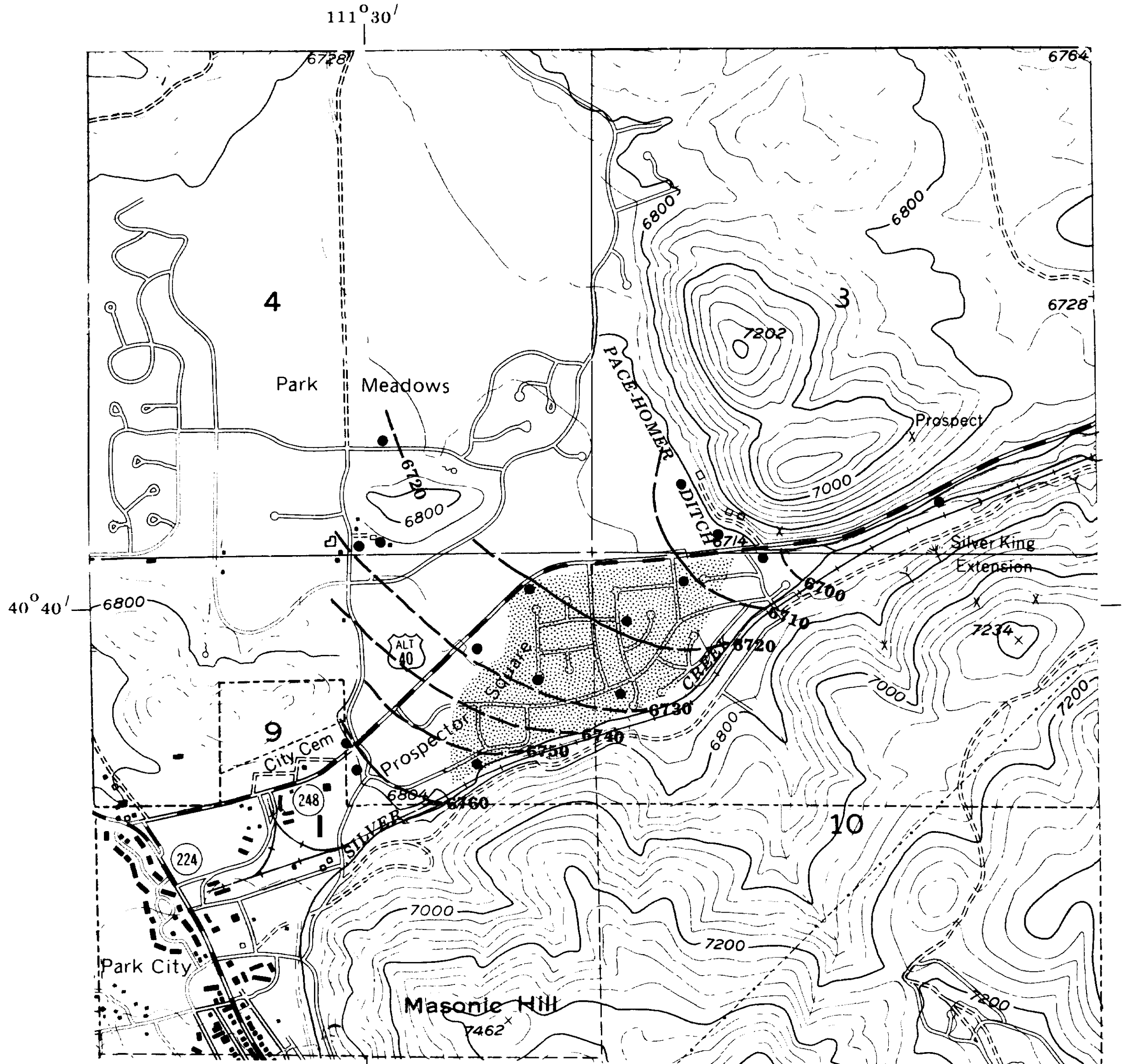
A downward component of ground-water flow was measured at three sites where monitoring wells were completed in the shallow unconsolidated valley fill near the contact of the unconsolidated valley fill with the consolidated rock. The difference between water levels was about 6 feet in wells PS-MW-1s and PS-MW-1d. This is equivalent to a downward hydraulic gradient of about 1 foot per 5 feet of valley fill. Near Silver Creek, the difference between water levels was about 10 feet in wells PS-MW-5 and PS-MW-5d, which is equivalent to a downward hydraulic gradient of about 1 foot per 6 feet of valley fill. Near the east edge of the unconsolidated valley fill, the difference between water levels was about 3 feet in wells PS-MW-7 and PS-MW-7d. In this area, the downward hydraulic gradient decreases to 1 foot per 35 feet of valley fill.

EXPLANATION

PRINCIPAL AREA OF TAILINGS--As shown on U.S. Geological Survey Park City East, 1:24,000, 1955

—— 6760 – – – WATER-TABLE CONTOUR--Shows altitude of the water table. Dashed where approximately located. Contour interval 10 feet. Datum is sea level

• OBSERVATION WELL



Base from U.S. Geological Survey Park City West, 1:24,000, 1955, revised 1975 and Park City East, 1:24,000, 1955

0 ¼ ½ ¾ 1 MILE

0 ¼ ½ ¾ 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DATUM IS SEA LEVEL

Figure 6.--Altitude and configuration of the water table in the shallow unconsolidated valley-fill aquifer, April 1988.

Discharge

Discharge from the unconsolidated valley fill in the Prospector Square study area is primarily by seepage to drains and streams, and subsurface outflow. Discharge by evapotranspiration is small. When phreatophyte vegetation was more prevalent, prior to residential development, discharge by evapotranspiration from plants probably was greater.

Seepage to drains and streams.--Drains at the downgradient end of the study area are used to dewater the shallow, unconsolidated valley fill. The discharge from two drains, labeled PS-DR-1 and PS-DR-2 on figure 3, was measured at time of ground-water sampling. During the spring and summer months when ground-water levels are near their peak, the combined discharge from the drains was about 0.4 cubic foot per second; and, during the winter months, the combined discharge was about 0.1 cubic foot per second. A new sewer line that parallels the Pace-Homer Ditch and extends beyond the area along Silver Creek, can be considered a drain because the fill around the sewer pipe can provide a permeable conduit through which ground water can readily flow. Data were not collected to estimate discharge from this source.

Seepage from the unconsolidated valley fill to the Pace-Homer Ditch can be calculated by subtracting the discharge from Dority Spring, the discharge from the drains, and the flow of any water diverted into the area from the Spiro Tunnel from the discharge measured at the Parshall flume east of Prospector Square. Data necessary for this calculation were collected during the aquifer-interference test and the results are discussed later in this report.

Subsurface outflow.--Discharge by subsurface outflow is restricted to the narrow canyon on the eastern side of the study area. The saturated thickness of the valley fill in this area is probably less than 20 feet, and the hydraulic gradient is slight and the permeability is minimal. Thus, the quantity of subsurface outflow in the valley fill is probably small with the exception of the more permeable fill around the sewer line.

Seasonal water-level fluctuations

Seasonal water-level fluctuations in the unconsolidated valley fill are a result of variations in recharge and discharge. The degree of water-level fluctuation in a well generally is related to the distance of the well, both vertical and horizontal, from the source of recharge and points of discharge, the permeability of the fill, the rates of recharge and discharge, and the storage coefficient of the unconsolidated valley fill. Water levels are lowest in the winter when recharge is minimal. In contrast, water levels are highest in the spring after maximum recharge by melting snow and high flows in streams.

Water levels in monitoring wells PS-MW-4 and PS-MW-5, near Silver Creek, rise substantially in the spring; water levels in the observation wells and in most of the other monitoring wells also rise, but to a lesser degree (fig. 7). Monitoring well PS-MW-5 responds more rapidly to leakage from Silver Creek than does monitoring well PS-MW-5d, which is open to a deeper zone. During the spring months, the difference in water levels in these two wells increased

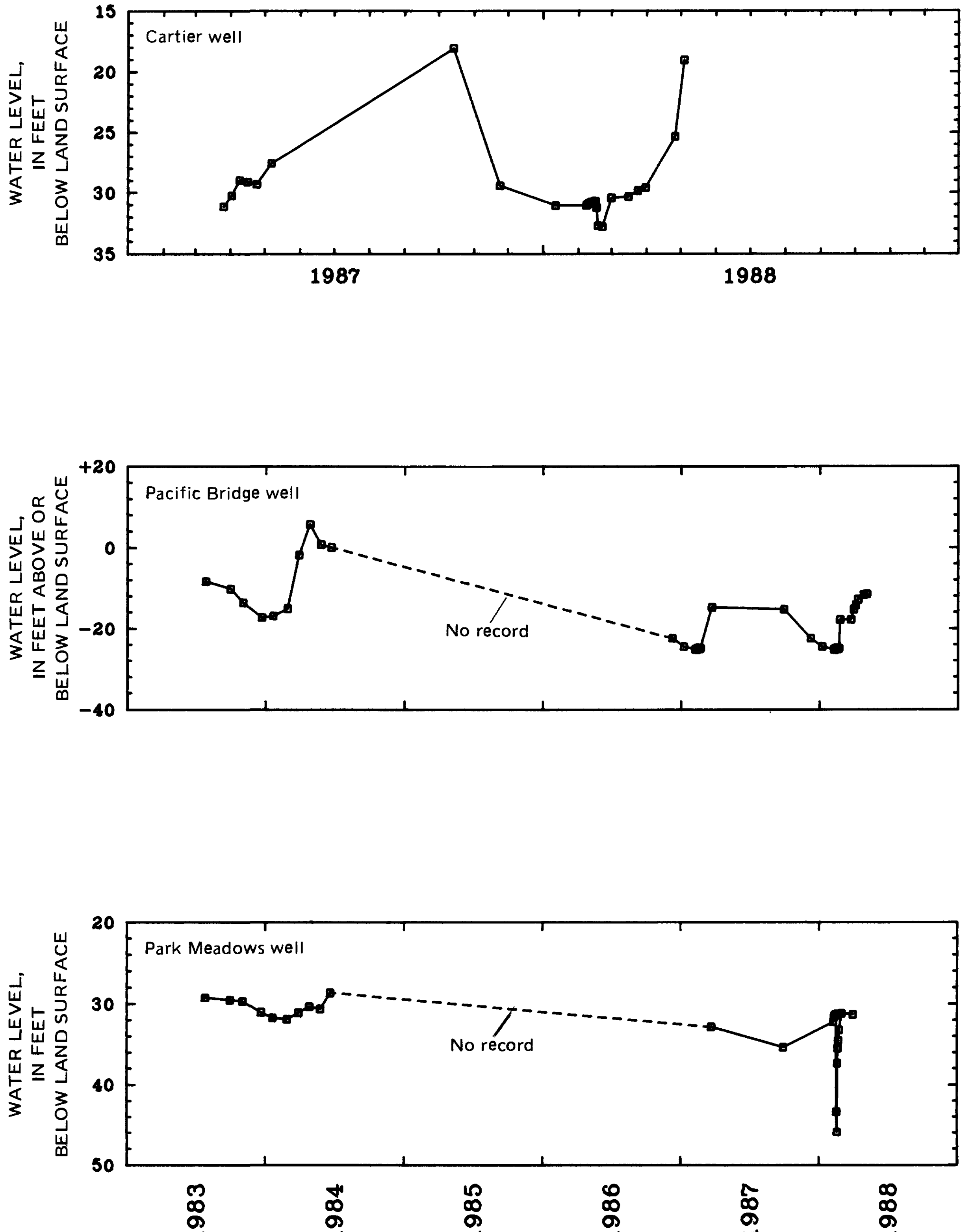


Figure 7.--Seasonal water-level fluctuations in observation and monitoring wells.

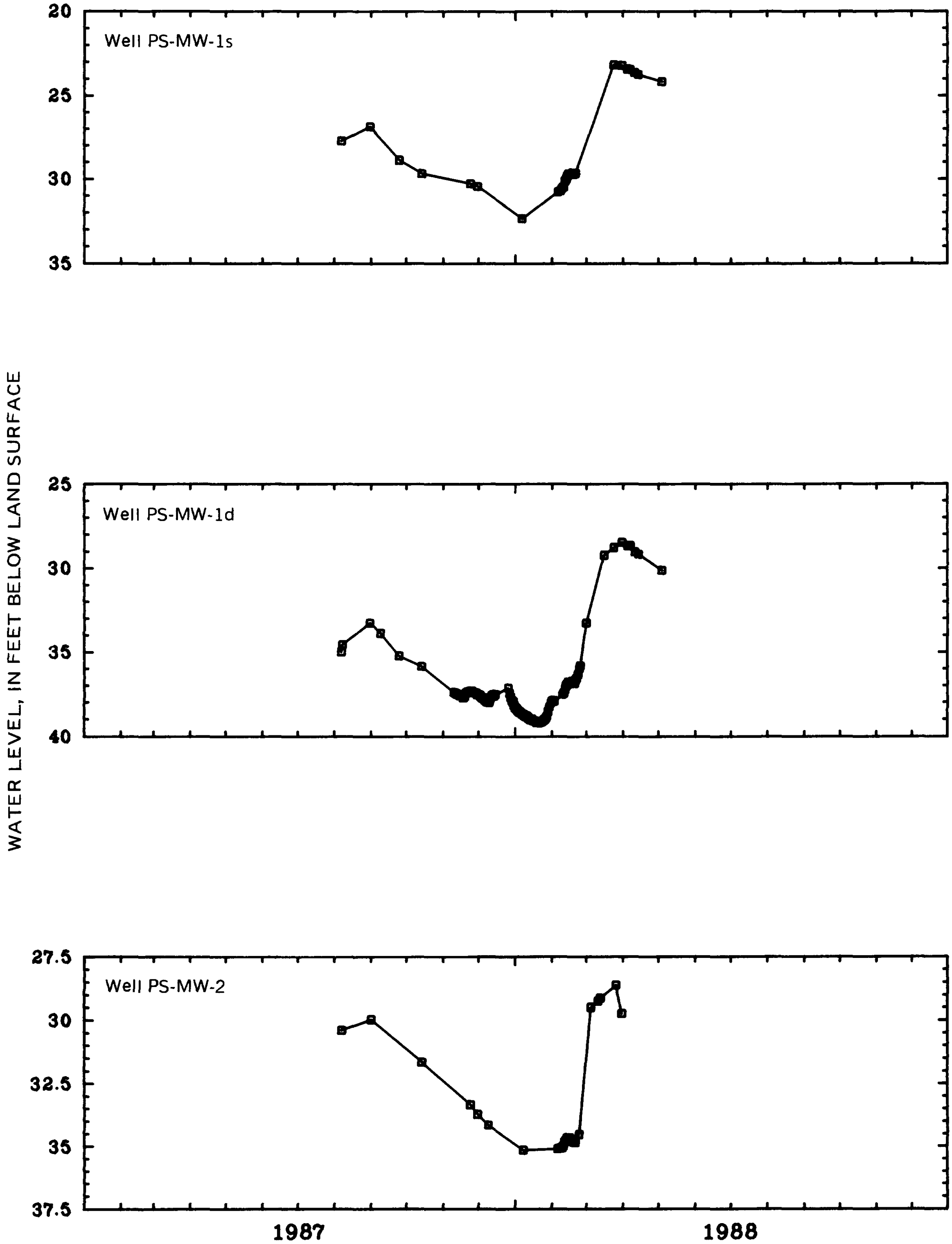


Figure 7.--Seasonal water-level fluctuations in observation and monitoring wells--Continued.

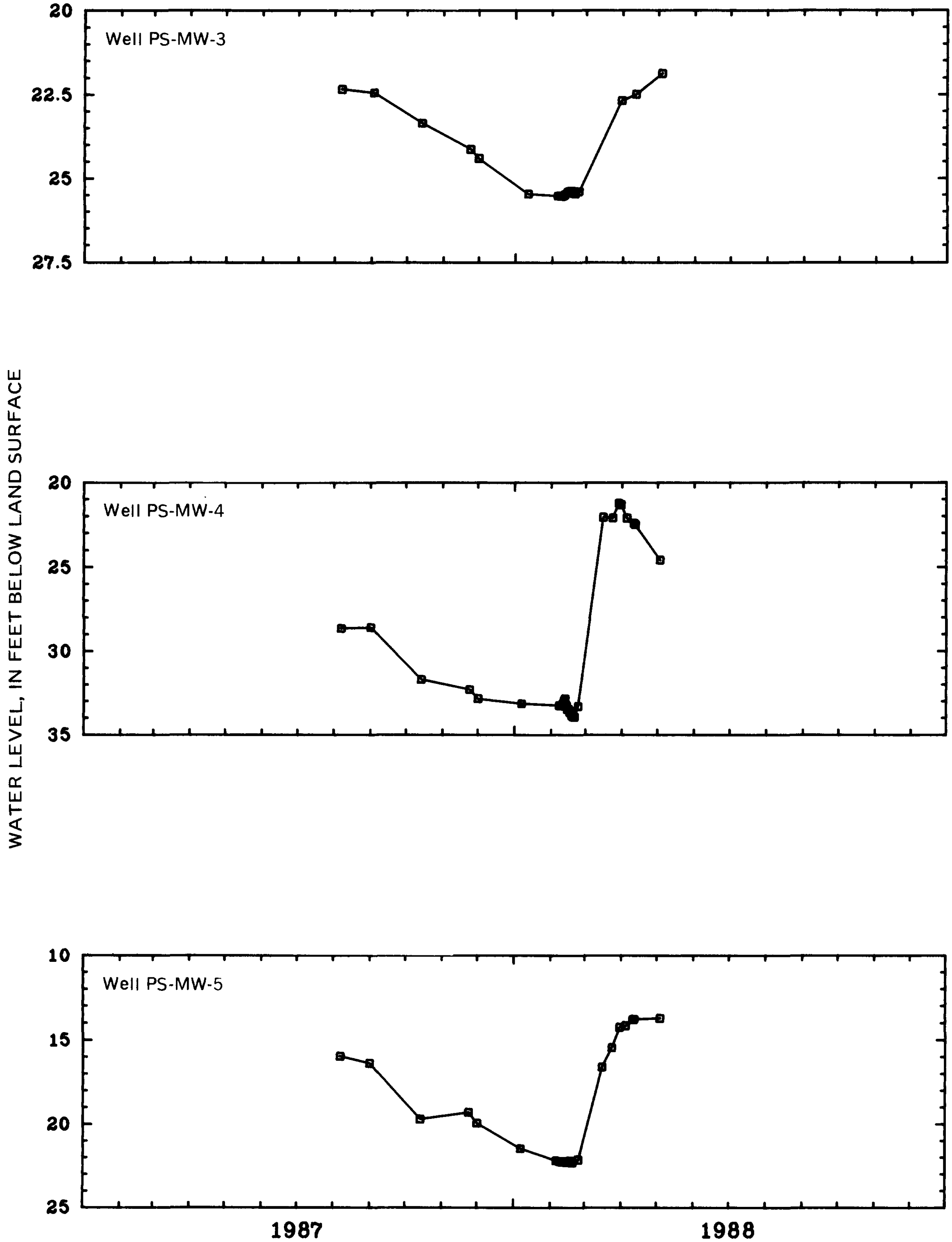


Figure 7.--Seasonal water-level fluctuations in observation and monitoring wells--Continued.

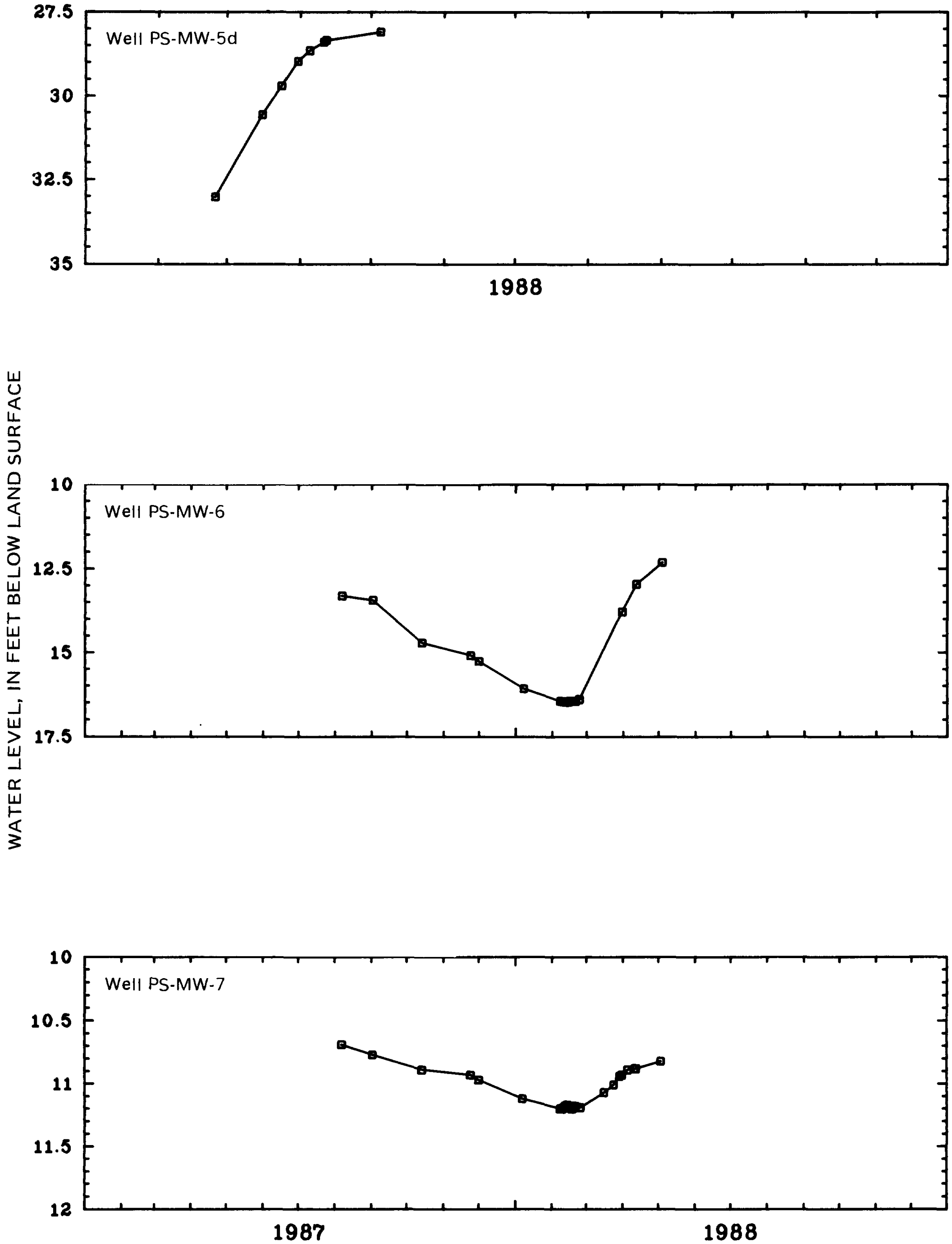


Figure 7.--Seasonal water-level fluctuations in observation and monitoring wells--Continued.

