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Prepared in cooperation with
Park County Government and the
Center of Colorado Water Conservancy District

Water-Quality Characteristics of Selected Streams in Park County, Colorado, September 1999

INTRODUCTION

In 1998, Park County had 13,330 residents and was one of the fastest growing counties in Colorado based on percentage of change in population. With increasing population and development comes an increased demand for water resources and the potential to affect the quality of the resource. Local entities in Park County are interested in obtaining current information on the status of water quality in the county. This information can be used to improve land-use and water-management strategies and to help identify current (1999) and future water-quality concerns.

The Middle Fork South Platte River Basin north of Alma

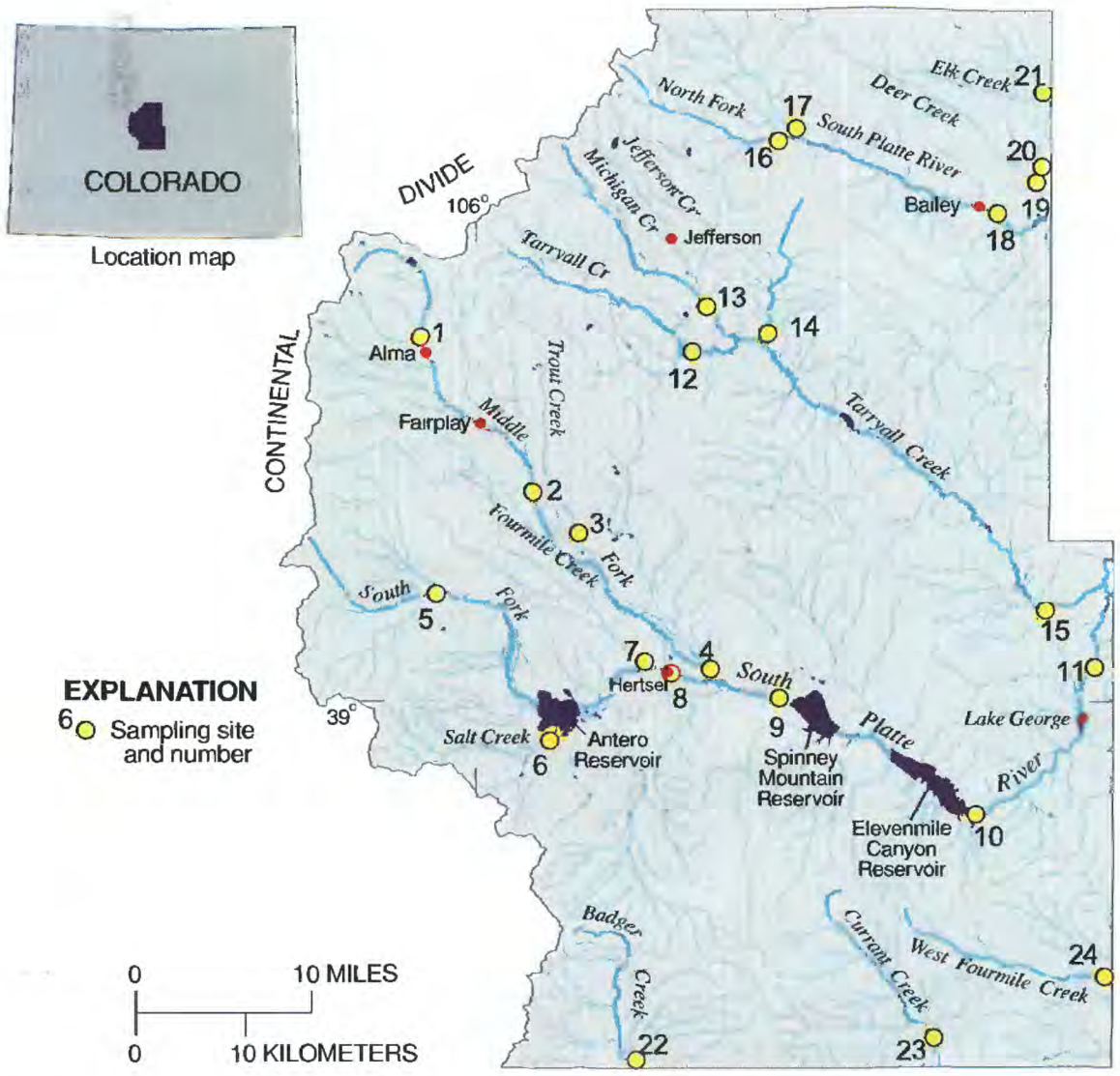

Figure 1. Park County and sampling locations.

Park County encompasses about 2,210 square miles in central Colorado and is adjacent to the eastern side of the Continental Divide. Most of Park County is situated in the headwaters area of the South Platte River Basin; major tributaries are Tarryall Creek and the South, Middle, and North Forks of the South Platte River (fig. 1). The southern part of the county is drained by streams in the Arkansas River Basin, including Badger, Currant, and West Fourmile Creeks (fig. 1).

