

# The Upper Colorado River National Water-Quality Assessment Program Surface-Water-Monitoring Network



U.S. Department of the Interior—U.S. Geological Survey

## INTRODUCTION

The U.S. Geological Survey began full implementation of the National Water-Quality Assessment (NAWQA) program in 1991. The long-term goals of the NAWQA program are to (1) describe current water-quality conditions for a large part of the Nation's freshwater streams, rivers, and aquifers; (2) describe how water quality is changing over time; and (3) improve understanding of the primary natural and human factors that affect water-quality conditions (Leahy and others, 1990). To meet these goals, 60 study units representing the Nation's most important river basins and aquifers are being investigated. The program design balances the unique assessment requirements of individual study units with a nationally consistent design structure that incorporates a multiscale, interdisciplinary approach for assessment of surface and ground water.

The Upper Colorado River Basin (UCOL) is one of the 60 NAWQA study units; hydrologic and water-quality assessments of the UCOL began in 1994. The study unit has a drainage area of about 17,800 mi<sup>2</sup>, and the primary river within the basin, the Colorado River, originates in the mountains of central Colorado and flows about 230 mi southwest into Utah. Major tributaries to the Colorado River in the study unit are the Blue, Eagle, Roaring Fork, and Gunnison Rivers. The Colorado River is the major supply of water to the southwestern United States. Streamflow from the study unit accounts for about 40 percent of the streamflow of the Colorado River at Lees Ferry.

The UCOL study unit is divided almost equally into two physiographic provinces—the southern Rocky Mountains in the eastern part and the Colorado Plateau in the western part. The Southern Rocky Mountain province is characterized by north-northwest-trending mountains of crystalline rocks that range in elevation from 11,000 to more than 14,000 ft. The Colorado Plateau province consists of high plateaus of sedimentary rocks with elevations ranging from about 5,500 to 8,500 ft.

Land use, classified as rangeland or forest, accounts for about 85 percent of the basin. The other major land uses in the basin are agriculture, mining, and urban. Surface water used for irrigation accounts for about 97 percent of the total offstream water use. A surface-water-monitoring network for the UCOL study unit was designed considering the critical natural and human factors that affect surface-water quality in the basin.

## WATER-QUALITY ISSUES

The following water-quality issues in the UCOL study unit have been identified as high-priority local-scale issues of concern to State and local water-resource managers.

- Effects of increasing urban development
- Effects of hydrologic modifications
- Effects of metal mining
- Effects of nonpoint- and point-agricultural sources
- Effects of salinity from natural, agricultural, and municipal sources

A national scale synthesis of the results generated by each NAWQA study unit is an integral component of the NAWQA program. The national synthesis allows a comprehensive assessment of specific water-quality issues at a national scale by comparative analysis of individual study-unit findings. National synthesis has identified pesticides, nutrients, and volatile organic contaminants to be the most important national water-quality issues. These local and national issues will partially be addressed by the use of a network of surface-water monitoring stations in the UCOL study unit.

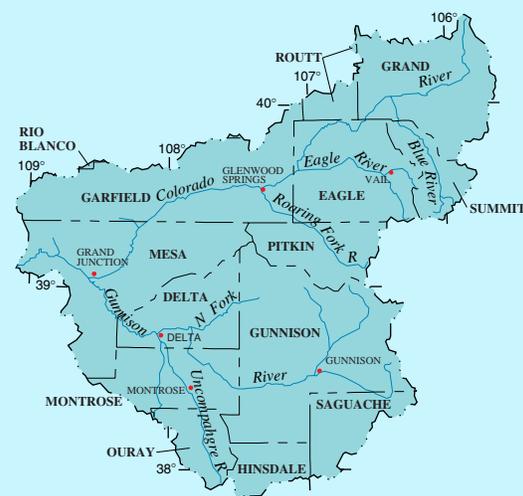
Upper Colorado River Basin Study Unit (shown in red)



National NAWQA Study Units (shown in gray)



