USGS
science for a changing world

Prepared in cooperation with the LEWIS AND CLARK COUNTY WATER QUALITY PROTECTION DISTRICT and the MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

TENMILE CREEK, MONTANA: WATERSHED OF MANY USES

—By Charles Parrett and Eloise Kendy, U.S. Geological Survey, and Patricia S. Hettinger, Lewis and Clark County Water Quality Protection District

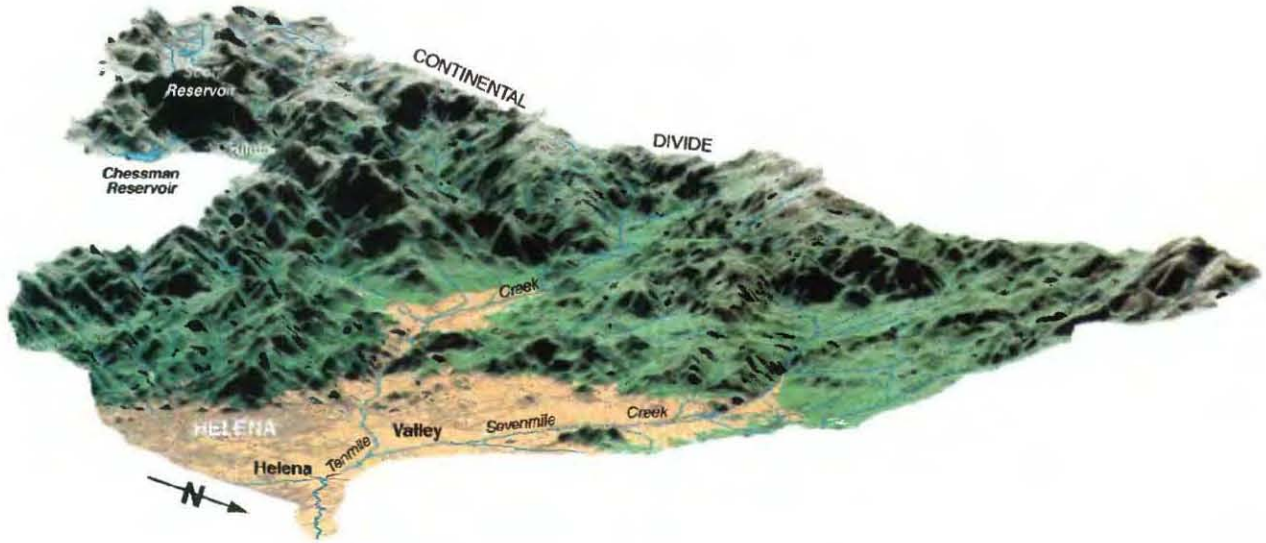
Tenmile Creek drains about 200 square miles of mountainous and valley terrain near the City of Helena, Montana. As part of a collaborative effort to obtain hydrologic information about the watershed, the U.S. Geological Survey (USGS), Lewis and Clark County Water Quality Protection District, the Montana Department of Natural Resources and Conservation, and volunteers collected streamflow data in 1997 and 1998 and water-quality data in 1997 from Tenmile Creek and its major tributaries. This Fact Sheet describes the streamflow and water quality of Tenmile Creek, based primarily on those data.

LAND AND WATER USE

Streamflow and water quality in Tenmile Creek are affected by differing land and water uses throughout its length. Tenmile Creek originates on the eastern side of the Continental Divide and flows about 12 miles through steep, forested mountains before reaching the valley floor near the Tenmile Water Treatment Plant west of Helena. Predominant land uses in the upper part of the Tenmile Creek watershed, upstream from the Tenmile Water Treatment Plant, include recreation, timber harvesting, and scattered residential development. The upper part of the watershed also has a 100-year history of hardrock mining, and numerous inactive mines and waste-rock piles that can affect water quality still exist within the watershed.

The major water use in the upper part of the watershed is for municipal-water supply for the City of Helena. Diversions for municipal supply are located on Tenmile Creek above Rimini and near the mouths of Beaver Creek, Minnehaha Creek, Moose Creek, and Walker Creek. Water from all diversions is carried to the Tenmile Water Treatment Plant in a common buried pipeline. In addition, the City of Helena stores water from several tributaries in Scott and Chessman Reservoirs (in the upper part of the watershed) when streamflow is high. This water is then released during times of high water demand, which typically occurs when natural streamflow is low. Despite the additional water available from reservoir storage, the water

Tenmile Creek Watershed location map.



