Session 2

INTEREST GROUP PERSPECTIVES ON CONSTRAINTS, EXPERIENCES, TRENDS, AND NEEDS

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EASTERN STATE PERSPECTIVES ON TREE RECLAMATION

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Appalachian Perspective

I looked at some of the literature from the people who are doing most of the work in Appalachia and most of them are from Virginia Tech. The following sums up their perspective. Most of the reclaimed land in Appalachia is of limited capability due to the terrain, limited and rocky soil materials, the climate, and the culture of the industry. Most of the current and potential land use is forestry. The land cannot be reclaimed for anything other than forestry that will provide any significant economic return. Restoration of productive forest land requires a deep, noncompacted, nontoxic mine soil, and the absence of a competitive ground cover.

In Appalachia, there have been many acres that have been lost for use as forests. Since the passage of SMCRA, fewer forests are being restored. Virginia has begun to make progress on restoring forests during the 1990s. Kentucky has indicated a loss of about 250,000 acres of forest land. In terms of forest productivity, despite the potential to create productive forest land, much of the surface mined land in Appalachia is reclaimed to a very low level because of compaction. Root zone quality is a big issue. Some coal mine operators will have to change the way they have been operating if they want to increase tree productivity. There was a statement made earlier that the regulations require compaction. That is not the case. From a productivity standpoint, the regulations definitely discourage compaction. There is an opportunity in these steep slope areas to create deeper soils than existed prior to mining. If equipment travel is limited, then grading costs can be reduced while improving the soils for tree growth.

The guidelines for planting trees in the Appalachian area are: (1) replace 3 to 4 feet of surface soil and/or weathered sandstone overburden taken from the surface 10 feet; (2) loosely grade a noncompacted topsoil or topsoil substitute; (3) revegetate using native, noncompetitive, domestic, ground cover species; and (4) plant nurse trees for wildlife and mine soil improvement as well as valuable crop trees.

Mid-Continent Perspective

In the Mid-Continent, the situation is different. Most of the land is either prime farmland or capable of crop production. The land can be used for a wide variety of things if the soils are replaced properly. These lands include some of the most productive in the world as they were originally developed under tall grass prairie. From a habitat standpoint, some would say that the tall grass prairie habitat is a lot more endangered in the Midwest than the forest habitat. They would be encouraging us to reclaim many of these sites to tall grass prairie rather than forest in states like Illinois and Indiana.

The guidelines for planting trees in the Mid-Continent area are: (1) use the same practices used to restore land to its original premine capability for prime farmland or cropland; this also will make the land productive for trees; (2) replace 4 to 6 feet of uncompacted rooting material (B or C Horizon materials or subsoil substitute); (3) truck/shovel equipment can best be used to limit compaction during soil handling operations; and (4) replace topsoil to premine thickness. We are hearing the same arguments for limiting compaction to restore tree productivity that we have found is necessary to restore crop land productivity.

Summary

In the East, you have land that has very limited ability to be used for anything other than forests. In the Mid-Continent, you have soil conditions and resources that give you a lot of options in terms of land use.

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REFORESTATION IN THE WESTERN STATES

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Introduction

I would like to look at just what we are trying to encourage in this process. We are trying to develop an energy resource and keep the economy strong. We are trying to encourage reclamation and productive postmining land uses. Where we usually get at odds with each other has to do with "What is a productive postmining land use?"

Diversity

The key that we are trying to get to, and have not focused in on, is the concept of diversity. There are times and places and situations where crops make sense, grasslands makes sense, or forests make sense. We are driven to the postmining land use usually by the premining land use. Unfortunately, there are a lot of situations where that premining land use is neither good for, or the most productive use of, the land. This is because there are people who are trying to use the land for the greatest amount of economic gain in the shortest amount of time. We are all used to making investments this way. Now you are going to get at odds with someone when you suggest that the premining land use is not the best use of the land. The way you may be able to get past this point is with lots of discussion and education as to the real capability and best use of a particular piece of land. This is where we need to start when we first get a permit in the door as regulators. Perhaps what we may give up in short-term profit will actually pay off in the long run. This educational process is important, not only for the landowner, but for the regulators, the state and local planning organizations, etc. That education needs to focus on the proper steward-ship and use of the land. We need to realize that the use of forests for diversity has a certain amount of economic value beyond its value for cutting trees.

