Sugarite Gob Reclamation Project - Phase III

The Sugarite Gob Reclamation Project – Phase III is located about six miles northeast of Raton in Colfax County, New Mexico. The project area is on unplatted public and private land within the Maxwell Land Grant.

This project consisted of reclaiming and controlling erosion on Gob A2S and Gob A7. Included was the construction of a gabion structure (PVC-coated) at the base of Gob A7, construction of straw bale and coir roll terraces and sediment barrier dams, construction of diverter and spreader coir rolls, incorporation of lime, gypsum, compost, wood waste and fertilizer into equipment accessible flat areas of Gob A2N, Gob A2S and A7, placement of deep straw mulch in indicated areas of Gob A2S, bank toe stabilization of the gully along the south edge of Gob A7 using juniper bales and coir rolls, installation of culverts near the top of Gob A2S to improve access, planting of 12,808 seedlings, and hydroseeding using a bonded fiber matrix.

Seedling survival after six months was 63%.

The contractor was C&R Forestry, Inc. of Post Falls, Idaho.

Year Completed: 2002
Cost: $666,350.54
Project Engineer: John Kretzmann, P.E.
Project Manager: Randall Armijo

Before and After Images of the Project

Sugarite is located in northeastern New Mexico, in a deep canyon on the edge of the Great Plains and a few miles south of the border with Colorado. In the years 1901 through 1941, coal was mined in Sugarite Canyon serving the domestic fuel market in New Mexico and east to Kansas. As many as 250 miners, largely immigrant, were on the payroll and a company mining town of up to 600 people flourished at the base of the canyon.

Waste rock from the underground mines on both sides of the canyon was brought to the surface and dumped, creating steep mine dumps. In a couple of places the mine waste piles almost reached the usually perennial stream 300 feet in elevation below the mine entries. Coal mine waste dumping eventually impacted a total of 22 acres.

Today the mine waste piles are located within Sugarite Canyon State Park, where the history of coal mining in the area is celebrated in a museum display, hiking trails through the ruins of the town site and to the edges of the mine waste piles, and reconstruction of the original mule barn and town post office. As part of the historic coal mining landscape in a heavily visited, publicly owned area, the State Historic Preservation Office required that the Bureau reclaim the mine waste piles in place with without significant alteration.

The coal mine waste is largely composed of shale fragments, with some sandstone and coal pieces. Weathering of the material has produced a soil high in clay content, with samples averaging 40 percent clay. The soil is moderately acid with pH averaging 5.8 and mildly saline, with electrical conductivities averaging 4.5 mmhos/cm. The main deterrent to plant growth, however, appears to be sodium with sodium absorption ratios for the coal gob averaging 24, and in one sample as high as 43. This compares with generally acceptable SAR values of below 8 for soils with high clay content.

Excess sodium results in poor soil aeration, slow infiltration rates, and causes serious nutritional disturbances in plants by affecting the availability of calcium, magnesium, and other ions required by plants. Slopes on the gob piles are extremely steep, averaging about 2:1, are rapidly eroding, and are extensively gullied, in some places to as much as twenty feet deep. At gully side walls, slopes are nearly vertical and are steeper than 1:1 at landslide scarps. The site is in one of the wetter areas of New Mexico, receiving an average of about 20 inches of precipitation per year.

The five largest gob piles all have signs of one or more landslides – hummocky, irregular, flatter slopes below steep upper slopes – although site inspections and slope stability analyses lead AML to conclude that the slopes are largely stable from further mass movement.

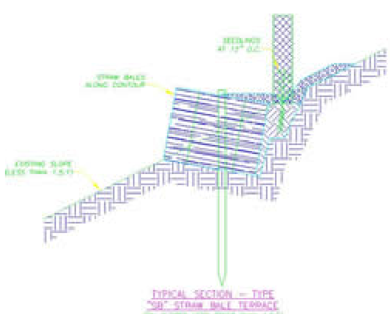
AML objectives for the project are then three-fold (and to some extent contradictory):

1. to improve water quality in Chicorica Creek, which is used for trout fishing and downstream irrigation, by reducing the rapid rate of erosion on the gob piles;
2. to preserve historic mining structures and mine waste piles;
3. to reduce the physical hazards for visitors of deep gullies and steep slopes on the waste piles.

