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HYDROLOGY OF THE COAL-RESOURCE AREAS IN THE UPPER DRAINAGES OF HUNTINGTON AND COTTONWOOD CREEKS, CENTRAL UTAH

U.S. GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS

OPEN-FILE REPORT 81-539

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By Terence W. Danielson, Michael D. ReMillard, and
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Salt Lake City, Utah

1981

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(U.S.)

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CONVERSION FACTORS

Numbers in this report are given in inch-pound units. For those readers who may prefer to use metric units rather than inch-pound units, the conversion factors for the terms used in the report are listed below. Multiply the inch-pound unit by the conversion factor to obtain the equivalent metric unit.

Inch-pound Unit	Abbreviation	Conversion factor	Metric Unit
Acre		0.4047	Square hectometer
Acre-foot	acre-ft	0.001233	Cubic hectometer
Acre-foot per square mile	acre-ft/mi^2	20.000476	Cubic hectometers per square kilometer
Cubic foot per second	ft^3/s	0.02832	Cubic meter per second
Foot	ft	0.3048	Meter
Foot per mile	ft/mi	0.1894	Meter per kilometer
Gallon per minute	gal/min	0.06309	Liter per second
Inch	in.	25.40	Millimeter
		2.540	Centimeter
Mile	mi	1.609	Kilometer
Square mile	mi^2	2.590	Square kilometer
Ton		0.9072	Metric ton

Chemical concentrations and water temperature are given only in metric units. Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). 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 one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is about the same as for concentrations in parts per million.

Chemical concentration in terms of ionic interacting values is given in milliequivalents per liter (meq/L). Meq/L is numerically equal to equivalents per million.

Water temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation: $°F=1.8(°C)+32$.

HYDROLOGY OF THE COAL-RESOURCE AREAS IN THE UPPER DRAINAGES OF HUNTINGTON AND COTTONWOOD CREEKS, CENTRAL UTAH

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ABSTRACT

The hydrology of coal-resource areas in the upper drainages of Huntington and Cottonwood Creeks in central Utah was studied in order to better define the hydrologic system, to identify the hydrologic effects of underground coal mining, and to devise methods to detect the effects.

Discharge records from gaging stations in this mountainous area indicated that there are large differences in the annual discharge of streams per unit area of drainage. These differences are attributed to differences in precipitation, differences in evaporation and sublimation of the snowpack, and to subsurface movement of water out of some basins. Surface waters sampled during 1977-79 were of good chemical quality; dissolved-solids concentrations rarely exceeded 500 milligrams per liter.

The Star Point Sandstone and the lower coal-bearing part of the Blackhawk Formation, both of Cretaceous age, are saturated in some areas, and the aquifer yields water to underground coal mines. Most of the larger discharging springs in the study area issue from the Star Point-Blackhawk aquifer where faulted. Ground water also occurs in several water-bearing zones above the Star Point-Blackhawk aquifer. It is not known whether the water in these overlying units is part of a continuous zone of saturation or whether unsaturated zones occur between units and some water is perched.

Dissolved-solids concentrations in water from about 140 springs ranged from 50 to 750 milligrams per liter. The chemical characteristics of water from the water-bearing zones of different formations usually were very similar.

Dewatering of underground coal mines was the largest manmade discharge from the Star Point-Blackhawk aquifer in the study area during 1979. The dewatering of mines has decreased the amount of water in storage in the aquifer, but water-level data were not available to define the extent of the depletion. Other possible impacts due to mine dewatering include the diminution of spring flows and increases in ground-water recharge, both of which are more likely to occur where rocks have been fractured due to subsidence above mines. Also, the flows of streams that receive water discharged from mines probably have increased accordingly. The discharge of mine water into streams causes some degradation in surface-water quality, but the quality of ground water is probably not adversely affected by mining.

Some environmental changes associated with underground mining are difficult to detect without data collected over a long period. With respect to the ground-water system, the year-to-year similarity of spring-discharge recession curves may provide a method to detect some of these changes. Changes in the benthic-invertebrate population may help detect pollution of surface waters.

Comprehensive studies of the ground-water system are needed in conjunction with hydrologic monitoring in order to fully assess the hydrologic impacts of the underground coal mining.

INTRODUCTION

Scope and objectives

The hydrology of coal-resource areas in the upper drainages of Huntington and Cottonwood Creeks in central Utah (fig. 1) were studied by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources and Energy, Division of Oil, Gas, and Mining. The study was conducted from July 1977 through September 1980. It included determination of sources, occurrence, and movement of ground water, evaluation of streamflow characteristics, and determination of the chemical and biological quality of water in the area. Data collection was concentrated in that part of the Huntington Creek drainage downstream from Electric Lake (pl. 1). Study of the remainder of the area was mainly on a reconnaissance level.

Study objectives were to define the hydrologic system, to identify the potential effects of coal mining on the hydrologic system, and to devise methods to detect the effects. The objectives were designed to provide the basic hydrologic information needed for effective management of coal leases and mining in the study area.

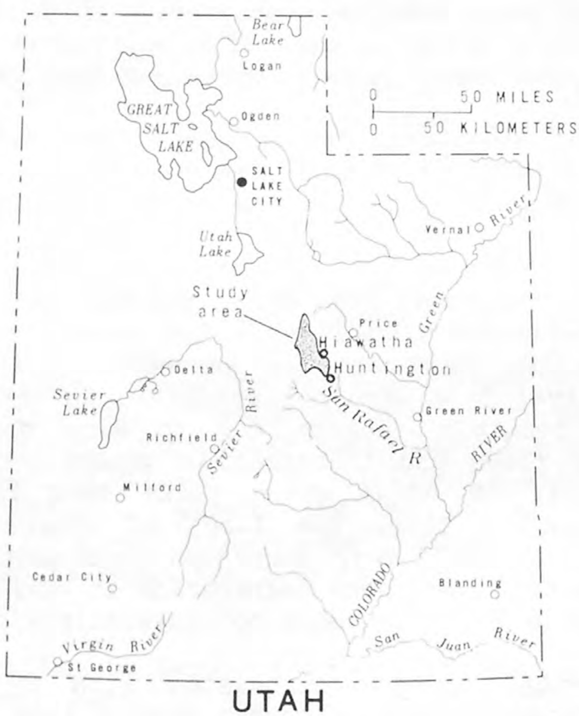

Figure 1.—Location of study area.

Methods of investigation

Most of the springs in the area were inventoried, and about 140 were sampled for chemical analyses. Periodic measurements were made at a few springs to define discharge, and ground-water levels were measured in four observation wells. Water samples for chemical analyses also were collected inside underground coal mines, and records were obtained of mine discharges.

Discharge measurements were made periodically on streams in the area during periods of base flow to delineate losing and gaining reaches. Samples of surface water from 25 sites throughout the study area were collected for chemical analyses to define the areal and seasonal variability in quality. Benthic-invertebrate samples were collected at 16 stream sites. In addition, daily-discharge records, chemical analyses, and benthic-invertebrate data were available for four gaging stations in the area that were operated as part of the U.S. Geological Survey hydrologic-monitoring network in Utah coal areas.

Most of the hydrologic data collected for this study are listed in tables 5-12. Locations of springs, wells, gaging stations, and other data-collection sites in the study area are shown on plate 1.

Previous investigations

Several other hydrologic studies have been completed in the general area of this study. Waddell, Contratto, Sumsion, and Butler (1981) described the water resources of the Wasatch Plateau and Book Cliffs coal-fields area based mainly on data (Waddell and others, 1978) collected during a 2-year reconnaissance of the area. Ground-water data for the Wasatch Plateau were also collected by Sumsion (1979). Mundorff and Thompson (1980) described the chemical quality and fluvial sediment of surface water in the San Rafael River basin, which includes both the Huntington and Cottonwood Creek drainages.

Streamflow records since 1909 for gaging station 09318000 on Huntington Creek and chemical analysis of water collected at the station during water years 1978 and 1979 are available in reports by the U.S. Geological Survey (1954, 1964, 1961-75, and 1976-80). In addition, streamflow records and chemical analyses of water for part of water year 1978 and all of water year 1979 are available for three other gaging stations in the study area (station 09317919 in Crandall Canyon, 09317920 in Tie Fork Canyon, and 09324200 on Cottonwood Creek, U.S. Geological Survey, 1980). All these gaging stations are operated as part of the Geological Survey hydrologic-monitoring network in Utah coal fields, and results of the hydrologic monitoring from August 1978 through September 1979 are summarized by Lines and Plantz (1981).

Acknowledgments

Appreciation is extended to all who aided in this study. Mr. Jerry Vaninetti of Utah Power & Light Co. and Mr. Bob Eccli of United States Fuel Co. arranged for the drilling of test holes in the Wilberg and King Mines. Employees under their direction acted as guides within the mines and assisted in the collection of water samples. Mr. Ted Crawford assisted in locating several springs on his property on East Mountain.

Data-site-numbering systems

The system of numbering wells and springs in Utah is based on the cadastral land-survey system of the U.S. Government. The number, in addition to designating the well or spring, describes its position in the land net. By the land-survey system, the State (fig. 2) is divided into four quadrants by the Salt Lake base line and meridian, and these quadrants are designated by the uppercase letters A, B, C, and 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 may be followed by three letters indicating the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section--generally 10 acres;[1] the letters a, b, c, and d indicate, respectively, the northeast, northwest, southwest, and southeast quarters of each subdivision. The number after the letters is the serial number of a well or spring within the 10-acre tract; the letter "S" preceding the serial number denotes a spring. Thus, (D-16-7)9cbd-S1 designates the first spring visited in the SE¼NW¼SW¼ sec. 9, T. 16 S., R. 7 E. Sites inside underground mines where water samples were collected and sites where rainfall data were obtained are numbered in the same mannner, but three letters are generally used after the section number and no serial number is used.

Streamflow gaging stations in the study area are identified by the U.S. Geological Survey 8-digit downstream numbering system (U.S. Geological Survey, 1980, p. 14). Miscellaneous streamflow measuring and sampling sites are numbered from 1 to 108 as shown on plate 1.

PHYSICAL SETTING

Topography and surface drainage

The area includes about 300 square miles of mountainous country of the Wasatch Plateau in central Utah. The area is drained by Huntington and Cottonwood Creeks, both perennial tributary streams to the San Rafael River.

Altitudes in the study area range from about 6,000 feet in the lower reaches of Huntington Creek to about 10,700 feet at the northern end of East Mountain. About 90 percent of the area, as shown in figure 3, is higher than 8,000 feet. The average channel gradient along Huntington Creek in the study area is about 100 feet per mile and along Cottonwood Creek it averages about 300 feet per mile. Both streams along their lower reaches are in deep, narrow canyons, and surface relief between the stream channels and tops of adjacent canyon walls is typically 2,000 feet or more. Mountain tops are generally flat in the southern part of the study area and pyramidal in the northern part.

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

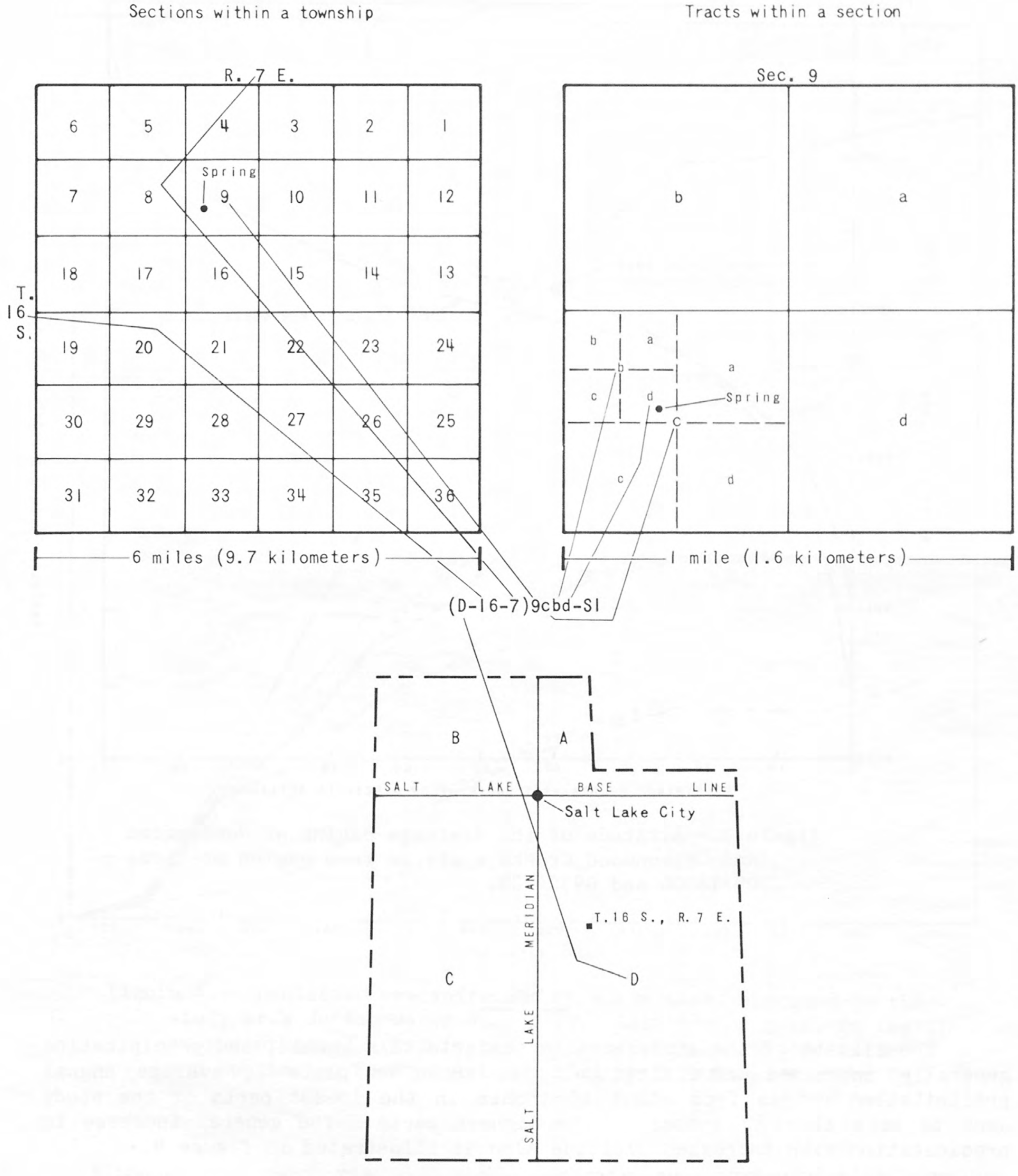

Figure 2.— Well- and spring-numbering system used in Utah.

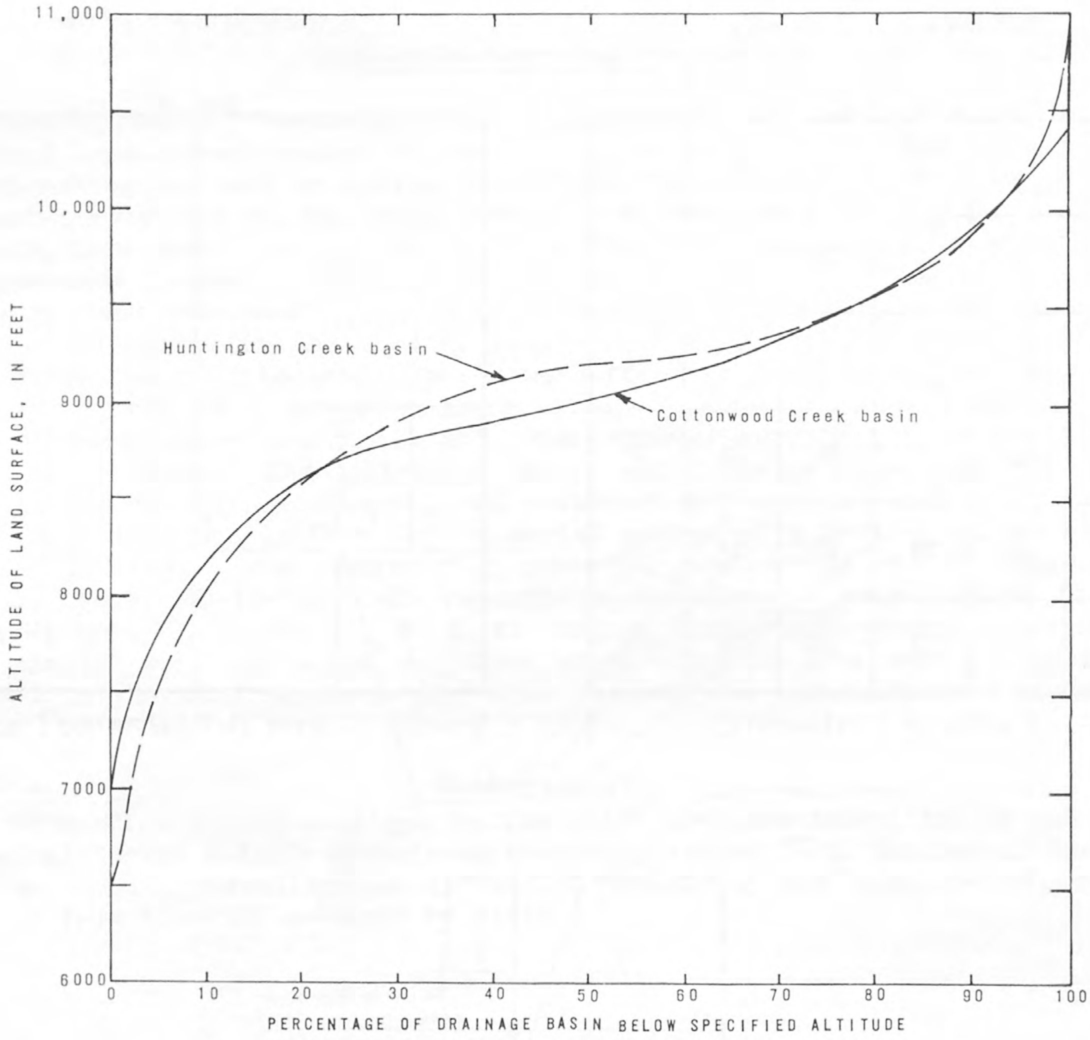

Figure 3.— Altitude of the drainage basins of Huntington and Cottonwood Creeks upstream from gaging stations 09318000 and 09324200.

Climate

The climate of the study area is semiarid to subhumid, and precipitation generally increases with altitude. As shown on plate 1, average annual precipitation ranges from about 10 inches in the lowest parts of the study area to more than 30 inches in the highest parts. The general increase in precipitation with increased altitude also is illustrated in figure 4.

Based on the precipitation contours shown on plate 1, it is estimated that in that part of the Huntington Creek drainage upstream from gaging station 09318000, annual precipitation averages about 26 inches or 260,000 acre-feet. In the Cottonwood Creek drainage upstream from gaging station 09324200, it is estimated that annual precipitation averages about 22 inches or 26,000 acre-feet.

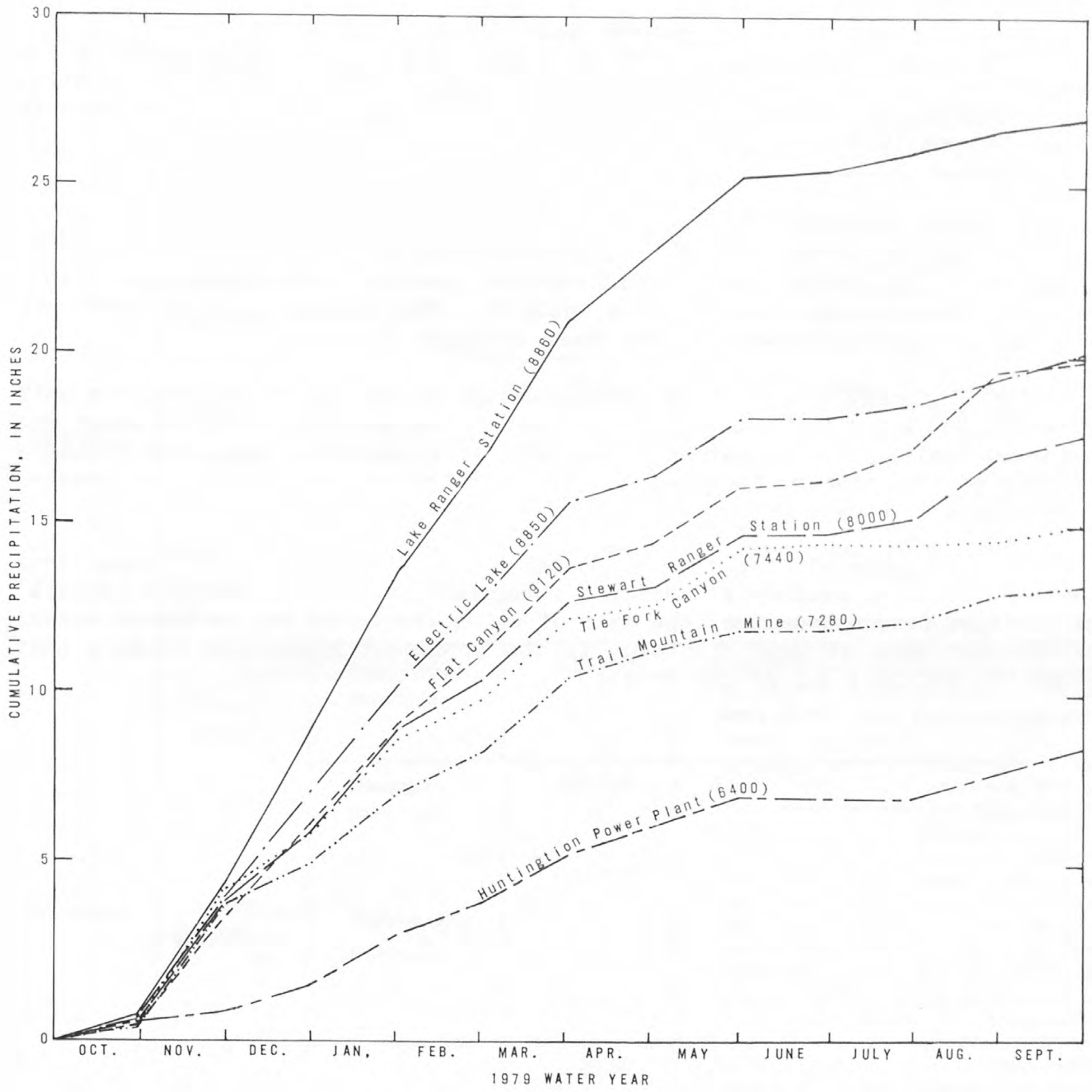

Figure 4.— Cumulative precipitation at seven gages operated in the study area during water year 1979. Altitude of gage, in feet, in parentheses. (Precipitation data for Lake Ranger Station and Huntington Power Plant supplied by Utah Power & Light Co.)

Although thunderstorms of high intensity are common during summer months, most precipitation in the study area falls as snow from November through March. April 1 water content on the Huntington Horseshoe snow course near the top of the Huntington Creek drainage at an altitude of 9,800 feet averaged 25 inches during 1930-79; April 1 snow depths averaged 50 inches (Whaley and Lytton, 1979, p. 206), but depths of 6 feet are common earlier in the year. During 1979, the April 1 water content of the snowpack on the snow course was 117 percent of the 1930-79 average.

Extreme air temperatures range from near 38°C in the lowest parts of the study area during summer to about -34°C in the highest parts during winter. Evaporation rates vary with altitude but average about 40 inches per year in the study area (Waddell and others, 1981, p. 6).

Geology

Geologic units exposed in the study area range in age from Cretaceous to Quaternary. The stratigraphic relationships, general lithologies, and thickness of each unit are summarized in table 1. The outcrop area of each unit and prominent geologic features are shown on plate 2.

The Blackhawk Formation of Cretaceous age is the major coal-bearing unit in the study area. The coal usually occurs in several seams in about the lower 150 feet of the formation. The most actively mined coal, the Hiawatha seam, is at the base of the Blackhawk. The Blackhawk typically is exposed on steep slopes as shown in figure 5.

Except where folded, the regional dip of rocks in the study area generally is in a southerly direction at angles that rarely exceed 4 degrees. The Straight Canyon Syncline, the axis of which trends to the northeast across the southern part of East Mountain, is one prominent structural feature that breaks the regional dip of the strata.

Figure 5.--Cretaceous rocks in the southwestern slopes of East Mountain adjacent to Cottonwood Creek. Ksp, Star Point Sandstone; Kbh, Blackhawk Formation; Kc, Castlegate Sandstone; Kpr, Price River Formation. View facing northeast.

Table 1.—Stratigraphic relationships, thicknesses, lithologies, and water-bearing characteristics of geologic units in the upper drainages of Huntington and Cottonwood Creeks (adapted from Stokes, 1964)

System	Series	Formations and members	Thickness (feet)	Lithology and water-bearing characteristics
Quaternary	Holocene and Pleistocene		0-100	Alluvium and colluvium; clay, silt, sand, gravel, and boulders; yields water to springs that may cease to flow in late summer.
Tertiary	Eocene and Paleocene	Flagstaff Limestone	10-300	Light-gray, dense, cherty, lacustrine limestone with some interbedded thin gray and green-gray shale; light-red or pink calcareous siltstone at base in some places; yields water to springs in upland areas. (See table 9.)
Tertiary / Cretaceous	Paleocene / Upper Cretaceous	North Horn Formation	800±	Variegated shale and mudstone with interbeds of tan-to-gray sandstone; all of fluvial and lacustrine origin; yields water to springs. (See table 9.)
Cretaceous	Upper Cretaceous	Price River Formation	600-700	Gray-to-brown, fine-to-coarse, and conglomeratic fluvial sandstone with thin beds of gray shale; yields water to springs locally.
Cretaceous	Upper Cretaceous	Castlegate Sandstone	150-250	Tan-to-brown fluvial sandstone and conglomerate; forms cliffs in most exposures; yields water to springs locally.
Cretaceous	Upper Cretaceous	Blackhawk Formation	600-700	Tan-to-gray discontinuous sandstone and gray carbonaceous shales with coal beds; all of marginal marine and paludal origin; locally scour-and-fill deposits of fluvial sandstone within less permeable sediments; yields water to springs and coal mines, mainly where fractured or jointed.
Cretaceous	Upper Cretaceous	Star Point Sandstone	350-450	Light-gray, white, massive, and thin-bedded sandstone, grading downward from a massive cliff-forming unit at the top to thin interbedded sandstone and shale at the base; all of marginal marine and marine origin; yields water to springs and mines where fractured and jointed.
Cretaceous	Upper Cretaceous	Masuk Member Mancos Shale	600-800	Dark-gray marine shale with thin, discontinuous layers of gray limestone and sandstone; yields water to springs locally.

There are a large number of generally north-trending faults in the study area, the most prominent of which is the Joes Valley Fault along the southwest side of the area. Displacement along the Joes Valley Fault which extends for several tens of miles south of the area, is 1,500 to 2,500 feet (Spieker, 1931, p. 57).

Displacement along other faults in the study area is not as large as along the Joes Valley Fault. For instance, displacement along the Pleasant Valley Fault is only about 140 feet where it crosses Huntington Creek. Displacement along the northwest-trending fault about 2 miles north of the axis of Straight Canyon Syncline is about 35 feet (R. Fry, Utah Power & Light Co., oral commun., March 1980).

COAL MINING AND LEASE ACTIVITIES

Areas leased for coal mining in the study area are shown on plate 1. Eight underground coal mines were active in the study area during 1979. The mines in order of most to least production in 1979 and general locations of the mine portals are: Deer Creek (SE$\frac{1}{4}$ sec.10, T. 17 S., R. 7 E.); Des Bee Dove (Deseret, Beehive, and Little Dove) (SW$\frac{1}{4}$ sec.26, T.17 S., R. 7 E.); Wilberg (NE$\frac{1}{4}$ sec. 27, T. 17 S., R. 7 E.); King (outside of map area) (SW$\frac{1}{4}$ sec. 26, T. 16, S., R. 7 E.); and Trail Mountain (SE$\frac{1}{4}$ sec. 25, T. 17 S., R. 6 E.). The portal of the King Mine is near the community of Hiawatha, about 1 mile east of the study area, but mining has advanced westward into the study area (under Gentry Mountain into the drainage of Tie Fork Canyon).

All mines, except the Deer Creek, Little Dove, Beehive, and King, mine coal from the Hiawatha seam at the base of the Blackhawk Formation. In these mines, coal is mined from other seams in the Blackhawk about 80 to 140 feet above the Hiawatha seam.

SURFACE-WATER HYDROLOGY

Reservoirs and diversions

Runoff from about 54 square miles in the upper part of the Huntington Creek drainage is regulated by reservoirs. Electric Lake was constructed in 1972 to store water for use downstream at the coal-fired Huntington Power Plant, and the reservoir has a storage capacity of about 25,000 acre-feet. During 1979, about 15 cubic feet per second of water was diverted from Huntington Creek about 2.5 miles upstream from gaging station 09318000 for use at the powerplant.

Cleveland, Miller Flat, Huntington, and Rolfson Reservoirs were constructed in the early 1900's to store water for irrigation downstream in Castle Valley. Approximate storage in acre-feet in these four reservoirs is as follows: Cleveland, 5,600; Miller Flat, 4,900; Huntington, 2,300; and Rolfson, 600 (C. B. Burton, Utah Power & Light Co., oral commun., 1980). During the irrigation season most of the flow of Huntington Creek is diverted for irrigation downstream from gaging station 09318000.

Annual discharge

The discharge at gaging station 09318000 on Huntington Creek during the 60 years of record (water years 1910-17, 1922-29, 1930-73, and 1978-79) averaged 96.3 cubic feet per second or 69,700 acre-feet per year. Discharge per unit area in the 190 square miles upstream from the gaging station averaged 367 acre-feet per square mile. Discharge during the 1979 water year (excluding diversions to the Huntington Power Plant) averaged 77.4 ft^3/s or 56,000 acre-feet.

During most years, about 65 percent of the annual discharge at the Huntington Creek station (09318000) occurs during the snowmelt period (April-July). Because most of the streamflow is derived from snowmelt, annual discharge at the gaging station correlates well with the April 1 snowpack water content as shown in figure 6.

Streams in Crandall and Tie Fork Canyons (major tributaries to Huntington Creek) also were gaged during the 1979 water year. Discharge at gaging station 09317919 in Crandall Canyon and at gaging station 09317920 in Tie Fork Canyon are shown in figure 7. About 80 percent of the streamflow at these two stations occurred between April and July as the result of snowmelt.

Even though the drainage areas upstream from the Tie Fork and Crandall Canyon stations are 11.7 and 5.7 square miles, mean annual discharges at the two stations were very similar during the 1979 water year. Discharge during water year 1979 averaged 2.04 cubic feet per second at the station in Tie Fork Canyon and 2.19 cubic feet per second at the station in Crandall Canyon. The annual discharge per unit area was 126 acre-feet per square mile at the station in Tie Fork Canyon and 280 acre-feet per square mile at the station in Crandall Canyon. Reasons for the smaller discharge per unit area in the Tie Fork drainage are unknown. It could be due in part to the southern exposure and gentle slopes in Wild Cattle and Gentry Hollows where a higher percentage of the snowpack may be lost to evaporation and sublimation. It also could be due in part to subsurface movement of ground water out of the Tie Fork drainage via the Bear Canyon Fault and (or) other faults (pl. 2) transversing the drainage.

Discharge during water year 1979 at gaging station 09324200 on Cottonwood Creek averaged 0.87 cubic feet per second; discharge per unit area averaged 29 acre-feet per square mile in the 21.9 square miles upstream from the station. Comparison of the hydrographs in figure 7 indicates that snowmelt runoff contributed a smaller percentage of the annual discharge at the station on Cottonwood Creek than at the stations in Tie Fork and Crandall Canyons. It is believed that because of the southern exposure and relatively gentle slopes of much of the Cottonwood Creek drainage, much of the water in the snowpack is lost through evaporation and sublimation. However, fracturing associated with the Joes Valley Fault (pl. 2) may provide conduits for subsurface movement of water out of the basin. Unlike the Huntington Creek streamflow during water year 1979, only about 2 percent is estimated to have left the Cottonwood Creek drainage as streamflow.

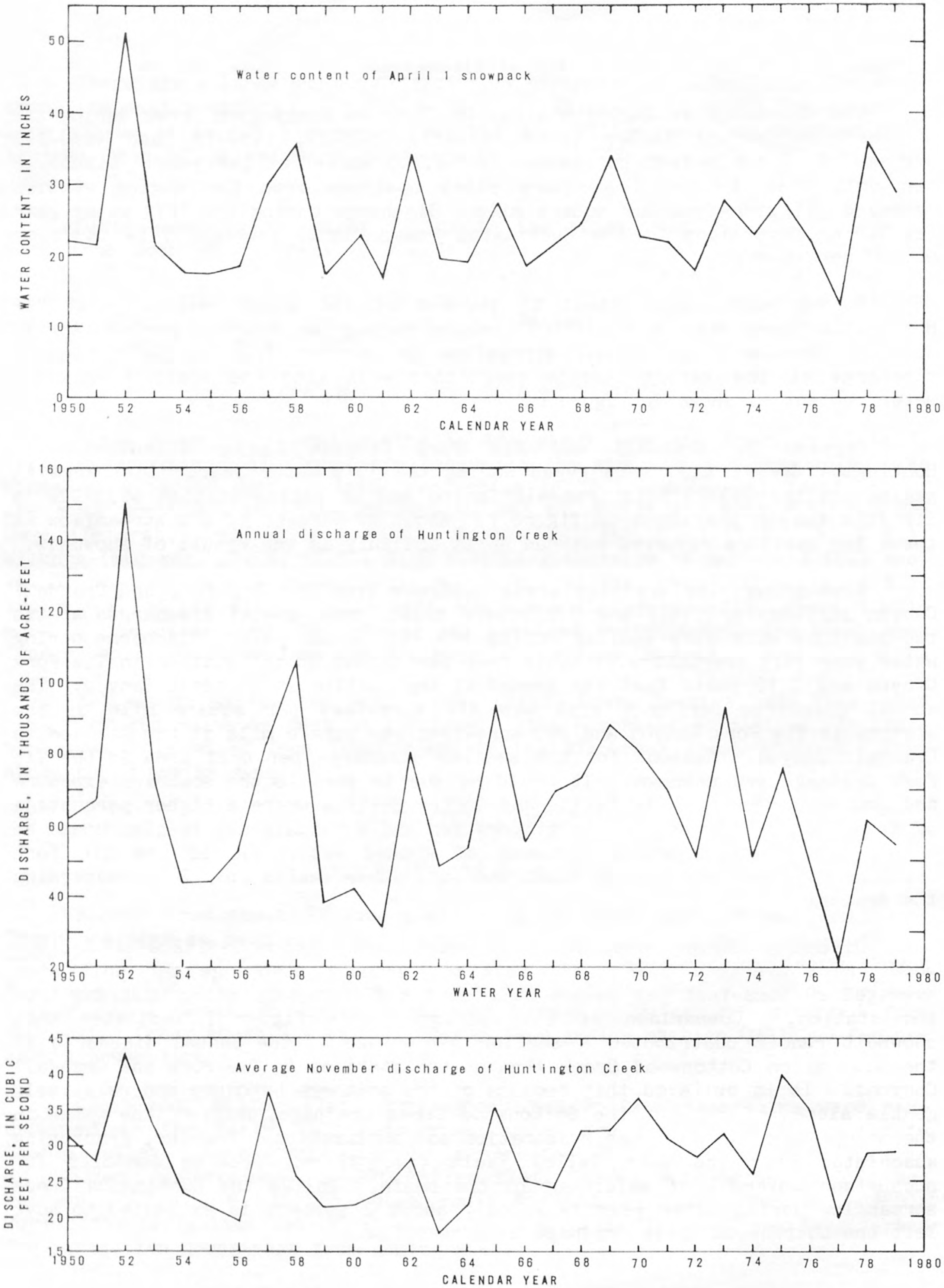

Figure 6.—Water content of April 1 snowpack at the Huntington Horseshoe snow course and the annual discharge of Huntington Creek at gaging station 09318000, 1950-79.

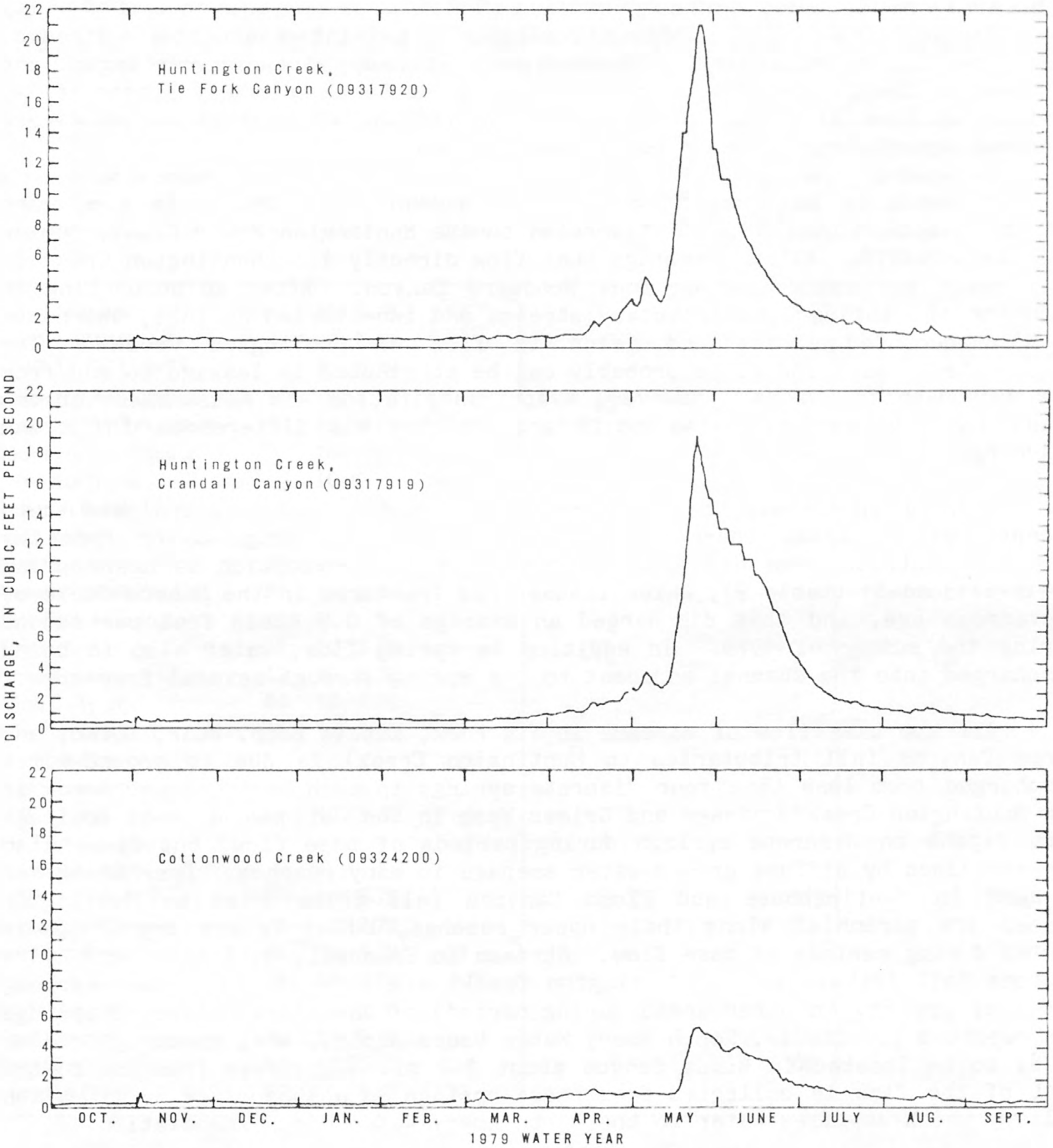

Figure 7.—Stream discharge at three gaging stations in the drainages of Huntington and Cottonwood Creeks, water year 1979.

Base flow

In an effort to determine losing and gaining reaches of streams, discharge measurements (table 5) were made at many sites on Huntington and Cottonwood Creeks and tributaries (pl. 1) during periods of base flow. Periods of base flow are defined as being periods when there is no direct overland runoff from snowmelt or rainfall.

Table 2 is an accounting of flow in Huntington Creek, in the reach between Electric Lake and the diversion to the Huntington Power Plant, during the fall of 1978. All the springs that flow directly into Huntington Creek in this reach are upstream from Nuck Woodward Canyon. After an accounting is made for the inflow from tributary streams and inventoried springs, there are both unaccounted losses and gains in flow of Huntington Creek. The unaccounted losses and gains probably can be attributed to leakage to and from the ground-water system. However, evapotranspiration and measurement errors (less than 10 percent) also could account for the differences in stream discharge.

Measurements along the Left Fork of Huntington Creek indicate that, except for one area, there is little ground-water leakage to or from the stream downstream from Scad Valley Creek. The one exception is near spring (D-15-6)13dad-S1 (table 9), which issues from fractures in the Mancos Shale of Cretaceous age, and that discharged an average of 0.9 cubic feet per second during the summer of 1979. In addition to spring flow, water also is being discharged into the channel adjacent to the spring through several fractures.

All the base flow of streams in Tie Fork, Little Bear, Bear, Blind, and Horse Canyons (all tributaries to Huntington Creek) is due to ground-water discharged from less than four discrete springs in each basin. Deer Creek in the Huntington Creek drainage and Grimes Wash in the Cottonwood Creek drainage also depend on discrete springs during periods of base flow, but flows also are sustained by diffuse ground-water seepage in many reaches. Deer Creek and streams in Meetinghouse and Flood Canyons (all tributaries to Huntington Creek) are perennial along their upper reaches, but they are dry at their mouths during periods of base flow. Streams in Crandall, Mill Fork, and Rilda Canyons (all tributaries to Huntington Creek) are perennial in some reaches, but they are dry in other areas during periods of base flow. Several springs are reported (J. Stoker, North Emery Water Users Assoc., oral commun., October 1978) to be located in Rilda Canyon about 1-2 miles upstream from the mouth. Most of the flow is collected from these springs in a subsurface infiltration gallery which supplies water to the North Emery Water Users Association.

Streams in Marinus and Dairy Canyons, both tributaries to Cottonwood Creek, are perennial. Streams in Mill, Meetinghouse, and Trail Canyons are intermittent; they were dry during the summer of 1977 but flowed at their mouths at Cottonwood Creek during the summers of 1978 and 1979, both years of above-normal precipitation. Other tributaries to Cottonwood Creek upstream from gaging station 09324200 are ephemeral and flow only in direct response to surface runoff from snowmelt and rainfall.