During September 13–16, 1999, the U.S. Geological Survey (USGS), in cooperation with Park County Government and the Center of Colorado Water Conservancy District, conducted a reconnaissance sampling of stream-water quality at several sites throughout the county. This report presents the water-quality results of that study and compares some of the results to instream water-quality standards or guidelines set by the Colorado Department of Public Health and Environment (CDPHE) (1998a, 1999a, 1999b), the U.S. Environmental Protection Agency (USEPA) (1986, 1996), and the U.S. Department of the Interior (1994).

Table 1. Stream-sampling sites in Park County, September 1999

Site number (see fig.1)	Site name
	Middle Fork South Platte River Basin sites
1	Middle Fork South Platte River above Alma
2	Middle Fork South Platte River below Fairplay
3	Trout Creek near mouth
4	Middle Fork South Platte River near mouth
	South Fork South Platte River Basin sites
5	South Fork South Platte River above Antero Reservoir
6	Salt Creek above Antero Reservoir
7	Fourmile Creek near mouth
8	South Fork South Platte River near Hartsel
	Main-stem South Platte River sites
9	South Platte River above Spinney Mountain Reservoir
10	South Platte River below Elevenmile Canyon Reservoir
11	South Platte River below Lake George
	Tarryall Creek Basin sites
12	Tarryall Creek below Park Gulch
13	Michigan Creek near mouth
14	Rock Creek near mouth
15	Tarryall Creek near mouth
	North Fork South Platte River Basin sites
16	North Fork South Platte River above Geneva Creek
17	Geneva Creek near mouth
18	North Fork South Platte River below Bailey
19	Deer Creek near Park County line
20	Roland Gulch near Park County line
21	Elk Creek near Park County line
	Arkansas River Basin sites
22	Badger Creek near Park County line
23	Currant Creek near Park County line
24	West Fourmile Creek near Park County line

DATA COLLECTION

Using standard USGS protocols (Wilde and others, 1998), physical properties of water were measured, and water samples were collected for analysis of chemical constituents at 24 stream sites in Park County (fig. 1, table 1). Samples were collected and processed using equipment made from Teflon or high-density polyethylene. Prior to use, the equipment was cleaned with a nonphosphate laboratory detergent and rinsed first with tap water, then with a 5-percent solution of hydrochloric acid, and last with deionized water. The equipment was rinsed with copious amounts of native water at the sampling sites before sample collection.

Depth- and width-integrated water samples were collected from streams by using the equal-width-increment method (Edwards and Glysson, 1988). Aliquots of unfiltered water were collected for analysis of the total constituent concentrations. Water pumped through 0.45-micrometer pore-size filters was used to determine constituent concentrations in the dissolved phase. With the exception of the field measurements obtained onsite, water samples were analyzed for the constituents listed in table 2 at the USGS National Water-Quality Laboratory in Lakewood, Colorado.

HYDROLOGIC CONDITIONS

Continuous streamflow data are available for sites 12 and 22, and hydrographs for these two sites for water year 1999 are shown in figure 2. The hydrographs show that streamflow was relatively low in September after peaking in May or June from annual snowmelt runoff. Streamflow in September is maintained primarily by ground-water inflow. Samples were collected at this time of year to avoid dilution effects that could occur during peak snowmelt runoff. Streamflow and instream constituent concentrations during this study also were not strongly influenced by large runoff events caused by summer rainstorms. Examples of relatively large storm runoff events at sites 12 and 22 are the peaks in streamflow in late July or early August that are large in magnitude but short in duration (fig. 2).

The instantaneous streamflows measured at the time of sampling ranged from less than 1 to 121 cubic feet per second (table 2). Streamflow was largest at several sites on the South