Land Value

I am glad to see that, some 20 years after the initiation of SMCRA, we are finally getting around to discussing the values inherent in these land use decisions we are making. We are currently trying to minimize erosion, get a quick sustainable vegetative cover, have vegetative productivity, and other things in order to obtain bond release. What we have done in the development of these programs is to drive the system so that it does not recognize forces beyond our control. If you look at a natural landscape, you do not see pristine systems with grass three feet tall and no erosion or sedimentation on the site. You do see this at mine sites. Is this good? Well, in the eyes of regulators during the early days of SMCRA, yes, this was good because we had erosion control and sediment control and we got bond release. What this did was to stifle diversity. This put the blinders on us as regulators so that we could say to the public that we were able to control erosion and sedimentation, clean up the water, and establish a good looking stand of grass, and get bond release in five years. The whole idea of setting a specific time limit on obtaining a bond release is artificial. What is the relevance of the time limit, if our goal is really to restore the land to a productive and diverse land use? Some of the constraints are artificial ones that we have placed on ourselves. In terms of the vegetative cover that will ultimately occupy the site and be best for the long-term land use, some things may take place that mother nature may want to have happen that are not in our plans. There is going to be erosion. Water channels are going to be reestablished where the water wants to go rather than where it was engineered to go. The same with the vegetation. We should be looking at what plants are going to naturally want to inhabit the site and try to incorporate that into our plans. We are presumptive in thinking that we can actually control what vegetation will ultimately occupy the site. We have looked at this in terms of our short-term benefits and gains, even in terms of benefits to the environment.

Summary

We need to look at our vegetation standards and at what we need in order to obtain bond release whether it be statistical vegetation sampling or soil replacement. We need to focus on education of the landowners and regulators as to what makes sense for the ultimate use of the land in terms of both the environment and the economy. I think we need to take this opportunity to explore and think about this issue. Where can we make significant improvements with some creative thinking?

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IMPEDIMENTS TO REFORESTATION: WHO OWNS THE PROBLEM?

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NMA Survey

I asked five questions of our members concerning this issue: (1) Do NMA members want to use forestry more often as a postmining land use?; (2) There have been a number or recent talks concerning the science of reforestation showing great successes; are there portions of the regulations that have the unintended consequences of discouraging the planting of trees where it might otherwise make sense, or is this whole thing a waste of time?; (3) Would you plant more trees and reclaim to forest if such impediments were removed?; (4) Are the cost comparisons for reclamation to forest as compared to other uses substantial?: (5) List any changes you would recommend.

Although there were significant differences in some of the responses, there were some trends. The answer to the first question is yes. Planting trees in general is good for public relations and the environment. We would like to plant more trees. Many companies we have heard from are already planting more trees than they planted before SMCRA, such as Texas Utilities. Others feel constrained by the rules and their application but otherwise would plant more trees in certain situations, but not necessarily for commercial forestry.

Generally, in the West the industry supports forest uses in water courses as wildlife habitat. The locals, however, are not supportive of planting trees for use other than this. Also, the cost for tree planting in the West is considered to be prohibitive, and survival is so low that the risk is too great.

I have combined the responses to the rest of the questions. There is a consensus that grading, ground cover, land use issues, and revegetation success standards all discourage the planting of trees. The industry is asking for the flexibility to grade in such a way as to promote tree growth. The type of grading that benefits the establishment of pasture does not benefit the establishment of trees. The increased cost, of first having to establish an herbaceous cover to control erosion and then later plant trees that must compete with that cover, deters many companies from planting trees. There needs to be more flexibility in determining the appropriate percentage of ground cover necessary to achieve different land uses. In the East, vandalism and theft was identified as a problem with tree planting. Many landowners view the pasture land use as a quicker economic return that is less risk than forestry. Some landowners do not like the tree species that have been planted, such as black locust. There is a good consensus that stem counts rather than a stocking standard is unreasonable as it increases the liability, increases replanting, and extends the responsibility period. These requirements to do not take into account natural succession. In terms of cost, many are concerned about the $1,000 per acre that some are reporting. This contrasts with Texas Utilities; it finds that the costs for planting trees is less than that required to plant pasture. For many miners, their profit margins are so small that they just can not assume the risks involved with planting trees.