Table 2.--An accounting of gains and losses in flow of Huntington Creek between Electric Lake and the diversion to the Huntington Power Plant, fall of 1978

[Springs and site numbers shown on plate 1; discharges are in cubic feet per second]

Stream or spring (tributaries to Huntington Creek and springs are indented)	Site no.	Date	Discharge of Huntington Creek	Measured gain(+) or loss(–) in discharge of Huntington Creek	Discharge of tributaries and springs	Unaccounted gain(+) or loss(–) in discharge of Huntington Creek (rounded)
Huntington Creek	2	10- 3-78	17		--	
(D-14-6)24baa-S1	--	10- 4-78	--		0.3	
(D-14-6)24adc-S1	--	10-20-78	--		.7	
North Hughes Canyon	4	10- 4-78	--	+2	.03	+0.8
(D-14-7)30bdc-S1	--	10- 4-78	--		.1	
South Hughes Canyon	6	10- 4-78	--		.02	
(D-15-7)8dab-S1	--	10-20-78	--		.1	
Huntington Creek	8	10- 3-78	19		--	
Nuck Woodward Canyon	19	10- 4-78	--	+2	.04	+1.9
Pole Canyon	20	10- 6-78	--		.04	
Huntington Creek	21	10- 3-78	21		--	
Left Fork Huntington Creek	40	10- 3-78	--	+16	14	+1.8
Horse Canyon	43	10- 6-78	--		.1	
Blind Canyon	44	10- 6-78	--		.1	
Huntington Creek	45	10- 3-78	37		--	
Crandall Canyon (gaging station 09317919)	51	10- 3-78	--		.5	
Tie Fork Canyon (gaging station 09317920)	67	10- 3-78	--	-1	.5	-2.2
Little Bear Canyon	70	10-13-78	--		.2	
Huntington Creek	71	10- 3-78	36		--	
Mill Fork Canyon	76	10- 6-78	--		0	
Rilda Canyon	78	10- 6-78	--	+3	.1	+2.8
Trail Canyon	79	11- 9-78	--		.03	
Bear Creek	81	10-25-78	--		.08	
Huntington Creek	82	10- 3-78	39		--	

On September 20, 1979, streams in Marinus, Mill, Dairy, Meetinghouse, and Trail Canyons had a combined flow of 0.07 cubic feet per second at their mouths along Cottonwood Creek. However, the reach of Cottonwood Creek between Indian Lodge and Trail Canyons was dry on that day. Flow of Cottonwood Creek is perennial downstream from spring (D-17-6)23aaa-S1.

Water quality

Chemical quality

Chemical analyses of selected surface-water samples collected during this study from the drainages of Huntington and Cottonwood Creeks are listed in table 6. Semiquantitative (approximate) concentrations of trace elements in selected surface-water samples are listed in table 12. No analyzed chemical constituents were present in concentrations that exceeded the drinking-water standards of the U.S. Environmental Protection Agency (1976).

The smallest observed dissolved-solids concentration in surface water in the Huntington Creek drainage during 1977-79 was 130 mg/L (milligrams per liter) at the outflow of Huntington Reservoir on Spring Creek (site 22); the largest was 503 mg/L near the mouth of Rilda Canyon (site 78). At gaging station 09318000 on Huntington Creek the observed dissolved-solids concentrations ranged from 175 mg/L during the snowmelt period in June 1979 to 289 mg/L during a period of base flow in August 1977.

During periods of base flow, there was little areal change in the chemistry of water in Huntington Creek and in the Left Fork of Huntington Creek because ground-water discharge was small in comparison to the water released from reservoirs. The predominant dissolved chemical constituents in water in Huntington Creek upstream from gaging station 09318000 were calcium and bicarbonate.

The predominant dissolved chemical constituents in water in tributaries to Huntington Creek were usually calcium, magnesium, and bicarbonate. However, during periods of base flow the concentrations of sulfate in water at the mouths of Deer Creek and Rilda Canyon were significantly higher than sulfate concentrations in water in Huntington Creek. Some of the discharge of these two streams at their mouths during periods of base flow is probably contributed by ground-water seepage from the Mancos Shale and the Star Point Sandstone of Cretaceous age. Water from the Star Point commonly contains slightly higher concentrations of both dissolved solids and sulfate than water from younger rocks in the area. Spring (D-16-7)22bbb-S1, which issues from the Star Point along the lower reaches of Mill Fork Canyon (pl. 1), contained 706 mg/L of dissolved solids and 290 mg/L of sulfate when sampled in September 1978.

During 1977-79, water samples were collected several times at site 103 upstream from the Trail Mountain Mine and at site 104 (gaging station 09324200) downstream from the mine (pl. 1). Chemistry of the water varied very little between the two sites. At site 103, observed dissolved-solids concentrations ranged from 276 mg/L in October 1977 to 355 mg/L in October 1979. At site 104 the dissolved-solids concentration ranged from 286 mg/L in October 1977 to 343 mg/L in October 1979. The predominant dissolved chemical constituents in all samples from both sites were calcium, magnesium, and bicarbonate.

Suspended sediment

As part of the Geological Survey water-monitoring program in Utah coal fields, 14 water samples were collected between August 1978 and September 1979 at gaging station 09318000 on Huntington Creek to determine suspended-sediment concentrations and loads. Three samples each were collected at gaging stations 09317919, 09317920, and 09324200 in Crandall and Tie Fork Canyons and on Cottonwood Creek. Five additional samples were collected by project personnel from these and other streams in the study area. Representative suspended-sediment concentrations and loads of streams in the study area are listed below:

			Suspended sediment	
Stream	Site No.	Date	Concentration (mg/L)	Load (tons per day)
Huntington Creek (gaging station 09318000)	88	8-13-78	104	27
		11-17-78	72	2.5
		6-13-79	114	66
		8- 7-79	44	15
Crandall Canyon (gaging station 09317919)	51	8-12-78	49	.14
		11-18-78	60	.08
		6-14-79	15	.41
		8- 6-79	56	.15
Tie Fork Canyon (gaging station 09317920)	67	8-13-78	12	.03
		11-18-78	57	.12
		6-14-79	38	.68
		8- 6-79	66	.17
Bear Creek	81	10-25-78	8,860	1.9
		6-14-79	2,140	4.0
Deer Creek	87	6-14-79	609	3.1
Cottonwood (gaging station 09324200)	104	8-15-78	5	.003
		11-19-78	130	.20
		8- 5-79	63	.09

Observed suspended-sediment loads at the gaging station on Huntington Creek ranged from 1.8 tons per day on February 18, 1979, to 66 tons per day on June 13, 1979. Observed suspended-sediment concentrations ranged from 29 to 181 mg/L. Sediment concentrations generally increased with increased stream discharge, but not enough data were available to compute daily sediment discharges.

Suspended-sediment concentrations varied widely in the study area. In most instances, however, the activities of man appeared to be associated with the higher concentrations. The relatively low concentrations of suspended sediment in the waters of Crandall and Tie Fork Canyons is attributed to a well-established channel and a scarcity of roads through the drainages. Conversely, in Deer Creek canyon large quantities of coal fines in the channel and erosion of unvegetated soils due to construction around the Deer Creek Mine are probably responsible for the relatively high suspended-sediment concentration in June 1979. Runoff down the heavily traveled dirt road below the Trail Mountain Mine is, in part, probably the cause of the sediment load in Cottonwood Creek in November 1978. The erosion of the large exposure of Mancos Shale in the lower reaches of the creek also contributes to high sediment load, especially during runoff from summer thunderstorms.

Bear Creek transported large quantities of suspended sediment during 1978 and 1979. Springs emerging from the North Horn Formation in the headwaters of Bear Creek continuously erode the shales and mudstone and permit sloughing of large amounts of fine-grained material from the escarpments.

Benthic invertebrates

Benthic invertebrates were collected at 16 stream sites (pl. 1) in October 1977, July and October 1978, and July and October 1979 to determine the number of organisms present and the species composition. The benthic-invertebrate samples are summarized in table 3, and the organisms identified in each sample are listed in table 7.

Previous studies (Chisholm and Downs, 1978; Fuller and others, 1978, p. 22-27; Cummins, 1973; Herricks and Cairns, 1973; and Patrick, 1949) have shown that benthic invertebrates may be used as an indicator of water quality, and changes in the benthic-invertebrate population may reflect changes in water quality. Benthic invertebrates were therefore collected to define existing conditions so that, if water-quality conditions change with increased coal mining, that change could be detected by changes in the benthic-invertebrate population.

The benthic invertebrates were generally collected using a Surber bottom sampler (Greeson and others, 1977, p. 172-3), which samples 1 square foot of stream bottom. Three samples were collected at each site in riffle areas (from the right side, middle, and left side of the stream). Where streams were too narrow to permit parallel sampling, the samples were taken from left to right in an upstream direction. The three samples were composited for the organism identification (table 7). Four samples collected in 1977 at sites 68, 69, 71, and 77 were attached to artificial substrate samplers (Hester and Dendy, 1962). The surface area of these samplers is 1 square foot. The samplers were anchored to the streambed in riffle areas in mid-July and removed for analyses in mid-October.

In the first set of samples, October 1977, identification generally was to the level of phylogenetic order, with a few organisms identified to the family level. In subsequent samples, identification generally was done to the genus level, with many organisms identified to the species level.

The Shannon-Weiner diversity index (Krebs, 1972, p. 506) for each sample is shown in table 3. Diversity index is used as an indicator of the "health" of the benthic-invertebrate population. In general terms, a diversity index (computed on the species level) of less than 1 indicates an unhealthy population and a polluted environment. Diversity indices approaching 3 generally indicate a healthy, well-balanced population and an unpolluted environment. The diversity index is most useful in evaluating aquatic environments that have been adversely affected by the addition of organic material but may be used to evaluate any effect on those environments.

A comparison of diversity indices may be used as an indication of differences in water quality, and the variation of the diversity index over time is an indication of the stability of the environment surrounding the benthic community. Sampling techniques, substrate material, flow velocities, and identification categories (order, family, genus, or species) must be similar before comparisons are valid.

The diversity index, DI, is calculated as:

$$DI = - \sum_{i=1}^{s} (P_i)(\log_2 P_i)$$

where P_i is the proportion of the total sample belonging to the i^{th} species and computed as N_i/N_s. N_i is the number of individuals in each species and N_s is the total number of individuals in all species, and s is the number of species.

A benthic-invertebrate population made up of only one species would have a diversity index of zero, whereas a population having more than one species has a diversity index greater than zero. The more evenly the individuals are divided among the species present, the higher the diversity.

Data indicate that there were significant seasonal differences in the benthic-invertebrate population at a given site in addition to areal differences. For example, at site 34 on the Left Fork of Huntington Creek which drains an undeveloped area, the diversity index ranged from 2.07 to 3.48 (table 3) in 1978-79. The minimum of 2.07 was due to a large number of Diaptomus sp. These organisms appeared in their maximum numbers in the July samples collected at sites in the higher altitudes of the study area, but they were not present in any of the October samples. The large numbers found in July, therefore, reflected a seasonal cycle rather than an unnatural condition that allowed one species to dominate.

The lowest observed diversity indices computed for 1978-79 (1.03) were from samples collected at site 76 in Mill Fork Canyon in October 1979 and at site 87 on Deer Creek in July 1978. Flow at both of these sites is low during late summer, and much of the streambed material is fine grained. At the Deer Creek site, a significant portion of the streambed material is fine coal derived from mining operations upstream. The sample collected at site 87 on Deer Creek in July 1979 indicated a relatively small, though diverse (diversity index of 3.37), benthic-invertebrate population.

Although the 1977 diversity indices cannot be compared to those of 1978 and 1979 because of different identification categories, it is of interest to examine the difference in the diversity index between sites 51 and 70. In spite of similar environmental conditions, the values differ by a fairly large margin (1.64 versus 0.91). Construction of a concrete enclosure in the summer of 1977 around spring (D-16-7)9cab-S1, a major source of water in the drainage, may have temporarily degraded the quality of water at the sampling site.

Table 3.--Summary of benthic-invertebrate samples collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79

Site no.: Shown on plate 1.
Diversity: Shannon-Weiner diversity index; see p. 24 for explanation.
No. of taxa: Phylogenetic level is species except in 1977, order.
No. of organisms: Collected with a Surber sampler (Greeson and others, 1977, p. 172-173) except as noted in some 1977 samples.

Location	Site No.	Date	Diversity	No. of taxa	No. of organisms
Left Fork Huntington Creek	34	10-12-77	1.89	7	1,130
		7-28-78	3.48	62	9,059
		10-17-78	3.48	32	786
		7-18-79	2.07	39	13,876
		10-15-79	3.19	33	4,612
Left Fork Huntington Creek	39	10-12-77	2.07	8	579
		7-26-78	1.30	38	8,512
		10-17-78	3.03	37	1,055
		7-19-79	2.73	37	6,391
		10-15-79	3.25	37	3,484
Huntington Creek	41	10-13-77	2.22	7	246
		7-26-78	2.46	38	4,450
		10-17-78	3.25	34	583
		7-19-79	3.15	42	5,640
		10-15-79	3.44	38	2,456
Crandall Canyon	51	10-12-77	1.64	6	150
		7-26-78	1.81	39	1,065
		10-18-78	2.83	23	310
		7-19-79	2.65	38	1,542
		10-15-79	2.98	32	721
Wild Cattle Hollow	61	10-13-77	1.45	6	709
		7-27-78	3.39	27	227
		10-17-78	3.68	32	723
		7-19-79	4.16	43	905
		10-15-79	3.45	39	1,552
Tie Fork Canyon	67	10-13-77	2.18	5	54
		7-26-78	3.29	39	834
		10-17-78	2.79	31	438
		7-19-79	3.59	42	516
		10-15-79	2.61	42	2,387
Huntington Creek	68	10-12-77[1]	2.03	8	132
		7-26-78	2.96	29	544
		10-17-78	3.68	32	479
		7-19-79	3.44	40	3,898
		10-15-79	1.82	37	3,712

Table 3.--Summary of benthic-invertebrate samples collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79--Continued

Location	Site No.	Date	Diversity	No. of taxa	No. of organisms
Huntington Creek	69	10-13-77[1]	1.80	5	86
		7-27-78	2.95	43	1,723
		10-18-78	3.19	33	578
		7-19-79	2.89	35	5,500
		10-16-79	3.10	40	3,936
Little Bear Canyon	70	10-13-77	.91	6	186
		7-27-78	2.32	18	249
		10-18-78	2.33	26	295
		7-19-79	3.03	34	998
		10-16-79	3.14	30	642
Huntington Creek	71	10-13-77[1]	1.95	5	109
		7-27-78	3.70	51	1,151
		10-18-78	2.95	40	712
		7-19-79	3.00	30	2,912
		10-16-79	3.11	37	2,345
Mill Fork Canyon	76	7-28-78	2.41	21	284
		7-19-79	2.83	32	1,056
		10-16-79	1.02	21	878
Huntington Creek	77	10-13-77[1]	2.31	6	149
		7-28-78	3.43	43	523
		10-18-78	2.64	28	569
		7-19-79	3.35	36	3,032
		10-16-79	3.09	45	4,523
Rilda Canyon	78	10-13-77	1.77	5	48
		7-26-78	3.21	31	374
		10-18-78	2.48	29	2,094
		7-18-79	3.88	36	396
		10-16-79	2.85	37	1,306
Deer Creek	87	7-28-78	1.03	8	156
		7-18-79	3.37	22	259
Cottonwood Creek	103	10-13-77	1.02	5	179
		7-27-78	1.80	16	323
		10-19-78	2.69	31	626
		7-18-79	3.68	33	239
		10-16-79	2.70	32	907
Cottonwood Creek	104	10-13-77	1.40	5	139
		7-27-78	1.96	17	985
		10-19-78	1.38	19	1,216
		7-18-79	3.02	37	756
		10-16-79	1.19	24	832

[1]Sample collected on artificial substrate multi-plate sampler (Hester and Dendy, 1962).

GROUND-WATER SYSTEM

Occurrence of ground water

Ground water occurs in all the geologic units listed in table 1, but none of the units are saturated everywhere. Rocks commonly are drained within short lateral distances from the walls of deeply incised canyons. Local exceptions occur where perched(?) ground water[1] is discharged by springs along canyon walls. This condition occurs in the coal-bearing Blackhawk Formation and overlying geologic units but is most common in the North Horn Formation of Cretaceous and Tertiary age.

In most cases, however, data are not available to prove if water in the overlying units is part of a continuous saturated zone or whether unsaturated zones occur between units and some water is perched. Many holes have been drilled in the study area to evaluate the coal resource, but those holes provided few reliable ground-water data from which to define the ground-water system. For instance, when an interval of a test hole was reported as being "dry," it is not certain whether the rock was unsaturated or was saturated but not permeable enough to yield detectable amounts of water while drilling.

Many springs issue from the North Horn Formation on the southern slopes of East Mountain (pl. 2), and many are at an altitude of about 9,300 feet. Evidence of seepage from the North Horn near Mill Canyon on the northwest slopes of East Mountain (fig. 8), and at approximately the same altitude, indicates that at least one of the perched(?) water-bearing zones may be extensive.

Other rocks in East Mountain also contain water. Drillers commonly report water in the Castlegate Sandstone of Cretaceous age. Here again, it is uncertain if this water-bearing zone is perched.

Data from coal-exploratory holes, springs, and underground mines indicate that an extensive aquifer exists in the Star Point Sandstone of Cretaceous age and, in some areas, the aquifer extends into the lower coal-bearing part of the Blackhawk Formation. Water produced in the Wilberg, Deer Creek, and King Mines is from the aquifer, herein referred to as the Star Point-Blackhawk aquifer. Ground-water levels and data from coal exploration

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[1]As defined by Lohman and others (1972, p. 7), " * * * perched ground water is unconfined ground water separated from an underlying body of ground water by an unsaturated zone. Its water table is a perched water table. It is held up by a perching bed whose permeability is so low that water percolating downward through it is not able to bring water in the underlying unsaturated zone above atmospheric pressure."

"Perched ground water may be either permanent, where recharge is frequent enough to maintain a saturated zone above the perching bed, or temporary, where intermittent recharge is not great or frequent enough to prevent the perched water from disappearing from time to time as a result of drainage over the edge of or through the perching bed."

Figure 8.--Area of seepage from the North Horn Formation near Mill Canyon on the northwest slopes of East Mountain. Band of seepage may be seen as area of dark-colored vegetation across center of photograph. View facing southeast.

holes, drill holes in mines, and a spring in the King Mine are summarized as follows:

Location	Geologic units penetrated	Depth of hole (feet)	Top of hole	Spring orifice	Top of Star Point Sandstone	Water surface	Date of measurement	Remarks
(D-15-7)24cab	—	—	—	8,815	—	8,185	9-31-78	Water emerging from floor of mine at Bear Canyon Fault.
24cdd-1	Blackhawk Formation	118	8,142	—	8,027	8,142	9-31-78	Flowing drill hole in floor of King Mine.
(D-15-8)19bcb-1	do.	135	8,248	—	8,070	8,120	10-11-79	Drill hole into floor of King Mine.
(D-16-7)29bbb-1	Alluvium Blackhawk Formation Star Point Sandstone	300	8,045	—	7,850	7,854	8-28-79	Coal-exploration hole, 4-inch perforated casing, gravel packed, soft surface cement. Water-bearing rock at 150 feet.
(D-17-6)24dcd-1	do.	280	7,418	—	7,319	7,371.5 7,371.7 7,371.2 7,372.5	4- 4-79 5-10-79 6- 7-79 9-18-79	Coal-exploration hole, 4-inch perforated casing, gravel packed, 50 feet surface cement. Water-bearing rock at 100-110 feet.
(D-17-7)27bbc-1	Star Point Sandstone	150	7,630	—	7,630	7,609	6-14-79	Drill hole into floor of Wilberg Mine.

In addition, exploratory hole (D-17-6)3ddd-1 at the mouth of Dairy Canyon may have tapped the Star Point-Blackhawk aquifer, and water flowed from the hole under "artesian pressure" (Davis and Doelling, 1977, p. 36). Several of the largest springs in the study area, such as (D-14-6)24adc-S1 and 2, (D-15-7)35cbc-S1, (D-16-7)9cad-S1 and 26adc-S1, issue from the Star Point-Blackhawk aquifer. The data necessary to determine whether or not the Star Point-Blackhawk aquifer is perched are not available.

Recharge

Snow in the higher altitudes of the study area commonly accumulates to depths of 6 feet or more, and snowmelt is the primary source of recharge to the ground-water system. To determine the source of recharge, several samples of water from rain, snow, springs, and mines were analyzed for concentrations of deuterium (a stable hydrogen isotope that has twice the mass of ordinary hydrogen). The results of the analyses, summarized in table 8, show that deuterium concentrations were similar in mine, spring, and snow waters but were different in rain water. Thus, it is concluded that most, if not all, ground water in the study area is derived from snow.

The amount of ground-water recharge varies in the study area, not only because of differences in the water content of snowpack, but also because of differences in surface relief and rock permeability. Low surface relief, as on the top of East Mountain as shown in figure 9, slows the runoff from snowmelt and allows large quantities of water to infiltrate the soils and percolate to deeper levels. On the top of East Mountain, the snowmelt rapidly percolates into fractures and solution openings in the Flagstaff Limestone.

Figure 9.--View of the top of East Mountain showing the low surface relief on the outcrop of the Flagstaff Limestone. View facing southeast.

On Candland and Seeley Mountains, steep slopes promote rapid snowmelt runoff and reduce recharge to the ground-water system. Unlike East Mountain, these two mountains are not capped by the permeable Flagstaff Limestone but instead are capped mainly by less permeable rocks in the Price River and Blackhawk Formations. The relatively small amounts of ground-water recharge are reflected in the small number of springs on these two mountains.

Surface relief on the tops of Trail and Gentry Mountains is low because there is not an extensive outcrop of Flagstaff Limestone. Therefore, recharge to Trail and Gentry Mountains probably is intermediate to the recharge that occurs on East Mountain and on the steep slopes of Seeley Mountain. The amount of recharge on Trail and Gentry Mountains probably is reflected in the number of springs in these two areas, most of which issue from the North Horn Formation.

Recharge to the Star Point-Blackhawk aquifer from direct infiltration of snowmelt on areas of outcrop probably is small in comparison to direct recharge to the Flagstaff Limestone. In the southern part of the study area, outcrop areas of the Blackhawk Formation and Star Point Sandstone usually are less than about 1 mile wide, and they are usually on steep slopes. Most of the recharge to the aquifer in the southern part of the area probably is from downward percolation of water, mainly along faults and fractures from overlying water-bearing zones. In the northern part of the area, the Blackhawk and Star Point are exposed over a much greater (and wetter) area than in the southern part. Many more springs issue from the Blackhawk and Star Point in the northern part of the area, generally reflecting the greater amount of recharge on their outcrops.

Some water may enter or leave the study area by subsurface flow. The Pleasant Valley, Joes Valley, and Trail Canyon Faults (pl. 2) may act as the major conduits for this interbasin movement of ground water.

Movement of ground water

Ground water generally moves from areas of recharge in the higher parts of the study area to areas of natural and manmade discharge, chiefly along streams and in coal mines. Geologic structure, such as faulting and the dip of bedding, in some areas influences the flow path followed between recharge and discharge areas. Most water movement through the ground-water system probably occurs through fractures, through openings between beds, and in the case of the Flagstaff Limestone, through solution openings.

Much of the recharge from snowmelt in the higher parts of the study area is discharged by a large number of springs close to the original recharge areas. The downward movement of water commonly is impeded by poorly permeable beds of shale and mudstone in the North Horn, Price River, and Blackhawk Formations. The water is discharged by springs and seeps where the less permeable rocks crop out at land surface.

Along faults where rock permeability has been increased by fracturing, water passes through beds that normally would impede vertical flow and into underlying rocks such as the Star Point-Blackhawk aquifer. Many of the large springs in the area issue from the Star Point-Blackhawk aquifer where it is faulted. The aquifer also yields the largest quantities of water to underground coal mines where the mine workings penetrate fractured rock.

Some water probably enters and leaves the drainages of Huntington and Cottonwood Creeks by subsurface movement mainly through fractured rock along faults. Subsurface movement of ground water may partly explain the differences in annual discharge per unit area at the four gaging stations in the study area during the 1979 water year. Discharges per unit area were less at gaging stations 09317920 and 09324200 in Tie Fork Canyon and on Cottonwood Creek than at gaging stations 09317919 and 09318000 in Crandall Canyon and on Huntington Creek. As noted earlier, differences in topography and evaporation and sublimation of the snowpack could account for this; however, it may also be due in part to interbasin transfer of water along faults or by mine drainage.

Some water probably leaves the Cottonwood Creek basin through a fractured permeable zone along the Joes Valley fault. Movement of water along the fault in the Emery area (about 30 miles south of the Cottonwood Creek drainage) is indicated by pressure gradients and the chemistry of water from the Ferron Sandstone of the Mancos Shale of Cretaceous age (Lines and Morrissey, 1981, p. 58, 71). Some ground water probably leaves the Tie Fork Canyon drainage through permeable zones along the Bear Canyon Fault, where it is diverted from the Tie Fork drainage by the King Mine to the Miller Creek drainage east of the study area.

Folds in the rocks apparently also control the movement of ground water. For example, ground water may move downdip along the Straight Canyon Syncline (pl. 2) into Cottonwood Creek between sites 99 and 100 (pl. 1). Discharge measurements (table 5) made in September 1978 and August 1979 indicate that more than half of the base flow in Cottonwood Creek originates as ground-water seepage within this reach.

The rate at which water moves through the ground-water system depends largely on the permeability of the rock through which water flows. It may take only a few days for water to flow through solution cavities in the Flagstaff Limestone from recharge area to discharge point; it may take years for water to travel the same distance through the less permeable Blackhawk Formation. Six water samples from the Star Point-Blackhawk aquifer were collected in 1979 from seepage areas inside the King and Wilberg Mines and from springs (D-16-7)9cab-S1 and 22bbb-S1. All six samples contained detectable concentration of tritium,[1] indicating that at least some of the water had been recharged to the system within the past 10 to 30 years.

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[1]Tritium, a radioisotope of hydrogen with an atomic weight of 3, has a half-life of 12.33 years. Tritium can be detected in water in concentrations as low as about 6 picocuries per liter (about 0.2 radioactive disintegrations per second per liter of water). Prior to nuclear weapons testing in the early 1950's, natural tritium levels were about 26 picocuries per liter. Tritium levels reached a peak in the Northern Hemisphere in 1963 when concentrations in the atmosphere exceeded the natural level by approximately three orders of magnitude (Thatcher, and others, 1977, p. 8).

Rapid movement of water through the ground-water system is indicated by the rapid response of spring discharge to changes in recharge. Generally, prior to construction of Electric Lake in 1972, most of the discharge of Huntington Creek during the fall of each year was derived from ground-water discharge. As shown in figure 6, the magnitude of base flow at gaging station 09328000 during November correlates well with the water content of the previous April 1 snowpack; it reflects a rapid response in base flow to melting of the snow and resulting ground-water recharge.

Discharge

Ground water in the study area is discharged naturally by springs and seeps and by evapotranspiration. Some water also may leave the drainages of Huntington and Cottonwood Creeks by subsurface flow, mainly along faults. The only known manmade diversion from the ground-water system in 1979 was dewatering of underground coal mines.

It is not possible with existing data to accurately estimate the amount of ground water evaporated or transpired by plants, or to determine the amount of subsurface outflow from the study area. Data are available, however, to describe the different types of springs and to describe how spring discharges naturally change with time. In some cases, existing data also allow for accurate estimates of mine discharges.

This discussion will concentrate on spring and mine discharges, both critical elements of the ground-water system that can be quantified and that are most likely to change with increased coal mining.

Springs

Most springs in the study area that discharge more than about 50 gallons per minute are associated with faulting and folding where rock permeability has been increased by fracturing. For example, spring (D-17-7)5cad-S1, the largest one on East Mountain, issues from the North Horn Formation where faulted (pl. 2). The spring is shown in figure 10.

Large springs that issue from the Star Point-Blackhawk aquifer where faulted include (D-16-7)26adc-S1 near the Bear Canyon Fault, (D-15-7)35cbc-S1 near the Trail Canyon Fault, and (D-14-6)24adc-S1 and 2 near the Valentine Fault. Large springs that issue from the Star Point-Blackhawk aquifer where fracturing probably is associated with folding include (D-16-7)9cad-S1 and (D-17-6)3ddc-S1 and 23aaa-S1. Fractures in the Star Point Sandstone near spring (D-16-7)9cab-S1 are shown in figure 11.

The discharge of springs varies seasonally as illustrated in figure 12 for spring (D-17-6)23aaa-S1. The spring issues from the Star Point-Blackhawk aquifer about 0.6 mile northwest of the axis of the Straight Canyon Syncline (pl.2). Like other springs in the study area, the discharge was greatest during the snowmelt period in the spring. Following periods of ground-water recharge, the discharge of the spring gradually receded. At the end of the water year, the discharge was only about 60 percent of the peak discharge that occurred during the middle part of the previous June.

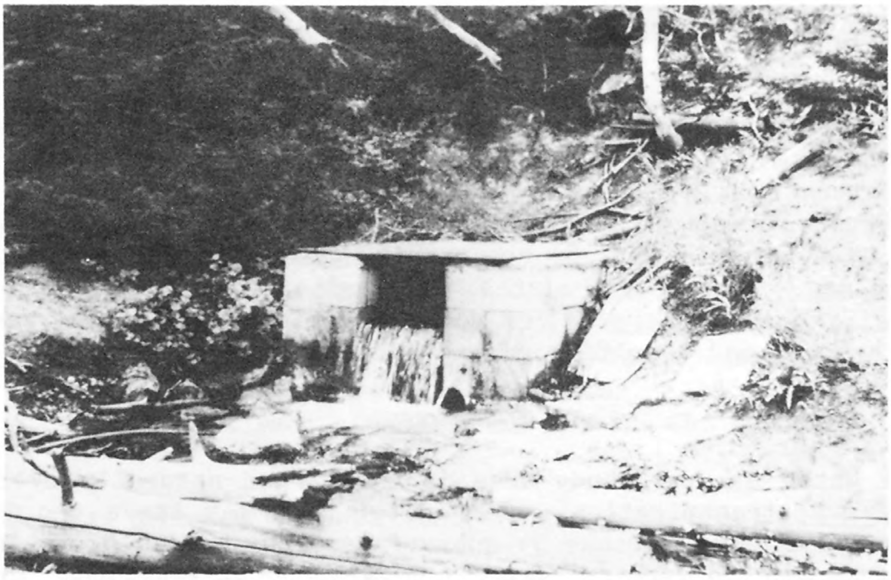

Figure 10.--Spring (D-17-7)5cad-S1, the largest one on East Mountain, issues from the North Horn Formation where faulted. Discharge at time of photograph was 120 gal/min.

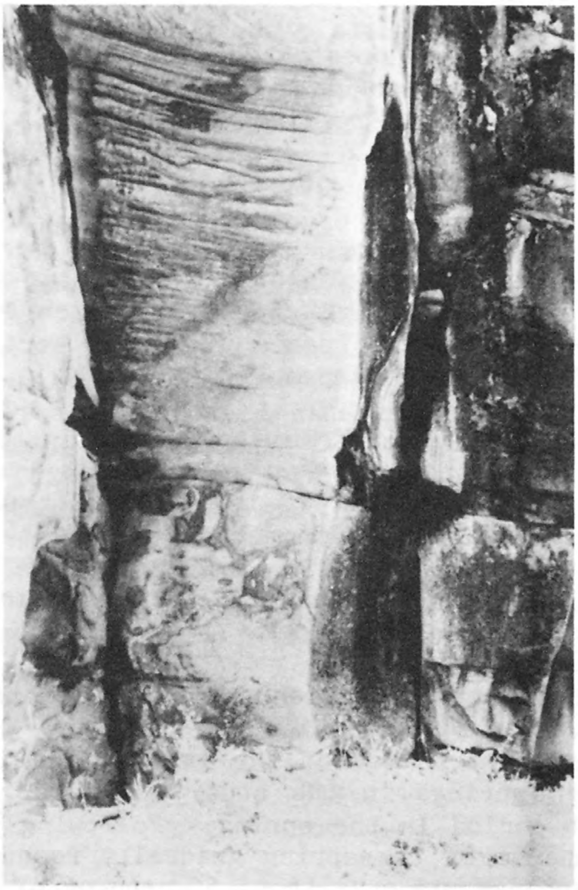

Figure 11.--Fractures in the Star Point Sandstone near spring (D-16-7)9cab-S1.

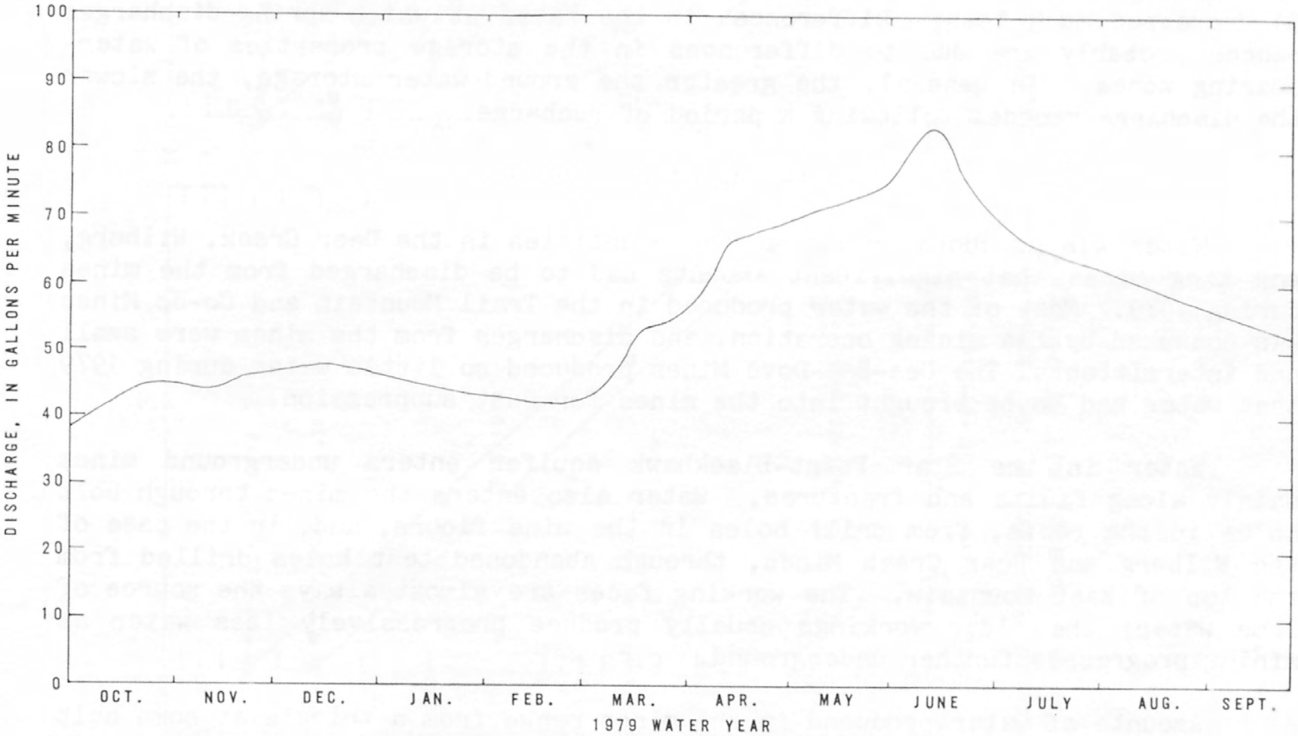

Figure 12.— Discharge of spring (D-17-6)23aaa-S1, water year 1979.

The recession of discharge following periods of snowmelt recharge is shown in figure 13 for three springs on East Mountain. Spring (D-17-6)1daa-S1 issues from the Flagstaff Limestone, and springs (D-17-7)5cad-S1 and 17dba-S1 issue from the North Horn Formation. At each of the three springs, the discharges during the summer and fall of 1978 and 1979 receded at the same rate (recession curves were parallel). Discharge measurements that plotted off the recession curves are believed to be due to measurement error. Discharges from the three springs on East Mountain recede more rapidly than the discharge of spring (D-17-6)23aaa-S1 (fig. 12) that issues from the Star Point-Blackhawk aquifer; their discharges decreased about one order of magnitude during the summer and early fall, whereas the discharge of (D-17-6)23aaa-S1 decreased much less. Differences in the rates at which spring discharges recede probably are due to differences in the storage properties of water-bearing zones. In general, the greater the ground-water storage, the slower the discharge recedes following a period of recharge.

Dewatering of coal mines

Water was produced in sufficient quantities in the Deer Creek, Wilberg, and King Mines that significant amounts had to be discharged from the mines during 1979. Most of the water produced in the Trail Mountain and Co-op Mines was consumed by the mining operation, and discharges from the mines were small and intermittent. The Des-Bee-Dove Mines produced so little water during 1979 that water had to be brought into the mines for dust suppression.

Water in the Star Point-Blackhawk aquifer enters underground mines mainly along faults and fractures. Water also enters the mines through bolt holes in the roofs, from drill holes in the mine floors, and, in the case of the Wilberg and Deer Creek Mines, through abandoned test holes drilled from the top of East Mountain. The working faces are almost always the source of some water; the older workings usually produce progressively less water as mining progresses further underground.

Amounts of water produced in the mines range from a trickle at some bolt holes in the roofs to several hundred gallons per minute at some faults. Water may flow from some discharge points for only a few days and from others for the life of the mine, depending on the amount stored in the rock and the degree of hydraulic connection to sources of recharge.

Wilberg Mine.--In November 1979, water production in the Wilberg Mine was estimated at about 450 gallons per minute. Most of the water was entering the mine at the working faces, through bolt holes in the roof as shown in figure 14, and through fractures in the mined coal seam in older workings. Some water was also flowing from the mine floor at the Pleasant Valley Fault and from an abandoned test hole, (D-17-7)28aad-1, drilled from the top of East Mountain. Water was discharged from the mine into Grimes Wash.

A test hole, (D-17-7)27bbc-1, was drilled into the floor of the mine to a depth of 150 feet. Periodic measurements during the summer of 1979 indicated a constant water level of 21 feet below the mine floor at an altitude of about 7,610 feet. Dewatering of the Star Point-Blackhawk aquifer by the mining operation probably has lowered the potentiometric surface to this altitude, but the areal extent of the lowering is unknown.

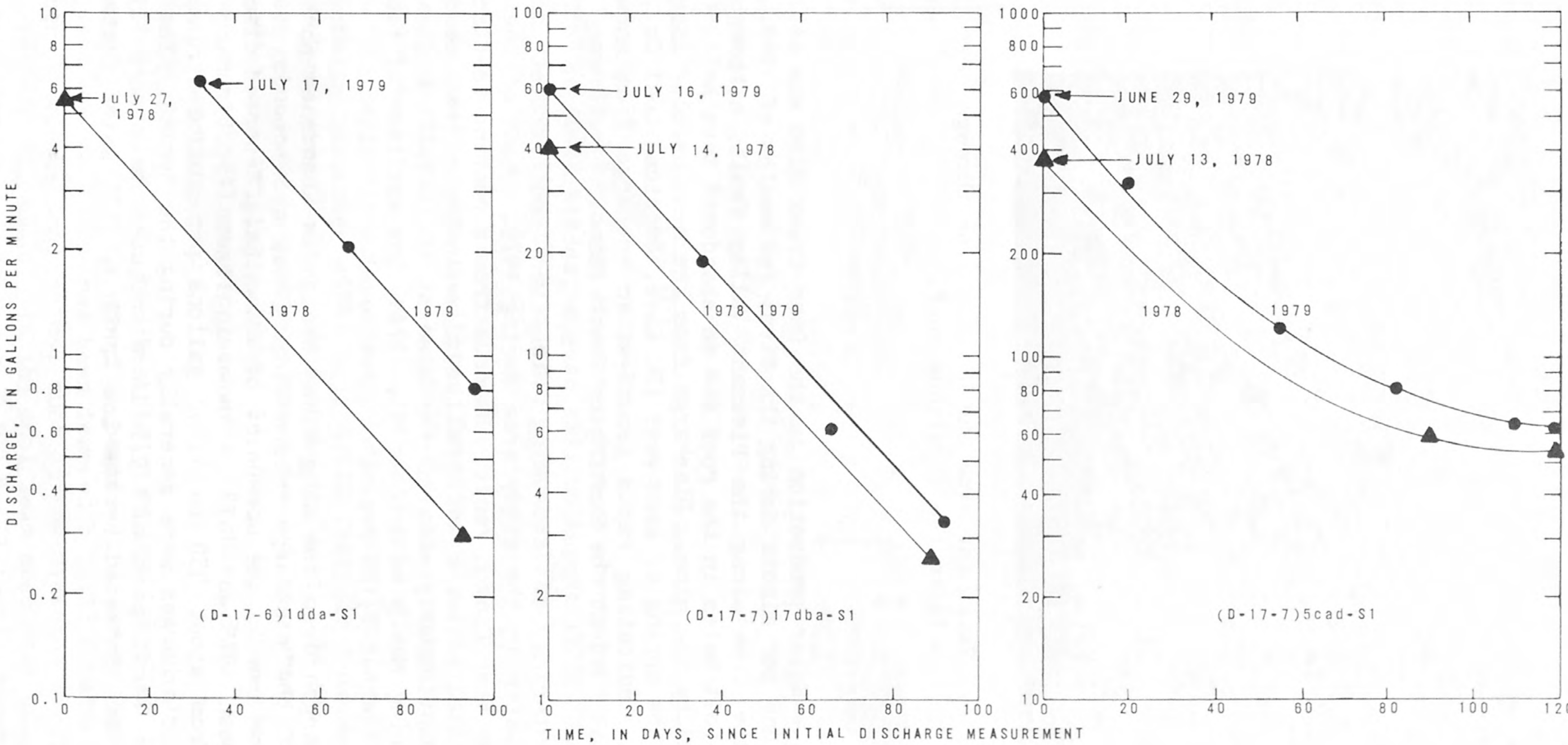

Figure 13.--Discharge-recession curves for three springs on East Mountain during the summer and fall of 1978 and 1979.