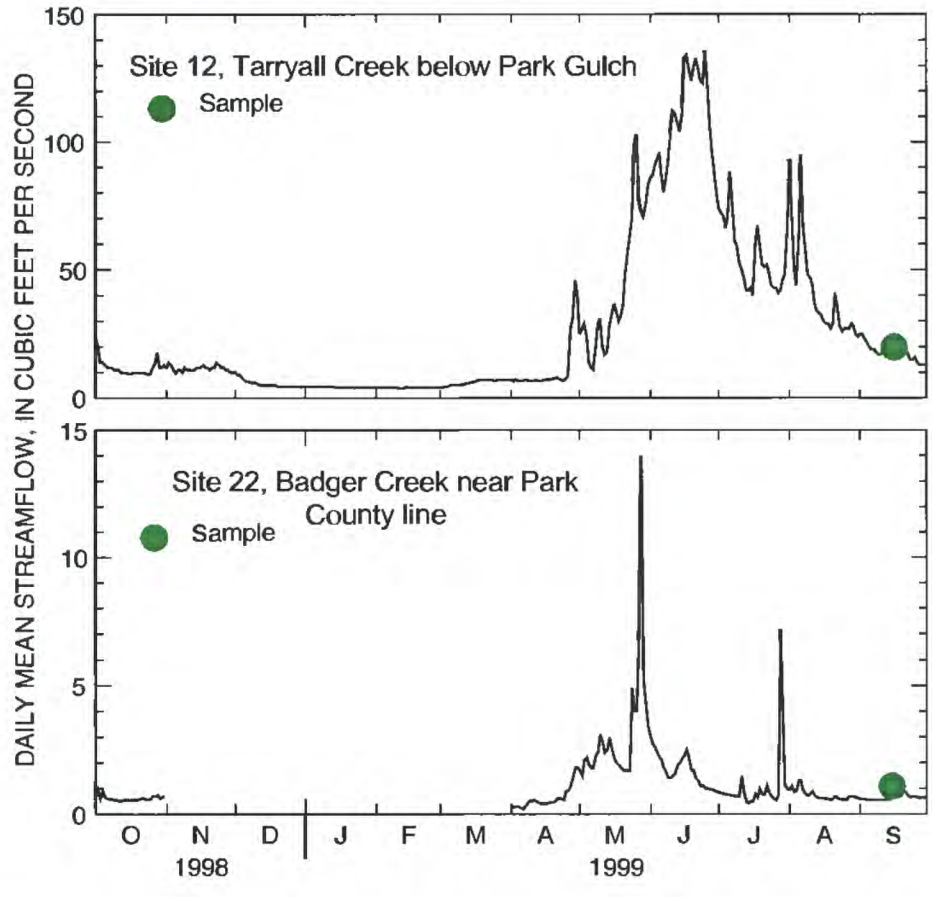

Figure 2. Streamflow hydrographs for sites 12 and 22, water year 1999.

Streamflow gage on Tarryall Creek below Park Gulch (site 12)

Platte River in the Middle Fork and North Fork Basins and at sites on the main-stem South Platte River downstream from Hartsel. Streamflow was smallest in Salt Creek (site 6), Roland Gulch (site 20), and Badger Creek (site 22).

WATER QUALITY

Field Measurements

The water-quality properties measured in the field for this study were water temperature, dissolved oxygen, pH, and specific conductance.

The metabolic rates of aquatic organisms and several chemical reactions in water are regulated to a certain extent by water temperature, dissolved oxygen, and pH. The CDPHE sets instream standards for water temperature primarily on the basis of the types of aquatic life present. In Park County streams, the maximum permissible water temperature is 20°C (degrees Celsius). During this study all measured water temperatures were less than this standard (table 2). The minimum dissolved-oxygen level set by the CDPHE for Park County streams is 6 mg/L (milligrams per liter), and all concentrations were greater than this level (table 2). Most values for pH, a measure of the hydrogen-ion activity, were within the 6.5 to 9.0 standard set by the CDPHE. One exception was at the North Fork South Platte River upstream from Geneva Creek (site 16) where a pH of 5.9 was recorded.

Specific conductance is a measure of the capacity of water to conduct an electrical current. The presence of charged ionic species in solution makes water conductive; therefore, specific-conductance measurements provide an indication of the dissolved ionic concentration. Specific conductance ranged from 50 µS/cm (microsiemens per centimeter at 25°C) in Rock Creek (site 14) to 8,660 µS/cm in Salt Creek (site 6), a saline tributary that flows into Antero Reservoir. The State of Colorado has not set standards for specific conductance for streams in Park County.

Major Ions and Dissolved Solids

The major ions analyzed for this study (bicarbonate, calcium, chloride, fluoride, magnesium, potassium, silica, sodium, and sulfate) are constituents commonly dissolved in most natural waters. The presence of major ions in solution is influenced primarily by interactions of water, rock, and soil but also can be affected by human activities. The CDPHE has set instream standards of 250 mg/L for two of the major ions—chloride and sulfate—that are applicable to most of the sites sampled in this study. With the exception of Salt Creek (site 6), all concentrations of chloride and sulfate were less than the standards (table 2). Concentrations of calcium, chloride, magnesium, potassium, sodium, and sulfate were largest in Salt Creek, and some of the concentrations were at least one order of magnitude larger than all others. Springs discharging from evaporite beds in the Maroon Formation, a sedimentary rock of Pennsylvanian and Permian age, could be the source of high major-ion concentrations in Salt Creek (Klein and others, 1978).

The sum of dissolved solids is a measurement of the total dissolved-constituent concentration. Major ions make up the bulk of dissolved-solids concentrations; other constituents such as nitrogen, phosphorus, iron, and manganese account for the remainder. The CDPHE has not set standards for dissolved solids in Colorado waters; however, there is a recommended limit for treated drinking water of 500 mg/L (U.S. Environmental Protection Agency, 1996). Additionally, crop losses might occur when dissolved-solids concentrations reach about 700–850 mg/L in irrigation water (U.S. Department of the Interior, 1994). With the exception of Salt Creek, all dissolved-solids concentrations

