

PENDLETON CREEK STRIP AML PROJECT

Thomas, Tucker County, WV

■ **Submitted by:**

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■ **Project start date:** July 27, 2010

■ **Project complete date:** June 9, 2011

■ **Construction cost:** \$763,450.00

■ **Responsible agency for reclamation:**

West Virginia Department of Environmental Protection
Office of Abandoned Mine Lands and Reclamation

■ **Contractor:** Eastern Arrow Corp.

■ **Design engineer:** Hatch Mott MacDonald

■ **Submitted on:** April 9, 2012

Introduction

The Pendleton Creek Strip AML project involved perennial surface drainage entering abandoned underground mine workings through vertical openings in the streambed, where the flows reversed direction and amplified an existing large drainage in the city of Thomas, West Virginia. In addition, there were 200 linear feet of highwall and three dangerous impoundments that required backfilling.

The Pendleton Creek Strip project utilized impervious sealing of the stream capture areas and construction of restored and relocated stream channels to convey the surface drainage along its original pre-mining path.



Highwall and dangerous impoundment.



Regrading work.

Background/Site Description

The Bakerstown coal seam was deep mined by the Davis Coal and Coke Coal Co. in the 1930s. This was a drift mine along the North Fork of the Blackwater River in the city of Thomas. The Davis Coal and Coke No. 23 main portal was one of the lowest elevation points in the Bakerstown cropline, which created a gravity discharge into the river. The surface elevations rise to the north beyond Thomas, and the coal seam goes beneath the North Fork River drainage in this direction. Much of the Bakerstown seam was mined in this area, with the exception being support pillars and the coal beneath the river drainage, which would have been left in place to prevent the river from potentially inundating the mine. The dip of the Bakerstown seam is to the northwest, with the portal in Thomas being along the coal cropline to the southwest. All of the flow through these mine workings on the northern end has no outlet, as the seam is below drainage. This creates a large area of workings which hold a mine pool that builds and flows back beneath Thomas, where it discharges at the low point in the cropline.

Just before World War II, the Bailey Coal Co. began a surface mine operation to remove the Bakerstown outcrop coal. The town of Thomas is on the western slope of the mountain and this surface mine was about one mile east of Thomas in a different drainage area on the eastern side. The surface drainage there flows to Pendleton Creek, which was received by the main Blackwater River in the canyon below the town of Davis, West Virginia. This surface

mine was a drag-line operation, which moved the overburden into long ridges of mine spoil to the east of the coal outcrop on this side. This pre-law surface mine removed all of the outcrop coal to the east, and encountered much of the underground workings to the west. It obliterated the easterly flowing creek channels, and by encountering the underground mines, intentionally allowed the surface streams above the mining to flow into the old underground workings as a method of drainage control. Not only were the stream channels removed, but the spoil ridges to the east prevented the easterly flowing streams from reaching the undisturbed drainage channels of Pendleton Creek beyond them.

Reclamation

Pendleton Creek is a pristine, Tier III stream which flows southward for less than two miles before entering Pendleton Lake in Blackwater Falls State Park. Blackwater Falls is one of the most popular of West Virginia's 34 state parks, with Pendleton Lake being one of its many attractions. This lake is used for recreation by thousands of visitors each summer, and much of the land between the project's construction limits and the lake is U.S Fish and Wildlife designated wetlands. While no Army Corps of Engineers permit was required due to the lack of existing stream channel and the project being outside these wetlands, the WVDEP elected to use "Natural Stream Channel" design protocols to restore drainage paths. Two channels were designed using coconut fiber (coir) blocks, logs and fabric to stabilize the channel sides. Although natural channel designs have been previously included in West Virginia Abandoned Mine Lands' projects, this was probably the most technical and labor-intensive channel design to date. The design engineer used a portion

of Club Run, in nearby Canaan Valley State Park, for a reference reach. All natural materials, consisting of 20,000 pounds of coconut fiber and wooden logs, stakes and wedges, were used to construct Type E channels with vertical sides, point bars, pools and riffles. Because the original surface flows were entering the underground mine workings, a geosynthetic bentonite liner was used on a compacted subgrade to prevent loss of drainage beneath these channels. Due to the types of materials being used and the sinuosity of these channels, some type of flexible forming was required to meet alignment needs. After trying flexible curbing forms, the contractor elected to build



Backfilling anchor trenches for liner.



