Photo: Yellow Dog Watershed Preserve

Acid Mine Drainage:
A Threat To Michigan's Water Quality

Acid mine drainage is one of the primary ways in which metallic sulfide mining causes water pollution. Not only does acidic water kill native trout and aquatic wildlife, but it also acts as a magnet for heavy metals, like arsenic, mercury, and lead. Exposure to these substances can be toxic to wildlife and people.

Of the estimated 500,000 abandoned mines in the western United States, some dating back to the late 19th century, many continue to pollute today.[1] According to the U.S. Environmental Protection Agency, stream reaches in the headwaters of more than 40 percent of western watersheds are contaminated by mining, much of it related to acid mine drainage.[2] And acid mine drainage is still seeping from mines in Europe that were worked by Romans prior to A.D. 476.[3] Even modern mines pose a threat. For example, a proposed new gold mine project in Nevada, the Phoenix Mine, could produce acid mine drainage for as long as 10,000 years.[4]

What Is Acid Mine Drainage?

When mining occurs in rock formations that contain sulfides, one of the nearly inevitable byproducts is acid mine drainage. As sulfide-bearing ores are unearthed and crushed to extract copper, nickel, gold, silver, or other valuable minerals and metals locked inside, sulfides are exposed to oxygen and water. This triggers a chemical reaction that produces sulfuric acid, which can drain into nearby rivers, lakes, streams, and groundwater.[5] This process can occur at open pit mines, underground mines, and in waste rock and tailings piles, wherever oxygen, water, and sulfides are present.[6] If acidophilic bacteria, which thrive in highly acidic environments, are also present, the process can be significantly accelerated.[7] The same chemical reaction occurs naturally as weathering exposes sulfide rocks to wind and rain, but mining can trigger it on a much larger scale and in places where it is not naturally occurring.

Acid mine drainage in Sudbury, Ontario.

A Danger to Wildlife

Acid mine drainage can harm both wildlife and people. Fish, plants, and insects are unlikely to survive in acidic streams.[8] Acid mine drainage can be 20 to 300 times more acidic than acid rain and can burn human skin and kill fish and aquatic organisms.[9] Some of the most acidic water ever recorded was in the Richmond Mine in California, where the water was more acidic than battery acid.[10]

Tebo creek polluted by acid mine drainage in Missouri.

Acid mine drainage is problematic because it also increases the amount of toxic metals and minerals, such as cadmium, zinc, lead, arsenic, selenium, and mercury, in waterways. When acidic waters pass through waste rock and tailings that contain heavy metals, these substances leach out and dissolve in runoff. In dissolved form, they are more readily absorbed by plants and animals, which store them in fatty tissues. In this way, heavy metals can "bio-accumulate" or move up and increase at higher levels of the food chain.[11] While many of these metals are not harmful in trace amounts, in higher concentrations they can be toxic. Wildlife generally has even lower tolerance levels than humans.[12]

Acid Mine Drainage in Michigan

Although much of the mining in Michigan's Upper Peninsula has occurred in oxide ore bodies, which do not produce acid mine drainage, there are notable exceptions. Ongoing acid mine drainage from the Buck Mine in Iron County is polluting parts of the Iron River watershed, according to the Michigan Department of Environmental Quality.[13] Beginning in 1973, acid mine drainage from the Dober Mine Complex, an underground and open pit iron mining operation also in Iron County, killed all the aquatic life in a seven-mile stretch of the Iron River immediately downstream from the site and damaged a ten-mile stretch of the Brule River.[14] Today, the Dober mines continue to produce acid mine drainage requiring ongoing water treatment.[15]

Mitigating the Impacts of Acid Mine Drainage

The only way to avert the devastating impacts caused by acid mine drainage is to prevent it from starting. Once acid mine drainage begins, the process can be difficult and expensive to slow and impossible to stop until the chemical reaction has run its course. Alkaline or basic materials in soil, such as limestone and other carbonates, can help neutralize runoff.[16] But water treatment must be continued, often for decades, to be of lasting effect. Installing lining systems underneath waste rock and tailings piles containing sulfides and covering them to prevent exposure to oxygen also can help. But whatever the treatment, decades of vigilant monitoring and maintenance are required to have even modest success in limiting damage from acid mine drainage.

Acid mine drainage in Sudbury, Ontario.

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