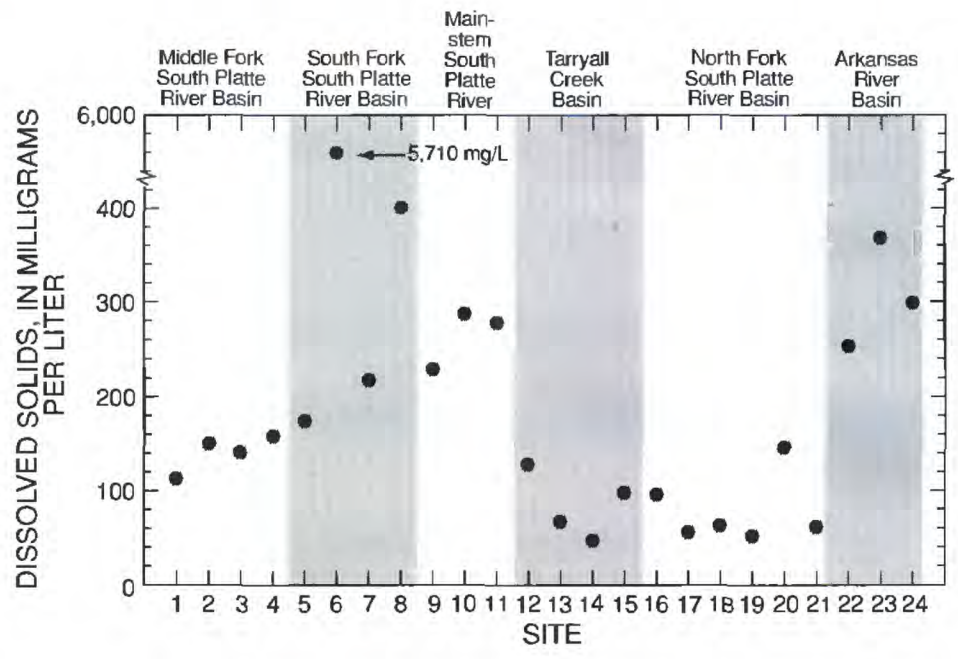

Figure 3. Concentrations of dissolved solids (alternate white and shading denotes different areas of Park County).

Table 2. Selected water-quality data for surface-water sites in Park County, Colorado, September 13–16, 1999

[ft^3/s, cubic feet per second; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; mg/L milligrams per liter; µg/L, micrograms per liter; TVS, Table Value Standard; pCi/L, picocuries per liter; <, less than detection limit; --, no data or standard]