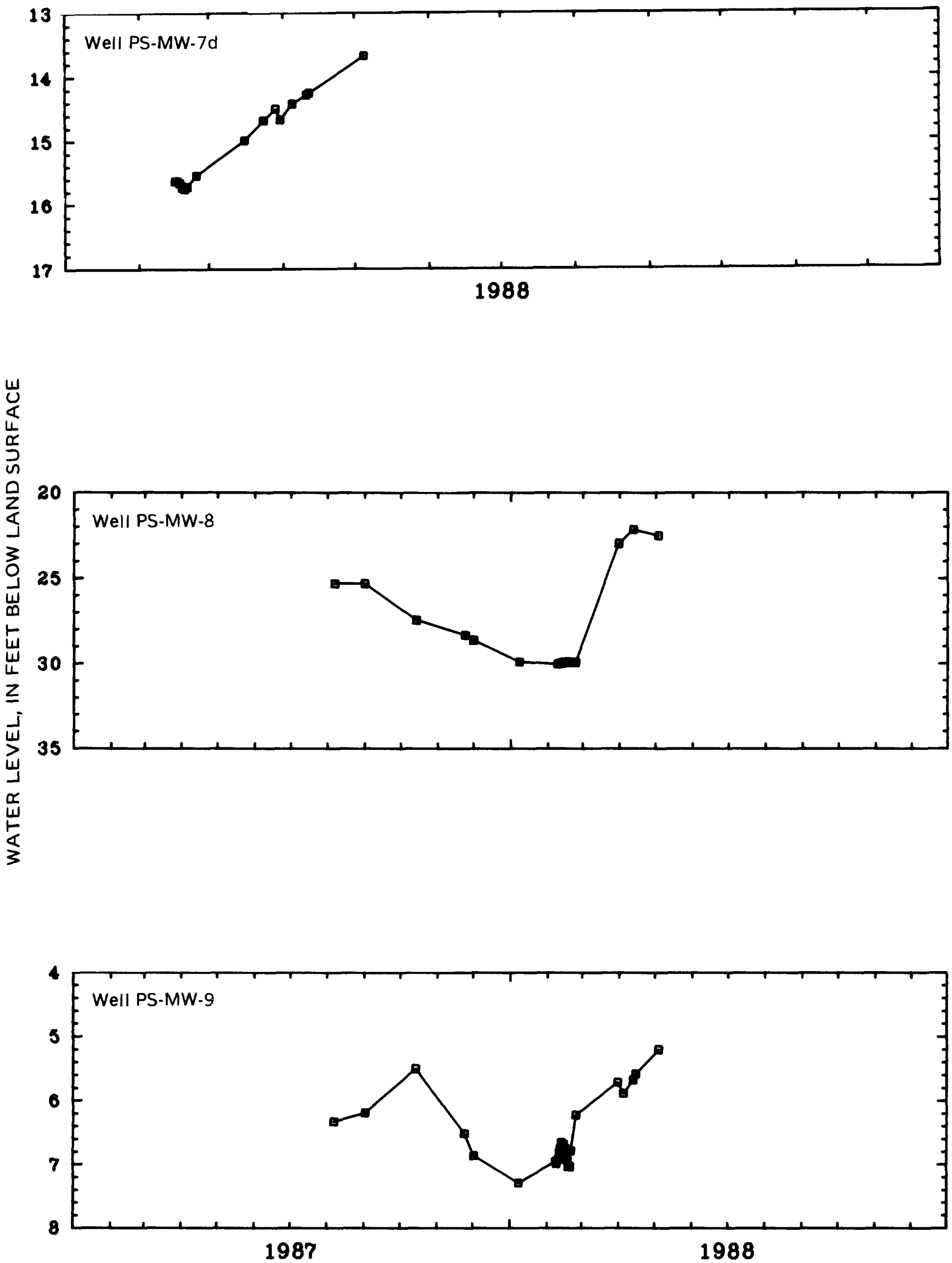


Figure 7.--Seasonal water-level fluctuations in observation and monitoring wells--Continued.

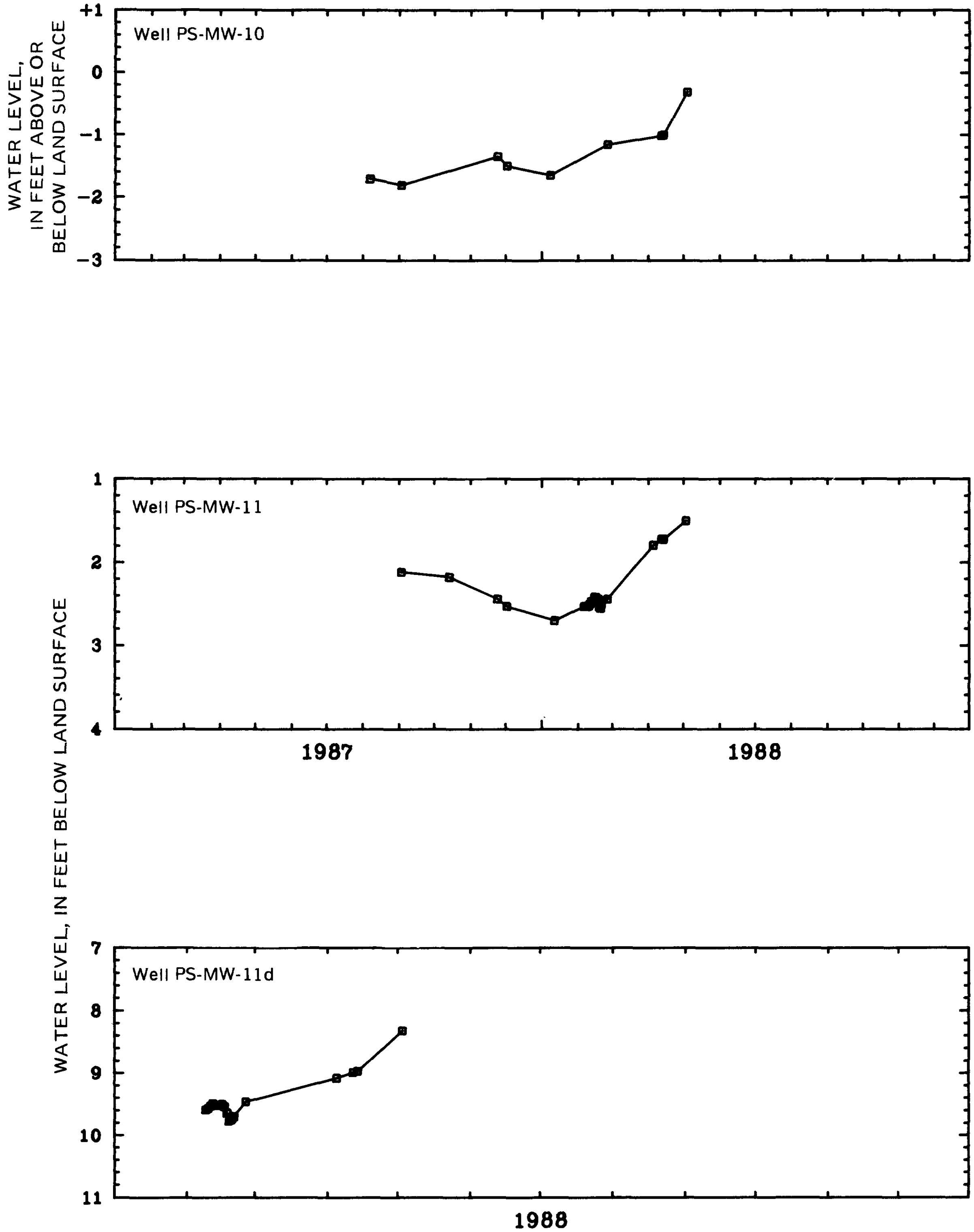


Figure 7.--Seasonal water-level fluctuations in observation and monitoring wells--Continued.

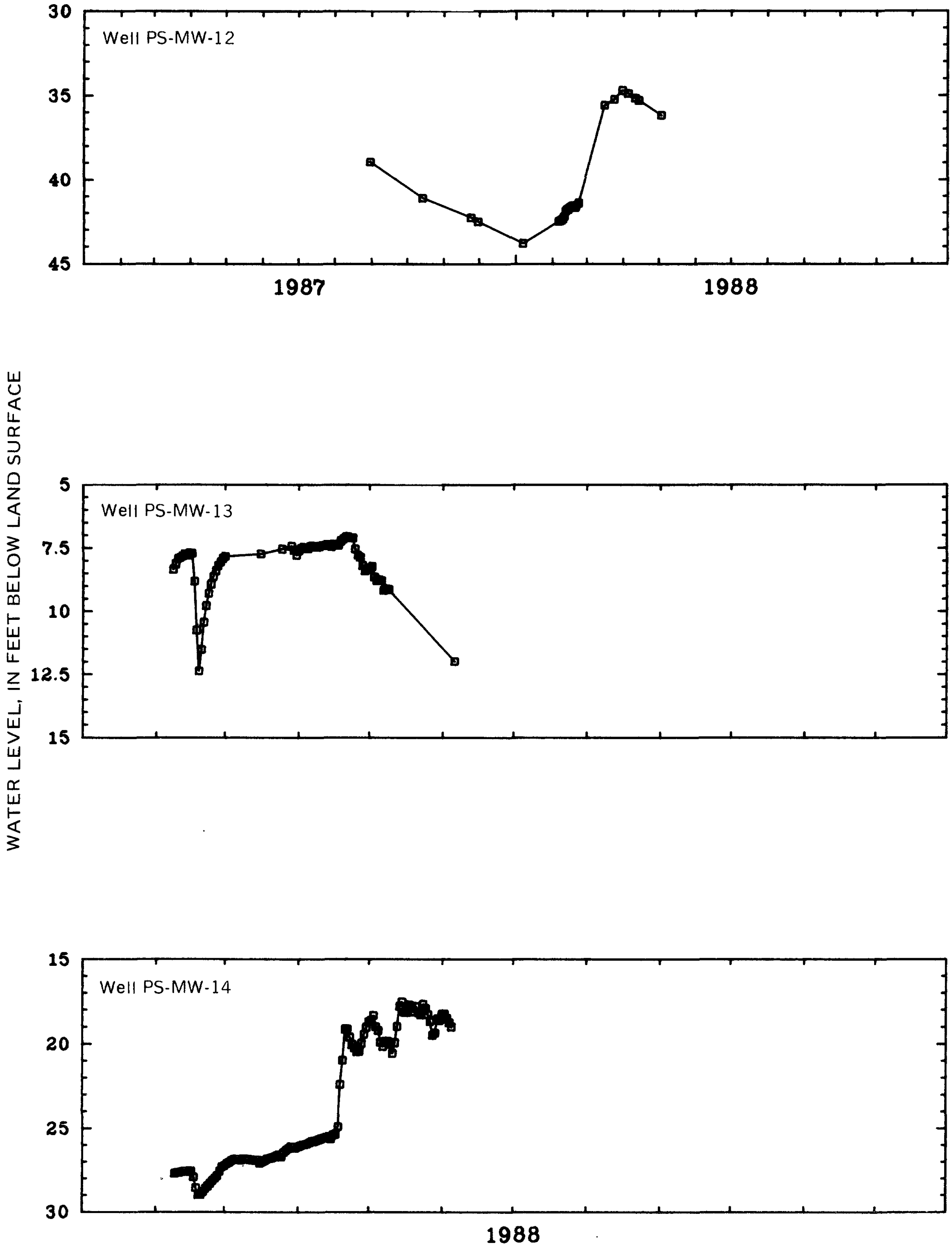


Figure 7.--Seasonal water-level fluctuations in observation and monitoring wells--Continued.

from more than 10 feet on February 25, 1988, to more than 14 feet on May 5, 1988, thus increasing the downward hydraulic gradient from 1 foot per 6 feet to about 1 foot per 4 feet of valley fill. Water levels in the Cartier well and in monitoring wells PS-MW-1d and PS-MW-14 also rose rapidly in the spring. The Cartier well and monitoring well PS-MW-14 are not located near Silver Creek, but the rises may be due to increased leakage from other small streams or irrigation ditches in the area. Water-level rises in monitoring well PS-MW-1d may be the result of upward leakage from the underlying consolidated rocks that receive recharge from nearby low-lying hills where the rocks crop out.

Water-level declines in the observation and monitoring wells generally are gradual and occur during several months in the fall and winter. Gradual water-level declines indicate discharge is a continual process throughout the year.

Therefore, water-level fluctuations are characterized by rapid water-level rises in the spring and summer followed by gradual declines during the fall and winter. Generally, water-level fluctuations are smaller in wells located further to the northeast of Silver Creek. This is most noticeable in monitoring well PS-MW-11 where the water level only varies by about 1 foot. However, water levels in monitoring well PS-MW-9, located in the City Park next to the Pace-Homer Ditch, respond rapidly and directly to the flow in the ditch. Similarly, monitoring well PS-MW-10, located near Silver Creek, east of the Prospector Square area, responds to the flow in the creek.

Hydraulic properties

The U.S. Geological Survey performed slug tests on 16 of the 18 monitoring wells installed as part of this study. A cylinder was lowered into the two-inch-diameter monitoring wells and when the water level in the well had returned to the original level, the cylinder was removed quickly and the recovering water levels were recorded at 2-second intervals using a pressure transducer and an electric data logger. The data were analyzed using methods described by Bouwer and Rice (1976) and Cooper and others (1967). The solution described by Bouwer and Rice (1976) is based on the assumption that the aquifer is isotropic; the solution omits storage in the aquifer, and treats the water table as a fixed, constant-head boundary. The solution described by Cooper and others (1967) is based on the assumption that the aquifer is confined, isotropic, and not leaky. The monitoring wells tested in the Prospector Square area represent partially-penetrating piezometers in an anisotropic, unconfined aquifer, and, therefore, an appropriate analytical solution to the boundary conditions does not exist. As a result, the values for hydraulic conductivity in table 5 have been rounded to the nearest whole number, and, in some instances, the values have been rounded to the nearest order of magnitude, due to the poor match of the data to the type curves.

The calculated values of hydraulic conductivity listed in table 5 were based on the thickness of the sand pack in the wells that varies in each monitoring well. The range of values for hydraulic conductivity, 1 to 14 feet per day, is representative of that for fine sand, silt, and mixtures of sand, silt, and clay. According to Chow (1964, p. 13-10), this range is indicative of slightly permeable aquifers, with 3 feet per day representing the transition value separating slightly permeable and permeable aquifers. Where the water-yielding material has a hydraulic conductivity of 3 feet per day or less, the predominant lithology is clay mixed with silt, fine sand, and gravel. Where the water-yielding material has a hydraulic conductivity of greater than 3 feet per day, the predominant lithology is the same, but layers of sand or sand and gravel may be present within the production interval.

The vertical hydraulic conductivity probably can be assumed to be at least 1 order of magnitude smaller than the horizontal hydraulic conductivity. Assuming 1 foot per day is a representative horizontal hydraulic conductivity for unsorted mixtures of clay, silt, sand, and gravel, then the vertical hydraulic conductivity probably would not be greater than 0.1 foot per day. This value could be considerably smaller where layers of clay are present.

Water in Consolidated Rocks

Consolidated rocks in the Prospector Square study area are an important source of water due to their large areal extent and ability, locally, to yield large quantities of water to wells. The consolidated rocks crop out or are covered by a thin layer of unconsolidated valley fill in the higher altitudes of the area and in a large part of the valley floor.

Extrusive igneous rocks of Tertiary age are present in the northeast corner of the study area but are not hydrologically important. However, most of the other consolidated rocks are fractured and water primarily moves along these fractures. Limestone, in which fractures have been enlarged by solution, yields the most water to wells.

Recharge

Recharge to the consolidated rocks is primarily from precipitation and stream infiltration and occurs in the high-altitude areas bordering the western and southwestern part of the study area. Most of the precipitation, which exceeds 40 inches per year in the highest parts of the contributing area, falls as snow during the winter and spring. Recharge to the consolidated rocks occurs after the soil has thawed sufficiently and has become saturated, thus allowing water to infiltrate through the veneer of soil.

Recharge to the consolidated rocks due to stream leakage also occurs in higher altitudes. Holmes and others (1986, p. 22) reported that this leakage can be inferred if the streamflow from a drainage basin is substantially smaller than the streamflow estimated from empirical equations incorparating drainage area and precipitaion. Thaynes Canyon Creek, which has its headwaters in the mountains west of the Prospector Square study area, generally has a smaller streamflow than would be expected based on drainage area and is probably a major source of recharge to the Thaynes Formation.

Movement

Water in the consolidated rocks generally moves from recharge areas at high altitudes to the discharge area at low altitudes. Water moves along faults and fractures rather than through the slightly permeable consolidated rocks. Drains and mine tunnels have changed the direction of ground-water movement in some consolidated rocks. In some parts of the consolidated rock adjacent to the tunnels, ground water now moves toward and discharges to these tunnels. Within the study area, not enough water-level information exists from the consolidated rocks underlying the unconsolidated valley fill to determine the direction of ground-water movement from one formation to another.

An upward vertical hydraulic gradient exists between the Woodside Shale and the overlying unconsolidated valley fill in the vicinity of the Pacific Bridge well. Water-level measurements at the Pacific Bridge well and the adjacent monitoring well, well PS-MW-2, indicate water-level differences of more than 10 feet during the winter months and more than 17 feet in early May (table 4).

A downward gradient in the unconsolidated valley fill, mentioned previously, and a possible upward gradient between consolidated rocks and the unconsolidated valley fill indicates the possible existence of a layer of well-sorted material at the base of the unconsolidated valley fill that can transmit water.

Discharge

Discharge from the consolidated rocks within the study area is primarily by springs, wells, and possible upward leakage to the unconsolidated valley fill. Several springs discharge from the Thaynes Formation at higher altitudes, but only one major spring, Dority Spring, has substantial discharge in the valley. When the Park Meadows well is not pumped, the flow from Dority Spring varies from about 0.5 to 2 cubic feet per second. The Park Meadows well, completed in the Thaynes Formation, is used when other sources for the municipal system do not provide enough water to meet demand. Discharge from the Park Meadows well may be as much as 1,200 gallons per minute. Due to the minimal transmissivity of and storage in the Woodside Shale that result in a small yield, the Pacific Bridge well is not used as a source of municipal water.

Seasonal water-level fluctuations

Seasonal water-level fluctuations in the consolidated-rock aquifers are related to recharge at high altitudes and hydraulic properties of the rocks. Water-level fluctuations in the Pacific Bridge well, completed in the Woodside Shale, are quite large. Data collected during this study indicate a seasonal change of 14 feet; data reported by Holmes and others (1986, p. 65) indicate a seasonal change of almost 23 feet. In contrast, seasonal fluctuations in the Park Meadows well completed in the Thaynes Formation are small. Water-level data collected by Holmes and others (1986, p. 65) indicate a seasonal variation of slightly more than 3 feet at a time when the Park Meadows well was not being pumped for municipal water.

Hydraulic properties

Previously reported transmissivity values for the Thaynes Formation (Holmes and others, 1986, p. 67), which are based on aquifer tests, ranged from 2,400 to 7,400 feet squared per day. Additional transmissivity values for rocks in the Propector Square study area include 360 feet squared per day for the Weber Quartzite, 280 feet squared per day for the Woodside Shale, 200 feet squared per day for the Nugget Sandstone, and 3 to 73 feet squared per day for the Tertiary extrusive igneous rocks (Holmes and others 1986, p. 67). No aquifer test data are available for the Park City Formation and the Ankareh Formation. Due to the lack of peripheral observation wells during the tests mentioned above, values for storage could not be determined.

Aquifer-Interference Test

As part of this study, an aquifer-interference test was completed to determine the possible effects of pumping the municipal Park Meadows well on the water levels in the unconsolidated valley fill overlying the Thaynes Formation and in the associated tailings. The primary question to be addressed was whether water in the unconsolidated valley fill underlying the Silver Creek tailings site could move toward and into the Thaynes Formation and possibly contaminate the water withdrawn from the Park Meadows well. An aquifer-interference test was designed that involved pumping the Park Meadows well for 72 hours followed by 72 hours of recovery. To help determine effects on water levels near the Park Meadows well, two additional monitoring wells (PS-MW-13 and PS-MW-14), located between the tailings area and the Park Meadows well, were drilled and completed near the base of the unconsolidated valley fill. In addition, three other monitoring wells (PS-MW-5d, PS-MW-7d, and PS-MW-11d), were completed at depths of 85, 96, and 138 feet in the unconsolidated valley fill underlying the tailings area. These five monitoring wells, the original 13 monitoring wells, the Pacific Bridge well, the Cartier well, pond and weir associated with Dority Spring, and the staff gage and Parshall flume on the Pace-Homer Ditch were monitored during the test (figs. 2 and 3).

Water levels were measured in all wells for 7 days prior to the test to establish water-level trends. Monitoring wells PS-MW-1d, PS-MW-13, and PS-MW-14 were equipped with pressure transducers and electronic data-loggers to obtain continuous measurements of water levels. Additional recorders were used to measure continuous gage height of the pond at Dority Spring and continuous discharge at the weir near Dority Spring. All other wells and the staff gage and flume on the Pace-Homer Ditch were measured every 2 hours during the first 12 hours of the test, every 4 hours for the next 24 hours, and about every 12 hours for the remaining 36 hours. All recorders were operated for several days after the pump in the Park Meadows well was shut off; periodic measurements also were made at the other data-collection sites during this time.

No major problems occurred during the test. The pump maintained a discharge rate of about 1,200 gallons per minute during the test except when the pump shut down for about 2 hours after about 45 hours of pumping. The water level in the Park Meadows well recovered slightly (fig. 8); but similar rises were not measured at other wells. Weather conditions were ideal throughout the test. Cool temperatures prevented excessive melting of snow that could have made it difficult to determine some of the effects on the streams in the area.

Water levels measured before, during, and after the pumping period (fig. 8) indicate that water levels in the Cartier well and monitoring wells PS-MW-13 and PS-MW-14 were definitely affected by the pumping of the Park Meadows well. The greatest decline, about 5 feet, was recorded at monitoring well PS-MW-13. The water level in monitoring well PS-MW-14 declined about 2

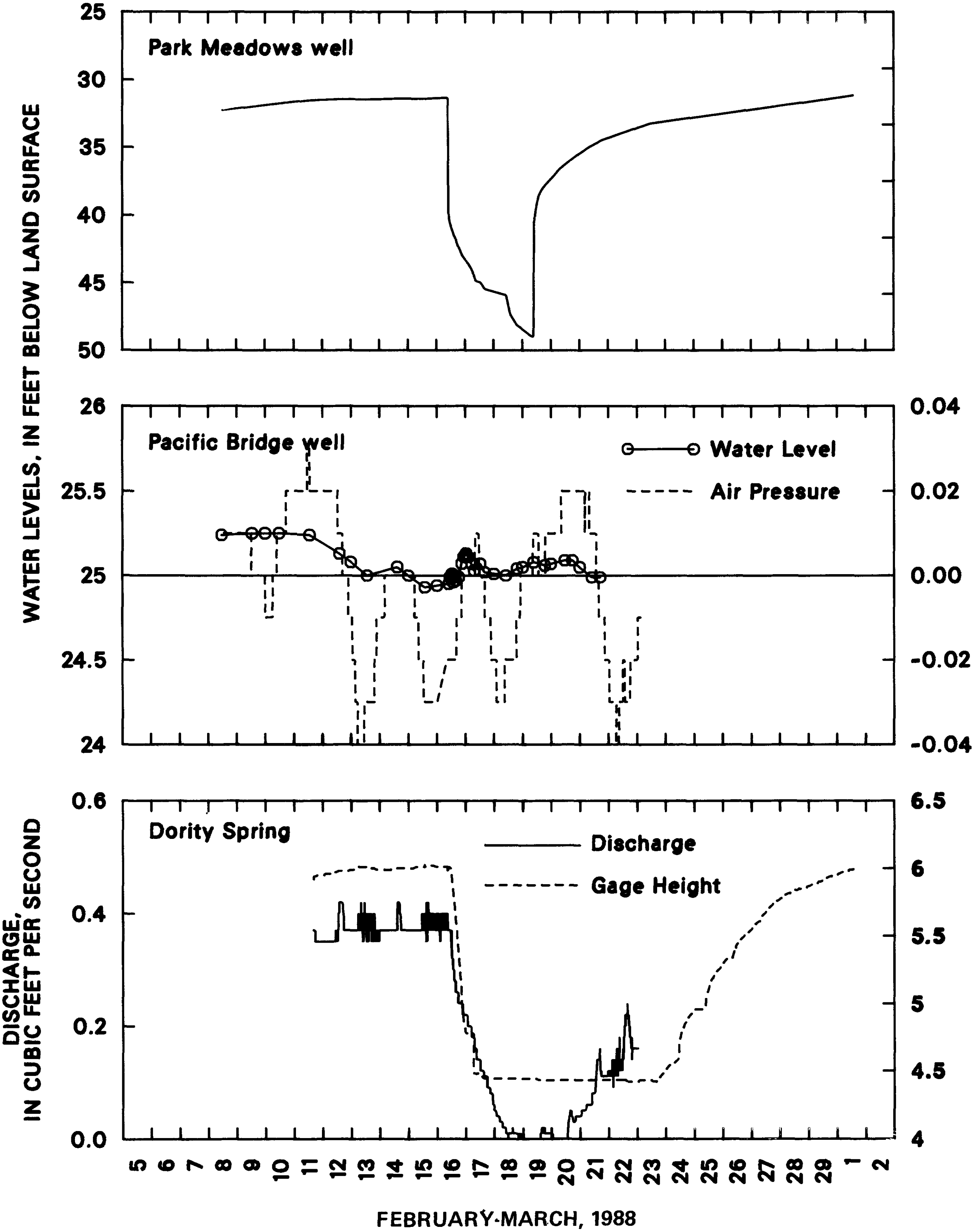


Figure 8.--Fluctuations during the aquifer-interference test at the various data-collection sites.

