Effect of Mining on Water Quality in the Red River, Taos County, New Mexico

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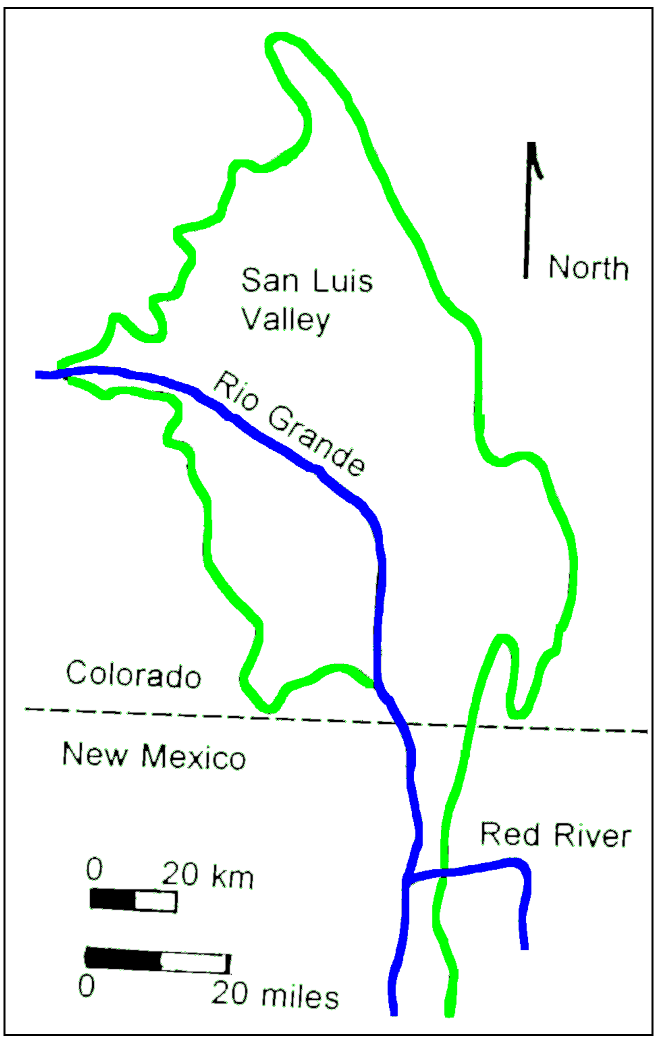
The Red River drains 190 square miles of the Sangre de Cristo Mountains, and empties into the Rio Grande twenty miles south of the Colorado border. The drainage exhibits some of the challenges to water quality in Rocky Mountain streams: naturally high dissolved metals, old abandoned mines whose practices were unregulated, current mines operating under modern environmental controls, and human waste from increasing tourism and population.



AREA GEOLOGY AND NATURAL METALS POLLUTION

The Sangre de Cristo mountains in the Red River drainage have geology similar to other mineral-rich areas in Colorado and northern New Mexico. Precambrian metamorphic rocks (amphibolite, schist, and quartzite) and granite are partly covered and intruded by Oligocene to Miocene intrusive and extrusive rocks, including andesite, quartz latite, quartz monzonite porphyry, and rhyolite. Caldera collapse followed the volcanic activity.

The drainage contains numerous "hydrothermal scars" where intensely altered rock does not support vegetation. Disseminated pyrite and chalcopyrite in the hydrothermally altered areas contribute natural acidic and metal-rich runoff to the drainage. Steep topography and high erosion rates of the hydrothermally altered rocks increase the natural contribution of dissolved and particulate metals, including manganese and aluminum.