Constituents and properties	Standard or guideline	Middle Fork South Platte River Basin Sites				South Fork South Platte River Basin sites				Main-stem South Platte River sites			Tarryall Creek Basin				North Fork South Platte River Basin sites						Arkansas River Basin sites		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Field measurements																									
Discharge (ft^3/s)	--	11	50	3.6	59	16	0.43	11	22	86	115	121	20	26	7.4	49	19	49	83	19	1.7	11	1.1	5.6	6.5
Temperature (°C)	[1]20	5.6	6.2	11	12.5	8.4	16.4	11.4	13.5	9.9	15.9	14.1	9.3	5.8	4.6	12.3	11.2	8.7	8.2	12	12.7	9.6	8.4	13.4	12.0
Oxygen, dissolved (mg/L)	[1]6.0	8.4	9.5	8.8	8.3	8.5	8.7	7.4	9.3	8.1	7.8	8.1	8.6	9.4	9.1	7.9	8.5	9.0	9.4	8.9	7.8	9.5	8.6	8.2	7.0
pH (standard units)	[1]6.5–9.0	7.7	8.3	8.5	8.8	8.4	8.2	8.7	9.0	8.6	8.7	8.9	8.4	8.3	7.8	8.5	5.9	7.9	8.1	8.0	8.2	7.6	8.5	8.7	8.1
Specific conductance (µS/cm)	--	192	255	229	260	278	8,660	343	662	394	494	489	205	103	50	166	110	71	93	65	227	81	387	556	456
Major ions, dissolved, and solids, dissolved (mg/L)																									
Bicarbonate	--	122	126	123	126	149	198	178	116	110	109	94	103	56	31	66	3	14	22	28	88	32	232	303	288
Calcium	--	23	31	32	34	38	380	41	41	36	38	38	30	14	5.5	22	9.1	6.9	9.3	6.8	27	8.9	53	53	56
Chloride	[1]250	1.0	3.1	0.8	2.6	0.3	2,300	2.5	95	29	53	52	0.5	0.4	0.4	1.3	1.6	0.3	1.9	1.8	16	1.6	4.7	12	5.4
Fluoride	--	<0.1	0.1	<0.1	0.1	0.2	0.3	<0.1	0.1	0.2	0.2	0.3	<0.1	<0.1	0.3	0.5	0.1	0.2	0.3	0.2	2.1	1.2	0.5	0.4	0.6
Magnesium	--	9.8	12	6.9	13	13	95	19	22	15	17	16	5.5	2.8	1.4	4.7	3.1	2.2	2.6	1.8	5.2	1.8	12	29	14
Potassium	--	0.8	0.9	0.7	1.0	0.7	22	0.9	2.0	1.2	1.6	1.7	0.8	0.7	0.7	0.9	0.8	0.8	0.9	0.8	2.2	1.4	3.8	2.9	1.8
Silica	--	4.0	5.0	6.5	3.8	9.5	13	6.1	6.0	4.5	5.1	4.5	8.4	7.4	13	9.9	16	10	12	11	19	15	25	23	26
Sodium	--	1.0	2.4	5.6	3.1	1.9	1,400	3.7	60	21	37	36	3.7	2.7	3.2	5.1	3.5	2.1	3.5	2.9	9.7	3.7	13	33	27
Sulfate	[1]250	11	20	19	23	25	1,200	33	88	42	59	58	16	6.6	3.2	10	42	21	22	3.3	6.9	4.6	14	32	29
Solids, total	[2]500	113	150	141	158	174	5,710	218	401	229	287	278	128	67	47	98	96	56	63	52	146	62	253	368	299
Nutrients (mg/L)																									
Nitrogen, ammonia, dissolved	--	0.007	0.096	0.008	0.008	0.004	0.016	0.037	0.049	<0.002	0.039	<0.002	0.010	0.011	0.005	<0.002	0.011	0.008	0.015	0.006	0.019	0.012	0.026	0.008	0.005
Nitrogen, nitrite, dissolved	[1]0.05	0.001	0.005	0.001	0.002	0.001	0.001	0.001	0.001	<0.001	0.009	0.002	0.003	0.003	0.001	0.001	0.001	0.001	0.001	0.002	0.004	0.003	0.001	0.001	0.001
Nitrogen, nitrite plus nitrate, dissolved	[1]10 (nitrate)	0.08	0.14	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	0.043	0.069	<0.005	<0.005	<0.005	<0.005	0.057	0.079	0.072	0.077	0.14	0.25	<0.005	<0.005	<0.005
Nitrogen, ammonia plus organic, total	--	0.2	0.3	0.8	0.1	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.3	0.2	0.5	0.2	0.2
Nitrogen, ammonia plus organic, dissolved	--	0.05	0.2	0.3	0.1	0.09	0.1	0.1	0.3	0.1	0.3	0.3	0.1	0.1	0.1	0.2	0.06	0.08	0.08	0.1	0.2	0.1	0.3	0.1	0.2
Phosphorus, total	[3]0.1	<0.004	0.028	0.1	0.007	0.017	0.009	0.012	0.014	0.007	0.069	0.035	0.025	0.009	0.029	0.011	0.009	0.005	0.006	0.012	0.053	0.015	0.079	0.097	0.16
Phosphorus, dissolved	--	<0.004	0.016	0.015	<0.014	0.007	<0.004	<0.004	0.005	<0.004	0.065	0.025	<0.004	<0.004	0.011	0.006	<0.004	<0.004	<0.004	0.004	0.032	0.004	0.009	0.093	0.16
Phosphorus, orthophosphorus, dissolved	[3]0.05	0.001	0.016	0.008	0.001	0.007	0.001	<0.001	0.001	<0.001	0.058	0.021	0.001	0.001	0.009	0.002	0.001	<0.001	0.001	0.002	0.027	0.002	0.007	0.098	0.15
Trace elements[4], dissolved (µg/L)																									
Aluminium	[2]50–200	4	8	4	3	8	1	6	7	2	<1	1	6	7	13	4	535	44	47	17	6	16	5	5	5
Arsenic	[1]50 (total)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	1
Barium	--	43	58	43	55	34	7	111	70	57	43	47	79	17	8	32	28	30	31	14	47	10	131	65	5
Chromium	[1]11	<1	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cobalt	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	5	2	1	<1	<1	<1	<1	<1	<1
Copper	[1]TVS	<1	1	<1	1	<1	1	<1	<1	1	<1	<1	<1	<1	1	<1	25	3	3	<1	<1	<1	<1	<1	1
Iron	[1]300	31	28	46	31	11	<10	10	<10	17	<10	<10	76	140	310	95	380	45	37	210	390	220	<10	<10	<10
Manganese	[1]50	37	15	13	13	16	1	3	5	10	<1	15	22	10	5	15	95	159	75	11	64	30	2	1	9
Molybdenum	--	<1	<1	<1	<1	1	1	<1	2	1	2	2	<1	<1	<1	<1	1	<1	<1	2	<1	2	1	2	2	2
Nickel	[1]TVS	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	9	4	4	<1	<1	<1	1	<1	1
Selenium	[1]10 (total)	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1
Uranium	[5]20 (proposed)	1	3	<1	3	2	<1	2	3	2	2	2	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	4	6	2
Zinc	[1]TVS	4	36	2	4	<1	1	2	2	4	<1	2	<1	<1	1	1	27	49	21	<1	2	1	<1	<1	1
Alpha and Beta Radioactivity (pCi/L)																									
Alpha, gross, dissolved	[5]15	--	4	<3	<3	--	--	<3	7	--	--	7	--	--	--	<3	<3	--	--	<3	--	<3	--	--	--
Beta, gross, dissolved	--	--	<4	<4	<4	--	--	<4	<4	--	--	<4	--	--	--	<4	<4	--	--	<4	--	<4	--	--	--

[1]Water-quality standard that is applicable to most or all of the sites sampled in this study (Colorado Department of Public Health and Environment, 1998a, 1999a, 1999b).
[2]Secondary maximum contaminant level for treated drinking water (U.S. Environmental Protection Agency, 1996).
[3]For total phosphorus, recommended limit for controlling eutrophication in rivers; for orthophosphorus, recommended limit where rivers enter lakes and reservoirs (U.S. Environmental Protection Agency, 1986).
[4]Five of the 18 trace elements analyzed for this study (antimony, beryllium, cadmium, lead, and silver) were not detected in any sample above the laboratory reporting limit of 1 microgram per liter and are not listed in table 2.
[5]Maximum contaminant level for treated drinking water; for alpha radioactivity, does not include emissions from radon and uranium (U.S. Environmental Protection Agency, 1996).

