# Best Management Practices Project (Mining): Chalk Creek Project

Conducted by: Colorado Division of Minerals and Geology
On the Web: http://mining.state.co.us/
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Project Partners: U.S. Department of Agriculture – Forest Service; Colorado Division of Wildlife; U.S. Environmental Protection Agency; Chaffee County; Kaess Contracting; University of Colorado; Volunteers for Outdoor Colorado; Coors Brewing Company
Contract Period: 1998-2000
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Matching Funds: $212,000

Chalk Creek and its tributaries drain the eastern slopes of the Collegiate Range in central Colorado, joining the Arkansas River near Buena Vista. The creek has seen elevated levels of heavy metals, particularly during spring runoff, a legacy of extensive hard-rock mining in the area from the late 1870s to the 1950s.

The Colorado Division of Wildlife first identified the heavy metals problem in 1986 after a fish kill at the Chalk Cliffs Fish Rearing Unit located in the lower reaches of the creek.

Water sampling identified zinc and cadmium levels in excess of state water quality standards. The effect was a reduction in the numbers of brown trout and the elimination of young fish for 12 miles below the mining district. Metal concentrations peaked in the vicinity of the Mary Murphy and Iron Chest Mines' tailings piles, approximately one mile above the town of St. Elmo. It was suspected that the interaction between mine drainage, creek flows and the tailings were contributing most of the metals to the stream.

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The Mary Murphy Mine developed steeply dipping gold/silver deposits and lead/zinc sulfide fissure vein deposits through extensive underground workings on 14 levels in the Tertiary-aged (Cenozoic era) Mount Princeton quartz-monzonite.

An NPS project in 1991 consolidated five tailings piles to an area just below the Mary Murphy Mine ruins. The material was then stabilized and vegetated. The drainage from the mine works was routed around the consolidated tailings into a constructed wetland.

Subsequent biotic sampling by the Colorado Division of Wildlife in 1994 and 1997 showed an improvement in Chalk Creek, shortening the recovery zone from 12 miles to four miles. Overall fish population had increased, as had their species and age diversity. However, zinc loads still exceeded state water quality standards.

The Colorado Division of Minerals and Geology (CDMG) completed hydrologic characterization of the Mary Murphy Mine in 1997, demonstrating that most of the water flow coming from the adit portals (horizontal entrances to the mine), was ground water intercepted at discrete fault/fracture structures within the mine works.

Coupling the hydrologic data with inspections of the Golf Adit workings and historical mining records, an underground source control plan was developed and funded in 1998, in part by an NPS grant.

This plan, a pilot effort, was designed to demonstrate the feasibility of a source control approach. The idea was to identify where ground water was interacting with mineralized rock and alter the plumbing of the mine to reduce the contamination.

The effort focused on the two lowest level adits – the Golf Adit (10,400 foot elevation) and the Main Adit (11,200 foot elevation) – that discharged 222 gallons of water per minute at peak flow and contributed 66.2 pounds per day of zinc to Chalk Creek.

Measurements of flow and metals concentration showed that 85 percent of the metals contamination exiting the Main Adit was

coming from one inflow (only 1.5 percent of the total water discharging from the adit) from the north drift of the Mary Vein. This same high concentration source accounted for 70 percent of the zinc discharging from the Golf Adit.

The contaminated inflow was traced back to an ore chute on a high-sulfide stope (an excavation in the form of steps made by the mining of ore from steeply inclined or vertical veins) on the north vein, which drained 15 gallons per minute.

Flow measurements taken within the mine showed that clean ground water inflows intercepted by the workings downstream from the contaminated stope inflow accounted for 70 percent of the total mine discharge. This proved it was possible to segregate the clean ground water inflows from the mine discharge, reducing the total discharge requiring treatment, from 220 gallons per minute to 20 gallons per minute, during peak flow periods.

CDMG chose to work with only the Main Adit level for its demonstration of an underground diversion to control metals loading. A temporary, underground earthen dam was built by hand to divert the high-concentration flow. Subsequent sampling showed that this diversion reduced dissolved zinc in the Main Adit from 5,000 mg/l to 250 mg/l, eliminating the need for a treatment alternative at the Main Adit.

This project demonstrated alternatives for addressing acid mine drainage. If clean inflows can be segregated, the volume of contaminated water is greatly reduced, and the scale of treating the remaining waste is greatly reduced. It appears to be technically feasible to isolate underground sources of pollution to such an extent that it might be possible to eliminate 80 percent of the pollution source within a mine rather than having to continually treat the discharge.