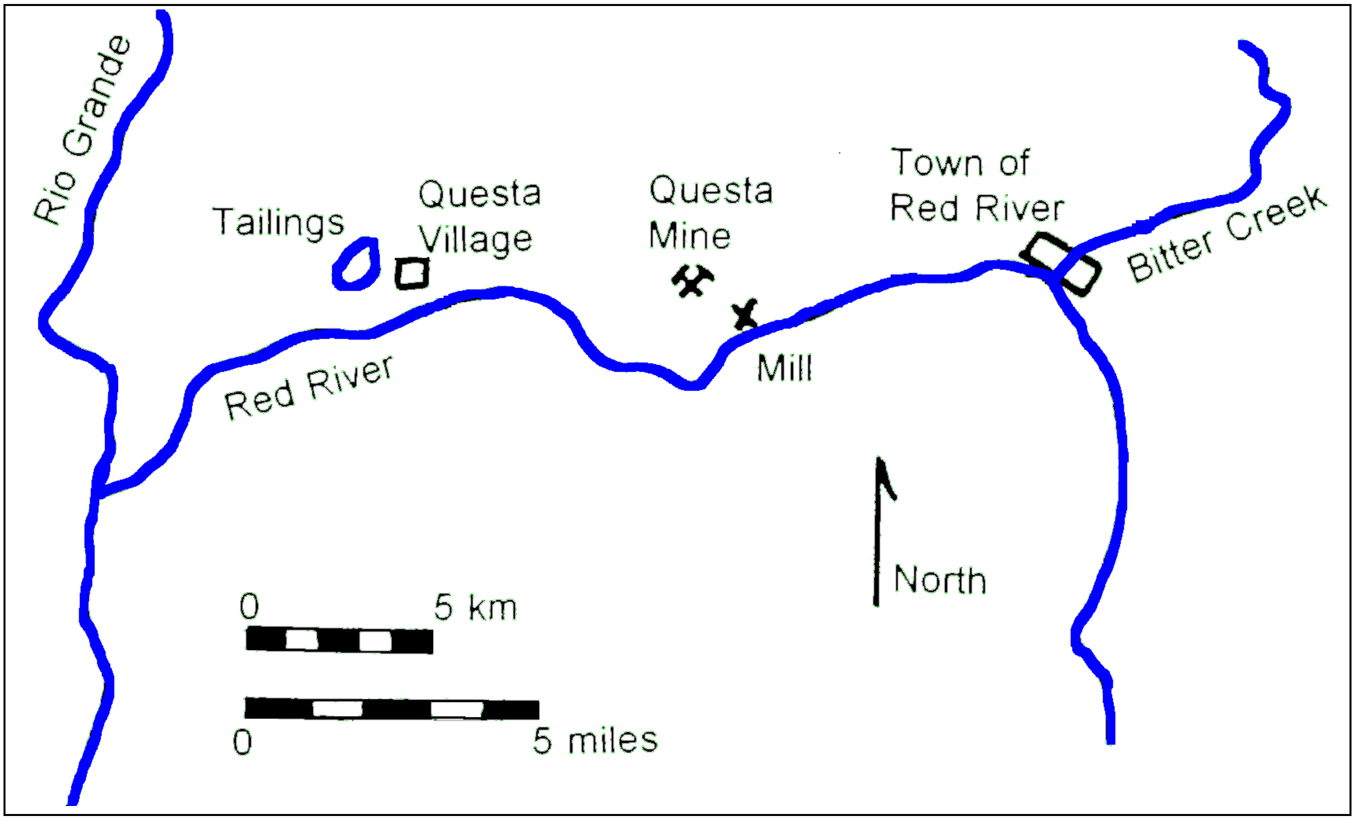
Reed (1922) noted several small streams rich in dissolved copper, and one spring in Alum Gulch whose flow was so high in dissolved copper that some miners tried to commercially recover the copper by directing the flow over scrap iron.

The name Alum Gulch suggests naturally acidic runoff, as does Bitter Creek, which empties into the Red River at the town of Red River. The name game should be played with caution, however, as the Rio Grande canyon west of Questa has Big Arsenic Springs and Little Arsenic Springs, both with good-quality water; the names were the discouraging words of an early settler who didn't want neighbors.