Three dimensional perspective diagram of the Tenmile Creek Watershed based on U.S. Geological Survey digital data (scale 1:24,000). Vertical exaggeration 2.5.

withdrawn to meet municipal demands commonly dries up the streambed for some distance below each diversion.

Tenmile Creek in the lower part of the watershed, downstream from the Tenmile Water Treatment Plant, flows about 15 miles through relatively flat-lying land used predominantly for rangeland, cropland, and urban and suburban development. The major water use in the lower part of the watershed is for irrigation of hay and grain crops. Irrigation withdrawals from Tenmile Creek in the lower part of the watershed generally deplete streamflow, resulting in dry streambed reaches in some areas, but some water withdrawn for irrigation may return to the stream as irrigation return flow or ground-water seepage.

Downstream from a municipal water diversion (center left), the streambed of Tenmile Creek is dry during most summers.

STREAMFLOW

Streamflow in the upper part of Tenmile Creek and its tributaries is typical of mountain streams in Montana. Flows are greatest in May and June when high-altitude snowmelt combines with spring rains to produce more than two-thirds of the total annual streamflow. Natural flows, which are streamflows unaffected by storage and withdrawals, generally are lowest in the winter months when ground water seeping into the stream channel provides most, if not all, streamflow. Although streamflow in the upper part of the watershed is variable, both seasonally and from year to year, Tenmile Creek and its major tributaries flow year-round above the municipal-water supply diversions. Downstream from each diversion, streams generally go dry during late summer. Inset A on the streamflow map compares estimated long-term natural streamflow conditions at a USGS streamflow-gaging station in the upper part of the watershed with streamflow as it is currently managed. Although the effects of streamflow management are most readily observed in late summer when streambeds downstream from diversions are dry, inset A indicates that the effects of management on the quantity of streamflow are greatest in May and June when some water from snowmelt runoff is stored in Scott and Chessman Reservoirs.

