REFORESTATION OF MINED LAND FOR PRODUCTIVE LAND USES AND ENVIRONMENTAL QUALITY

James Burger and David Mitchem
Department of Forestry, Virginia Tech

PROGRESS REPORT (2006-2007)

The Forestry Reclamation Approach

The Forestry Reclamation Approach (FRA) requires five straightforward steps: (1) select the best soil or mine spoil for trees and apply about 4 feet for the final surface material; (2) grade it lightly or not at all to leave it loose and uncompacted; (3) employ a professional tree planter who guarantees his work; (4) have him plant a mix of commercially valuable native hardwoods (oaks, black cherry, sugar maple, ash, etc., at a rate of 600 trees/acre) along with a lesser amount of wildlife or nurse trees (dogwood, redbud, hawthorn, crabapple, etc. at a rate of 100 trees/acre); (5) after the trees are planted in winter, hydroseed a tree-compatible ground cover the following spring. More specific recommendations for the FRA can be found in the Virginia Cooperative Extension Bulletin 460-123 at http://www.ext.vt.edu/pubs/mines/460-123/460-123.html.

The foundation for the Forestry Reclamation Approach is our ongoing Powell River Project reforestation research program consisting of many forestry research sites in Virginia and adjacent states. The results from these research sites allow us to develop reforestation guidelines for reclaiming mined land, and they allow us to demonstrate the value of reclaimed forests. Because forestry is a long-term enterprise, we maintain and monitor our field sites over time. The older these research sites become, the more valuable they are, because they show how reclamation treatments will ultimately affect the success and value of the restored forest. As we collect data from these older sites, we adjust our guidelines and recommendations in ways that will improve reclamation for better long-term land uses.

Research Reports

This year we put emphasis on FRA Step #5, which is to minimize ground cover competition by using a tree-compatible ground cover. Herbaceous ground covers used for erosion control can be very competitive and detrimental to tee survival and growth. This was demonstrated in a five-year study that showed that native hardwoods can grow at three times the rate when ground cover is reduced to 60 to 80% while still controlling erosion. We summarized the results of this and other long-term studies in a draft of a Powell River Project Virginia Cooperative Extension Publication that is currently under review. This draft is attached to this report.

Another major mined land reforestation research effort concluded during this year was a comparison of topsoil substitutes for trees. The study is located in Wise County, Virginia, on the Marcum Hollow member of the Upper Wise Formation. The site was mined in 1979 and reclaimed in 1980. In 1981, field plots were constructed with different topsoil substitutes spoil mixes and pitch x loblolly pines were planted in 1983. In 2001 the pines were removed and replaced with red oaks in the winter of 2001-2002. Four replicate plots of five different mine spoil mixes were planted with nine red oak seedlings each. Mine spoils consisted of different proportions of weathered sandstone and un-weathered siltstone. Tree survival, height and

diameter were measured each year for five years. Results show that survival and growth was best on topsoil substitutes consisting of a mix of sandstone and siltstone. Trees survived and grew poorly on plots constructed from either pure sandstone or siltstone. Reasons for the poor oak performance on the high sandstone plots were not clear, but could possibly be related to lower pH and available Ca levels. Poor oak performance on the pure siltstone plots was most likely related to higher rock fragment and lower bulk water holding content. The full paper is attached to this report.

Ongoing Research Activities

Our ongoing Powell River Project reforestation research program is dedicated to: (1) helping coal operators meet their reclamation requirements; (2) helping landowners maximize the value of their reclaimed mined land; and (3) helping mining communities meet their socio-economic needs. The following studies are being conducted to meet these goals:

1. Use of herbicides for weed control to improve native hardwood establishment.

- This PRP project is in its sixth growing season. The results after three years were published recently in the proceedings of the American Society for Mining and Reclamation. A final report based on the 5-year data will be published next year.

Burger, J. A., D. O. Mitchem, C. E. Zipper, and R. Williams. 2005. Herbaceous ground cover control effects on native hardwoods planted on mined land. In: R. I. Barnhisel (ed.). Proc., 22nd Mtg., Amer. Soc. for Mining and Reclamation. June 18-24, 2005, Breckenridge, CO. ASMR, 3234 Montavesta Rd., Lexington, KY.