MINING IN THE UPPER RED RIVER DRAINAGE

Although local tradition credits Spaniards with mining along the Red River at an early date, the first documented mining took place in 1867. The most active period was from 1893 to 1904 (Schilling 1960). Prospectors first searched the area for placer gold, then for hard rock sulfide deposits bearing gold, silver, lead, and copper.

At least nine mills on the Red River and its tributaries treated ore by mercury amalgamation or cyanide leaching. A copper smelter operated very briefly at the town of Red



River. Controls on mercury and cyanide releases were often poor in turn-of-the-century mill operations, and tailings were typically discharged directly into the adjacent water course.

Most of the mining and milling was in the Bitter Creek Drainage. Although there are dozens of shafts and adits, some extending hundreds of feet, actual recorded metal production was very small. No mines are currently active in the upper Red River drainage.

ACIDITY AND DISSOLVED METALS ABOVE THE QUESTA MILL

While the effects on water quality of natural degradation and abandoned mines are difficult to separate, intensive studies of water quality between Red River and the Questa molybdenum mill suggest that springs and thunderstorm runoff from hydrothermal scars contribute most of the sulfate and aluminum in that part of the Red River (Smolka and Tague 1989). The river above the Questa mill has elevated levels of dissolved sulfate, manganese, molybdenum and zinc (Garn 1985).

Some tributaries are acidic, but the Red River itself is usually neutral to slightly alkaline. The pH of thirty U.S. Geological Survey water samples collected over time from the Red River slightly above the Questa molybdenum plant varied between 7.2 and 8.4 (Garrabrant 1993). However, thunderstorm runoff in small tributaries can have pH as low as 3.3, which can temporarily lower pH in parts of the Red River (Smolka and Jacobi 1986).

Metals dissolved in acidic tributary flow tend to precipitate in the higher pH of the River. Aluminum hydroxide precipitate, primarily from natural acidic sources, degrades the river habitat between Red River and Questa by cementing the bottom gravel.

QUESTA MOLYBDENUM MINE AND MILL

On the north side of the Red River, downstream from the turn-of-the-century mining and milling activity, Molycorp Inc. operates the Questa mine and mill, historically a major primary molybdenum producer.

The Questa deposit was discovered in 1916. Underground mining began on a small scale in 1919, treating the ore at the June Bug Mill, a former precious metals mill near the town of Red River (Schilling 1960). A mill specifically built to treat the molybdenum ore was erected at the present plant site in 1923, with the tailings placed in small impoundments near the plant. The start of large-scale open pit mining in 1964 created the need for a larger tailings disposal area than could fit in Red River canyon, so Molycorp built an 8-mile pipeline along the river to carry tailings slurry from the mill to tailings impoundments northwest of the village of Questa.

Molycorp stopped working the open pit in August 1981 and renovated the mill to receive ore from a new underground mine on the property. Due to low molybdenum prices, the underground mine did not begin until August 1983, and the updated mill restarted in October 1983. Low molybdenum prices caused the mine and mill to again shut down at the end of February 1986. The operation remained dormant until mining resumed in late 1989. The mine closed once more in January 1992, and remained so until dewatering operations began in 1995 in response to higher molybdenum prices.

By the early 1980s, Molycorp began looking ahead for more tailings areas, and applied for permits to build a new impoundment in a large saddle on Guadalupe mountain northwest of Questa. The federal Bureau of Land Management first approved the plan, then rescinded its approval and required Molycorp to investigate other alternatives. In the meantime, Molycorp is raising the heights of its existing impoundments.

The Questa mill, which discharges through the tailings impoundment downstream from the village of Questa, has historically raised the levels of dissolved molybdenum, sulfate, and cyanide in the Red River below the outfall. The water quality of the mill discharge complies with the limits imposed by the National Pollution Discharge Elimination System (NPDES) permit. Elevated sulfate and aluminum values in the Red River adjacent to the Molycorp mine and mill area have historically been considered to be the result of leaching of hydrothermally altered rock; some dump material is also composed of this altered rock. Over the years numerous breaks and leaks in the tailings slurry pipeline have added short-term turbidity to the river.