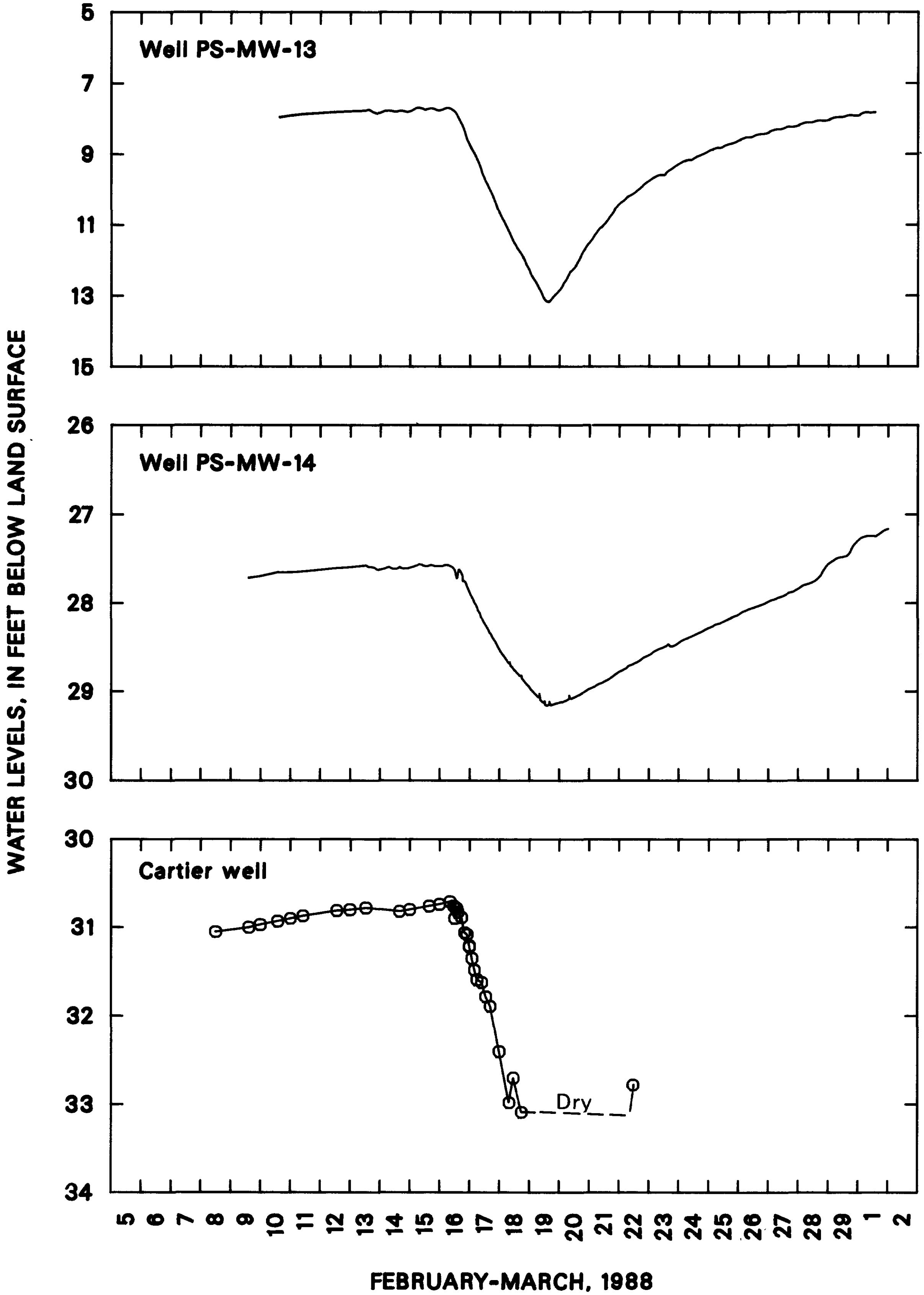


Figure 8.--Fluctuations during the aquifer-interference test at the various data-collection sites--Continued.

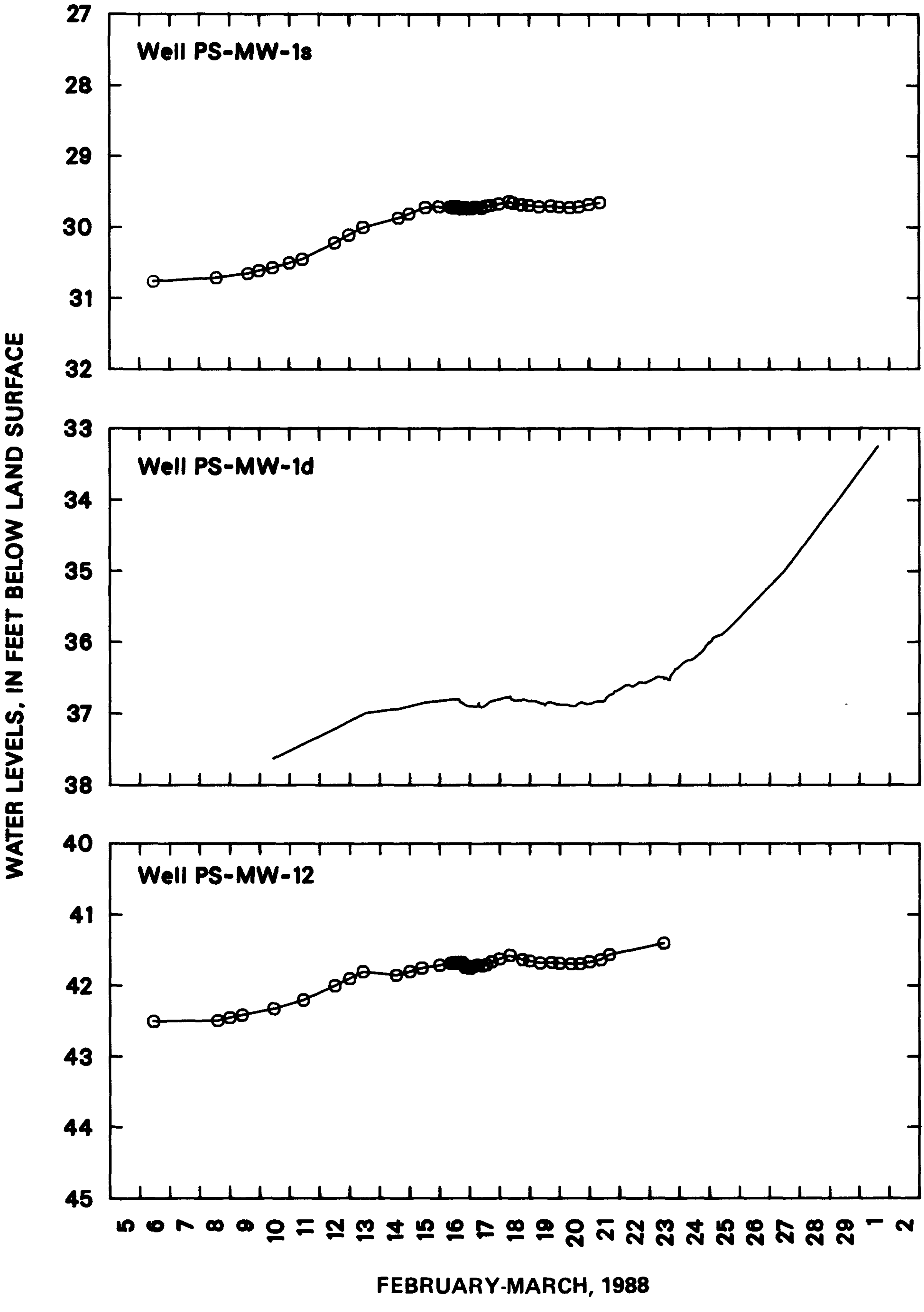
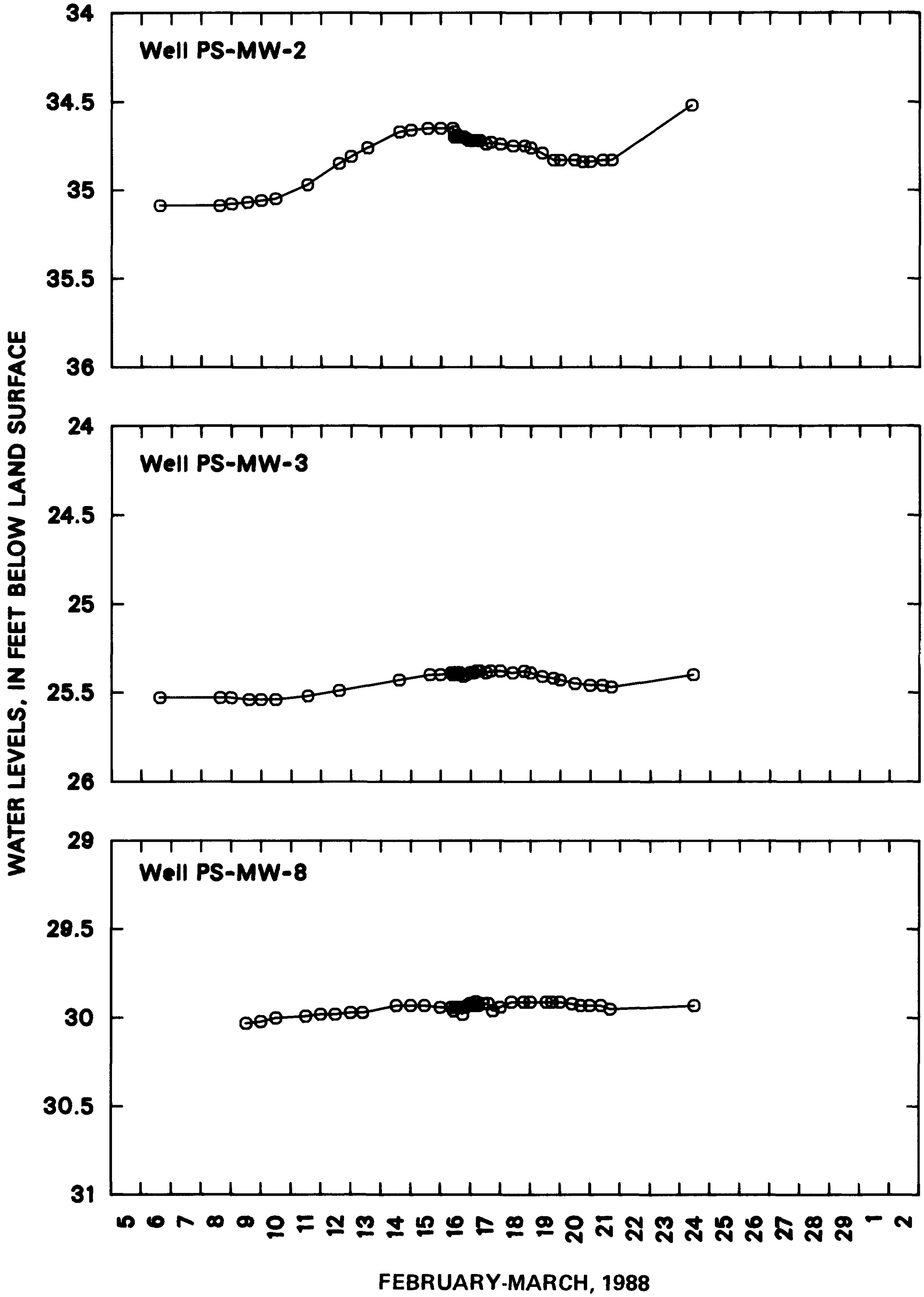


Figure 8.--Fluctuations during the aquifer-interference test at the various data-collection sites--Continued.



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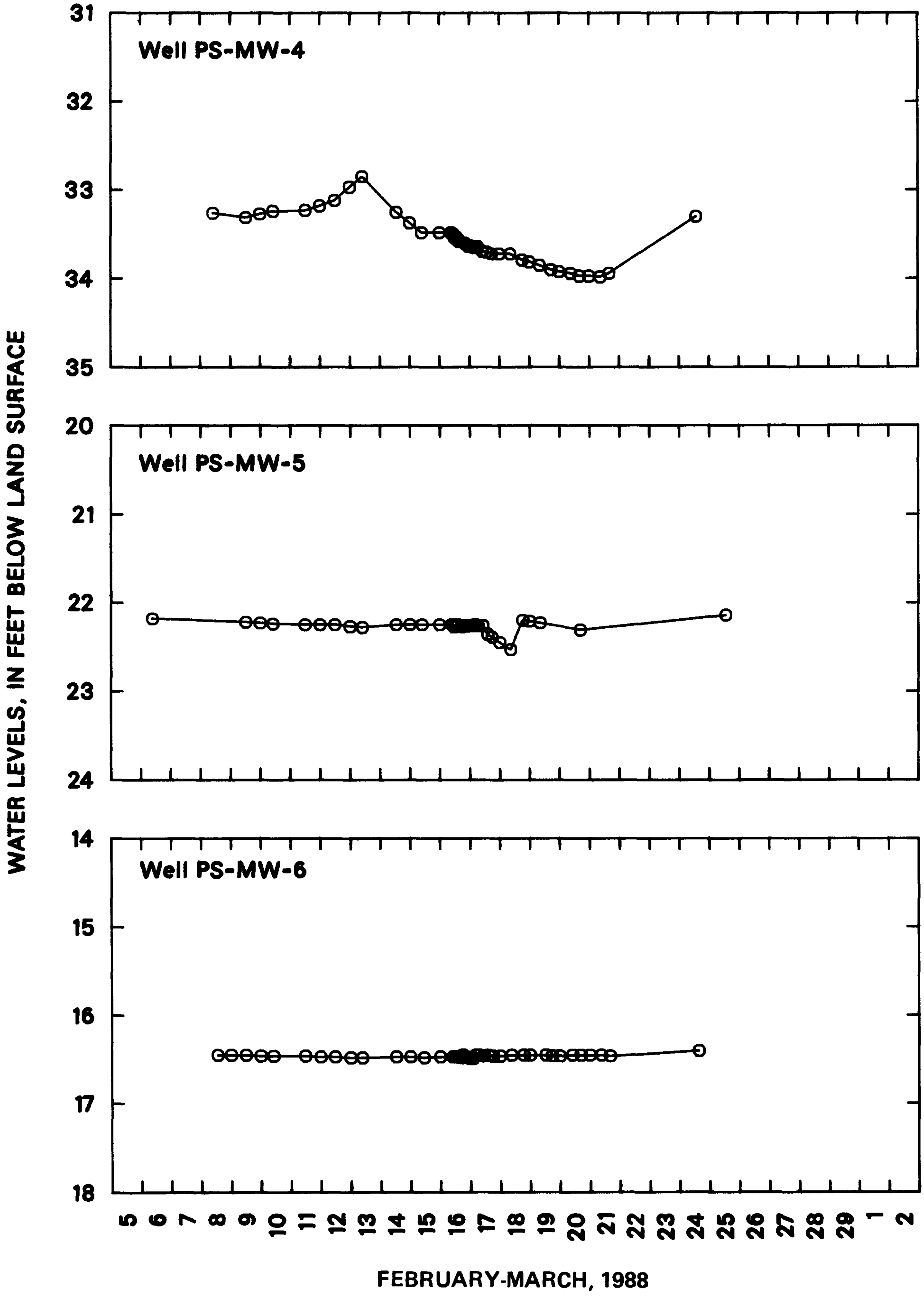

Figure 8.--Fluctuations during the aquifer-interference test at the various data-collection sites--Continued.

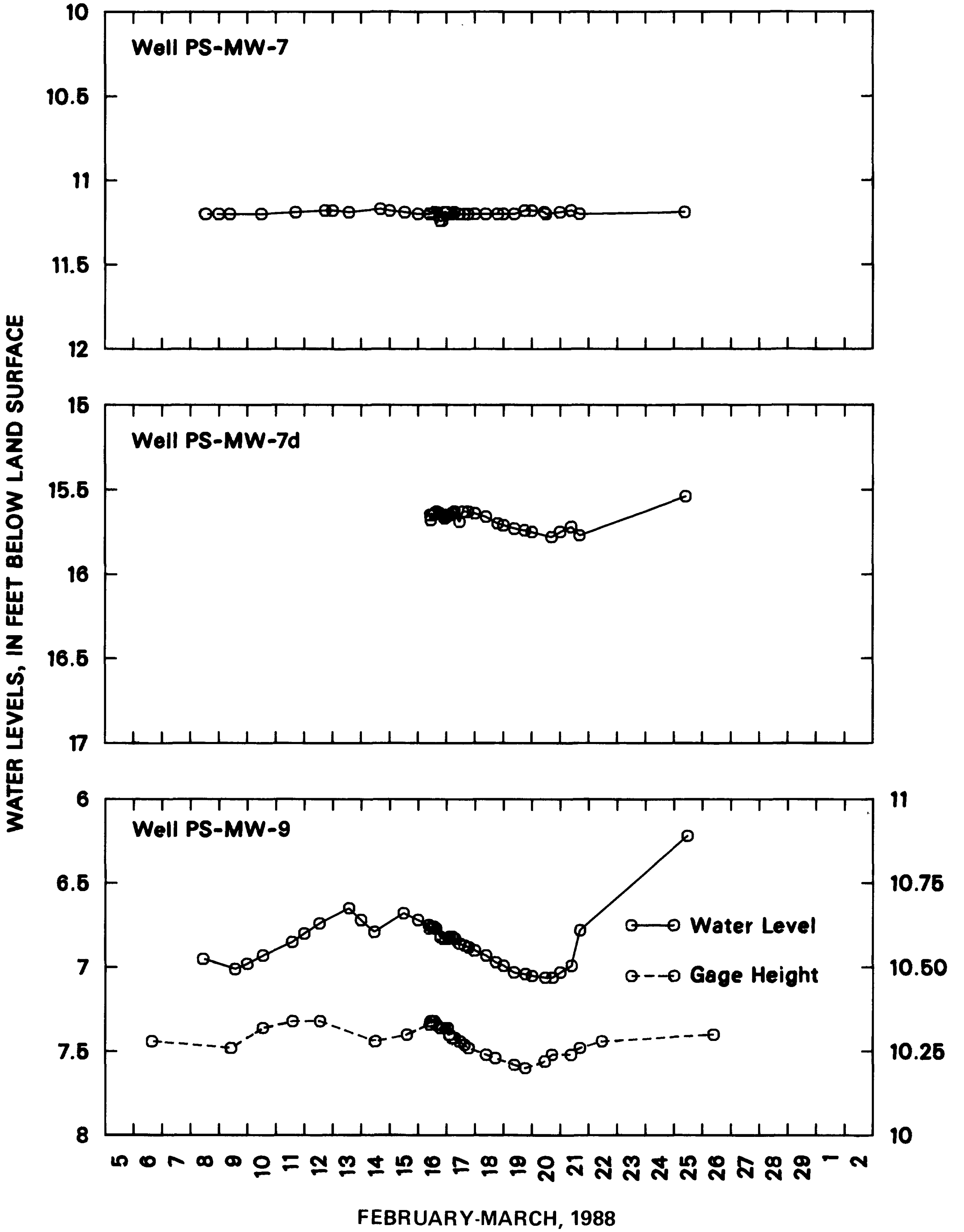

Figure 8.--Fluctuations during the aquifer-interference test at the various data-collection sites--Continued.

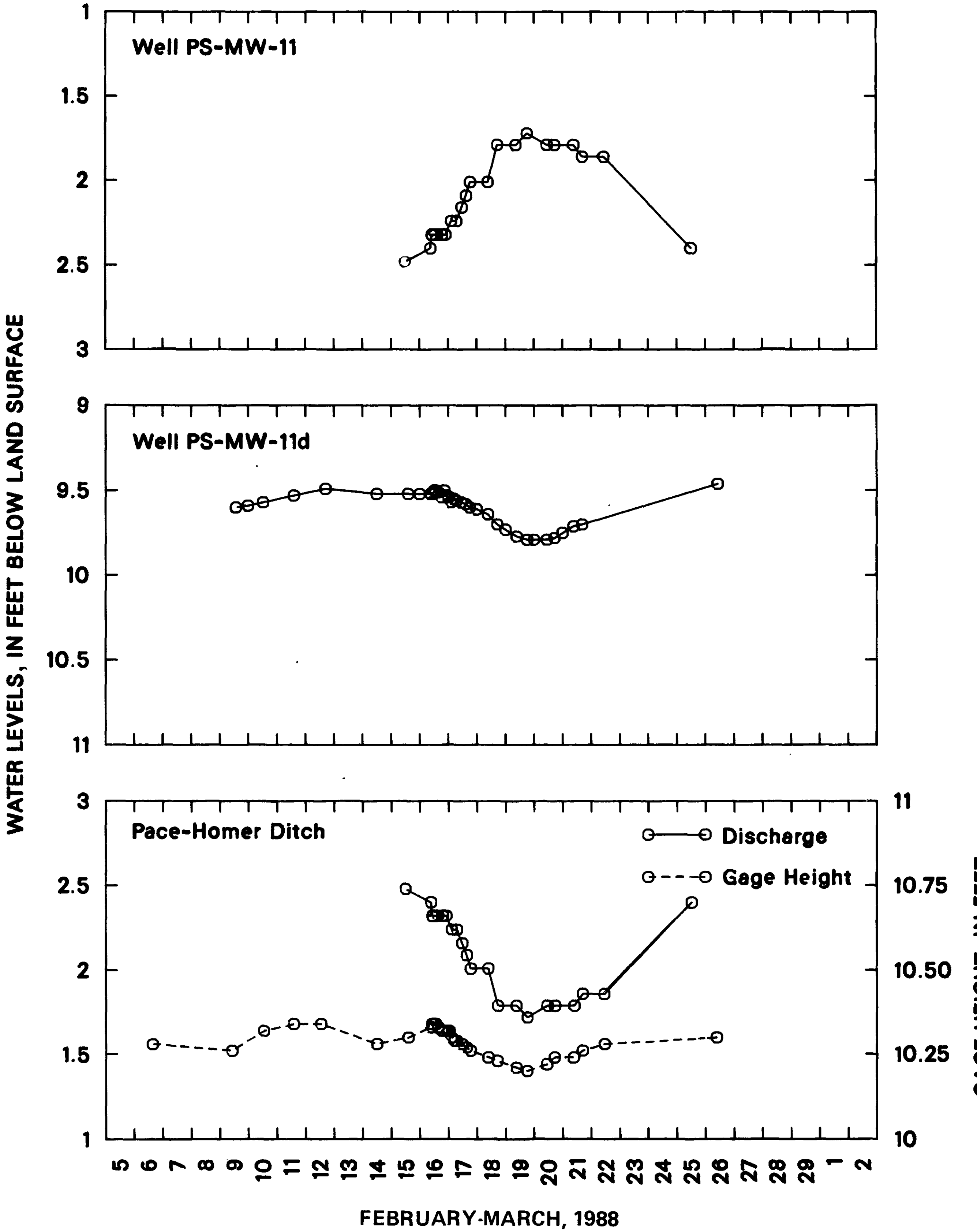

Figure 8.--Fluctuations during the aquifer-interference test at the various data-collection sites--Continued.

feet as did the level in the Cartier well, which became dry on the second day of the test and remained dry for about 48 hours after pumping ceased.

