NO LONGER MINE

Improving vegetation establishment practices for surface mine reclamation in the Appalachian Coal Basin

By Brian Free

The Appalachian Coal Basin encompasses multiple mountain ranges, several major river gorges and numerous state and national parks. The striking geography of the region draws visitors from across the country and around the world. The area also is home to one of the most important coal-producing regions in the country and one of the largest on the globe. Appalachian coal has been mined for the past three generations and now is most commonly used for electrical power generation. Coal mining is economically vital to many rural communities across the basin and is a cornerstone of domestic energy supply.

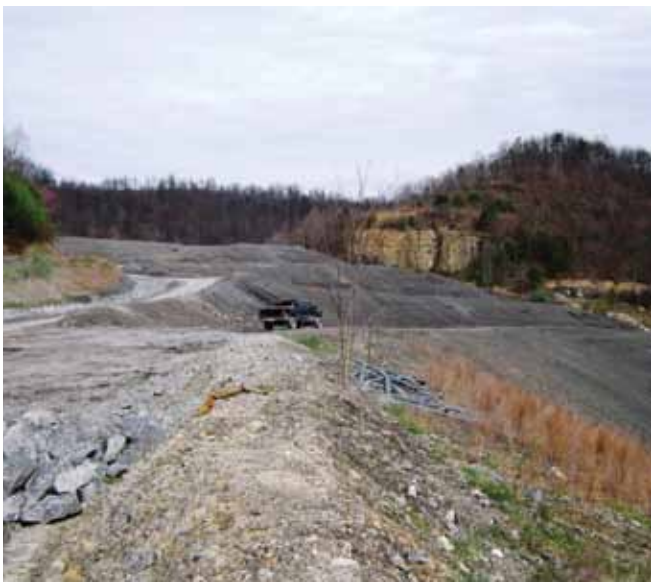
The U.S. Environmental Protection Agency has authority over mining operations through the Clean Water Act, which identifies mining operations as potential point sources for pollutants and regulates these sites under the National Pollutant Discharge Elimination System (NPDES) permit.

In 2009, Massey Coal Services, a major coal producer in the Appalachian Basin, partnered with Madison, Ga.-based Pennington Seed to develop more efficient reclamation techniques for rehabilitating surface mines on the Grey Eagle processing site in Mingo County, W.Va. The primary goal was to improve vegetation establishment with initial seeding applications to meet permit requirements and avoid the compounded costs associated with failed vegetation. The cost of seeding materials was quite small in comparison with the total reclamation cost, which included earthmoving and hydroseeding equipment, mobilization, fuel, maintenance and plenty of labor.

A collaborative approach between Massey's environmental managers and Pennington's agronomic team was utilized, and a more efficient reclamation model emerged. Mine site operators coordinated soil tests and analyses with Pennington prior to seeding to allow for site-specific reclamation plans that addressed soil fertility, pH, erodibility factors, seed selection and erosion control measures. This increased the establishment success rate of permanent vegetation that complemented post-reclamation land uses.

Foundation for Growth

Soil testing is critical on mine sites to help ensure the establishment of permanent vegetation. Depending on the geological profile from which material is mined, the surface soils can vary greatly in composition. Soil organic matter (OM), nutrient availability and pH can range widely, even if they are within a close proximity on the surface. Acidic conditions also can



Left: The slopes went through a process of shaping and preparation before seeding. Right: The seed was hydraulically applied along the slopes and vegetation was quickly established.

arise in post-mining operations due to acid mine drainage and the presence of certain elements.

Because the seed bed was largely composed of crushed bedrock and shale, the majority of the sites tested showed extremely low levels of OM. Ideally, a minimum of 4% OM should be present to sustain vegetation. Mycorrhiza soil fungi, beneficial bacteria and multiple biostimulants—the building blocks of healthy soils—were applied to the prepared slopes at the time of seeding to address OM deficiencies.