were less than 500 mg/L (fig. 3). Dissolved-solids concentrations less than 200 mg/L were measured at all sites in the Middle Fork and North Fork South Platte River Basins; the Tarryall Creek Basin; and in the South Fork South Platte River upstream from Antero Reservoir (site 5). In addition to Salt Creek, dissolved-solids concentrations greater than 200 mg/L were measured in the South Fork and main-stem South Platte River downstream from Antero Reservoir and the three sites in the Arkansas River Basin.

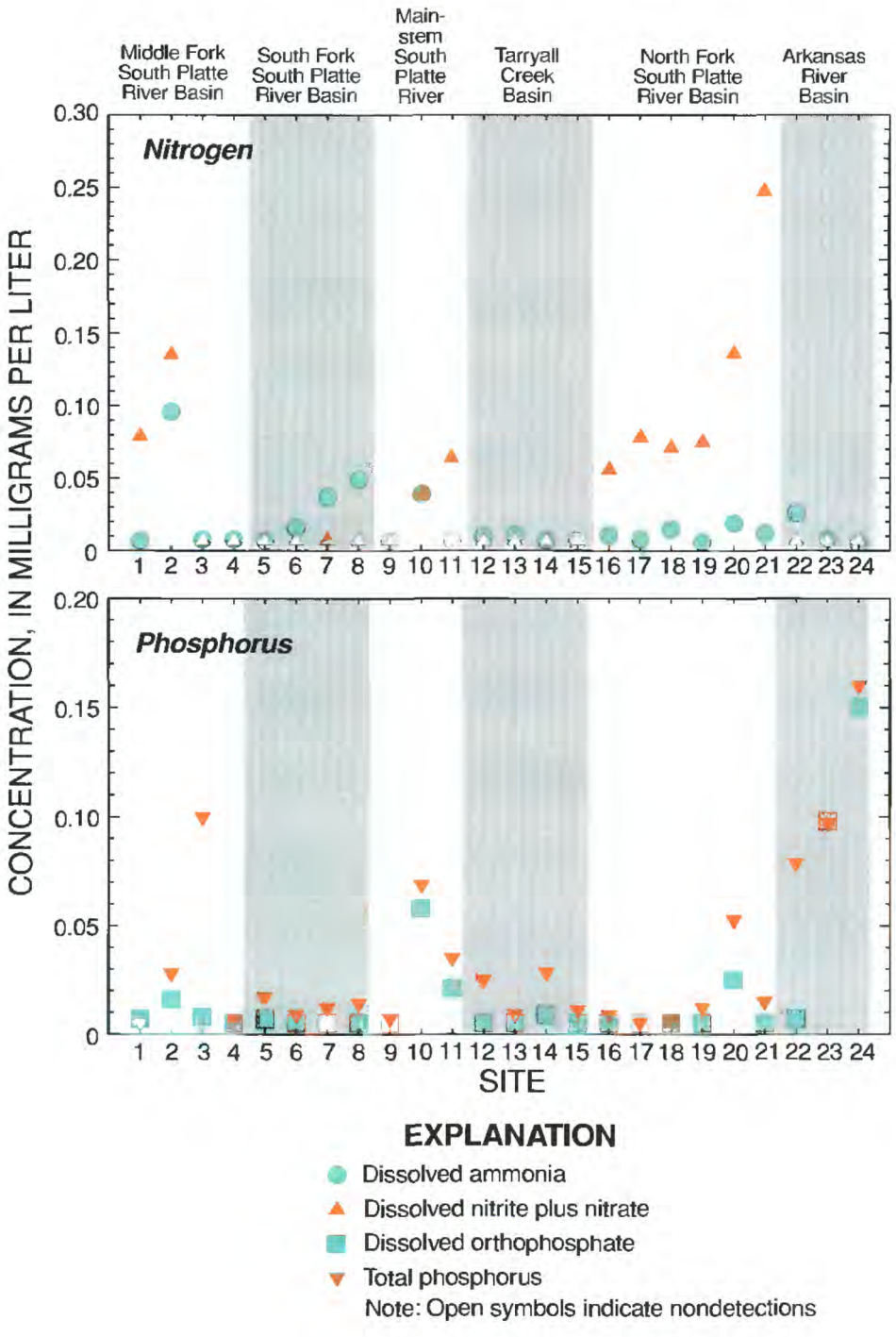

Figure 4. Concentrations of selected nutrient species (alternate white and shading denotes different areas of Park County).

Nutrients

Nitrogen and phosphorus are essential nutrients for plant growth; however, excessive nutrient concentrations in water accelerate the growth of algae and other aquatic plants, which leads to degraded aquatic habitat and higher treatment costs for drinking water. High nitrogen levels in the form of un-ionized ammonia can be toxic to fish and in the form of nitrate in drinking water can be a health concern for humans.