The pond at Dority Spring became dry, and discharge ceased at the weir during the 72-hour test. Due to pumping of the Park Meadows well, the water level in the Thaynes Formation was lowered such that discharge from the spring ceased after about 48 hours. After the pump was turned off, about 24 hours elapsed before discharge from the spring resumed. Spring discharge measured at the weir, about 150 feet downstream from the pond, resumed more than 72 hours before water began appearing in the pond because an underground pipe intercepts some discharge underneath the pond and delivers it to the channel downstream.

Water-level changes in the Pacific Bridge well and in monitoring well PS-MW-1d were the result of changes in barometric pressure. When fluctuations in barometric pressure (plotted as the inverse of equivalent feet of water) and water levels are plotted a graph (fig. 8), both curves follow the same trends of high and low values. Thus, when peaks on the graph coincide, water levels are high in response to low barometric pressure.

To determine any effects of pumping in the Pace-Homer Ditch, both the staff gage near monitoring well PS-MW-11 and the Parshall flume were monitored throughout the test. During the test, the water level in the Pace-Homer Ditch declined by 0.14 foot as measured at the staff gage. Flow in the Pace-Homer Ditch decreased by 0.6 cubic foot per second, of which about 0.4 cubic foot per second was due to the elimination of discharge from Dority Spring. The remaining 0.2 cubic foot per second possibly may have been due to a decrease in discharge from the unconsolidated valley fill and the Thaynes Formation into the Pace-Homer Ditch.

Monitoring well PS-MW-9, located in the City Park at the downgradient end of the Prospector Square study area, was affected during the test. Due to its close proximity to the Pace-Homer Ditch, water-level changes in this well are a direct result of decreased flow in the ditch. This relation is shown graphically in the plot that compares the water level in monitoring well PS-MW-9 to the gage height as measured at the staff gage on the Pace-Homer Ditch (fig. 8).

Small fluctuations in monitoring wells PS-MW-1s, PS-MW-1d, PS-MW-2, PS-MW-3, PS-MW-4, PS-MW-7d, and PS-MW-11d may have been due to pumping of the Park Meadows well. However, changes in recharge due to surface runoff of melting snowpack prior to the test and the lack of runoff during the test, also may have had some effect on water levels in these wells, but data were insufficient to identify the specific causes.

Effects due to pumping of the Park Meadows well appear to be limited to the unconsolidated valley fill overlying the Thaynes Formation. Monitoring wells in Prospector Square completed in the unconsolidated valley fill overlying the Woodside Shale appparently are not affected by the pumping. Therefore, the pumping of the Park Meadows well does not cause water-level declines in the Woodside Shale and the overlying unconsolidated valley fill. Water-level declines in the unconsolidated valley fill overlying the Thaynes Formation are not sufficiently large to affect water levels in the unconsolidated valley fill overlying the Woodside Shale.

WATER QUALITY

Surface Water and Stream Sediment

Five surface-water sampling sites were established to monitor the quality of surface water flowing through the tailings site (fig. 2). On both Silver Creek and the Pace-Homer Ditch, surface water was sampled upstream and downstream from the tailings site; surface water also was sampled at a fifth site located downstream from the point where water from the Pace-Homer Ditch can be diverted into Silver Creek. Samples were collected at high, medium, and low flows during this study; however, because the snowpack and runoff were less than normal during 1987 and early 1988, flows during this study probably were not representative of long-term average flows.

During sampling, filtered samples were collected for the analysis of dissolved constituents and unfiltered samples were collected for the analysis of total constituents. Grab samples were collected rather than an integrated sample due to small cross-sectional area of flow in the stream and ditch. Sediment samples also were collected from the banks of the stream and ditch at the surface-water/air contact. Instantaneous stream discharge, specific conductance, pH, temperature and alkalinity were measured at each sampling site (table 6). Bicarbonate and carbonate concentrations included in table 6 were calculated from field alkalinity data, except where noted.

The chemical composition of water in both Silver Creek and the Pace-Homer Ditch varies between spring and summer. Specific conductance generally is larger in Silver Creek than the Pace-Homer Ditch (table 6). During the spring, pH is larger and alkalinity is smaller in Silver Creek than in the Pace-Homer Ditch. However, during the summer, pH and alkalinity are similar in both drainages.

During high flows in the spring, the major ions in Silver Creek are sodium and chloride, but during low flows in the summer, the major ions are calcium and sulfate (table 7). The larger concentrations of sodium and chloride in the spring may be the result of surface runoff of water containing dissolved road salt. During the spring, the major ions in the Pace-Homer Ditch are calcium and bicarbonate. During the summer, the bicarbonate concentration (table 6) decreases and becomes approximately equal to the sulfate concentration. The decrease in bicarbonate is a result of decreased discharge from the Thaynes Formation at Dority Spring caused by withdrawals from the Park Meadows well.

The water at the sampling site on Silver Creek downstream from Prospector Square (fig. 2) consists of water from several sources, and generally reflects the water chemistry of the primary source at the time of sampling. During surface-water sampling in April 1987 and in April 1988, both Silver Creek and the Pace-Homer Ditch contributed water for the combined site. As expected, specific conductance, pH, and alkalinity were less during both April samplings than during the low-flow sampling in July 1987, when Silver Creek was dry downstream from Wyatt Earp Drive.

Despite more than 2 cubic feet per second of flow in the Pace-Homer Ditch, practically all of this water continued down the ditch with only a small quantity leaking into Silver Creek. Therefore, in July 1987, water at the site on Silver Creek downstream from Prospector Square appears to be from drain PS-DR-1, which discharges into Silver Creek downstream from the City Park.

Chemical analyses of filtered water collected from surface-water sites indicated that concentrations of dissolved cadmium, manganese, and zinc were greater than background concentrations only during low-flow conditions (table 7). Concentrations of dissolved cadmium, manganese, and zinc that were greater than background were not detected during low flow at the upstream site on Silver Creek at Bonanza Drive; but the water collected during low flow from Silver Creek at Wyatt Earp Drive had concentrations of dissolved manganese and zinc that were about 10 times greater than concentrations measured during average or high flow. Similarly, the dissolved-cadmium concentration at this site was about 15 micrograms per liter at low flow; whereas, only about 2 micrograms per liter cadmium was detected during high flow.

Water collected at the site on Silver Creek downstream from Prospector Square also had concentrations of dissolved manganese and zinc that were greater than background concentrations along with a detectable concentration of dissolved cadmium during low flow; however, the concentrations were less than those at the site at Wyatt Earp Drive. As mentioned above, Silver Creek was dry downstream from Wyatt Earp Drive, and the primary source for the water at the site on Silver Creek downstream from Prospector Square appears to have been drain PS-DR-1. Similar values of specific conductance and alkalinity along with similar concentrations of dissolved cadmium, manganese, and zinc in water at the site on Silver Creek downstream from Prospector Square and in water from drain PS-DR-1 support the conclusion that little or no water was being contributed by flow in the Pace-Homer Ditch.

Chemical analyses of unfiltered water (table 8) collected at the surface-water sites had concentrations similar to those detected in the filtered water (table 7). The only substantial differences are the much greater concentrations of total iron and lead in unfiltered samples collected at the three sites along Silver Creek. During the first round of surface-water sampling in April 1987, total-iron and total-lead concentrations were largest at the upstream site at Bonanza Drive and decreased downstream. The concentrations of these constituents also decreased in subsequent rounds of sampling at all sites on Silver Creek. Therefore, the suspended iron and lead in the water appears to be due to a disturbance of surficial deposits upstream prior to the first round of sampling, which was not repeated prior to later rounds of sampling.

Chemical analyses of stream sediment are presented in table 9 (Supplemental Data Section at back of report). Varying concentrations of all selected metals were present, with the largest concentrations being total-recoverable iron, lead, manganese, and zinc. No distinct pattern among sites and sampling rounds is apparent. Sediment from the site on the Pace-Homer Ditch downstream from Prospector Square had concentrations similar to the sites on Silver Creek, indicating that the ditch, like Silver Creek, is probably cut through tailings.

Ground Water

Ground-water samples for chemical analysis were collected on four occasions. The first sampling was at the end of August and the beginning of September 1987, before ground-water levels had begun the seasonal decline (fig. 7). Subsequent sampling rounds were at the beginning of December 1987, the end of February 1988, and the middle of April 1988. Ground-water levels were at a minimum for the two rounds of sampling during the winter. In contrast, the overall ground-water levels were near their yearly highs during the April sampling.

The ground-water sampling procedure involved several specific tasks. Water-level measurements were made to determine the volume of water within the well casing. Three to five casing volumes of water subsequently were pumped from the well. During the first round of sampling, all purged water was placed in containers pending the results of the chemical analyses. Specific conductance, pH, and temperature were measured at all sites during each sampling round.

During the first round of sampling, alkalinity values determined at the sampling sites were compared to values of alkalinity determined in the laboratory. Both values compared favorably for water from all wells; and therefore, alkalinity determinations at the sampling sites were eliminated during the remaining rounds. Filtered samples were collected to determine concentrations of most dissolved constituents. Filtered and unfiltered samples were collected to determine concentrations of chloride and sulfate. The U.S. Geological Survey laboratory uses filtered water for chloride and sulfate determinations. In contrast, the State laboratory and the contract laboratories of the U.S. Environmental Protection Agency used unfiltered water for determinations of these constituents. Unfiltered samples were collected to determine values of alkalinity and concentrations of cyanide.

Large pH values in water from two monitoring wells, wells PS-MW-13 and PS-MW-14, indicated that the grout used in well installation moved around the bentonite seal and impregnated the sand pack. Therefore, these wells were not sampled to determine the quality of water due to the uncertainty of the results.

Chemical analyses of the water collected from the monitoring wells and drains indicate that the concentrations of major ions vary areally and vertically within the unconsolidated valley fill (table 10 in Supplemental Data Section at back of report). In water from most of the monitoring wells and drains, the prevalent ions were calcium and sulfate, except in a few wells where sodium and chloride predominated. In water from monitoring well PS-MW-1s, the concentration of sodium was similar to the concentration of calcium, and the concentration of chloride was much greater than the concentration of sulfate. As expected, the specific conductance of the water in this well was large due to the dissolved-solids concentration. The anomalous dissolved-solids concentration in water from this well compared to water from other wells in the Prospector Square area may be due to the storage of snow removed from city streets at this location. Road salt contained in the snow probably dissolved as the snow melted in the spring and the resulting melt water containing large concentrations of sodium and chloride infiltrated into the unconsolidated valley fill.

Water from monitoring well PS-MW-1d, which is next to monitoring well PS-MW-1s, also had a chloride concentration in excess of that of sulfate, but the concentration of sodium was much less than that of calcium. Concentrations similar to those in water from monitoring well PS-MW-1d were detected in water from monitoring well PS-MW-2, and concentrations similar to those in water from monitoring well PS-MW-1s were detected in water from monitoring well PS-MW-3, but to a lesser degree. Monitoring well PS-MW-3 is located adjacent to Kearns Boulevard and water in this well also may be affected by the infiltration of water containing sodium and chloride from road salt. The monitoring wells that were completed near the base of the unconsolidated valley fill, with the exception of well PS-MW-1d, generally yield water with small specific conductance values and pH values greater than 7.0. These monitoring wells include wells PS-MW-5d, PS-MW-7d, PS-MW-11d, and PS-MW-12. The water from these wells, similar to that from wells completed in the shallow unconsolidated valley fill, had calcium and sulfate as the most prevalent ions, but in much smaller concentrations. The small dissolved-solids concentrations in water derived from the base of the unconsolidated valley fill beneath the Silver Creek tailings site may indicate that ground water in the shallow unconsolidated valley fill does not appear to move downward even though the hydraulic gradient is downward. If water from the shallow unconsolidated valley fill is moving downward, then the quantity of water is probably small and it is diluted at depth.

Concentrations greater than background concentrations for dissolved zinc were detected in water from six monitoring wells and one drain, and concentrations greater than background concentrations for dissolved manganese were detected in water from three monitoring wells and both drains. The dissolved-zinc concentration in water from monitoring wells PS-MW-4, PS-MW-5, and PS-MW-10 varied seasonally with the largest concentrations coinciding with high ground-water levels. The dissolved-manganese concentration in water from monitoring wells PS-MW-4, PS-MW-5, PS-MW-10, and drain PS-DR-2 also varied seasonally, but, unlike zinc, the largest concentrations coincided with the lowest ground-water levels. However, the dissolved-manganese concentration in water from monitoring well PS-MW-10 followed the same pattern as that for dissolved zinc with the largest concentration coinciding with high ground-water levels. The large dissolved-zinc concentrations may be related to the influx of water during the spring months with slightly smaller pH and more dissolved oxygen. Zinc may be more soluble under these conditions. In contrast, the larger dissolved-manganese concentrations may be related to reducing conditions during the winter months, which coincide with low ground-water levels. This is evident in water from drain PS-DR-2, where the concentrations of iron and manganese were large in December 1987.

Cadmium was present in water from six monitoring wells and one drain, with larger concentrations detected in water from monitoring well PS-MW-8 and drain PS-DR-1. Arsenic and lead were present only in water from monitoring well PS-MW-10, which is located in close proximity to Silver Creek downstream from Prospector Square. Because arsenic and lead were not present in water from any of the other monitoring wells, their presence at this location may be due to exposed tailings, just upgradient from the well. An additional source of arsenic may be the water from the Pace-Homer Ditch, which had dissolved-arsenic concentrations more than 10 micrograms per liter (table 7).

All of the selected metals are present in tailings and stream deposits throughout the Prospector Square study area with concentrations of iron, lead, manganese, and zinc being the largest. The concentration of these metals could increase in both surface and ground water in the future if the pH of the water were to decrease substantially from the present ranges of 7.4 to 8.6 for surface water and 6.0 to 7.6 for ground water.

CONCLUSIONS

The unconsolidated valley fill in the Prospector Square area consists of poorly sorted deposits of clay, silt, sand, gravel, and cobbles. Clay mixed with fine sand and intermittent layers of interbedded gravel are most prevalent. Estimates of horizontal hydraulic conductivity in the unconsolidated valley fill computed from the results of slug tests ranged from 1 to 14 feet per day. On the basis of lithologic logs and computed values of horizontal hydraulic conductivity, the vertical hydraulic conductivity would be at least 1 order of magnitude smaller than the horizontal hydraulic conductivity.

During the aquifer-interference test, effects of pumping the Park Meadows well on water levels were observed at Dority Spring, which resulted in decreased flow in the Pace-Homer Ditch; lower water levels in monitoring wells PS-MW-13 and PS-MW-14, and in the Cartier well; and in the possible decrease in ground-water discharge to the Pace-Homer Ditch. Water-level fluctuations in the Pacific Bridge well were primarily caused by fluctuations in barometric pressure, and water-level fluctuations in monitoring well PS-MW-9 were primarily due to fluctuations in the flow in the Pace-Homer Ditch.

On the basis of present (1988) hydrologic conditions in the unconsolidated valley fill, such as hydraulic gradient, horizontal and vertical hydraulic conductivity, and the present distribution of ground-water withdrawal from the consolidated rocks, water underlying the tailings area does not appear to be moving toward the Park Meadows well and would not do so under present pumping conditions. This is primarily due to the direction of the hydraulic gradient, which is away from the Park Meadows well.

Filtered and unfiltered water and stream-sediment samples were collected. Concentrations greater than background concentrations for dissolved cadmium, manganese, and zinc were detected only during low-flow conditions in Silver Creek. No concentrations of dissolved constituents greater than background concentrations were detected at the upstream site on Silver Creek. Chemical analyses of unfiltered water indicated this water contained similar concentrations to those detected in filtered water for all constituents except for much larger concentrations of suspended iron and lead, which decreased downstream along Silver Creek. The concentrations of suspended iron and lead decreased in subsequent rounds of sampling and, therefore, may have been due to a disturbance of surficial deposits upstream prior to the first round of sampling, which was not repeated before later sampling rounds.

Chemical analyses of stream sediment from four surface-water sites indicated the presence of all selected metals. Total-recoverable iron, lead, manganese, and zinc were detected in the largest concentrations. Patterns of stream-sediment composition were not apparent between sampling rounds and sites.

Water in the unconsolidated valley fill had concentrations of dissolved cadmium, manganese, and zinc greater than background concentrations in water from six monitoring wells and a drain within the Silver Creek tailings site. In water from two monitoring wells near Silver Creek, large dissolved-zinc concentrations and small dissolved-manganese concentrations coincided with high ground-water levels; whereas, small dissolved-zinc and large dissolved-manganese concentrations coincided with low ground-water levels. In water from a monitoring well located close to Silver Creek downstream from Prospector Square, large dissolved-manganese and dissolved-zinc concentrations coincided with high ground-water levels. Arsenic and lead also were present in water from this well; however, these constituents were not detected in water from any of the other monitoring wells within the Prospector Square area. The presence of arsenic and lead in the ground water may be due to exposed tailings, just upgradient from this well. The presence of arsenic also may be due to infiltration of water from the Pace-Homer Ditch, which contained more than 10 micrograms per liter dissolved arsenic.

The mill tailings were penetrated sporadically during the test drilling. Chemical analyses of tailings samples collected from three of the nine monitoring wells completed in the area of mill tailings indicated concentrations of metals similar to concentrations in stream-sediment samples. All metals of concern were detected; iron, lead, manganese, and zinc concentrations were the largest. Because all metals of concern were detected in the tailings and stream sediments, the concentrations of these metals in surface and ground water could increase in the future if the pH of the water decreases substantially from the present values of about 7 (neutral).

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SUPPLEMENTAL

DATA

Table 1.--Selected data for 3 observation wells and 18 monitoring wells

Altitude of land surface: Surveyed altitudes given in feet and decimal fractions; altitudes interpolated from U.S. Geological Survey topographic maps given to nearest foot.
Screened interval: Upper and lower limits of screen given in feet below land surface, P indicates perforated casing.
Production interval: Upper and lower limits of the well that are open to the aquifer material, given in feet below land surface.
Principal water-yielding unit: Trt, Thaynes Formation; Trw, Woodside Shale; Qa, unconsolidated valley fill.
Tailings interval: Upper and lower limits of tailings given in feet below land surface.
Other available data: C, water-quality data in table 9; L, lithologic logs in table 2; and W, water-level data in table 3.

Well identfier	Depth of borehole (feet)	Altitude of land surface (feet)	Screened interval (feet)	Production interval (feet)	Principal water-yielding unit	Tailings interval (feet)	Other available data
			OBSERVATION WELLS				
Park Meadows well (D-2-4)8aaa-1	320	6,751.75	100-113(P)	[1]100-165	Trt	--	L,W
Pacific Bridge well (D-2-4)9aac-1	446	6,758.53	300-446(P)	300-446	Trw	--	L,W
Cartier well (D-2-4)4dcc-1	33	6,750.22	--	--	Qa	--	L,W
			MONITORING WELLS				
PS-MW-1s (D-2-4)9bdd-1	47.0	6,791.87	35.0-40.0	32.5-45.5	Qa	--	C,L,W
PS-MW-1d (D-2-4)9bdd-2	85.5	6,791.06	70.0-80.0	62.0-80.0	Qa	--	C,L,W
PS-MW-2 (D-2-4)9aac-2	44.5	6,758.44	33.0-38.0	29.0-44.5	Qa	--	C,L,W
PS-MW-3 (D-2-4)9aab-1	36.0	6,743.35	25.5-30.5	19.0-35.5	Qa	1.0-2.0	C,L,W
PS-MW-4 (D-2-4)9adc-1	45.0	6,773.42	34.0-39.0	17.0-45.0	Qa	--	C,L,W
PS-MW-5 (D-2-4)10bcb-1	34.0	6,741.04	23.0-28.0	20.0-33.0	Qa	0.6-1.4 4.5-9.0	C,L,W
PS-MW-5d (D-2-4)10bcb-2	95.5	6,741.99	83.0-93.0	81.0-95.0	Qa	do	C,L,W
PS-MW-6 (D-2-4)10bbc-1	29.0	6,731.48	19.0-24.0	14.0-29.0	Qa	--	C,L,W
PS-MW-7 (D-2-4)10bba-1	25.5	6,722.46	15.5-20.5	11.5-25.5	Qa	--	C,L,W
PS-MW-7d (D-2-4)10bba-2	138.0	6,722.59	120.0-130.0	116.0-134.0	Qa	--	C,L,W
PS-MW-8 (D-2-4)9aac-3	40.5	6,751.41	28.5-33.5	19.5-40.0	Qa	--	C,L,W
PS-MW-9 (D-2-4)10bab-1	16.5	6,707.90	8.5-13.5	5.0-15.5	Qa	1.5-2.0 2.4-3.5	C,L,W
PS-MW-10 (D-2-4)3dcd-1	13.0	6,680	6.0-11.0	4.9-11.5	Qa	--	C,L,W

Table 1.--Selected data for 3 observation wells and 18 monitoring wells--Continued

Well identfier	Depth of borehole (feet)	Altitude of land surface (feet)	Screened interval (feet)	Production interval (feet)	Principal water-yielding unit	Tailings interval (feet)	Other available data
PS-MW-11 (D-2-4)3ccd-1	21.5	6,711.19	10.0-15.0	3.5-20.0	Qa	--	C,L,W
PS-MW-11d (D-2-4)3cdc-1	85.0	6,715.89	69.8-79.8	66.0-79.8	Qa	--	C,L,W
PS-MW-12 (D-2-4)9acc-1	125	6,797.70	110.0-120.0	98.5-120.0	Qa	--	C,L,W
PS-MW-13 (D-2-4)4dcb-1	61.0	6,728.42	41.0-51.0	38.0-52.0	Qa	--	C,L,W
PS-MW-14 (D-2-4)4dcc-2	75.0	6,712.44	48.5-58.5	43.0-63.5	Qa	--	C,L,W

[1] Although the completed well was originally 320 feet deep, a recent televiewer log shows that the borehole wall has caved in the uncased part of the well below a depth of 113 feet.

Table 2.—Chemical analyses of total-recoverable metals from tailings
[Constituents in parts per million; State, Utah Department of Health; USGS, U.S. Geological Survey; dashes indicate no data; >, greater than]

Location:	Monitoring well PS-MW-3	Monitoring well PS-MW-5	Monitoring well PS-MW-5
Tailings Interval:	1.0-2.0 feet	1.0-1.5 feet	4.5-5.5 feet
	State	State	State
Arsenic	380	410	480
Barium	210	94	57
Cadmium	190	83	88
Chromium	57	36	31
Copper	710	680	570
Iron	22,000	20,000	17,000
Lead	13,000	6,800	9,300
Manganese	2,000	2,100	2,400
Mercury	3.7	4.5	4.3
Silver	67	52	57
Zinc	23,000	16,000	17,000

Location:	Monitoring well PS-MW-5		Monitoring well PS-MW-5	Monitoring well PS-MW-5	
Tailings Interval:	5.5-7.0 feet		7.5-9.0 feet	1.5-2.0 feet	
	State	USGS	State	State	USGS
Arsenic	380	470	400	460	390
Barium	59	290	120	14	300
Cadmium	92	77	82	220	60
Chromium	32	53	33	35	55
Copper	540	840	660	490	9
Iron	22,000	—	16,000	>72,000	32,000
Lead	7,000	9,400	7,700	8,500	6,700
Manganese	1,900	2,300	2,100	2,000	2,100
Mercury	2.3	13	3.8	0.8	—
Silver	59	68	55	59	50
Zinc	15,000	18,000	15,000	31,000	13,000

Table 2.—Chemical analyses of total-recoverable metals from tailings—Continued

Location:	Monitoring well PS-MW-9		Monitoring well PS-MW-9	
Tailings Interval:	2.4-3.0 feet		3.0-4.0 feet	
	State	USGS	State	USGS
Arsenic	530	500	430	450
Barium	18	39	66	27
Cadmium	130	110	77	180
Chromium	29	42	33	39
Copper	730	23	630	29
Iron	>76,000	100,000	34,000	120,000
Lead	9,400	8,700	8,300	9,800
Manganese	1,800	2,100	1,900	1,900
Mercury	3.0	--	4.5	--
Silver	53	55	50	65
Zinc	19,000	23,000	13,000	34,000

Table 3.--Lithologic logs of 2 observation wells and 18 monitoring wells

Altitude of land surface: Alt., in feet above sea level.
Thickness in feet.
Depth in feet below land surface.