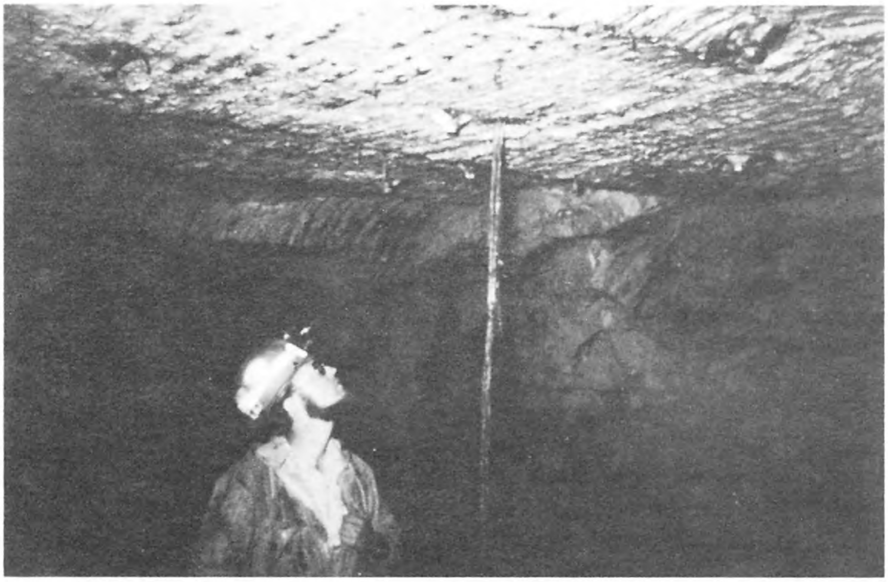

Figure 14.--Water entering the Wilberg Mine through a bolt hole in the sandstone roof.

Deer Creek Mine.--Water production in the Deer Creek Mine was estimated to be about 160 gallons per minute during the first few months of 1980. Most water was entering the mine along the Pleasant Valley Fault, although some also entered through bolt holes in the roof and an abandoned test hole, (D-17-7)16cdd-1, intercepted by the mine. Discharge from the mine usually increases substantially during the spring of each year (D. Cave, American Coal Co., oral commun., June 1979), indicating rapid ground-water recharge from snowmelt. Water from the mine was used at the Huntington Power Plant.

King Mine.--Dewatering of the King Mine was the largest manmade discharge of ground water in the study area during 1979. Much of the water enters the mine at the Bear Canyon Fault. Records from a continuous-discharge recorder that was installed on a weir in the mine indicate that about 140 gallons per minute continuously entered the mine at (D-15-7)24cab along the Bear Canyon Fault during May 9 to October 11, 1979. The altitude of the mine floor at this point is about 8,185 feet above sea level.

Water is discharged from the King Mine through an abandoned portal at (D-16-8)8dda. Some of the discharge enters Cedar Creek and some is diverted through a pipeline for use in the community of Hiawatha. Reported discharge from the portal between 1975 and 1978 is shown in figure 15. Discharge from the portal ranged from about 350 to 1,100 gallons per minute during this period, and the peak discharges were generally during the spring. The lower discharge during the first part of 1977 is attributed to abnormally low precipitation, which is indicated by the low April 1, 1977 water content of snowpack (fig. 6).

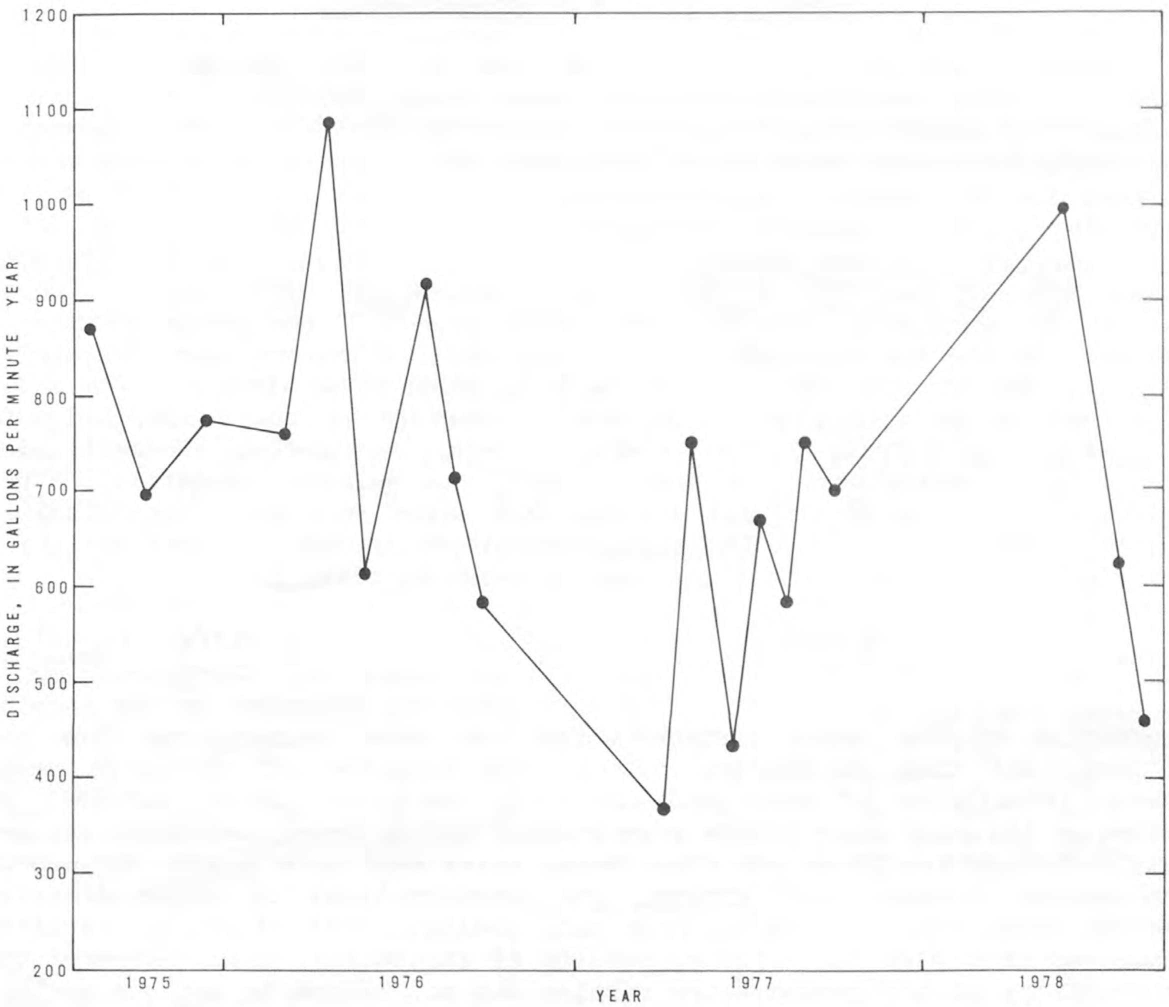

Figure 15.— Reported discharge from an abandoned portal of the King Mine at (D-16-8)8dda, August 1975 to August 1978. (Bob Eccli, United States Fuel Co., written commun., 1978.)

Water levels were available from three points in the workings of the King Mine: A flowing test hole (D-15-7)24cdd-1, water emerging from the floor at (D-15-7)24cab, and a drill hole into the floor of the mine at (D-15-8)19bcb-1. Respective altitudes of the water levels were 8,142 feet, 8,185 feet (both in September 1978), and 8,120 feet (in October 1979). These data indicate local ground-water movement to the east. In the vicinity of the King Mine the ground water probably moves toward the abandoned portal at (D-16-8)8dda which was initially opened in 1908. All water encountered in the mine is directed to the lowest point (altitude about 7,800 feet) from where it is discharged from the mine.

The water level in the test hole at (D-15-8)19bcb-1 was 135 feet below the mine floor. This is probably because the potentiometric surface in the vicinity of the test hole has been lowered by: (1) dewatering of mine workings in deeper mined-out coal seams, such as the Hiawatha seam, and (2) dewatering of the mine working downdip in the coal seam presently being mined. The lower (Hiawatha) seam (altitude about 8,100-8,140 feet), about a quarter of mile southeast of the test hole, has been mined out for several years.

Chemical quality of ground water

Chemical analyses of water samples from about 140 springs are shown in table 10. Field determinations of pH, temperature, specific conductance, and alkalinity of other spring waters are listed in table 9. Dissolved-solids concentrations ranged from 50 to 750 mg/L. Although no water samples were analyzed for all chemical constituents, no constituents were found in concentrations that exceeded recommended drinking-water standards (U.S. Environmental Protection Agency, 1976). The predominant dissolved chemical constituents in most spring waters were calcium and bicarbonate. Concentrations of magnesium, commonly were about one-half the concentrations of calcium. In the northern part of the study area, concentrations of dissolved sodium generally were less than 10 mg/L in water from springs. The sodium concentrations in spring waters tended to increase to the south, and water from one spring on Trail Mountain contained 94 mg/L of sodium. Concentrations of sulfate generally were less than 40 mg/L, but sulfate concentrations were typically higher in water from springs that issue from Star Point-Blackhawk aquifer below coal seams. The areal variability in the chemical quality of spring waters throughout the study area is shown on plate 2.

The chemical characteristics of spring waters from different geologic units in the study area are summarized in table 4. Concentrations of dissolved chemical constituents in ground water are dependent on the chemical composition of the rocks through which the water passes, the flow path followed, and time in storage between the recharge and discharge areas. Because lithologies of most geologic units change in short distances and because of the complexity of the ground-water system where some water may move rapidly through fractures and other water moves much more slowly through the pore spaces between sand grains, the concentrations of major dissolved chemical constituents in water from each geologic unit is highly variable. Because of this high variability, results of statistical tests indicate that the chemistry of the ground-water samples was not unique to any one geologic unit, at least over a large area.

Several water samples were collected from the Star Point-Blackhawk aquifer in the Wilberg and Deer Creek Mines during 1978 and 1979. Chemical analyses of these samples, as well as analyses of water from the King and Trail Mountain Mines and of well water, are listed in table 11.

The quality of ground water entering the Wilberg and Deer Creek Mines during 1978-79 is shown in figure 16. In the Wilberg Mine, coal is mined from the Hiawatha seam at the base of the Blackhawk Formation; in the Deer Creek Mine, coal is mined from the Blind Canyon seam which averages about 70 feet above the base of the Blackhawk. In both mines, as shown in figure 16, the dissolved-solids concentration of ground water entering the mines generally increased from the north to the south. In the Deer Creek Mine, increased dissolved-solids concentrations mainly were due to increased concentrations of calcium and bicarbonate; in the Wilberg Mine, they also were due to significant increases in the concentrations of magnesium and sulfate.

The pattern of increasing dissolved solids in water entering the Wilberg and Deer Creek Mines probably reflects differences in the time that the water has been held in transient storage; it also may indicate north to south movement of ground water near the mines; however, potentiometric-surface data are not available to determine the natural (or mining induced) direction of ground-water movement in this area.

Table 4.—Summary of chemical characteristics of spring waters from different water-bearing zones in and adjacent to the upper drainages of Huntington and Cottonwood Creeks

	pH (units)	Temperature (°C)	Milligrams per liter Dissolved calcium	Dissolved magnesium	Dissolved sodium	Dissolved potassium	Dissolved chloride	Dissolved sulfate	Dissolved solids	Bicarbonate
North Horn Formation										
No. Samples	51	51	51	51	51	51	51	51	43	51
Mean	7.5	6.3	61	29	19	.9	9.8	32	290	320
Minimum	6.3	.1	15	2.0	1.2	.2	1.2	2.1	63	49
Maximum	8.5	17.0	100	63	94	1.9	54	180	633	500
Price River Formation										
No. Samples	18	18	18	18	18	18	18	18	17	18
Mean	7.5	6.3	63	18	5.7	1.3	5.1	23	220	260
Minimum	6.5	3.8	12	2.9	1.4	.4	1.5	3.7	50	39
Maximum	8.2	16.0	87	51	39	3.4	18	120	524	427
Castlegate Sandstone										
No. Samples	9	9	9	9	9	9	9	9	9	9
Mean	7.5	5.6	60	29	7.1	1.3	5.6	33	290	300
Minimum	7.1	2.2	41	14	2.1	.9	3.6	4.0	163	183
Maximum	8.1	7.5	79	41	23	2.4	14	110	385	370
Blackhawk Formation										
No. Samples	31	31	31	31	31	31	31	31	30	31
Mean	7.4	6.1	57	19	4.1	1.1	4.3	21	220	250
Minimum	6.3	.1	15	2.0	1.2	.2	1.2	2.1	53	49
Maximum	8.1	13.0	98	52	16	3.5	16	120	539	460
Star Point Sandstone										
No. Samples	19	19	19	19	19	19	19	19	18	19
Mean	7.3	6.6	75	40	8.0	2.0	6.9	77	370	350
Minimum	6.8	2.8	48	3.0	.1	.9	2.7	13	213	244
Maximum	8.4	11.0	120	89	26	4.9	27	300	750	427
All Units										
No. Samples	128	128	128	128	128	128	128	128	132	128
Mean	7.5	6.3	62	27	11.0	1.2	7.1	34	295	300
Minimum	6.3	.1	12	2.0	.1	.2	1.2	2.1	50	39
Maximum	8.5	17.0	120	89	94	4.9	54	300	750	500

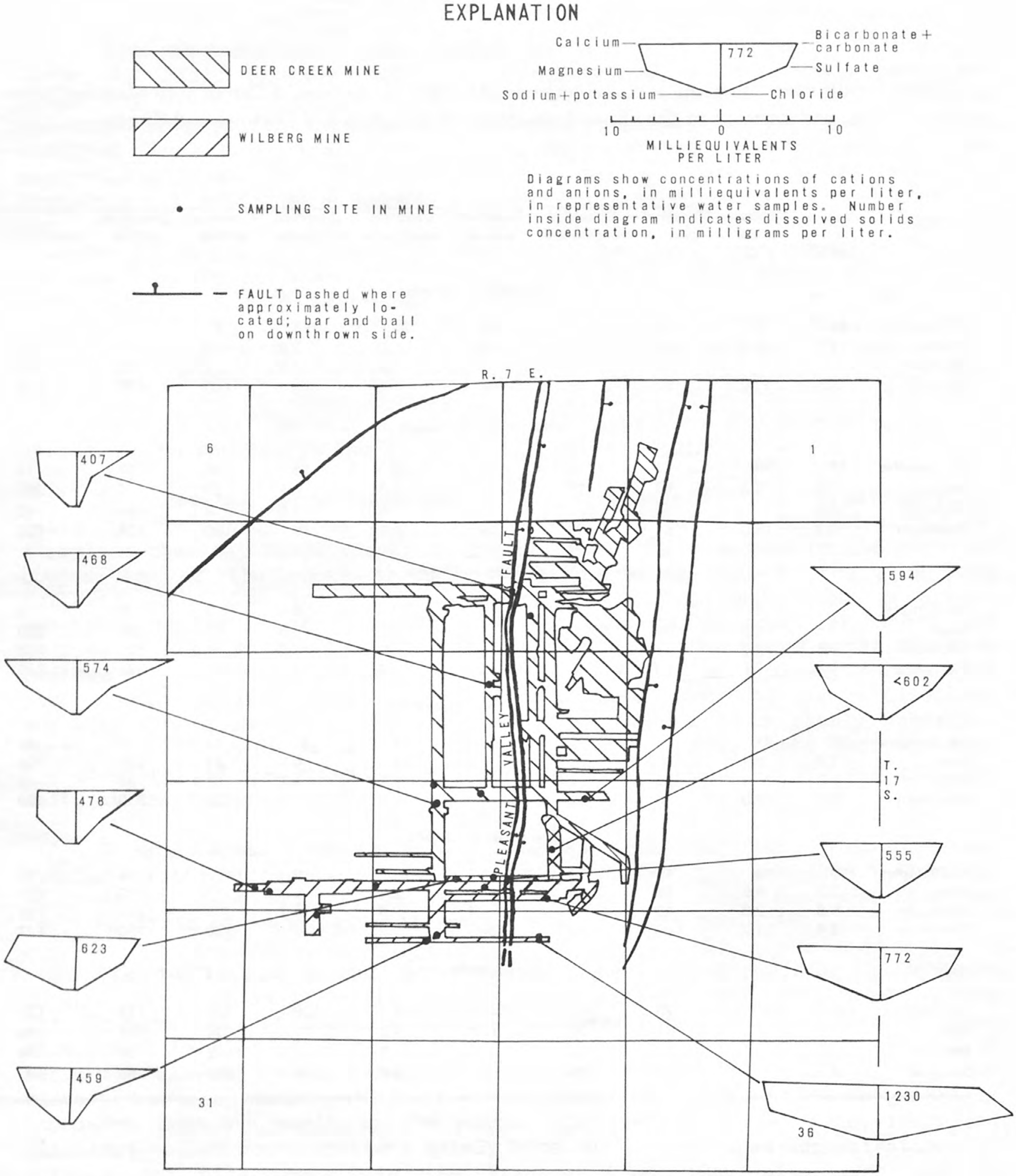

Figure 16.— Chemical quality of ground water entering the Wilberg and Deer Creek Mines, 1978-79. (Outlines of mines and faults supplied by Utah Power & Light Co.)

HYDROLOGIC EFFECTS OF COAL MINING

The effects of underground coal mining on the water resources of the study area mainly are dependent on the amount of mine dewatering and the magnitude and areal extent of mine-related land subsidence. Increased sediment yield from the mine surface facilities (roads, parking lots, and coal-stockpile areas) is a potential impact on surface-water quality, but this can be minimized with proper construction, drainage, and maintenance techniques.

Predictions on the effects of mine dewatering are difficult to quantify with current understanding of the ground-water system. Aquifer characteristics, hydraulic connection between water-bearing zones, and directions of ground-water movement are not adequately defined. Much can be learned from histories of water production in existing mines but, in most cases, even this is poorly documented. The quality of ground water that will be encountered during future mining can be predicted with some degree of accuracy based on available chemical analyses of spring waters in the area.

Little detectable land subsidence had occurred in the study area through 1979. This probably is due to several factors including the almost exclusive use of the roof supporting room-and-pillar mining system, and the thickness and competency of overburden. During 1979, one section of coal in the Deer Creek Mine was being mined using the long-wall method. This method causes the roof of the mine to immediately collapse behind the mining machine. It allows recovery of coal that would be left for roof support by room-and-pillar mining, but the method could possibly induce more land subsidence.

Effects on ground water

Theis (1957, p. 3) points out that water discharged from a well must be balanced by an increase in recharge to the ground-water system, by a decrease in natural discharge from the system, by a decrease of ground water in storage, or by a combination of all of these. Water discharged from underground mines produces the same changes in the ground-water system as do wells. In the following discussion, Theis' explanation is used to describe the possible changes in the ground-water system that may result from removing water from the Star Point-Blackhawk aquifer by dewatering underground mines. The analysis is complicated somewhat by the possibility of subsidence and associated rock fracturing, which could cause an increase in the hydraulic connection between the aquifer and overlying water-bearing zones.

Ground water in storage in the Star Point-Blackhawk aquifer has decreased around all water-producing mines in the study area as indicated by the diminution of ground-water flow into the older working of active mines. Historic water-level data from observation wells, however, are not available to define the extent and degree of the depletion.

Where subsidence has not been extensive and where water-bearing zones that overlie the Star Point-Blackhawk aquifer are perched, it is unlikely that mine dewatering induces greater recharge to the ground-water system. Neither is it likely under these conditions that the flow of springs that issue from the perched zones or the rate of natural downward leakage into the Star Point-Blackhawk aquifer are affected by mine dewatering. However, natural recharge and discharge relationships can change if hydraulic connection between the perched zones and the Star Point-Blackhawk aquifer is increased by fracturing due to subsidence.

If there are water-bearing zones above the Star Point-Blackhawk aquifer that are not perched, then mine dewatering of the aquifer and the associated lowering of head in the aquifer will induce additional downward leakage from overlying zones. The increased downward leakage into the Star Point-Blackhawk aquifer will in turn be balanced by changes in recharge, discharge, and (or) water in storage in the aquifer and in the overlying water-bearing zones. All of the changes to the ground-water system become larger if hydraulic connection is increased by subsidence.

Effects on surface water

Dewatering of underground mines through 1979 probably has had only a minor impact on the quantity and quality of surface water in the study area. Where subsidence has not been extensive, it is unlikely that snowmelt runoff has been affected. However, changes in the natural ground-water flow system brought about by mine dewaterings may have changed the base flow of some streams. In some cases the flow of streams may have been increased, and in others it may have decreased. For example, dewatering of the King Mine probably diverts ground water into the drainage of Cedar Creek that normally would enter Huntington Creek, thus reducing the base flow of Huntington Creek. Streamflow in Grimes Wash downstream from the Wilberg Mine undoubtedly also is increased by discharge from the mine. This may also result in some reduction of base flow in Huntington Creek.

Natural ground-water discharge above the Huntington Creek gaging station may be assumed to be the average 1911-72 November discharge or about 30 cubic feet per second. Limited mine discharge data from the three largest water-producing mines (King, Wilberg, and Deer Creek Mines) indicates that combined discharge from those mines may approach 3 cubic feet per second or about 10 percent of the natural ground-water discharge. However, as mentioned earlier, much of the mine discharge is probably a depletion of ground-water storage, and it also may be an interruption of ground water moving out of the basin. Therefore, a 10-percent depletion of natural ground-water discharge by existing mines may be used as the upper limit of the current effect of mining on the discharge of Huntington Creek.

Chemical analyses of mine waters (table 11) indicate that they are of poorer chemical quality during most periods of the year than surface water in the mine areas. The impact on surface-water quality, however, is difficult to assess because it is not known where or how much of the water discharged from mines would naturally have been discharged by springs and seeps.

NEEDED STUDIES AND MONITORING

To fully assess hydrologic impacts throughout a mined basin, comprehensive studies are needed to define aquifer characteristics, potentiometric surfaces, directions of ground-water movement, hydraulic connection between water-bearing zones, and recharge-discharge relationships. Monitoring of water levels in properly constructed observation wells that each tap a single water-bearing zone is needed near existing mines and in areas proposed for mining. A detailed study of the past and present occurrence and quality of water in underground mines also is needed.

Continued monitoring of discharge and water quality at the four Geological Survey gaging stations in the study area should be useful in detecting major changes that may occur in the future, particularly in the drainages of Tie Fork and Crandall Canyons (basins not extensively mined as of 1979). Minor changes in surface-water quality probably can be detected and quantified only with monitoring of mine discharges.

As part of the Geological Survey hydrologic monitoring in the study area, base-flow measurements are made at sites throughout the drainages of Huntington and Cottonwood Creeks (Lines and Plantz, 1981, figs. 23, 26). If changes in natural ground-water discharge caused by mine dewaterings were great enough, the base-flow measurements would indicate the general area that had been impacted; but the diminution of flow of individual springs could not be quantified in most cases.

Discharge-recession curves could be used to detect unnatural changes in the flow of some springs. The magnitude and duration of spring discharge is controlled by the physical characteristics of the water-bearing zone supporting the flow. The magnitude of spring discharge is dependent directly on permeability and hydraulic head in the aquifer; the duration of spring discharge (the discharge recession) is related directly to storage in the aquifer. Because the physical characteristics of an aquifer normally do not change, a unique spring discharge should occur for each level of head. Moreover, as water drains from the aquifer, the discharge-recession curves should be similar (should be parallel) from year to year for similar ranges in discharge if the physical characteristics of the aquifer remain unchanged.

Care should be taken in selecting springs for monitoring. The discharge-recession curves of springs that are supported by more than one water-bearing zone may not be similar from year to year because of nonconformity of recharge to the different zones from year to year. Also, algae and plant roots could clog the plumbing in developed springs, resulting in an unnatural change in flow characteristics. Ideally, the monitoring of spring discharges should be in conjunction with water-level monitoring in observation wells, in order to detect recharge that may occur during the normal recession period that would alter the recession curve.

Periodic sampling of benthic invertebrates downstream from mine areas could be used to detect short-term slugs of pollutants that may enter streams. Samples collected thus far in the study area indicate that there was a fairly large variation in diversity of organisms at a given site, both from one season to the next and within the same season in different years. Additional samples are needed to adequately document natural variations that occur in the benthic-invertebrate population. Future changes then can be accurately evaluated.

Changes in water-quality parameters resulting from mining activities, such as changes in pH, dissolved solids, and trace metals, have been shown to affect benthic invertebrates (Fuller and others, 1978; Herricks and Cairns, 1973). Unnatural changes in the benthic-invertebrate population may be manifest by changes in diversity index, number of species, number of individual organisms, or the presence or absence of a particular species. Increases in the concentration of organic matter and sediment also affect benthic invertebrates. Members of the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Tricoptera (caddisflies) are especially susceptible to damage from increased sediment.

CONCLUSIONS

Annual discharge and the base flow of Huntington Creek correlate well with water content of the spring snowpack. There are large differences in the annual discharge of streams per unit area of drainage as there are large differences in annual precipitation throughout the study area. However, unlike the Huntington Creek basin where about 30 percent of the precipitation leaves the basin as streamflow, only about 2 percent left the Cottonwood Creek basin as streamflow during the 1979 water year. Differences in the ratio of annual discharge to precipitation are attributed mainly to differences in evaporation and sublimation of the snowpack. However, in some areas, such as in Tie Fork Canyon and in the Cottonwood Creek drainage, significant quantities of water also probably leave the basins by subsurface movement of water mainly along faults.

Surface water in the study area was of good chemical quality during 1977-79, and no analyzed chemical constituents were present in concentrations that exceeded drinking-water standards (U.S. Environmental Protection Agency, 1976). The major dissolved chemical constituents in most surface waters were calcium and bicarbonate, and dissolved-solids concentrations rarely exceeded 500 mg/L.

Ground water occurs in a number of water-bearing zones in the study area. The Star Point Sandstone and lower part of the Blackhawk Formation are saturated in most areas and comprise the aquifer that yields water to underground coal mines in the area. Water-bearing zones that overlie the Star Point-Blackhawk aquifer are probably perched in many areas, but this is not known for certain.

Snowmelt is the source of most ground-water recharge. Much of the recharge to the ground-water system is discharged by springs that issue from water-bearing zones above the Star Point-Blackhawk aquifer close to the original recharge areas. Most water moves through the ground-water system fairly rapidly through fractures in faulted areas, and most of the springs with the largest discharges issue from the Star Point-Blackhawk aquifer along faults. The faults also discharge large quantities of water in underground mines.

Dissolved-solids concentrations in water from about 140 springs in the study area ranged from 50 to 750 mg/L. The predominant dissolved chemical constituents in most spring waters were calcium and bicarbonate, and the chemical characteristics of water from the different water-bearing zones usually were very similar.

Dewatering of underground coal mines was the largest manmade discharge from the Star Point-Blackhawk aquifer in the study area during 1979. There has been some depletion of storage in the aquifer around water-producing mines, but water-level data are not available to define the extent of the depletion. Other possible impacts on the ground-water system due to mine dewatering include the diminution of spring flows that supply the base flows of streams and perhaps increases in ground-water recharge. Both of these impacts are more likely to occur in areas above the mines affected by fracturing due to subsidence.

Mine waters generally are of poorer chemical quality than stream waters in the mine areas during most periods of the year. The degree of degradation of the quality of streamflow owing to mining cannot be quantified, however, because it is not known how much or where the mine waters would have been discharged naturally by springs. It is unlikely that mine dewatering in the study area has had any adverse effect on the chemical quality of the ground water.

To fully assess the hydrologic impacts of underground mining, comprehensive studies of the ground-water system are needed in conjunction with monitoring of the quantity and quality of both surface and mine-discharge waters. Monitoring the discharge of individual springs to develop discharge-recession curves, in conjunction with water-level monitoring in properly constructed observation wells, is needed to detect possible unnatural changes in the ground-water system and to quantify unnatural changes in spring discharges. Benthic invertebrates, good indicators of the "health" of a stream, should be monitored to detect possible pollutants that may enter streams.

REFERENCES CITED

Chisolm, J. L., and Downs, S. C., 1978, Stress and recovery of aquatic organisms as related to highway construction along Turtle Creek, Boone County, West Virginia: U.S. Geological Survey Water-Supply Paper 2055, 40 p.

Craig, H., 1961, Isotopic variations in meteoric water: Science, v. 133, p. 1702-1703.

Cummins, K. W., 1973, Trophic relationships of aquatic insects: Annual Review of Entomology, v. 18, p. 183-206.

Davis, F. D., and Doelling, H. H., 1977, Coal drilling at Trail Mountain, North Horn Mountain, and John Peak areas, Wasatch Plateau, Utah: Utah Geological and Mineral Survey Bulletin 112, 90 p.

Fuller, R. H., Shay, J. M., Ferreira, R. F., and Hoffman, R. J., 1978, An evaluation of problems arising from acid mine drainage in the vicinity of Shasta Lake, Shasta County, California: U.S. Geological Survey Water-Resources Investigations 78-32, 39 p.

Greeson, P. E. chm. , and others, 1977, Methods for collection and analysis of aquatic biological and microbiological samples: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A4, 332 p.

Herricks, E. C., and Cairns, John, Jr., 1973, Rehabilitation of streams receiving acid mine drainage: Virginia Water Resources Research Center Bulletin 66, 284 p.

Hester, F. E., and Dendy, J. S., 1962, A multiple plate sampler for aquatic macroinvertebrates: Transactions of the American Fisheries Society, v. 91, p. 420-421.

Krebs, C. J., 1972, Ecology, the experimental analysis of distribution and abundance: New York, Harper and Row, 694 p.

Lines, G. C., and Morrissey, D. J., 1981, Hydrology of the Ferron sandstone aquifer and effects of proposed surface-coal mining in Castle Valley, Utah, with a section on Stratigraphy by T. A. Ryer and a section on Leaching of overburden by R. H. Fuller: U.S. Geological Survey Open-File Report 81-535, 108 p. (to be duplicated as U.S. Geological Survey Water-Supply Paper 2195).

Lines, G. C., and Plantz, G. G., 1981, Hydrologic monitoring in the coal fields of central Utah, August 1978-September 1979: U.S. Geological Survey Water-Resources Investigations 81-138, 56 p.

Lohman, S. W., and others, 1972, Definition of selected ground-water terms--revisions and conceptual refinements: U.S. Geological Survey Water-Supply Paper 1988, 21 p.

Mundorff, J. C., and Thompson, K. R., 1980, Reconnaissance of the quality of surface water in the San Rafael River basin, Utah: U.S. Geological Survey Open-File Report 80-574, 52 p. (to be duplicated as Utah Department of Natural Resources and Energy Technical Publication 72).

Patrick, Ruth, 1949, A proposed biological measure of stream conditions based on a survey of the Conestoga Basin, Lancaster County, Pennsylvania: Academy of Natural Sciences Proceedings, v. 101, p. 277-341.

Spieker, E. M., 1931, The Wasatch Plateau coal field, Utah: U.S. Geological Survey Bulletin 819, 210 p.

Stokes, W. L., ed., 1964, Geologic map of Utah: University of Utah, Salt Lake City, scale 1:250,000.

Sumsion, C. T., 1979, Selected coal-related ground-water data, Wasatch Plateau-Book Cliffs area, Utah: U.S. Geological Survey Open-File Report 79-915 (duplicated as Utah Basic-Data Report 32), 25 p.

Thatcher, L. L., Janzer, V. J., and Edwards, K. W., 1977, Methods for determination of radioactive substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A5, 95 p.

Theis, C. V., 1957, The source of water derived from wells, essential factors controlling the response of an aquifer to development: U.S. Geological Survey Ground Water Notes 34, 16 p. (published in 1940 by American Society of Civil Engineering in Civil Engineering, p. 277-280).

U.S. Environmental Protection Agency, 1976, National interim primary drinking water regulations: Washington, U.S. Government Printing Office, 159 p.

U.S. Geological Survey, 1954, Compilation of records of surface waters of the United States through September 1950, Part 9, Colorado River Basin: U.S. Geological Survey Water-Supply Paper 1313, 749 p.

_____1964, Compilation of records of surface waters of the United States, October 1950 to September 1960, Part 9, Colorado River Basin: U.S. Geological Survey Water-Supply Paper 1733, 586 p.

_____1961-1975, Water resources data for Utah, Part 1, surface-water records, water years 1960-74.

_____1976-80, Water resources data for Utah, water years 1975-79: Water-Data Reports UT-75-1 through UT-79-1.

U.S. Weather Bureau, 1963 , Normal annual and May-September precipitation (1931-60) for the State of Utah: Map of Utah, scale 1:500,000.

Utah Geological and Mineral Survey, 1979, Map of land control and coal reserves of the Wasatch Plateau Coal Field and the Emery Coal Field, 1979: scale 1:125,000.

Waddell, K. M., Contratto, P. K., Sumsion, C. T., and Butler, J. R., 1979, Hydrologic reconnaissance of Wasatch Plateau-Book Cliffs coal-fields area, Utah: U.S. Geological Survey Water-Supply Paper 2068, 45 p.

Waddell, K. M., Vickers, H. L., Upton, R. T., and Contratto, P. K., 1978, Selected hydrologic data, 1931-77, Wasatch Plateau-Book Cliffs coal-fields area, Utah: U.S. Geological Survey Open-File Report 78-121 (duplicated as Utah Basic-Data Release 31), 33 p.

Whaley, B. L., and Lytton, L. K., 1979, Summary of snow survey measurements for Utah, 1924-79: U.S. Department of Agriculture, Soil Conservation Service, 321 p.

Table 5.--Streamflow measurements made during 1977-79 in the upper drainages of Huntington and Cottonwood Creeks

HUNTINGTON CREEK DRAINAGE

Stream	Site no. (pl. 1)	Date	Discharge (ft^3/s)
Valentines Gulch	1	6-12-79	0.46
Huntington Creek	2	9-22-77	11
		2-16-78	6.9
		9-27-78	19
		10- 3-78	17
		11- 9-78	15
		8-28-79	20
Unnamed tributary to Huntington Creek	3	6-12-79	.81
North Hughes Canyon	4	10- 4-78	.03
		12-14-78	.17
		6-12-79	1.8
		10-30-79	.12[1]
Huntington Creek	5	9-22-79	12
South Hughes Canyon	6	10- 4-78	.02
		12-14-78	.05
		6-14-79	1.2
		10-30-79	.12[1]
Flood Canyon	7	11- 9-78	.10
		12-15-78	.10
		6-12-79	1.6
		10-30-79	.06[1]
Huntington Creek	8	2-16-78	9.2
		10- 3-78	19
		10- 4-78	18
		8-28-79	22
Unnamed tributary to Nuck Woodward Canyon	9	9-19-79	.02
Nuck Woodward Canyon	10	9-19-79	.07
Sawmill Canyon	11	9-19-79	.03
Nuck Woodward Canyon	12	9-19-79	.28
Second Canyon	13	9-19-79	.01
Nuck Woodward Canyon	14	9-19-79	.26
First Canyon	15	9-19-79	.08
Nuck Woodward Canyon	16	9- 4-79	.34
		9-19-79	.32
Do.	17	9- 4-79	.35
Do.	18	9- 4-79	.18
Do.	19	10- 4-78	.04
		6-12-79	3.8
		9- 4-79	.05
Pole Canyon	20	10- 6-78	.04
		6-12-79	.18
		10-30-79	.02[1]
Huntington Creek	21	10- 3-78	21
		10- 4-78	20
		11- 9-78	18
		8-29-79	24
		8-30-79	25
Spring Creek	22	8-15-77	.25
Left Fork of Huntington Creek	23	8-15-77	1.8
Lake Canyon	24	6-29-79	18
Do.	25	10- 5-78	3.5
Rolfson Creek	26	6-29-79	17
Do.	27	10- 5-78	1.7
Staker Canyon	28	6-26-79	16
Do.	29	10- 5-78	1.1
Miller Flat Creek	30	6-29-79	19
Do.	31	10- 5-78	5.1
Left Fork of Huntington Creek	32	9-22-77	4.9
Paradise Creek	33	6-26-79	4.5
Left Fork of Huntington Creek	34	10- 6-78	14
		8-30-79	39
Do.	35	8-30-79	39
Do.	36	8-30-79	35
Do.	37	9-22-77	8.2
		10- 6-78	15
Do.	38	8-30-79	42
Do.	39	9-22-77	7.9
		10- 3-78	14
		11- 9-78	11
		3- 7-79	7.9
Do.	40	6-12-79	113
		8-29-79	45
		8-30-79	38
Huntington Creek	41	6-22-77	36
Do.	42	6-22-77	36
Horse Canyon	43	10- 6-78	.1
		6-12-79	3.4
Blind Canyon	44	10- 6-78	.1
		6-14-79	2.7
		10-30-79	.13[1]

Table 5.--Streamflow measurements made during 1977-79 in the upper drainages of Huntington and Cottonwood Creeks--Continued

HUNTINGTON CREEK DRAINAGE--Continued

Stream	Site no. (pl. 1)	Date	Discharge (ft^3/s)
Huntington Creek	45	6-23-77	37
		9-27-78	40
		10 -3-78	37
		10- 4-78	36
		8-29-79	66
		8-29-79	63
Crandall Canyon	46	10-22-78	.07
Do.	47	4-26-78	.18
		10-22-78	.20
		9- 4-79	.28
		8-11-78	.20
Do.	48	4-26-78	.68
		10-22-78	.09
		11- 8-78	.11
		9- 4-79	.14
Do.	49	11- 8-78	.31
		9- 4-79	.54
Do.	50	9- 4-79	.65
Do.	51 (gaging station 09317919)	4-26-78	1.60
		10- 3-78	.49
		10-22-78	.46
		6-14-79	10
		8-29-79	.75
		9- 4-79	.77
Huntington Creek	52	6-22-77	39
Tie Fork Canyon	53	9- 5-79	.06
Do.	54	9- 5-79	.02
Do.	55	9- 5-79	.08
Unnamed tributary to Tie Fork Canyon	56	9- 5-79	.10
Tie Fork Canyon	57	9- 5-79	.15
Do.	58	9- 5-79	.06
Do.	59	8-29-78	.32
		9- 5-79	.29
Do.	60	9- 5-79	.51
Wild Cattle Hollow	61	8-29-78	.07
		11- 8-78	.08
		12-13-78	.14
		9- 5-79	.14
Tie Fork Canyon	62	9- 5-79	.64
		10-31-79	.58[1]
Do.	63	9- 5-79	.57
Do.	64	9- 5-79	.76
		10-31-79	.43[1]
Tie Fork Canyon	65	9- 5-79	.76
		10-31-79	.59[1]
Do.	66	9- 6-79	.61
		10-31-79	.42[1]
Do.	67 (gaging station 09317920)	8-29-78	.51
		10- 3-78	.50
		6-14-79	6.6
		8-29-79	.65
		9- 5-79	.69
		10-31-79	.53[1]
Little Bear Canyon	70	10-13-78	.24
		10-30-79	.24
Huntington Creek	71	6-23-77	34
		10 -3-78	36
		10- 4-78	36
		8-30-79	65
Mill Fork Canyon	72	10-12-78	.03
Do.	73	10-12-78	.02
Do.	74	10-12-78	.01
Do.	75	10-12-78	Dry
Do.	76	10- 6-78	Dry
		7-19-79	.14
		10-16-79	.04
Huntington Creek	77	10-31-79	82[1]
		11- 1-79	34[1]
Rilda Canyon	78	10- 6-78	.1
		6-14-79	5.3
		10-30-79	.19[1]
Trail Canyon	79	11- 9-78	.03
		6-14-79	.48
		10-30-79	.05[1]
Huntington Creek	80	6-23-77	37
Bear Creek	81	8-10-78	.09
		10 25-78	.08
		11- 8-78	.06
		12-13-78	.04
		6-27-79	.34
		7-16-79	.21
		10-30-79	.05[1]
Huntington Creek	82	2-16-78	26
		10- 3-78	38
		10- 4-78	39
		8-30-79	68
		11- 1-79	35
Meetinghouse Canyon	83	6-14-79	3.0
Do.	84	10- 6-78	Dry

Table 5.--Streamflow measurements made during 1977-79 in the upper drainages of Huntington and Cottonwood Creeks--Continued

HUNTINGTON CREEK DRAINAGE--Continued

Stream	Site no. (pl. 1)	Date	Discharge (ft^3/s)
Deer Creek	85	8-26-79	0.07
Do.	86	8-26-79	.13
Do.	87	6-14-79	1.9
Huntington Creek	88 (gaging station 09318000)	8-30-79	66
Fish Creek	89	8-10-79	.18
Do.	90	6-14-79	2.5

COTTONWOOD CREEK DRAINAGE

Stream	Site no. (pl. 1)	Date	Discharge (ft^3/s)
Marinus Canyon	91	6-13-79	.11
		9-20-79	.02
Winks Canyon	92	6-13-79	.09
Mill Canyon	93	6-13-79	.62
		9-20-79	.01
Dairy Canyon	94	6-13-79	.48
		9-20-79	.02
Meetinghouse Canyon	95	6-13-79	.03
		9-20-79	.01
Unnamed tributary to Cottonwood Creek	96	6-13-79	.03
Trail Canyon	97	6-13-79	.08
		9-20-79	.01
Cottonwood Creek	98	9- 6-78	Dry
		6-13-79	2.0
		8-28-79	.07
Do.	99	9- 6-78	.08
		8-28-79	.19
Cottonwood Creek	100	6- 1-78	1.2
		9- 6-78	.34
		6-13-79	2.5
		8-28-79	.46
Roans Canyon	101	6- 1-78	3.4
		6-13-79	.73
		8-28-79	.04
Cottonwood Creek	102	4-27-78	.43
		6- 1-78	4.7
		9- 6-78	.34
		8-28-79	.50
Do.	104 (gaging station 09324200)	9- 6-78	.35
		6-13-79	3.3
		8-28-79	.51
Do.	105	8-28-79	.58
Grimes Wash	106	8-26-79	.02
Do.	107	8-26-79	.03

[1] Accuracy of the measurement may be affected by ice conditions.

Concentration: In milligrams per liter, unless otherwise indicated; < , less than.
Site No.: Shown on plate 1.
Discharge: Measured except E, estimated.
Specific conductance: In micromhos per centimeter at 25 degrees Celsius.
Other data available: SQS, semiquantitative determination of trace elements reported in table 12.

