MINE DRAINAGE DISCHARGE QUALITY AND HYDROLOGY OF AN ABANDONED HARD-ROCK MINING WATERSHED[1]

Robert W. Nairn and Niki J. Iverson[2]

Abstract. Abandoned mine drainage water quality and discharge hydrology were examined in the Beaver Creek watershed, a 17 km^2-drainage basin located within the Tar Creek Superfund Site of northeastern Oklahoma. From approximately 1902-1970, the watershed was the site of extensive underground lead and zinc mining. Mine drainage discharges currently emanate from abandoned boreholes, air vents, shafts and other seepage points. Mine drainage water quality (pH, conductivity, dissolved oxygen, total alkalinity, turbidity, temperature, Fe, Zn, Pb, Cd, As, Ca, Mg, Na, Mn, SO_4^{-2}, and Cl^-) and discharge rates were determined monthly for a full year. Of the 20 mine drainage discharges identified as part of this study, 11 sites flowed at various times from February 2002 through January 2003. Measurable discharge rates ranged from 2 to >1500 L/minute. All mine drainage discharges were characterized as net alkaline (by 91-208 mg/L as $CaCO_3$) with variously elevated concentrations of iron (<1-32 mg/L), zinc (1.1-7.4 mg/L), lead (0.004-5.1 mg/L), cadmium (0.005-0.015 mg/L) and arsenic (0.005-0.019 mg/L). Overall, although contaminant concentrations for most discharges were relatively modest, metal concentrations did exceed appropriate requirements for maintenance of aquatic communities. In addition to mine drainage discharges, in-stream seeps contributed to contaminant loading. Based on a tiered evaluation approach, a single discharge was prioritized and recommended for treatment. However, the wide spatial and temporal variability of mine drainage discharge rates indicated a need for more comprehensive and thorough hydrological analyses. Mine drainage discharge rates responded to both seasonal changes in the regional water balance and to single storm events, demonstrating a possible direct link between the mine pool and surface waters. Although passive treatment of specific discharges appears to be both reasonable and desirable from a stream health perspective, the closing of open surface connections to the mine pool may eliminate or decrease impacts from mine drainage discharges.

Additional Key Words: water quality, watershed restoration, stream ecology

---

[1]Paper was presented at the 2004 National Meeting of the American Society of Mining and Reclamation and The 25th West Virginia Surface Mine Drainage Task Force, April 18-24, 2004. Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

[2]Robert W. Nairn is Associate Professor, University of Oklahoma, School of Civil Engineering and Environmental Science, Norman, OK 73019 and Niki J. Iverson is Executive Assistant to the General Manager, Sunrise Water Authority, Portland, OR 97236.