Most ammonia concentrations were less than 0.05 mg/L (fig. 4). Additionally, all concentrations of un-ionized ammonia (not shown), calculated using ammonia concentrations, water temperature, and pH, were less than the CDPHE instream standard of 0.02 mg/L. All nitrite plus nitrate concentrations were at least one order of magnitude less than the CDPHE instream nitrate standard of 10 mg/L. Nitrite plus nitrate was not detected at several sites but was detected at low concentrations in the upper Middle Fork and the main-stem South Platte River downstream from Elevenmile Canyon Reservoir and at all sites in the North Fork South Platte River Basin (fig. 4).

Dissolved orthophosphate, the only form of phosphorus available for use by algae, and total phosphorus typically were present at concentrations less than 0.03 mg/L (fig. 4). Total phosphorus concentrations greater than 0.09 mg/L were measured in Trout Creek in the Middle Fork South Platte River Basin (site 3) and in the Arkansas River Basin in Currant and West Fourmile Creeks (sites 23 and 24). Total phosphorus concentrations in the upper South Platte River are of particular concern because limits on phosphorus loading into Chatfield Reservoir from the upper South Platte River watershed have been set (Colorado Department of Public Health and Environment, 1999c). Total phosphorus concentrations in the South Platte River near the county line were 0.035 mg/L in the main stem downstream from Lake George (site 11) and 0.006 mg/L in the North Fork downstream from Bailey (site 18).

Trace Elements

Trace elements are naturally occurring substances that commonly occur in concentrations less than 1.0 mg/L in natural waters. Five of the 18 trace elements analyzed for this study—antimony, beryllium, cadmium, lead, and silver—were not detected in any sample. Arsenic, chromium, cobalt, nickel, and selenium were detected at fewer than six sites and at dissolved concentrations less than 10 µg/L (micrograms per liter) (table 2). Aluminum, barium, iron, and manganese were some of the more commonly detected trace elements (table 2). All four of these elements are fairly abundant in igneous and sedimentary rocks that are present throughout Park County.

The CDPHE has set instream standards for several trace elements (table 2). Comparing the dissolved concentrations measured in this study to some of the CDPHE criteria is difficult, either because the criteria are for total concentrations determined from unfiltered water (arsenic and selenium) or because the standards are site