Stream	Site No.	Date	Temperature (degrees C)	Discharge (ft^3/s)	Alkalinity (as $CaCO_3$)	Bicarbonate	Dissolved boron (μg/L)	Dissolved calcium	Carbonate	Dissolved chloride	Dissolved fluoride
Huntington Creek	21	8-15-77	15.0	16	140	200	10	49	0	2.5	0.1
		6- 6-78	5.5	45	160	190	20	49	0	2.9	.1
Spring Creek	22	8-15-77	15.0	0.25	110	140	20	38	0	2.9	.1
		6- 6-78	4.5	25.0	130	160	10	45	0	2.9	.1
Left Fork of Huntington Creek	23	8-15-77	19.5	1.8	110	130	40	50	0	3.5	.1
Lake Canyon	24	8-15-77	15.0	1.6	160	200	20	57	0	2.1	.1
Left Fork of Huntington Creek	34	10-12-77	4.0	8E	170	210	5	54	1	2.3	.1
		7-28-78	16.1	–	130	160	20	45	1	1.7	.1
		10-17-78	3.4	10E	190	–	20	49	–	2.1	.1
		7-18-79	8.0	70	130	–	30	40	–	1.7	.1
		10-15-79	11.0	45E	131	160	20	36	–	1.5	.1
	39	10-12-77	5.6	10E	200	240	10	55	1	2.8	.1
		7-26-78	–	–	140	170	10	44	0	1.7	.1
		10-17-78	4.7	12E	180	–	20	50	–	2.8	.1
		7-19-79	7.5	80	140	–	40	41	–	1.8	.1
		10-15-79	10.0	45E	146	178	20	38	–	1.7	.1
Huntington Creek	41	7-26-78	18.5	–	140	170	30	47	0	2.6	.1
		10-17-78	5.5	30E	180	–	30	51	–	3.4	.1
		7-19-79	7.5	100	140	–	20	43	–	2.2	.1
		10-15-79	9.5	65	153	186	20	41	–	2.1	.1
Crandall Canyon (gaging station 09317919)	51	10-12-77	3.0	1.0E	220	270	30	59	1	7.6	.2
		7-26-78	18.2	–	190	230	20	54	0	3.8	.1
		10-18-78	4.9	.7E	230	–	30	53	–	4.7	.1
		7-19-79	9.5	1.9	200	–	40	48	–	4.4	.1
		10-15-79	6.0	.54	–	288	20	54	–	4.7	.1
Wild Cattle Hollow	61	10-13-77	7.5	70E	200	240	10	67	0	5.0	.1
		7-27-78	10.1	–	210	250	20	60	0	5.5	.1
		10-17-78	6.0	.1E	250	–	50	64	–	5.2	.1
		7-19-79	9.0	1.5	210	–	30	48	–	4.1	.1
		10-15-79	8.0	.25	249	303	20	62	–	4.8	.1
Tie Fork (gaging station 09317920)	67	10-13-77	6.3	.43	190	230	30	63	1	4.4	.1
		6- 9-78	5.3	8.8	–	–	–	68	–	3.6	–
		7-26-78	16.3	–	200	240	20	53	–	4.4	.1
		10-17-78	6.4	50E	250	–	30	64	–	4.6	.1
		7-19-79	12.5	1.8	200	–	50	49	–	4.3	.1
		10-15-79	8.0	.51	–	302	20	58	–	4.5	.1
Huntington Creek	68	7-27-78	16.1	420	150	170	20	47	4	2.2	.1
		10-18-78	6.0	30E	180	–	30	51	–	3.2	.1
		7-19-79	12.0	105	150	–	30	51	–	2.4	.1
		10-15-79	9.5	70E	156	190	30	42	–	2.3	.1
	69	7-27-78	15.8	–	150	180	20	46	0	2.1	.1
		10-18-78	5.7	30E	190	–	30	53	–	3.0	.1
		7-19-79	11.5	110	140	–	20	40	–	2.1	.1
		10-16-79	6.5	70E	159	194	20	44	–	2.2	.1
Little Bear Canyon	70	7-27-78	15.5	–	230	280	30	54	0	5.6	.1
		10-18-78	7.1	.5E	190	230	40	65	–	6.3	.2
		7-19-79	13.5	1.0	240	–	40	47	–	6.5	.1
		10-16-79	5.0	.75	276	337	30	58	–	6.2	.1
Huntington Creek	71	7-27-78	17.6	–	140	170	20	49	0	4.7	.1
		10-18-78	5.6	30E	180	–	20	52	–	3.1	.1
		7-19-79	13.5	110	140	–	50	40	–	2.2	.1
		10-16-79	7.0	70E	160	195	20	43	–	2.3	.1
Mill Fork	76	7-27-78	18.2	–	250	300	30	53	0	7.9	.1
		7-19-79	14.5	14	250	–	60	46	–	9.4	.2
		10-16-79	6.0	.04	295	360	40	58	–	10	.1
Huntington Creek	77	7-28-78	13.2	–	150	180	20	49	0	2.5	.1
		10-18-78	5.7	30E	160	–	30	50	–	4.6	.1
		7-19-79	14.0	110	140	–	50	40	–	2.3	.1
		10-16-79	8.0	75E	157	191	20	44	–	2.4	.1
Rilda Canyon	78	7-15-76	12.0	.50	279	340	40	62	–	11	.2
		7-26-78	15.2	–	230	280	40	59	0	6.6	.1
		10-18-78	6.4	.35E	360	–	80	73	–	8.6	.2
		7-18-79	11.5	2.0	170	–	60	50	–	7.6	.2
		10-16-79	7.0	< 1.0	336	410	50	75	–	10	.2
Huntington Creek	80	8-15-77	17.0	25	160	200	30	43	0	3.8	.1
		6- 6-78	6.0	360	150	180	10	50	0	2.7	.1
Meetinghouse Canyon	84	8- 6-79	18.5	.21	180	–	50	39	12	5.8	.2
Deer Creek	86	8-26-79	8.6	.26	270	–	110	110	–	7.2	.2
	87	7-28-78	15.2	–	210	260	60	55	0	22	.7
		7-18-79	17.0	1.0	230	0	120	65	–	16	.2
Huntington Creek (gaging station 09318000)	88	6- 9-77	15.0	–	160	190	30	55	0	3.9	.1
		8-15-77	19.0	13	170	210	40	57	0	15	.2
		6- 6-78	6.5	360	160	190	20	51	0	9.1	.1
		11-14-78	2.5	16	210	250	50	60	0	6.8	.1
		6-13-79	13.0	216	140	–	20	52	2	3.3	.2
		11-11-79	0	19	250	–	20	59	0	4.4	.1
Cottonwood Creek	103	10-13-77	2.8	1.0E	180	210	30	66	7	7.6	.1
		7-27-78	10.0	–	220	270	30	57	0	8.2	.1
		10-19-78	4.7	.28	284	–	40	59	–	8.6	.1
		7-18-79	14.0	.97	240	–	60	47	–	9.9	.2
		10-16-79	5.0	–	287	350	30	60	–	9.4	.1
Cottonwood Creek (gaging station 09324200)	104	10-13-77	2.3	1.0E	220	260	30	56	1	7.8	.1
		7-27-78	12.4	–	220	270	30	46	0	8.2	.1
		10-19-78	4.7	.8E	260	–	50	52	–	9.8	.1
		7-18-79	16.0	.97	210	–	50	37	–	9.9	.2
		10-16-79	5.0	.51	277	330	30	51	4	9.5	.1
Grimes Wash	107	8-26-79	13.3	.10	260	–	40	78	–	12	.2
	108	9-29-76	14.5	< .01	256	312	110	97	0	22	.2

Concentration													
Hardness (as $CaCO_3$)	Noncarbonate hardness (as $CaCO_3$)	Dissolved iron (µg/L)	Dissolved magnesium	Dissolved potassium	Dissolved silica	Dissolved sodium	Dissolved solids	Dissolved sulfate	Dissolved strontium (µg/L)	Sodium adsorption ratio	pH (units)	Specific conductance	Other data available
180	20	–	1.3	0.6	3.3	2.9	154	5.7	–	0.1	8.2	330	–
180	20	–	.9	1.3	3.1	2.5	193	20	–	.1	7.8	300	–
120	3	–	5.5	.8	2.7	2.0	130	8.9	–	.1	7.5	220	–
140	8	–	6.6	.7	3.9	1.6	147	7.5	–	.1	7.5	230	–
150	42	–	5.8	1.2	22	2.8	191	41	–	.1	7.3	300	–
180	13	–	8.5	.6	3.9	1.9	179	6.6	–	.1	8.0	290	–
200	31	–	17	.8	5.2	1.5	192	6.5	–	0	8.7	340	–
150	15	–	8.7	.6	2.7	1.5	147	6.1	–	.1	8.8	240	–
170	2	20	12	.7	3.3	1.7	176	4.2	100	.1	8.7	303	–
130	1	10	7.6	.5	3.1	1.2	140	7.7	–	0	7.8	273	–
140	4	10	11	.5	1.0	1.6	136	5.5	–	.1	8.1	270	–
220	25	–	21	1.2	5.6	3.3	220	12	–	.1	8.4	420	–
150	12	–	10	.7	2.6	1.7	152	6.6	–	.1	8.4	260	–
200	15	< 10	17	.9	3.7	2.8	197	11	120	.1	8.4	400	–
140	0	10	8.7	.7	3.0	1.5	150	8.8	–	.1	7.9	285	–
140	0	10	12	.5	1.4	1.7	150	7.2	–	.1	8.1	267	–
170	31	–	13	1.1	3.4	2.2	169	15	–	.1	8.8	300	SQS
190	9	40	15	1.1	3.5	2.6	201	16	100	.1	8.3	380	–
150	6	60	9.4	.8	3.0	1.4	154	10	–	.1	7.8	307	–
160	3	20	13	.7	2.1	1.9	165	12	–	.1	8.1	290	–
290	68	–	35	2.0	7.0	7.2	287	35	–	.2	8.6	470	SQS
220	33	–	21	1.3	5.6	4.3	234	30	–	.1	8.6	480	–
250	22	10	29	1.3	6.1	4.9	273	35	180	.1	7.8	500	–
220	23	0	25	1.2	5.2	5.2	240	31	–	.1	7.9	450	–
260	22	20	30	1.4	6.2	5.3	282	38	–	.1	8.2	470	–
260	61	–	22	1.4	6.5	4.4	251	26	–	.1	8.3	520	–
260	52	–	26	1.3	5.8	3.8	266	38	–	.1	7.8	390	–
280	29	< 10	29	1.3	6.1	4.5	273	26	200	.1	7.9	560	–
210	0	0	21	1.1	5.4	3.3	224	15	–	.1	7.6	426	–
270	17	40	27	1.4	6.0	4.3	281	26	–	.1	8.0	485	–
310	120	–	36	1.8	6.9	3.8	265	35	–	.1	8.6	500	SQS
250	–	–	19	3.3	–	2.6	185	13	–	–	8.6	410	–
250	55	–	29	1.6	5.9	3.8	247	30	–	.1	8.8	450	–
290	62	20	32	1.8	6.7	3.0	289	38	270	.1	8.2	543	–
230	29	10	26	7.3	6.3	3.9	234	23	–	.1	8.1	450	–
270	25	40	31	1.8	6.3	4.1	293	38	–	.1	8.2	501	–
170	21	–	12	.8	2.9	1.9	166	11	–	.1	8.5	260	–
200	18	40	17	1.1	3.6	3.1	201	19	120	.1	8.4	378	–
170	23	10	11	.8	3.2	1.8	174	13	–	.1	8.0	308	–
160	7	10	14	.8	2.2	2.1	171	14	–	.1	8.3	301	–
160	17	–	12	.8	2.9	1.8	165	10	–	.1	8.2	280	–
210	21	30	18	1.2	3.5	3.4	209	18	120	.1	8.3	380	–
140	1	10	10	.6	3.1	1.7	154	12	–	.1	7.9	273	–
170	8	10	14	.8	2.1	2.1	175	14	–	.1	8.1	309	–
290	62	–	38	1.8	6.6	7.1	291	39	–	.2	8.7	500	–
210	22	< 10	12	1.8	6.8	7.4	250	36	250	.2	8.2	575	–
270	34	10	38	1.8	6.5	8.1	292	40	–	.2	7.8	548	–
300	25	< 10	38	1.7	6.7	7.5	326	42	–	.2	8.2	538	–
180	36	–	13	.9	2.9	2.0	175	18	–	.1	8.8	270	–
200	24	30	18	1.1	3.2	3.1	205	16	120	.1	8.6	370	–
150	5	10	11	.4	3.1	2.0	155	12	–	.1	8.1	296	–
170	5	20	14	.8	2.1	2.1	174	13	–	.1	8.2	302	–
280	39	–	37	2.0	7.1	11	318	52	–	.3	8.7	440	–
280	34	0	41	5.2	6.8	10	327	58	–	.3	8.0	514	–
340	47	10	48	3.0	7.4	12	391	75	–	.3	8.3	612	–
170	24	–	12	.9	2.8	2.2	170	11	–	.1	8.4	285	–
200	39	30	18	1.2	3.2	3.6	203	26	120	.1	8.3	390	–
140	–	10	10	.8	3.1	1.7	154	12	–	.1	8.4	302	–
170	11	< 10	14	.8	2.0	2.3	176	16	–	.1	8.2	316	–
380	98	20	54	2.5	8.2	17	424	100	–	.4	–	–	–
310	82	–	40	2.0	6.4	10	326	63	–	.2	8.9	500	–
410	65	20	54	3.1	8.8	18	429	99	430	.4	8.1	840	–
290	120	–	39	1.1	6.7	13	292	72	–	.3	8.1	620	–
420	82	20	56	3.2	8.6	18	503	130	–	.4	8.1	730	–
180	17	–	18	1.7	4.3	4.1	196	22	–	.1	8.3	332	–
170	27	–	12	.6	3.0	2.1	173	14	–	.1	7.8	280	–
230	50	0	32	3.9	5.3	10	260	43	310	.3	8.6	438	–
410	140	190	33	1.1	6.4	19	< 372	32	–	.4	8.4	490	–
380	170	–	59	4.0	10	29	476	160	–	.6	8.8	650	SQS
360	130	0	47	4.1	7.9	25	474	170	–	.6	8.1	790	–
200	43	–	15	1.1	3.4	4.6	200	23	–	.1	8.3	390	–
250	73	–	25	1.9	5.8	13	289	67	–	.4	8.1	478	–
180	21	–	12	.8	4.0	2.9	183	14	–	.1	7.8	290	–
250	44	20	24	1.4	5.7	9.2	278	47	160	.3	8.2	470	–
140	3	10	3.1	.5	3.2	4.2	175	21	190	.2	8.4	365	–
230	34	10	21	1.4	4.7	5.8	251	33	150	.2	8.3	435	–
330	150	–	41	2.0	7.0	10	276	32	–	.2	8.5	540	–
300	81	–	39	1.7	6.7	12	306	47	–	.3	7.8	470	–
300	54	20	38	1.8	6.9	12	317	40	330	.3	8.6	620	–
280	38	10	39	1.8	6.9	18	319	52	–	.5	7.9	640	–
310	23	20	39	2.0	6.8	14	355	51	–	.3	8.0	583	–
310	94	–	41	2.1	7.0	11	286	32	–	.3	8.5	540	SQS
280	58	–	40	1.8	6.5	12	294	45	–	.3	8.3	470	–
290	31	10	39	2.0	6.9	12	319	40	330	.3	8.7	512	–
240	35	0	37	2.1	6.2	18	290	53	–	.5	8.0	610	–
290	15	20	40	2.1	6.7	15	343	52	–	.4	8.4	550	–
370	110	150	43	1.4	8.0	22	< 384	63	–	.5	8.3	580	SQS
580	320	20	82	4.8	8.9	31	763	360	700	.6	8.0	1,200	–

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79

Organism. Collected with a Surber sampler (Greeson and others, 1977, p. 172-173) except as noted in some 1977 samples. Identified by order, . family, or . . genus; Uid; unidentified.
Site. Shown on plate 1.

Organism	Site 34 – Left Fork of Huntington Creek					Site 39 – Left Fork of Huntington Creek				
	10-12-77[1]	7-28-78	10-17-78	7-18-79	10-15-79	10-12-77[2]	7-26-78	10-17-78	7-19-79	10-15-79
Hydroida										
. Hydridae										
. . *Hydra* sp.	–	–	40	–	–	–	–	–	–	–
Tricladida										
. Planariidae										
. . *Polycelis coronata*	–	3	–	–	–	–	–	1	–	–
Haplotaxida										
. Tubificidae										
. . *Limnodrilus hoffmeisteri*	–	–	–	–	–	–	–	–	–	–
. . *Rhyacodrilus* sp.	–	20	13	24	4	–	3	4	24	–
. . Uid. sp.	–	–	4	–	–	–	–	–	–	–
. Naididae										
. . *Nais pseudobtusa*	–	–	8	–	8	–	–	3	–	4
. Enchytraeidae										
. . *Enchytraeus* sp.	–	7	–	20	–	–	–	4	20	8
. Lumbricidae										
. . *Eisenella* sp.	–	–	–	–	–	–	–	–	4	–
Diptera										
. Ceratopogonidae										
. . *Bezzia* sp.	–	–	–	–	4	–	–	–	–	–
. . *Forcipomyia* sp. A	–	–	–	–	–	–	–	–	–	–
. . *Forcipomyia* sp. B	–	–	–	–	–	–	–	–	–	–
. . *Dasyhelea* sp.	–	1	–	–	–	–	–	–	–	–
. Tipulidae	467	–	–	–	–	174	–	–	–	–
. . *Tipula* sp.	–	3	–	–	–	–	–	–	–	–
. . *Hexatoma* sp.	–	–	–	–	–	–	–	–	–	–
. . *Limnophila* sp.	–	–	–	–	–	–	–	–	–	–
. . *Antocha* sp.	–	23	68	20	936	–	2	47	8	364
. . *Erioptera* sp. B	–	–	–	–	–	–	–	–	–	–
. . *Limonia* sp.	–	–	–	–	–	–	–	–	–	–
. . *Ormosia* sp.	–	–	–	–	–	–	–	–	–	–
. . *Pedicia* sp.	–	–	1	–	–	–	–	10	–	52
. . *Hesperoconopa* sp.	–	–	1	–	–	–	–	–	4	28
. Psychodidae	–	–	–	–	–	–	–	–	–	–
. . *Pericoma* sp.	–	–	1	–	–	–	–	2	–	–
. Simuliidae	–	–	–	–	–	6	–	–	–	–
. . *Simulium* sp. B	–	4	–	132	–	–	3	–	616	–
. . *Simulium arcticum*	–	145	–	–	–	–	32	–	4	–
. . *Simulium argus*	–	–	–	–	–	–	–	–	–	–
. . *Simulium aureum*	–	–	–	–	–	–	–	–	–	–
. . *Simulium canadense*	–	–	–	–	–	–	–	–	–	–
. . *Simulium vittatum*	–	–	–	–	–	–	–	–	–	–
. . *Prosimulium onychodactylum*	–	–	–	–	–	–	–	–	–	–
. . *Metacnephia jeanae*	–	–	–	–	–	–	–	–	–	–
. . Uid. sp.	–	–	–	–	–	–	–	–	–	–
. Stratiomyiidae										
. . *Euparyphus* sp.	–	–	–	–	–	–	–	–	–	–
. Empididae	–	–	–	–	–	–	–	–	–	–
. . *Hemerodromia* sp.	–	–	–	–	–	–	–	–	–	–
. . *Wiedemannia* sp.	–	–	–	–	–	–	–	–	–	4
. . *Chelifera* sp.	–	11	1	16	20	–	–	5	8	8
. Ephydridae										
. . *Hydrellia* sp.	–	–	–	–	–	–	–	–	–	–
. Rhagionidae	24	–	–	–	–	5	–	–	–	–
. . *Atherix variegata*	–	4	2	–	4	–	1	4	8	16
. Chironomidae	143	–	–	–	–	10	–	–	–	–
. . *Procladius* sp.	–	4	–	–	–	–	–	–	–	–
. . *Psectrotanypus* sp.	–	1	–	–	–	–	–	–	–	–
. . *Ablabesmyia* sp.	–	1	–	–	–	–	–	–	–	–
. . *Thienemannimyia*	–	5	–	–	–	–	1	–	–	–
. . *Parochlus kiefferi*	–	–	–	–	–	–	–	–	–	–
. . *Diamesa* sp. A	–	1	–	4	–	–	2	–	–	–
. . *Diamesa* sp. B	–	80	–	–	–	–	156	7	–	–
. . *Monodiamesa* sp.	–	–	–	–	–	–	3	–	–	–
. . *Pseudodiamesa* sp. A	–	–	–	488	720	–	–	–	20	64
. . *Pseudodiamesa* sp. B	–	–	–	–	–	–	–	–	8	–
. . *Pseudodiamesa* sp.	–	227	83	–	–	–	8	3	–	–
. . *Odontomesa* sp.	–	2	–	–	–	–	–	–	–	–
. . *Prodiamesa* sp.	–	–	–	–	–	–	–	–	–	–
. . *Brillia* sp.	–	2	–	–	–	–	–	–	–	–
. . *Brillia* sp. A	–	–	–	–	–	–	–	–	–	–
. . *Brillia* sp. B	–	–	–	–	–	–	–	–	–	–
. . *Corynoneura* sp.	–	21	–	4	–	–	4	–	–	–
. . *Cricotopus* sp. B	–	–	–	16	–	–	2	–	8	–
. . *Cricotopus* sp. C	–	–	1	–	–	–	–	–	–	–
. . *Cricotopus* sp. D	–	–	–	–	–	–	–	–	–	–
. . *Heterotrissocladius hirtapex*	–	–	–	–	–	–	–	–	–	–
. . *Heterotrissocladius oliveri*	–	24	–	20	4	–	6	–	8	8
. . *Orthocladius* sp. A	–	158	25	132	240	–	22	58	16	28
. . *Orthocladius* sp. B	–	228	8	116	–	–	81	76	36	–
. . *Orthocladius* sp. C	–	–	–	–	–	–	–	–	–	24
. . *Orthocladius* sp. D	–	–	–	–	–	–	–	–	–	16
. . *Orthocladius dorenus*	–	4	6	88	–	–	–	7	60	28
. . *Orthocladius obumbratus*	–	1,111	8	260	–	–	740	11	252	20
. . *Psectrocladius* sp.	–	20	–	20	–	–	–	1	–	–
. . *Smittia* sp.	–	–	–	–	–	–	–	–	–	–
. . *Trichocladius* sp. A	–	100	–	4	–	–	11	–	48	–
. . *Trichocladius* sp. B	–	2	–	–	–	–	–	–	–	–
. . *Trissocladius* sp.	–	–	–	–	–	–	–	–	–	–
. . *Chironomus* sp.	–	4	–	–	–	–	–	–	–	–
. . *Cryptochironomus* sp.	–	–	–	–	–	–	–	–	–	–
. . *Phaenopsectra* sp.	–	–	–	4	4	–	–	–	–	–
. . *Polypedilum* sp.	–	1	–	4	–	–	–	–	–	–
. . *Cladotanytarsus* sp.	–	–	–	4	–	–	–	1	–	–

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 34 — Left Fork of Huntington Creek—continued					Site 39 — Left Fork of Huntington Creek—continued				
	10-12-77	7-28-78	10-17-78	7-18-79	10-15-79	10-12-77	7-26-78	10-17-78	7-19-79	10-15-79
Diptera—continued										
. Chironomidae—continued										
. . *Micropsectra* sp.	—	26	—	8	—	—	13	7	—	—
. . *Micropsectra* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Micropsectra* sp. B	—	—	—	—	4	—	—	—	—	8
. . *Paracladopelma nais*	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Eukiefferiella* sp. A	—	635	—	—	—	—	28	—	—	—
. . *Eukiefferiella* sp. B	—	29	122	1,260	1,268	—	12	21	264	88
. . *Eukiefferiella* sp. C	—	3	—	—	—	—	—	—	—	—
. . *Eukiefferiella* sp. F	—	—	—	—	—	—	—	—	—	—
. . Uid. *Tanytarsini*	—	1	—	—	—	—	2	—	—	—
. . Uid. Pupa	—	—	—	—	—	—	—	1	—	—
. Muscidae										
. . *Limnophora* sp.	—	—	—	—	—	—	—	—	—	—
. . *Lispe* sp.	—	1	—	4	—	—	2	—	—	—
. Dolichopodidae										
. . *Dolichopus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Campsicnemus* sp.	—	—	—	—	—	—	—	—	—	—
. Dixidae										
. . *Dixa* sp.	—	—	—	—	—	—	—	—	—	—
. Tanyderidae										
. . *Protoplasa* sp.	—	—	—	—	—	—	—	—	—	—
Trichoptera	105	—	—	—	—	13	—	—	—	—
. Hydropsychidae										
. . *Hydropsyche* sp.	—	—	—	—	4	—	—	4	—	20
. . *Arctopsyche* sp. A	—	29	23	—	36	—	—	—	—	12
. . *Parapsyche* sp.	—	—	—	—	—	—	—	—	—	—
. Rhyacophilidae										
. . *Rhyacophila* sp. B	—	—	12	—	112	—	—	9	4	32
. . *Rhyacophila* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila acropedes*	—	8	3	4	12	—	—	—	—	—
. . *Rhyacophila angelita*	—	1	—	—	—	—	—	—	—	—
. Hydroptilidae										
. . *Neotrichia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Ochrotrichia* sp.	—	10	—	—	—	—	4	—	28	—
. Brachycentridae										
. . *Brachycentrus americanus*	—	—	—	—	—	—	—	1	—	40
. . *Brachycentrus* sp.	—	—	—	—	—	—	1	—	—	—
. . *Micrasema* sp.	—	—	—	—	4	—	—	—	—	—
. Limnephilidae										
. . *Dicosmoecus atripes*	—	2	—	—	—	—	—	—	—	—
. . *Hesperophylax* sp.	—	—	—	—	—	—	—	—	—	—
. . *Limnephilus* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Neothrema* sp.	—	—	—	—	—	—	—	—	—	—
. . *Oligophlebodes* sp.	—	1	3	—	64	—	—	3	—	12
. . *Ecclisomyia* sp.	—	—	—	—	—	—	—	—	—	—
Plecoptera	198	—	—	—	—	19	—	—	—	—
. Pteronarcidae										
. . *Pteronarcella badia*	—	4	3	—	28	—	1	6	44	52
. . *Pteronarcys californica*	—	—	—	—	—	—	—	—	—	—
. Nemouridae										
. . *Amphinemura* sp.	—	1	—	—	—	—	1	—	—	—
. . *Malenka* sp.	—	—	—	—	—	—	—	—	—	—
. . *Podmosta prostoia*	—	—	—	—	32	—	—	—	—	440
. Perlidae										
. . *Hesperoperla pacifica*	—	3	1	—	12	—	—	1	—	4
. Perlodidae										
. . *Isogenoides zionensis*	—	—	29	12	—	—	—	61	12	8
. . *Isoperla* sp.	—	14	—	—	—	—	—	—	—	—
. . *Isoperla* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Isoperla sp.* B	—	—	—	—	48	—	—	—	—	8
. Chloroperlidae										
. . *Alloperla* sp.	—	—	—	8	16	—	—	—	32	—
. . *Kathroperla perdita*	—	—	—	—	8	—	—	1	—	12
. . *Sweltsa albertersis*	—	—	—	—	—	—	—	—	—	—
. . *Sweltsa* sp.	—	5	—	—	—	—	—	—	4	—
. Taeniopterygidae										
. . *Taenionema* sp.	—	—	—	—	—	—	—	—	—	—
. Capniidae										
. . Uid. sp.	—	—	3	—	28	—	—	32	—	240
Hemiptera	—	—	—	—	—	1	—	—	—	—
Coleoptera										
. Elmidae	40	—	—	—	—	231	—	—	—	—
. . *Narpus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Optioservus seriatus*	—	101	51	8	176	—	9	47	80	204
. Hydrophilidae										
. . *Ametor* sp.	—	—	—	—	—	—	—	—	—	—
. . *Helophorus* sp.	—	—	—	—	—	—	1	—	—	—
. . *Hydrobius* sp.	—	—	—	—	—	—	—	—	—	—
. Dytiscidae										
. . *Hydroporus* or *Hygrotus* sp.	—	1	—	4	—	—	8	—	—	—
. . *Deronectes* sp.	—	—	—	—	—	—	—	—	—	—
. . *Agabus* sp.	—	—	—	—	—	—	—	—	—	—
. Dryopidae										
. . *Helichus suteralis*	—	—	—	—	—	—	—	—	—	—
Ephemeroptera	128	—	—	—	—	78	—	—	—	—
. Ephemerellidae										
. . *Ephemerella aurivillii*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella coloradensis*	—	—	—	4	—	—	—	—	—	—
. . *Ephemerella doddsi*	—	—	2	—	—	—	—	—	—	—
. . *Ephemerella grandis*	—	9	1	36	12	—	3	10	52	20
. . *Ephemerella margarita*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella serratella* sp. A	—	127	22	64	252	—	5	17	104	4

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 34 — Left Fork of Huntington Creek—continued					Site 39 — Left Fork of Huntington Creek—continued				
	10-12-77	7-28-78	10-17-78	7-18-79	10-15-79	10-12-77	7-26-78	10-17-78	7-19-79	10-15-79
Ephemeroptera—continued										
. Baetidae										
. . *Baetis* sp.	—	2,949	—	—	—	—	363	—	—	—
. . *Baetis* sp. A	—	—	236	324	484	—	—	536	420	1,432
. . *Baetis* sp. B	—	—	—	—	—	—	—	—	—	—
. Heptageniidae										
. . *Epeorus longimanus*	—	1	—	4	—	—	—	—	—	—
. . *Cinygmula* sp. A	—	6	—	16	—	—	1	—	84	—
. . *Rhithrogena* sp.	—	—	4	—	40	—	—	38	—	132
. . *Heptagenia criddlei*	—	—	—	—	—	—	—	—	—	—
. . *Heptagenia elegantula*	—	6	—	—	—	—	—	2	4	—
. Leptophlebiidae	—	—	—	—	—	—	—	—	—	—
. . *Paraleptophlebia* sp.	—	—	—	—	—	—	—	—	—	—
. Tricorythidae										
. . *Tricorythodes minutus*	—	—	—	—	—	—	—	—	—	—
Podocopa										
. Cypridae										
. . *Prionocypris longiforma*	—	3	—	8	4	—	1	—	—	—
Dorylaimida										
. Dorylaimidae										
. . *Alaimus* sp.	—	—	—	20	20	—	—	—	44	24
. . Uid. genera	—	4	—	—	—	—	3	13	—	—
Diplostraca										
. Daphnidae										
. . *Daphnia* sp.	—	2,416	—	1,248	—	—	6,776	—	399	—
Copepoda										
. Diaptomidae										
. . *Diaptomus* sp.	—	403	—	9,056	—	—	164	—	3,496	—
. Canthocamptidae										
. . *Attheyella* sp.	—	—	—	—	—	—	—	—	4	—
. Cyclopidae										
. . Uid. sp.	—	—	—	384	—	—	—	—	108	—
Acari										
. Mideidae										
. . *Mideopsis* sp.	—	4	—	—	—	—	—	—	—	—
. Hygrobatidae										
. . *Atractides* sp.	—	—	—	—	4	—	—	—	—	4
. Sperchonidae										
. . *Sperchon* sp.	—	36	1	28	—	—	37	1	56	16
. Limnesiidae										
. . *Tyrellia* sp.	—	—	—	—	—	—	—	—	—	—
. Lebertiidae										
. . *Lebertia* sp.	—	—	—	—	—	—	—	—	—	—
Heterondonta										
. Sphaeriidae	—	—	—	—	—	—	—	—	—	—
. . *Pisidium milium*	—	3	—	—	—	—	—	—	—	—
Hydracarina	3	—	—	—	—	6	—	—	—	—
Basommatophora										
. Lymnaeidae	—	—	—	—	—	—	—	—	—	—

	Site 41 — Huntington Creek					Site 51 — Crandall Canyon				
	10-13-77[3]	7-26-78	10-17-78	7-19-79	10-15-79	10-12-77[4]	7-26-78	10-18-78	7-19-79	10-15-79
Hydroida										
. Hydridae										
. . *Hydra* sp.	—	—	—	—	—	—	—	—	—	—
Tricladida										
. Planariidae										
. . *Polycelis coronata*	—	—	—	—	—	—	1	5	9	7
Haplotaxida										
. Tubificidae										
. . *Limnodrilus hoffmeisteri*	—	—	—	—	—	—	—	—	—	—
. . *Rhyacodrilus* sp.	—	3	1	36	60	—	6	—	—	—
. . Uid. sp.	—	—	—	—	—	—	—	—	2	—
. Naididae										
. . *Nais pseudobtusa*	—	9	1	36	—	—	—	—	—	—
. Enchytraeidae										
. . *Enchytraeus* sp.	—	—	2	44	12	—	1	1	4	40
. Lumbricidae										
. . *Eisenella* sp.	—	—	1	4	4	—	—	—	—	11
Diptera										
. Ceratopogonidae										
. . *Bezzia* sp.	—	—	—	—	—	—	1	—	—	2
. . *Forcipomyia* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Forcipomyia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Dasyhelea* sp.	—	—	—	—	—	—	—	—	—	—
. Tipulidae	31	—	—	—	—	5	—	—	—	—
. . *Tipula* sp.	—	—	—	—	—	—	—	—	—	—
. . *Hexatoma* sp.	—	—	—	—	—	—	1	—	1	—
. . *Limnophila* sp.	—	—	—	—	—	—	—	4	—	—
. . *Antocha* sp.	—	20	58	12	216	—	2	1	1	74
. . *Erioptera* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Limonia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Ormosia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Pedicia* sp.	—	—	—	—	16	—	—	4	—	8
. . *Hesperoconopa* sp.	—	—	—	—	4	—	—	—	—	5
. Psychodidae	—	—	—	—	—	1	—	—	—	—
. . *Pericoma* sp.	—	—	—	—	—	—	—	—	—	—
. Simuliidae	—	—	—	—	—	—	—	—	—	—
. . *Simulium* sp. B	—	3	—	84	—	—	—	—	708	—
. . *Simulium arcticum*	—	770	—	—	—	—	6	—	1	3
. . *Simulium argus*	—	—	—	—	—	—	—	—	—	—
. . *Simulium aureum*	—	—	—	—	—	—	—	—	—	—
. . *Simulium canadense*	—	—	1	—	—	—	—	1	—	—
. . *Simulium vittatum*	—	—	—	—	—	—	—	—	—	—
. . *Prosimulium onychodactylum*	—	—	—	—	—	—	—	—	—	—
. . *Metacnephia jeanae*	—	—	—	—	—	—	—	—	—	—
. . Uid. sp.	—	—	—	—	—	—	—	—	—	—

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 41 – Huntington Creek—continued					Site 51 – Crandall Canyon—continued				
	10-13-77	7-26-78	10-17-78	7-19-79	10-15-79	10-12-77	7-26-78	10-18-78	7-19-79	10-15-79
Diptera—continued										
. Stratiomyiidae										
. . *Euparyphus* sp.	—	—	—	—	—	—	—	—	—	—
. Empididae	—	—	—	—	—	—	—	—	—	—
. . *Hemerodromia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Wiedemannia* sp.	—	—	—	—	—	—	1	—	—	—
. . *Chelifera* sp.	—	7	—	24	4	—	11	1	11	—
. Ephydridae										
. . *Hydrellia* sp.	—	—	—	—	—	—	—	—	—	—
. Rhagionidae	8	—	—	—	—	—	—	—	—	—
. . *Atherix variegata*	—	3	1	4	8	—	—	—	—	—
. Chironomidae	3	—	—	—	—	18	—	—	—	—
. . *Procladius* sp.	—	—	—	—	—	—	—	—	—	—
. . *Psectrotanypus* sp.	—	—	—	—	—	—	—	—	—	1
. . *Ablabesmyia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Thienemannimyia*	—	1	1	—	—	—	2	9	2	1
. . *Parochlus kiefferi*	—	—	—	—	—	—	—	—	—	—
. . *Diamesa* sp. A	—	—	—	—	—	—	—	—	2	—
. . *Diamesa* sp. B	—	144	4	—	—	—	—	—	—	—
. . *Monodiamesa* sp.	—	—	—	—	—	—	—	—	—	—
. . *Pseudodiamesa* sp. A	—	—	—	—	8	—	—	—	10	—
. . *Pseudodiamesa* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Pseudodiamesa* sp.	—	34	9	—	—	—	1	—	—	—
. . *Odontomesa* sp.	—	—	—	4	—	—	2	—	—	—
. . *Prodiamesa* sp.	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Corynoneura* sp.	—	—	—	8	—	—	—	1	—	—
. . *Cricotopus* sp. B	—	6	—	—	—	—	1	—	—	—
. . *Cricotopus* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Cricotopus* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Heterotrissocladius hirtapex*	—	—	1	4	—	—	—	—	—	—
. . *Heterotrissocladius oliveri*	—	—	—	36	16	—	1	1	8	—
. . *Orthocladius* sp. A	—	38	14	76	12	—	—	—	—	—
. . *Orthocladius* sp. B	—	71	12	36	12	—	—	—	1	—
. . *Orthocladius* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius* sp. D	—	—	—	—	16	—	—	1	—	—
. . *Orthocladius dorenus*	—	4	19	52	4	—	—	—	6	—
. . *Orthocladius obumbratus*	—	338	25	252	16	—	3	—	27	6
. . *Psectrocladius* sp.	—	—	—	—	—	—	—	—	—	—
. . *Smittia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Trichocladius* sp. A	—	34	—	76	—	—	9	—	24	—
. . *Trichocladius* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Trissocladius* sp.	—	—	—	—	—	—	—	—	—	—
. . *Chironomus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Cryptochironomus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Phaenopsectra* sp.	—	—	—	4	—	—	12	—	—	—
. . *Polypedilum* sp.	—	—	—	—	—	—	—	—	—	—
. . *Cladotanytarsus* sp.	—	—	1	4	—	—	—	—	2	13
. . *Micropsectra* sp.	—	4	—	4	—	—	—	6	—	—
. . *Micropsectra* sp. A	—	—	—	—	—	—	—	—	—	21
. . *Micropsectra* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Paracladopelma nais*	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Eukiefferiella* sp. A	—	134	—	28	—	—	—	—	—	—
. . *Eukiefferiella* sp. B	—	—	11	220	48	—	1	—	164	3
. . *Eukiefferiella* sp. C	—	2	—	—	—	—	3	—	—	—
. . *Eukiefferiella* sp. F	—	—	—	—	—	—	—	—	—	1
. . Uid. *Tanytarsini*	—	—	—	—	—	—	—	—	—	—
. . Uid. Pupa	—	—	—	—	—	—	—	—	—	—
. Muscidae										
. . *Limnophora* sp.	—	—	—	—	—	—	2	—	—	—
. . *Lispe* sp.	—	—	—	—	—	—	—	—	—	—
. Dolichopodidae										
. . *Dolichopus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Campsicnemus* sp.	—	—	—	—	—	—	—	—	—	—
. Dixidae										
. . *Dixa* sp.	—	—	—	—	—	—	—	—	—	—
. Tanyderidae										
. . *Protoplasa* sp.	—	—	—	—	—	—	—	—	—	—
Trichoptera	19	—	—	—	—	9	—	—	—	—
. Hydropsychidae										
. . *Hydropsyche* sp.	—	—	3	8	28	—	4	—	12	43
. . *Arctopsyche* sp. A	—	10	—	—	12	—	—	—	—	—
. . *Parapsyche* sp.	—	—	—	—	—	—	—	—	—	—
. Rhyacophilidae										
. . *Rhyacophila* sp. B	—	—	7	—	64	—	—	—	—	14
. . *Rhyacophila* sp. C	—	—	—	—	—	—	—	—	6	—
. . *Rhyacophila* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila acropedes*	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila angelita*	—	—	—	—	—	—	—	—	—	—
. Hydroptilidae										
. . *Neotrichia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Ochrotrichia* sp.	—	7	—	28	—	—	82	—	13	—
. Brachycentridae										
. . *Brachycentrus americanus*	—	—	14	16	8	—	—	—	1	15
. . *Brachycentrus* sp.	—	7	—	—	—	—	1	—	—	—
. . *Micrasema* sp.	—	—	—	—	—	—	—	—	—	—
. Limnephilidae										
. . *Dicosmoecus atripes*	—	—	—	—	—	—	—	—	—	—
. . *Hesperophylax* sp.	—	—	—	—	—	—	—	—	—	—
. . *Limnephilus* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Neothrema* sp.	—	—	—	—	—	—	—	—	—	—
. . *Oligophlebodes* sp.	—	—	3	—	24	—	—	4	—	6
. . *Ecclisomyia* sp.	—	—	—	—	—	—	—	—	—	—
Plecoptera	21	—	—	—	—	15	—	—	—	—
. Pteronarcidae										
. . *Pteronarcella badia*	—	2	3	20	36	—	3	1	2	—
. . *Pteronarcys californica*	—	2	1	—	—	—	—	—	—	—

