Table of Contents

3.0 Longwall Mining Techniques and Historical Operations

3.1 General Description

Coal mining in Southwestern Pennsylvania began around 1800 and during its first 150 years, was an unregulated industry. Until the time of World War I, coal mining was conducted almost exclusively underground and largely by manual labor. These underground mining operations gained access to coal seams by vertical mine shafts of up to 200 feet deep, by horizontal mine entries (drift entries) cut into hillsides at the coal elevation, or by sloping tunnels angling downward from the ground surface. Early underground mines were small, discontinuous, and poorly mapped. To maximize coal production, roof support was usually minimal. Furthermore, coal pillars were often removed upon abandonment of the mines, making them highly prone to later subsidence.

With the advent of large, efficient excavating equipment, new drilling techniques, and newly developed explosives in the mining industry around World War II large earthmoving operations became possible. Surface mining operations became an economic alternative to underground mining. In surface mining, all of the rock and soil (overburden) above the desired coal seam is excavated, exposing the coal seam at the surface. The excavated rock and soil, known as "mine spoil," is placed in piles away from the excavation site. The exposed coal is removed in a way that includes as little non-coal rock as possible.

There are two basic types of deep mining, room-and-pillar, and longwall. Most underground mines in the United States use the room-and-pillar method of mining. A series of rooms are cut into the coal bed and pillars of coal are left for roof support. Wooden timbers and roof bolts are used as additional supports. As room-and-pillar mining advances, a gridlike pattern is formed. Typically, rooms are 20 to 30 feet wide and up to 400 feet long. Pillars are 20 to 30 feet wide and 90 feet long. In this style of mining, generally 50 to 70 percent of the coal is recovered and the remainder is left as roof support.

The mining technique used below the study area is the longwall mining technique. The coal is mined from one long face--the longwall. Longwall mining involves extracting coal in large blocks called “panels” using a mechanized shearer. The area to be mined can be up to 15,000 feet long and 1,100 feet wide. Multiple panels comprise a single mining operation. A machine with a revolving cylinder studded with tungsten carbide bits moves back and forth across the working face, shearing off chunks of coal, while water is sprayed on the coal to minimize the amount of coal dust generated. The coal falls onto a conveyor system or is loaded onto underground rail or shuttle cars and carried to the surface. In longwall mining, moveable steel supports (shields) hold up the roof over the immediate working area. As the

mining machine moves forward, steel roof supports advance with the machine, allowing the roof in the mined-out area behind the supports to collapse in a controlled and predictable manner. Nearly 80 percent of the coal can be removed using this method.

By necessity, surface land is disturbed in the process of longwall mining coal. Strata above the mine level are altered as the mine roof caves behind the shields (hydraulic supports), creating zones where blocks of rock fill the mine void, or fracture or deform as rock layers warp downward. These alterations in overburden characteristics potentially induce large strains in the overlying strata that in turn may result in a strongly heterogeneous and anisotropic hydraulic conductivity field. This strain-dependent conductivity field is of special importance in evaluating the potential impact of longwall mining on groundwater and surface water resources.

3.2 Study Area

Extraction of the Pittsburgh Coal beneath the study area was accomplished using longwall mining techniques between 1995 and 1999. Initial development of the mine included sinking a sloped shaft from the surface to the coal seam and constructing a main gallery horizontal to the access shaft. During the developmental phase of the mine, gate entries were driven perpendicular to the gallery forming panels of coal. Generally, the gates are approximately 260 to 270 feet wide and panels of coal for extraction are 900 to 1,000 feet across and approximately 8,500 feet long. Mining height was between 5 and 7.5 feet.

The gallery and gate entries are formed using room-and-pillar techniques in order to support the access ways during mining activities. The width and length of panels is a function of surface structures, subsurface conditions, proximity of oil/gas wells, and coal quality. Continuous mining removes approximately 30 to 50 percent of the coal in the gallery and gate sections of the mine. Longwall mining results in 100 percent extraction in the panel areas of the mine. In general, the 16-foot wide gate entries are designed to be relatively temporary, constructed solely to access the longwall panels. Two to three rows of pillars would be left intact between the mined-out longwall panels. These pillars account for the characteristic swale pattern left on the surface.

Sheet 3 presents the location of the gallery, gates and panels for the Enlow Fork Mine within the study area. The sheet also presents the date that mining was completed in each panel.