Summary

Essentially my responses looked like a typical bell curve. Some companies are heavily involved with tree planting and have been for a long time. Most would like to plant more trees and believe that they would if conceived constraints were removed. Some would not increase tree planting under any scenario. These responses hinge on several factors. Certainly the size of the mining operation, whether or not the land is owned by the mine or leased, the relationship the mine has with the state regulatory authority, and the geography of the mine are all factors in determining a companies willingness to plant trees. A consensus between the mine operator, landowner, and regulatory authority must be reached if there is going to be progress in this area. Changes in the regulations may, in some cases, make tree planting more possible, but they will not make people want to plant trees. The industry needs both flexibility and dependability in terms of its relationship to the regulatory environment.

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HISTORIC REVIEW OF MINESITE REFORESTATION IN TENNESSEE

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I began inspecting coal mines in 1974 for the Tennessee Valley Authority (TVA) out of Norris, Tennessee after graduating from college. In those days TVA had reclamation provisions in their contracts. I started with OSM in July, 1978 as a Reclamation Specialist in London, Kentucky. That makes 25 years in this business, so I have seen a mine or two. During all those years, I have inspected mines in Tennessee, Kentucky, Virginia, West Virginia, Ohio, Pennsylvania, Alabama, and Oklahoma.

In Tennessee in the late 1950s and early 1960s, steam coal sold for $1.50 to $2.00 per ton. Most mining in those days was done by deep mining techniques, but some surface mining was being done using steam shovels. No reclamation was required during those early years, so the spoil was just dumped over the hill to reclaim itself. In most cases, these old areas healed over just fine, except in places where the spoil was too acid. Many of these old sites have reclaimed themselves so well that most people don't even recognize then as minesites. Highwalls were generally fairly short and have fallen in over the years, leaving only a slope. Most of these old mines were very narrow cuts around the side of the mountain. Today they are used as paths or trails for 4X4s and are revegetated by native tree species of oak, poplar, locust, black cherry, sycamore, sourwood, dogwood, and a few introduced species like *Paulonia tomentosa*. The nearness of the seed source contributed greatly to the successful reforestation of most of these early strip mines.

While working at TVA, I was asked to conduct a tour of some mines. The group I was touring was comprised of several members of a garden club. After explaining to these ladies about mines that were being reclaimed to the standards of the time, we came to an old mine that was all grown over with trees and had an impoundment in the pit below an old collapsed highwall. The group could not believe it had been a mine. They asked why the company we just left was doing all that reclamation if this is what it looked like when nothing was done. I explained that new mining techniques had made it possible to mine much larger cuts than the old mine we were standing on and that disturbing larger areas left more area to erode during rainfall events. Along with this was the fact that there were many more mines now than when the mine we were on was mined.

In the early 1970s, mining began to increase in Tennessee. One factor in this increase was the introduction of much larger and more efficient equipment. Mining companies were required to do some minimal reclamation, such as grading the soil so the bench sloped back toward the highwall and planting trees. Silt structures were constructed of rock and logs, but sediment ponds were not required. The trees that were planted were mostly virginia pine or locust. Most of the areas mined during that time are now well forested with native trees that have seeded themselves.

One of the first mines I was on is located in the Ollis Creek watershed in Campbell County, Tennessee. This area was mined in the early 1970s and TVA minerals were extracted for use in one of their steam plants. I mention that the minerals were owned by TVA because this mine was located at the upper reaches of the watershed that contained the water supply of a nearby town. The water began to be adversely impacted by the mining and the town complained to TVA. It appears that sediment and water of low pH was flowing off this mine into the lake from which the town got its drinking water. TVA began a multiyear project to reclaim this mine. Initially, improvements in the sediment controls were made. Several ponds were constructed below the mine. The next thing to do was to increase the spoil pH so revegetation could begin. The pH was found to be low over most of the mine, with the pH averaging around 3.0 over a large portion of the mine. Lime was spread and incorporated into the soil at a rate of 10 tons per acre. This had to be done three years in a row over part of the mine in order to get grasses to grow. Fertilizer was spread at the rate of 200 lbs/ac. The outslopes were stabilized by staking hay bales and planting pine trees on them. Other species of trees also were planted. They include sawtooth oak and cherry along with virginia pine, shortleaf pine, and loblolly pine. Shrubs also were planted, including autumn olive and bi-color lespedeza. These trees and shrubs were planted over a four year period from 1974 to 1977. Some of the pines now

have a diameter of 12 to 14 inches and the oaks are up to 10 inches.