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 41 – Huntington Creek–continued					Site 51 – Crandall Canyon–continued				
	10-13-77	7-26-78	10-17-78	7-19-79	10-15-79	10-12-77	7-26-78	10-18-78	7-19-79	10-15-79
Plecoptera—continued										
. Nemouridae										
. . *Amphinemura* sp.	–	–	–	–	–	–	17	–	5	–
. . *Malenka* sp.	–	–	–	–	–	–	–	–	–	–
. . *Podmosta prostoia*	–	–	–	–	132	–	–	–	–	–
. Perlidae										
. . *Hesperoperla pacifica*	–	–	–	16	4	–	–	–	–	–
. Perlodidae										
. . *Isogenoides zionensis*	–	–	22	8	8	–	–	2	5	–
. . *Isoperla* sp.	–	1	–	–	–	–	1	–	–	–
. . *Isoperla* sp. A	–	–	–	–	–	–	–	–	–	–
. . *Isoperla* sp. B	–	–	–	–	16	–	–	–	–	6
. Chloroperlidae										
. . *Alloperla* sp.	–	–	–	24	–	–	–	–	–	–
. . *Kathroperla perdita*	–	–	1	–	24	–	–	–	–	–
. . *Sweltsa albertersis*	–	1	–	–	–	–	–	–	–	–
. . *Sweltsa* sp.	–	2	–	–	–	–	9	–	1	–
. Taeniopterygidae										
. . *Taenionema* sp.	–	–	–	–	–	–	–	–	–	–
. Capniidae										
. . Uid. sp.	–	–	30	–	140	–	–	27	–	6
Hemiptera	–	–	–	–	–	–	–	–	–	–
Coleoptera										
. Elmidae	87	–	–	–	–	3	–	–	–	–
. . *Narpus* sp.	–	–	–	–	4	–	–	–	–	–
. . *Optioservus seriatus*	–	13	35	144	216	–	17	–	15	6
. Hydrophilidae										
. . *Ametor* sp.	–	–	–	–	–	–	–	–	–	–
. . *Helophorus* sp.	–	–	–	–	–	–	–	–	–	–
. . *Hydrobius* sp.	–	–	–	–	–	–	1	–	1	–
. Dytiscidae										
. . *Hydroporus* or *Hygrotus* sp.	–	2	–	–	–	–	–	–	–	–
. . *Deronectes* sp.	–	–	–	–	–	–	–	–	–	–
. . *Agabus* sp.	–	–	–	–	–	–	1	–	–	–
. Dryopidae										
. . *Helichus suteralis*	–	–	–	–	–	–	–	–	–	–
Ephemeroptera	71	–	–	–	–	96	–	–	–	–
. Ephemerellidae										
. . *Ephemerella aurivillii*	–	–	–	–	–	–	–	–	–	–
. . *Ephemerella coloradensis*	–	–	–	–	–	–	–	–	1	–
. . *Ephemerella doddsi*	–	–	–	–	–	–	–	–	–	–
. . *Ephemerella grandis*	–	5	7	168	44	–	6	3	3	2
. . *Ephemerella margarita*	–	–	–	–	–	–	–	–	–	–
. . *Ephemerella serratella* sp. A	–	7	9	92	8	–	–	–	5	–
. Baetidae										
. . *Baetis* sp.	–	510	–	–	–	–	–	–	–	–
. . *Baetis* sp. A	–	–	266	556	1,004	–	795	113	338	363
. . *Baetis* sp. B	–	–	–	–	–	–	–	53	–	–
. Heptageniidae										
. . *Epeorus longimanus*	–	1	–	12	–	–	2	–	112	3
. . *Cinygmula* sp. A	–	1	–	48	–	–	10	–	8	–
. . *Rhithrogena* sp.	–	–	10	–	140	–	–	–	–	–
. . *Heptagenia criddlei*	–	–	–	–	–	–	–	–	–	40
. . *Heptagenia elegantula*	–	–	4	–	4	–	1	6	–	–
. Leptophlebiidae	–	–	–	–	–	–	–	–	–	–
. . *Paraleptophlebia* sp.	–	–	–	–	–	–	–	–	–	1
. Tricorythidae										
. . *Tricorythodes minutus*	–	–	–	–	–	–	–	–	–	–
Podocopa										
. Cypridae										
. . *Prionocypris longiforma*	–	–	–	8	–	–	10	64	–	8
Dorylaimida										
. Dorylaimidae										
. . *Alaimus* sp.	–	–	–	32	8	–	–	–	14	3
. . Uid. genera	–	9	3	8	72	–	3	1	1	7
Diplostraca										
. Daphnidae										
. . *Daphnia* sp.	–	2,228	–	708	–	–	–	–	–	–
Copepoda										
. Diaptomidae										
. . *Diaptomus* sp.	–	14	2,592	–	–	–	–	–	1	–
. Canthocamptidae										
. . *Attheyella* sp.	–	–	–	–	–	–	–	–	–	1
. Cyclopidae										
. . Uid. sp.	–	–	–	56	–	–	–	–	–	–
Acari										
. Mideidae										
. . *Mideopsis* sp.	–	–	–	–	–	–	1	–	–	–
. Hygrobatidae										
. . *Atractides* p.	–	–	–	–	–	–	–	–	–	–
. Sperchonidae										
. . *Sperchon* sp.	–	3	3	48	4	–	34	–	15	1
. Limnesiidae										
. . *Tyrellia* sp.	–	–	–	–	–	–	–	–	–	–
. Lebertiidae										
. . *Lebertia* sp.	–	–	–	–	–	–	–	–	–	–
Heterondonta										
. Sphaeriidae	–	–	–	–	–	–	–	–	–	–
. . *Pisidium milium*	–	–	–	–	–	–	–	–	–	–
Hydracarina	2	–	–	–	–	–	–	–	–	–
Basommatophora										
. Lymnaeidae	–	–	–	–	–	–	–	–	–	–

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 61 – Wild Cattle Hollow					Site 67 – Tie Fork Canyon				
	10-13-77[5]	7-27-78	10-17-78	7-19-79	10-15-79	10-13-77[6]	7-26-78	10-17-78	7-19-79	10-15-79
Hydroida										
. Hydridae										
. . *Hydra* sp.	—	—	—	—	—	—	—	—	—	—
Tricladida										
. Planariidae										
. . *Polycelis coronata*	—	70	91	206	212	—	—	2	3	8
Haplotaxida										
. Tubificidae										
. . *Limnodrilus hoffmeisteri*	—	—	—	—	—	—	—	—	—	—
. . *Rhyacodrilus* sp.	—	3	—	—	—	—	7	1	—	2
. . Uid. sp.	—	—	—	4	—	—	—	—	1	—
. Naididae										
. . *Nais pseudobtusa*	—	—	—	—	1	—	—	—	—	—
. Enchytraeidae										
. . *Enchytraeus* sp.	—	5	8	40	7	—	—	1	8	7
. Lumbricidae										
. . *Eisenella* sp.	—	—	—	—	—	—	2	—	—	1
Diptera										
. Ceratopogonidae										
. . *Bezzia* sp.	—	1	1	4	2	—	2	1	4	2
. . *Forcipomyia* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Forcipomyia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Dasyhelea* sp.	—	—	—	—	—	—	—	—	—	—
. Tipulidae	3	—	—	—	—	3	—	—	—	—
. . *Tipula* sp.	—	6	5	4	1	—	—	6	—	1
. . *Hexatoma* sp.	—	—	—	—	—	—	—	—	—	—
. . *Limnophila* sp.	—	4	2	11	3	—	—	—	—	1
. . *Antocha* sp.	—	—	1	—	7	—	3	64	3	27
. . *Erioptera* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Limonia* sp.	—	1	—	—	—	—	—	—	—	—
. . *Ormosia* sp.	—	1	—	—	—	—	—	—	—	—
. . *Pedicia* sp.	—	—	2	5	3	—	—	2	1	23
. . *Hesperoconopa* sp.	—	—	—	—	—	—	—	—	—	2
. Psychodidae	29	—	—	—	—	—	—	—	—	—
. . *Pericoma* sp.	—	—	7	—	15	—	—	1	—	3
. Simuliidae	4	—	—	—	—	2	—	—	—	—
. . *Simulium* sp. B	—	—	—	5	—	—	—	—	3	—
. . *Simulium arcticum*	—	—	—	—	—	—	6	—	—	—
. . *Simulium argus*	—	—	—	—	—	—	—	—	—	—
. . *Simulium aureum*	—	—	—	—	26	—	—	—	—	4
. . *Simulium canadense*	—	—	—	—	—	—	—	1	—	1
. . *Simulium vittatum*	—	—	—	—	—	—	—	—	—	—
. . *Prosimulium onychodactylum*	—	—	—	—	—	—	—	—	—	—
. . *Metacnephia jeanae*	—	—	—	—	—	—	—	—	—	—
. . Uid. sp.	—	—	—	—	—	—	—	—	—	—
. Stratiomyiidae										
. . *Euparyphus* sp.	—	—	—	—	1	—	—	—	—	—
. Empididae	—	—	—	—	—	—	—	—	—	—
. . *Hemerodromia* sp.	—	—	—	—	—	—	—	—	—	1
. . *Wiedemannia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Chelifera* sp.	—	—	1	—	4	—	16	11	9	—
. Ephydridae										
. . *Hydrellia* sp.	—	—	—	—	—	—	—	—	—	—
. Rhagionidae	—	—	—	—	—	—	—	—	—	—
. . *Atherix variegata*	—	—	—	—	—	—	—	—	—	—
. Chironomidae	442	—	—	—	—	3	—	—	—	—
. . *Procladius* sp.	—	—	—	—	—	—	—	—	—	—
. . *Psectrotanypus* sp.	—	—	7	—	5	—	—	7	—	—
. . *Ablabesmyia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Thienemannimyia*	—	—	3	—	2	—	3	12	6	18
. . *Parochlus kiefferi*	—	—	—	—	—	—	—	—	—	—
. . *Diamesa* sp. A	—	—	—	1	—	—	—	—	6	—
. . *Diamesa* sp. B	—	—	—	—	—	—	1	—	—	—
. . *Monodiamesa* sp.	—	1	1	—	—	—	—	—	—	—
. . *Pseudodiamesa* sp. A	—	—	—	1	11	—	—	—	22	2
. . *Pseudodiamesa* sp. B	—	—	—	—	—	—	—	—	8	—
. . *Pseudodiamesa* sp.	—	1	6	—	—	—	29	6	—	—
. . *Odontomesa* sp.	—	—	—	—	—	—	—	—	—	—
. . *Prodiamesa* sp.	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. B	—	—	9	—	—	—	—	1	—	—
. . *Corynoneura* sp.	—	6	2	4	—	—	7	—	3	—
. . *Cricotopus* sp. B	—	2	—	—	—	—	8	—	—	—
. . *Cricotopus* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Cricotopus* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Heterotrissocladius hirtapex*	—	—	—	—	—	—	—	—	—	—
. . *Heterotrissocladius oliveri*	—	3	109	36	68	—	5	1	25	—
. . *Orthocladius* sp. A	—	—	—	5	—	—	—	—	2	—
. . *Orthocladius* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius dorenus*	—	—	65	—	—	—	3	2	6	—
. . *Orthocladius obumbratus*	—	2	—	87	18	—	299	4	58	—
. . *Psectrocladius* sp.	—	—	—	3	—	—	—	—	—	—
. . *Smittia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Trichocladius* sp. A	—	—	—	—	—	—	30	—	8	—
. . *Trichocladius* sp. B	—	27	—	20	—	—	—	—	1	—
. . *Trissocladius* sp.	—	—	—	—	—	—	—	—	—	—
. . *Chironomus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Cryptochironomus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Phaenopsectra* sp.	—	—	—	—	—	—	—	—	—	—
. . *Polypedilum* sp.	—	—	—	—	—	—	—	1	—	—
. . *Cladotanytarsus* sp.	—	—	—	—	—	—	2	—	5	2

Organism	Site 61 – Wild Cattle Hollow—continued					Site 67 – Tie Fork Canyon—continued				
	10-13-77	7-27-78	10-17-78	7-19-79	10-15-79	10-13-77	7-26-78	10-17-78	7-19-79	10-15-79
Diptera—continued										
. Chironomidae—continued										
. . *Micropsectra* sp.	–	19	30	72	–	–	41	24	9	–
. . *Micropsectra* sp. A	–	–	–	–	–	–	–	–	–	35
. . *Micropsectra* sp. B	–	–	–	–	–	–	–	–	–	–
. . *Paracladopelma nais*	–	–	–	–	–	–	–	–	–	–
. . *Zavrelimyia* sp.	–	–	–	1	–	–	–	–	–	–
. . *Zavrelimyia* sp. B	–	–	–	–	5	–	–	–	–	–
. . *Eukiefferiella* sp. A	–	2	–	–	–	–	4	1	–	–
. . *Eukiefferiella* sp. B	–	–	12	34	12	–	30	–	14	3
. . *Eukiefferiella* sp. C	–	–	–	–	–	–	1	–	–	–
. . *Eukiefferiella* sp. F	–	–	–	–	1	–	–	–	–	–
. . Uid. *Tanytarsini*	–	–	–	–	–	–	2	–	–	2
. . Uid. Pupa	–	–	–	–	–	–	–	–	–	–
. Muscidae										
. . *Limnophora* sp.	–	–	–	–	–	–	3	–	–	–
. . *Lispe* sp.	–	–	–	–	–	–	–	–	–	–
. Dolichopodidae										
. . *Dolichopus* sp.	–	–	–	–	–	–	–	–	–	–
. . *Campsicnemus* sp.	–	–	–	–	–	–	–	–	–	–
. Dixidae										
. . *Dixa* sp.	–	–	–	–	–	–	–	–	–	–
. Tanyderidae										
. . *Protoplasa* sp.	–	–	–	–	–	–	–	–	–	–
Trichoptera	80	–	–	–	–	16	–	–	–	–
. Hydropsychidae										
. . *Hydropsyche* sp.	–	–	–	–	1	–	6	10	5	146
. . *Arctopsyche* sp. A	–	–	–	5	5	–	–	–	–	–
. . *Parapsyche* sp.	–	1	–	–	–	–	–	–	–	–
. Rhyacophilidae										
. . *Rhyacophila* sp. B	–	–	–	–	–	–	–	–	–	1
. . *Rhyacophila* sp. C	–	–	–	–	–	–	–	–	–	–
. . *Rhyacophila* sp. D	–	–	–	37	31	–	–	–	–	–
. . *Rhyacophila acropedes*	–	–	1	–	–	–	–	–	–	–
. . *Rhyacophila angelita*	–	–	–	1	–	–	6	–	3	–
. Hydroptilidae										
. . *Neotrichia* sp.	–	–	–	–	–	–	–	–	–	–
. . *Ochrotrichia* sp.	–	–	–	–	–	–	4	–	2	–
. Brachycentridae										
. . *Brachycentrus americanus*	–	–	–	–	–	–	–	–	–	1
. . *Brachycentrus* sp.	–	–	–	–	–	–	–	–	–	–
. . *Micrasema* sp.	–	–	–	–	–	–	–	–	–	–
. Limnephilidae										
. . *Dicosmoecus atripes*	–	–	–	–	–	–	–	–	–	–
. . *Hesperophylax* sp.	–	–	16	–	5	–	–	1	–	3
. . *Limnephilus* sp. A	–	–	–	–	–	–	–	–	–	–
. . *Neothrema* sp.	–	–	–	3	2	–	–	–	–	–
. . *Oligophlebodes* sp.	–	–	12	3	30	–	–	1	–	–
. . *Ecclisomyia* sp.	–	–	–	–	–	–	1	–	–	–
Plecoptera	98	–	–	–	–	8	–	–	–	–
. Pteronarcidae										
. . *Pteronarcella badia*	–	–	–	–	–	–	–	–	4	5
. . *Pteronarcys californica*	–	–	–	–	–	–	–	–	–	–
. Nemouridae										
. . *Amphinemura* sp.	–	3	–	32	–	–	43	–	10	–
. . *Malenka* sp.	–	–	18	–	62	–	–	–	–	8
. . *Podmosta prostoia*	–	–	–	–	1	–	–	–	–	23
. Perlidae										
. . *Hesperoperla pacifica*	–	–	–	–	–	–	–	–	–	–
. Perlodidae										
. . *Isogenoides zionensis*	–	–	2	3	–	–	–	4	–	–
. . *Isoperla* sp.	–	1	–	–	–	–	8	–	–	–
. . *Isoperla* sp. A	–	–	–	4	5	–	–	–	5	27
. . *Isoperla* sp. B	–	–	–	–	–	–	–	–	1	–
. Chloroperlidae										
. . *Alloperla* sp.	–	–	–	1	–	–	–	–	–	1
. . *Kathroperla perdita*	–	–	–	–	–	–	–	–	–	2
. . *Sweltsa albertersis*	–	–	–	–	–	–	–	–	–	–
. . *Sweltsa* sp.	–	1	–	–	–	–	16	–	–	–
. Taeniopterygidae										
. . *Taenionema* sp.	–	–	–	–	–	–	–	–	–	1
. Capniidae										
. . Uid. sp.	–	–	129	18	334	–	–	18	9	953
Hemiptera	–	–	–	–	–	–	–	–	–	–
Coleoptera										
. Elmidae	–	–	–	–	–	–	–	–	–	–
. . *Narpus* sp.	–	–	–	–	–	–	1	–	–	–
. . *Optioservus seriatus*	–	1	–	3	–	–	1	–	–	1
. Hydrophilidae										
. . *Ametor* sp.	–	–	–	–	–	–	–	–	–	–
. . *Helophorus* sp.	–	–	–	–	–	–	–	–	–	–
. . *Hydrobius* sp.	–	–	–	–	–	–	–	–	–	–
. Dytiscidae										
. . *Hydroporus* or *Hygrotus* sp.	–	–	–	–	–	–	3	–	2	–
. . *Deronectes* sp.	–	–	–	–	–	–	–	–	–	–
. . *Agabus* sp.	–	–	–	–	–	–	–	–	–	–
. Dryopidae										
. . *Helichus suteralis*	–	–	–	–	–	–	–	–	–	–
Ephemeroptera	48	–	–	–	–	17	–	–	–	–
. Ephemerellidae										
. . *Ephemerella aurivillii*	–	–	–	–	–	–	–	–	–	–
. . *Ephemerella coloradensis*	–	32	–	46	–	–	2	–	1	–
. . *Ephemerella doddsi*	–	–	–	–	–	–	–	–	–	–
. . *Ephemerella grandis*	–	–	–	1	–	–	1	2	–	–
. . *Ephemerella margarita*	–	–	–	–	–	–	–	–	–	–
. . *Ephemerella serratella* sp. A	–	–	23	–	113	–	–	–	–	–

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 61 — Wild Cattle Hollow—continued					Site 67 — Tie Fork Canyon—continued				
	10-13-77	7-27-78	10-17-78	7-19-79	10-15-79	10-13-77	7-26-78	10-17-78	7-19-79	10-15-79
Ephemeroptera—continued										
. Baetidae										
. . *Baetis* sp.	—	—	—	—	—	—	—	—	—	—
. . *Baetis* sp. A	—	3	37	67	421	—	202	228	219	658
. . *Baetis* sp. B	—	—	—	—	—	—	—	—	—	—
. Heptageniidae										
. . *Epeorus longimanus*	—	—	—	3	—	—	—	—	21	—
. . *Cinygmula* sp. A	—	—	—	12	—	—	—	—	1	—
. . *Rhithrogena* sp.	—	—	2	—	—	—	—	15	—	14
. . *Heptagenia criddlei*	—	—	—	—	60	—	—	—	—	319
. . *Heptagenia elegantula*	—	—	—	—	—	—	—	—	2	—
. Leptophlebiidae	—	—	—	—	—	—	—	—	—	—
. . *Paraleptophlebia* sp.	—	—	—	14	18	—	—	5	3	21
. Tricorythidae										
. . *Tricorythodes minutus*	—	—	—	—	—	—	—	—	—	—
Podocopa										
. Cypridae										
. . *Prionocypris longiforma*	—	27	111	9	12	—	3	1	6	3
Dorylaimida										
. Dorylaimidae										
. . *Alaimus* sp.	—	—	—	—	25	—	—	—	4	46
. . Uid. genera	—	2	7	67	17	—	15	4	3	—
Diplostraca										
. Daphnidae										
. . *Daphnia* sp.	—	—	—	—	—	—	—	—	—	—
Copepoda										
. Diaptomidae										
. . *Diaptomus* sp.	—	—	—	10	—	—	—	—	—	—
. Canthocamptidae										
. . *Attheyella* sp.	—	—	2	5	—	—	—	—	1	—
. Cyclopidae										
. . Uid. sp.	—	—	—	1	—	—	—	—	—	—
Acari										
. Mideidae										
. . *Mideopsis* sp.	—	—	—	—	—	—	1	—	1	—
. Hygrobatidae										
. . *Atractides* sp.	—	—	—	—	—	—	—	—	—	3
. Sperchonidae										
. . *Sperchon* sp.	—	2	1	15	4	—	17	—	16	—
. Limnesiidae										
. . *Tyrellia* sp.	—	—	—	—	—	—	—	—	—	3
. Lebertiidae										
. . *Lebertia* sp.	—	—	—	—	2	—	—	—	—	3
Heterondonta										
. Sphaeriidae	—	—	—	—	—	—	—	—	—	—
. . *Pisidium milium*	—	—	—	2	—	—	—	—	—	—
Hydracarina	4	—	—	—	—	—	—	—	—	—
Basommatophora										
. Lymnaeidae	—	—	—	—	—	—	—	—	—	—

Organism	Site 68 — Huntington Creek					Site 69 — Huntington Creek				
	10-12-77[7,12]	7-26-78	10-17-78	7-19-79	10-15-79	10-13-77[13]	7-27-78	10-18-78	7-19-79	10-16-79
Hydroida										
. Hydridae										
. . *Hydra* sp.	—	—	—	—	—	—	—	—	—	—
Tricladida										
. Planariidae										
. . *Polycelis coronata*	—	—	—	4	4	—	—	—	—	4
Haplotaxida										
. Tubificidae										
. . *Limnodrilus hoffmeisteri*	—	—	—	—	—	—	—	—	—	—
. . *Rhyacodrilus* sp.	—	10	18	154	56	—	25	28	28	240
. . Uid. sp.	—	—	—	20	—	—	—	—	—	—
. Naididae										
. . *Nais pseudobtusa*	—	1	6	—	20	—	2	22	36	44
. Enchytraeidae										
. . *Enchytraeus* sp.	—	—	2	16	8	—	—	3	32	20
. Lumbricidae										
. . *Eisenella* sp.	—	—	—	—	—	—	—	1	4	—
Diptera										
. Ceratopogonidae										
. . *Bezzia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Forcipomyia* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Forcipomyia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Dasyhelea* sp.	—	—	—	—	—	—	—	—	—	—
. Tipulidae	—	—	—	—	—	—	—	—	—	—
. . *Tipula* sp.	—	—	—	—	—	—	—	—	—	—
. . *Hexatoma* sp.	—	—	—	4	—	—	1	—	—	—
. . *Limnophila* sp.	—	—	—	—	—	—	—	—	—	—
. . *Antocha* sp.	—	3	27	16	184	—	3	8	28	284
. . *Erioptera* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Limonia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Ormosia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Pedicia* sp.	—	—	—	8	—	—	—	—	—	—
. . *Hesperoconopa* sp.	—	—	2	—	8	—	—	—	—	12
. Psychodidae	—	—	—	—	—	—	—	—	—	—
. . *Pericoma* sp.	—	—	—	—	—	—	—	—	—	—
. Simuliidae	—	—	—	—	—	—	—	—	—	—
. . *Simulium* sp. B	—	—	—	32	—	—	—	—	36	—
. . *Simulium arcticum*	—	1	—	—	—	—	351	—	—	—
. . *Simulium argus*	—	—	—	—	—	—	—	—	—	—
. . *Simulium aureum*	—	—	—	—	—	—	—	—	—	—
. . *Simulium canadense*	—	—	—	—	—	—	—	—	—	—
. . *Simulium vittatum*	—	—	—	—	—	—	—	—	—	—
. . *Prosimulium onychodactylum*	—	—	—	—	—	—	—	—	—	—
. . *Metacnephia jeanae*	—	—	—	—	—	—	—	—	—	—
. . Uid. sp.	—	—	—	—	—	—	—	—	—	—

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 68 — Huntington Creek—continued					Site 69 — Huntington Creek—continued				
	10-12-77	7-26-78	10-17-78	7-19-79	10-15-79	10-13-77	7-27-78	10-18-78	7-19-79	10-16-79
Diptera—continued										
. Stratiomyiidae										
. . *Euparyphus* sp.	—	—	—	—	—	—	—	—	—	—
. Empididae	—	—	—	—	—	—	—	—	—	—
. . *Hemerodromia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Wiedemannia* sp.	—	—	4	—	—	—	—	—	—	24
. . *Chelifera* sp.	—	1	3	—	8	—	3	—	—	—
. Ephydridae										
. . *Hydrellia* sp.	—	—	—	—	—	—	—	—	—	—
. Rhagionidae	2	—	—	—	—	2	—	—	—	—
. . *Atherix variegata*	—	15	8	40	12	—	2	4	4	32
. Chironomidae	73	—	—	—	—	13	—	—	—	—
. . *Procladius* sp.	—	—	—	—	—	—	1	—	—	—
. . *Psectrotanypus* sp.	—	—	—	—	—	—	1	—	—	—
. . *Ablabesmyia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Thienemannimyia*	—	2	—	—	—	—	4	—	12	8
. . *Parochlus kiefferi*	—	—	—	—	—	—	—	—	—	—
. . *Diamesa* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Diamesa* sp. B	—	6	—	—	—	—	23	—	—	—
. . *Monodiamesa* sp.	—	39	—	—	—	—	2	—	—	—
. . *Pseudodiamesa* sp. A	—	—	—	12	12	—	—	—	—	—
. . *Pseudodiamesa* sp. B	—	—	—	—	4	—	—	—	—	—
. . *Pseudodiamesa* sp.	—	4	7	—	—	—	2	1	—	—
. . *Odontomesa* sp.	—	2	—	—	—	—	1	—	—	—
. . *Prodiamesa* sp.	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. B	—	—	1	—	—	—	—	—	—	—
. . *Corynoneura* sp.	—	—	—	—	—	—	1	—	—	—
. . *Cricotopus* sp. B	—	—	—	—	4	—	—	—	24	—
. . *Cricotopus* sp. C	—	—	—	—	—	—	—	2	—	—
. . *Cricotopus* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Heterotrissocladius hirtapex*	—	—	—	8	—	—	—	1	—	—
. . *Heterotrissocladius oliveri*	—	2	—	32	—	—	9	—	8	—
. . *Orthocladius* sp. A	—	1	12	12	24	—	15	10	—	32
. . *Orthocladius* sp. B	—	10	1	16	4	—	68	20	—	32
. . *Orthocladius* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius* sp. D	—	—	—	—	—	—	—	—	—	4
. . *Orthocladius dorenus*	—	—	36	16	20	—	2	14	4	52
. . *Orthocladius obumbratus*	—	125	57	96	56	—	125	58	28	60
. . *Psectrocladius* sp.	—	1	—	—	—	—	1	—	—	—
. . *Smittia* sp.	—	—	—	—	—	—	2	—	—	—
. . *Trichocladius* sp. A	—	1	—	40	—	—	31	2	60	—
. . *Trichocladius* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Trissocladius* sp.	—	—	—	—	—	—	—	—	—	—
. . *Chironomus* sp.	—	—	—	—	—	—	2	—	—	—
. . *Cryptochironomus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Phaenopsectra* sp.	—	—	—	—	—	—	—	—	—	—
. . *Polypedilum* sp.	—	3	—	—	—	—	—	—	4	—
. . *Cladotanytarsus* sp.	—	—	8	4	—	—	—	—	28	4
. . *Micropsectra* sp.	—	21	3	—	—	—	5	4	—	—
. . *Micropsectra* sp. A	—	—	—	—	12	—	—	—	—	—
. . *Micropsectra* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Paracladopelma nais*	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Eukiefferiella* sp. A	—	5	—	—	—	—	25	—	—	—
. . *Eukiefferiella* sp. B	—	—	7	104	124	—	—	13	32	112
. . *Eukiefferiella* sp. C	—	—	—	—	—	—	2	—	—	—
. . *Eukiefferiella* sp. F	—	—	—	—	—	—	—	—	—	—
. . Uid. *Tanytarsini*	—	—	—	—	—	—	1	—	—	—
. . Uid. Pupa	—	—	—	—	—	—	—	—	4	—
. Muscidae										
. . *Limnophora* sp.	—	—	—	—	—	—	—	—	—	—
. . *Lispe* sp.	—	—	—	—	—	—	—	—	—	—
. Dolichopodidae										
. . *Dolichopus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Campsicnemus* sp.	—	—	—	—	—	—	—	—	—	—
. Dixidae										
. . *Dixa* sp.	—	—	—	—	—	—	—	—	—	—
. Tanyderidae										
. . *Protoplasa* sp.	—	—	—	—	—	—	—	1	—	—
Trichoptera	13	—	—	—	—	49	—	—	—	—
. Hydropsychidae										
. . *Hydropsyche* sp.	—	—	3	96	20	—	—	8	112	32
. . *Arctopsyche* sp. A	—	—	—	—	8	—	9	3	—	24
. . *Parapsyche* sp.	—	—	—	—	—	—	—	—	—	—
. Rhyacophilidae										
. . *Rhyacophila* sp. B	—	—	1	—	60	—	—	5	—	8
. . *Rhyacophila* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila acropedes*	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila angelita*	—	—	—	—	—	—	—	—	—	—
. Hydroptilidae										
. . *Neotrichia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Ochrotrichia* sp.	—	6	—	4	—	—	3	—	60	—
. Brachycentridae										
. . *Brachycentrus americanus*	—	—	15	28	8	—	—	3	2	36
. . *Brachycentrus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Micrasema* sp.	—	—	—	—	—	—	—	—	—	—
. Limnephilidae										
. . *Dicosmoecus atripes*	—	—	—	—	—	—	—	—	—	—
. . *Hesperophylax* sp.	—	—	—	—	—	—	—	—	—	—
. . *Limnephilus* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Neothrema* sp.	—	—	—	—	—	—	—	—	—	—
. . *Oligophlebodes* sp.	—	—	1	—	4	—	—	—	—	20
. . *Ecclisomyia* sp.	—	—	—	—	—	—	—	—	—	—
Plecoptera	6	—	—	—	—	6	—	—	—	—
. Pteronarcidae										
. . *Pteronarcella badia*	—	—	1	12	24	—	1	10	20	44
. . *Pteronarcys californica*	—	—	—	12	—	—	—	—	8	24

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 68 -- Huntington Creek—continued					Site 69 — Huntington Creek—continued				
	10-12-77	7-26-78	10-17-78	7-19-79	10-15-79	10-13-77	7-27-78	10-18-78	7-19-79	10-16-79
Plecoptera—continued										
. Nemouridae										
. . *Amphinemura* sp.	—	—	—	—	—	—	—	—	—	—
. . *Malenka* sp.	—	—	—	—	—	—	—	—	—	—
. . *Podmosta prostoia*	—	—	—	—	8	—	—	—	—	16
. Perlidae										
. . *Hesperoperla pacifica*	—	—	—	20	—	—	—	—	—	—
. Perlodidae										
. . *Isogenoides zionensis*	—	—	4	12	12	—	—	4	8	4
. . *Isoperla* sp.	—	—	—	—	—	—	2	—	—	—
. . *Isoperla* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Isoperla* sp. B	—	—	—	—	4	—	—	—	—	16
. Chloroperlidae										
. . *Alloperla* sp.	—	—	—	4	—	—	—	—	8	—
. . *Kathroperla perdita*	—	—	—	—	—	—	—	—	—	—
. . *Sweltsa albertersis*	—	—	—	—	—	—	—	—	—	—
. . *Sweltsa* sp.	—	—	—	—	—	—	—	—	—	—
. Taeniopterygidae										
. . *Taenionema* sp.	—	—	—	—	4	—	—	1	—	4
. Capniidae										
. . Uid. sp.	—	—	16	—	32	—	—	8	—	52
Hemiptera	—	—	—	—	—	—	—	—	—	—
Coleoptera										
. Elmidae	21	—	—	—	—	9	—	—	—	—
. . *Narpus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Optioservus seriatus*	—	52	62	388	48	—	27	40	320	580
. Hydrophilidae										
. . *Ametor* sp.	—	—	—	—	—	—	1	—	—	—
. . *Helophorus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Hydrobius* sp.	—	—	—	—	—	—	—	—	—	—
. Dytiscidae										
. . *Hydroporus* or *Hygrotus* sp.	—	—	—	—	—	—	3	—	12	—
. . *Deronectes* sp.	—	—	—	—	—	—	—	—	—	—
. . *Agabus* sp.	—	—	—	—	—	—	—	—	—	—
. Dryopidae										
. . *Helichus suteralis*	—	—	—	—	—	—	—	—	—	—
Ephemeroptera	7	—	—	—	—	7	—	—	—	—
. Ephemerellidae										
. . *Ephemerella aurivillii*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella coloradensis*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella doddsi*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella grandis*	—	—	7	76	52	—	1	2	56	52
. . *Ephemerella margarita*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella serratella* sp. A	—	—	2	4	8	—	1	6	—	16
. Baetidae										
. . *Baetis* sp.	—	—	—	—	—	—	—	—	—	—
. . *Baetis* sp. A	—	211	143	1,148	2,812	—	172	273	968	1,860
. . *Baetis* sp. B	—	—	—	—	—	—	—	2	—	—
. Heptageniidae										
. . *Epeorus longimanus*	—	—	—	8	—	—	—	—	—	—
. . *Cinygmula* sp. A	—	1	—	28	—	—	—	—	—	—
. . *Rhithrogena* sp.	—	—	4	—	32	—	—	4	—	28
. . *Heptagenia criddlei*	—	—	—	—	—	—	—	—	—	20
. . *Heptagenia elegantula*	—	2	6	32	4	—	2	13	40	40
. Leptophlebiidae	—	—	—	—	—	—	—	—	—	—
. . *Paraleptophlebia* sp.	—	—	—	—	—	—	—	—	—	8
. Tricorythidae										
. . *Tricorythodes minutus*	—	—	—	—	—	—	—	—	—	—
Podocopa										
. Cypridae										
. . *Prionocypris longiforma*	—	—	—	—	—	—	—	—	—	—
Dorylaimida										
. Dorylaimidae										
. . *Alaimus* sp.	—	—	—	24	—	—	—	—	20	56
. . Uid. genera	—	5	11	20	4	—	3	4	20	20
Diplostraca										
. Daphnidae										
. . *Daphnia* sp.	—	3	—	276	—	—	687	—	772	—
Copepoda										
. Diaptomidae										
. . *Diaptomus* sp.	—	5	—	956	—	—	93	—	2,328	—
. Canthocamptidae										
. . *Attheyella* sp.	—	—	—	—	—	—	—	—	—	—
. Cyclopidae										
. . Uid. sp.	—	—	—	36	—	—	—	—	270	—
Acari										
. Mideidae										
. . *Mideopsis* sp.	—	—	—	—	—	—	—	—	—	—
. Hygrobatidae										
. . *Atractides* sp.	—	—	—	—	4	—	—	—	—	4
. Sperchonidae										
. . *Sperchon* sp.	—	6	1	80	4	—	8	—	104	36
. Limnesiidae										
. . *Tyrellia* sp.	—	—	—	—	—	—	—	—	—	—
. Lebertiidae										
. . *Lebertia* sp.	—	—	—	—	—	—	—	—	—	—
Heterondonta										
. Sphaeriidae	4	—	—	—	—	—	—	—	—	—
. . *Pisidium milium*	—	—	—	—	—	—	—	—	—	—
Hydracarina	—	—	—	—	—	—	—	—	—	—
Basommatophora										
. Lymnaeidae	1	—	—	—	—	—	—	—	—	—

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 70 — Little Bear Canyon					Site 71 — Huntington Creek				
	10-18-77[8]	7-28-78	10-18-78	7-19-79	10-16-79	10-13-77[12]	7-27-78	10-18-78	7-19-79	10-16-79
Hydroida										
. Hydridae										
. . *Hydra* sp.	—	—	—	—	—	—	—	—	—	—
Tricladida										
. Planariidae										
. . *Polycelis coronata*	—	—	1	5	1	—	—	—	—	—
Haplotaxida										
. Tubificidae										
. . *Limnodrilus hoffmeisteri*	—	—	—	—	—	—	—	—	—	—
. . *Rhyacodrilus* sp.	—	3	2	30	4	—	17	20	72	40
. . Uid. sp.	—	—	—	6	—	—	—	—	—	—
. Naididae										
. . *Nais pseudobtusa*	—	—	—	—	—	—	3	2	—	136
. Enchytraeidae										
. . *Enchytraeus* sp.	—	—	6	90	28	—	6	—	12	24
. Lumbricidae										
. . *Eisenella* sp.	—	—	5	7	13	—	4	—	—	—
Diptera										
. Ceratopogonidae										
. . *Bezzia* sp.	—	2	—	1	1	—	—	—	—	—
. . *Forcipomyia* sp. A	—	—	—	—	—	—	—	—	4	—
. . *Forcipomyia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Dasyhelea* sp.	—	—	—	1	—	—	—	—	—	—
. Tipulidae	21	—	—	—	—	1	—	—	—	—
. . *Tipula* sp.	—	—	2	1	—	—	—	—	—	—
. . *Hexatoma* sp.	—	—	—	—	—	—	1	1	—	—
. . *Limnophila* sp.	—	5	14	2	18	—	—	2	—	—
. . *Antocha* sp.	—	3	1	—	—	—	5	13	—	244
. . *Erioptera* sp. B	—	—	—	—	—	—	—	—	—	1
. . *Ormosia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Pedicia* sp.	—	—	7	5	23	—	—	1	—	12
. . *Hesperoconopa* sp.	—	—	—	—	—	—	—	1	—	4
. Psychodidae	19	—	—	—	—	—	—	—	—	—
. . *Pericoma* sp.	—	—	1	—	5	—	—	—	—	—
. Simuliidae	—	—	—	—	—	—	—	—	—	—
. . *Simulium* sp. B	—	—	—	4	—	—	1	12	—	—
. . *Simulium arcticum*	—	—	—	—	2	—	60	—	—	—
. . *Simulium argus*	—	—	—	—	—	—	—	—	—	—
. . *Simulium aureum*	—	—	—	—	7	—	—	—	—	—
. . *Simulium canadense*	—	—	—	—	—	—	—	3	—	—
. . *Simulium vittatum*	—	—	—	1	—	—	—	—	—	—
. . *Prosimulium onychodactylum*	—	—	—	—	—	—	—	—	—	—
. . *Metacnephia jeanae*	—	—	—	—	—	—	—	—	—	—
. . Uid. sp.	—	—	—	—	—	—	—	—	—	—
. Stratiomyiidae										
. . *Euparyphus* sp.	—	—	—	—	—	—	—	—	—	—
. Empididae	—	—	—	—	—	—	—	—	—	—
. . *Hemerodromia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Wiedemannia* sp.	—	3	—	4	—	—	—	2	—	24
. . *Chelifera* sp.	—	—	1	11	4	—	3	1	8	4
. Ephydridae										
. . *Hydrellia* sp.	—	—	—	—	—	—	—	—	—	—
. Rhagionidae	—	—	—	—	—	2	—	—	—	—
. . *Atherix variegata*	—	1	—	—	—	—	9	3	8	16
. Chironomidae	114	—	—	—	—	13	—	—	—	—
. . *Procladius* sp.	—	—	—	—	—	—	1	—	—	—
. . *Psectrotanypus* sp.	—	—	4	—	7	—	—	—	—	—
. . *Ablabesmyia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Thienemannimyia*	—	—	—	—	1	—	4	4	4	—
. . *Parochlus kiefferi*	—	—	—	—	—	—	—	—	—	—
. . *Diamesa* sp. A	—	—	—	—	—	—	—	—	—	—
. . *Diamesa* sp. B	—	—	—	—	—	—	22	—	—	—
. . *Monodiamesa* sp.	—	—	—	—	—	—	2	—	—	—
. . *Pseudodiamesa* sp. A	—	—	—	2	1	—	—	—	16	8
. . *Pseudodiamesa* sp. B	—	—	—	—	8	—	—	—	—	—
. . *Pseudodiamesa* sp.	—	—	—	—	—	—	5	3	—	—
. . *Odontomesa* sp.	—	—	—	—	—	—	—	—	—	—
. . *Prodiamesa* sp.	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp.	—	—	—	—	1	—	—	—	—	—
. . *Brillia* sp. A	—	—	10	—	—	—	—	—	—	—
. . *Brillia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Corynoneura* sp.	—	1	—	—	—	—	—	—	—	—
. . *Cricotopus* sp. B	—	6	—	—	—	—	5	—	16	—
. . *Cricotopus* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Cricotopus* sp. D	—	—	—	3	—	—	—	—	—	—
. . *Heterotrissocladius hirtapex*	—	—	—	—	—	—	—	—	—	—
. . *Heterotrissocladius oliveri*	—	7	—	19	4	—	10	1	4	4
. . *Orthocladius* sp. A	—	—	—	—	—	—	5	4	—	16
. . *Orthocladius* sp. B	—	—	—	—	—	—	11	9	—	—
. . *Orthocladius* sp. C	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius dorenus*	—	3	5	—	—	—	—	19	—	44
. . *Orthocladius obumbratus*	—	—	1	341	16	—	94	95	4	16
. . *Psectrocladius* sp.	—	—	—	—	—	—	4	3	4	4
. . *Smittia* sp.	—	—	—	—	—	—	1	—	—	—
. . *Trichocladius* sp. A	—	—	—	—	—	—	43	1	20	—
. . *Trichocladius* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Trissocladius* sp.	—	—	—	—	—	—	—	—	—	—
. . *Chironomus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Cryptochironomus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Phaenopsectra* sp.	—	—	—	—	—	—	—	—	—	—
. . *Polypedilum* sp.	—	—	—	—	—	—	—	—	—	—
. . *Cladotanytarsus* sp.	—	—	—	—	—	—	—	3	—	—