Most soil analyses indicated acidic pH levels with differing inherent nutrient values. Large amounts of lime were required to raise the pH to an ideal range of 6 to 6.5, where soil nutrients become plant-available. Customized fertility plans also increased reclamation efficiency. This process showed that there could be considerable cost savings to standardized fertilizer applications and also decreased the potential for water quality impairment by eliminating excess fertilizer.

Seeding Method

Due to the steep terrain of the basin and large tracks of land that needed to be reclaimed, hydraulic seeding, or hydroseeding, was the preferred seeding method. Hydroseeding offered a distinct advantage over other seeding methods because the ingredients in the tank mix recipe could be easily adjusted based on soil test results and site requirements. This allowed for the implementation of site-specific revegetation plans that could accurately and efficiently address all major obstacles to vegetation establishment at the time of seeding.

The Right Seed

Much of the seed Massey had previously used was not labeled and provided inconsistent results. Third-party seed laboratory tests determined that inexpensive annual grains, such as wheat or rye, dominated the mixes, while perennial specialty legumes, such as birdsfoot trefoil or yellow blossom clover, were lacking under permit requirements. Vegetation establishment efforts were greatly enhanced by selecting seed mixes with attached guaranteed analysis tags that complemented permit requirements.

Expanding the Model

Overburden materials, which are bi-product waste materials of coal processing often used to reclaim high walls and fill valley impoundments, proved another challenge. A common practice for reclamation of these areas was to apply a minimum soil layer as a "cap" prior to seeding. Massey was convinced by Pennington's previous success with direct-seeding fly ash (a byproduct of coal fired power plants) and opted to direct seed the overburden areas, eliminating a soil layer on top of the overburden material. This method resulted in significant time and cost savings.

As part of the analysis, there were two similarities between the overburden material and fly ash: low pH and percentage of OM. The overburden

material also had a dark surface color that readily absorbed thermal radiation, making the surface at least 20°F hotter than surrounding soils in the summer. To sustain vegetation, the acidic pH levels were raised with pulverized limestone and fast-acting dry lime. Nutrient deficiencies were resolved with the reintroduction of highly concentrated bio-stimulates, beneficial soil microbes and fertilizer.

When the Grey Eagle site decided to apply this approach, the project team selected a cool-season Slopemaster seed mixture specifically designed for erosion control applications. The seed mixture was treated with GermMax germination aid to increase seedling vigor during germination and establishment, as well as Myco Advantage mycorrhizal inoculants to increase nutrient and water absorption and help mitigate drought stress and salt stress. The seed was hydraulically applied along with soil amendments and 3,000 lb per acre of a high-performance flexible growth medium that effectively stabilized the site from erosion while also acting as a sunscreen over the dark material to reduce temperatures and evaporation rates.

Because the initial seeding occurred in March 2011, there has been positive feedback from Massey. At the one-year mark, the site's enviromental manager, Gary Hatfield, said, "[The site] went from a nearly 40-acre impoundment that had been idle for 12-plus years with minimal vegetation to a heavily vegetated site. We followed Pennington Seed recommendations on seeding materials and direct seeding applications and converted the site from exposed refuse to a lush green facility, greatly exceeding our expectations."

Lessons Learned

This collaborative effort addressed the traditional challenges of vegetation establishment on rehabilitated surface mines, as well as seeding applications on coal refuse and overburden areas. The site-specific reclamation model provided improved BMPs for soil stabilization and erosion control. Starting with a soil test, corrective actions could be taken to mitigate soil conditions at the time of seeding to create the right foundation for long-term sustainable growth.

By utilizing a comprehensive approach that encompassed soil science, agronomy and improved soil stabilization techniques, Massey substantially increased initial vegetation establishment success rates across its sites. This did not go without notice when Alpha Natural Resources purchased Massey Energy in June 2011. Alpha continues to utilize Pennington in the evaluation of their reclamation best management practices. SWS

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