Today, the area is so well vegetated that if you were shown the portions without the highwall, you could not tell you were on a mine. The area is now part of a state wildlife management area. I don't know the cost of the work done at this site, but it had to be high, even though most of the labor was done by employees of the CETA program. This was a program similar to the WPA for unemployed young people.

During the 1970s, mining laws changed to require the addition of grasses along with the trees. Figure 1 is from this time period. This particular mine is located on land that was owned by a land company that only wanted white pines planted. It was like pulling teeth to get the man that owned the company to allow the mining company to plant any grasses at all. And don't even think about planting or seeding a locust on his property. The man that owned the company that did the mining on this property was all for sowing the area with grass and did what he called mulching with seed. When he seeded an area, the ground would almost be covered with seed. He said he thought it was easier and cheaper to seed that way than to go back and do it over later. He would put down four to five times the recommended seed for a given area. It seemed to work, but I don't recommend it.

As you all know, OSM came into existence in 1978. The date for compliance with these new regulations was May 3, 1978. Anyone mining on this date had to begin returning their mined areas to approximate original contour. Figure 2 was mined shortly after this date. Originally it was seeded with lespedeza and planted with only locust trees. As you can now see, the mine is completely covered with trees. The mined area was a relatively narrow cut around the contour of a mountain that provided an abundant seed source. The locust trees originally planted are mostly dead, and maples, oaks, sourwood, and dogwood have taken their place.

In the 1980s, mines seemed to get larger and, as a result, seeding from nearby natural sources became physically more difficult. This is evident when viewing large reclaimed areas. You can see where natural reseeding is occurring around the edges and not as much towards the center of these larger mines. The planting or seeding of these larger mines with a single species of trees has created monocultures that are vulnerable to disease or insect infestation. In late summer, mined areas that are covered in locust trees appear from the distance to be brown, dead strips of land, due to infestations of leaf borers turning all the leaves brown. I don't know if that is what eventually kills these trees, but about 15 to 20 years seems to be the life span of a locust tree in these locations. I have not noticed similar problems where pines were planted.

The 1990s brought about more changes for the mining industry. Falling coal prices forced more and more companies out of business, leaving a few large companies with the majority of the remaining permits. In the past few years, I have noticed fewer trees are being planted. Most permits issued in the past few years in Tennessee have had a postmining land use of "undeveloped land." These mines are sown in grasses with some wildlife shrubs planted. The mines that have been reforested have been sown with locust or planted in pines. Mining companies have been reluctant to plant hardwoods because of the difficulty in achieving the required success rate; however, changes are in the works. A new mine site reforestation policy in Tennessee will be out soon for comment. This policy will give the landowner more say in the species of trees planted on his land. Other topics addressed include grading and spoil compaction; topsoil and topsoil substitutes; tree species; survival rates; and ground cover species selection. This new policy will be out for public comment within the next 30 days. Hopefully, this new policy will promote a more diverse species selection when trees are planted on mine sites in Tennessee.

Over the past 25 years, there have been many changes in the mining industry as far as reclamation goes, and I'm sure there are many more changes to come. I plan on inspecting mines for a few years yet and I hope to see still more improvements in mine site reforestation.

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Figure 1. Area mined and reclaimed in the 1970's prior to May 3, 1978.

ACADEMIC RESEARCH PERSPECTIVE ON EXPERIENCES, TRENDS, CONSTRAINTS, AND NEEDS RELATED TO REFORESTATION OF MINED LAND

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Introduction

Reforestation of mined land during the past 50 years in the United States has been influenced by many factors, including silvicultural technology, availability of plant materials, mining procedures, economic incentives, landowner objectives, and federal and state regulations. The amount of disturbed land planted to trees, as well as the success of these plantings, has varied greatly from state to state during this 50-year period. A major factor reducing the amount and quality of reforested land was the implementation of the Surface Mining Control and Reclamation Act of 1977 (SMCRA). Prior to 1977, most mined land was reforested and reforestation success was primarily a function of applying good silvicultural techniques, but implementation of the law created a number of disincentives caused by a combination of economic, legal, engineering, land use, and physical constraints.

The purpose of this paper is to review how reforestation of mined land has changed over time, the factors that have influenced the amount of land reforested, the success of the trees and stands planted, the constraints and impediments affecting reforestation, and research, policy, and operational needs that, if fulfilled, would improve reforestation. An emphasis is placed on the influence of federal and state regulations since the implementation of the SMCRA because of the profound effect this law has had on land use conversion, productivity, and function.