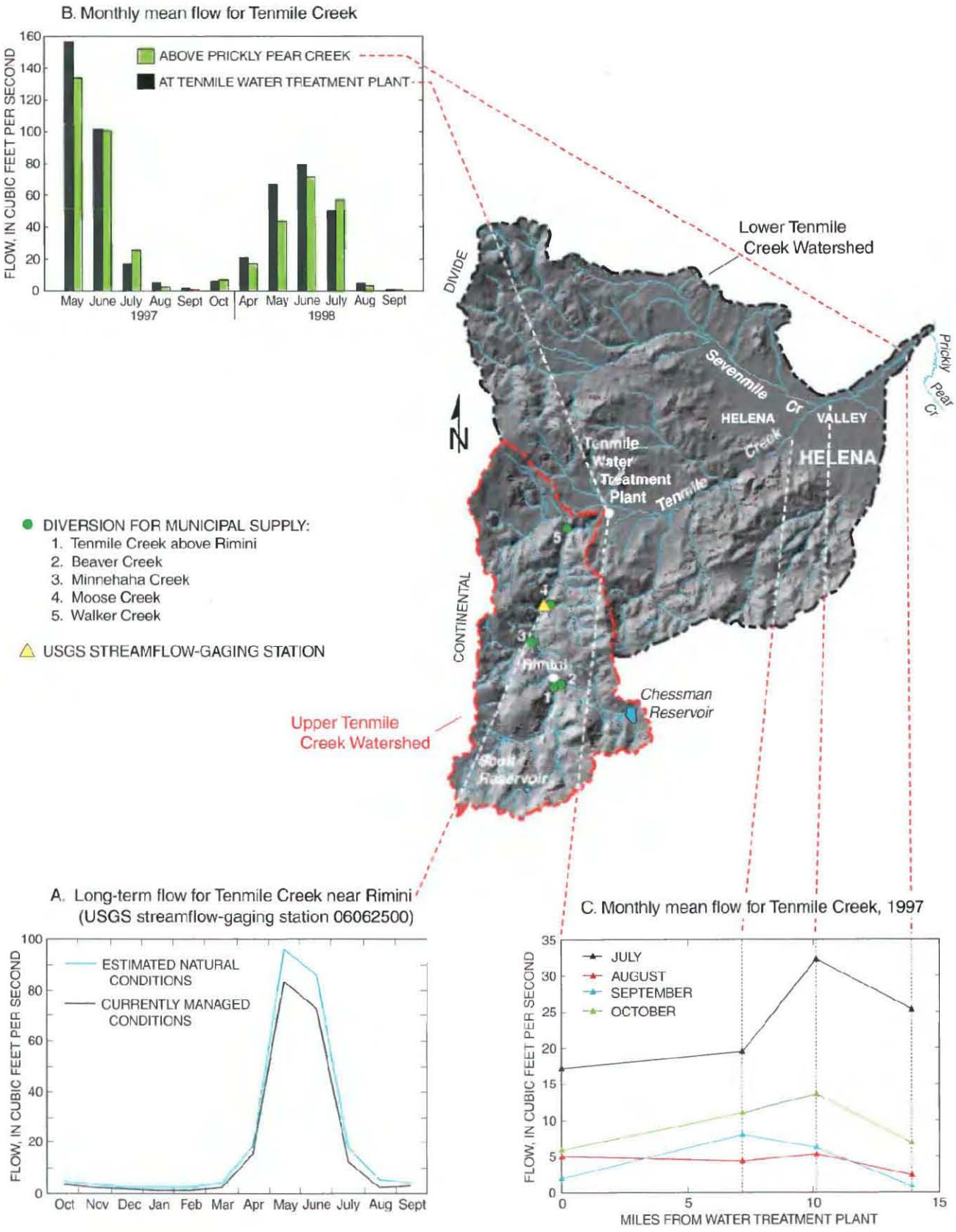
Streamflow in the lower part of Tenmile Creek is more variable than in the upper part of the watershed because of the net effects of sporadic and highly variable tributary flow, several irrigation diversions, irrigation return flows, and channel reaches that naturally lose flow to seepage at certain times of the year. Although the entire Tenmile Creek watershed is more than three times as large as the upper part of the watershed, streamflow at the mouth of Tenmile Creek commonly is less than that at the Tenmile Water Treatment Plant. As shown on inset B on the map, May through October monthly mean streamflow during 1997 was larger at the mouth only for July and October. Thus, except for brief periods of runoff from lower tributaries, notably Sevenmile Creek, the lower part of the watershed contributes little or no additional flow to Tenmile Creek. Streamflow also varies from reach to reach throughout the year (see inset C on the map). Lower Tenmile Creek commonly is dry downstream from the larger irrigation diversions and near the mouth in late summer.

Sampling water quality at a Tenmile Creek tributary.