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 70 — Little Bear Canyon—continued					Site 71 — Huntington Creek—continued				
	10-18-77	7-28-78	10-18-78	7-19-79	10-16-79	10-13-77	7-27-78	10-18-78	7-19-79	10-16-79
Diptera—continued										
. Chironomidae—continued										
. . *Micropsectra* sp.	—	4	—	1	—	—	5	4	—	—
. . *Micropsectra* sp. A	—	—	—	—	3	—	—	—	—	8
. . *Micropsectra* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Paracladopelma nais*	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp.	—	—	1	—	—	—	—	—	—	—
. . *Zavrelimyia* sp. B	—	—	—	—	—	—	—	—	—	—
. . *Eukiefferiella* sp. A	—	2	—	—	—	—	10	—	—	—
. . *Eukiefferiella* sp. B	—	3	1	93	1	—	4	6	24	64
. . *Eukiefferiella* sp. C	—	—	—	—	—	—	3	—	—	—
. . *Eukiefferiella* sp. F	—	—	—	—	—	—	—	—	—	—
. . Uid. *Tanytarsini*	—	—	—	—	—	—	2	—	—	—
. . Uid. Pupa	—	—	—	1	—	—	—	—	4	—
. Muscidae										
. . *Limnophora* sp.	—	—	—	—	—	—	—	—	—	—
. . *Lispe* sp.	—	—	—	—	—	—	—	—	—	—
. Dolichopodidae										
. . *Dolichopus* sp.	—	—	—	—	—	—	—	—	—	—
. . *Campsicnemus* sp.	—	—	—	—	—	—	—	—	—	—
. Dixidae										
. . *Dixa* sp.	—	—	—	—	—	—	—	—	—	—
. Tanyderidae										
. . *Protoplasa* sp.	—	—	—	—	—	—	—	—	—	—
Trichoptera	1	—	—	—	—	54	—	—	—	—
. Hydropsychidae										
. . *Hydropsyche* sp.	—	—	2	—	1	—	4	5	20	28
. . *Arctopsyche* sp. A	—	—	—	—	—	—	9	1	—	4
. . *Parapsyche* sp.	—	—	—	—	—	—	—	—	—	—
. Rhyacophilidae										
. . *Rhyacophila* sp. B	—	—	1	—	—	—	—	6	—	24
. . *Rhyacophila* sp. C	—	—	—	12	5	—	—	—	—	—
. . *Rhyacophila* sp. D	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila acropedes*	—	—	—	—	—	—	1	—	—	—
. . *Rhyacophila angelita*	—	—	—	2	—	—	—	—	—	—
. Hydroptilidae										
. . *Neotrichia* sp.	—	—	—	—	—	—	—	—	—	—
. . *Ochrotrichia* sp.	—	—	—	16	—	—	2	—	28	—
. Brachycentridae										
. . *Brachycentrus americanus*	—	—	—	1	—	—	—	4	—	48
. . *Brachycentrus* sp.	—	—	—	—	—	—	1	—	—	—
. . *Micrasema* sp.	—	—	—	—	—	—	—	—	—	—
. Limnephilidae										
. . *Dicosmoecus atripes*	—	—	—	—	—	—	—	—	—	—
. . *Hesperophylax* sp.	—	—	—	1	11	—	—	—	—	—
. . *Limnephilus* sp. A	—	—	—	—	—	—	—	1	—	—
. . *Neothrema* sp.	—	—	—	—	—	—	—	—	—	—
. . *Oligophlebodes* sp.	—	—	—	—	—	—	—	—	—	4
. . *Ecclisomyia* sp.	—	—	—	—	—	—	—	—	—	—
Plecoptera	7	—	—	—	—	7	—	—	—	—
. Pteronarcidae										
. . *Pteronarcella badia*	—	—	—	—	—	—	9	—	4	24
. . *Pteronarcys californica*	—	—	—	—	—	—	1	—	16	16
. Nemouridae										
. . *Amphinemura* sp.	—	60	—	96	—	—	—	—	—	—
. . *Malenka* sp.	—	—	8	—	43	—	—	—	—	—
. . *Podmosta prostoia*	—	—	—	—	—	—	—	—	—	—
. Perlidae										
. . *Hesperoperla pacifica*	—	—	—	—	—	—	—	—	—	—
. Perlodidae										
. . *Isogenoides zionensis*	—	—	1	—	—	—	—	9	28	4
. . *Isoperla* sp.	—	—	—	—	—	—	14	—	—	—
. . *Isoperla* sp. A	—	—	—	—	—	—	—	—	—	4
. . *Isoperla* sp. B	—	—	—	—	18	—	—	—	—	—
. Chloroperlidae										
. . *Alloperla* sp.	—	—	—	—	—	—	—	—	12	—
. . *Kathroperla perdita*	—	—	—	—	—	—	—	—	—	—
. . *Sweltsa albertersis*	—	—	—	—	—	—	—	—	—	—
. . *Sweltsa* sp.	—	—	—	—	—	—	1	—	—	—
. Taeniopterygidae										
. . *Taenionema* sp.	—	—	—	—	—	—	—	2	—	12
. Capniidae										
. . Uid. sp.	—	—	26	4	172	—	—	13	—	24
Hemiptera	—	—	—	—	—	—	—	—	—	—
Coleoptera										
. Elmidae	—	—	—	—	—	21	—	—	—	—
. . *Narpus* sp.	—	—	—	—	1	—	—	—	—	—
. . *Optioservus seriatus*	—	—	—	2	—	—	159	34	236	244
. Hydrophilidae										
. . *Ametor* sp.	—	—	—	—	—	—	—	—	—	—
. . *Helophorus* sp.	—	—	—	—	—	—	1	—	—	—
. . *Hydrobius* sp.	—	—	—	—	—	—	—	—	—	—
. Dytiscidae										
. . *Hydroporus* or *Hygrotus* sp.	—	—	—	—	—	—	5	—	—	—
. . *Deronectes* sp.	—	—	—	—	—	—	—	—	—	—
. . *Agabus* sp.	—	—	—	—	—	—	—	—	—	—
. Dryopidae										
. . *Helichus suteralis*	—	—	—	—	—	—	1	—	—	—
Ephemeroptera	21	—	—	—	—	11	—	—	—	—
. Ephemerellidae										
. . *Ephemerella aurivillii*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella coloradensis*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella doddsi*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella grandis*	—	—	1	—	—	—	12	3	36	20
. . *Ephemerella margarita*	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella serratella* sp. A	—	—	—	—	—	—	4	1	—	20

Table 7.–Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79–Continued

Organism	Site 70 – Little Bear Canyon–continued					Site 71 – Huntington Creek–continued				
	10-18-77	7-28-78	10-18-78	7-19-79	10-16-79	10-13-77	7-27-78	10-18-78	7-19-79	10-16-79
Ephemeroptera–continued										
. Baetidae										
. . *Baetis* sp.	–	–	–	–	–	–	304	–	–	–
. . *Baetis* sp. A	–	132	187	221	226	–	–	376	644	1,124
. . *Baetis* sp. B	–	–	–	–	–	–	–	–	–	–
. Heptageniidae										
. . *Epeorus longimanus*	–	–	–	–	–	–	–	–	–	–
. . *Cinygmula* sp. A	–	–	–	–	–	–	10	–	60	–
. . *Rhithrogena* sp.	–	–	–	–	1	–	–	15	–	24
. . *Heptagenia criddlei*	–	–	–	–	6	–	–	3	–	–
. . *Heptagenia elegantula*	–	1	–	–	–	–	5	12	4	24
. Leptophlebiidae	–	–	–	–	–	–	–	–	–	–
. . *Paraleptophlebia* sp.	–	–	–	–	–	–	–	–	–	–
. Tricorythidae										
. . *Tricorythodes minutus*	–	–	–	–	–	–	1	–	–	–
Podocopa										
. Cypridae										
. . *Prionocypris longiforma*	–	10	6	–	1	–	–	–	–	–
Dorylaimida										
. Dorylaimidae										
. . *Alaimus* sp.	–	–	–	5	–	–	–	–	60	16
. . Uid. genera	–	–	–	–	–	–	3	14	–	–
Diplostraca										
. Daphnidae										
. . *Daphnia* sp.	–	–	–	–	–	–	220	–	328	–
Copepoda										
. Diaptomidae										
. . *Diaptomus* sp.	–	–	–	1	–	–	33	–	1,080	–
. Canthocamptidae										
. . *Attheyella* sp.	–	–	1	1	7	–	–	–	–	–
. Cyclopidae										
. . Uid. sp.	–	–	–	–	–	–	–	–	100	–
Acari										
. Mideidae										
. . *Mideopsis* sp.	–	–	–	–	–	–	–	–	–	–
. Hygrobatidae										
. . *Atractides* sp.	–	–	–	–	–	–	–	–	–	–
. Sperchonidae										
. . *Sperchon* sp.	–	3	–	8	1	–	11	–	56	12
. Limnesiidae										
. . *Tyrellia* sp.	–	–	–	–	–	–	–	–	–	–
. Lebertiidae										
. . *Lebertia* sp.	–	–	–	–	–	–	–	–	–	–
Heterondonta										
. Sphaeriidae	2	–	–	–	–	–	–	–	–	–
. . *Pisidium milium*	–	–	–	–	1	–	–	–	–	–
Hydracarina	–	–	–	–	–	–	–	–	–	–
Basommatophora										
. Lymnaeidae	–	–	–	–	–	–	–	–	–	–

Organism	Site 76 – Mill Fork Canyon			Site 77 – Huntington Creek					Site 78 – Rilda Canyon				
	7-28-78	7-19-79	10-16-79	10-13-77[9,12]	7-28-78	10-18-78	7-19-79	10-16-79	10-13-77[10]	7-26-78	10-18-78	7-18-79	10-16-79
Hydroida													
. Hydridae													
. . *Hydra* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–
Tricladida													
. Planariidae													
. . *Polycelis coronata*	–	–	–	–	–	–	–	–	–	6	149	61	420
Haplotaxida													
. Tubificidae													
. . *Limnodrilus hoffmeisteri*	–	–	–	–	–	–	–	12	–	–	–	–	–
. . *Rhyacodrilus* sp.	–	–	–	–	29	4	168	208	–	11	–	7	3
. . Uid. sp.	–	–	–	–	–	1	84	4	–	–	–	27	–
. Naididae													
. . *Nais pseudobtusa*	–	–	4	–	1	4	32	884	–	2	1	–	13
. Enchytraeidae													
. . *Enchytraeus* sp.	72	106	25	–	–	–	140	60	–	5	–	19	6
. Lumbricidae													
. . *Eisenella* sp.	–	–	–	–	1	–	–	4	–	12	53	25	4
Diptera													
. Ceratopogonidae													
. . *Bezzia* sp.	–	–	–	–	–	–	–	–	–	1	–	2	1
. . *Forcipomyia* sp. A	–	–	–	–	–	–	4	–	–	–	–	–	–
. . *Forcipomyia* sp. B	–	–	–	–	–	–	4	–	–	–	–	–	–
. . *Dasyhelea* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–
. Tipulidae	–	–	–	–	–	–	–	–	12	–	–	–	–
. . *Tipula* sp.	–	–	–	–	–	–	–	–	–	–	4	4	5
. . *Hexatoma* sp.	–	–	–	–	–	–	4	8	–	–	–	–	–
. . *Limnophila* sp.	–	–	–	–	–	–	–	–	–	–	–	4	–
. . *Antocha* sp.	1	–	3	–	–	13	12	132	–	2	–	–	–
. . *Erioptera* sp. B	–	–	–	–	–	–	–	–	–	–	–	–	–
. . *Limonia* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–
. . *Ormosia* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–
. . *Pedicia* sp.	–	–	14	–	–	1	–	20	–	–	12	1	1
. . *Hesperoconopa* sp.	–	–	–	–	–	–	–	12	–	–	2	–	2
. Psychodidae	–	–	–	–	–	–	–	–	–	–	–	–	–
. . *Pericoma* sp.	–	–	1	–	–	–	–	–	–	–	–	–	2
. Simuliidae	–	–	–	–	–	–	–	–	–	–	–	–	–
. . *Simulium* sp. B	–	81	–	–	–	–	12	–	–	–	–	–	–
. . *Simulium arcticum*	4	1	–	–	16	–	–	–	–	9	–	–	15
. . *Simulium argus*	–	–	–	–	–	–	–	–	–	–	–	–	–
. . *Simulium aureum*	–	–	–	–	–	–	–	–	–	–	–	2	–
. . *Simulium canadense*	–	–	–	–	–	–	–	–	–	–	–	–	–
. . *Simulium vittatum*	–	5	–	–	–	–	–	–	–	–	–	–	–
. . *Prosimulium onychodactylum*	–	3	–	–	–	–	–	–	–	–	–	–	–
. . *Metacnephia jeanae*	–	11	–	–	–	–	–	–	–	–	–	–	–
. . Uid. sp.	–	25	–	–	–	–	–	–	–	–	–	–	–

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creek, 1977-79—Continued

Organism	Site 76 — Mill Fork Canyon—continued			Site 77 — Huntington Creek—continued					Site 78 — Rilda Canyon—continued				
	7-28-78	7-19-79	10-16-79	10-13-77	7-28-78	10-18-78	7-19-79	10-16-79	10-13-77	7-25-78	10-18-78	7-18-79	10-16-79
Diptera—continued													
. Stratiomyiidae													
. . *Euparyphus* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. Empididae	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Hemerodromia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Wiedemannia* sp.	—	—	—	—	—	2	—	44	—	—	—	—	—
. . *Chelifera* sp.	4	2	4	—	2	1	4	8	—	3	1	4	1
. Ephydridae													
. . *Hydrellia* sp.	—	—	—	—	—	—	—	—	—	—	2	—	—
. Rhagionidae	—	—	—	11	—	—	—	—	—	—	—	—	—
. . *Atherix variegata*	—	—	—	—	2	2	4	23	—	—	—	—	—
. Chironomidae	—	—	—	11	—	—	—	—	12	—	—	—	—
. . *Procladius* sp.	—	—	—	—	1	—	—	—	—	—	—	—	—
. . *Psectrotanypus* sp.	—	—	—	—	—	—	—	—	—	—	2	—	—
. . *Ablabesmyia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Thienemannimyia*	2	—	5	—	3	1	8	8	—	2	64	5	3
. . *Parochlus kiefferi*	1	—	1	—	—	—	—	—	—	—	—	—	—
. . *Diamesa* sp. A	—	1	—	—	1	—	—	—	—	—	—	—	—
. . *Diamesa* sp. B	—	—	—	—	25	—	—	—	—	—	—	—	—
. . *Monodiamesa* sp.	—	—	—	—	1	—	—	—	—	—	—	—	—
. . *Pseudodiamesa* sp. A	—	1	1	—	—	—	—	8	—	—	—	—	1
. . *Pseudodiamesa* sp. B	—	—	1	—	—	—	—	—	—	—	—	—	5
. . *Pseudodiamesa* sp.	—	—	—	—	2	—	—	—	—	—	—	—	—
. . *Odontomesa* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Prodiamesa* sp.	—	—	—	—	—	—	—	—	—	—	1	—	—
. . *Brillia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. A	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. B	—	—	—	—	—	—	—	—	—	—	1	—	—
. . *Corynoneura* sp.	—	13	2	—	1	—	—	—	—	9	26	—	1
. . *Cricotopus* sp. B	2	—	—	—	6	—	24	—	—	34	—	—	—
. . *Cricotopus* sp. C	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Cricotopus* sp. D	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Heterotrissocladius hirtapex*	133	—	2	—	—	—	—	—	—	—	—	—	—
. . *Heterotrissocladius oliveri*	1	—	—	—	7	—	—	—	—	10	1	2	5
. . *Orthocladius* sp. A	—	—	—	—	2	10	8	4	—	—	—	1	2
. . *Orthocladius* sp. B	—	3	—	—	22	1	—	4	—	1	—	4	—
. . *Orthocladius* sp. C	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius* sp. D	—	—	—	—	—	—	—	4	—	—	—	—	—
. . *Orthocladius dorenus*	—	—	—	—	2	5	—	24	—	—	3	—	—
. . *Orthocladius obumbratus*	3	5	—	—	194	108	16	36	—	2	—	3	—
. . *Psectrocladius* sp.	—	—	—	—	2	—	4	—	—	—	—	—	1
. . *Smittia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Trichocladius* sp. A	—	—	—	—	11	—	24	—	—	30	—	1	—
. . *Trichocladius* sp. B	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Trissocladius* sp.	30	—	1	—	—	—	—	—	—	—	—	—	—
. . *Chironomus* sp.	—	—	—	—	1	—	—	—	—	—	—	—	—
. . *Cryptochironomus* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Phaenopsectra* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Polypedilum* sp.	—	—	—	—	1	—	—	—	—	—	—	1	—
. . *Cladotanytarsus* sp.	—	—	—	—	—	4	—	—	—	—	—	—	1
. . *Micropsectra* sp.	2	2	—	—	8	—	—	—	—	—	4	—	—
. . *Micropsectra* sp. A	—	—	—	—	—	—	—	4	—	—	—	—	5
. . *Micropsectra* sp. B	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Paracladopelma nais*	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp. B	—	—	—	—	—	—	—	—	—	—	—	—	2
. . *Eukiefferiella* sp. A	—	—	—	—	15	—	—	—	—	2	—	—	—
. . *Eukiefferiella* sp. B	14	77	—	—	8	11	48	52	—	7	—	2	—
. . *Eukiefferiella* sp. C	1	—	—	—	4	—	—	—	—	—	—	—	—
. . *Eukiefferiella* sp. F	—	—	—	—	—	—	—	—	—	—	—	—	—
. . Uid. *Tanytarsini*	—	—	—	—	1	—	—	—	—	—	—	—	—
. . Uid. Pupa	—	—	—	—	—	—	—	—	—	—	—	—	—
. Muscidae													
. . *Limnophora* sp.	2	2	—	—	—	—	—	—	—	—	—	—	—
. . *Lispe* sp.	2	—	—	—	—	—	—	—	—	—	—	—	—
. Dolichopodidae													
. . *Dolichopus* sp.	1	—	—	—	—	—	—	—	—	—	—	—	—
. . *Campsicnemus* sp.	—	—	1	—	—	—	—	—	—	—	—	—	—
. Dixidae													
. . *Dixa* sp.	—	—	—	—	—	—	—	—	—	—	—	—	1
. Tanyderidae													
. . *Protoplasa* sp.	—	—	—	—	—	—	—	4	—	—	—	—	—
Trichoptera	—	—	—	22	—	—	—	—	3	—	—	—	—
. Hydropsychidae													
. . *Hydropsyche* sp.	—	—	12	—	—	12	36	68	—	3	5	1	3
. . *Arctopsyche* sp. A	—	—	—	—	1	1	—	—	—	—	—	—	—
. . *Parapsyche* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. Rhyacophilidae													
. . *Rhyacophila* sp. B	—	—	—	—	—	1	—	28	—	—	—	—	—
. . *Rhyacophila* sp. C	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila* sp. D	—	—	—	—	—	—	—	—	—	—	—	4	5
. . *Rhyacophila acropedes*	—	—	—	—	—	—	—	—	—	1	15	—	—
. . *Rhyacophila angelita*	—	—	—	—	—	—	—	—	—	—	—	—	—
. Hydroptilidae													
. . *Neotrichia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Ochrotrichia* sp.	—	1	—	—	2	—	16	—	—	4	—	—	—
. Brachycentridae													
. . *Brachycentrus americanus*	—	—	—	—	—	20	12	116	—	—	—	—	—
. . *Brachycentrus* sp.	—	—	—	—	1	—	—	—	—	—	—	—	—
. . *Micrasema* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. Limnephilidae													
. . *Dicosmoecus atripes*	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Hesperophylax* sp.	—	—	6	—	—	—	—	—	—	—	15	—	1
. . *Limnephilus* sp. A	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Neothrema* sp.	—	—	—	—	—	—	—	—	—	1	—	—	—
. . *Oligophlebodes* sp.	—	—	—	—	—	—	—	4	—	—	—	—	2
. . *Ecclisomyia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
Plecoptera	—	—	—	22	—	—	—	—	15	—	—	—	—
. Pteronarcidae													
. . *Pteronarcella badia*	—	—	—	—	1	—	—	12	—	—	—	—	—
. . *Pteronarcys californica*	—	—	—	—	—	—	—	4	—	—	—	—	—

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creek, 1977-79—Continued

Organism	Site 76 – Mill Fork Canyon—continued			Site 77 — Huntington Creek—continued					Site 78 – Rilda Canyon—continued				
	7-28-78	7-19-79	10-16-79	10-13-77	7-28-78	10-18-78	7-19-79	10-16-79	10-13-77	7-26-78	10-18-78	7-18-79	10-16-79
Plecoptera—continued													
. Nemouridae													
. . *Amphinemura* sp.	—	—	—	—	—	—	—	—	—	21	—	33	—
. . *Malenka* sp.	—	—	—	—	—	—	—	—	—	—	46	—	30
. . *Podmosta prostoia*	—	—	5	—	—	—	—	4	—	—	—	—	—
. Perlidae													
. . *Hesperoperla pacifica*	—	—	—	—	—	—	—	—	—	—	—	—	—
. Perlodidae													
. . *Isogenoides zionensis*	—	—	—	—	—	9	28	4	—	—	45	2	—
. . *Isoperla* sp.	—	—	—	—	3	—	—	—	—	2	—	—	—
. . *Isoperla* sp. A	—	2	1	—	—	—	—	—	—	—	—	13	147
. . *Isoperla* sp. B	—	—	—	—	—	—	—	4	—	—	—	—	—
. Chloroperlidae													
. . *Alloperla* sp.	—	—	—	—	—	—	4	—	—	—	—	1	—
. . *Kathroperla perdita*	—	—	—	—	—	1	—	12	—	—	—	—	—
. . *Sweltsa albertersis*	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Sweltsa* sp.	—	—	—	—	—	—	8	—	—	1	—	—	—
. Taeniopterygidae													
. . *Taenionema* sp.	—	—	—	—	—	—	—	12	—	—	—	—	—
. Capniidae													
. . Uid. sp.	—	5	7	—	—	4	—	52	—	—	282	1	219
Hemiptera	—	—	—	—	—	—	—	—	—	—	—	—	—
Coleoptera													
. Elmidae	—	—	—	48	—	—	—	—	—	—	—	—	—
. . *Narpus* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Optioservus seriatus*	—	1	—	—	21	21	168	520	—	1	5	2	—
. Hydrophilidae													
. . *Ametor* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Helophorus* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Hydrobius* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. Dytiscidae													
. . *Hydroporus* or *Hygrotus* sp.	—	—	—	—	1	—	4	—	—	—	—	—	—
. . *Deronectes* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Agabus* sp.	—	3	—	—	—	—	—	—	—	—	—	—	—
. Dryopidae													
. . *Helichus suteralis*	—	—	—	—	—	—	—	—	—	—	—	—	—
Ephemeroptera	—	—	—	33	—	—	—	—	3	—	—	—	—
. Ephemerellidae													
. . *Ephemerella aurivillii*	—	—	—	—	—	—	4	—	—	—	—	—	—
. . *Ephemerella coloradensis*	—	—	—	—	—	—	—	—	—	—	—	5	—
. . *Ephemerella doddsi*	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella grandis*	—	1	—	—	1	2	4	28	—	—	—	1	—
. . *Ephemerella margarita*	—	—	—	—	—	—	—	—	—	8	—	—	—
. . *Ephemerella serratella* sp. A	—	—	—	—	1	1	—	44	—	—	—	—	—
. Baetidae													
. . *Baetis* sp.	6	—	—	—	103	—	—	—	—	—	—	—	—
. . *Baetis* sp. A	—	514	764	—	—	298	704	1,876	—	173	1,182	95	326
. . *Baetis* sp. B	—	—	—	—	—	—	—	—	—	—	52	—	—
. Heptageniidae													
. . *Epeorus longimanus*	—	6	—	—	—	—	—	—	—	—	—	—	4
. . *Cinygmula* sp. A	—	5	—	—	6	—	—	—	—	—	—	1	—
. . *Rhithrogena* sp.	—	—	—	—	—	14	—	36	—	—	17	—	—
. . *Heptagenia criddlei*	—	—	18	—	—	—	24	—	—	—	—	—	25
. . *Heptagenia elegantula*	—	3	—	—	—	12	12	12	—	—	—	—	—
. Leptophlebiidae	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Paraleptophlebia* sp.	—	—	—	—	—	—	—	—	—	—	77	9	19
. Tricorythidae													
. . *Tricorythodes minutus*	—	—	—	—	—	—	—	—	—	—	—	—	—
Podocopa													
. Cypridae													
. . *Prionocypris longiforma*	—	1	—	—	—	—	—	—	—	7	23	—	12
Dorylaimida													
. Dorylaimidae													
. . *Alaimus* sp.	—	5	—	—	—	—	—	44	—	—	—	3	—
. . Uid. genera	—	4	—	—	4	5	28	12	—	3	4	7	2
Diplostraca													
. Daphnidae													
. . *Daphnia* sp.	2	49	—	—	2	—	296	—	—	1	—	3	—
Copepoda													
. Diaptomidae													
. . *Diaptomus* sp.	1	73	—	—	6	—	924	—	—	—	—	38	—
. Canthocamptidae													
. . *Attheyella* sp.	—	—	—	—	—	—	—	—	—	—	—	—	1
. Cyclopidae													
. . Uid. sp.	—	45	—	—	—	—	104	—	—	—	—	—	—
Acari													
. Mideidae													
. . *Mideopsis* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. Hygrobatidae													
. . *Atractides* sp.	—	—	—	—	—	—	—	4	—	—	—	—	—
. Sperchonidae													
. . *Sperchon* sp.	—	—	—	—	1	—	56	60	—	—	—	1	—
. Limnesiidae													
. . *Tyrellia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
. Lebertiidae													
. . *Lebertia* sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
Heterondonta													
. Sphaeriidae	—	—	—	—	—	—	—	—	—	—	—	—	—
. . *Pisidium milium*	—	—	—	—	—	—	—	—	—	—	—	—	—
Hydracarina	—	—	—	—	—	—	—	—	—	—	—	—	—
Basommatophora													
. Lymnaeidae	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 87 — Deer Creek		Site 103 — Cottonwood Creek					Site 104 — Cottonwood Creek				
	7-28-78	7-18-79	10-13-77[11]	7-27-78	10-19-78	7-18-79	10-16-79	10-13-77	7-27-78	10-19-78	7-18-79	10-16-79
Hydroida												
. Hydridae												
. . *Hydra* sp.	—	—	—	—	—	—	—	—	—	—	—	—
Tricladida												
. Planariidae												
. . *Polycelis coronata*	—	—	—	—	4	6	8	—	—	—	—	—
Haplotaxida												
. Tubificidae												
. . *Limnodrilus hoffmeisteri*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Rhyacodrilus* sp.	—	—	—	21	—	2	—	—	—	—	—	—
. . Uid. sp.	—	—	—	—	—	7	—	—	—	—	—	—
. Naididae												
. . *Nais pseudobtusa*	—	—	—	1	6	—	3	—	—	5	3	4
. Enchytraeidae												
. . *Enchytraeus* sp.	—	2	—	—	4	11	37	—	2	2	10	4
. Lumbricidae												
. . *Eisenella* sp.	—	—	—	—	1	—	—	—	—	1	7	—
Diptera												
. Ceratopogonidae												
. . *Bezzia* sp.	—	—	—	1	4	1	1	—	—	1	7	—
. . *Forcipomyia* sp. A	—	1	—	—	—	—	—	—	3	—	—	—
. . *Forcipomyia* sp. B	—	—	—	—	—	—	—	—	—	—	—	—
. . *Dasyhelea* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Tipulidae	—	—	1	—	—	—	—	—	—	—	—	—
. . *Tipula* sp.	—	1	—	—	—	3	—	—	—	1	—	—
. . *Hexatoma* sp.	—	—	—	—	—	—	—	—	—	—	1	—
. . *Limnophila* sp.	—	—	—	—	11	—	2	—	—	—	—	—
. . *Antocha* sp.	—	—	—	—	—	—	3	—	—	—	—	—
. . *Erioptera* sp. B	—	—	—	—	—	—	—	—	—	—	—	—
. . *Limonia* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Ormosia* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Pedicia* sp.	—	—	—	—	4	—	6	—	—	—	2	—
. . *Hesperoconopa* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Psychodidae	—	—	—	—	—	—	—	—	—	—	—	—
. . *Pericoma* sp.	—	—	—	—	3	—	—	—	—	—	—	1
. Simuliidae	—	—	—	—	—	—	—	3	—	—	—	—
. . *Simulium* sp. B	—	—	—	—	—	—	—	—	—	—	48	—
. . *Simulium arcticum*	1	—	—	15	—	—	84	—	216	—	—	22
. . *Simulium argus*	—	—	—	—	—	—	—	—	—	—	—	1
. . *Simulium aureum*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Simulium canadense*	—	—	—	—	4	—	—	—	—	178	—	—
. . *Simulium vittatum*	—	—	—	—	—	—	—	—	—	—	2	—
. . *Prosimulium onychodactylum*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Metacnephia jeanae*	—	—	—	—	—	—	—	—	—	—	—	—
. . Uid. sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Stratiomyiidae												
. . *Euparyphus* sp.	—	—	—	—	—	2	—	—	—	—	—	—
. Empididae	—	—	—	—	—	—	—	1	—	—	—	—
. . *Hemerodromia* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Wiedemannia* sp.	—	—	—	—	—	—	1	—	—	—	—	—
. . *Chelifera* sp.	—	38	—	5	9	7	3	—	—	3	7	2
. Ephydridae												
. . *Hydrellia* sp.	—	—	—	—	1	—	—	—	—	—	—	—
. Rhagionidae	—	—	—	—	—	—	—	—	—	—	—	—
. . *Atherix variegata*	—	—	—	—	—	—	—	—	—	—	—	—
. Chironomidae	—	—	6	—	—	—	—	—	—	—	—	—
. . *Procladius* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Psectrotanypus* sp.	—	—	—	—	—	—	—	—	—	—	—	1
. . *Ablabesmyia* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Thienemannimyia*	20	7	—	4	145	3	10	—	—	12	7	3
. . *Parochlus kiefferi*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Diamesa* sp. A	—	—	—	—	—	—	—	—	—	—	3	—
. . *Diamesa* sp. B	—	—	—	—	—	—	—	—	—	—	—	—
. . *Monodiamesa* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Pseudodiamesa* sp. A	—	—	—	—	—	1	—	—	—	—	—	—
. . *Pseudodiamesa* sp. B	—	—	—	—	—	—	3	—	—	—	—	—
. . *Pseudodiamesa* sp.	—	—	—	—	—	—	—	—	1	—	—	—
. . *Odontomesa* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Prodiamesa* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. A	—	—	—	—	—	—	—	—	—	—	—	—
. . *Brillia* sp. B	—	—	—	—	—	—	—	—	—	1	—	—
. . *Corynoneura* sp.	1	4	—	—	3	—	—	—	11	1	—	—
. . *Cricotopus* sp. B	—	—	—	—	—	1	—	—	—	—	—	—
. . *Cricotopus* sp. C	—	—	—	—	—	—	—	—	—	—	—	—
. . *Cricotopus* sp. D	—	—	—	—	—	—	—	—	—	—	—	—
. . *Heterotrissocladius hirtapex*	—	25	—	—	—	—	2	—	—	—	—	—
. . *Heterotrissocladius oliveri*	—	—	—	2	—	6	—	—	10	—	—	—
. . *Orthocladius* sp. A	—	—	—	—	—	—	1	—	—	—	—	—
. . *Orthocladius* sp. B	—	7	—	—	—	—	—	—	—	—	4	—
. . *Orthocladius* sp. C	—	—	—	—	—	—	—	—	—	—	—	—
. . *Orthocladius* sp. D	—	—	—	—	—	—	—	—	—	1	—	—
. . *Orthocladius dorenus*	1	—	—	2	3	25	6	—	—	—	21	—
. . *Orthocladius obumbratus*	—	1	—	6	—	1	—	—	126	—	19	—
. . *Psectrocladius* sp.	—	—	—	—	—	6	—	—	1	—	1	—
. . *Smittia* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Trichocladius* sp. A	—	18	—	—	—	—	—	—	23	—	23	—
. . *Trichocladius* sp. B	—	—	—	—	—	—	—	—	—	—	—	—
. . *Trissocladius* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Chironomus* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Cryptochironomus* sp.	—	—	—	—	1	—	—	—	—	—	—	—
. . *Phaenopsectra* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Polypedilum* sp.	—	1	—	2	—	—	3	—	—	—	3	—
. . *Cladotanytarsus* sp.	—	1	—	—	2	—	—	—	—	—	—	—

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 87 — Deer Creek—continued		Site 103 — Cottonwood Creek—continued					Site 104 — Cottonwood Creek—continued				
	7-28-78	7-18-79	10-13-77	7-27-78	10-19-78	7-18-79	10-16-79	10-13-77	7-27-78	10-19-78	7-18-79	10-16-79
Diptera—continued												
. Chironomidae—continued												
. . *Micropsectra* sp.	4	—	—	—	13	—	—	—	1	1	1	—
. . *Micropsectra* sp. A	—	—	—	—	—	—	3	—	—	—	—	1
. . *Micropsectra* sp. B	—	—	—	—	—	—	—	—	—	—	—	—
. . *Paracladopelma nais*	—	1	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Zavrelimyia* sp. B	—	—	—	—	—	—	—	—	—	—	—	—
. . *Eukiefferiella* sp. A	—	—	—	—	—	—	—	—	29	—	—	—
. . *Eukiefferiella* sp. B	—	42	—	—	—	4	7	7	10	1	15	—
. . *Eukiefferiella* sp. C	—	—	—	—	—	—	—	—	—	—	—	—
. . *Eukiefferiella* sp. F	—	—	—	—	—	—	—	—	—	—	—	—
. . Uid. *Tanytarsini*	—	—	—	—	—	—	—	—	—	—	—	—
. . Uid. Pupa	—	—	—	—	2	—	—	—	—	—	—	—
. Muscidae												
. . *Limnophora* sp.	2	—	—	—	—	—	—	—	—	—	—	—
. . *Lispe* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Dolichopodidae												
. . *Dolichopus* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Campsicnemus* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Dixidae												
. . *Dixa* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Tanyderidae												
. . *Protoplasa* sp.	—	—	—	—	—	—	—	—	—	—	—	—
Trichoptera	—	—	7	—	—	—	—	6	—	—	—	—
. Hydropsychidae												
. . *Hydropsyche* sp.	1	16	—	4	42	12	205	—	1	85	8	63
. . *Arctopsyche* sp. A	—	—	—	—	—	—	—	—	—	—	—	—
. . *Parapsyche* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Rhyacophilidae												
. . *Rhyacophila* sp. B	—	—	—	—	—	—	1	—	—	—	—	3
. . *Rhyacophila* sp. C	—	—	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila* sp. D	—	—	—	—	—	—	—	—	—	—	—	—
. . *Rhyacophila acropedes*	—	—	—	—	2	—	—	—	—	—	—	—
. . *Rhyacophila angelita*	—	—	—	—	—	—	—	—	—	—	—	—
. Hydroptilidae												
. . *Neotrichia* sp.	—	—	—	—	—	1	—	—	—	—	3	—
. . *Ochrotrichia* sp.	—	—	—	1	3	—	—	—	2	4	1	—
. Brachycentridae												
. . *Brachycentrus americanus*	—	—	—	—	5	1	18	—	—	15	4	11
. . *Brachycentrus* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Micrasema* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Limnephilidae												
. . *Dicosmoecus atripes*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Hesperophylax* sp.	—	—	—	—	4	1	2	—	—	—	—	3
. . *Limnephilus* sp. A	—	—	—	—	—	—	—	—	—	—	—	—
. . *Neothrema* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Oligophlebodes* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Ecclisomyia* sp.	—	—	—	—	—	—	—	—	—	—	—	—
Plecoptera	—	—	145	—	—	—	—	73	—	—	—	—
. Pteronarcidae												
. . *Pteronarcella badia*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Pteronarcys californica*	—	—	—	—	—	—	—	—	—	—	—	—
. Nemouridae												
. . *Amphinemura* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Malenka* sp.	—	—	—	—	3	1	3	—	—	—	—	—
. . *Podmosta prostoia*	—	—	—	—	—	—	—	—	—	—	—	—
. Perlidae												
. . *Hesperoperla pacifica*	—	—	—	—	—	—	—	—	—	—	—	—
. Perlodidae												
. . *Isogenoides zionensis*	—	—	—	—	11	—	—	—	—	9	—	—
. . *Isoperla* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Isoperla* sp. A	—	—	—	—	—	3	22	—	—	—	2	6
. . *Isoperla* sp. B	—	—	—	—	—	—	3	—	—	—	—	2
. Chloroperlidae												
. . *Alloperla* sp.	—	—	—	—	—	2	—	—	—	—	—	—
. . *Kathroperla perdita*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Sweltsa albertersis*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Sweltsa* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Taeniopterygidae												
. . *Taenionema* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. Capniidae												
. . Uid. sp.	—	—	—	—	14	3	36	—	—	—	—	8
Hemiptera	—	—	—	—	—	—	—	1	—	—	—	—
Coleoptera												
. Elmidae	—	—	—	—	—	—	—	—	—	—	—	—
. . *Narpus* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Optioservus seriatus*	—	—	—	—	—	2	1	—	—	—	—	1
. Hydrophilidae												
. . *Ametor* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Helophorus* sp.	—	—	—	—	—	—	—	—	—	—	—	—
. . *Hydrobius* sp.	—	2	—	—	—	—	—	—	—	—	—	—
. Dytiscidae												
. . *Hydroporus* or *Hygrotus* sp.	—	28	—	—	—	—	—	—	—	—	—	—
. . *Deronectes* sp.	—	1	—	—	—	—	—	—	—	—	—	—
. . *Agabus* sp.	—	5	—	1	—	—	—	—	1	—	4	—
. Dryopidae												
. . *Helichus suteralis*	—	—	—	—	—	—	—	—	—	—	—	—
Ephemeroptera	—	—	18	—	—	—	—	55	—	—	—	—
. Ephemerellidae												
. . *Ephemerella aurivillii*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella coloradensis*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella doddsi*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella grandis*	—	—	—	—	—	—	—	—	—	—	2	—
. . *Ephemerella margarita*	—	—	—	—	—	—	—	—	—	—	—	—
. . *Ephemerella serratella* sp. A	—	—	—	—	1	—	—	—	—	2	—	2

Table 7.—Benthic invertebrates collected in the upper drainages of Huntington and Cottonwood Creeks, 1977-79—Continued

Organism	Site 87 – Deer Creek–continued		Site 103 – Cottonwood Creek—continued					Site 104 – Cottonwood Creek—continued				
	7-28-78	7-18-79	10-13-77	7-27-78	10-19-78	7-18-79	10-16-79	10-13-77	7-27-78	10-19-78	7-18-79	10-16-79
Ephemeroptera--continued												
. Baetidae												
. . *Baetis* sp.	–	–	–	–	–	–	–	–	–	–	–	–
. . *Baetis* sp. A	126	56	–	222	302	88	412	–	544	893	394	689
. . *Baetis* sp. B	–	–	–	–	–	–	–	–	–	–	–	–
. Heptageniidae												
. . *Epeorus longimanus*	–	–	–	–	–	–	–	–	–	–	–	1
. . *Cinygmula* sp. A	–	–	–	1	–	–	–	–	–	–	–	–
. . *Rhithrogena* sp.	–	–	–	–	–	–	–	–	–	–	–	–
. . *Heptagenia criddlei*	–	–	–	–	2	–	2	–	–	–	4	1
. . *Heptagenia elegantula*	–	–	–	35	–	11	–	–	4	–	39	–
. Leptophlebiidae	–	–	–	–	–	–	–	–	–	–	–	–
. . *Paraleptophlebia* sp.	–	–	–	–	16	–	–	–	–	–	–	1
. Tricorythidae												
. . *Tricorythodes minutus*	–	–	–	–	–	–	–	–	–	–	–	–
Podocopa												
. Cypridae												
. . *Prionocypris longiforma*	–	–	–	–	–	16	17	–	–	–	2	–
Dorylaimida												
. Dorylaimidae												
. . *Alaimus* sp.	–	1	–	–	–	4	–	–	–	–	3	–
. . Uid. genera	–	–	–	–	–	1	–	–	–	–	2	1
Diplostraca												
. Daphnidae												
. . *Daphnia* sp.	–	–	–	–	–	–	–	–	–	–	23	–
Copepoda												
. Diaptomidae												
. . *Diaptomus* sp.	–	–	–	–	–	5	–	–	–	–	62	–
. Canthocamptidae												
. . *Attheyella* sp.	–	–	–	–	–	–	–	–	–	–	–	–
. Cyclopidae												
. . Uid. sp.	–	1	–	–	–	–	–	–	–	–	2	–
Acari												
. Mideidae												
. . *Mideopsis* sp.	–	–	–	–	–	–	–	–	–	–	–	–
. Hygrobatidae												
. . *Atractides* sp.	–	–	–	–	–	–	–	–	–	–	–	–
. Sperchonidae												
. . *Sperchon* sp.	–	–	–	–	1	1	–	–	–	–	16	1
. Limnesiidae												
. . *Tyrellia* sp.	–	–	–	–	–	–	–	–	–	–	–	–
. Lebertiidae												
. . *Lebertia* sp.	–	–	–	–	–	–	–	–	–	–	–	–
Heterondonta												
. Sphaeriidae	–	–	–	–	–	–	–	–	–	–	–	–
. . *Pisidium milium*	–	–	–	–	–	1	1	–	–	–	–	–
Hydracarina	–	–	–	–	–	–	–	–	–	–	–	–
Basommatophora												
. Lymnaeidae	–	–	–	–	–	–	–	–	–	–	–	–

[1] Sample also contained 22 organisms in the class Oligochaeta.
[2] Sample also contained 36 organisms in the class Oligochaeta.
[3] Sample also contained 4 organisms in the class Oligochaeta.
[4] Sample also contained 3 organisms in the class Oligochaeta.
[5] Sample also contained 1 organism in the class Oligochaeta.
[6] Sample also contained 5 organisms in the class Oligochaeta.
[7] Sample also contained 5 organisms in the class Oligochaeta.
[8] Sample also contained 1 organism in the class Oligochaeta.
[9] Sample also contained 2 organisms in the class Oligochaeta.
[10] Sample also contained 3 organisms in the class Oligochaeta.
[11] Sample also contained 2 organisms in the class Oligochaeta.
[12] Sample collected on artificial substrate multi-plate sampler (Hester and Dendy, 1962).

Table 8.--Concentrations of deuterium in rain, snow, spring waters, and waters in mines

[Analyses by Centre D'Etudes Nucleaires de Saclay, France]

Location: See explanation of data-site-numbering system in text, plate 1, and figure 16.

Source: 1, rain; 2, snow; 3, spring water; 4, Wilberg Mine water; 5, Deer Creek Mine water.

Date: As shown except for source 1, accumulated rain June-October 1978; source 2, core of accumulated snow October 1978-May 1979.

Altitude: In feet above National Geodetic Vertical Datum of 1929.

Value:

$$\text{Value} = \frac{(D/H)\ \text{sample} - (D/H)\ \text{SMOW}}{(D/H)\ \text{SMOW}} \times 1{,}000;$$

where

H = hydrogen content,

D = deuterium content, and

SMOW = Standard Mean Ocean Water (Craig, 1961).