Forest Functions

In order to fully appreciate the importance of mined land reforestation and its success, I believe it is important to review what forests "do" for us. The following is a list of several important forest functions:

- wood and fiber production
- hydrologic control
- water quality maintenance
- wildlife habitat
- plant and animal diversity
- carbon sequestration
- air pollution mitigation
- aesthetic landscapes
- ecosystem stability

The first item on the list, wood and fiber production, is the most tangible and provides direct benefits to forest landowners. Most of the remaining forest functions on the list are services that forests provide to the public at large. Most people recognize and appreciate these services, but it is difficult to measure their true dollar value. The value of these forest functions is invariably underestimated. A full accounting is needed in order to understand the implications of mining effects on the forest landscape.

We also must realize that the relative importance of land uses is a function of region. Table 1 shows the order of relative importance of traditional postmining land uses in the Western, Midwestern, and Eastern coalfield regions. Rangeland is clearly the dominant premining land use in the West, so it is reasonable that it is the preferred and dominant postmining land use, with shrub and forestland playing a tertiary role. In the Midwest, cropland is

dominant, therefore reclamation is predominantly and properly targeted towards cropland postmining land uses. However, due to the low abundance of forest land in both regions, its replacement, when disturbed, is important, especially when it is needed to provide the service functions listed above.

Table 1. Land uses – relative importance.

Western Coalfields	Midwestern Coalfields	Eastern Coalfields
1. Hayland/pasture 2. Cropland 3. Forest/shrub land	1. Cropland 2. Hayland/pasture 3. Forest/shrub land	1. Forest land 2. Hayland/pasture 3. Cropland

In the Eastern coalfield region, forests dominate the landscape and they are the dominant renewable resource underpinning the long-term economies of many of the Appalachian states. Huge amounts of virgin timber were cut and marketed during the 50-year period between 1880 and 1930. Towards the end of this virgin timber harvest, coal mining became the region's economic mainstay, with timber and wood products playing a secondary role. However, the value of the second-growth forest is resurging, with nationwide demand for hardwood products and the advent of wood-processing mills that use timber of all quality grades. This wood-product resurgence is evidenced by many new paper, fiberboard, and lumber mills built or proposed throughout the region during this decade. Water quality, wildlife habitat, and biodiversity are additional forest functions that are highly valued in the region. Land use diversity is clearly desirable when the uses are productive, but the landscape, history, and economy of the region dictates forest land uses as the logical postmining alternative.

Experiences

Pre-SMCRA: During the 30-year period from 1947 to 1977, most mined land was reforested. In the Appalachian coalfield region most mined land had been forested originally, and so disturbed forests were returned to forests. In the Midwestern coalfields, much of the mined land had been cropland and pastureland originally, but the majority was reforested because cast overburden was not graded and topsoiled. Because most spoil materials were left ungraded, they were loose and uncompacted. Trees were planted directly into the loose spoil and were unencumbered by competitive ground covers. With a few exceptions, trees survived and grew very well, and today there are many 30- to 60-year-old stands that will bring landowners considerable revenue from the wood products these forests contain.

Revegetation research conducted during this prelaw period by company reclamation specialists, academic and Forest Service scientists, and other agency researchers was focused on species selection, seeding and planting techniques, improving planting stock, developing mycorrhizal planting stock, and improving minesoil fertility. By the mid-1970s, reforestation biology and silviculture was well established and successful.

Post-SMCRA: After the implementation of the SMCRA, the revegetated landscape, and the techniques used to achieve it, changed dramatically. Federal and state regulations and regulators emphasized short-term hydrologic impacts, sediment control, surface stability, and complete ground cover. In response, coal operators established lush stands of grasses and legumes to prevent soil erosion, vegetation that was sown on compacted fill material engineered for stability. In the Appalachian coalfields, land was reclaimed using one of three revegetation scenarios:

Scenario #1: Forest converted to hayland/pasture:

- Topsoil substitutes chosen for ground cover success
- Minesoils compacted while preparing sites for grass
- Lush ground cover created with heavily fertilized domestic grasses and legumes
- After bond release, hayland/pasture abandoned of further management

- Natural forest succession proceeds, but at a very slow pace due to compacted, inappropriate minesoils

and the presence of competitive exotic grass and legume species.