Location and material	Thickness	Depth
OBSERVATION WELLS		
Park Meadows well		
(D-2-4) 8aaa-1		
Alt. 6,751.75 feet.		
Log by Dave's Drilling		
Clay	10	10
Sand and gravel	30	40
Clay	10	50
Sand and gravel	10	60
Clay	10	70
Sand and gravel	10	80
Cobbles	10	90
Shale, reddish	40	130
Shale, reddish, mixed with limestone, gray	50	180
Limestone, gray, mixed with shale, reddish	40	220
Limestone, gray	80	300
Unknown	20	320
Pacific Bridge well		
(D-2-4)9aac-1		
Alt. 6,758.53 feet.		
Log by Larry W. Dalton		
Sand and gravel	5	5
Sand	4	9
Clay and gravel	57	66
Gravel, loose, some water	4	70
Clay and gravel	95	165
Clay, fine gravel, and quartzite	10	175
Clay	25	200
Clay and gravel	10	210
Gravel, loose, some water	5	215
Clay and quartzite	45	260
Shale, red	35	295
Shale, red, some water	20	315
Shale, red, quartzite and gravel	45	360
Lime, hard, quartzite and shale	5	365
Shale, red, quartzite	60	425
Shale, red, sulfur odor	7	432
Shale, red, quartzite, gravel	13	445
Bedrock, very hard	1	446
MONITORING WELLS		
PS-MW-1s (D-2-4)9bdd-1		
Alt. 6,791.87 feet.		
Fill, dark brown, soil mixed with sand and gravel	3	3
Clay, moderate brown, with interbedded sand and gravel, intermittent cobbles	10	13
Clay, silty, moderate brown, intermittent layers of gravel and cobbles	5	18
Cobbles, with interbedded clay and sand	1	19
Clay, moderate brown, interbedded with sand and gravel	5	24
Clay, moderate brown, interbedded sand and gravel, intermittent layers of cobbles	6	30
PS-MW-1s (D-2-4)9bdd-1--Continued		
Gravel, with interbedded clay and sand	6	36
Clay, moderate brown, interbedded sand, intermittent thin layers of cobbles	3	39
Gravel, with interbedded clay and sand	8	47
PS-MW-1d (D-2-4)9bdd-2		
Alt. 6,791.06 feet.		
Lithology similar to PS-MW-1s for first 45 feet.		
Clay, moderate brown, interbedded sand, fine to coarse, minor amount of gravel, high plasticity	5	50
Clay, as above but low to medium plasticity	1	51
Sand, fine to coarse, with clay and gravel	3	54
Cobbles, with clay and sand	1	55
Sand, fine to coarse, with interbedded clay and some gravel	7	62
Clay, moderate brown, with interbedded sand and numerous cobbles	7	69
Clay, moderate brown, with interbedded sand and some gravel, few cobbles	9	78
Clay, as above, high plasticity	5	83
Clay, as above, decreasing plasticity with increasing depth	2	85
Bedrock, silty shale, reddish brown	0.5	85.5
PS-MW-2 (D-2-4)9aac-2		
Alt. 6,758.44 feet.		
Fill, silt, sand, gravel, light brown	2.5	2.5
Silty sand, light brown, small amount of clay	2	4.5
Sandy clay, dark brown, intermittent gravel, 30 percent	2.5	7
Gravel, cobbles, up to 4 inches, 30 percent silty sand, moderate brown	3.5	10.5
Sand, gravel, moderate brown, intermittent cobble layers	3.5	14
Clay, moderate brown, silt and sand present, intermittent cobble layers	7.5	21.5
Clay, silty, light to moderate brown, medium plasticity, sand and gravel present, unsorted	9.5	31
Clay, moderate brown, medium plasticity, fine sand present	4	35

Table 3.--Lithologic logs of 2 observation wells and 18 monitoring wells--Continued

Location and material	Thickness	Depth
PS-MW-2 (D-2-4)9aac-2--Continued		
Gravel, coarse sand, angular...	1	36
Clay, moderate brown, with fine to medium sand, high plasticity, intermittent, thin cobble layers	8.5	44.5
PS-MW-3 (D-2-4)9aab-1 Alt. 6,743.35 feet.		
Topsoil.......................	1	1
Sand, light brown, medium-grained, well sorted..........	2	3
Clay, moderate brown, minor amount of sand and gravel, low plasticity................	3	6
Cobbles, with clay and sand, moderate brown...............	6	12
Clay, moderate brown, with fine sand, minor amount of cobbles.......................	3	15
Clay, moderate brown, fine sand.........................	1.5	16.5
Clay, moderate brown, with fine sand, intermittent gravel, rounded to angular....	9.5	26
Clay, moderate brown, with fine sand, medium to high plasticity, some gravel.......	9	35
Gravel, with clay and fine sand.........................	1	36
PS-MW-4 (D-2-4)9adc-1 Alt. 6,773.42 feet.		
Sand, light brown, fine to coarse, well rounded, minor amount of gravel.............	0.5	0.5
Clay, dark brown, with minor amount of gravel, thin sand layer........................	4	4.5
Gravel, with sandy clay, medium plasticity, intermittent thin sand layers........................	5.5	10
Clay, red-brown, medium plasticity, with fine to medium sand, intermittent pebbles.......................	3	13
Gravel, fine to coarse, angular, minor amount of fine sand.........................	2	15
Clay, red-brown, with fine to medium sand and intermittent quartz pebbles...............	1	16
Gravel and cobbles, angular to subrounded, with minor amount of fine sand..........	3.5	19.5
Gravel and cobbles, with minor amount of clay, moderate brown, fine sand.....	1	20.5
Cobbles (minimal recovery).....	2.5	23
Clay, moderate brown, with fine sand and gravel..........	1.5	24.5
Cobbles (minimal recovery).....	1.5	26
Clay, moderate brown, with fine sand and gravel..........	5	31
PS-MW-4 (D-2-4)9adc-1--Continued		
Clay, moderate brown, tight in some layers, fine sand, intermittent cobble layers....	8	39
Sand, medium to coarse, poorly sorted, gravel present, interbedded clay.....	6	45
PS-MW-5 (D-2-4)10bcb-1 Alt. 6,741.04 feet.		
Topsoil, silty sand, moderate brown.........................	0.5	0.5
Sand, light tan, medium-grained, well sorted..........	1	1.5
Sand, moderate brown, fine- to medium-grained, some gravel...	2.5	4
Clay, moderate brown, sand, fine to medium, gravel........	0.5	4.5
Sand, light tan, medium to coarse........................	4.5	9
Sand, moderate brown, interbedded silty clay, some cobbles present...............	3.5	12.5
Clay, moderate brown, some silt, gravel in upper foot....	2.5	15
Clay, moderate brown, with minor amount of interbedded coarse sand, intermittent thin gravel layers............	9.5	24.5
Clay, moderate brown, with interbedded fine sand, intermittent gravel layers....	3.5	28
Clay, moderate brown, with fine to medium sand, high plasticity...................	6	34
PS-MW-5d (D-2-4)10bcb-2 Alt. 6,741.99 feet.		
No lithologic log of initial 34 feet. Refer to log of PS-MW-5.......................	34	34
Clay, reddish-brown, matrix mixed with fine to coarse sand, angular to subangular...	1.5	35.5
No data.......................	8.5	44
Clay, gravel, sand, poorly sorted, 60 percent clay, 25 percent gravel, and 15 percent sand, clay reddish-brown, sand medium to coarse, angular to subangular....................	1.5	45.5
No data.......................	8.5	54
Clay, silty, with sand and gravel, poorly sorted, large rock fragment.................	1.5	55.5
No data.......................	8.5	64
Clay, reddish-brown, very fine silt within matrix, clay tight, intermixed rock fragments.....................	1.5	65.5
No data.......................	13.5	79

Table 3.--Lithologic logs of 2 observation wells and 18 monitoring wells--Continued

Location and material	Thickness	Depth
PS-MW-5d (D-2-4)10bcb-2--Continued		
Clay and gravel, clay reddish-brown, intermixed with angular to subangular fragments, 0-1 inch, possible Woodside Shale.......	1.5	80.5
No data........................	13.5	94
Clay, silty, reddish-brown, low plasticity...............	0.5	94.5
Gravel, medium to coarse, graded toward top of sample (may not be representative of aquifer material)..........	1	95.5
PS-MW-6 (D-2-4)10bbc-1		
Alt. 6,731.48 feet.		
Topsoil, moderate to dark brown........................	1.5	1.5
Sand, moderate brown, silt, and gravel, poorly sorted, some cobbles..................	11.5	13
Clay, moderate brown, with interbedded fine sand and gravel.......................	16	29
PS-MW-7 (D-2-4)10bba-1		
Alt. 6,722.46 feet.		
Topsoil, dark brown...........	0.5	0.5
Sand, silt, clay, moderate brown, with interbedded pebbles......................	5.5	6
Sand and gravel, light tan, unsorted......................	1	7
Sandy clay, moderate brown, interbedded gravel............	2	9
Clay, sandy, moderate brown, numerous interbedded cobbles..	7	16
Clay, moderate brown, interbedded gravel and sand...	9.5	25.5
PS-MW-7d (D-2-4)10bba-2		
Alt. 6,722.59 feet.		
Log by D. Coker.		
No lithologic log of initial 30 feet. Refer to log of PS-MW-7 located 5 feet to the north.....................	25.5	25.5
Sand, very fine to fine, angular to subangular, some interbedded coarse gravel, with 10 percent clay matrix...	1.5	27
Sand and clay, unsorted........	8	35
Clay, red-brown to gray, soft to hard, with black streaks of carbonaceous material, intermittent layers with clay and sand, medium to coarse, subangular to rounded, unsorted.....................	1.5	36.5
Clay, some sand, unsorted......	3.5	40
Sand, fine to medium, angular to subangular, some rock fragments, and gravel increasing in size with depth, some sandy clay, 5 to 10 percent......................	1.5	41.5
PS-MW-7d (D-2-4)10bba-2--Continued		
Clay, sandy, brown.............	3.5	45
Clay, brown, with sand and gravel........................	1.5	46.5
Clay, sandy, brown.............	4.5	51
Clay, sand, gravel, unsorted...	4	55
Clay, sand, gravel, poorly sorted, angular to subangular, about 10 percent clay.........	1.5	56.5
Clay, sand, gravel, unsorted...	8.5	65
Clay, sand, gravel, with some cobbles, poorly sorted, with quartzite clasts..............	1.5	66.5
Clay, sand, gravel, poorly sorted........................	8.5	75
Clay, sand, gravel, cobbles, poorly sorted, with silty shale and sandstone fragments, clay about 10 percent.........	1.5	76.5
Clay, sand, gravel, poorly sorted........................	8.5	85
Clay, sand, gravel, cobbles, red-brown to yellow-brown, clay also dark green/brown and gray, poorly sorted, subangular to subrounded, sandstone, quartzite, and rock fragments...............	1.5	86.5
Clay, sand, gravel, poorly sorted........................	8.5	95
Clay, sand, gravel, interbedded and mixed, red-brown, clay sandy and hard, sand, medium to coarse, poorly sorted, subangular to subrounded......	1.5	96.5
Clay, sand, gravel, poorly sorted........................	3.5	100
Clay, gray with yellow streaks, hard, imbedded quartzite and sandstone rock fragments, some brown and black carbonaceous material in clay..........................	1.5	101.5
Clay, sand, gravel, poorly sorted........................	8.5	110
Clay, sand, gravel, cobbles, red-brown, soft clay, sand, medium to coarse, poorly sorted, quartzite rock fragments.....................	1.5	111.5
Clay, sand, gravel, poorly sorted........................	3.5	115
Clay, sandy....................	5	120
Clay, brown with yellow and pink, medium stiffness, silty.........................	1.5	121.5
Clay, sandy....................	8.5	130
Gravel, sand, clay.............	5	135
Gravel, fine pebbles, well sorted, subangular to sub-rounded, a few rock fragments (may not be representative)...............	1.5	136.5
Gravel, sand, clay............	1.5	138

Table 3.--Lithologic logs of 2 observation wells and 18 monitoring wells--Continued

Location and material	Thickness	Depth
PS-MW-8 (D-2-4)9aac-3 Alt. 6,751.41 feet.		
Topsoil, dark brown...........	0.5	0.5
Sand, silty, moderate brown, with minor amount of interbedded gravel...........	4	4.5
Clay, dark brown, with interbedded fine sand.........	0.5	5
Gravel, cobbles, some sand and silt.....................	6.5	11.5
Clay, silty, moderate brown, minor amount of interbedded coarse sand, medium plasticity...................	2.5	14
Gravel........................	1	15
Clay, moderate brown, with interbedded sand and gravel...	1.5	16.5
Gravel, with sand and clay.....	0.5	17
Clay, silty, moderate brown....	1	18
Gravel, with sand and clay.....	2	20
Sand, silty, moderate brown, some clay, low plasticity, interbedded gravel...........	10	30
Sand, coarse, gravel, minor amount of clay and fine sand..	10.5	40.5
PS-MW-9 (D-2-4)10bab-1 Alt. 6,707.90 feet.		
Topsoil, dark brown...........	1	1
Gravel, with sand, coarse......	0.5	1.5
Sand, light tan, fine-grained, well sorted, mineralized..................	0.5	2
Clay, moderate brown, with interbedded sand, fine to medium.....................	0.5	2.5
Sand, light tan, fine-grained, well sorted, highly mineralized..................	1.5	4
Clay, dark brown, organic material present, low plasticity..................	2.5	6.5
Gravel, cobbles, with interbedded sandy clay........	3	9.5
Gravel, interbedded sandy clay.........................	2.5	12
Clay, moderate brown, interbedded fine sand and some gravel, high plasticity..	3	15
Clay, reddish-brown, with fine sand and angular rock fragments....................	0.5	15.5
Bedrock, angular fragments, red silty shale, friable......	1	16.5
PS-MW-10 (D-2-4)3dcd-1 Alt. 6,680 feet.		
Sand, fine to coarse, some gravel.......................	1	1
Soil, dark brown, organic material.....................	0.5	1.5
Sand, fine to coarse, with silty sand lenses and gravel..	3.5	5
Gravel, fine to coarse, poorly sorted.................	1	6
Sand, fine to coarse, poorly sorted, with silty sand lenses and gravel............	4	10
PS-MW-10 (D-2-4)3dcd-1--Continued		
Gravel, fine to coarse, poorly sorted.................	1.5	11.5
Bedrock, shale, dark reddish-brown, weathered, parts easily.......................	1.5	13
PS-MW-11 (D-2-4)3ccd-1 Alt. 6,711.19 feet.		
Fill, sand, silt, gravel, dry, loose....................	2	2
Clay, dark brown to black, organic, low to medium plasticity....................	6	8
Clay, dark gray to black, with some interbedded gravel, medium to high plasticity.....	2	10
Sand, moderate brown, fine- to medium-grained, some gravel...	0.5	10.5
Sand, silty, with some gravel, reddish-orange color........................	5.5	16
Clay, dark gray, low plasticity....................	1	17
Gravel, with silt and sand.....	3	20
Sand, gravel, with some gray-green clay..............	1.5	21.5
PS-MW-11d (D-2-4)3cdc-1 Alt. 6,715.89 feet. Log by K. Moll and D. Coker.		
Soil, clayey, silty...........	1.5	1.5
Gravel, sand..................	2.5	4
Clay, silty, with 4-inch layer of decomposed straw.....	2	6
Gravel, with very fine sand....	4	10
Gravel, coarse, with very fine sand and silt, poorly sorted, rounded to subrounded, quartz, feldspar, and shale rock chips........................	1.5	11.5
Silt, dark brown, with gravel and very fine to fine sand....	3.5	15
Clay, dark gray, sticky, very plastic, and gravel, coarse, angular to subrounded, poorly sorted.......................	1.5	16.5
Clay, gravel, poorly sorted....	2	18.5
Clay, stiff...................	1.5	20
Clay, dark gray, no plasticity, very stiff...................	1.5	21.5
Clay, dark gray, stiff.........	5.5	27
Sand, fine to coarse, sorted...	3	30
Sand, light brown, very fine to coarse, subangular to subrounded, well sorted.......	1.5	31.5
Sand, coarse, with gravel......	7.5	39
Gravel, coarse................	1	40
Gravel, very coarse to cobbles, angular to rounded, sorted....	1.5	41.5
Gravel, coarse................	5.5	47
Clay, silty...................	3	50
Clay, light brown, silty, tight.........................	1.5	51.5
Clay, silty...................	3.5	55
Sand, light brown, coarse, with gravel, silt 30 percent, and quartz pebbles...........	1.5	56.5

Table 3.--Lithologic logs of 2 observation wells and 18 monitoring wells--Continued

Location and material	Thickness	Depth
PS-MW-11d (D-2-4)3cdc-1--Continued		
Sand, with gravel.............	8.5	65
Clay, red-brown, tight, with coarse gravel................	1.5	66.5
Clay, with gravel.............	1.5	68
Sand, light brown, silty, small amount of clay...............	7	75
Sand, light brown, fine to medium.......................	1.5	76.5
Sand, silty...................	3.5	80
Sand, light brown, well sorted, grades from fine at top to coarse at bottom split-spoon barrel (may be settling of material inside drill pipe)...	1.5	81.5
Sand, fine to coarse..........	3.5	85
PS-MW-12 (D-2-4)9acc-1		
Alt. 6,797.70 feet.		
Gravel, with silt and sand, moderate brown...............	2	2
Gravel, coarse, alternating with layers of sand and gravel.......................	13	15
Gravel, cobbles, alternating with layers of interbedded clay, sand and gravel.........	10	25
Clay, fine sand, moderate brown, some interbedded gravel.......................	3	28
Cobbles.......................	1	29
Clay, fine sand, moderate brown, some interbedded gravel.......................	23	52
Gravel, some sandy clay........	2	54
Clay, sandy, moderate brown, with some interbedded gravel, medium plasticity............	9.5	63.5
Clay, sand, fine to coarse, moderate brown, some gravel, high plasticity..............	2.5	66
Cobbles, sandy clay, moderate brown.........................	1	67
Clay, moderate brown, with interbedded sand and gravel, low plasticity...............	12	79
Clay, moderate brown, with interbedded sand and gravel, high plasticity..............	6	85
Cobbles, with interbedded clay, sand, and gravel, dense, moist.................	12	97
Gravel, sand, fine to coarse, some cobbles, intermittent thin sandy clay layers........	17	114
Gravel, sand, fine to coarse, igneous and quartzite boulders.....................	6	120
Bedrock, silty shale, reddish-brown, friable........	5	125

Location and material	Thickness	Depth
PS-MW-13 (D-2-4)4dcb-1		
Alt. 6,728.42 feet.		
Loam, dark brown..............	3	3
Gravel, with silt and sandy loam.........................	4	7
Gravel........................	6	13
Gravel, with cobbles..........	9	22
Clay, with 20-30 percent gravel.......................	4	26
Clay and gravel, unsorted, light brown, subangular clasts.......................	11	37
Gravel, sand, poorly sorted, quartz and siltstone rock fragments (split-spoon sample taken at 37 feet with no recovery)....................	12	49
Clay, medium brown, with coarse sand.........................	11	60
PS-MW-14 (D-2-4)4dcc-2		
Alt. 6,712.44 feet.		
Clay, silty, red-brown, with gravel.......................	5	5
Clay, medium brown, moist......	7	12
Clay and gravel, unsorted, with cobbles 2-3 inches in length, subangular...........	8	20
Clay, light brown, silty, low to medium plasticity, and sand, fine to very fine, iron staining present.........	1.5	21.5
Clay with some cobbles 1-2 inches in length, poorly sorted, subangular to subrounded..................	7.5	29
Clay, sand, gravel, poorly sorted.......................	3	32
Gravel, coarse to very coarse, subangular, with 30 percent sand and 10 percent clay......	8	40
Clay, medium brown, tight, with very fine sand and interbedded subangular gravel, iron staining present.........	1.5	41.5
Clay, sand, gravel, unsorted, gravel increasing with depth..	12.5	54
Sand, gravel..................	1	55
Limestone, light gray to white, massive, with weathered shale fragments....................	6	61
Gravel, coarse, with clay and sand, limestone rock fragments....................	1.5	62.5
Gravel, with clay and sand.....	6.5	69
Shale, purple, and limestone...	6	75

Table 4.--Water levels in 3 observation wells and 18 monitoring wells

Water levels in feet above (+) or below land surface datum.