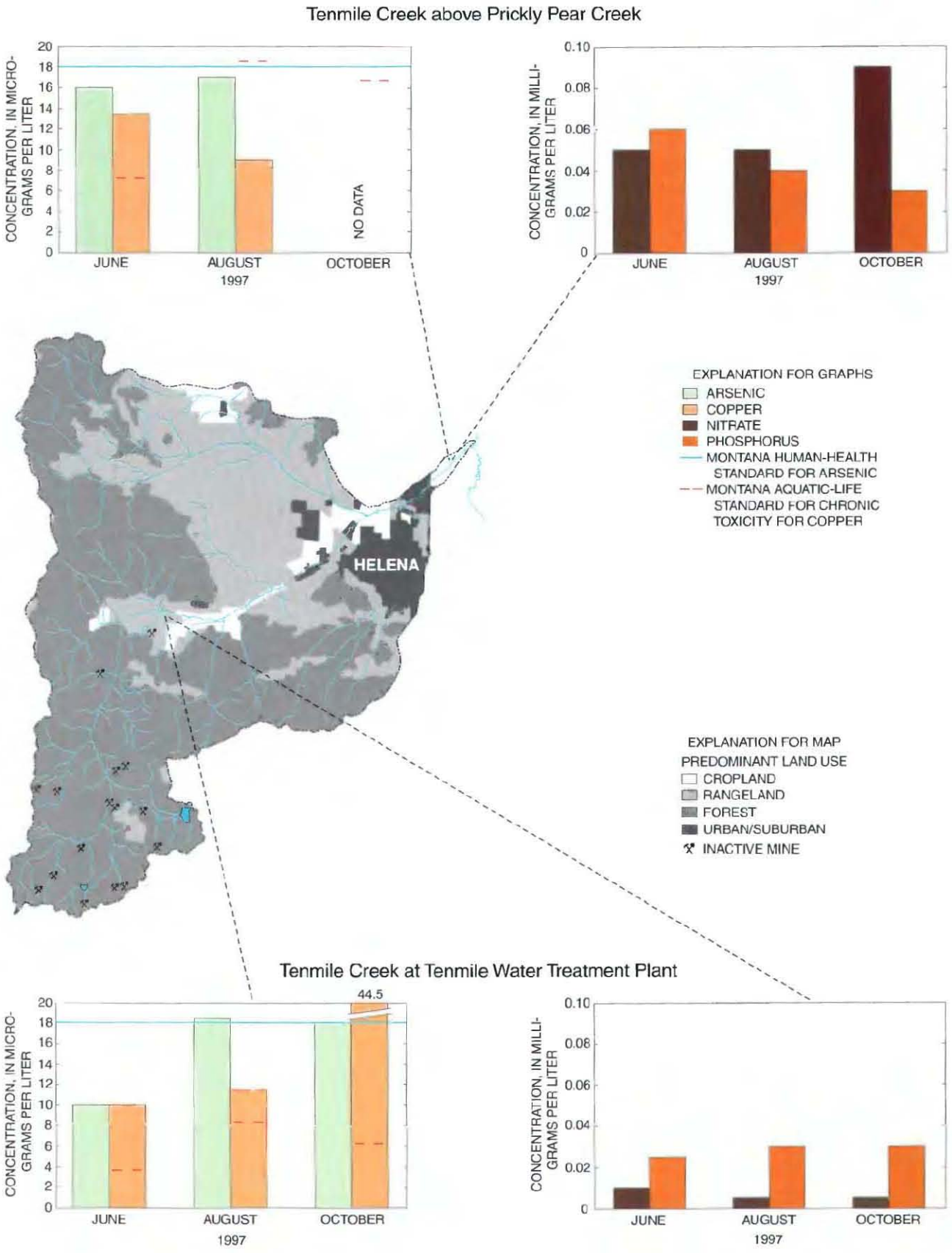
WATER-QUALITY CHARACTERISTICS

The water quality of Tenmile Creek is affected by natural processes as well as by human activity within the watershed. For example, runoff from rainfall and snowmelt can dissolve and suspend natural materials and residues of domestic, agricultural, and commercial activities. Water that percolates beneath the land surface can dissolve minerals from soil and rock before seeping into Tenmile Creek or one of its tributaries. Insets on the land-use map show total-recoverable concentrations of arsenic, copper, nitrate, and phosphorus in stream samples collected in June, August, and October 1997.

Arsenic and copper are trace elements that occur naturally in ore deposits and thus may be expected to occur in streams, such as Tenmile Creek, that drain areas of past mining activity. Excessive amounts of arsenic in drinking water can affect human health; excessive amounts of copper can affect aquatic organisms. Nitrate and phosphorus are essential plant nutrients. However, excessive amounts of these nutrients stimulate the growth of algae and other aquatic plants in streams, and excessive amounts of nitrate can render water unsuitable for drinking. Algal growths impart undesirable tastes and odors to water, interfere

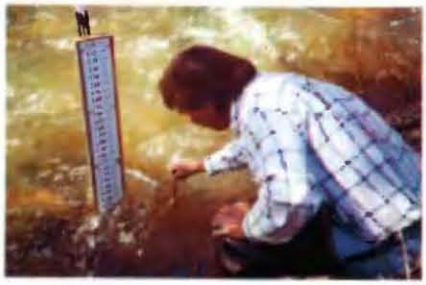


Tenmile Creek Watershed and various streamflow features and locations.



Tenmile Creek Watershed and various land uses and water-quality features and locations.

with water treatment, and contribute to summertime algal blooms. Potential sources of elevated concentrations of nitrate and phosphorus in streams include fertilizers, septic-system effluent, and soil erosion.



Watershed landowner helping collect streamflow data.

Tenmile Creek flowing through the Helena Valley in the lower part of the watershed.