2. Hardwood establishment field trials:

- This is a large study with 10 three-acre sites located in three states. We completed tree, ground cover, and site measurements for eight continuous years. A preliminary analysis of this project was presented and published at the annual meeting of the American Society of Mining and Reclamation in Breckenridge, Colorado, in June, 2005. A final report will be completed next year.

Auch, W. T., J. A. Burger, and D. O. Mitchem. 2005. Hardwood stocking after five years on reclaimed mined land in the Central Appalachians. In: R. I. Barnhisel (ed.). Proc., 22nd Mtg., Amer. Soc. for Mining and Reclamation. June 18-24, 2005, Breckenridge, CO. ASMR, 3234 Montavesta Rd., Lexington, KY.

3. Mined land classification system for forestry interpretations:

- We continue to monitor an 80-acre native hardwood planting on Rapoca Coal Company land. This cooperative effort between Rapoca, Virginia Tech, and the Virginia DMME serves as a model for the application of Powell River Project reforestation guidelines. We recently completed a study of white oak response to mine soil types on this field site. The results of this work were published in Spring, 2007.

Showalter, J. M., J. A. Burger, C. E. Zipper, J. M. Galbraith, and P. F. Donovan. 2007. Influence of mine soil properties on white oak seedling growth: A proposed mine soil classification model. Southern Journal of Applied Forestry 31 (2) 99-107.

4. Carbon sequestration by forests and soils on mined land:

- This project is funded largely by the Virginia Department of Mines, Minerals and Energy, The Nature Conservancy, and the U.S. Department of Energy. The reforestation of mined land has the potential to sequester large amounts of atmospheric carbon, which is associated with the greenhouse effect and climate change. Much of the elevated level of CO2 in the atmosphere is attributed to land use change and the burning of coal and other fossil fuels. This project helps determine the benefits of reforesting mined land for sequestering carbon from the atmosphere.

Amichev, Beyhan Y. 2007. Biogeochemistry of carbon on disturbed forest landscapes. Ph.D. Dissertation. Virginia Polytechnic Institute and State University. 371 p.

5. Red oak Seedling Response to Different Topsoil Substitutes After 5 Years:

- This study compares the growth of red oak on different topsoil substitutes made up of different proportions of sandstone and siltstone. Red oak did best in a mixture of the two rock types. The results of this study were presented at the annual meeting of the American Society of Mining and Reclamation, June, 2007, Gillette, WY. The publication is attached to this report.

Auch, W. T., J. A. Burger, and D. O. Mitchem. 2005. Hardwood stocking after five years on reclaimed mined land in the Central Appalachians. In: R. I. Barnhisel (ed.). Proc., 22nd Mtg., Amer. Soc. for Mining and Reclamation. June 18-24, 2005, Breckenridge, CO. ASMR, 3234 Montavesta Rd., Lexington, KY.

Outreach Activities

A major outreach activity co-hosted by the Powell River Project was the first Mined Land Reforestation Conference held at the Southwest Virginia Higher Education Center in Abingdon, Virginia, on August 7-9, 2007. Our reforestation research sites on the Powell River Project were featured during the field tour the second day of the conference. Approximately 200 people attended the indoor session and 120 attended the field trip.

What Are the Benefits of This Reforestation Research?

Our work has provided the foundation for the Forestry Reclamation Approach used by many coal operators in Virginia and adjacent states. It is currently being promoted by the Office of Surface Mining's Appalachian Regional Reforestation Initiative. Economic analyses have shown that the return on mined land reclaimed according to guidelines based on PRP research can be several times higher than land currently reclaimed to unmanaged land uses. While improving the value of mined land for the landowner, coal operators benefit through more timely and successful recovery of performance bonds, and local communities benefit from land reclamation that improves water quality, reduces flooding potential, is more aesthetically pleasing, and more valuable for a diversifying economy.