Location	Source	Date	Altitude	Value
(D-14-6)7cbb	2	–	8,520	–147.1
13cdb	2	–	8,520	–147.1
14daa	1	–	8,350	–84.5
21dca	2	–	9,020	–121.2
28abc	1	–	8,860	–84.3
(D-15-6)13dad-S1	3	8-23-79	8,320	–129.9
(D-15-7)5dbb	2	–	8,020	–140.3
29dca	2	–	7,520	–125.5
34cdd-S1	3	8-22-79	8,000	–125.9
34dac	2	–	8,000	–122.8
35cbc-S1	3	8- 4-78	8,010	–126.7
35dba	2	–	9,060	–145.8
(D-16-5)16ddb	2	–	9,820	–148.0
(D-16-6)1aca-S1	3	11- 8-78	8,320	–125.5
	3	7-19-79	8,320	–124.9
23cad	2	–	10,200	–145.2
27aaa	2	–	9,250	–137.0
27adb	1	–	9,120	–77.8
(D-16-7)9cbd-S1	3	10-13-78	7,600	–124.7
	3	8- 3-79	7,600	–124.1
13bac-S1	3	5-16-79	9,180	–119.8
17ccb-S1	3	9- 5-78	8,060	–122.5
21bbb-S1	3	9- 5-78	7,600	–124.8
22bbb-S1	3	9- 7-78	7,220	–127.9
23ccb	2	–	7,020	–136.6
26adc-S1	3	5-11-79	7,120	–124.0
26bca-S1	3	8- 9-79	6,860	–125.5
28cba	2	–	7,680	–123.7
(D-16-7)35abc-S1	3	8- 9-79	6,620	–123.2
(D-16-8)5bac-S1	3	5-16-79	8,400	–120.8
(D-17-6)11cdc	2	–	8,100	–141.7
23aaa-S1	3	8- 9-79	7,766	–127.6
25bdd	1	–	7,280	–54.4
(D-17-7)5cad-S1	3	5-16-79	9,320	–153.7
10cbd	5	8- 2-79	–	–125.8
10ccb	5	8- 2-79	–	–122.5
16aad	5	8- 2-79	–	
16cdd	5	8- 2-79	–	–123.2
18abb-S1	3	8- 8-79	8,980	–125.1
18dcd-S1	3	8- 8-79	8,960	–125.7
20cca	4	7- 5-79	–	–121.6
20ccb	4	7- 5-79	–	–122.7
20dcc	4	7- 5-79	–	–122.2
21aab	5	8- 2-79	–	–123.2
21bad	5	8-30-78	–	–123.7
21cbc	4	7- 5-79	–	–122.2
21dbd	5	8- 2-79	–	–122.5
21dda	4	8-30-78	–	–123.8
22abd	5	8- 2-79	–	–122.3
22cab	4	7- 5-79	–	–121.8
22ccb	4	8-30-78	–	–122.1
22cdc	4	7- 5-79	–	–121.7
27bac	4	7- 5-79	–	–123.1
	4	7- 5-79	–	–122.3
28abc	4	8-30-78	–	–122.2
28bad	4	7- 5-79	–	–121.9

Table 9.--Field determinations of discharge, specific conductance, pH, water temperature and alkalinity at selected springs

Location: See explanation of data-site numbering system in text.

Geologic unit: 200MNCS, Mancos Shale; 211SRPN, Star Point Sandstone; 211BCKK, Blackhawk Formation; 211CSLG, Castlegate Sandstone; 211PCRV, Price River Formation; 125NRHR, North Horn Formation; 123FLGF, Flagstaff Limestone; indicates formation of spring orifice.

Date of sample: Year-month-day.

Altitude: Altitude of land surface at spring, in feet, interpolated from topographic maps. National Geodetic Vertical Datum of 1929.

Discharge: Measured except E, estimated.

LOCATION	GEO-LOGIC UNIT	DATE OF SAMPLE	ALTI-TUDE	DIS-CHARGE (GAL/MIN)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	ALKA-LINITY FIELD (MG/L) AS CACO3)
(D-13- 6)10CAC-S1	211PCRV	78-07-17	9410.00	1.8	110	7.4	4.8	40
15AAB-S1	211PCRV	78-07-17	9280.00	.3	60	7.4	4.8	--
23BCB-S1	211BCKK	78-07-21	9140.00	12	380	7.4	4.4	185
36ACC-S1	211BCKK	78-07-18	9680.00	.7	220	7.2	4.7	125
36CAD-S1	211BCKK	78-07-18	9810.00	8.0	180	7.7	4.0	85
36DAB-S1	211BCKK	78-07-18	9600.00	3.9	180	7.3	2.5	90
36DDB-S1	211BCKK	78-07-18	9680.00	.4	200	7.4	5.5	90
(D-14- 6)23BCD-S1	211PCRV	79-09-20	9040.00	10	340	--	6.0	--
24ADC-S1	211SRPN	79-07-16	8320.00	485	--	--	7.5	--
	211SRPN	79-08-22	8320.00	418	545	--	6.5	--
	211SRPN	79-08-28	8320.00	410	--	--	--	--
	211SRPN	79-09-17	8320.00	386	495	--	8.0	--
24ADC-S2	211SRPN	79-06-12	8310.00	87	490	7.4	6.5	--
	211SRPN	79-07-16	8310.00	88	--	--	7.5	--
	211SRPN	79-08-28	8310.00	45	--	--	--	--
	211SRPN	79-09-17	8310.00	67	510	--	7.0	--
24BAA-S1	211BCKK	78-10-04	8450.00	120	--	--	--	--
26CCC-S1	111ALVM	79-09-20	9020.00	6.0	518	--	7.0	--
35BDA-S1	211BCKK	79-09-20	8940.00	8.6	550	--	6.0	--
(D-14- 7) 7CAD-S1	211BCKK	78-07-19	10000.00	.4	220	7.9	6.6	120
7CDA-S1	211BCKK	78-07-19	9860.00	3.7	360	7.2	5.0	190
7DDB-S1	211BCKK	78-07-19	10240.00	3.8	440	7.3	4.0	200
17CCC-S1	211BCKK	78-07-20	10120.00	1.4	330	7.7	5.7	160
17CCC-S2	211BCKK	78-07-20	10100.00	.2	400	7.4	6.0	200
22BBD-S1	211PCRV	79-09-20	9300.00	.7	--	--	7.0	--
29AAA-S1	211BCKK	78-07-19	9840.00	9.0	300	7.5	4.0	140
29BCA-S1	211SRPN	78-08-16	8900.00	--	570	--	6.0	210
30BDC-S1	200MNCS	78-10-04	8230.00	40	--	--	--	--
33ABA-S1	211PCRV	78-07-20	9570.00	5.6	290	7.2	4.2	165
(D-15- 6) 1ADA-S1	211BCKK	78-08-08	9470.00	.5	380	7.7	7.0	215
1BCC-S1	211BCKK	79-09-20	9360.00	6.0	480	--	6.5	--
13DAD-S1	200MNCS	79-06-28	8320.00	450	520	--	10.5	--
	200MNCS	79-07-19	8320.00	453	560	--	10.5	--
	200MNCS	79-08-23	8320.00	383	540	--	9.5	--
	200MNCS	79-09-17	8320.00	364	540	--	9.5	--
(D-15- 7) 8DAB-S1	200MNCS	78-10-20	7920.00	36	595	--	8.5	--
14ACD-S1	125NRHR	78-07-03	9800.00	3.9	440	7.9	4.7	--
15ACB-S1	125NRHR	78-07-06	9520.00	1.0	440	7.6	8.0	--
15DCC-S1	125NRHR	78-07-06	9480.00	9.9	445	7.8	4.0	--
15DDA-S1	211PCRV	78-07-06	9390.00	8.5	480	7.7	5.0	--

Table 9.--Field determinations of discharge, specific conductance, pH, water temperature and alkalinity at selected springs--Continued

LOCATION	GEO- LOGIC UNIT	DATE OF SAMPLE	ALTI- TUDE	DIS- CHARGE (GAL/MIN)	SPE- CIFIC CON- DUCT- ANCE (UMHOS)	PH (UNITS)	TEMPER- ATURE (DEG C)	ALKA- LINITY FIELD (MG/L) AS CACO3)
(D-15- 7)16CAD-S1	211SRPN	78-08-28	8320.00	.5	790	7.6	8.0	345
18BDD-S1	211BCKK	78-08-07	9440.00	4.0	420	7.8	5.8	--
22AAA-S1	211PCRV	78-07-06	9120.00	3.0	460	7.6	5.0	--
22DAC-S1	211PCRV	78-07-06	8960.00	--	--	--	--	220
23CAC-S1	125NRHR	78-07-05	9100.00	1.1	440	7.7	6.0	--
26DDA-S1	125NRHR	78-07-04	9230.00	5.2	500	7.2	5.4	--
26DDB-S2	125NRHR	78-07-04	9200.00	15	460	7.1	5.2	--
27ABC-S1	125NRHR	78-07-05	9300.00	11	310	7.9	5.5	--
34CDD-S1	211BCKK	79-06-28	8000.00	7.6	600	7.3	9.5	--
	211BCKK	79-07-19	8000.00	14	490	8.0	13.5	--
	211BCKK	79-08-22	8000.00	15	770	--	11.0	--
	211BCKK	79-09-17	8000.00	8.6	460	--	11.5	--
35ACC-S1	211BCKK	78-04-25	8440.00	49	--	--	--	--
	211BCKK	78-08-29	8440.00	16	--	--	--	--
	211BCKK	79-09-05	8440.00	2.7	--	--	--	--
35CBC-S1	211BCKK	78-04-25	8010.00	75	--	--	--	--
	211BCKK	78-05-25	8010.00	94	--	--	--	--
	211BCKK	78-06-02	8010.00	79	--	--	--	--
	211BCKK	78-06-08	8010.00	81	560	--	9.1	--
	211BCKK	78-06-29	8010.00	79	--	--	--	--
	211BCKK	78-07-06	8010.00	80	--	--	--	--
	211BCKK	78-08-04	8010.00	73	--	--	--	--
	211BCKK	78-08-10	8010.00	71	--	--	--	--
	211BCKK	78-08-28	8010.00	77	--	--	--	--
	211BCKK	78-10-12	8010.00	79	--	--	--	--
	211BCKK	78-10-25	8010.00	77	--	--	--	--
	211BCKK	78-11-07	8010.00	77	--	--	--	--
	211BCKK	78-12-13	8010.00	79	--	--	--	--
	211BCKK	79-02-08	8010.00	79	--	--	9.0	--
	211BCKK	79-04-03	8010.00	71	--	--	--	--
	211BCKK	79-05-09	8010.00	81	--	--	--	--
	211BCKK	79-05-30	8010.00	81	650	--	9.0	--
	211BCKK	79-06-14	8010.00	79	--	--	--	--
	211BCKK	79-08-22	8010.00	79	580	--	9.0	--
	211BCKK	79-09-05	8010.00	79	--	--	--	--
	211BCKK	79-09-17	8010.00	79	--	--	--	--
	211BCKK	79-10-12	8010.00	79	550	--	10.5	--
35CBD-S1	211BCKK	78-04-25	8060.00	8.0	--	--	--	--
	211BCKK	78-08-29	8060.00	8.0	--	--	--	--
(D-16- 6) 1ACA-S1	211BCKK	78-04-26	8320.00	8.0	--	--	--	--
	211BCKK	78-11-08	8320.00	2.2	--	--	--	--
	211BCKK	79-08-23	8320.00	26	540	--	4.0	--
	211BCKK	79-09-17	8320.00	22	560	--	4.5	--
	211BCKK	79-10-16	8320.00	8.8	520	--	6.0	--
1CCA-S1	211BCKK	78-10-22	8680.00	33	--	--	--	--
12CCD-S1	211CSLG	78-10-12	9250.00	10	--	--	--	--
13AAB-S1	211BCKK	78-10-12	8700.00	20	--	--	--	--
22CDA-S1	211CSLG	79-06-28	8890.00	15	600	7.6	4.9	290

Table 9.--Field determinations of discharge, specific conductance, pH, water temperature and alkalinity at selected springs--Continued

LOCATION	GEO-LOGIC UNIT	DATE OF SAMPLE	ALTI-TUDE	DIS-CHARGE (GAL/MIN)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	ALKA-LINITY FIELD (MG/L) AS CACO3)
(D-16- 6)23DDA-S1	125NRHR	78-08-30	10260.00	.5	245	8.2	4.0	210
26DCA-S1	211PCRV	79-08-22	9350.00	4.0	520	7.3	5.2	290
27AAC-S1	211PCRV	79-09-20	9200.00	.7	480	--	8.5	--
27ADD-S1	211PCRV	78-02-01	9190.00	.2	--	--	--	--
	211PCRV	78-06-22	9190.00	2.0	--	--	--	--
34ABD-S1	211PCRV	78-09-06	9300.00	2.0	317	7.2	4.5	270
	211PCRV	79-08-01	9300.00	.0	580	7.2	7.0	305
34DDA-S1	211CSLG	79-08-01	8720.00	3.2	560	7.4	7.3	295
	211CSLG	79-09-20	8720.00	2.1	550	--	7.5	--
35AAC-S1	211PCRV	79-08-22	9350.00	2.6	540	7.7	6.5	295
35ACA-S1	211PCRV	79-08-22	9280.00	10	530	8.0	6.6	290
35ACB-S1	211PCRV	79-08-22	9120.00	2.4	560	7.6	4.0	275
(D-16- 7) 1CAD-S1	125NRHR	78-08-15	9440.00	5.6	460	7.2	4.6	280
9CAB-S1	211SRPN	78-04-27	7600.00	430	--	--	--	--
	211SRPN	78-08-29	7600.00	296	--	--	8.5	--
	211SRPN	78-10-13	7600.00	260	--	--	--	--
	211SRPN	78-11-08	7600.00	190	--	--	--	--
11DBB-S1	125NRHR	78-08-15	9060.00	.9	540	6.9	8.6	300
17CCB-S1	211BCKK	78-09-05	8060.00	30	530	7.5	6.5	--
	211BCKK	79-06-27	8060.00	44	660	7.4	7.0	--
	211BCKK	79-07-19	8060.00	76	530	6.7	6.5	--
	211BCKK	79-08-22	8060.00	36	570	--	10.5	--
	211BCKK	79-09-18	8060.00	27	580	--	6.0	--
	211BCKK	79-10-17	8060.00	24	520	--	8.5	--
18ABB-S1	211BCKK	78-10-12	8360.00	1.8	--	--	--	--
20ABA-S1	211BCKK	76-08-18	7880.00	1.5	470	7.5	8.0	--
22BBB-S1	211SRPN	78-10-12	7220.00	.9	--	--	--	--
	211SRPN	78-11-08	7220.00	3.3	--	--	10.5	--
	211SRPN	78-12-14	7220.00	3.0	--	--	10.0	--
	211SRPN	79-06-27	7220.00	5.0	1140	7.2	10.5	--
	211SRPN	79-07-19	7220.00	4.7	1120	7.0	10.0	--
	211SRPN	79-08-22	7220.00	4.8	1200	--	10.0	--
	211SRPN	79-09-18	7220.00	4.2	1260	--	9.5	--
	211SRPN	79-10-17	7220.00	4.4	1070	--	11.0	--
26ADC-S1	211SRPN	78-04-27	7120.00	110	--	--	--	--
	211SRPN	78-05-26	7120.00	110	--	--	--	--
	211SRPN	78-06-09	7120.00	120	--	--	--	--
	211SRPN	78-06-23	7120.00	130	--	--	--	--
	211SRPN	78-07-06	7120.00	150	--	--	--	--
	211SRPN	78-07-28	7120.00	150	--	--	--	--
	211SRPN	78-08-10	7120.00	160	--	--	--	--
	211SRPN	78-08-30	7120.00	155	--	--	--	--
	211SRPN	78-10-13	7120.00	165	--	--	--	--
	211SRPN	78-10-25	7120.00	160	--	--	--	--
	211SRPN	78-11-01	7120.00	155	--	--	--	--
	211SRPN	78-12-13	7120.00	145	--	--	--	--
	211SRPN	79-03-07	7120.00	135	--	--	--	--
26BCA-S1	211SRPN	78-05-25	6860.00	23	--	--	--	--
	211SRPN	78-08-10	6860.00	19	--	--	11.0	--
	211SRPN	78-10-11	6860.00	19	--	--	11.0	--
	211SRPN	78-11-07	6860.00	19	--	--	10.5	--
	211SRPN	78-12-13	6860.00	19	--	--	10.0	--

Table 9.--Field determinations of discharge, specific conductance, pH, water temperature, and alkalinity at selected springs--Continued

LOCATION	GEO-LOGIC UNIT	DATE OF SAMPLE	ALTI-TUDE	DIS-CHARGE (GAL/MIN)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	ALKA-LINITY FIELD (MG/L) AS CACO3)
(D-16- 7)26BCA-S1	211SRPN	79-06-14	6860.00	10	--	--	11.0	--
	211SRPN	79-06-28	6860.00	10	720	8.0	11.0	--
	211SRPN	79-07-20	6860.00	9.3	660	7.0	11.5	--
	211SRPN	79-08-22	6860.00	21	750	--	10.5	--
	211SRPN	79-09-17	6860.00	19	750	--	10.5	--
	211SRPN	79-10-16	6860.00	20	680	--	11.5	--
26CBB-S1	211SRPN	78-08-10	6950.00	57	--	--	11.0	--
	211SRPN	78-10-11	6950.00	57	--	--	10.0	--
	211SRPN	78-11-07	6950.00	57	--	--	10.0	--
	211SRPN	78-12-13	6950.00	57	--	--	10.0	--
	211SRPN	79-05-10	6950.00	44	--	--	--	--
	211SRPN	79-06-28	6950.00	30	820	7.6	10.5	--
	211SRPN	79-07-16	6950.00	27	710	7.0	12.5	--
	211SRPN	79-09-18	6950.00	65	760	--	9.5	--
	211SRPN	79-10-18	6950.00	60	750	--	11.0	--
27ADC-S1	211SRPN	78-08-10	7000.00	15	--	--	11.0	--
	211SRPN	78-10-11	7000.00	5.8	--	--	11.0	--
	211SRPN	78-11-07	7000.00	4.9	--	--	10.0	--
	211SRPN	78-12-13	7000.00	5.4	--	--	10.0	--
	211SRPN	79-05-10	7000.00	.0	--	--	--	--
	211SRPN	79-06-28	7000.00	.0	--	--	--	--
	211SRPN	79-08-22	7000.00	2.0	870	--	10.0	--
	211SRPN	79-09-18	7000.00	3.4	780	--	10.0	--
	211SRPN	79-10-18	7000.00	3.1	730	--	11.5	--
27DAA-S1	211SRPN	78-08-10	6960.00	5.0	--	--	11.0	--
	211SRPN	78-10-11	6960.00	4.6	--	--	10.5	--
	211SRPN	78-11-07	6960.00	4.1	--	--	10.0	--
	211SRPN	78-12-13	6960.00	4.1	--	--	10.0	--
	211SRPN	79-05-10	6960.00	1.0	--	--	--	--
	211SRPN	79-06-28	6960.00	1.7	760	7.4	10.5	--
	211SRPN	79-07-16	6960.00	1.0	820	6.9	13.0	--
	211SRPN	79-08-22	6960.00	1.5	870	--	10.0	--
	211SRPN	79-09-18	6960.00	2.0	800	--	10.0	--
	211SRPN	79-10-18	6960.00	1.0	650	--	11.0	--
28CBC-S1	211BCKK	78-08-10	7680.00	23	--	--	--	--
	211BCKK	78-10-11	7680.00	23	--	--	13.0	--
	211BCKK	78-11-07	7680.00	23	--	--	12.0	--
	211BCKK	78-12-13	7680.00	22	--	--	10.5	--
	211BCKK	79-06-28	7680.00	25	800	6.9	14.0	380
	211BCKK	79-07-16	7680.00	22	770	6.9	13.0	--
	211BCKK	79-08-22	7680.00	21	770	--	13.0	--
	211BCKK	79-09-17	7680.00	24	860	--	12.0	--
	211BCKK	79-10-16	7680.00	22	760	--	13.0	--
32DDC-S1	125NRHR	78-10-11	7740.00	3.0	495	--	4.0	--
	125NRHR	78-11-08	7740.00	2.5	500	--	4.0	--
	125NRHR	79-07-17	7740.00	10	500	--	13.5	--
	125NRHR	79-08-21	7740.00	5.4	460	--	4.0	--
	125NRHR	79-09-19	7740.00	5.9	490	--	4.5	--
	125NRHR	79-10-17	7740.00	3.8	480	--	4.0	--
32DDC-S2	125NRHR	78-11-08	7740.00	.5	520	--	6.5	--
	125NRHR	79-07-17	7740.00	11	520	--	15.0	--

Table 9.--Field determinations of discharge, specific conductance, pH, water temperature, and alkalinity at selected springs--Continued

LOCATION	GEO-LOGIC UNIT	DATE OF SAMPLE	ALTI-TUDE	DIS-CHARGE (GAL/MIN)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	ALKA-LINITY FIELD (MG/L) AS CACO3)
(D-16- 7)32DDC-S2	125NRHR	79-08-21	7740.00	2.3	480	--	8.0	--
	125NRHR	79-09-19	7740.00	1.4	510	--	8.0	--
35ABC-S1	111ALVM	78-10-13	6620.00	22	--	--	--	--
	111ALVM	78-11-08	6620.00	20	--	--	--	--
	111ALVM	78-12-11	6620.00	23	--	--	--	--
	111ALVM	79-05-11	6620.00	26	--	--	--	--
	111ALVM	79-06-28	6620.00	20	960	8.1	10.5	--
	111ALVM	79-07-20	6620.00	21	900	7.2	10.5	--
	111ALVM	79-08-07	6620.00	35	760	7.3	11.0	--
	111ALVM	79-08-22	6620.00	38	1080	--	10.0	--
	111ALVM	79-08-31	6620.00	35	--	--	--	--
	111ALVM	79-09-17	6620.00	40	1090	--	9.5	--
	111ALVM	79-10-16	6620.00	32	850	--	11.0	--
(D-16- 8)18CAD-S1	125NRHR	79-08-09	9200.00	3.9	600	7.3	4.5	310
21CDC-S1	211SRPN	79-08-09	7320.00	3.9	2630	7.4	11.5	425
28ADD-S1	200MNCS	79-08-09	6960.00	1.0	2710	7.2	21.0	--
(D-17- 6) 1DAA-S1	124FLGF	78-07-27	10080.00	5.5	400	--	5.0	--
	124FLGF	78-10-14	10080.00	.3	405	--	7.0	--
	124FLGF	79-06-15	10080.00	49	400	--	3.5	--
	124FLGF	79-07-17	10080.00	6.3	--	--	5.0	--
	124FLGF	79-08-21	10080.00	2.1	320	--	6.5	--
	124FLGF	79-09-19	10080.00	.8	430	--	7.0	--
3ABD-S1	211PCRV	79-06-19	8960.00	.7	560	7.4	7.5	320
3ABD-S2	211PCRV	79-07-19	8960.00	.4	500	7.6	7.8	320
3ADC-S1	211CSLG	79-07-04	8800.00	7.1	550	7.6	7.3	300
3ADD-S1	211CSLG	79-07-04	8740.00	24	550	7.5	7.4	300
	211CSLG	79-09-20	8740.00	19	560	--	8.0	--
3BAB-S1	125NRHR	79-07-20	9640.00	.1	490	7.4	7.2	260
3BAD-S1	211PCRV	79-07-19	9450.00	1.3	490	7.6	6.4	265
3DDC-S1	211CSLG	79-07-04	8710.00	13	560	7.4	7.2	300
12ADC-S1	125NRHR	79-08-08	9460.00	5.2	480	7.5	5.6	285
12DAA-S1	125NRHR	79-08-08	9400.00	3.8	460	7.4	6.2	295
14BCB-S1	125NRHR	79-06-27	9080.00	.6	470	8.0	22.6	295
21DCD-S1	125NRHR	79-07-10	9030.00	4.0	560	7.4	6.2	280
23AAA-S1	211BCKK	78-06-08	7766.00	43	--	--	--	--
	211BCKK	78-06-28	7766.00	41	--	--	--	--
	211BCKK	78-07-10	7766.00	35	--	--	--	--
	211BCKK	78-07-27	7766.00	33	--	--	--	--
	211BCKK	78-07-28	7766.00	33	--	--	--	--
	211BCKK	78-08-09	7766.00	36	--	--	--	--
	211BCKK	78-09-06	7766.00	37	--	--	--	--
	211BCKK	78-10-09	7766.00	38	590	--	8.5	--
	211BCKK	78-10-13	7766.00	41	--	--	--	--
	211BCKK	78-12-22	7766.00	47	590	--	7.5	--
	211BCKK	79-03-06	7766.00	44	--	--	8.0	--
	211BCKK	79-05-31	7766.00	72	660	--	8.0	--
	211BCKK	79-06-12	7766.00	83	630	7.0	8.0	--
	211BCKK	79-07-06	7766.00	67	640	--	8.0	--
	211BCKK	79-07-19	7766.00	64	600	--	8.0	--
	211BCKK	79-08-28	7766.00	55	--	--	--	--

Table 9.--Field determinations of discharge, specific conductance, pH, water temperature, and alkalinity at selected springs--Continued

LOCATION	GEO-LOGIC UNIT	DATE OF SAMPLE	ALTI-TUDE	DIS-CHARGE (GAL/MIN)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	ALKA-LINITY FIELD (MG/L) AS CACO3)
(D-17- 6)23BCB-S1	125NRHR	79-07-13	8840.00	14	620	7.5	4.2	315
26CBB-S1	125NRHR	79-07-18	9180.00	4.0	580	7.4	6.2	325
27CBB-S1	125NRHR	79-08-16	8800.00	3.2	650	7.8	7.1	330
27CCD-S1	125NRHR	79-08-16	8780.00	3.2	625	7.8	7.5	320
28BBC-S2	125NRHR	79-08-29	8500.00	6.0	540	7.7	.0	275
35CBB-S1	125NRHR	79-07-11	8760.00	.8	750	7.8	8.2	355
(D-17- 7) 5CAD-S1	125NRHR	78-07-13	9320.00	376	450	7.7	4.0	--
	125NRHR	78-10-11	9320.00	58	400	--	4.0	--
	125NRHR	78-11-08	9320.00	53	455	--	4.0	--
	125NRHR	79-06-29	9320.00	566	480	7.9	4.5	--
	125NRHR	79-07-19	9320.00	342	400	--	4.0	--
	125NRHR	79-08-23	9320.00	123	440	--	6.0	--
	125NRHR	79-09-19	9320.00	81	450	--	4.5	--
	125NRHR	79-10-17	9320.00	63	430	--	3.5	--
7ACC-S1	125NRHR	79-08-08	9590.00	2.2	390	7.8	5.7	160
7BDA-S1	124FLGF	78-07-27	9740.00	10	400	7.1	6.0	--
	124FLGF	78-10-11	9740.00	2.6	420	--	7.5	--
	124FLGF	78-11-08	9740.00	2.3	450	--	8.0	--
	124FLGF	79-06-13	9740.00	27	380	--	4.5	--
	124FLGF	79-07-16	9740.00	13	390	--	6.0	--
	124FLGF	79-08-21	9740.00	5.8	400	--	8.0	--
	124FLGF	79-09-19	9740.00	2.2	450	--	8.5	--
	124FLGF	79-10-17	9740.00	2.7	420	--	7.0	--
7BDD-S1	125NRHR	79-08-08	9410.00	2.8	400	7.2	6.2	250
8DBC-S1	125NRHR	78-07-11	9320.00	48	460	6.6	5.5	--
	125NRHR	78-10-11	9320.00	11	495	--	6.0	--
	125NRHR	78-11-08	9320.00	9.1	500	--	6.0	--
	125NRHR	79-06-15	9320.00	76	495	--	5.0	--
	125NRHR	79-07-17	9320.00	24	730	--	5.5	--
	125NRHR	79-08-24	9320.00	14	480	--	5.5	--
	125NRHR	79-09-19	9320.00	5.5	525	--	4.5	--
	125NRHR	79-10-17	9320.00	4.0	500	--	7.0	--
14BCB-S1	125NRHR	79-07-19	8800.00	E3.0	620	--	5.0	--
16ACA-S1	125NRHR	78-07-27	9020.00	2.1	650	7.1	5.0	--
	125NRHR	78-10-11	9020.00	1.4	655	--	6.0	--
	125NRHR	79-06-13	9020.00	2.6	660	--	6.0	--
	125NRHR	79-07-17	9020.00	2.5	--	--	6.0	--
	125NRHR	79-08-21	9020.00	1.2	640	--	6.0	--
	125NRHR	79-09-19	9020.00	3.8	720	--	4.5	--
	125NRHR	79-10-17	9020.00	1.4	660	--	7.0	--
16BAB-S1	125NRHR	78-10-11	8880.00	5.4	540	--	4.0	--
	125NRHR	79-06-15	8880.00	15	540	--	3.5	--
	125NRHR	79-07-17	8880.00	15	--	--	6.0	--
	125NRHR	79-08-24	8880.00	6.2	500	--	4.5	--
	125NRHR	79-10-17	8880.00	3.8	520	--	5.0	--
16CBA-S1	125NRHR	78-10-10	9320.00	2.4	570	--	6.0	--
	125NRHR	79-06-13	9320.00	34	480	--	4.5	--
	125NRHR	79-07-16	9320.00	15	600	--	6.0	--
	125NRHR	79-08-21	9320.00	6.7	500	--	5.5	--
	125NRHR	79-09-19	9320.00	3.8	505	--	9.0	--
	125NRHR	79-10-17	9320.00	2.7	515	--	6.5	--

Table 9.--Field determinations of discharge, specific conductance, pH, water temperature, and alkalinity at selected springs--Continued

LOCATION	GEO-LOGIC UNIT	DATE OF SAMPLE	ALTI-TUDE	DIS-CHARGE (GAL/MIN)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	ALKA-LINITY FIELD (MG/L) AS CACO3)
(D-17- 7)16DCD-S1	125NRHR	78-07-14	9280.00	8.2	495	7.4	6.0	--
	125NRHR	78-10-10	9280.00	7.3	500	--	7.0	--
	125NRHR	79-06-13	9280.00	10	510	--	5.5	--
	125NRHR	79-07-16	9280.00	30	700	--	6.0	--
	125NRHR	79-08-21	9280.00	17	500	--	6.5	--
	125NRHR	79-09-19	9280.00	16	510	--	6.0	--
	125NRHR	79-10-17	9280.00	13	490	--	6.0	--
17DBA-S1	125NRHR	78-07-14	9320.00	40	--	--	4.0	--
	125NRHR	78-10-11	9320.00	2.6	465	--	5.0	--
	125NRHR	79-06-13	9320.00	167	440	--	4.5	--
	125NRHR	79-07-16	9320.00	61	580	--	4.5	--
	125NRHR	79-08-21	9320.00	19	460	--	4.5	--
	125NRHR	79-09-19	9320.00	6.1	505	--	9.5	--
	125NRHR	79-10-17	9320.00	3.3	470	--	3.0	--
18AAB-S1	125NRHR	79-08-08	9440.00	6.6	570	6.9	--	305
18ABB-S2	125NRHR	78-09-19	9390.00	--	746	--	--	--
18DCD-S1	125NRHR	79-08-08	8960.00	1.6	695	7.2	7.5	355
18DDA-S1	125NRHR	79-08-08	9320.00	5.4	540	7.7	11.0	--
18DDD-S1	125NRHR	79-08-08	9320.00	3.5	595	7.7	10.5	--
20ACD-S1	125NRHR	78-07-12	9360.00	8.0	510	7.4	5.0	--
	125NRHR	79-06-13	9360.00	30	530	--	5.0	--
	125NRHR	79-07-16	9360.00	6.4	910	--	11.0	--
	125NRHR	79-08-21	9360.00	.7	500	--	12.5	--
(D-17- 7)21BAB-S1	125NRHR	78-07-12	9240.00	7.5	--	--	15.4	--
	125NRHR	78-10-10	9240.00	2.4	505	--	6.0	--
	125NRHR	79-06-13	9240.00	8.6	540	--	5.0	--
	125NRHR	79-08-21	9240.00	4.3	470	--	7.0	--
	125NRHR	79-09-19	9240.00	2.6	595	--	6.0	--
	125NRHR	79-10-17	9240.00	2.5	500	--	6.5	--
21BDD-S1	125NRHR	78-07-12	8930.00	5.7	710	--	4.5	--
	125NRHR	78-10-10	8930.00	1.3	710	--	6.0	--
	125NRHR	79-06-13	8930.00	16	790	--	4.0	--
	125NRHR	79-08-21	8930.00	5.4	725	--	12.5	--
	125NRHR	79-09-19	8930.00	4.1	690	--	4.4	--
	125NRHR	79-10-17	8930.00	3.3	760	--	5.0	--
21BDD-S2	125NRHR	78-07-12	8860.00	--	790	7.2	7.0	--
	125NRHR	78-10-10	8860.00	1.2	780	--	8.5	--
	125NRHR	79-08-21	8860.00	.7	800	--	10.0	--
	125NRHR	79-09-19	8860.00	1.0	760	--	9.0	--
	125NRHR	79-10-17	8860.00	.01	710	--	8.0	--
21CDC-S1	125NRHR	78-07-12	9320.00	7.3	--	--	4.0	--
	125NRHR	78-10-10	9320.00	2.6	550	--	4.0	--
	125NRHR	79-06-13	9320.00	36	560	--	4.0	--
	125NRHR	79-07-16	9320.00	19	600	--	7.5	--
	125NRHR	79-08-21	9320.00	9.5	470	--	4.0	--
	125NRHR	79-09-19	9320.00	8.1	495	--	4.0	--
	125NRHR	79-10-17	9320.00	9.2	520	--	6.0	--

Table 9.--Field determinations of discharge, specific conductance, pH, water temperature, and alkalinity at selected springs--Continued

LOCATION	GEO-LOGIC UNIT	DATE OF SAMPLE	ALTI-TUDE	DIS-CHARGE (GAL/MIN)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	ALKA-LINITY FIELD (MG/L) AS CACO3)
(D-17- 7)22DAA-S1	211PCRV	79-07-19	8840.00	E1.0	570	--	14.0	--
26BBA-S1	125NRHR	79-07-19	9000.00	E1.0	760	--	8.0	--
27ABA-S1	211SRPN	78-11-09	7600.00	1.0	1300	8.4	8.0	--
28CBC-S1	125NRHR	78-07-14	9340.00	.6	545	7.3	5.0	328
	125NRHR	78-10-09	9340.00	.6	545	--	6.0	--
	125NRHR	79-06-13	9340.00	.9	630	--	5.0	--
	125NRHR	79-07-16	9340.00	.9	610	--	6.0	--
	125NRHR	79-08-21	9340.00	1.4	540	--	6.5	--
	125NRHR	79-09-19	9340.00	1.5	520	--	6.0	--
	125NRHR	79-10-17	9340.00	1.4	550	--	6.0	--
(D-17- 7)29BBB-S1	125NRHR	78-10-10	9860.00	2.0	610	--	6.5	--
	125NRHR	79-06-13	9860.00	7.7	615	--	5.0	--
	125NRHR	79-07-16	9860.00	5.0	950	--	13.0	--
	125NRHR	79-08-21	9860.00	3.8	610	--	6.0	--
	125NRHR	79-09-19	9860.00	3.8	600	--	6.0	--
	125NRHR	79-10-17	9860.00	3.5	680	--	8.0	--

Location: See explanation of data-site numbering system in text.
Geologic unit: 200 MNCS, Mancos Shale; 211SRPN, Star Point Sandstone; 211BCKK, Blackhawk Formation; 211CSLG, Castlegate Sandstone; 211PCRV, Price River Formation; 125NRHR, North Horn Formation; 124FLGF, Flagstaff Limestone.
Altitude: Altitude of land surface at spring, in feet, interpolated from topographic maps. National Geodetic Vertical Datum of 1929.
Discharge: Measured except E, estimated.
Specific conductance: In micromhos per centimeter at 25 degrees Celsius.
Other data: SQS, semiquantitative determinations reported in table 12.
Remarks: The symbol ">" indicates the value was greater than number shown. The symbol "<" indicates the value was less than number shown.

Location	Geologic unit	Date of sample	Altitude	Hardness (as $CaCO_3$)	Noncarbonate hardness (as $CaCO_3$)	Discharge (gal/min)	Specific conductance	pH (units)	Water temperature (degrees C)	Dissolved calcium (as Ca)	Dissolved magnesium (as Mg)	Dissolved sodium (as Na)
(D-13-6) 14ccd-S1	211BCKK	7-21-78	9,440	180	16	2.6	340	7.3	4.0	59	7.0	3.3
15bda-S1	211BCKK	7-17-78	9,120	53	11	.71	120	7.3	6.5	17	2.5	2.1
23cac-S1	211BCKK	7-21-78	9,340	190	21	2.1	370	6.8	5.8	63	8.2	3.1
36bba-S1	211BCKK	7-20-78	9,600	190	0	4.9	360	7.4	3.6	63	7.6	2.0
36cda-S1	211BCKK	7-18-78	9,700	98	4	.50	218	7.4	3.8	34	3.2	1.3
(D-14-6) 1dad-S1	211BCKK	7-19-78	9,840	170	28	5.0	300	7.7	5.3	56	6.7	1.4
17adc-S1	125NRHR	10- 6-77	9,405	200	14	.90	440	7.1	3.9	63	11	1.6
23bcd-S1	211PCRV	10-13-77	9,040	110	14	3.0E	280	6.9	4.4	40	3.1	1.4
24adc-S1	211SRPN	6-12-79	8,320	300	28	—	550	7.4	7.0	73	28	3.3
24adc-S2	211SRPN	6-12-79	8,310	280	18	—	490	7.4	6.5	70	25	3.5
25cba-S1	211BCKK	8- 6-78	10,000	180	6	1.0	320	7.8	6.0	49	13	1.4
26caa-S1	211PCRV	8-20-76	9,202	220	6	4.5	345	8.2	3.8	72	9.4	2.2
	211PCRV	10-13-77	9,202	170	0	5.1	390	7.5	3.3	49	11	2.6
26ccc-S1	111ALVM	10-13-77	9,020	57	11	1.2	130	6.9	6.1	20	1.8	1.6
35bda-S1	211BCKK	10-13-77	8,940	260	10	5.3	520	7.6	5.0	68	21	2.5
36bcb-S1	211BCKK	8- 6-78	10,040	88	8	.65	175	7.8	9.0	25	6.3	1.2
36bdb-S1	211BCKK	8- 6-78	9,520	180	23	.42	345	8.1	8.5	52	13	1.6
(D-14-7) 7dbc-S1	211BCKK	8-27-76	10,220	200	14	5.0	315	7.0	5.5	64	9.9	1.6
15bcd-S1	211PCRV	10- 6-77	9,395	84	16	1.2	160	6.6	7.8	22	7.0	2.1
15ccb-S1	125NRHR	8-25-76	9,390	53	15	1.0	95	7.1	4.5	14	4.4	1.6
18dab-S1	211BCKK	7-19-78	10,080	230	47	1.2	500	7.4	5.0	63	17	9.0
20add-S1	211BCKK	7-21-78	9,680	46	12	.64	90	6.3	4.9	15	2.0	2.2
22bbd-S1	211PCRV	10- 6-77	9,300	42	10	2.5	100	6.5	6.7	12	2.9	2.1
27bba-S1	211BCKK	10- 6-77	9,156	120	7	2.0	230	6.9	3.9	36	7.7	2.7
29bca-S1	211SRPN	8-16-78	8,900	230	22	.53	570	8.4	6.3	88	3.0	3.0
30ddc-S1	200MNCS	8-20-76	8,720	280	5	28	465	7.4	11.8	67	28	8.7
31dbb-S1	211SRPN	10- 4-77	8,365	310	53	.30	500	7.5	2.8	80	26	5.2
32bdd-S1	211SRPN	8-16-78	8,640	240	5	.23	480	7.7	7.4	60	23	4.7
33aac-S1	211PCRV	10- 6-77	9,400	190	10	10	330	7.0	3.9	62	8.7	1.8
33abb-S1	125NRHR	7-20-78	9,720	180	35	5.1	330	7.3	3.0	57	8.0	2.1
(D-15-6) 1acd-S1	211BCKK	8- 8-78	9,520	130	4	.82	270	7.7	6.0	39	8.9	2.2
1bcc-S1	211BCKK	10-13-77	9,360	200	0	6.1	380	7.4	2.8	50	17	2.2
1ccb-S1	211BCKK	8- 8-78	9,670	210	15	1.0	400	7.9	7.8	54	17	2.2
2cad-S1	211BCKK	8- 8-78	8,760	300	17	.63	550	8.1	6.5	71	29	3.9
2dcd-S1	211BCKK	11-10-77	8,940	200	17	5.8	350	7.1	.1	41	23	2.8
11aab-S1	211BCKK	11-10-77	8,820	240	10	19	460	7.5	4.0	63	20	2.8
11bab-S1	111ALVM	11-10-77	8,300	240	35	6.3	420	7.2	.1	28	23	2.7
13dad-S1	200MNCS	10- 5-78	8,320	280	28	413	500	7.5	11.0	65	28	5.4
25ccd-S1	125NRHR	8-29-78	9,980	150	11	1.3	375	7.2	5.5	46	8.7	1.5
26bcb-S1	211BCKK	8- 9-78	9,200	220	8	2.0	420	7.8	4.9	56	19	2.7
26caa-S1	211PCRV	8-29-78	9,860	130	12	.51	420	7.9	7.0	40	7.9	3.0
(D-15-7) 6dbd-S1	211SRPN	10- 4-77	8,640	210	14	7.4	350	7.2	3.3	48	22	2.9
7ddc-S1	211BCKK	8- 7-78	9,200	230	12	.08	440	8.0	10.2	63	18	1.9
8dbc-S1	211SRPN	10-11-77	8,320	280	29	5.4	540	6.9	3.9	54	36	3.9
11aca-S1	211CSLG	7- 4-78	9,640	160	10	.76	310	8.1	7.5	41	14	2.1
14aad-S1	125NRHR	7- 4-78	9,840	180	8	7.3	380	8.0	4.5	53	11	1.8
15abd-S1	125NRHR	8-26-76	9,520	220	18	5.0	385	7.4	13.0	50	22	1.2
15dab-S1	125NRHR	7- 5-78	9,380	290	71	1.9	540	7.7	4.6	85	19	2.7
15ddd-S1	211PCRV	7- 6-78	9,270	240	38	3.7	480	7.5	5.0	72	14	2.8
16cbb-S1	211SRPN	8-17-78	7,960	390	52	2.7	760	7.4	8.2	86	43	5.5
16cbd-S1	211SRPN	10- 4-77	8,190	380	83	8.5	600	7.2	4.4	69	50	6.8
20cdd-S1	211SRPN	10- 5-77	8,360	320	46	3.1	500	7.1	5.0	69	37	3.9
22dac-S1	211PCRV	7- 6-78	8,960	290	67	10	500	7.3	4.0	82	20	3.7
23adc-S1	125NRHR	7- 6-78	9,600	280	42	8.2	475	8.1	5.0	75	23	3.0
25cbb-S1	125NRHR	7- 6-78	9,040	290	88	24	530	7.8	6.0	79	22	2.7
26ddb-S1	125NRHR	7- 4-78	9,220	260	55	2.1	480	7.1	5.7	68	23	2.5
27aca-S1	125NRHR	7- 5-78	8,900	270	49	29	440	7.7	5.5	73	21	2.6
30abc-S1	211SRPN	10- 5-77	8,080	300	18	11	500	7.3	3.9	56	38	5.3
30dac-S1	211BCKK	8- 8-79	8,800	230	2	10	420	7.6	6.2	60	20	1.9
31abc-S1	211BCKK	8- 8-79	8,160	340	16	1.8	570	7.3	9.0	75	36	4.8
34bab-S1	125NRHR	8-19-76	9,460	320	21	.66	566	7.7	8.2	96	20	2.9
35bdc-S1	211CSLG	11- 7-77	8,800	240	24	1.7	420	7.1	5.6	47	29	4.9
35cbc-S1	211BCKK	10- 5-77	8,010	330	65	90	560	7.1	8.9	80	31	3.5
(D-16-6) 1aca-S1	211BCKK	10-17-77	8,460	260	37	2.8	500	7.3	3.9	62	25	4.2
	211BCKK	6-28-79	8,320	290	8	35	520	7.3	5.0	74	25	4.0
	211BCKK	7-19-79	8,320	280	26	—	610	7.3	5.3	66	27	3.5
11dbc-S1	125NRHR	8-29-78	10,240	230	55	2.4	260	7.7	4.0	62	17	2.1
12daa-S1	125NRHR	8-30-78	9,500	260	33	1.5	500	8.3	8.0	69	22	3.5
13aab-S1	211BCKK	8-18-76	8,700	310	44	15	525	7.6	4.0	75	30	6.6
	211BCKK	10- 4-77	8,700	300	57	5.0E	500	7.1	4.4	70	31	6.5