Photograph by John Elliott



### EXPLANATION

- County Boundary
- Basin Boundary

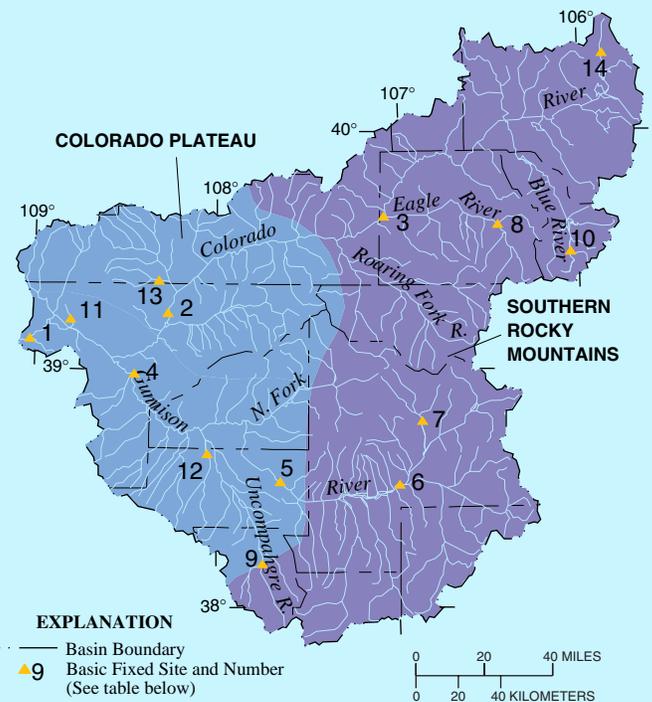


## DESCRIPTION OF BASIC FIXED SITES

The NAWQA program refers to the network of surface-water-quality sampling sites that describe current water-quality conditions as basic fixed sites. Water-quality conditions are measured at the basic fixed sites for a minimum two-year period.

The NAWQA basic-fixed-site network consists of integrator and indicator sites. Integrator basic fixed sites represent large subbasins in the study unit. The water-quality characteristics at these sites are integrators of many land uses and water-quality impacts (example, Gunnison River near Grand Junction).

Indicator basic fixed sites represent selected land uses and water-quality impacts. Indicator sites represent each of the major environmental settings or water-quality issues of a study unit (example, East River below Cement Creek). Special types of indicator sites are reference sites that represent smaller basins minimally impacted by land use. Reference sites are in relatively undisturbed areas and represent background conditions (example, Colorado River below Baker Gulch).



Upper Colorado River study unit basic-fixed-site network

Site name and number on map	U.S. Geological Survey site identifier	Site type	Drainage area (square miles)	Minimum basin elevation (feet)	Maximum basin elevation (feet)
Colorado River near Colorado-Utah State line (1)	09163500	Main-stem integrator	17,843	4,325	14,270
Colorado River near Cameo (2)	09095500	Main-stem integrator	8,050	4,813	14,270
Colorado River at Dotsero (3)	09070500	Main-stem integrator	4,394	6,130	14,270
Gunnison River near Grand Junction (4)	09152500	Main-stem integrator	7,928	4,628	14,265
Gunnison River below Gunnison Tunnel (5)	09128000	Main-stem integrator	3,965	6,526	14,265
Gunnison River at County Road 32 (6)	383103106594200	Main-stem Integrator	2,128	7,570	14,265
East River below Cement Creek (7)	09112200	Indicator	238	8,006	14,265
Gore Creek at mouth near Minturn (8)	09066510	Indicator	102	7,730	13,357
Uncompahgre River near Ridgway (9)	09146200	Indicator	149	6,878	14,150
French Gulch near Breckenridge (10)	09046530	Indicator	11	9,485	13,679
Reed Wash near Mack (11)	09153290	Indicator	16	4,505	4,990
Dry Creek near Begonia Road (12)	09149480	Indicator	175	5,215	9,680
Dry Fork at upper station near DeBeque (13)	09095300	Reference	97	5,385	8,658
Colorado River below Baker Gulch (14)	09010500	Reference	53	8,750	12,940

## BASIC FIXED SITE WATER-QUALITY SAMPLING

At each basic fixed site, monthly and three extreme (low and high flow) water-quality samples are collected each year. Following are the measurements and analyses performed for each sample:

### Field measurements:

Dissolved oxygen, pH, alkalinity, specific conductance, water temperature, and discharge

### Laboratory analyses for concentrations of:

Suspended sediment

Major constituents:

Dissolved solids, calcium, chloride, fluoride, iron, manganese, potassium, silica, sodium, and sulfate

Nutrients:

Total and total dissolved nitrogen, ammonia, nitrite, nitrate, total and total dissolved phosphorus, and orthophosphate

Other:

