RELICS UPON THE LAND

The once bustling mining community of Hilliards , Butler County, in 19--
(Photo courtesy of Dr. Dean DeNicola)

The years of mining with unsophisticated technology and no environmental regulations have left the land and water of Pennsylvania scarred with relics from a bygone era. It may be difficult to imagine that abandoned mine sites and virtual ghost towns were once bustling communities that housed hundreds of families whose husbands, children, and fathers were employed by the town's sole source of income, the coal mine. Sadly, the most visible evidence that remains of this era are the over 250,000 acres of abandoned mine lands, coal refuse piles and old mine shafts spanning 45 of Pennsylvania's 67 counties. What was once the source of economic development and a way of life for thousands of people is now producing a disastrous effect on our environment.

Pennsylvania currently has approximately 7,800 old, abandoned, or inactive underground mines that are contributing to one of the most severe environmental problems in the country. This legacy now provides a unique challenge to the citizens of the Commonwealth to restore our ecosystem and to preserve our rich cultural history.

Acid Mine Drainage

The degradation of thousands of miles of freshwater streams is the most significant impact of the hundreds of abandoned mine sites in Pennsylvania.

Acid mine drainage (AMD) is the result of materials, normally found buried deep underground, becoming exposed to water and oxygen. ***Pyrite***, or Fool's Gold, is the material primarily responsible for the formation of acid mine drainage. Pyrite is a mineral containing iron and

Severely eroded coal refuse piles
(Photo courtesy of US Dept. of the Interior, Office of Surface Mining Reclamation and Enforcement)

sulfur that is often found in or near coal seams. Oxygen and water react with the pyrite creating a mild form of ***sulfuric acid***, with similar acidity to vinegar. This acidic solution is capable of dissolving many of the minerals and metals it may come in contact with. The resulting mine drainage can contain not only iron but also other metals such as aluminum and manganese. This combination of acid and metals can have a disastrous effect on a stream habitat. Acid mine drainage is often easily recognized by reddish-orange staining of rocks, discolored water, and the absence of vegetation; however, in many cases the water can appear clear and clean.

Several standard mining methods of the 1800's and early 1900's that had greatly improved efficiency and safety are now contributing to much of Pennsylvania's AMD problems. Approximately 4,600 miles of Pennsylvania's freshwater streams have been impacted by acid mine drainage flowing from abandoned deep and surface mines.

Abandoned mine drainage *(Photo courtesy of Stream Restoration Incorporated)*

Location, Location, Location

To be profitable, early coal mines needed an efficient means to transport the coal from the mine to the consumer. Most coal was moved by train. Trains, however, need a fairly flat surface to operate. Stream valleys provided this flat surface, thus, many early mine entrances were located beside a stream. While this made for easy transportation of coal it now provides for easy transportation of AMD into the stream.

Historically, streams were valued for transportation and as a source of power. Mills, such as the remains of this saw mill at the Jennings Environmental Education Center, were a common site along Pennsylvania's many waterways.
(Photo courtesy of Jennings Environmental Education Center)

Underground Mining

Physical evidence of past underground mining may often remain on the surface. These clues can often reveal the history and location of a once working mine. These sites are rich in history and problems.

Coal Refuse Piles

Coal refuse piles are mounds of soil, rock, coal and coal-like materials located where coal is prepared for market, often near the mine entrance. These materials are not marketable and need to be removed from the rest of the coal after leaving the mine. This is accomplished by separating the coal from the waste. Historically, young boys did this by hand. Since these materials come from deep within the mine they often contain the mineral pyrite and are a source of AMD. There are approximately 2.6 billion cubic yards (approximately 62 million tractor-trailer loads) of coal ***refuse piles*** dotting the landscape of Pennsylvania. A convoy of trucks twice encircling the globe would be needed to remove Pennsylvania's coal refuse piles. Many of these piles are in or near streams, thus contributing greatly to the state's coal mine drainage problem.

Entries

Today, entries to abandoned underground mines may appear as nothing more than a hole in the ground, but when the mine was operating they were a miners only link to the surface. Holes found around an abandoned mine site may either have been a means to enter the mine or a method of ventilation for the mine. Long after the mine has shut down, entries will continue to circulate oxygen within the mine. This constant supply of air provides the perfect environment for the formation of acid mine drainage. Abandoned mine entries also pose a safety hazard.

