# A SUBSTITUTE TOPSOIL PLAN FOR RECLAMATION OF A MOUNTAINTOP REMOVAL MINE IN SOUTHERN WEST VIRGINIA[1]

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Steep topography and thin native soils in the Southern Appalachian coalfields present special problems in reclaiming large surface mines. By investigating geologic core logs or highwall samples, certain strata can be targeted for use as an alternative topsoil material. A mining plan was developed to recover three coal seams and reclaim with a mudstone-sandstone mixture. The substitute topsoil tested high in calcium, magnesium, and potassium with pH readings ranging from 6.2 to 7.2 standard units. A 72-yd.$^3$ dragline removed most of the overburden and deposited it in the previous pit. The spoil piles were then regraded to their final postmining topography. To facilitate revegetation of the gently rolling plateaus to hay and pasture land, a two-step seeding plan was devised. The regraded mudstone-sandstone spoil was initially seeded in an annual grass-legume mixture to provide quick erosion control. After one growing season, the annual cover was turned under with a heavy-duty offset disk harrow. The initial cover acted as a "green manure" to enhance nutrient and water-holding capacities of the new minesoil. The cultivated area was then reseeded in a timothy-alfalfa mixture providing a local source of quality hay and grazing land.

## INTRODUCTION

Successful revegetation of large surface mines in southern West Virginia is largely dependent on the availability of enough quality topsoil to cover the regraded area so that the approved postmining land use can be achieved. In most areas, the native soils are thin, acidic, and highly weathered. Average slopes over much of the southern coalfields exceed forty percent. In some cases, however, the nature of some overburdens is conducive to plant growth. A careful examination of the physical and chemical characteristics of the mudstones and sandstones overlying the coal seam may provide useful information in determining if an alternative soil material is present. By identifying such formations, a reclamation plan was developed to utilize a topsoil substitute that is in many ways superior to that of native soils. Soil management techniques were used to enhance

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the water-holding and nutrient exchange capacities of the developing minesoil so that the approved postmining land use could be realized.

## TOPSOIL SUBSTITUTION PLAN

An approved topsoil substitute plan is currently in use at the Hobet Mining Number 21 Surface Mine located in Boone County, WV. The operation lies within the Allegheny and Kanawha geologic formations in the southwestern part of the state. Most of the production is from the Five Block (Lower Kittanning) and Upper and Middle Stockton Coal Seams. Occasionally some Middle Kittanning Coal is found on the highest ridgetops. The lithology of the area is predominantly light gray sandstone and gray mudstone with some weathered brown sandstone occupying significant areas on ridgetops and points. A relatively continuous rider seam lies some 10 to 15 ft. above the Upper Stockton Seam.

The mine plan utilized a 27-yd.$^3$ electric shovel and rock truck spread to remove the overburden from the mountaintop down to the Five Block Seam. This material was placed in end-dump, durable rockfills. A flat area was left after the coal was removed, providing a working space for a 72-yd.$^3$ walking dragline. The dragline then removed approximately 100 ft. of overburden to uncover the Stockton Seams. This overburden above the Stockton Seams is comprised of about 75 ft. of gray sandstone and 25 ft. of gray mudstone. Most of the mudstone lies directly above the Upper Stockton. As the dragline excavated, the sandstone was deposited in spoil piles in the preceding pit. The mudstone was removed last and placed on the top and sides of the spoil piles. The spoil piles were then regraded, leaving a mixture of gray sandstone and mudstone on top.

### Minesoil Analysis

The Acid-Base accounting of core logs that is required in the permit application provided general guidelines as to the type, location, and paste pH of the overburden. This information was useful in determining which strata would best be suited for further sampling and testing. The highwall was sampled when accessible and correlated with additional samples after regrading (Sobek et al. 1978). Test results of the substitute material appear in Table 1. Native soil test results are shown for comparison. (Laboratory methods used are according to Sobek et al. (1978).

In comparing the test results, it is clear that the substitute material is superior to the native soil in nearly all aspects with the exception of phosphorus and clay content.