Dissolved and suspended organic carbon



Photograph by Randy Parker

### Upper Colorado River study unit basic-fixed-site network—continued

Mean daily flow duration statistics <sup>1</sup>			Based on water years	Historic water-quality data	Primary reason for site
10-percent exceedance	50-percent exceedance	90-percent exceedance			
(Cubic feet per second)					
14,400	4,420	2,600	1970–95	Yes	Outlet of the study unit
9,310	2,320	1,530	1970–95	Yes	Main-stem site upstream from the Grand Valley agricultural area
5,000	1,330	810	1970–95	Limited	Main-stem site near physiographic province boundary
4,970	2,120	890	1970–95	Yes	Near mouth of largest tributary in study unit
2,510	1,020	280	1970–95	No	Downstream from major reservoir system. Baseline site for the lower Gunnison River Basin
New gaging station, no historic streamflow information				No	Upstream from major reservoir system. Integrator of the upper Gunnison River Basin
1,080	105	56	1970–72, 80–81, 94–95	Limited	Downstream from area of rapid urbanization
New gaging station, no historic streamflow information				No	Downstream from area of rapid urbanization
454	80	43	1970–95	No	Downstream from area of metal mining
New gaging station, no historic streamflow information				No	Downstream from area of metal mining
89	56	3.8	1970–95	Limited	Downstream from agricultural area
New gaging station, no historic streamflow information				Limited	Downstream from agricultural area
New gaging station, no historic streamflow information				No	Reference site for Colorado Plateau
205	18	6.6	1970–95	No	Reference site for southern Rocky Mountains

<sup>1</sup>Daily average flows that are exceeded 10, 50, and 90 percent of the time.

## SAMPLING-SITE SELECTION CRITERIA

In the NAWQA program, sampling-site selection needs to meet national and local criteria. Because NAWQA is a national program, some sites were selected to meet national goals. Water-quality issues defined by the local resource managers also were considered in site selection to ensure that the study design was not only nationally consistent but locally relevant. Additional factors that contributed to site selection were local interest in water-quality conditions, limitation of resources, and potential for additional research.

The general procedure used to select sites for the basic-fixed-site network is as follows. The potential effects on water quality of the combination of physiography, climate, geology, soils, land use, and water management were analyzed. This analysis was combined with the important national and local water-quality issues to generate a list of potential basic fixed sites. A basinwide reconnaissance of these potential sites was conducted during March 1995. During the reconnaissance, each site was evaluated as to suitability for hydrologic and biologic sampling. Sites that were classified as unsuitable for sampling were excluded from further consideration. Examples of factors that would render a site unsuitable are poorly mixed cross section, poor hydraulics, unsafe conditions, or lack of access.

After the reconnaissance, the potential basic fixed sites were ranked by suitability for sampling and potential to meet local and national program goals. Ancillary items then were included to generate a final priority list from which the basic fixed sites would be selected. If all other items were similarly ranked, higher priority was given to sites with a current gaging station (particularly on the main stem where gaging-station installation is costly), sites where the NAWQA program could be integrated with other water-quality studies, and sites at which active local interest in water-quality concerns were deemed relevant to national objectives. Sites at which other Federal, State, or local agencies were collecting data similar to NAWQA data were given a lower priority in order to expand water-quality sampling throughout the basin. The final list of potential sites was extensively discussed with local water-resource managers and NAWQA national synthesis personnel. The final 14 basic fixed sites then were selected by study unit personnel.

Stream-gaging stations were installed, where required, during September 1995. Water-quality sampling began at all network sites in October 1995 and will continue for a minimum of 2 years.

## SELECTED REFERENCES

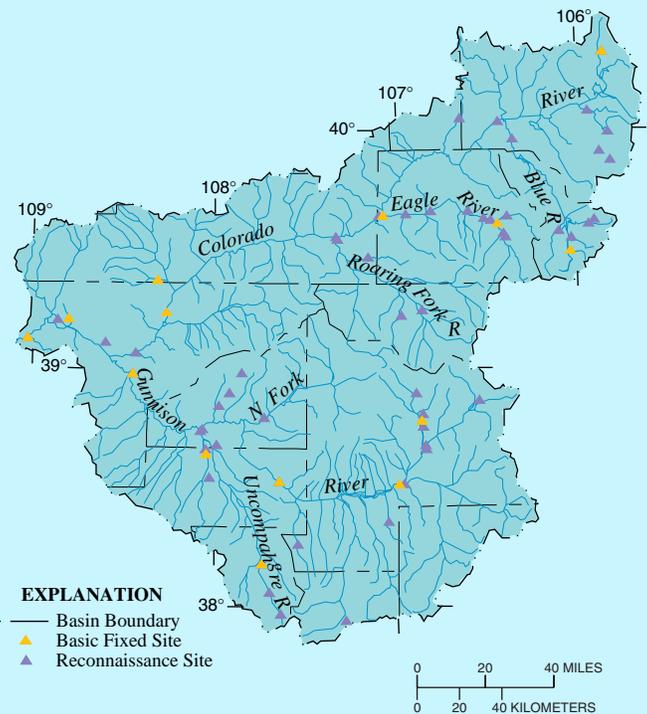
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Information on technical reports and hydrologic data related to the NAWQA program can be obtained from:

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