OBSERVATION WELLS

Park Meadows well (D-2-4)8aaa-1

Records available 1979 to current year (1988)

Date	Water level	Date	Water level	Date	Water level	Date	Water level
JUL 26, 1983	29.23	APR 26, 1984	30.35	FEB 11, 1988	31.46	FEB 18, 1988	45.92
SEPT 30	29.52	MAY 25	30.62	12	31.42	19	37.34
NOV 02	29.67	JUNE 20	28.66	13	31.43	20	35.48
DEC 21	31.03	MAR 23, 1987	32.86	14	31.38	21	34.52
JAN 20, 1984	31.71	SEPT 29	35.35	15	31.34	23	33.23
FEB 27	31.88	FEB 08, 1988	32.23	16	31.32	MAR 01	31.18
MAR 28	31.08	10	31.63	17	43.36	31	31.32

Pacific Bridge well (D-2-4)9aac-1

Records available 1948 to current year (1988)

Date	Water level	Date	Water level	Date	Water level	Date	Water level
JUL 26, 1983	8.30	FEB 09, 1987	25.25	MAR 23, 1987	14.76	FEB 17, 1988	25.01
SEPT 30	10.16	10	25.25	SEPT 29	15.29	18	25.00
NOV 02	13.54	11	25.24	DEC 09	22.45	19	25.06
DEC 21	17.23	12	25.08	JAN 08, 1988	24.51	20	25.05
JAN 20, 1984	16.86	13	25.00	FEB 08	25.24	21	24.99
FEB 27	15.03	14	25.00	09	25.25	24	17.81
MAR 28	1.80	15	24.93	10	25.25	MAR 24	17.81
APR 26	+5.75	16	24.95	11	25.24	31	15.27
MAY 25	+0.82	17	25.01	12	25.08	APR 05	14.18
JUNE 22	+0.08	18	25.00	13	25.00	11	12.82
DEC 09, 1986	22.45	19	25.06	14	25.00	26	11.61
JAN 08, 1987	24.51	20	25.05	15	24.93	MAY 04	11.44
FEB 08	25.24	FEB 21, 1987	24.99	16	24.95		

Cartier well (D-2-4)4dcc-1

Records available 1970 to current year (1988)

Date	Water level	Date	Water level	Date	Water level	Date	Water level
MAR 26, 1987	31.15	NOV 24, 1987	29.43	FEB 13, 1988	30.78	MAR 01, 1988	30.42
APR 02	30.24	JAN 12, 1988	31.06	14	30.80	16	30.32
09	28.96	FEB 08	31.05	15	30.74	24	29.83
16	29.10	09	30.97	16	30.71	31	29.58
24	29.30	10	30.90	17	31.22	APR 26	25.33
MAY 07	27.56	11	30.87	18	32.70	MAY 04	19.03
OCT 14	18.06	FEB 12, 1988	30.80	22	32.78		

Table 4.—Water levels in 3 observation wells and 18 monitoring wells—Continued

MONITORING WELLS

PS-MW-1s (D-2-4)9bdd-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	27.71	FEB 08, 1988	30.71	FEB 15, 1988	29.71	MAR 24, 1988	23.16
31	26.85	09	30.61	16	29.71	31	23.20
SEPT 25	28.87	10	30.50	17	29.67	APR 05	23.41
OCT 14	29.67	11	30.45	18	29.64	07	23.44
NOV 24	30.28	12	30.11	19	29.70	11	23.62
30	30.45	13	30.00	20	29.68	14	23.73
JAN 07, 1988	32.35	14	29.81	21	29.65	MAY 04	24.16
FEB 06	30.76						

PS-MW-1d (D-2-4)9bdd-2

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	34.98	DEC 01, 1987	37.54	JAN 07, 1988	38.68	FEB 03, 1988	37.91
08	34.55	02	37.58	08	38.70	10	37.52
31	33.25	03	37.68	09	38.76	11	37.43
SEPT 09	33.87	04	37.73	10	38.82	12	37.21
25	35.22	05	37.75	11	38.79	13	36.99
OCT 14	35.86	06	37.84	12	38.89	14	36.90
NOV 10	37.39	07	37.88	13	38.96	15	36.82
11	37.42	08	37.96	14	39.01	16	36.80
12	37.47	09	37.98	15	38.98	17	36.80
13	37.51	10	37.99	16	39.05	18	36.75
14	37.53	11	37.72	17	39.09	19	36.82
15	37.58	12	37.59	18	39.10	20	36.84
16	37.57	13	37.55	19	39.17	21	36.66
17	37.58	14	37.59	20	39.19	22	36.54
18	37.71	15	37.52	21	39.20	23	36.34
19	37.65	26	37.13	22	39.18	24	36.00
20	37.46	27	37.44	23	39.12	25	35.82
21	37.40	28	37.69	24	39.12	MAR 01	33.25
22	37.38	29	37.87	25	39.06	16	29.22
23	37.36	30	37.95	26	39.00	24	28.76
24	37.34	31	38.16	27	38.92	31	28.45
25	37.32	JAN 01, 1988	38.29	28	38.79	APR 05	28.66
26	37.38	02	38.36	29	38.52	07	28.65
27	37.42	03	38.45	30	38.25	11	29.03
28	37.42	04	38.52	31	38.03	14	29.16
29	37.45	05	38.56	FEB 01	37.93	MAY 04	30.12
30	37.53	06	38.60	02	37.89		

PS-MW-2 (D-2-4)9aac-2

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	30.39	FEB 06, 1988	35.09	FEB 14, 1988	34.66	FEB 21, 1988	34.83
SEPT 01	29.97	08	35.08	15	34.65	24	34.52
OCT 14	31.65	09	35.06	16	34.65	MAR 05	29.49
NOV 24	33.34	10	35.05	17	34.72	11	29.24
30	33.72	11	34.97	18	34.75	13	29.13
DEC 09	34.15	12	34.81	19	34.79	26	28.61
JAN 08, 1988	35.15	13	34.76	20	34.83	31	29.73

Table 4.--Water levels in 3 observation wells and 18 monitoring wells--Continued

PS-MW-3 (D-2-4)9aab-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	22.34	FEB 06, 1988	25.53	FEB 14, 1988	25.43	FEB 20, 1988	25.45
SEPT 03	22.45	08	25.53	15	25.40	21	25.46
OCT 14	23.35	09	25.54	16	25.39	24	25.40
NOV 24	24.13	10	25.54	17	25.38	MAR 31	22.68
DEC 01	24.40	11	25.52	18	25.38	APR 12	22.49
JAN 12, 1988	25.47	12	25.49	19	25.41	MAY 04	21.87

PS-MW-4 (D-2-4)9adc-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	28.64	FEB 10, 1988	33.24	FEB 17, 1988	33.63	MAR 24, 1988	22.09
SEPT 01	28.59	11	33.18	18	33.72	29	21.22
OCT 14	31.69	12	32.97	19	33.85	31	21.32
NOV 24	32.30	13	32.85	20	33.94	APR 05	22.10
DEC 01	32.84	14	33.25	21	33.94	11	22.40
JAN 07, 1988	33.14	15	33.48	24	33.30	12	22.49
FEB 08	33.26	16	33.48	MAR 16	22.04	MAY 03	24.58
09	33.27						

PS-MW-5 (D-2-4)10bcb-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	15.96	FEB 09, 1988	22.22	FEB 16, 1988	22.25	MAR 24, 1988	15.45
SEPT 01	16.38	10	22.24	17	22.25	31	14.25
OCT 14	19.70	11	22.25	18	22.20	APR 05	14.15
NOV 24	19.29	12	22.25	19	22.23	11	13.81
DEC 01	19.93	13	22.28	20	22.31	12	13.79
JAN 07, 1988	21.47	14	22.25	25	22.14	MAY 04	13.72
FEB 06	22.18	15	22.25	MAR 16	16.59		

PS-MW-5d (D-2-4)10bcb-2

Date	Water level	Date	Water level	Date	Water level	Date	Water level
FEB 25, 1988	33.02	MAR 24, 1988	29.71	APR 05, 1988	28.65	APR 12, 1988	28.34
MAR 16	30.56	31	28.97	11	28.40	MAY 05	28.09

Table 4.--Water levels in 3 observation wells and 18 monitoring wells--Continued

PS-MW-6 (D-2-4)10bbc-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	13.31	FEB 08, 1988	16.45	FEB 14, 1988	16.47	FEB 20, 1988	16.45
SEPT 02	13.44	09	16.45	15	16.47	21	16.45
OCT 14	14.71	10	16.46	16	16.45	24	16.40
NOV 24	15.09	11	16.46	17	16.45	MAR 31	13.78
DEC 01	15.26	12	16.47	18	16.45	APR 12	12.96
JAN 08, 1988	16.08	13	16.48	19	16.45	MAY 04	12.31

PS-MW-7 (D-2-4)10bba-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	10.69	FEB 10, 1988	11.20	FEB 17, 1988	11.19	MAR 24, 1988	11.01
SEPT 02	10.77	11	11.19	18	11.20	29	10.94
OCT 14	10.89	12	11.18	19	11.18	31	10.93
NOV 24	10.93	13	11.19	20	11.19	APR 05	10.89
DEC 01	10.97	14	11.17	21	11.18	11	10.88
JAN 07, 1988	11.12	15	11.19	25	11.19	12	10.88
FEB 08	11.20	16	11.19	MAR 16	11.07	MAY 03	10.82
09	11.20						

PS-MW-7d (D-2-4)10bba-2

Date	Water level	Date	Water level	Date	Water level	Date	Water level
FEB 16, 1988	15.63	FEB 20, 1988	15.75	MAR 24, 1988	14.68	APR 11, 1988	14.28
17	15.63	21	15.72	29	14.50	12	14.25
18	15.66	25	15.54	31	14.67	MAY 05	13.67
19	15.73	MAR 16	14.99	APR 05	14.42		

PS-MW-8 (D-2-4)9aac-3

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	25.32	FEB 09, 1988	30.02	FEB 15, 1988	29.93	FEB 21, 1988	29.93
SEPT 01	25.31	10	30.00	16	29.92	24	29.93
OCT 14	27.45	11	29.98	17	29.91	MAR 31	22.95
NOV 24	28.33	12	29.97	18	29.91	APR 12	22.14
DEC 01	28.63	13	29.97	19	29.91	MAY 03	22.49
JAN 08, 1988	29.90	14	29.93	20	29.92		

Table 4.--Water levels in 3 observation wells and 18 monitoring wells--Continued

PS-MW-9 (D-2-4)10bab-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	6.33	FEB 09, 1988	6.98	FEB 16, 1988	6.75	FEB 25, 1988	6.22
SEPT 02	6.19	10	6.93	17	6.82	MAR 31	5.71
OCT 14	5.50	11	6.80	18	6.93	APR 05	5.88
NOV 24	6.51	12	6.74	19	7.03	13	5.67
DEC 02	6.86	13	6.65	20	7.03	15	5.58
JAN 08, 1988	7.29	14	6.79	21	6.78	MAY 04	5.20
FEB 08	6.95	15	6.68				

PS-MW-10 (D-2-4)3dcd-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 07, 1987	1.71	DEC 02, 1987	1.50	FEB 26, 1988	1.15	APR 14, 1988	1.00
SEPT 03	1.81	JAN 08, 1988	1.65	APR 12	1.01	MAY 04	0.31
NOV 24	1.35						

PS-MW-11 (D-2-4)3ccd-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
SEPT 03, 1987	2.12	FEB 08, 1988	2.53	FEB 15, 1988	2.42	FEB 21, 1988	2.50
OCT 14	2.18	09	2.53	16	2.42	26	2.44
NOV 24	2.44	10	2.52	17	2.45	APR 05	1.79
DEC 02	2.53	11	2.50	18	2.44	12	1.72
JAN 12, 1988	2.70	12	2.47	19	2.53	14	1.72
FEB 06	2.53	14	2.47	20	2.55	MAY 03	1.50

PS-MW-11d (D-2-4)3cdc-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
FEB 09, 1988	9.59	FEB 15, 1988	9.52	FEB 19, 1988	9.77	APR 05, 1988	9.08
10	9.57	16	9.50	20	9.75	12	8.99
11	9.53	17	9.54	21	9.70	14	8.97
12	9.49	18	9.64	26	9.46	MAY 03	8.32
14	9.52						

PS-MW-12 (D-2-4)9acc-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
AUG 31, 1987	38.95	FEB 09, 1988	42.41	FEB 16, 1988	41.67	MAR 16, 1988	35.58
OCT 14	41.11	10	42.32	17	41.62	24	35.23
NOV 24	42.27	11	42.20	18	41.57	31	34.70
30	42.52	12	41.90	19	41.67	APR 05	34.88
JAN 07, 1988	43.80	13	41.80	20	41.66	11	35.15
FEB 06	42.50	14	41.80	21	41.56	14	35.28
08	42.45	15	41.71	23	41.40	MAY 03	36.17

Table 4.--Water levels in 3 observation wells and 18 monitoring wells--Continued

PS-MW-13 (D-2-4)4dcb-1

Date	Water level	Date	Water level	Date	Water level	Date	Water level
FEB 08, 1988	8.33	FEB 25, 1988	8.62	APR 07, 1988	7.41	APR 24, 1988	7.09
09	8.12	26	8.39	08	7.45	25	7.53
10	7.91	27	8.19	09	7.45	26	7.77
11	7.87	28	8.04	10	7.43	27	7.86
12	7.81	29	7.90	11	7.40	28	8.18
13	7.74	MAR 01	7.82	12	7.39	29	8.40
14	7.77	16	7.72	13	7.37	30	8.32
15	7.70	25	7.53	14	7.39	MAY 01	8.30
16	7.70	29	7.42	15	7.44	02	8.22
17	8.80	30	7.57	16	7.36	03	8.63
18	10.74	31	7.77	17	7.38	04	8.78
19	12.36	APR 01	7.59	18	7.37	05	8.74
20	11.51	02	7.51	19	7.21	06	8.78
21	10.43	03	7.47	20	7.13	07	9.16
22	9.77	04	7.48	21	7.06	08	9.10
23	9.28	05	7.51	22	7.05	09	9.13
24	8.92	06	7.44	23	7.09	JUNE 06	11.98

PS-MW-14 (D-2-4)4dcc-2

Date	Water level	Date	Water level	Date	Water level	Date	Water level
FEB 09, 1988	27.69	MAR 10, 1988	26.83	APR 09, 1988	25.73	MAY 08, 1988	19.84
10	27.65	11	26.84	10	25.67	09	19.84
11	27.64	12	26.87	11	25.62	10	20.01
12	27.59	13	26.90	12	25.58	11	20.55
13	27.57	14	26.90	13	25.53	12	19.92
14	27.58	15	26.89	14	25.50	13	18.97
15	27.55	16	27.07	15	25.63	14	17.78
16	27.56	17	26.99	16	25.39	15	17.52
17	27.90	18	26.92	17	25.35	16	18.14
18	28.55	19	26.83	18	24.89	17	18.16
19	28.97	20	26.79	19	22.39	18	17.70
20	28.97	21	26.76	20	20.97	19	17.81
21	28.78	22	26.70	21	19.13	20	18.12
22	28.59	23	26.64	22	19.12	21	17.80
23	28.45	24	26.58	23	19.60	22	18.15
24	28.28	25	26.71	24	20.03	23	18.29
25	28.13	26	26.43	25	20.23	24	17.67
26	27.98	27	26.31	26	20.47	25	17.90
27	27.84	28	26.21	27	20.44	26	18.28
28	27.56	29	26.10	28	19.96	27	18.68
29	27.29	30	26.14	29	19.43	28	19.48
MAR 01	27.24	31	26.17	30	19.02	29	19.36
02	27.11	APR 01	26.09	MAY 01	18.70	30	18.53
03	27.03	02	26.04	02	18.62	31	18.62
04	26.93	03	25.98	03	18.33	JUNE 01	18.26
05	26.85	04	25.96	04	18.99	02	18.23
06	26.84	05	25.93	05	19.21	03	18.50
07	26.86	06	25.85	06	19.89	04	18.75
08	26.88	07	25.78	07	20.15	05	19.00
09	26.84	08	25.77				

Table 5.—Estimated values of hydraulic conductivity determined from slug tests

Location	Hydraulic conductivity (feet per day)	Method
PS-MW-1s	1	Bouwer and Rice (1976)
PS-MW-1d	[1]1	Cooper and others (1967)
PS-MW-2	7	Bouwer and Rice (1976)
PS-MW-3	9	Bouwer and Rice (1976)
PS-MW-4	3	Bouwer and Rice (1976)
PS-MW-5	2	Bouwer and Rice (1976)
PS-MW-5d	[1]1	Cooper and others (1967)
PS-MW-6	[1]10	Bouwer and Rice (1976)
PS-MW-7	14	Bouwer and Rice (1976)
PS-MW-7d	2	Cooper and others (1967)
PS-MW-8	[1]1	Bouwer and Rice (1976)
PS-MW-9	[1]10	Bouwer and Rice (1976)
PS-MW-10	4	Bouwer and Rice (1976)
PS-MW-11	6	Bouwer and Rice (1976)
PS-MW-11d	[1]10	Bouwer and Rice (1976)
PS-MW-12	2	Bouwer and Rice (1976)

[1]Values rounded to nearest order of magnitude.

Table 6.—Instantaneous discharge and water-quality data measured at surface-water sites

[ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter]

Location	Date	Instantaneous discharge (ft^3/s)	Specific conductance (µS/cm)	pH (units)	Temperature (°C)	Alkalinity (mg/L as $CaCO_3$)	Calculated from alkalinity data: Bicarbonate (mg/L)	Calculated from alkalinity data: Carbonate (mg/L)
Silver Creek at Bonanza Drive	04-29-87	0.76	990	8.6	18.5	102	120	12
	07-09-87	0.04	925	8.6	19.0	84	104	0
	04-13-88	1.99	1,190	8.5	15.5	[1]107	[1]131	[1]0
Silver Creek at Wyatt Earp Drive	04-29-87	0.65	1,080	8.6	18.0	100	120	8
	07-09-87	0.002	1,570	8.0	19.5	123	150	0
	04-13-88	1.45	1,200	8.5	15.5	[1]109	[1]153	[1]0
Silver Creek downstream from Prospector Square	04-29-87	2.18	990	7.5	11.0	151	180	0
	07-09-87	0.24	1,450	7.4	13.5	105	128	0
	04-13-88	4.31	1,010	7.8	13.0	[1]152	[1]185	[1]0
Pace-Homer Ditch at Park Meadows collection box	04-29-87	0.08	720	8.0	15.5	174	210	0
	07-09-87	2.03	825	8.2	19.5	116	142	0
	04-13-88	0.893	695	8.0	10.0	[1]186	[1]227	[1]0
Pace-Homer Ditch downstream from Prospector Square	04-29-87	1.33	830	7.9	13.0	184	220	0
	07-09-87	2.50	870	8.2	18.0	134	164	0
	04-13-88	2.44	775	7.6	9.0	[1]185	[1]225	[1]0

[1]Values determined by State lab.

(p. 60 follows)

Table 7.—Chemical analyses of filtered water

[USGS, U.S. Geological Survey; State, Utah Department of Health; mg/L, milligrams per liter; μg/L, micrograms per liter;

Location	Date of sample	Reporting agency	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Aluminum, dissolved (μg/L as Al)	Arsenic, dissolved (μg/L as As)
Silver Creek at Bonanza Drive	04-29-87	USGS	79	16	100	2.9	200	120	--	5
		State	76	15	96	3	173	110	<200	5.5
		EPA	78.4	5.5	95.8	8	--	—	<140	<10
	07-09-87	USGS	78	17	71	2.9	150	110	--	6
		State	--	--	--	--	--	—	--	7
		EPA	79.4	17.3	76.5	3.2	--	—	32	<10
	04-13-88	USGS	82	17	130	3.1	260	92	--	3
		State	--	--	--	--	267.4	82	--	2.5
		EPA	--	--	--	--	--	—	--	--
Silver Creek at Wyatt Earp Drive	04-29-87	USGS	87	17	110	2.9	220	150	--	5
		State	83	17	100	3	174	120	<200	4.5
		EPA	83	17.1	106	2.7	--	—	<140	<10
	07-09-87	USGS	230	62	39	3.9	55	650	--	2
		State	--	--	--	--	--	—	--	3.2
		EPA	238	63.1	40.6	4.2	--	—	17	<10
	04-13-88	USGS	83	17	130	3.3	260	100	--	3
		State	--	--	--	--	259.5	89	--	1.5
		EPA	--	--	--	--	--	—	--	--
Silver Creek downstream from Prospector Square	04-29-87	USGS	--	--	--	--	--	—	--	--
		State	120	27	44	2	98	210	<200	5.5
		EPA	123	27.2	46.7	2.4	--	—	<140	<10
	07-09-87	USGS	--	--	--	--	--	—	--	--
		State	--	--	--	--	--	—	--	9.5
		EPA	218	34.4	48	3.8	--	—	26	<10
	04-13-88	USGS	110	27	64	2.9	140	180	--	6
		State	--	--	--	--	147.5	180	--	5.5
		EPA	--	--	--	--	--	—	--	--
Pace-Homer Ditch at Park Meadows collection box	04-29-87	USGS	--	--	--	--	--	—	--	--
		State	91	31	17	2	27	180	<200	12.5
		EPA	94.2	29.8	17.3	1.8	--	—	<140	<10
	07-09-87	USGS	--	--	--	--	--	—	--	--
		State	--	--	--	--	--	—	--	18.5
		EPA	120	36.3	8.8	1.8	--	—	16	17
	04-13-88	USGS	89	29	20	2.6	28	150	--	8
		State	--	--	--	--	29.9	140	--	5.5
		EPA	--	--	--	--	--	—	--	--
Pace-Homer Ditch downstream from Prospector Square	04-29-87	USGS	--	--	--	--	--	—	--	--
		State	100	31	22	2	15.5	170	<200	5.5
		EPA	107	30.5	23.3	1.7	--	—	<140	<10
	07-09-87	USGS	--	--	--	--	--	—	--	--
		State	--	--	--	--	--	—	--	12.5
		EPA	120	33.8	16.8	1.9	--	—	20	11
	04-13-88	USGS	110	30	23	2.1	47	180	--	5
		State	--	--	--	--	48	170	--	2.5
		EPA	--	--	--	--	--	—	--	--

collected from surface-water sites
EPA, U.S. Environmental Protection Agency;
dashes indicate no data; <, less than]

Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Zinc, dissolved (µg/L as Zn)
83	<0.5	1	<10	<3	10	8	<10	130	<0.1	<10	<1	68
74	<1	1	<5	<20	<20	40	10	120	<0.25	<10	<2	59
<70	<3	<4	<10	<20	30	<60	7	122	<0.4	<24	--	62
61	<0.5	1	<10	<3	10	15	<10	12	<0.1	<10	<1	28
51	--	1	<5	--	--	<20	10	11	--	--	<10	30
49	<1	<4	<4	<9	6.1	29	<5	18	<0.2	<8	<4	38
94	<0.5	4	<5	<3	10	6	<10	290	--	<10	<1	140
81	<1	<1	<5	<20	<20	20	<5	270	<0.2	<10	<2	150
--	--	--	--	--	--	--	--	--	--	--	--	--
84	<0.5	2	<10	<3	<10	4	<10	280	<0.1	--	<1	80
75	<1	2	<5	<20	<20	<20	10	260	0.2	<10	<2	70
80	<3	<4	<10	<30	23	<60	9	259	<0.2	<24	--	68
73	<0.5	13	<10	<3	<10	4	<10	2,910	0.1	--	<1	3,400
62	--	17	<5	--	--	<20	<5	2,900	--	--	<10	3,300
60	<1	17	<4	<9	10	27	<5	2,970	<0.2	8.5	<4	3,500
88	<0.5	2	<5	<3	<10	5	<10	240	--	<10	<1	160
74	<1	<1	<5	<20	<20	20	<5	220	<0.2	<10	<2	170
--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--
41	<1	4	<5	<20	<20	<20	10	360	0.25	<10	<2	590
<70	<3	<4	<10	<30	16	<60	8	353	<0.2	<24	<10	559
--	--	--	--	--	--	--	--	--	--	--	--	--
49	--	7	<5	--	--	81	--	970	--	--	<10	2,300
46	<1	6	<4	<4	<6	80	6.2	980	<0.2	<8	<4	2,380
49	<0.5	2	<5	<3	<10	15	<10	180	--	<10	1	280
39	<1	<1	<5	<20	<20	20	<5	170	<0.2	<10	<2	270
--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--
50	<1	<1	<5	<20	<20	320	<5	170	0.2	<10	<2	33
<70	<3	<4	<10	<30	<11	<60	<5	158	<0.2	<24	--	32
--	--	--	--	--	--	--	--	--	--	--	--	--
22	--	<1	<5	--	--	<20	<5	57	--	--	<10	<15
22	<1	<4	<4	9	28	<24	<5	60	<0.2	<8	<4	16
64	<0.5	2	<5	<3	<10	22	<10	310	--	<10	<1	4
52	<1	<1	<5	<20	<20	21	<5	290	<0.2	<10	<2	29
--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--
23	<1	<1	<5	<20	<20	580	5	75	0.25	<10	<2	52
<70	<3	<4	<10	<30	13	110	27	72	<0.2	<24	<10	63
--	--	--	--	--	--	--	--	--	--	--	--	--
30	--	<1	<5	--	--	<20	<5	11	--	--	<10	26
28	<1	<4	<4	<9	11	<24	14	23	<0.2	<8	<4	23
44	<0.5	<1	<5	<3	<10	16	<10	110	--	<10	<1	47
36	<1	<1	<5	<20	<20	20	<5	110	<0.2	<10	<2	62
--	--	--	--	--	--	--	--	--	--	--	--	--

Table 8.—Chemical analyses of unfiltered

[USGS, U.S. Geological Survey; State, Utah Department of Health; µg/L, micrograms per liter;