Scenario #2: Forest converted to "wildlife habitat":

- Topsoil substitutes chosen for ground cover success
- Minesoils compacted while preparing sites for grass
- Lush ground cover created with heavily fertilized domestic grasses and legumes
- Woody wildlife species planted
- After bond release, wildlife habitat abandoned of further management
- Natural forest succession proceeds, but at a very slow pace due to compacted, inappropriate minesoils and the presence of competitive exotic grass, legumes, and woody shrub species.

Scenario #3: Forest returned to forest:

- Topsoil substitutes chosen for ground cover success
- Minesoils compacted while preparing sites for grass
- Lush ground cover created with heavily fertilized domestic grasses and legumes
- Plant forest trees, the permanent cover, in conditions created for the temporary ground cover
- Frequent establishment failures, slow tree growth, and poor productivity due to unnatural competition from exotic grasses and legumes and compacted spoils of the wrong type.

In the Midwestern coalfield region, forest land also is being converted to other uses. In the event forests are returned to forests, productivity is often degraded because clayey, dense, and impervious subsoils are replaced in a compacted condition near the surface.

Trends In Reforestation and Restored Forests

The SMRCA has been a very important law that has accomplished a great deal and brought great benefits to the coalfields of the United States, the most important of which were in the areas of human safety and environmental quality. The entire mining community can feel justifiably proud of these accomplishments. Regrettably, the law has failed in one important area; it has caused a systematic reduction in the amount, diversity, and productivity of forest land throughout the coalfield areas of the country. The general trend in mined land reforestation before the implementation of the SMRCA was toward increasing amounts of mined land restored to healthy, productive forests, followed by a dramatic decrease in both the amount and productivity of mined land reforested during the 15-year period following the implementation of the SMCRA.

Due to increasing landowner and public awareness of the short- and long-term loss of the multiple values forests provide, an increase in attempted reforestation has occurred during the past five years. Tree planting has in-creased in most eastern states, and increasing numbers of trees planted is often used by regulators and others as a measure of renewed reforestation success. However, real measures of reforestation success must be used and must include the following criteria:

Criteria for Measuring Reforestation Success:

- amount of mined land, originally forested, returned to forests;
- species composition and functional quality of restored forests compared to the original forest prior to mining; and
- productivity of the restored mined sites compared to the original forest sites.

The trend during the past 20 years has clearly been negative with regard to these three criteria: 1) There has been a significant net loss of forest land due to mining in every state in the east (created "wildlife habitat" is not forest land); 2) the species composition and functional quality of restored forests has been greatly reduced; and 3) the

productivity of the land, that is, the ability of the land to produce forest biomass, has declined. These postmining

conditions are presented next in greater detail.

Forest Conversions to Uses of Lesser Value:

Hayland/pasture and wildlife habitat are the postmining uses imposed on the majority of mined land throughout the East. These land uses are generally chosen by the coal operator for bond-release expediency and to satisfy the regulatory authority's concern for erosion and sediment control. After bond release, 95% of the land reclaimed to these uses is abandoned and reverts to forests via the process of natural succession. This reclamation approach amounts to converting land to uses of lesser value, which is technically against the law.

Figure 1 illustrates the land-use opportunity lost when hayland/pasture and wildlife habitat is imposed on the land and then abandoned, compared to reforestation with hardwoods or conifers. The upper window of the diagram shows a time line beginning at the point of hayland/pasture or wildlife habitat establishment to a point 120 years later when an early successional forest is in place. When these land uses are abandoned from management, a slow process of species recruitment and species recombination occurs. This process is retarded 15 to 30 years because of the competitiveness of the planted exotic grasses, legumes, and shrubs. Tall fescue, sericia lespedeza, and russian olive are examples of competitive species that retard natural forest succession. Even if these species were not originally planted, they are ubiquitous in the coalfields from earlier reclamation planting and quickly invade newly established grasslands and created wildlife habitat. Tall fescue is a known alleopathic species; that is, it exudes toxic substances that prevent the germination and emergence of many native plants. Sericia lespedeza is a tall, competitive legume and a prolific seed producer. Seed is consumed by birds, but not digested because of its hard seed coat, and is widely disseminated across the landscape as it passes through birds' digestive systems. Eventually, early invaders like sumac find openings in the dense, non-native cover and start a process of autogenic succession and facilitation that finally results in a forest consisting of early successional native species. After 120 years, the plant community will have the physical stature and species diversity of a native forest, but another 50 to 80 years must pass before heavy-seeded species like the oaks become the dominant canopy component resembling the surrounding native forest.

