Carswell Eroding Refuse
AML Project

Location: Kimball, McDowell County, West Virginia

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Project start date: 1/16/2006

Project complete date: 5/15/2007

Construction cost: $2,542,182

Responsible agency for reclamation:
WV Department of Environmental Protection
Division of Land Restoration
Abandoned Mine Lands and Reclamation
Contractor: Green Mountain Company
Design Engineer: Ackenheil Engineers & Geologists

Date Submitted: 5/12/2008

I. Background

The Carswell Eroding Refuse project is located along Laurel Branch in the small coal mining community of Carswell Hollow, just north of the Town of Kimball, in West Virginia's most southerly county of McDowell. This neighborhood is situated about 4 miles east of the City of Welch, the county seat, along US Route 52, and 12 miles north of Tazewell County, Virginia. The project area drains into Elkhorn Creek, which eventually flows into the Tug Fork River as it meanders its way westward to create the state boundary between Kentucky and West Virginia.

Carswell, like so many other southern West Virginia communities, is inexorably linked to coal mining activities as they progressed throughout the nineteenth and twentieth centuries. During these periods, many of the mining operators constructed company homes adjacent to or even on top of coal refuse areas due to the severe shortage of flat land in the steep hollows, so often found in this part of West Virginia. Gradually, however, problems began to develop that ultimately threatened both properties and lives.

One such problem arose in the Carswell and Kimball communities after repeated flooding events in July 2000 and May 2002. During these events, high stream flows began eroding the toe of a 1940's coal refuse embankment near the mouth of Laurel Branch in Carswell Hollow. As the flooding progressed, two sections of the cut-stone retaining wall collapsed, causing some of the material to spill into the creek channel, thereby impeding its flow. Immediately following the flooding, the West Virginia Division of Highways removed numerous pieces of collapsed cut-stone and enough of the refuse material that had fallen into the creek channel, as well as additional debris that had washed downstream, to temporarily restore its flow.

Photo #1

This photo shows one section of the failing cut stone retaining wall partially blocking stream flow along Laurel Branch. Further collapse of the wall would have blocked stream flow causing nearby homes to be flooded or even destroyed if the refuse embankment itself were to fail.

While residents were appreciative of the immediate help, serious problems remained and were of great concern. Along the east portion of the stream, loose coal refuse still existed and continued to slide into the creek. The 2002 flood had also damaged the upper level roadway shoulder, making the only access to and from several of the homes in the hollow, unsafe. To make matters worse, the damaged cut-stone retaining wall continued to collapse, allowing even more coal refuse to spill into the creek. As a consequence, residents were afraid that, in the event of another serious flood, even more of the refuse embankment would collapse, block the stream, and re-route flood waters onto their property and into their homes. An even more ominous possibility also existed in that the refuse material extended under several of the homes located on the upper portion of the east bank. Should this material become saturated during heavy rains, and the already damaged cut-stone retaining wall collapse even more, the potential existed for mass failure, certainly an event that needed to be avoided.

Coupled with the looming potential for catastrophic property damage along Laurel Branch, located nearby was another abandoned mine lands site, Site #2, which consisted of a 20-acre refuse pile. This pile had steep slopes and the easily erodable material was very unstable. Numerous homes as well as a public road located at the pile's toe were in danger of being flooded or destroyed by a landslide, should one develop. Local residents and abandoned mine lands officials alike were concerned that this site could also cause serious damage to downslope properties should these issues go unresolved.

Photo #2

This photo shows the abandoned, partially vegetated 20 acre refuse area with its highly erodable and unstable outslopes.

II. Project Design

This project involved addressing serious abandoned mine lands problems at two locations. Each of these sites had unique conditions requiring special design considerations and innovative construction techniques.

As noted earlier, Site #1 consisted of a coal refuse disposal area, covering 1.5 acres, with a public road on top of the embankment and a stream along the toe. The vertical slope was approximately 40 feet in length and erosion along the toe coupled with vehicular traffic on top continued to make it very unstable. These field conditions prohibited the traditional approach to reclamation of re-grading and topsoiling, so an alternative design, something new to southern West Virginia abandoned mine lands sites, would be required.

After reviewing their options, project engineers elected to use a high tensile-strength steel wire mesh known as TECCO® mesh, which is made by Geobrugg, a slope stabilization product company located in Romanshorn, Switzerland. Used successfully by other state agencies such as the West Virginia Division of Highways to stabilize vertical rock slopes along roadway cuts, thereby increasing safety for motorists, the TECCO® mesh system seemed ideal for this type of project.

The TECCO® mesh slope stabilization system owes its high strength to a heavy gauge alloyed, high-tensile steel wire that is fastened to the rock and soil at predetermined intervals with large helical screws and heavy spike plates. This approach allows the mesh to closely fit the topography thereby preventing not only future slides but also rocks from breaking out of the grid and falling into the creek or onto a roadway. Installation first involves cleaning, trimming and leveling the slope's surface. Next, holes are drilled at predetermined intervals into the rock or soil so large screws or rock nails can be installed. Lastly, the face is covered by a steel-wire mesh, which is attached to the soil or rock nails by large spike plates and tensioned at the proper torque force to achieve maximum strength and grid tautness.