LOCATION	Date of sample	Reporting agency	Calcium, total (mg/L as Ca)	Magnesium, total (mg/L as Mg)	Sodium, total (mg/L as Na)	Potassium, total (mg/L as K)	Aluminum, total (µg/L as Al)	Arsenic, total (µg/L as As)	Barium, total (µg/L as Ba)
Silver Creek at Bonanza Drive	04-29-87	USGS	72	17	90	2.8	—	17	100
		State	77	16	97	3	580	18	91
		EPA	76.9	15.7	97	3.2	1,360	27	80
	07-09-87	USGS	71	16	62	2.7	—	6	<100
		State	--	—	--	--	—	7	51
		EPA	78.9	17.2	76.4	3	60	<10	51
	04-13-88	USGS	--	—	-	--	—	--	--
		State	79	16	130	3	<400	2	73
		EPA	97.3	22.4	54.6	1.9	<100	5.2	34
Silver Creek at Wyatt Earp Drive	04-29-87	USGS	74	17	91	2.7	—	18	100
		State	78	16	--	3	500	14	80
		EPA	78.2	15.7	563	3.3	1,370	17	<70
	07-09-87	USGS	170	50	29	3.6	—	2	<100
		State	--	—	--	--	3.5	62	--
		EPA	238	63.1	40.6	42	17	<10	60
	04-13-88	USGS	--	—	--	--	—	--	--
		State	81	17	130	3	450	5.5	84
		EPA	69.8	14.2	110	1.9	<100	28	66
Silver Creek downstream from Prospector Square	04-29-87	USGS	--	—	--	--	—	--	--
		State	120	27	45	3	<200	10	44
		EPA	120	26.6	47	2.4	420	12	<70
	07-09-87	USGS	--	—	--	--	—	--	--
		State	--	—	--	--	—	16	47
		EPA	225	34.7	49.4	4	198	12	46
	04-13-88	USGS	--	—	--	--	—	--	--
		State	110	26	66	3	<400	3.5	36
		EPA	71.1	14.4	112	1.6	<100	<2	--
Pace-Homer Ditch at Park Meadows collection box	04-29-87	USGS	--	—	--	--	—	--	--
		State	91	31	17	2	<200	10.5	51
		EPA	95.7	31.1	17.5	1.9	<140	10	<70
	07-09-87	USGS	--	—	--	--	—	--	--
		State	--	—	--	--	—	19	23
		EPA	118	35.4	9.4	1.9	71	18	11
	04-13-88	USGS	--	—	--	--	—	--	--
		State	86	27	20	3	<400	5.5	55
		EPA	77.2	24.9	17.5	1.5	<100	5.4	46
Pace-Homer Ditch downstream from Prospector Square	04-29-87	USGS	--	—	--	--	—	--	--
		State	100	30	22	2	<200	7.5	25
		EPA	105	29.8	22.8	1.7	<140	<10	<70
	07-09-87	USGS	--	—	--	--	—	--	--
		State	--	—	--	--	—	13	31
		EPA	120	33.2	16.1	1.8	32	12	30
	04-13-88	USGS	--	—	--	--	—	--	--
		State	100	28	22	2	<400	3.5	39
		EPA	91.5	25.6	19.4	1.2	<100	5.2	31

water collected at surface-water sites
EPA, U.S. Environmental Protection Agency; mg/L, milligrams per liter;
dashes indicate no data; <, less than]

Beryllium, total (μg/L as Be)	Cadmium, total (μg/L as Ca)	Chromium, total (μg/L as Cr)	Cobalt, total (μg/L as Co)	Copper, total (μg/L as Cu)	Cyanide, total (μg/L as Cn)	Iron, total (μg/L as Fe)	Lead, total (μg/L as Pb)	Manganese, total (μg/L as Mn)	Mercury, total (μg/L as Hg)	Nickel, total (μg/L as Ni)	Silver, total (μg/L as Ag)	Zinc, total (μg/L as Zn)
--	8	<10	--	44	<10	1,900	700	290	0.3	--	1	960
<1	5	<5	<20	38	<20	1,600	700	290	0.75	<10	<2	870
<3	<4	<10	<30	54	<10	2,350	580	309	<0.2	<24	<10	525
--	<1	<10	--	8	<10	150	21	20	0.1	--	2	50
--	<1	<5	--	<20	--	110	10	13	<0.2	--	<0.2	57
<1	<4	<4	<9	11	<10	192	42	28	<0.2	<8	<4	77
--	--	--	--	--	--	--	--	--	--	--	--	--
<1	<1	<5	<20	<20	<20	<20	<5	<5	<0.2	<10	<2	65
<2	<1.1	<4	<6	22	19	111	14	165	<0.2	<11	5.5	260
--	7	<10	--	38	<10	1,400	440	350	0.3	--	1	620
<1	4	<5	<20	31	<20	1,100	430	350	0.55	<10	<2	560
<3	<4	<10	<30	40	<10	1,860	330	309	<0.2	<24	<10	525
--	<3	46	--	5	<10	90	18	2,400	<0.1	--	2	3,100
--	16	<5	--	<20	--	72	<5	2,900	<0.2	--	<0.2	3,300
<1	17	<4	<9	10	--	27	<5	2,970	<0.2	8.5	<4	3,500
--	--	--	--	--	--	--	--	--	--	--	--	--
<1	4	<5	<20	<20	<20	770	<5	310	<0.2	<10	<2	440
<2	1.1	<4	<6	21	<10	<100	4.2	207	<0.2	<11	<5	151
--	--	--	--	--	--	--	--	--	--	--	--	--
<1	6	<5	<20	<20	<20	580	165	410	0.65	<10	<2	780
<3	<4	<10	<30	26	--	810	166	382	<0.2	<24	--	755
--	--	--	--	--	--	--	--	--	--	--	--	--
--	7	<5	--	220	--	79	105	1,000	<0.2	--	<0.2	2,500
<1	7.1	<4	<9	16	<10	759	161	1,050	0.3	8.6	4	2,610
--	--	--	--	--	--	--	--	--	--	--	--	--
<1	1	<5	<20	<20	<20	<20	<5	<5	<0.2	10	<2	100
<2	<1.1	<4	<6	23	<10	<100	3.5	260	<0.2	<11	<5	136
--	--	--	--	--	--	--	--	--	--	--	--	--
<1	<1	<5	<20	<20	<20	82	<5	170	0.25	<10	<2	31
<3	<4	<10	<30	<11	<10	120	<5	129	<0.2	24	92	29
--	--	--	--	--	--	--	--	--	--	--	--	--
--	<1	<5	--	56	--	85	<5	83	<0.2	--	<0.2	100
<1	<4	<4	<9	56	<10	90	<5	86	<0.2	<8	<4	23
--	--	--	--	--	--	--	--	--	--	--	--	--
<1	1	<5	<20	<20	<20	83	<5	310	<0.2	10	<2	<20
<2	<1.1	<4	<6	14	<10	121	17	284	<0.2	<11	<5	14
--	--	--	--	--	--	--	--	--	--	--	--	--
<1	<1	<5	<20	<20	<20	61	30	82	0.75	<10	<2	62
<3	<4	<10	<30	20	<10	<60	24	63	<0.2	24	119	73
--	--	--	--	--	--	--	--	--	--	--	--	--
--	4	<5	--	<20	--	57	<5	33	<0.2	--	<0.2	240
<1	<4	<4	<9	16	<10	65	13	33	<0.2	<8	<4	28
--	--	--	--	--	--	--	--	--	--	--	--	--
<1	<1	<5	<20	<20	<20	57	<5	120	<0.2	<10	<2	64
<2	<1.1	<4	<6	10	<10	152	11	106	<0.2	<11	<5	50

Table 9.—Chemical analyses of total-recoverable metals from stream sediment
[Constituents in micrograms per gram; USGS, U.S. Geological Survey; State, Utah Department of Health; EPA, U.S. Environmental Protection Agency]

Surface-water sampling April 29, 1987

	Silver Creek at Bonanza Drive			Silver Creek at Wyatt Earp Drive			Silver Creek downstream from Prospector Square		Pace-Homer Ditch downstream from Prospector Square	
	USGS	State	EPA	USGS	State	EPA	State	EPA	State	EPA
Arsenic	190	180	2,173	220	--	229	300	256	190	159
Barium	470	180	263	510	--	200	37	213	37	77
Cadmium	27	29	43	38	--	33	72	45	32	23
Chromium	100	49	186	80	--	52	31	50	49	44
Copper	330	240	280	390	--	191	360	343	360	293
Iron	30,000	22,000	54,500	37,000	--	30,600	30,000	36,400	25,000	24,500
Lead	5,200	4,500	5,900	6,000	--	3,910	4,300	5,960	3,600	3,786
Manganese	1,700	1,400	5,020	1,600	--	1,430	1,300	1,570	1,500	1,430
Mercury	<4	2.5	16	<4	--	24	5.5	8.5	7	1.1
Silver	38	21	18	42	--	28	31	31	26	18
Zinc	5,500	4,000	7,390	7,800	--	6,130	9,300	8,320	4,500	4,710

Surface-water sampling on July 9, 1987

	Silver Creek at Bonanza Drive			Silver Creek at Wyatt Earp Drive			Silver Creek downstream from Prospector Square		Pace-Homer Ditch downstream from Prospector Square	
	USGS	State	EPA	USGS	State	EPA	State	EPA	State	EPA
Arsenic	140	58	514	57	46	25	58	385	220	54
Barium	430	150	682	520	170	93	6.7	96	150	58
Cadmium	32	29	123	23	24	14	83	63	43	14
Chromium	100	41	115	81	44	15	19	14	38	8.7
Copper	280	170	1,200	120	69	58	580	400	430	154
Iron	35,000	23,000	86,300	25,000	24,000	13,000	32,000	24,000	22,000	6,370
Lead	4,900	3,200	19,300	1,700	960	670	7,700	5,000	4,600	1,640
Manganese	1,500	1,300	4,090	3,700	2,200	2,050	1,700	1,650	1,100	431
Mercury	6.6	3.6	14	4.4	2.2	1.5	6.5	7.2	16	6.6
Silver	26	15	110	10	5.3	5.9	51	35	36	12
Zinc	6,800	4,500	22,900	4,100	3,300	3,130	15,000	12,800	7,400	2,330

Surface-water sampling on April 13, 1988

	Silver Creek at Bonanza Drive		Silver Creek at Wyatt Earp Drive		Silver Creek downstream from Prospector Square		Pace-Homer Ditch downstream from Prospector Square	
	State	EPA	State	EPA	State	EPA	State	EPA
Arsenic	93	165	100	22.9	370	78.4	200	143
Barium	200	73.1	140	109	6	164	170	215
Cadmium	15	96.5	14	3.5	140	23.6	31	28.9
Chromium	75.5	14.3	43	24.6	30	31.5	72	59.1
Copper	93	317	63	36.4	1,400	173	440	435
Iron	2,000	23,200	29,000	25,700	30,000	21,000	3,500	30,100
Lead	1,300	5,290	380	164	12,000	2,960	3,100	3,340
Manganese	1,800	1,910	410	294	1,900	1,450	1,300	1,500
Mercury	1.2	3.6	0.4	0.3	3.4	1.8	6.7	12
Silver	6.8	31.6	3	2.7	86	15.4	20	22.8
Zinc	2,100	19,000	720	372	30,000	3,670	4,700	4,890

(p. 66 follows)

Table 10.—Chemical analyses of

[µS/cm, microsiemens per centimeter at 25 degrees Celsius;
EPA, U.S. Environmental Protection Agency; mg/L, milligrams per liter;

Location	Date of sample	Specific conductance, field (µS/cm)	pH, field (units)	Temperature, field (°C)	Reporting agency	Alkalinity, laboratory (mg/L as $CaCO_3$)	Bicarbonate (mg/L)	Carbonate (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)
Monitoring well PS-MW-1s (D-2-4)9bdd-1	08-31-87	3,830	6.8	13.5	USGS	140	--	--	320	61	270	3.3	910	260
					State	--	--	--	340	60	260	3	925	250
					EPA	--	--	--	354	61.7	277	4.03	--	--
	11-30-87	3,530	6.8	10.5	USGS	--	--	--	--	--	--	--	--	--
					State	137	168	0	340	63	280	3	885	270
					EPA	--	--	--	359	62.1	310	3.52	--	--
	04-11-88	3,380	6.1	11.0	USGS	--	--	--	--	--	--	--	--	--
					State	138	169	0	320	55	270	3	889.9	240
					EPA	135	--	--	294	51.8	--	3.5	860	260
Monitoring well PS-MW-1d (D-2-4)9bdd-2	08-31-87	1,840	6.8	13.0	USGS	90	--	--	220	43	74	2.3	380	240
					State	--	--	--	230	44	77	2	380	240
					EPA	--	--	--	220	41.3	72.1	2.32	--	--
	11-30-87	2,060	6.7	10.0	USGS	--	--	--	--	--	--	--	--	--
					State	114	140	0	260	52	88	2	450	270
					EPA	--	--	--	249	49.3	91.1	2.39	--	--
	02-23-88	2,100	7.4	10.0	USGS	--	--	--	--	--	--	--	--	--
					State	113	--	--	260	48	88	2	500	250
					EPA	--	--	--	248	47.6	83.6	2.5	--	--
	04-11-88	2,160	6.6	12.0	USGS	115	--	--	250	51	88	2.3	500	260
					State	113	138	0	260	49	87	2	534.9	240
					EPA	102	--	--	230	44.5	80.2	1.6	437	238
Monitoring well PS-MW-2 (D-2-4)9aac-2	09-01-87	1,740	6.7	14.0	USGS	108	--	--	220	44	58	2.0	370	200
					State	--	--	--	230	44	53	2	357	210
					EPA	--	--	--	--	41.8	51.1	1.57	--	--
	11-30-87	1,770	6.5	10.0	USGS	--	--	--	--	--	--	--	--	--
					State	121	148	0	230	46	54	2	362	210
					EPA	--	--	--	255	50.5	61.5	2.04	--	--
	02-24-88	1,220	7.2	8.5	USGS	--	--	--	--	--	--	--	--	--
					State	121	--	--	240	43	50	2	360	200
					EPA	--	--	--	220	42.1	48	2.2	--	--
	04-11-88	1,710	6.2	12.5	USGS	122	--	--	220	43	50	1.9	340	230
					State	121	147	0	220	42	49	2	364.9	210
					EPA	112	--	--	210	40.3	48.6	1.4	332	226
Monitoring well PS-MW-3 (D-2-4)9aab-1	09-03-87	1,730	7.0	10.0	USGS	146	--	--	180	35	110	1.9	350	190
					State	--	--	--	180	36	110	2	345	180
					EPA	--	--	--	184	35.9	114	1.63	--	--
	12-01-87	1,630	6.7	10.0	USGS	--	--	--	--	--	--	--	--	--
					State	154	188	0	170	34	110	2	300	200
					EPA	--	--	--	186	36.9	134	1.94	--	--
	02-24-88	1,580	7.0	9.0	USGS	--	--	--	--	--	--	--	--	--
					State	155	--	--	160	31	110	2	310	180
					EPA	--	--	--	153	29.5	104	2.3	--	--
	04-12-88	1,580	6.7	13.5	USGS	151	--	--	170	34	110	1.9	330	170
					State	150	184	0	170	32	110	2	349.9	180
					EPA	142	--	--	157	31.3	--	1.6	292	--

water from wells and drains
°C, degrees Celsius; USGS, U.S. Geological Survey; State, Utah Department of Health;
µg/L, micrograms per liter; dashes indicate no data; <, less than]

Aluminum, dissolved (µg/L as Al)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L) as Be)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Cyanide, total (µg/L as Cn)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Zinc, dissolved (µg/L as Zn)
--	<1	120	<0.5	<1	<5	<3	<10	--	120	<10	110	--	<10	1	19
<400	<1.1	96	<1	<1	<30	<20	<20	<23	<20	<5	94	<0.2	--	<2	25
<100	<6	103	<4	<4	<9	<7	<17	<10	<100	<20	99.1	<0.2	<6	9.2	22.5
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	<1.1	94	2	--	<5	<20	<20	<20	--	<5	90	<0.2	<10	2	69
<90	<2	109	<2	0.7	<10	<25	<8	<10	57	1.7	99	<0.2	<22	<6	71
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	<1	100	<1	<1	<5	<20	<20	<20	<20	<5	22	0.23	<10	<2	<20
<100	<2	98	<2	<1.1	<4	<6	16	<10	<100	<30	28	<0.2	<11	<5	14
--	<1	110	<0.5	<1	<5	<3	<10	--	--	<10	460	--	10	<1	12
<400	<1.1	89	1	--	<30	<20	<20	<20	79	<5	430	<0.2	--	<2	19
<100	<6	91.6	<4	<4	<9	<7	<17	<10	<100	<20	434	<0.2	7	<7	<7
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	<1.1	70	1	--	<5	<20	<20	<20	51	<5	75	<0.2	<10	<2	<20
113	<2	79	<2	1.3	<10	<25	18	<10	101	1.6	80	<0.2	<22	<6	85
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<200	<1	63	<1	<1	<5	<20	<20	<20	<20	<5	16	<0.2	<10	<2	44
<100	<3	60	<4	<0.5	<9	<9	<12	<1	<100	<2	14	0.2	13	<8	<20
--	1	74	<0.5	<3	<5	<3	<10	--	4	<10	9	--	<10	<1	5
<400	1.5	65	<1	<1	<5	<20	<20	<20	<20	<5	12	0.23	<10	<2	<20
<100	<2	--	<2	<1.1	<4	<6	12	<10	138	<3	14	<0.2	<11	15	48
--	<1	65	<0.5	<1	<5	<3	<10	--	63	<10	110	--	<10	<1	30
<400	<1.1	53	1	1	<30	<20	<20	<20	95	<5	110	<0.2	--	<2	26
<100	<6	47.1	<4	<4	<9	<7	<17	<10	<100	<2	79.7	<0.2	<6	<7	<7
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	<1.1	55	<1	--	<5	<20	<20	<20	33	<5	30	0.2	<10	<2	41
<90	<2	67	<2	0.4	<10	<25	<8	<10	26	1.8	32	<0.2	<22	<6	22
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<200	<1	54	<1	<1	<5	<20	<20	<20	25	<5	64	<0.2	<10	<2	89
<100	<3	51	<4	1	<9	<9	20	<1	<100	2.3	80	0.4	<7	<8	<20
--	2	61	<0.5	3	<5	<3	<10	--	6	<10	3	--	<10	1	3
<400	<1	54	<1	<1	<5	<20	<20	<20	<20	<5	<5	2.6	<10	<2	<20
<100	<2	54	<2	<1.1	<4	<6	11	<10	100	<3	7.3	<0.2	<11	<5	<7
--	<1	110	<0.5	<1	<5	<3	<10	--	14	<10	6	--	<10	<1	6
<400	<1.1	100	<1	<1	<30	<20	<20	<20	<20	<5	8	<0.2	--	<2	<15
<100	<6	101	<4	<4	<9	<7	27.8	<10	<100	<20	8.8	<0.2	<6	<7	<7
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	1.1	70	1	--	<5	<20	<20	<20	<20	<5	6	<0.2	<10	<2	<20
<90	<2	86	<2	0.2	<10	<25	<8	<10	100	2.5	5	<0.2	<22	<6	16
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<200	<1	71	<1	<1	<5	<20	<20	<20	27	<5	7	<0.2	<10	<2	52
<100	<3	63	<4	<0.5	<9	<9	<12	<1	<100	3.2	<8	0.4	<7	<8	<20
--	<1	86	<0.5	<1	<5	<3	<10	--	140	<10	13	--	<10	<1	12
<400	<1.1	76	<1	<1	<5	<20	<20	<20	<20	<5	13	<0.2	<10	<2	26
<100	<2	70	<2	<1.1	4.5	<6	34	<10	<100	<3	7.8	<0.2	<11	<5	9.1

Table 10.—Chemical analyses of

Location	Date of sample	Specific conductance, field (µS/cm)	pH, field (units)	Temperature, field (°C)	Reporting agency	Alkalinity, laboratory (mg/L as $CaCO_3$)	Bicarbonate (mg/L)	Carbonate (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)
Monitoring well	09-01-87	1,490	6.4	13.0	USGS	87	--	--	220	38	42	6.7	140	540
PS-MW-4					State	--	--	--	220	39	53	7	132	530
(D-2-4)9adc-1					EPA	--	--	--	226	39.1	54.9	8.1	--	--
	12-01-87	1,540	6.9	11.0	USGS	--	--	--	--	--	--	--	--	--
					State	104	128	0	240	39	51	6	130	540
					EPA	--	--	--	262	47.8	62.6	6.93	--	--
	02-24-88	1,710	7.3	10.5	USGS	--	--	--	--	--	--	--	--	--
					State	97	--	--	230	40	80	7	262	450
					EPA	--	--	--	220	38.2	71.4	6.6	--	--
	04-12-88	1,380	6.2	12.0	USGS	60	--	--	200	34	47	7.2	150	490
					State	60	74	0	190	33	52	7	153	470
					EPA	55	--	--	177	30.7	50.9	5.3	145	--
Monitoring well	09-01-87	1,350	6.5	14.5	USGS	54	--	--	190	34	56	4.2	130	500
PS-MW-5					State	--	--	--	200	34	54	4	125	500
(D-2-4)10bcb-1					EPA	--	--	--	206	35.2	57.1	5.25	--	--
	12-01-87	1,300	6.7	11.0	USGS	80	--	--	190	33	49	3.3	110	460
					State	80	98	0	190	34	48	3	105	470
					EPA	--	--	--	189	34.8	55.2	3.39	--	--
	02-24-88	1,250	6.9	11.5	USGS	104	--	--	190	35	39	--	88	490
					State	104	--	--	210	37	40	2	90	500
					EPA	--	--	--	199	36.5	40.8	2.3	--	--
	04-12-88	1,300	6.2	12.0	USGS	63	--	--	220	43	49	3.8	130	470
					State	63	77	0	180	32	50	4	130	460
					EPA	58	--	--	165	29.3	46	2.5	125	484
Monitoring well	02-25-88	775	7.5	12.0	USGS	114	--	--	110	27	16	1.7	33	260
PS-MW-5d					State	114	--	--	110	27	16	2	34.9	250
(D-2-4)10bcb-2					EPA	--	--	--	108	25.9	15	1.4	--	--
	04-12-88	775	7.1	12.0	USGS	115	--	--	110	27	16	1.2	33	260
					State	115	141	0	110	26	15	1	31.9	240
					EPA	108	--	--	99.8	24	14.2	0.7	36	258
Monitoring well	09-02-87	1,520	6.5	16.0	USGS	55	--	--	230	33	44	4.4	130	550
PS-MW-6					State	--	--	--	240	33	42	5	132	550
(D-2-4)10bbc-1					EPA	--	--	--	247	34	44.6	5.48	--	--
	12-01-87	1,470	6.9	11.0	USGS	55	--	--	230	32	42	4.3	140	540
					State	57	70	0	240	32	40	4	130	540
					EPA	--	--	--	236	33.2	43.8	4.3	--	--
	02-24-88	1,380	6.5	11.0	USGS	55	--	--	210	29	38	4.3	130	490
					State	56	--	--	220	29	38	4	127	500
					EPA	--	--	--	198	27.3	33.8	--	--	--
	04-12-88	1,370	6.3	14.0	USGS	56	--	--	220	32	41	4.3	130	540
					State	55	67	0	230	30	40	4	138	530
					EPA	50	--	--	208	29.5	38.5	2.9	112	--