Molycorp has acted to minimize the various discharges. In 1983, Molycorp began ion exchange treatment of its tailings decant water to reduce molybdenum before discharge to the Red River. Also in 1983, Molycorp eliminated cyanide from its waste stream by substituting another reagent in the ore flotation process. During its most recent shutdown Molycorp completely rebuilt the tailings-slurry pipeline to eliminate accidental leaks and breaks.

To further reduce natural and mine-related environmental impact to the Red River from the Questa mine area, Molycorp is discussing with the New Mexico Environment Department a plan to intercept seeps and runoff. Under the plan, collected drainage would be used as part of mill process water, then discharged to the tailings areas as alkaline tailings slurry.

As of this writing, the mine has been dewatered and is being prepared for the resumption of mining in July 1996, with the mill scheduled to restart in September.

THE RISE IN RECREATIONAL USE OF THE RED RIVER

The old mining town of Red River is now a ski resort town. Although the permanent population is small, large numbers of tourists pass through in summer and winter. The old sewage treatment system was inadequate for the added burdens, and from 1971 discharged incompletely treated effluent to the Red River, in violation of the NPDES permit. A new advanced sewage treatment plant starting in 1983 met the required discharge limitations. Because phosphate was identified as the limiting algal nutrient in the river, the new treatment plant included steps to reduce phosphate and ammonia to minimize algal growth (Williams Tamburini and Miller 1984).

Other discharges to the Red River come from the waste water lagoon at the village of Questa, and from the state fish hatchery. Smolka and Jacobi (1986) characterized the effects from these as minimal. The area around the town of Red River has numerous vacation homes with individual waste systems.

The Red River is a very popular trout stream. Upstream from the town of Red River, the river supports reproducing populations of cutthroat, brook, and brown trout. For miles downstream from the town and the confluence with the Bitter Creek drainage, trout do not reproduce, but the river is stocked annually with rainbow trout. The river below Questa has a reproducing brown trout population.

The lower four miles of the Red River were given special protection from water quality degradation by the Wild and Scenic Rivers Act of 1968. Although the protected section of the Red River received effluent from the towns of Red River and Questa, the Molycorp mine and mill, numerous abandoned mines, and the state fish hatchery, the water quality was initially described as "exceptional" (Robert Kerr Research Center 1966) and "very good" (U.S. Environmental Protection Agency 1970).

More recent water quality surveys have discovered environmental problems in the Red River. While the water quality is usually good, events such as thunderstorm runoff can cause short-term degradation of water quality, with long-term consequences. The failure of the river to support reproducing trout populations between Red River and Questa has been attributed not to water quality, but to poor habitat caused by cementing of the river bed by precipitated aluminum hydroxide (Smolka and Tague 1987).

Below the village of Questa, no loss of habitat due to aluminum hydroxide precipitate has been noted. The lower stretch of river supports reproducing populations of trout, despite being downstream from Molycorp's tailings decantate discharge.

SUMMARY

The effects of mining on the Red River are difficult to separate from those from natural inflows low in pH and high in metals. For the reach between the towns of Red River and Questa, the inability of the river to support reproducing trout populations appears to be due primarily to natural degradation.

The Questa molybdenum mine continues to be a source of metals in the Red River, though less than in previous years. The reach of river downstream from Molycorp's main discharge point continues to support reproducing trout populations. Molycorp has acted to minimize negative effects on water quality in the Red River by eliminating cyanide use, reducing molybdenum in the tailings effluent, and by replacing the tailings pipeline to preclude accidental breaks and spills. The company is considering measures to further reduce discharges.

Despite environmental concerns, the Red River remains a popular scenic attraction and trout fishing stream.

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