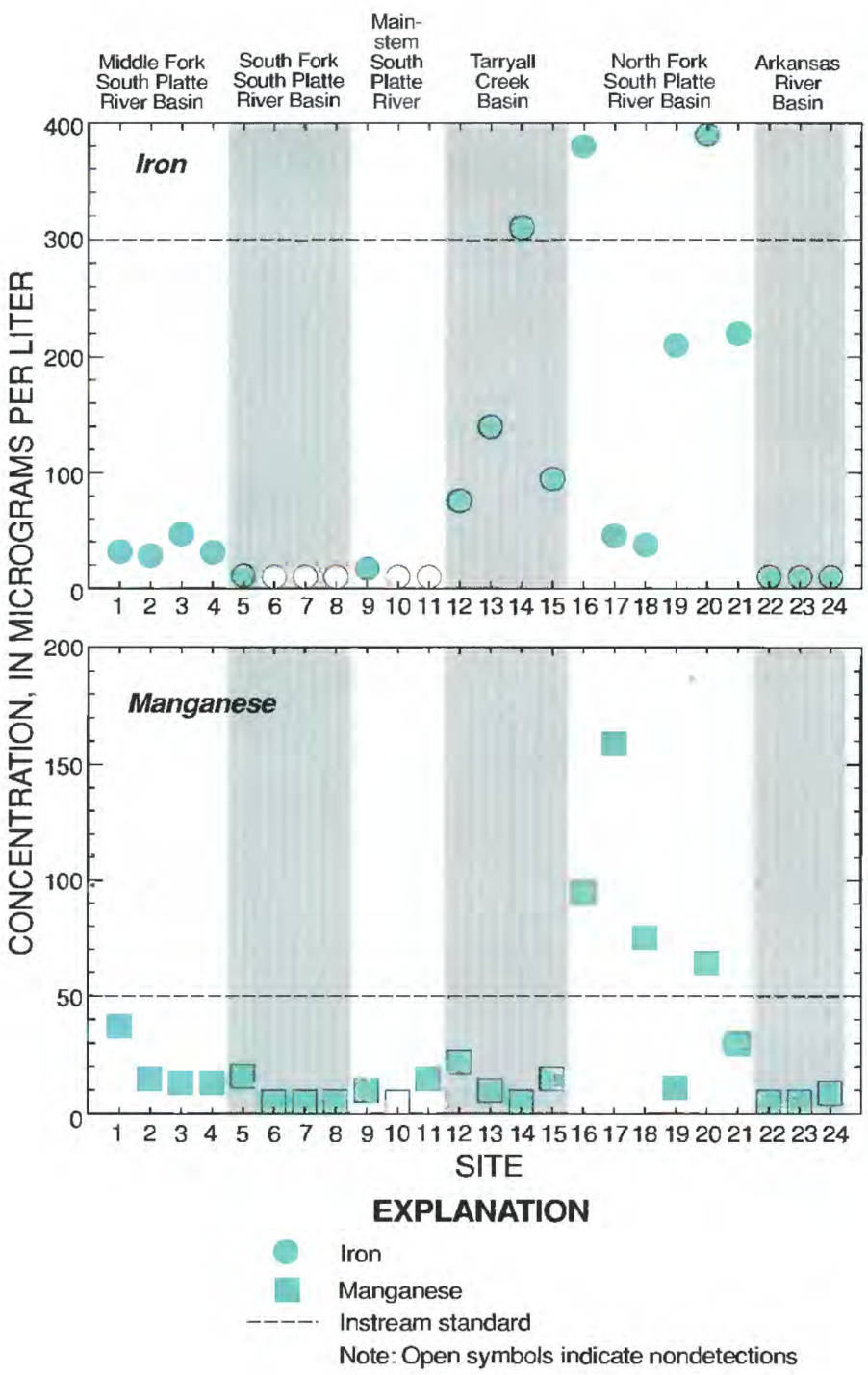

Figure 5. Concentrations of dissolved iron and manganese (alternate white and shading denotes different areas of Park County).

specific "Table Value Standards" (TVS), which require an average hardness value for computing the standard. Chromium, iron, and manganese are the only trace elements having a single dissolved numeric standard that is applicable to most Park County streams. The USEPA has set standards for certain trace elements in treated drinking water (table 2). The drinking-water standards do not apply to streams but do provide a point of reference for comparing the dissolved concentrations measured in this study.

Iron and manganese were the only trace elements measured in concentrations greater than the countywide instream dissolved standards (fig. 5). Iron and manganese concentrations generally were largest in the North Fork South Platte River Basin, and some of the higher concentrations were from the North Fork South Platte River upstream from Geneva Creek (site 16) and in Geneva Creek (site 17). Other trace elements also measured in higher concentrations at these two sites included aluminum, cobalt, copper, nickel,

South Platte River below Elevenmile Canyon Reservoir (site 10)

and zinc. Sections of Geneva Creek and the North Fork South Platte River upstream from Geneva Creek have been identified as being impaired because of elevated trace-element concentrations and are listed on the 1998 303(d) list (Colorado Department of Public Health and Environment, 1998b). The 303(d) list identifies water-quality-impaired stream segments within Colorado and is prepared by the CDPHE, Water Quality Control Division, to fulfill section 303(d) of the Federal Clean Water Act.

Alpha and Beta Radioactivity

Naturally occurring radioactive elements such as uranium, radium, and radon emit alpha or beta radiation as part of the decay process. Determinations of gross alpha or gross beta emissions (activity) are general indicators of radioactive contamination in natural waters and are an alternative to measuring the radioactive emissions from each individual element.

There are no standards for alpha and beta activity in streams in Park County; however, the potential for alpha and beta emissions to cause various kinds of cancers has prompted the USEPA to establish an enforceable limit for gross alpha activity in treated drinking water of 15 picocuries per liter (pCi/L). Gross alpha activity exceeded the laboratory reporting limit of 3 pCi/L at only 3 of 10 sites sampled, and all three values were less than 15 pCi/L (table 2). Gross beta activity was below the laboratory reporting limit of 4 pCi/L at all 10 sites.

SUMMARY

Water-quality samples were collected from 24 stream sites in Park County in September 1999 when streamflow was relatively low compared to other times of the year. All field measurements of water temperature and dissolved oxygen and most measurements of pH were within limits set by the CDPHE. With the exception of one site (Salt Creek) the

dissolved-solids concentrations were less than 500 mg/L. Concentrations of dissolved solids and several major ions were at least one order of magnitude larger in Salt Creek, a saline tributary that flows into Antero Reservoir.

At this time (1999), nutrient concentrations do not appear to be a concern in streams of Park County. All concentrations of un-ionized ammonia were less than the CDPHE instream standard of 0.02 mg/L, and all nitrite plus nitrate concentrations were at least one order of magnitude lower than the instream nitrate standard of 10 mg/L. Orthophosphate and total phosphorus concentrations typically were less than 0.03 mg/L.

Five trace elements—antimony, beryllium, cadmium, lead, and silver—were not detected in any sample, and five others—arsenic, chromium, cobalt, nickel, and selenium—were infrequently detected at relatively low dissolved concentrations. Numeric instream standards applying to most Park County streams exist for dissolved chromium, iron, and manganese. Other instream trace-element standards apply to total concentrations or are site specific. Dissolved iron and manganese concentrations larger than instream standards primarily occurred at sites in the North Fork Basin. In addition to iron and manganese, the dissolved concentrations of aluminum, cobalt, copper, nickel, and zinc were generally highest at one of two sites in the North Fork South Platte River Basin: the North Fork South Platte River upstream from Geneva Creek and Geneva Creek.

Determinations of gross alpha or gross beta activity are general indicators of radioactive contamination in natural waters. Gross alpha activity was detected at 3 of 10 sites sampled, and all three values were less than 15 pCi/L. Gross beta activity was below the laboratory reporting limit at all 10 sites.

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Badger Creek near Park County line (site 22)

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