It was initially unclear to the design engineer how to proceed with solutions to these problems. He made literature searches in several places – primarily in soil bioengineering methods and in sodic mine waste remediation – and installed a few small test plots to get a feeling for what might work.

From soil bioengineering concepts of hedge and brush layering, he got the idea of densely planting trees and shrubs along contour to reduce erosion. Classical methods to treat soil sodicity include chemical amendment with gypsum and other chemicals, which replace sodium ions in the soils with calcium or other ions, and the incorporation of large amounts of high-carbon organic matter (with nitrogen fertilization to prevent nitrogen immobilization).

Combining these approaches on slopes inaccessible to almost any type of construction equipment lead me to the idea of embedding straw bales partially into the slope and end-to-end along contour. Native seedlings would then be planted on one foot centers just above the resulting straw bale terraces. In addition to ameliorating the sodicity, the straw bales also serve as temporary erosion barriers and harvest storm runoff to water the establishing seedlings. The terraces are spaced at eight-foot contour intervals and gypsum and bio-organic fertilizer spread along the 20-inch wide benches onto which the bales are placed and staked. On gob slopes, up to 1000 pounds per acre of gypsum, along with seed and bonded fiber matrix material, is applied using hydroseeding equipment and long hoses.



Observation of the pilot construction project on 1.9 acres in 1999, led to the addition of straw wattles on top of the straw bales on slopes steeper than 1.5:1 in subsequent projects. This allows the seedlings to be planted closer to the original slope line.

The Phase II project, completed in late 2000 on steeper slopes than the first project, encompassed 4.6 acres. Observation of the second project led to the further refinement of using 16-inch diameter coir rolls on contour for slopes between 1:1 and 0.75:1 in the third project , although the success of this approach is still uncertain. Phase III was completed this spring and reclaimed another 7.2 acres of gob.

All species seeded or planted on the slopes are native plants. The species planted, primarily bareroot stock and one-year-old 10-cubic inch tublings, have been quite diverse, including a total of over a dozen different species, but have focused primarily on the use of New Mexico locust, skunkbush sumac, and fourwing saltbush.

Our specifications required the contractor to guarantee at least 40 percent survival of the seedlings after six months. In the pilot project, 55 percent survival was achieved and, in the second phase, 67 percent. Wood’s rose, skunkbush sumac, Gambels oak and mountain mahogany have achieved over 70 percent survival after six months. No studies of longer-term survival have yet been done.

The seed mixes used have also been quite diverse (containing up to 22 species), but the most common species in the mixes have been western wheatgrass, alkali sacaton, and fringed and prairie sagebrushes. The seeds are placed in two-step bonded fiber matrix hydroseeding applications. Being extremely dependant on moisture conditions for success, the hydroseeding results in the first two projects have not yet been as strong as the project engineer had hoped except on some of the flatter slopes.

To stabilize gullies, several options have been used. At headcutting reaches near the base of two of the gob piles and at the top of another pile, gabion drop structures were designed and constructed. Live willow brushlayers and fascines and live cottonwood poles were used at the gabion structures near the creek to blend them visually with nearby stream corridor vegetation. At the more accessible v-shaped gullies, ponderosa pine trees and branches from lumber mill waste and a forest thinning operation were packed into the gullies and, in the deeper gullies, wired to cross logs placed every seven feet. Sediment logs, twenty-inch diameter tubes stuffed with aspen excelsior fiber, were placed at frequent intervals across smaller gullies.

Costs have been high, given the amount of hand labor involved and the difficulty of access to and on the gob piles for men, equipment, and delivery of materials. Construction costs for the nearly 14 acres treated to date, appearing as the gray areas in this aerial photo, are expected to total $1,325,000, including gabion structures, three hardened stream crossings necessary to access the site, and other access improvements. This is more than $95,000 per acre of gob reclaimed. Consider however that five miles of straw bale terraces have been excavated and installed, almost entirely by hand, and nearly 23,000 seedlings planted to reclaim the two largest gob piles and three smaller ones.

If current trends continue, it may be another two or three decades for the gob piles to be indistinguishable on first glance from the surrounding hill slopes – then we will know that erosion has been reduced to a fraction of its original rate and sediment delivery from the gob piles to Chicorica Creek much lessened, and that the gullies are stabilizing and becoming less dangerous. At the same time the gob piles will be providing wildlife habitat and still be discernible to the keen observer.