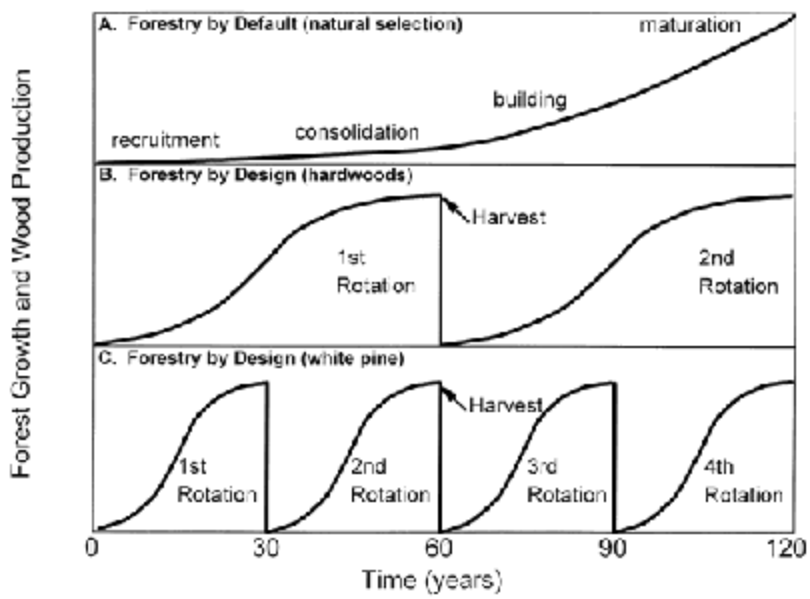

Figure 1. Generalization of wood production on reclaimed mined land.

In the same 120-year period, shown in the middle and lower windows of Figure 1, a landowner could benefit greatly from the production and harvest of two 60-year rotations of mixed stands of valuable native hardwood species, and

with more intensive management, four rotations of conifer plantations could be produced and harvested. This level and rate of forest growth on mined land has been clearly demonstrated (Ashby 1998; Kelting et al. 1997).

Degraded Forestland Productivity:

The productivity of mined land for forestry in both the Eastern and Midwestern coalfield regions can be increased on some sites by the process of reclamation. If natural soils are shallow, or if they contain compacted, clayey subsoils, their quality can be improved by soil reconstruction. Conversely, soil quality can be degraded by reclamation, primarily by selecting poor soil substitutes from overburden materials, replacing undesirable subsoils, and by compacting the reconstructed soil profile. In any case, reclamation has a profound impact on the long-term productivity of restored forest soils.

Figure 2 illustrates relative tree growth rate across a minesoil-quality gradient. In the same way that bushels of corn per acre are used to measure cropland productivity, tree height after a set period of time (25 years for pines; 50 years for hardwoods) is used to measure forest land productivity. This measure is called site index (SI). The diagram shows that a poor to good minesoil quality gradient produces a SI ranging from 45 to 70. That is, 25-year-old trees growing on a poor-quality minesoil will be 45 feet tall, while 25-year-old trees growing on a good quality minesoil will be 70 feet tall. Trees growing on minesoils of average quality will be intermediate in height. The effect of minesoil quality on tree height is intuitive to most people, but not well understood is the fact that the amount and value of the wood contained in trees increases approximately exponentially as tree height increases. Therefore, a stand of trees on minesoils of average quality will be five times more valuable than trees of the same age on poor-quality minesoils, and trees on minesoils of good quality will be 20 times more valuable than trees of the same age on poor quality minesoils. Large trees of the same age have disproportionately greater amounts of wood in their stems, and large stems have a disproportionately higher value per unit of wood because of its higher quality. Therefore, increasing minesoil quality incrementally on the "good" end of the gradient is worth much more than increasing it incrementally on the "poor" end of the gradient.