Aluminum, dissolved (µg/L as Al)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L) as Be)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Cyanide, total (µg/L as Cn)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Zinc, dissolved (µg/L as Zn)
--	<1	38	<0.5	5	<5	<3	<10	--	23	<10	300	--	<10	<1	1,800
<400	<1.1	27	<1	6	<30	<20	<20	<20	290	<5	300	<0.2	--	<2	1,700
<100	<6	40	<4	6.4	<9	<7	<17	<10	<100	<2	317	<0.2	<6	<7	1,940
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	<1.1	40	2	3	<5	<20	<20	<20	120	<5	1,800	<0.2	<10	<2	640
<90	<2	47	<2	3.2	<10	<25	<8	<10	145	3.1	2,250	<0.2	<22	<6	759
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<200	1	43	<1	2	<5	<20	<20	<20	91	<5	2,700	<0.2	10	<2	400
<100	<3	<45	4	<0.5	<9	<9	26	<1	259	<2	2,750	<0.2	9.5	<8	361
--	<1	60	<0.5	9	<5	<3	<10	--	3	<10	46	--	<10	<1	2,300
<400	<1.1	22	<1	8	<5	<20	<20	<20	<20	<5	46	<0.2	<10	<2	2,400
<100	<2	20	<2	<5.5	<4	<6	12	18	<100	<3	44	<0.2	<11	<5	2,290
--	<1	51	<0.5	6	<5	<3	<10	--	33	<10	120	--	10	<1	2,300
<400	1.2	38	<1	--	<30	<20	<20	<20	380	<5	120	<0.2	--	<2	2,100
<100	<6	42.5	<4	7.1	<9	<7	<17	<10	<100	<2	126	<0.2	12.4	<7	2,460
--	1	50	<0.5	3	<5	<3	10	--	29	<10	260	--	<10	1	880
<400	<1.1	45	1	--	<5	<20	<20	<20	86	<5	260	0.2	<10	<2	930
<90	<2	49	<2	3.1	<10	<25	<8	<10	32	2.7	276	<0.2	<22	<6	899
--	<1	38	<0.5	3	<5	<3	<10	--	150	<10	120	--	<10	<1	71
<200	<1	31	<1	<1	<5	<20	<20	<20	20	<5	100	<0.2	<10	<2	97
<100	<3	<45	<4	<0.5	<9	<9	<12	<1	<100	3	487	0.2	<7	<8	<20
--	<1	62	<0.5	2	<5	<3	<10	--	4	<10	2	--	<10	<1	--
<400	<1.1	32	<1	--	<5	<20	<20	<20	<20	<5	44	<0.2	<10	<2	1,900
<100	<2	29	<2	3.6	5.2	<6	12	16	121	<3	47	<0.2	13	<5	1,780
--	<1	89	<0.5	2	<5	<3	<10	--	14	<10	500	--	<10	<1	19
460	<1	82	<1	<1	<5	<20	<20	<20	260	<5	470	<0.2	<10	<2	59
<100	<3	<45	<4	<0.5	<9	<9	<12	<1	<100	10	107	0.4	<7	<8	74
--	2	73	<0.5	<1	<5	3	<10	--	3	<10	88	--	<10	<1	6
<400	<1.1	67	<1	<1	<5	<20	<20	<20	<20	<5	86	<0.2	<10	<2	<20
<100	<2	61	<2	<1.1	<4	<6	14	<10	<100	<3	82	<0.2	<11	<5	8.8
--	<1	38	<0.5	6	<5	<3	<10	--	14	<10	440	--	<10	<1	1,100
<400	<1.1	25	<1	--	<30	<20	<20	<20	160	<5	440	<0.2	--	<2	1,100
136	<6	40	<4	5.9	<9	<7	<17	<10	136	<2	456	<0.2	<6	<7	1,210
--	1	27	<0.5	7	<5	<3	<10	--	51	<10	270	--	<10	<1	1,200
<400	<1.1	22	<1	--	<5	<20	<20	<20	--	<5	280	<0.2	<10	<2	1,400
<90	<2	23	<2	5.8	<10	<25	<8	<10	89	2.0	287	<0.2	<22	<6	1,300
--	2	34	<0.5	7	<5	<3	<10	--	9	<10	82	--	<10	1	1,100
<200	<1	26	<1	6	<5	<20	<20	<20	<20	<5	85	0.25	<10	<2	1,100
<100	<3	<45	<4	5.4	<9	<9	14	<1	<100	2.6	80	0.3	<7	<8	1,060
--	<1	31	<0.5	8	<5	<3	<10	--	6	<10	--	--	<10	<1	1,500
<400	<1.1	22	<1	8	<5	<20	<20	<20	<20	<5	57	<0.2	<10	<2	1,600
<100	<2	20	<2	<5.5	5.1	<6	18	<10	<100	<3	63	<0.2	<11	<5	1,540

Location	Date of sample	Specific conductance, field (µS/cm)	pH, field (units)	Temperature, field (°C)	Reporting agency	Alkalinity, laboratory (mg/L as $CaCO_3$)	Bicarbonate (mg/L)	Carbonate (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)
Monitoring well PS-MW-7 (D-2-4)10bba-1	09-02-87	1,570	6.4	16.0	USGS	47	--	--	250	33	42	5.7	110	660
					State	--	--	--	260	33	52	6	110	660
					EPA	--	--	--	269	33.2	53.1	7.05	--	--
	12-01-87	1,530	6.4	10.0	USGS	49	--	--	240	30	41	5.4	110	630
					State	59	72	0	260	31	51	6	110	640
					EPA	--	--	--	225	29.2	50.3	5.34	--	--
	02-25-88	1,310	6.2	6.5	USGS	50	--	--	220	29	42	2.5	120	580
					State	56	--	--	240	29	51	5	120	590
					EPA	--	--	--	220	27.4	46.6	5.1	--	--
	04-12-88	1,450	6.0	12.5	USGS	59	--	--	230	30	42	5.5	120	610
					State	58	71	0	230	28	49	5	120	580
					EPA	--	--	--	216	27.2	47.2	3.5	112	--
Monitoring well PS-MW-7d (D-2-4)10bba-2	02-25-88	355	7.5	8.0	USGS	121	--	--	43	11	11	1.1	12	45
					State	119	--	--	44	12	12	1	12	45
					EPA	--	--	--	41.8	11	10.3	<0.5	--	--
	04-12-88	339	7.4	13.5	USGS	123	--	--	44	12	11	0.9	12	46
					State	123	150	0	43	11	11	<1	12.3	44
					EPA	115	--	--	37.2	10	9.4	0.5	--	31
Monitoring well PS-MW-8 (D-2-4)9aac-3	09-01-87	1,470	6.8	18.5	USGS	52	--	--	220	31	49	6.2	160	490
					State	--	--	--	220	32	48	7	155	490
					EPA	--	--	--	228	32.2	48.8	7.49	--	--
	12-01-87	1,310	6.6	11.0	USGS	55	--	--	190	27	42	5	140	440
					State	57	70	0	200	26	44	6	132	430
					EPA	--	--	--	203	30.3	49.9	6.16	--	--
	02-24-88	1,230	7.0	10.0	USGS	57	--	--	180	27	30	5.5	140	430
					State	59	--	--	190	27	39	6	135	410
					EPA	--	--	--	183	26.1	37.4	5.8	--	--
	04-12-88	1,410	6.3	15.0	USGS	56	--	--	220	33	49	7	160	520
					State	56	68	0	230	30	49	6	171	520
					EPA	50	--	--	--	27.9	42.9	4.8	170	512
Monitoring well PS-MW-9 (D-2-4)10bab-1	09-02-87	1,450	7.2	15.0	USGS	213	--	--	190	32	57	2.6	130	340
					State	--	--	--	200	32	64	3	147	330
					EPA	--	--	--	206	32.8	68.1	2.65	--	--
	12-02-87	1,350	6.7	13.0	USGS	130	--	--	190	31	63	2.6	150	330
					State	218	266	0	210	33	60	3	135	340
					EPA	--	--	--	164	26.8	48.7	2.19	--	--
	02-25-88	1,260	7.1	8.0	USGS	--	--	--	--	--	--	--	--	--
					State	196	--	--	170	30	50	2	170	270
					EPA	--	--	--	173	29.1	47.4	1.9	--	--
	04-13-88	1,500	7.2	11.0	USGS	213	--	--	210	38	64	2.3	220	390
					State	212	259	0	220	37	66	2	227.5	330
					EPA	195	--	--	200	33.6	59	1.6	207	--

water from wells and drains--Continued

Aluminum, dissolved (µg/L as Al)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L) as Be)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Cyanide, total (µg/L as Cn)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Zinc, dissolved (µg/L as Zn)
--	<1	29	<0.5	8	<5	<3	<10	--	45	<10	250	--	10	<1	2,000
<400	<1.5	21	<1	15	<30	<20	<20	<20	<20	<5	240	<0.2	--	<2	2,000
<100	<6	40	<4	8.1	<9	<7	<17	<10	<100	<2	248	<0.2	10.2	<7	2,200
--	2	26	<0.5	8	<5	<3	<10	--	22	<10	59	--	10	<1	2,100
<400	<1.1	<20	2	8	<5	<20	<20	<20	44	<5	68	0.2	15	<2	2,400
429	2.1	22	<2	9.8	<10	<25	<8	<10	442	4.0	70	<0.2	<22	<6	2,150
--	<1	22	<0.5	9	<5	<3	<10	--	7	<10	24	--	10	<1	2,100
<200	<1	16	<1	8	<5	<20	<20	<20	130	<5	32	8.3	15	<2	2,100
150	<3	88	<4	--	<9	<9	14	<1	151	12	29	0.4	7.7	<8	2,180
--	2	23	<0.5	7	<5	<3	<10	--	6	<10	7	--	<10	<1	2,100
<400	<1.1	14	<1	<1	<5	<20	<20	<20	<20	<5	11	<0.2	<10	<2	2,100
<100	<2	18	<2	<5.5	<4	<6	14	<10	<100	<3	14	<0.2	<11	<5	2,030
--	2	43	<0.5	2	<5	<3	<10	--	36	<10	170	--	<10	3	6
<200	<1	35	<1	<1	<5	<20	<20	<20	65	<5	160	<0.2	<10	<2	42
<100	<3	<45	<4	<0.5	<9	<9	<12	<1	<100	3.4	162	<0.2	<7	<8	<20
--	3	53	<0.5	3	<5	<3	<10	--	29	<10	430	--	<10	<1	3
<400	<1.1	46	<1	<1	<5	<20	<20	<20	26	<5	420	<0.2	<10	<2	<20
<100	<2	39	<2	<1.1	<4	<6	<9	<10	<100	5.4	383	<0.2	<11	<5	8.1
--	1	32	<0.5	20	<5	<3	<10	--	36	<10	430	--	<10	<1	2,900
<400	<1.1	23	<1	29	<30	<20	<20	<20	<20	<5	420	<0.2	--	<2	2,800
<100	<6	40	<4	17.9	<9	<7	<17	<10	<100	<2	441	<0.2	8.0	<7	3,210
--	1	22	<0.5	15	<5	<3	10	--	11	<10	430	--	10	<1	2,600
<400	<1.1	21	<1	12	<5	<20	<20	<20	20	<5	430	0.25	10	<2	2,700
<90	3.8	24	<2	16	15	<25	<8	<10	21	9.3	472	<0.2	<22	<6	2,890
--	<2	24	<0.5	16	<5	<3	<10	--	9	<10	110	--	10	<1	2,100
<200	<1	17	<1	14	14	<20	<20	<20	22	<5	110	<0.2	<10	<2	2,100
<100	<3	<45	<4	--	<9	<9	19	<1	<100	2.9	114	0.3	<7	<8	2,160
--	<1	29	<0.5	22	<5	<3	<10	--	77	<10	130	--	<10	<1	3,000
<400	<1.1	22	<1	22	<5	<20	<20	<20	<20	<5	120	<0.2	<10	<2	2,900
<100	<2	20	<2	20	<4	<6	15	14	<100	<3	115	<0.2	<11	6.7	2,780
--	5	54	<0.5	<1	<5	<3	<10	--	230	<10	1,600	--	<10	<1	10
<400	6.5	53	<1	<1	<30	<20	<20	<20	50	<5	1,200	<0.2	--	<2	<15
<100	<6	57.4	<4	<4	<9	<7	<17	<10	<100	<20	1,290	<0.2	<6	<7	7.7
--	5	68	<0.5	<1	<5	<3	<10	--	65	<10	1,300	--	<10	<10	7
<400	5.0	50	<1	<5	<5	<20	<20	<20	26	<5	1,500	0.2	<10	<2	<20
123	3.4	43	<2	0.2	<10	<25	<8	<10	476	7.4	1,400	<0.2	<22	<6	16
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<200	2	35	<1	<1	<5	<20	<20	<20	610	<5	850	0.3	<10	<2	51
<100	<3	<45	<4	--	<9	<9	<12	<1	595	6.3	889	0.3	<7	<8	<20
--	4	52	<0.5	2	<5	<3	<10	--	950	<10	1,200	--	<10	1	6
<400	2.5	43	<1	<1	<5	<20	<20	<20	950	<5	1,100	<0.2	<10	<2	<20
<100	2.4	40	<2	<1.1	<4	<6	23	<10	918	<3	1,100	<0.2	<11	<5	16

Table 10.--Chemical analyses of

Location	Date of sample	Specific conductance, field (µS/cm)	pH, field (units)	Temperature, field (°C)	Reporting agency	Alkalinity, laboratory (mg/L as $CaCO_3$)	Bicarbonate (mg/L)	Carbonate (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)
Monitoring well PS-MW-10 (D-2-4)3dcd-1	09-03-87	1,120	7.3	14.0	USGS	230	--	--	140	35	46	2.7	90	230
					State	--	--	--	130	36	45	3	92.4	230
					EPA	--	--	--	140	36.3	46.9	3.13	--	--
	12-02-87	965	7.1	10.0	USGS	222	--	--	130	37	38	1.9	100	190
					State	223	272	0	130	39	41	2	83.9	84
					EPA	--	--	--	131	38.5	40.9	1.95	--	--
	02-26-88	940	7.2	8.0	USGS	--	--	--	--	--	--	--	--	--
					State	203	--	--	120	35	35	2	101	160
					EPA	--	--	--	113	32.8	33.8	1.2	--	--
	04-13-88	1,130	7.2	7.0	USGS	229	--	--	150	41	43	2.2	110	260
					State	227	277	0	150	41	43	2	115	250
					EPA	215	--	--	141	38.8	40.9	1.3	95	251
Monitoring well PS-MW-11 (D-2-4)3ccd-1	09-03-87	1,920	6.7	11.5	USGS	264	--	--	290	57	44	2.1	160	520
					State	--	--	--	320	59	42	2	155	500
					EPA	--	--	--	330	58.8	44.6	1.88	--	--
	12-02-87	1,370	6.8	10.0	USGS	--	--	--	--	--	--	--	--	--
					State	200	244	0	220	38	35	2	170	300
					EPA	--	--	--	204	38.1	34.3	1.93	--	--
	02-26-88	1,260	6.5	7.0	USGS	--	--	--	--	--	--	--	--	--
					State	170	--	--	92	24	16	1	38.9	130
					EPA	--	--	--	88.8	22.8	14.7	1.2	--	--
	04-14-88	1,220	6.5	9.0	USGS	172	--	--	180	35	28	1.5	180	250
					State	170	208	0	190	34	28	2	187.5	240
					EPA	160	--	--	165	30.2	24.2	0.5	167	244
Monitoring well PS-MW-11d (D-2-4)3cdc-1	02-26-88	648	7.6	9.0	USGS	166	--	--	95	24	16	1.6	38	130
					State	170	--	--	92	24	16	1	38.9	130
					EPA	--	--	--	88.8	22.8	14.7	1.2	--	--
	04-14-88	682	9.0	8.5	USGS	171	--	--	91	24	16	1.3	38	140
					State	170	208	0	89	24	16	1	39	130
					EPA	--	--	--	81	20.9	13.9	<0.5	35	122
Monitoring well PS-MW-12 (D-2-4)9acc-1	08-31-87	525	7.8	13.0	USGS	92	--	--	68	18	12	1.1	40	85
					State	--	--	--	67	18	12	1	37.5	83
					EPA	--	--	--	64.8	17.6	11.5	<0.5	--	--
	11-30-87	530	6.9	9.0	USGS	--	--	--	--	--	--	--	--	--
					State	119	146	0	72	20	10	<1	96.9	190
					EPA	--	--	--	74.2	20.3	11	1.11	--	--
	02-23-88	555	7.6	8.5	USGS	--	--	--	--	--	--	--	--	--
					State	117	--	--	73	19	10	1	37	94
					EPA	--	--	--	67.5	18.1	9.4	1	--	--
	04-11-88	580	6.8	13.0	USGS	119	--	--	74	20	10	1	38	96
					State	119	145	0	70	20	10	<1	39.5	90
					EPA	110	--	--	65.8	18.2	9.3	0.5	40	--

Aluminum, dissolved (µg/L as Al)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L) as Be)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Cyanide, total (µg/L as Cn)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Zinc, dissolved (µg/L as Zn)
--	<1	110	<0.5	7	<5	<3	<10	--	6	40	1,100	--	<10	<1	1,900
<400	28	110	<1	7	<30	<20	<20	<20	<20	30	1,100	<0.2	--	<2	1,800
<100	23.2	110	<4	8.6	<9	<7	18.5	<10	<100	43.4	1,130	<0.2	<6	9.7	1,950
--	11	93	<0.5	3	<5	<3	<10	--	6	20	430	--	<10	<1	650
<400	13	91	<1	3	<5	<20	<20	<20	21	15	420	0.2	<10	<2	680
<90	11	94	<2	3.8	<10	<25	<8	<10	28	22	442	0.52	<22	<6	697
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<200	11	75	<1	2	<5	<20	<20	<20	28	15	380	14.9	<10	<2	610
<100	9	88	<4	8.9	<9	<9	22	<1	<100	20	389	0.2	<7	<8	614
--	10	100	<0.5	6	<5	<3	<10	--	19	30	1,300	--	<10	<1	1,900
<400	14	91	<1	7	<5	<20	<20	<20	<20	20	1,200	0.2	<10	<2	1,800
<100	9.6	88	<2	5	4.1	<6	22	<10	114	31	1,220	<0.2	<11	<5	1,930
--	<1	81	<0.5	<1	<5	6	<10	--	28	<10	550	--	<10	<1	13
<400	1.5	68	<1	3	<30	<20	<20	<20	320	<5	570	<0.2	--	<2	18.0
<100	<6	67.4	<4	<4	<9	<7	<17	<10	<100	<2	577	<0.2	<6	<7	9.9
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	<1.1	37	<1	<1	<5	<20	20	<20	<20	<5	240	0.37	<10	<2	<20
1,000	<2	42	<2	0.9	<10	<25	<8	<10	--	5	320	<0.2	<22	<6	31
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<200	<1	29	<1	<1	<5	<20	23	<20	120	<5	140	<0.2	<10	<2	47
<100	<3	<45	<4	1.2	<9	<9	<13	11	115	2.9	141	0.34	<7	<8	<20
--	<1	34	<0.5	<1	<5	<3	<10	--	3	<10	130	--	<10	<1	11
<400	<1	25	<1	<1	<5	<20	<20	<20	<20	<5	120	<0.2	<10	<2	<20
<100	<2	--	<2	<1.1	<4	<6	25	<10	<100	<3	118	<0.2	<11	<5	38
--	2	59	<0.5	2	<5	<3	<10	--	8	<10	500	--	<10	<1	6
<200	<1	52	<1	<1	<5	<20	<20	<20	--	<5	480	<0.2	<10	<2	39
<100	<3	48	<4	1.5	<9	<9	<12	<1	<100	11	482	0.2	<7	<8	<20
--	2	60	<0.5	<1	<5	<3	<10	--	3	<10	260	--	<10	<1	3
<400	<1	51	<1	<1	<5	<20	<20	20	<20	<5	250	<0.2	<10	<2	<20
<100	2.6	56	<2	<1.1	<4	<6	29	<10	118	3.1	244	<0.2	<11	<5	13
--	1	65	<0.5	<1	<5	<3	<10	--	10	<10	39	--	<10	<1	38
<400	<1.1	52	<1	1	<30	<20	<20	<20	--	<5	43	<0.2	--	<2	40
135	<6	52.6	<4	<4	<9	<7	<17	<10	<100	2.75	39.4	<0.2	<6	7.6	<7
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	25	60	<1	4	<5	<20	<20	<20	<20	<5	8	0.3	<10	<2	<20
90	<2	66	<2	0.2	<10	<25	<8	<10	23	1.3	8	0.2	<22	<6	17
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<200	2	59	<1	1	<5	<20	<20	<20	28	<5	<5	<0.2	<10	<2	71
<100	<3	53	<4	<0.5	<9	<9	12	<1	<100	--	<8	<0.2	<7	<8	<20
--	2	70	<0.5	5	<5	<3	<10	--	3	<10	1	--	<10	<1	3
<400	<1	60	<1	<1	<5	<20	<20	<20	<20	<5	<5	<0.2	<10	<2	<20
<100	2.7	57	<2	<1.1	<4	<6	10	<10	--	6.5	<7	<0.2	<11	<5	<7

Location	Date of sample	Specific conductance, field (µS/cm)	pH, field (units)	Temperature, field (°C)	Reporting agency	Alkalinity, laboratory (mg/L as $CaCO_3$)	Bicarbonate (mg/L)	Carbonate (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)
Drain PS-DR-1 (D-2-4)3cdd	09-02-87	1,610	6.6	15.0	USGS	96	--	--	240	34	31	4.8	150	560
					State	--	--	--	250	35	53	5	150	550
					EPA	--	--	--	263	35.5	55.9	5.98	--	--
	12-02-87	1,570	6.4	10.0	USGS	104	--	--	--	--	--	4.6	160	520
					State	104	128	0	240	32	51	4	156	500
					EPA	--	--	--	208	28.5	44.2	4.48	--	--
	02-22-88	1,470	6.5	8.0	USGS	114	--	--	200	30	64	4.3	190	410
					State	114	--	--	210	30	73	4	190	400
					EPA	--	--	--	197	28.7	66.3	4	--	--
	04-13-88	1,500	6.4	8.0	USGS	91	--	--	240	34	41	4.5	170	520
					State	91	111	0	250	33	52	4	172.5	510
					EPA	80	--	--	215	32.6	47.3	3.4	197	522
Drain PS-DR-2 (D-2-4)3ccd	09-02-87	1,070	6.8	16.0	USGS	94	--	--	160	39	15	2.2	39	330
					State	--	--	--	150	39	14	2	40	330
					EPA	--	--	--	159	39.5	14.6	2.07	--	--
	12-02-87	1,530	6.8	8.5	USGS	--	--	--	--	--	--	--	--	--
					State	313	382	0	240	47	44	3	172	270
					EPA	--	--	--	226	47.4	43.3	2.94	--	--

water from wells and drains--Continued

Aluminum, dissolved (µg/L as Al)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L) as Be)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Cyanide, total (µg/L as Cn)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Nickel, dissolved (µg/L as Ni)	Silver, dissolved (µg/L as Ag)	Zinc, dissolved (µg/L as Zn)
--	1	33	<0.5	18	<5	<3	<10	--	740	<10	1,000	--	<10	<1	3,600
<400	13.5	25	1	32	<30	<20	<20	<20	860	<5	980	<0.2	--	<2	3,500
<100	7.59	40	<4	18.6	<9	<7	18.5	<10	750	<2	1,050	<0.2	<6	<7	3,980
--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	5.5	21	<1	15	<5	<20	<20	<20	290	<5	630	<0.2	10	<2	2,700
94	3.9	20	<2	27	<10	<25	<8	<10	301	7	574	0.2	<22	<6	2,460
--	7	27	<0.5	11	<5	<3	<10	--	470	<10	890	--	<10	<1	2,000
<200	7	22	<1	8	<5	<20	<20	<20	480	<5	840	<0.2	<10	<2	1,900
<100	5.2	<45	4	24	<9	<9	16	<1	491	11	875	0.3	<7	<8	2,050
--	2	27	<0.5	19	<5	<3	<10	--	120	<10	560	--	<10	<1	3,000
<400	<1	18	<1	19	<5	<20	<20	<20	120	<5	530	<0.2	<10	<2	2,800
<100	<2	16	<2	12	5	<6	19	<10	287	4.4	531	<0.2	<11	<5	2,860
--	10	56	<0.5	1	<5	<3	<10	--	1,800	<10	560	--	<10	<2	130
<400	4.5	50	2	--	<30	<20	<20	<20	--	<5	560	<0.2	--	<2	450
<100	<6	49.9	<4	<4	<9	<7	17.5	<10	1,860	<2	575	<0.2	<6	8.7	116
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<400	7.5	69	<1	1	<5	<20	<20	<20	6,100	<5	2,000	<0.2	<10	<2	240
90	7.8	81	<2	1.5	<10	<25	<8	<10	6,510	5.1	2,190	0.2	<22	<6	245