Site #1 not only consisted of the unstable refuse slope along the creek but also included the old cut-stone retaining wall that failed in two sections during one of the earlier floods. To repair the damage and match the appearance of the existing wall as much as possible, as well as provide the necessary lateral supporting strength, engineers decided to use a modular, interlocking, pre-cased concrete stone block with a natural look and texture. However, because the unconsolidated fill behind the existing wall contained a large amount of rock that might prevent each helical screw from reaching an adequate depth in some areas, a new design was required to meet specifications. After inserting each screw to its greatest depth possible, it was decided that each 12 inch diameter hole would then be filled with non-shrink grout, effectively gluing it to the surrounding matrix.

Field conditions at Site #2 also required special design considerations. Of greatest concern was establishing an adequate toe and subdrainage system for the re-graded 20 acre refuse area. These concerns would be satisfied by the installation of a large rock toe fill to serve as both a supporting buttress that would hold the material in place as well as provide drainage, along with a drainage blanket to collect subsurface water.

A special aspect of this project involved a unique partnership between two separate sections of the West Virginia Department of Environmental Protection's Division of Land Restoration, the Office of Special Reclamation and the Office of Abandoned Mine Lands. Early in the design stage it was learned that Site #1 was not eligible for abandoned mine lands funding because the area had previously been permitted for reprocessing the coal refuse. The reprocessing endeavor ultimately failed, and as a consequence, the bond was forfeited, making the site ineligible for expenditure of abandoned mine lands funds.

Under normal circumstances the Office of Special Reclamation would have been responsible for reclamation within the permitted area, but unable to address the failing retaining wall and clogged stream problem caused by the partially obstructed streambed. Therefore, for more efficient and timely operation, the two offices developed a plan to share the costs involved in both design and reclamation, heralding in a new era of interagency cooperation.

The Office of Abandoned Mine Lands undertook primary responsibility for construction but Special Reclamation remained involved and informed throughout the process. This cooperative approach to reclamation was new to the Department of Environmental Protection, and with its success, opened the door to future cooperative endeavors.

III. <u>Project Implementation</u>

Each natural appearance man-made concrete block used to repair the damaged wall at Site #1 were 30" deep, 46" long, and 18" in height, and weighed approximately 2,400 lbs. After placing the first course of block on a pad of class I stone aggregate, each successive row was installed and tied-in to the existing stone at both ends to insure maximum strength. As installation progressed, the contractor filled the void behind each block with compacted stone. In total, the contractor repaired 55 linear feet of damage wall.

Photo #3

This photo shows repair at one of the damaged sections of the cut stone wall. Installation involves placing successive rows of a modular, interlocking, pre-cased concrete stone block with a natural appearance that tie into the existing wall at both ends.

After repairing the stone wall, its entire 200 feet length was pre-bored with 12" diameter holes. Helical screws were inserted into the refuse material located behind the wall, grouted, and then attached to the steel wire mesh with spike plates.

Just downstream of the stone wall, the steep, 672 feet long, 40 feet high refuse outslope was also covered with steel wire mesh, in similar fashion to the stone wall. Afterwards, the steel mesh was then covered with straw matting to provide a bonding surface so the entire slope could be seeded, making the stabilization material invisible.

A total of 554 screws and spike plates were used to secure of 48,000 square feet of steel wire mesh to the entire length of stone wall as well as the refuse outslope. Each screw consisted of

<u>Photo #4</u>

This photo shows the contractor installing one of the long helical screws into the unstable refuse outslope at Site #1. After all the screws are in place, the slope is covered with steel mesh and secured with spike plates.

five joints that were 7 feet in length. Upon reaching the top of the block wall with compacted backfill, the steel mesh was also covered with stone and tied to the block with reinforcing bars, thus providing even greater stability.

<u>Photo #5</u>

This photo shows the repaired stone wall after it was covered with high tensile-strength steel mesh. The entire wall is now stable and safe.

New gabion basket crib walls, placed along the refuse outslope between the stream and roadway, provided additional erosion protection against future flooding. Helical screws tied each gabion basket to the refuse to prevent movement. These baskets replaced earlier ones that had been damaged by flooding in 2002.

The unstable refuse at Site #2 was then graded to a 2:1 slope with drainage benches placed at 50 feet intervals. A total 191,000 cubic yards of refuse were excavated in the process and a rock toe fill consisted of 6,450 cubic yards of sandstone shot rock. Also, a drainage blanket 40 feet wide, 4 feet thick, and 510 feet long was placed to collect subsurface water.

IV. Results & Conclusion

Through interdepartmental coordination and cooperation this project allowed the Division of Land Restoration to address a serious abandoned mine lands problem with an ineligible component. It also gave the Office of Abandoned Mine Lands the opportunity to think "outside the box" by employing a unique approach to stabilizing eroding slopes and unsafe embankments.

Photo #6

This photo shows the reclaimed 20 acre refuse area after being re-graded and vegetated. This work eliminated the potential threat of flooding or a devastating landslide.

Numerous tests of the helical screws installed in the wall and refuse embankment at Site #1 indicated that the unique method of locking them into the material with grout exceeded original installation specifications. With the repair of the wall and stabilization of the outslope along Laurel Branch, the site should easily be able to weather future flooding events without causing the residents of Carswell and Kimball to be concerned for their property or again fear for their lives. Since completion, the refuse slope along Laurel Branch has also been stable and the road appears to be safe for public use on a long-term basis.

The refuse area at Site #2 continues to be stable and should provide safety on a long-term basis.