Table 1.--Nutrient and texture analyses of substitute topsoil and native soil materials.

| Soil Characteristic | Topsoil Substitute | Native Soil |
|---|---|---|
| Nutrient analysis, lb./acre: | | |
| P . . . . . . . . . . | < 1.0 | 7.6 |
| K . . . . . . . . . . | 297 | 127 |
| Ca . . . . . . . . . | 3,100 | 60 |
| Mg . . . . . . . . . | 600 | 40 |
| Lime required, ton/acre | 0 | 3.2 |
| pH . . . . . . . . . . | 6.7 | 4.6 |
| Texture analysis, percent: | | |
| Sand . . . . . . . | 64.3 | 56.8 |
| Silt . . . . . . . | 21.2 | 21.8 |
| Clay . . . . . . . | 14.5 | 21.4 |
| Texture class . . . . . | Sandy Loam | Sandy Clay Loam |

Experience at this site has shown that the data derived from the Acid-Base accounting proved effective in determining the best available substitute minesoil.

### Soil Management Practices

The objective of the reclamation plan was to reclaim the flat to gently rolling areas of the mine site to hay and pasture land. Since the substitute topsoil was generally low in clay content, it was determined that the limiting factors in establishing a productive pasture cover were water-holding and nutrient exchange capabilities of the material.

To reduce these deficiencies, a two-step seeding process was developed. In the fall or early spring, the plateaus were fertilized and hydroseeded in a seed mixture designed to provide quick erosion control that later was tilled in as green manure. This initial seeding served two important purposes. First, to incorporate the organic matter in the substitute material in order to increase nutrient and water-holding capacities. Second, to allow the material to weather through several freezing and thawing cycles to help break up larger stones. The following seeding season, this initial cover was turned under with a heavy-duty offset disk harrow.

After cultivation, the area was again fertilized and reseeded in a permanent hay and pasture mix. Those areas too steep for cultivation were seeded in a herbaceous mixture and developed into a wildlife or forest land postmining use. The disk harrow is a heavy-duty

Table 2.--Species used in two-step seeding process.

| Hay and Pasture Mix | |
|---|---|
| Species | Application (lb./acre) |
| Alfalfa | 18 |
| Birdsfoot Trefoil | 18 |
| Timothy | 12 |
| Perennial Rye Grass | 18 |
| Orchard Grass | 36 |
| Mammoth Red Clover | 18 |
| **Green Manure Mix** | |
| Species | Application (lb./acre) |
| For Fall Seeding: | |
| Hairy Vetch | 80 |
| Annual Rye Grass | 40 |
| For Spring Seeding: | |
| Yellow Sweet Clover | 50 |
| Annual Rye Grass | 70 |
| **Fertilizer** | |
| Type | Application (lb./acre) |
| 15-30-15 | 400 |

model specifically designed for highway or construction use. This particular model has a 15-ft.-wide cut. It has 28 disks, each 32 inches in diameter, made of one-half inch hardened steel and weighing 500 lbs. Disk penetration of 8 to 10 inches was common in the regraded mudstone material. Many large stones were crushed and broken up by the slicing action of the disks; complete turning under of the green manure crop was realized. The disks were pulled by a D-8 bulldozer or equivalent. The pasture mix and green manure mix consisted of the species listed in Table 2.

## RESULTS AND CONCLUSIONS

The primary objectives of disking in the cover crop were to enhance the ability of the developing minesoil to hold water and nutrients so that the permanent vergetation could become established. As the alfalfa-orchard grass cover matured, the roots would be able to penetrate deep enough so that soil moisture would not be critically limited during extended dry periods. Also, natural recycling of nutrients from decaying matter would help resupply the root zone with nitrogen and phosphorus.

Although there has been no actual soil testing to verify that the cation exchange or the water-holding capacities have been improved, the density and drought resistance of the vegetative cover is readily apparent. Ground cover in most areas is 90 percent or greater. Root penetration has been seen to exceed 24 inches. The summer of 1987 was exceptionally dry with only 0.65 inches of rainfall from July 15 to September 4. The alfalfa or orchard grass stand was dormant during this time but grew vigorously with a soaking rain. Total height of the stand exceeded 18 inches.

In areas where native soils are scarce or infertile, an alternative strata can be utilized to create a new soil that is capable of supporting vegetation. With proper management, such a minesoil can sustain grasses and legumes and provide quality forage to local cattle-raising efforts.

## LITERATURE CITED

Sobek, A. A., W. A. Schuller, J. R. Freeman, and R. M. Smith. 1978. Field and laboratory methods applicable to overburdens and minesoils. EPA-600/2-78-054. U. S. Environmental Protection Agency, Cincinnati, OH.