Taking Advantage of Gravity

Miners in early underground mines were faced with a problem to which most of us can relate. Dig a hole and chances are it will fill with water. Having a mine fill with water was both uncomfortable and dangerous to the early coal miner. To solve this dilemma miners used the cheap and plentiful force of gravity. Rather than dig down to the coal seam, mine entrances were often located at the lowest point of the coal bed where it was exposed at the surface. This allowed water to drain out of the mine rather than collect where the miners must work. This inexpensive and efficient method of draining the mine was so effective it continues to work years after the mine has closed. Many abandoned mines have miles of underground "tunnels" that act as reservoirs to brew AMD. The result is a steady stream of damaging mine drainage flowing from hundreds of abandoned drift mines throughout Pennsylvania. Improved mining technology, such as pumps and ventilation systems, make this method of keeping the mine safe and relatively dry obsolete. Today, every part of a mine must be located below the level of the entry, thus inhibiting the discharge of mine drainage from the entry.

Acid drainage continuously flows from this abandoned underground mine in northern Butler County. (Photo courtesy of Stream Restoration Incorporated)

60,000 cubic yards of coal refuse lie within a tributary near the community of Goff Station in northern Butler County. This pile has since been removed due to ongoing reclamation efforts occurring throughout Pennsylvania.
(Photo courtesy of Stream Restoration Incorporated)

Subsidence depressions may cause extensive property damage.
(Photo courtesy of US Dept. of the Interior, Office of Surface Mining Reclamation and Enforcement)

Often these entries are hidden by vegetation and go unnoticed until someone falls or a curious child decides to explore.

Subsidence Depressions

Subsidence depressions, which look like sink holes, occur when the surface of the ground sinks due to significant excavation beneath the surface. Due to erosion over time, the roof of an underground mine may no longer be able to support the weight of the overlying rocks and will collapse. Areas susceptible to subsidence depressions may look stable for many years. Structures may be built in these areas, later to be severely damaged when the ground sinks. Subsidence depressions tend to collect water. This water often drains into the abandoned mine, contributing to the formation of acid mine drainage. These mine-related depressions can be dangerous. Vegetation often conceals the depression increasing the chance of an unexpected fall and injury.

Surface Mines

Abandoned surface mines are also contributing to the state's mine drainage problems. Evidence of abandoned surface mining operations are commonly seen in Pennsylvania and pose serious safety concerns.

Highwalls

During surface mining, a hillside is often removed to reveal the underlying coal. This vertical open cut is similar to cuts frequently seen along roadsides where a hillside has been removed to make room for the road. If the mine ceases to operate, the cut that remains is called the ***final face*** of the mine and is often referred to as a ***highwall***. Highwalls are extremely steep and can be dangerously high. Erosion, slumping and rockslides are commonly associated with highwalls. Today, surface mine operators are required to restore the surface of the earth to its original shape, called approximate original contour. Hillsides must be repaired so that no highwall remains.

A relatively small, yet dangerous, highwall and open pit, abandoned after a surface mining operation
(Photo courtesy of DEP, Knox District Mining Office)

Spoil Piles

Overburden removed during surface mine operations was placed in a pile near the newly exposed ***pit***. These piles can become quite expansive depending on the size of the operation. These huge piles of earth contain minerals, such as pyrite, that can produce acid mine drainage when exposed to oxygen and water. Often the materials found closest to the coal seam contain these acid producing minerals. Similar to digging a hole with a shovel, the material to last be removed from the hole is placed on top of the pile and in direct contact with the air and water. Abandoned spoil piles produce a significant amount of acid mine drainage. In addition, vegetation rarely grows on these piles so wind and rain easily erode them. This erosion causes sedimentation and increased turbidity in streams, which can choke fish and hurt vegetation.

Today surface mine operators are required to return all spoil to the pit. Usually acid producing materials are identified before mining and handled separately during the mining process. These materials are then returned to the pit "high and dry". This simply means the material is buried deep enough under ground to avoid contact with oxygen, but not placed on the pit floor where it may come in contact with ground water. Often lime or ***limestone*** is mixed and buried with the spoil to neutralize the acidic material.

Very little vegetation will grow on spoil piles, encouraging erosion and the weathering of acid bearing materials. (Photo courtesy of Jennings Environmental Education Center)

Abandoned mining equipment, like this stripping shovel, are a widespread reminder of busier times. (Photo courtesy of Stream Restoration Inc.)

Open Pits

Open pits are the holes from which coal was removed during a surface mining operation. These holes often collect large amounts of water and are commonly seen as deep ponds spanning several acres. Bordered by dangerous highwalls and large spoil piles, open pits are extremely dangerous. These pits can be attractive swimming holes to those unaware of the many hidden dangers. Several unfortunate individuals are badly injured or killed in these pits each year.

Surface mine operators are no longer permitted to leave the pit exposed. All disturbed ground must be returned to the pre-mining shape (approximate original contour) and vegetation replaced.

The estimated cost to reclaim the land and water in Pennsylvania affected by these past mining practices is $15 billion. No single organization or agency can possibly afford to tackle this immense challenge. Only through the partnership of concerned citizens, agencies, and industries will Pennsylvania's landscape be repaired.