The inset graphs on the land use map show that arsenic and copper were present in all samples from Tenmile Creek at the Tenmile Water Treatment Plant and Tenmile Creek above the mouth. Concentrations of arsenic and copper increased downstream slightly in June and decreased downstream slightly in August. The downstream increases in arsenic and copper concentrations in June and arsenic in October were the result of substantial inputs from Sevenmile Creek in addition to the concentrations originating in the upper part of the watershed. The slight decrease in arsenic and copper concentrations in August reflect the fact that Sevenmile Creek contributed little or no additional arsenic or copper to Tenmile Creek.

The inset graphs for nitrate and phosphorus show downstream increases in concentrations for all sampling dates. The downstream increases probably reflect the increased agricultural and residential land-use effects in the lower part of the watershed.

EFFECTS ON HUMAN HEALTH AND AQUATIC LIFE

State and Federal governments have established water-quality standards that, if exceeded, indicate potential health risks to humans, should they drink the water, or to aquatic organisms, especially fish, that live in the stream. Concentrations of arsenic, cadmium, and lead exceeded the State of Montana human-health standards for drinking water at least occasionally in both upper and lower Tenmile Creek. However, no samples collected from sites above the municipal diversions on Tenmile Creek, Beaver Creek, Moose Creek, Minnehaha Creek, or Walker Creek had trace-element concentrations above the standards for human health. Water from Tenmile Creek below these diversions is not suitable, at least at times, for human consumption without treatment.

The ability of Tenmile Creek to support a viable fishery is limited by the concentrations of trace elements. The State of Montana aquatic-life standards for cadmium, copper, iron, lead, and zinc were exceeded in numerous samples from Tenmile Creek as well as from several of its tributaries. Although no standard for minimum streamflow currently exists, the ability of Tenmile Creek to support a fishery also is severely limited by the lack of water in some reaches during late summer.

PUBLIC PARTICIPATION

Watershed groups are forming all across Montana, inviting people to participate in solving local water-resource problems. The Upper Tenmile Watershed Steering Group was formed in 1996 to address concerns about current streamflow and water-quality conditions in Tenmile Creek. The group needed hydrologic information to make informed decisions to improve and enhance watershed management. Local landowners from the upper part of the Tenmile Creek watershed participated in the collection of streamflow data by taking periodic measurements from staff gages at monitoring sites on Tenmile Creek and its tributaries.

Federal agencies like the USGS have cooperated with watershed groups needing technical assistance. The cooperative partnerships formed for the Tenmile Creek water-resources investigations have pro-

vided needed information and strengthened relationships between landowners and members of the watershed group.

Suggestions for Additional Information

Montana Department of Environmental Quality, 1999, Montana numeric water quality standards: Helena, Mont., Planning, Prevention an Assistance Division, Standards and Economic Analysis Section Circular WQB-7, 41 p.

Parrett, Charles, and Hettinger, P.S., 2000, Streamflow and water-quality characteristics in the upper Tenmile Creek watershed, Lewis and Clark County, west-central Montana: U.S. Geological Survey Water-Resources Investigations Report 00-4129, 71 p.

Parrett, Charles, and Kendy, Eloise, 2001, Streamflow and water quality of the lower Tenmile Creek watershed, Lewis and Clark County, west-central Montana, 1997 and 1998: U.S. Geological Survey Water-Resources Investigations Report 01-4120, 35 p.

This Fact Sheet summarizes information contained in U.S. Geological Survey Water-Resources Investigations Report 00-4129, "Streamflow and water-quality characteristics in the upper Tenmile Creek watershed, Lewis and Clark County, west-central Montana," by Charles Parrett and Patricia S. Hettinger; and U.S. Geological Survey Water-Resources Investigations Report 01-4120, "Streamflow and water quality of the lower Tenmile Creek watershed, Lewis and Clark County, west-central Montana, 1997 and 1998," by Charles Parrett and Eloise Kendy. Copies of these reports can be purchased from U.S. Geological Survey, Branch of Information Services, Box 25286, Denver, CO, 80225-0286, telephone 1-888-ASK-USGS.

For more information, contact:

District Chief
U.S. Geological Survey
3162 Bozeman Avenue
Helena, MT 59601
(406) 457-5900
or
1-888-ASK-USGS

Lewis and Clark County
Water Quality Protection
District
1930 9th Avenue
Helena, MT 59601
(406) 447-1668

Please visit the USGS on the Internet. The Montana District homepage is:

http://montana.usgs.gov/

The National USGS homepage is:

http://www.usgs.gov

To learn more about local watershed groups in Montana:
http://water.montana.edu.