	Milligrams per liter									Micrograms per liter			
Sodium-adsorption ratio	Dissolved potassium (as K)	Bicarbonate (as HCO_3)	Carbonate (as CO_3)	Alkalinity (as $CaCO_3$)	Dissolved sulfate (as SO_4)	Dissolved chloride (as Cl)	Dissolved fluoride (as F)	Dissolved silica (as SiO_2)	Dissolved solids, sum of constituents	Dissolved boron (as B)	Dissolved iron (as Fe)	Dissolved strontium (as Sr)	Other data
.1	1.2	–	–	160	10	5.0	0.1	5.5	187	20	50	90	–
.1	1.0	–	–	42	6.9	2.8	.1	7.8	66	60	60	40	–
.1	2.3	–	–	170	11	15	.1	6.0	211	30	10	90	–
.1	.5	–	–	190	5.1	1.9	.1	4.9	199	20	<10	70	–
.1	1.2	–	–	94	2.7	1.2	.1	4.6	105	10	<10	40	–
.0	–	–	–	155	15	2.2	–	–	171	20	10	100	–
.0	.5	230	0	190	5.5	1.6	.1	5.1	202	10	–	110	–
.1	.4	120	0	98	4.5	2.0	.1	5.8	117	20	–	70	–
.1	.9	–	–	270	37	2.9	.1	5.8	314	80	10	210	–
.1	1.8	–	–	260	26	2.7	.1	5.7	291	80	0	210	–
.0	.6	–	–	170	7.3	3.1	.1	4.1	181	20	10	60	–
.1	.5	259	0	212	8.2	2.4	.1	6.3	230	20	20	110	–
.1	.4	230	0	190	4.9	2.4	.1	7.5	191	7	–	90	–
.1	.6	56	0	46	5.9	1.9	.1	6.8	66	20	–	50	–
.1	.6	300	0	250	8.1	2.5	.1	6.9	258	20	–	80	–
.1	.5	–	–	80	2.1	1.4	.1	4.7	89	10	10	30	–
.1	.2	–	–	190	5.3	2.3	.1	4.9	176	30	10	60	–
.1	.8	228	0	187	6.9	1.7	.2	5.8	206	10	10	120	–
.1	.8	83	0	68	11	2.0	.1	7.5	93	9	–	40	–
.1	.5	46	0	38	6.0	1.4	.1	6.4	63	40	20	60	–
.3	1.2	–	–	180	38	16	.1	5.7	258	30	20	90	–
.1	.5	–	–	40	4.7	2.8	.1	5.0	53	30	40	60	–
.1	.6	39	0	32	3.7	1.5	.1	7.7	50	20	–	50	–
.1	1.0	140	0	110	6.4	2.6	.1	4.1	130	30	–	–	–
.1	1.9	–	–	210	30	2.9	.2	6.7	262	50	10	160	–
.2	2.9	339	0	278	19	3.4	.2	7.6	304	40	40	270	–
.1	1.2	310	0	250	43	4.2	.1	6.2	319	50	–	210	–
.1	1.4	–	–	240	13	4.1	.1	6.6	257	20	70	90	–
.1	.7	220	0	180	4.1	1.9	.1	5.9	194	20	–	110	–
.1	.6	–	–	170	3.5	2.5	.1	6.3	165	10	80	140	–
.1	.3	–	–	130	4.7	2.3	.1	5.3	141	10	10	50	–
.1	.5	240	0	200	7.8	2.5	.1	5.7	204	10	–	70	–
.1	.6	–	–	190	6.4	3.1	.1	6.2	204	10	<10	50	–
.1	1.2	–	–	280	18	4.5	.1	6.8	303	30	<10	110	–
.1	.9	220	0	180	7.5	3.2	.1	5.4	192	9	–	90	–
.1	.7	280	0	230	6.5	3.0	.1	6.6	241	10	–	130	–
.1	.9	250	0	210	19	3.8	.1	8.7	209	40	–	70	–
.1	2.0	–	–	250	22	3.4	.1	6.9	283	30	10	180	–
.1	1.0	–	–	140	12	4.3	.1	4.9	163	40	10	90	–
.1	.7	–	–	210	16	3.0	.1	6.1	230	10	10	60	–
.1	.7	–	–	120	18	5.4	.0	5.2	152	50	30	50	–
.1	1.0	240	0	200	14	3.0	.1	3.5	213	20	–	120	–
.1	.3	–	–	220	5.5	2.1	.1	6.3	230	10	50	100	–
.1	1.6	310	0	250	25	4.2	.1	6.4	284	30	–	150	–
.1	1.1	–	–	150	4.0	3.6	.1	6.6	163	40	20	50	–
.1	.5	–	–	170	4.0	2.4	.0	4.9	180	10	10	50	–
.0	.4	241	0	198	3.2	1.4	.2	4.7	210	10	0	180	–
.1	.8	–	–	220	10	4.2	.1	6.2	260	40	10	140	–
.1	3.4	–	–	200	14	5.3	.1	6.0	238	30	<10	220	–
.1	2.4	–	–	340	61	6.9	.1	7.5	417	60	30	150	–
.2	2.6	360	0	300	71	7.2	.1	7.9	392	30	–	350	–
.1	1.4	340	0	280	21	4.1	.1	6.7	311	20	–	70	–
.1	4.2	–	–	220	10	3.6	.1	5.5	262	300	10	80	–
.1	.6	–	–	240	12	3.8	.2	5.9	268	20	<10	250	–
.1	.9	–	–	200	11	2.9	.1	62	245	40	0	230	–
.1	1.1	–	–	210	6.0	3.0	.1	6.4	237	40	60	170	–
.1	1.2	–	–	220	7.0	4.1	.1	6.1	248	30	<10	170	–
.1	1.6	340	0	280	20	5.6	.1	7.3	302	30	–	100	–
.1	.6	–	–	230	12	2.6	.2	5.8	241	20	0	80	–
.1	1.2	–	–	320	20	4.6	.2	8.3	343	50	30	160	–
.1	.8	368	0	302	11	3.8	.2	6.2	325	30	30	250	–
.1	1.6	260	0	210	24	4.7	.1	7.1	247	30	–	340	–
.1	1.6	320	0	260	36	3.5	.1	6.6	320	20	–	260	–
.1	1.1	270	0	220	27	2.9	.1	5.6	261	20	–	210	–
.1	1.3	–	–	280	22	4.3	.1	5.8	305	30	0	180	–
.1	1.2	–	–	250	33	3.3	.1	5.8	290	20	20	200	SQS
.1	–	–	–	200	22	2.4	–	–	213	20	10	150	–
.1	.8	–	–	230	24	4.7	.0	5.2	268	50	20	210	–
.2	1.2	326	0	267	40	4.0	.1	4.7	323	30	20	260	–
.2	1.2	300	0	250	39	3.5	.1	5.7	305	20	–	290	–

Location	Geologic unit	Date of sample	Altitude	Hardness (as $CaCO_3$)	Noncarbonate hardness (as $CaCO_3$)	Discharge (gal/min)	Specific conductance	pH (units)	Water temperature (degrees C)	Dissolved calcium (as Ca)	Dissolved magnesium (as Mg)	Dissolved sodium (as Na)
(D-16-6) 22cda-S1	211CSLG	10-14-77	8,890	270	17	3.8	600	7.2	5.0	64	27	4.8
22ddb-S1	211PCRV	6-28-79	9,400	240	13	3.7	540	7.8	5.5	66	19	4.1
24dac-S1	211CSLG	8-28-79	8,780	280	25	3.0	490	8.0	6.4	66	29	7.8
27aac-S1	211PCRV	11-11-77	9,200	300	21	.30	560	7.3	5.0	82	23	4.6
27add-S1	211PCRV	6-20-79	9,190	280	39	.57	420	7.8	6.2	77	21	6.0
27bcd-S1	211PCRV	8-23-79	9,510	220	18	.79	400	7.9	6.0	56	19	5.6
27dcc-S1	211PCRV	8- 1-79	9,460	260	1	4.8	510	7.5	4.3	73	19	3.5
34acc-S1	125NRHR	6-20-79	9,580	250	0	13	440	7.6	4.8	68	19	3.8
34bdc-S1	125NRHR	6-20-79	9,690	240	18	17	470	7.6	5.1	64	19	3.6
34cad-S1	211PCRV	9- 6-78	9,360	310	78	.49	565	7.6	8.5	87	22	3.7
34dda-S1	211CSLG	10-14-77	8,720	260	0	3.8	560	7.4	6.7	54	30	4.8
35bda-S1	211PCRV	8-31-78	8,960	300	49	1.3	620	8.2	6.0	75	27	5.9
(D-16-7) 1acb-S1	125NRHR	8-26-76	9,660	250	6	11	401	7.5	5.5	61	23	2.1
9cab-S1	211SRPN	8-18-76	7,600	320	40	120	530	7.6	8.3	67	38	7.1
11bbb-S1	125NRHR	8-15-78	9,060	270	36	4.1	500	7.2	6.1	65	25	5.7
12bba-S1	125NRHR	8-15-78	9,270	270	21	6.6	520	7.2	3.9	69	24	4.0
13bac-S1	125NRHR	10-15-78	9,180	220	36	10E	385	8.1	6.0	42	27	2.7
17ccb-S1	211BCKK	9- 5-78	8,060	290	0	>30	530	7.5	6.5	65	30	5.9
21bbb-S1	211SRPN	10- 4-77	7,600	400	69	7.1	650	7.2	5.6	78	49	13
	211SRPN	9- 5-78	7,600	350	59	22	640	7.4	7.2	67	44	10
22bbb-S1	211SRPN	9- 7-78	7,220	590	290	4.0	1,000	7.4	10.6	89	89	18
26adc-S1	211SRPN	10- 3-77	7,120	320	64	75	550	6.8	9.5	78	30	4.1
26bca-S1	211SRPN	8- 9-79	6,860	380	61	15	690	7.5	11.0	83	42	6.6
26cbb-S1	211SRPN	8-22-79	6,950	440	94	54	830	7.2	10.0	82	58	21
28cbc-S1	211BCKK	8- 9-79	7,680	440	85	20E	800	7.2	12.5	92	52	16
29dbb-S1	211SRPN	10- 4-77	7,608	360	41	45	700	7.0	5.6	70	45	11
32ddc-S1	125NRHR	7-13-78	7,740	250	2	8.6	490	7.2	3.9	48	32	9.5
35abc-S1	111ALVM	8- 9-79	6,620	510	200	9.5	900	7.7	10.0	92	69	24
(D-16-8) 5bac-S1	125NRHR	8-15-78	—	250	47	2.0	440	7.1	5.2	74	15	1.9
18ada-S1	125NRHR	8- 9-79	9,100	280	28	9.5	520	7.2	4.0	70	25	3.4
19abb-S1	211CSLG	8- 9-79	8,400	320	28	.80	570	7.5	4.5	76	31	4.8
(D-17-6) 3acb-S1	211PCRV	6-21-79	8,960	280	12	60	530	7.6	6.2	75	23	6.2
3adc-S1	211CSLG	11-10-77	8,800	330	26	4.7	600	7.5	6.7	79	32	6.6
3add-S1	211CSLG	10-14-77	8,719	270	23	26	540	7.3	7.2	63	27	5.2
3bda-S1	211PCRV	6-21-79	9,040	250	8	50	520	7.4	6.3	68	19	5.4
3cbd-S1	125NRHR	7-31-79	9,400	290	0	.62	470	7.4	6.9	81	21	7.5
15adc-S1	125NRHR	6-27-79	9,080	300	15	1.6	490	7.5	6.3	62	34	9.2
15cad-S1	125NRHR	7- 5-79	8,820	300	33	1.0	560	7.9	8.3	55	40	24
15cbd-S1	125NRHR	7-13-79	8,930	360	11	>1.1	680	7.4	13.5	85	36	18
15dda-S1	125NRHR	7- 5-79	8,520	340	28	1.4	650	7.8	8.1	66	42	17
21abb-S1	125NRHR	6-26-79	9,330	240	0	3.2	550	7.4	5.7	50	27	61
21dcd-S2	125NRHR	7-10-79	9,080	250	4	31	520	7.6	6.2	47	33	20
22cdc-S1	125NRHR	6-27-79	9,230	220	0	15	475	7.6	6.3	39	30	17
23aaa-S1	211BCKK	10-14-77	7,766	260	22	40	600	7.4	6.1	43	37	11
	211BCKK	7-27-78	7,766	320	—	—	595	7.2	8.1	69	35	12
23bcb-S2	125NRHR	7-13-79	8,780	340	33	24	630	7.2	4.3	83	33	11
26cba-S1	125NRHR	6-27-79	9,120	280	0	6.3	560	7.6	8.2	51	38	19
26ccb-S1	125NRHR	7-18-79	8,960	330	0	17	700	7.3	4.8	60	43	49
27bbd-S1	125NRHR	8-16-79	9,060	230	0	3.9	500	7.6	6.5	40	31	13
27ccc-S1	125NRHR	8-16-79	8,720	290	0	3.9	700	7.8	7.8	42	44	54
27daa-S1	125NRHR	7-12-79	9,100	220	0	16	500	7.4	6.2	47	26	13
28bbc-S1	125NRHR	8-29-79	8,364	330	0	6.0	800	7.4	8.0	61	44	94
32acb-S1	211PCRV	8-31-79	7,620	400	53	—	790	8.0	16.5	77	51	39
33cbb-S1	125NRHR	8-30-79	8,380	360	0	.12	950	7.8	12.0	41	63	79
35ccb-S1	125NRHR	7-12-79	8,720	250	0	5.0	560	7.6	6.6	38	38	35
(D-17-7)5cad-S1	125NRHR	7-27-78	9,320	290	—	—	440	7.9	4.2	60	33	6.2
7bda-S1	124FLGF	7-27-78	9,740	220	—	—	400	7.1	5.8	74	9.2	2.9
16aca-S1	125NRHR	7-27-78	9,020	350	—	—	650	7.1	5.3	85	33	23
16bab-S1	125NRHR	7-11-78	8,880	280	33	8.8	520	7.5	3.9	72	25	12
16dcd-S1	125NRHR	7-27-78	9,280	260	—	—	490	6.8	6.2	59	28	15
18abb-S2	125NRHR	9-19-78	9,390	240	0	2.0	450	7.9	3.5	38	36	34
19abc-S1	125NRHR	8- 8-79	8,570	390	0	17	840	7.4	17.0	60	59	47
20acd-S1	125NRHR	7-11-78	9,360	270	0	8.0	510	7.4	4.8	67	24	12
21bdd-S1	125NRHR	7-12-78	8,930	420	110	5.7	790	7.2	7.3	100	41	23
21dcd-S1	125NRHR	10-22-76	9,000	400	29	.62	820	7.4	5.6	89	43	22
27abc-S1	211SRPN	9-29-76	7,360	630	330	1.2	1,000	7.3	10.2	120	81	26
28bad-S1	125NRHR	10-22-76	9,280	290	0	2.7	575	8.5	3.4	63	32	14
29bbb-S1	125NRHR	7-12-78	9,860	210	0	2.0	605	7.7	5.5	41	27	61
(D-18-6) 2bbd-S1	125NRHR	7-12-79	8,130	380	41	.46	940	7.4	8.1	55	59	84
3bac-S1	111ALVM	11- 9-77	7,080	490	120	—	1,180	7.6	2.2	69	77	88
4bab-S1	211CSLG	11- 9-77	7,125	290	64	6.7	660	7.4	2.2	50	41	23
4bbc-S1	211BCKK	8-31-79	7,000	460	79	1.5	800	7.2	12.7	98	52	16

from selected springs—Continued

	Milligrams per liter									Micrograms per liter			
Sodium-adsorption ratio	Dissolved potassium (as K)	Bicarbonate (as HCO_3)	Carbonate (as CO_3)	Alkalinity (as $CaCO_3$)	Dissolved sulfate (as SO_4)	Dissolved chloride (as Cl)	Dissolved fluoride (as F)	Dissolved silica (as SiO_2)	Dissolved solids, sum of constituents	Dissolved boron (as B)	Dissolved iron (as Fe)	Dissolved strontium (as Sr)	Other data
.1	1.0	310	0	250	15	4.8	0.2	7.7	278	10	–	230	–
.1	1.2	–	–	230	14	4.2	.2	7.2	254	30	0	200	–
.2	1.2	–	–	260	47	3.9	.2	5.8	318	70	30	360	–
.1	1.1	340	0	280	10	5.0	.1	7.1	301	10	–	190	–
.2	1.1	–	–	240	15	5.6	.1	7.5	<278	60	0	190	SQS
.2	1.3	–	–	200	12	5.2	.1	5.4	225	30	0	160	–
.1	1.2	–	–	260	12	3.7	.2	5.8	275	30	0	210	–
.1	1.0	–	–	250	12	3.7	.1	5.2	264	180	0	190	–
.1	.6	–	–	220	25	3.5	.1	5.2	254	20	0	210	–
.1	1.8	–	–	290	86	3.8	.1	7.2	350	50	50	230	–
.1	1.6	370	0	300	14	4.4	.1	7.5	299	20	–	180	–
.1	1.4	–	–	290	32	18	.1	7.6	318	40	10	270	SQS
.1	.4	294	0	241	6.6	2.0	.2	6.0	248	10	10	200	–
.2	1.5	346	0	284	35	5.3	.1	5.6	332	30	40	260	–
.2	.5	–	–	230	13	5.5	.2	6.8	260	30	<10	200	–
.1	1.2	–	–	250	9.4	3.0	.1	8.3	270	40	150	180	–
.1	.8	–	–	180	17	5.4	.1	5.7	209	30	10	210	–
.2	1.1	–	–	300	28	3.8	.1	5.9	320	30	<0	220	–
.3	2.3	400	0	330	65	9.4	.1	7.7	422	30	–	450	–
.2	2.3	–	–	290	54	8.3	.1	7.2	368	50	10	320	–
.3	4.9	–	–	300	290	27	.1	7.2	706	80	<0	380	–
.1	1.1	310	0	250	26	4.0	.1	6.6	303	20	–	280	–
.1	2.3	–	–	320	71	8.1	.2	7.6	<414	80	0	360	SQS
.4	2.7	–	–	350	140	7.3	.2	7.4	<530	30	20	430	SQS
.3	3.3	–	–	380	120	5.6	.1	7.8	<514	30	90	630	SQS
.3	1.8	390	0	320	48	5.1	.1	7.5	381	30	–	350	–
.3	1.1	–	–	250	13	4.7	.1	5.6	265	30	<10	300	–
.5	3.9	–	–	310	190	15	.2	10	591	70	0	490	–
.1	.5	–	–	237	6.0	2.9	.1	5.6	227	10	<10	120	–
.1	.6	–	–	250	23	3.2	.2	7.0	283	10	10	260	–
.1	1.0	–	–	290	38	4.1	.2	7.1	337	30	50	330	–
.2	1.1	–	–	270	17	4.4	.1	6.5	296	30	0	270	–
.2	1.2	370	0	300	29	5.9	.2	7.2	344	30	–	260	–
.1	.9	300	0	250	13	4.6	.1	7.0	269	30	–	240	–
.2	1.1	–	–	270	15	3.6	.2	6.0	263	20	10	20	–
.2	.6	–	–	290	20	4.4	.1	5.5	315	30	10	230	–
.2	.8	–	–	290	42	6.5	.3	7.1	331	40	0	340	–
.6	1.1	–	–	270	48	13	.2	6.7	351	40	0	450	–
.4	1.4	–	–	350	43	11	.2	8.4	414	40	0	410	–
.4	.9	–	–	310	46	23	.2	8.1	390	40	0	510	–
1.7	1.8	–	–	330	20	18	.3	6.1	<383	40	0	660	SQS
.5	.9	–	–	250	16	22	.2	6.2	296	40	0	260	–
.5	1.2	–	–	230	17	9.5	.2	6.1	259	40	0	360	–
.3	1.6	290	0	240	39	7.3	.1	6.8	289	20	–	340	SQS
.3	1.7	–	–	290	44	7.7	.1	6.8	–	–	–	–	–
.3	.9	–	–	310	53	6.1	.1	6.1	380	20	10	140	–
.5	1.0	–	–	290	20	8.4	.3	7.0	320	50	0	480	–
1.2	1.3	–	–	390	39	14	.4	8.1	450	90	0	550	–
.4	.8	–	–	240	13	13	.2	5.9	262	20	40	210	–
1.4	1.0	–	–	330	32	27	.3	7.5	<407	50	0	490	SQS
.4	.8	–	–	230	14	5.3	.2	6.2	251	30	10	270	–
2.2	1.8	–	–	340	180	19	.2	6.2	<611	50	10	770	SQS
.8	3.0	–	–	350	120	15	.2	7.2	<524	180	0	610	SQS
1.8	1.2	–	–	400	74	54	.3	8.1	562	90	0	590	–
1.0	1.3	–	–	260	29	28	.2	6.4	333	50	0	390	–
.2	.8	–	–	240	10	3.2	.1	5.5	–	–	–	–	SQS
.1	.2	–	–	220	7.6	3.0	.1	5.5	–	–	–	–	SQS
.5	.7	–	–	360	24	8.8	.2	7.4	–	–	–	–	SQS
.3	.6	–	–	330	19	5.1	.1	6.7	291	50	0	260	–
.4	.6	–	–	240	10	4.2	.2	6.7	–	–	–	–	SQS
1.0	1.5	–	–	270	26	13	.2	6.2	318	60	10	370	–
1.0	1.4	–	–	410	72	18	.3	8.0	<513	60	10	710	SQS
.3	.5	–	–	270	9.1	4.2	.1	5.4	285	30	<10	230	–
.5	.9	–	–	310	130	11	.2	7.0	500	70	10	470	–
.5	1.1	452	0	371	66	11	.2	6.9	469	50	30	490	–
.5	4.5	374	0	307	300	18	.1	9.5	750	100	20	780	–
.4	.8	361	0	296	33	3.7	.2	5.9	332	20	30	320	–
1.8	1.9	–	–	300	73	14	.3	9.4	378	60	10	400	–
1.9	1.7	–	–	340	170	50	.3	7.5	<633	180	0	720	–
1.7	3.5	450	0	370	220	41	.2	8.9	730	70	–	790	–
.6	2.4	280	0	230	110	14	.1	6.0	385	40	–	360	–
.3	3.5	–	–	380	120	13	.1	7.0	<539	320	0	410	–

Location: See explanation of data-site numbering system in text.
Concentration: In milligrams per liter unless otherwise specified.
Specific conductance: In micromhos per centimeter at 25 degrees Celsius.
Remarks: DC, Deer Creek Mine; K, King Mine; SQS, semiquantitave determination of trace elements reported in table 12; T, Trail Mountain Mine; W, Wilberg Mine.

Location	Date	Temperature (degrees C)	Discharge (gal/min)	Concentration						
				Alkalinity (as $CaCO_3$)	Dissolved boron (μg/L)	Dissolved calcium	Dissolved chloride	Dissolved fluoride	Hardness (as $CaCO_3$)	Dissolved iron (μg/L)
(D-15-7)24cab	8-31-78	8.5	–	344	7	110	3.2	0.1	420	50
24cdd	8-31-78	10.0	–	292	0	87	3.3	.1	340	210
(D-15-8)18ccb	8-31-78	8.5	–	235	4	68	2.3	.1	260	30
(D-16-7)29bbb-1	10-12-79	7.0	–	140	–	23	7.3	.2	150	–
(D-16-8)8dad	10-12-77	6.0	240	360	100	130	4.3	.2	570	30
8dda	9-18-75	12.5	300	353	100	150	3.4	.2	600	20
(D-17-6)24dcd-1	10-10-79	8.5	–	250	–	18	14	.1	150	–
25acc-1	9- 6-78	10.5	–	194	120	110	7.6	.2	530	20
25acc-2	9- 6-78	6.5	–	228	380	230	10	.4	1,100	50
25dcc	8-10-79	10.8	–	310	720	17	4.8	1.0	77	290
(D-17-7)10ccb	8- 2-79	9.0	–	300	30	78	6.7	.2	370	0
10cbd	8- 2-79	11.2	–	300	20	83	7.0	.2	380	10
10daa	4-20-76	–	–	290	–	77	7.9	–	370	–
16aad	8- 1-79	11.0	–	300	30	97	7.6	.1	440	10
16cdd	8- 2-79	13.0	–	350	40	110	9.6	.1	490	200
20cca	8- 2-79	14.2	–	310	90	100	9.3	.2	490	70
20ccb	7- 5-79	14.5	–	300	180	74	9.0	.2	380	40
20dcc	7- 5-79	14.2	–	360	80	120	9.2	.1	580	140
21aab	8- 2-79	13.5	–	330	40	130	9.7	.1	570	20
21bad	8-30-78	13.5	–	428	40	130	12	.1	560	0
21cbc	7- 5-79	14.2	–	300	40	88	7.5	.1	410	50
21dbd	7-31-79	11.0	–	290	140	110	9.7	.1	600	10
21dda	8-30-78	11.5	–	360	20	100	8.4	.1	430	70
21dda	9-29-76	29.0	–	341	70	85	9.9	.2	440	10
	3-30-77	5.0	60	250	130	71	11	.1	380	10
	11- 1-77	6.0	–	250	100	70	10	.1	390	30
22abd	7-31-79	12.0	–	340	50	130	11	.2	490	30
22caa	6-14-79	12.5	–	420	90	130	10	.1	590	90
22cab	7- 5-79	13.0	–	320	50	120	11	.2	540	190
22cab	5-10-79	–	–	410	50	140	10	.2	600	10
22ccb	8-30-78	14.0	–	343	40	110	10	.1	490	260
22cdc	7- 5-79	10.0	–	360	80	150	13	.2	710	300
27bac	7- 5-79	11.5	–	430	100	210	21	.1	1,000	30
	7- 5-79	11.5	–	430	100	210	20	.1	1,100	10
28abc	8-30-78	13.5	–	380	30	100	8.5	.1	440	20
28bad	7- 5-79	14.0	–	320	20	90	7.3	.2	410	60

from mines and wells, 1975-79

Concentration									
Dissolved magnesium	Dissolved potassium	Dissolved silica	Dissolved sodium	Dissolved solids	Dissolved sulfate	Dissolved strontium (μg/L)	pH (units)	Specific conductance	Remarks
35	2.0	7.0	2.2	409	69	350	7.2	670	K,SQS, sample collected at Bear Canyon Fault
29	1.7	6.7	2.3	313	43	330	7.3	565	K, drill hole in floor
23	1.2	6.2	1.8	245	27	160	7.6	430	K,SQS, roof fracture
23	2.0	.7	14	190	35	–	7.6	360	–
59	4.8	9.3	6.5	642	210	990	6.9	1,150	K, Mohrland portal
55	5.0	8.4	7.0	671	230	–	7.3	940	K, Mohrland portal
26	23	2.0	58	327	35	–	6.6	600	–
61	5.6	3.2	22	768	410	1,100	7.8	940	T
120	9.2	9.3	78	1,700	1,000	2,200	7.5	1,700	SQS,T, ponded water
8.4	3.6	8.9	120	355	3.7	270	8.2	560	T
42	3.8	7.4	17	407	71	910	7.8	680	DC
41	1.7	6.2	19	419	80	440	7.6	720	DC
44	2.5	–	18	–	100	–	–	–	DC, mine effluent
48	2.5	6.6	21	<460	96	470	7.5	760	DC,SQS
53	3.7	7.3	18	573	160	620	7.0	930	DC, drill hole to land surface
58	5.8	8.6	24	554	160	1,100	7.4	950	W
47	10	8.9	26	<478	120	2,000	7.5	800	SQS,W
69	3.8	8.3	26	624	170	730	7.2	1,050	W
60	4.7	7.2	20	601	170	560	7.4	940	DC,SQS
56	2.9	8.5	15	574	160	510	7.7	890	DC,SQS
46	3.0	8.1	22	446	90	600	7.4	800	W
78	4.5	19	26	623	200	1,600	7.2	1,130	DC
43	2.2	7.9	18	451	100	430	7.7	740	SQS,W
56	3.2	8.3	21	551	160	450	7.8	800	W, mine effluent
49	3.3	8.6	22	434	120	470	7.2	600	W, mine effluent
52	3.5	9.0	22	481	160	520	7.0	750	W, mine effluent
39	2.9	8.0	18	594	180	500	7.2	950	DC
65	2.7	6.5	19	697	210	580	7.2	1,050	W
58	2.9	7.2	20	<602	190	500	7.1	1,000	SQS,W
60	5.1	6.9	18	675	190	–	–	980	W
52	3.0	8.7	18	555	190	500	7.3	860	SQS,W, sample collected at Pleasant Valley Fault
82	3.9	7.2	19	<772	280	–	7.3	1,240	SQS,W
120	4.7	7.4	28	1,230	580	910	7.0	1,725	W
140	4.9	7.1	25	1,330	660	860	7.5	1,900	W
46	2.3	8.6	19	459	93	450	7.4	750	SQS,W
46	2.5	7.8	20	<458	91	460	7.2	800	SQS,W

Location: See explanation of data-site numbering system in text; numbers for surface-water sampling sites in parentheses.
Discharge: Springs, in gallons per minute; streams, in cubic feet per second.
Concentration: <, Value is less than that shown. Results are reported from detection limit to upper concentration limit in steps of 1, 3, 4, 7, 10. Due to rounding techniques, results are an estimate of one significant figure; precision is approximately plus or minus one step at 68 percent confidence level and plus or minus two steps at 95 percent confidence level.
Specific conductance: In micromhos per centimeter at 25°C.
Remarks: K, King Mine; T, Trail Mountain Mine; DC, Deer Creek Mine; W, Wilberg Mine.

Location	Date	Temperature (°C)	Discharge	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Gallium (Ga)	Dissolved Germanium (Ge)	Dissolved Iron (Fe)
SPRINGS AND MINES																
(D-15-7)24cab	8-31-78	8.5	–	100	<30	70	<1	<1,000	–	10	<50	<5	<10	<30	100	–
24ccd	8-31-78	10.0	–	100	<30	70	<1	<1,000	–	3	<50	7	<10	<30	100	–
(D-15-8)18ccb	8-31-78	8.5	–	100	<30	70	<1	<1,000	–	5	<50	<5	<10	<30	100	–
(D-16-6)1aca-S1	7-19-79	5.3	–	700	<30	70	<1	<1,000	–	<1	<50	<5	<10	<30	100	–
27add-S1	6-20-79	6.2	0.57	–	<30	100	<1	<1,000	–	10	<50	<5	<10	<30	100	–
35bda-S1	9- 6-79	–	–	1,000	<30	100	<1	<1,000	5	<1	<50	<5	<10	<30	100	7
(D-16-7)26bca-S1	8- 9-79	11.0	15	700	<30	50	<1	<1,000	–	<1	<50	<5	<10	<30	300	–
26cbb-S1	8-22-79	–	–	1,000	<30	50	<1	<1,000	–	<1	<50	<5	<10	<30	300	–
28cbc-S1	8- 9-79	12.5	–	500	<30	50	<1	<1,000	–	7	<50	<5	<10	<30	300	–
(D-17-6)21abb-S1	6-26-79	5.7	3.2	–	<30	100	<1	<1,000	–	<1	<50	<5	<10	<30	100	–
23aaa-S1	7-27-77	–	–	100	<30	100	<1	<1,000	30	7	<50	<5	<10	<30	100	–
25acc	9- 6-78	6.5	–	500	70	10	<1	<1,000	–	7	<50	30	<10	50	500	–
	9- 6-78	10.5	–	300	100	50	<1	<1,000	–	7	<50	10	<10	70	300	–
27ccc-S1	8-16-79	7.8	4.0	–	<30	100	<1	<1,000	–	<1	<50	<5	<10	<30	300	–
28bbc-S1	8-29-79	8.0	6.0	–	<30	30	<1	<1,000	–	<1	<50	<5	<10	<30	100	–
32acb-S1	8-31-79	16.5	–	–	<30	30	<1	<1,000	–	<1	<50	<5	<10	<30	300	–
(D-17-7)5cad-S1	7-27-78	–	–	100	<30	100	<1	<1,000	–	7	<50	<5	<10	<30	70	–
7bda-S1	7-27-78	–	–	70	<30	100	<1	<1,000	30	5	<50	<5	<10	<30	30	–
(D-17-7)16aad	8- 1-79	11.0	–	700	<30	50	<1	<1,000	–	10	<50	<5	<10	<30	300	–
16aca-S1	7-27-78	–	–	100	<30	100	<1	<1,000	50	<1	<50	<5	<10	<30	100	–
16dcd-S1	7-27-78	–	–	100	<30	10	<1	<1,000	10	<1	<50	<5	<10	<30	70	–
19abc-S1	8- 8-79	17.0	17	1,000	<30	100	<1	<1,000	–	<1	<50	<5	<10	<30	300	–
20ccb	7-15-79	14.5	–	1,000	<30	500	<1	<1,000	–	7	<50	<5	<10	<30	300	–
21bad	8-30-78	13.5	–	300	30	30	<1	<1,000	–	5	<50	5	<10	<30	300	–
21dda	8-30-78	11.5	–	300	30	50	<1	<1,000	–	5	<50	<5	<10	<30	300	–
22cab	7- 5-79	13.0	–	700	<30	30	<1	<1,000	–	5	<50	<5	<10	<30	300	–
28abc	8-30-78	13.5	–	300	50	50	<1	<1,000	–	3	<50	<5	<10	<30	300	–
28bad	7- 5-79	14.0	–	500	<30	50	<1	<1,000	–	1	<50	<5	<10	<30	300	–
(D-18-6)2bbd-S1	7-12-79	8.1	.46	–	<30	30	<1	<1,000	–	<1	<50	<5	<10	<30	300	–
4bbc-S1	8-31-79	12.7	1.6	–	<30	50	<1	<1,000	–	<1	<50	<5	<10	<30	300	–
STREAMS																
Deer Creek (86)	8-26-79	8.6	.26	1,000	<30	100	<1	<1,000	–	10	<50	<5	<10	<30	100	–
Fish Creek (90)	6-14-79	20.0	2.5	1,000	<30	100	<1	<1,000	7	<1	<50	<5	<10	<30	300	10
Deer Creek (87)	6-14-79	15.5	1.9	1,000	<30	70	<1	<1,000	10	<1	<50	<5	<10	<30	100	30
Marinus Canyon (91)	6-13-79	5.5	.47	100	<30	70	<1	<1,000	<5	<1	<50	<5	<10	<30	100	10
Trail Canyon (79)	6-14-79	16.0	.48	300	<30	100	<1	<1,000	10	<1	<50	<5	<10	<30	300	30
Crandall Canyon (51)	6-14-79	14.0	–	1,000	<30	70	<1	<1,000	<5	<1	<50	<5	<10	<30	100	30
Huntington Creek (41)	10-17-78	5.5	–	100	<30	70	<1	<1,000	–	3	<50	<5	<10	<30	70	–
Nuck Woodward Canyon (19)	6-12-79	11.0	3.8	70	<30	30	<1	<1,000	<5	<1	<50	<5	<10	<30	30	50
Flood Canyon (70)	6-12-79	14.5	1.6	100	<30	30	<1	<1,000	<5	<1	<50	<5	<10	<30	70	300
Valentines Gulch (1)	6-12-79	8.0	.46	100	<30	50	<1	<1,000	<5	<1	<50	<5	<10	<30	70	10
Tie Fork Canyon (67)	6-14-79	9.5	6.6	1,000	<30	70	<1	<1,000	<5	<1	<50	<5	<10	<30	100	10
Cottonwood Creek (104)	6-13-79	17.0	3.3	1,000	<30	70	<1	<1,000	10	<1	<50	<5	10	<30	300	30
Grimes Wash (107)	8-26-79	13.3	.10	1,000	<30	100	<1	<1,000	40	7	<50	<5	<10	<30	300	–
Left Fork Huntington Creek (40)	6-12-79	14.0	113	70	<30	50	<1	<1,000	<5	<1	<50	<5	10	<30	100	10

in water from selected springs, mines, and streams, 1978-79

Concentration																	pH (units)	Specific conductance	Remarks
Micrograms per liter													Milligrams per liter						
Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Manganese (Mn)	Dissolved Molybdenum (Mo)	Dissolved Nickel (Ni)	Dissolved Potassium (K)	Dissolved Silver (Ag)	Dissolved Strontium (Sr)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Dissolved Calcium (Ca)	Dissolved Magnesium (Mg)	Dissolved Silica (Si)	Dissolved Sodium (Na)			
—	10	30	<10	<50	—	<10	—	100	<5	<10	7	<5	—	—	—	—	—	—	K
<30	10	10	<10	<50	—	<10	—	100	<5	<10	<5	<5	—	—	—	—	—	—	K
<30	10	10	<10	<50	—	<10	—	100	<5	<10	<5	<5	—	—	—	—	—	—	K
—	10	<1	<10	<50	—	<10	—	100	<5	<10	7	<5	—	—	—	—	—	—	—
—	10	<1	<10	<50	—	<10	—	<50	<5	<10	<5	<5	—	—	—	—	—	—	—
—	10	<1	<10	<50	—	<10	300	100	<5	<10	<5	<5	70	30	10	7	8.2	—	—
—	10	<1	<10	<50	—	<10	—	100	<5	<10	<5	<5	—	—	—	—	—	—	—
—	30	<1	<10	<50	—	<10	—	300	<5	<10	<5	<5	—	—	—	—	—	—	—
—	30	10	<10	<50	—	<10	—	500	<5	<10	<5	<5	—	—	—	—	—	—	—
—	30	<1	<10	<50	—	<10	—	100	<5	<10	<5	<5	—	—	—	—	—	—	—
—	10	<1	<10	<50	<1,000	<10	300	<50	<5	<10	<5	<5	50	30	—	—	—	—	—
—	30	100	30	100	—	<10	—	700	<5	<10	30	7	—	—	—	—	—	—	T
—	30	5	30	100	—	30	—	500	7	<10	30	10	—	—	—	—	—	—	T
—	30	<1	<10	<50	—	<10	—	100	<5	<10	<5	<5	—	—	—	—	—	—	—
—	30	<1	<10	<50	—	<10	—	100	<5	<10	<5	<5	—	—	—	—	—	—	—
—	10	<1	<10	<50	—	<10	—	100	<5	<10	30	<5	—	—	—	—	—	—	—
<30	10	<1	<10	<50	—	<10	—	<50	<5	<10	<5	<5	—	—	—	—	—	—	—
<30	<5	<1	<10	<50	<1,000	<10	100	50	<5	<10	<5	<5	70	10	—	—	—	—	—
—	30	7	<10	<50	—	<10	—	100	<5	<10	10	<5	—	—	—	—	—	—	DC
<30	10	—	<10	<50	<1,000	<10	300	<50	<5	<10	<5	<5	70	30	—	—	—	—	—
<30	10	<1	<10	<50	<1,000	<10	300	<50	<5	<10	<5	<5	50	30	—	—	—	—	—
—	10	<1	<10	<50	—	<10	—	300	<5	<10	<5	<5	—	—	—	—	—	—	—
—	30	3	<10	<50	—	<10	—	100	<5	<10	30	<5	—	—	—	—	—	—	W
30	10	30	<10	<50	—	<10	—	300	<5	<10	10	<5	—	—	—	—	—	—	DC
30	10	10	<10	<50	—	<10	—	300	<5	<10	7	<5	—	—	—	—	—	—	W
—	30	30	<10	<50	—	<10	—	300	<5	<10	<5	<5	—	—	—	—	—	—	W
30	10	10	<10	<50	—	<10	—	300	<5	<10	10	<5	—	—	—	—	—	—	W
—	10	10	<10	<50	—	<10	—	300	<5	<10	<5	<5	—	—	—	—	—	—	W
—	50	<1	<10	<50	—	<10	—	300	<5	<10	<5	<5	—	—	—	—	—	—	—
—	10	3	<10	<50	—	<10	—	100	<5	<10	<5	<5	—	—	—	—	—	—	—
—	10	50	<10	<50	—	<10	—	100	<5	<10	70	<5	—	—	—	—	—	—	—
—	30	1	<10	<50	—	<10	300	300	<5	<10	10	<5	50	50	10	30	7.9	660	—
—	10	1	<10	<50	—	<10	300	100	<5	<10	10	<5	50	30	10	30	7.8	540	—
—	10	1	<10	<50	—	<10	300	100	<5	<10	5	<5	70	30	10	3	7.7	295	—
—	10	7	<10	<50	—	<10	300	100	<5	<10	10	<5	50	30	10	5	7.7	470	—
—	10	1	<10	<50	—	<10	100	100	<5	<10	7	<5	50	30	10	7	7.8	410	—
<30	10	7	<10	<50	—	<10	—	70	<5	<10	7	<5	—	—	—	—	—	—	—
—	<10	3	<10	<50	—	<10	50	<50	<5	<10	10	<5	30	7	10	1	7.4	210	—
—	<10	3	<10	<50	—	<10	50	70	<5	<10	10	<5	50	10	10	1	7.9	290	—
—	<10	3	<10	<50	—	<10	70	<50	<5	<10	10	<5	50	10	10	1	7.6	370	—
—	10	1	<10	<50	—	<10	100	70	<5	<10	<5	<5	70	30	10	5	7.9	470	—
—	10	3	<10	<50	—	<10	300	100	<5	<10	5	<5	50	30	10	10	7.8	470	—
—	30	30	<10	<50	—	<10	500	100	<5	<10	10	<5	—	43	—	—	—	—	—
—	<10	3	<10	<50	—	<10	100	70	<5	<10	<5	<5	50	10	0	1	7.7	280	—

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