Constructing flexible forms.

custom forms using wood, steel and building foam to better meet their needs. These forms had to be built in place, utilized for the section of stream being worked on, then partially dismantled and rebuilt downstream to match the next section of channel to be constructed. In addition to the large amount of hand labor required, the numerous bends necessitated some smaller equipment for material placement and compaction.



Installing coir logs for point bars on inside bends.

Throughout the construction process, the existing drainage had to be controlled to bypass the work areas. The large spoil ridges left below the site were regraded to provide the relatively level topography for this type of drainage area and sediment control was important to protect the wetlands areas immediately beyond the construction limits. An old mine haulroad existed through the wetlands between the project and Pendleton Creek. There were only two culverts beneath more than 3,000 linear feet of road fill adjacent to the project. These culverts allowed the connection of the wetlands on either side of this road. Because construction of these new stream channels would increase the flows toward Pendleton Creek, it was necessary to increase the carrying capacity of drainage through the road fill. Two culverts were added in the location below the smaller channel and three culverts were added in the location of the larger channel. The invert of the new culverts were set slightly higher than the existing culvert inverts in order to protect the wetland balance. During normal flows the wetland water level above the road would not increase significantly. At times of high flows, the extra water would not be impounded by the roadway.



Relocated stream No. 2 in winter after completion.

Reclamation Benefits

Multiple, long-term beneficial impacts to hydrology were derived from capturing the surface water at the project and creating a positive drainage flow:

- Infiltration into the Thomas mine void decreased.
- Freshwater flow to Pendleton Creek and Pendleton Creek Lake increased
- Freshwater flow to downstream wetlands increased.

While the Bakerstown mine workings have many sources of infiltration, including both surface and groundwater, the following flow data shows that during a sampling period between Jan. 24 and March 2 of this year, flows from the Thomas discharge were reduced by an average of 4.5 percent. With flow samples measured between 4.93 and 30.65 cubic feet per second, this is a significant reduction in the flow contributing to degradation of water quality

in the Blackwater River drainage. The columns for the measured discharges on Pendleton Creek indicate water that was flowing in the constructed stream channel that had previously infiltrated into the mine.

Date	Pendleton Creek Site 1 (cfs)	Pendleton Creek Site 3 (cfs)	Thomas discharge (cfs)	Reduction in flow (%)
1/24/2012	0.5574	0.1389	10.0619	6.47
2/3/2012	0.2710	0.0965	8.0391	4.37
2/10/2012	0.1323	0.0096	4.9840	2.77
2/15/2012	0.0844	0.0282	4.9315	2.23
2/22/2012	0.1482	0.0824	6.1039	3.64
3/2/2012	0.6076	0.2773	30.6465	2.81

There is an average of 56 inches of precipitation annually for the drainage area in which the project is located. With a 244-acre drainage area above the Pendleton Creek Strip project, an average of 49,600,320 cubic feet, or more than 370 million gallons of water, falls above the project. After absorption, a very significant amount of water will no longer enter the mine pool but will now be transported across this project to the main stem of Pendleton Creek. Laboratory samples obtained during the month of February analyzed the contribution of aluminum and manganese discharged in the North Fork Blackwater River. The loading of aluminum and manganese was on the order of 20-40 pounds per day. By reducing mine infiltration, metal loads to the river consequently decrease.

The West Virginia Department of Environmental Protection has completed five major drilling and grouting stabilization projects within the city of Thomas. The majority of the town is undermined and many of the homes show evidence of subsidence. After spending approximately \$8 million to protect the health and safety of the town’s residents, reducing the amount of drainage flowing beneath the town lessens the amount of erosion on the remaining coal pillars within the mine. Previous infiltration work was completed on one of the first projects.

Because the design included graded limestone as a substrate for the channel bottoms at the time of construction, the sampling also revealed an increase in surface water quality as drainage flows through this project. This water quality improvement will be a long-term benefit to the Pendleton Creek, Pendleton Lake and the entire Blackwater River drainage with both the pH and alkalinity of the drainage improving due to this reclamation project. The increase in neutralizing potential will help offset other acid sources within the area.

Reforestation

Due to the length of time that had elapsed since the surface mining operation took place, the spoil ridges had reforested naturally. Because disturbing these ridges was necessary to properly backfill the capture areas and regrade the site to provide for positive drainage, 10 acres of reforestation was included in this project. The landowner for this project site is Western Pocahontas Properties. The company maintain a full time forester to manage the thousands of acres of land holdings in West Virginia. This individual is very tree-oriented and partnered with the West Virginia DEP for the inclusion of the Forestry Reclamation Approach in the revegetation of this project. The planting plan incorporated the five steps of the Forestry Reclamation Approach: proper growth medium, non-compacted grading, native and non-competitive ground cover, tree species selection, and planting technique. In order to loosen the top 4 or 5 feet of ground for planting the tree seedlings, a bulldozer dragged a ripper tooth through the regraded areas along the contours of the slopes. This bulldozer was careful to overlap its tracks to avoid re-compacting the loosened material. The ground where the tracks ran may have been further loosened during the following winter by the retention of water and the freeze-thaw cycle.

While the regrading and stream channel construction were completed during a dry fall, tree planting had to be scheduled for the following spring. Tree seedling planting began on March 31 in a light rain. A late snowstorm on April 1 kept the seedlings dormant and moist. Tree species included Red Spruce, White Pine, Red Oak, White Oak, Black Cherry, Tulip Poplar, Red Maple, American Chestnut, Common Serviceberry, Speckled Alder, Quaking Aspen, Mountain Holly and Mountain Ash. A total of 11,400 trees were planted on this project. Additionally, the riparian zones along the restored stream channels



Regrading and liming complete.



Dozer dragging ripper tooth to loosen soil.



Live branch cuttings planted in stream channel riparian zones.

were planted with 22,400 locally harvested live branch cuttings. Local harvesting of the woody plant material for the riparian zones began at the same time as tree seedling planting. The species placed in the riparian zones were Willow, Dogwood, Arrowwood and Aspen. Although the planting techniques and wet weather in 2011 greatly enhanced root development, heavy deer browsing was detrimental to the trees and branch plantings later in the year.

The landowner's forester expressed his satisfaction with the project. He visits this site regularly to check on the progress of the reforestation. The land on which this project is located is leased to the Mountain Top Hunt Club. The members of the club are hunters, fishermen, hikers, cyclists and cross-country skiers who all depend on the forest for their recreation. This reforestation initiative fits in very well with the surrounding communities. The Pendleton Creek Strip project has been selected as the "Excellence in Reforestation" regional award winner for 2011.



Tree planting in April.



White Pine, Red Spruce and mixed hardwoods.

Summary

In summary, the Pendleton Creek Strip AML Project corrected numerous safety hazards with a regrading plan that included eliminating dangerous highwall and dangerous impoundments of surface drainage. The environmental impacts of this project were much more profound. By preventing two tributaries of Pendleton Creek from entering the mine pool, each year millions of gallons of fresh water will be kept from travelling through the



Riparian branch plantings.

underground mine workings and contributing to AMD discharges associated with the Davis Coal & Coke No. 23 mine. In addition, by regrading and providing cover for areas of acidic spoil material, and the introduction of carbonates in the reconstructed stream channel substrates, the quality of the surface water leaving the project is much improved.