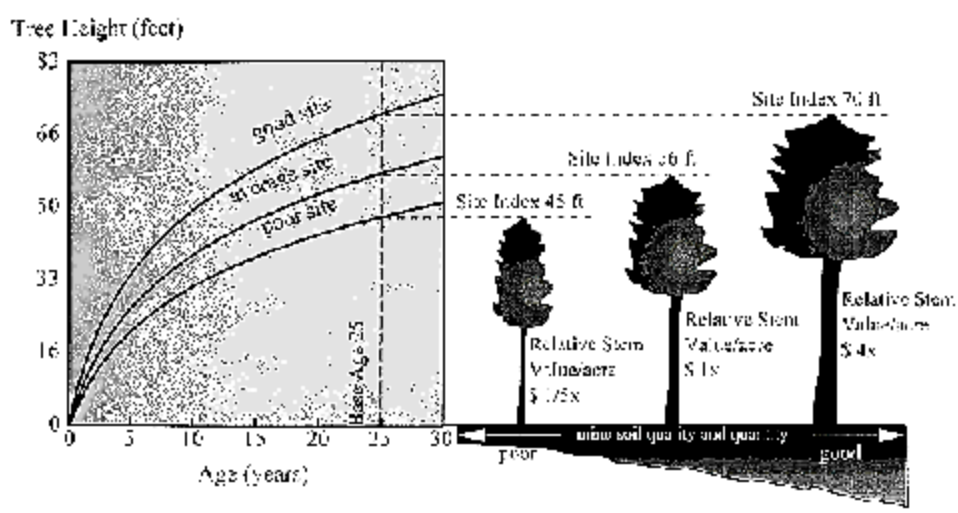

Figure 2. Minesoil quality controls forest productivity.

Torbert and coworkers from Virginia Polytechnic Institute and State University conducted a three-year study funded by the Office of Surface Mining Reclamation and Enforcement (OSMRE) that determined the effect that mining and reclamation are having on forest land productivity and value. The first row of data in Table 2 shows the

average quality of an undisturbed Appalachian forest site using white pine as the indicator species (white pine is widely planted throughout the Appalachians on reclaimed sites). The average height of a well-stocked stand of white pine growing on an average undisturbed site is 55 feet (SI 55), according to USDA Forest Service data (Doolittle, 1958). If such a stand were grown to the harvestable age of 30, it would contain about 35,000 board feet per acre (Vimmerstedt, 1962) worth $1,755 per acre (Timber-Mart South, 1998). Based on the rate of white pine growth across 78 reclaimed mines in Virginia, West Virginia, and Kentucky (Torbert *et al*., 1994), the projected average quality of post-SMCRA minesoils is SI 45. By age 30, the estimated volume yield would be 6,100 board feet per acre, with a per-acre value of $122. A white pine stand growing on a good quality minesoil in Virginia (Kelting *et al*., 1997) will have an estimated 46,100 board feet per acre valued at $3,480 per acre.

Table 2. Effects of reclamation technique on white pine productivity and stand value at 30 years.

White Pine Site Type	Site Index (base age 25)	Volume at Age 30 (MBF/ac)	Harvestable Wood Products	Harvest Price ($/MBF)	Total Value* ($/ac)
Typical reclaimed minesoil (Torbert et al. 1994)	45	6.1	pulp	20	122
Undisturbed Appalachian forest site (Doolittle 1958)	55	35.1	small sawtimber	50	1755
Above-average reclaimed minesoil (Kelting et al. 1997)	70	46.4	large sawtimber	75	3480

*Stumpage value from Timber-Mart South, 1st quarter 1998.

These data show the huge difference in expected value across minesoils of different quality. They show that forest land quality can be greatly enhanced on some sites compared to the productivity of average undisturbed sites. Furthermore, these data show the extent to which current reclamation practice is degrading the value of forest land for wood production. The effect of reclamation on other forest functions and values is difficult to estimate, but there is an extensive base of forest science literature showing that amenity values are well correlated with the ability of a forest site to produce biomass; that is, as wood production capability increases, the amenity values increase proportionately.

Needs: Guideline Changes, Education, and Research

To improve the state of reforestation of mined land, the mining community needs to change its outlook on forest land, recognize its value, and realize that many traditional reclamation practices used for establishing crop and pastureland are not suitable for reforestation. Reforestation "needs" can be summarized around three initiatives: 1) changing guidelines and rules; 2) improving techniques and practices; and 3) changing mind-set and tradition through research and education. I have identified seven issues constraining successful reforestation of mined land. I maintain that mined land reforestation throughout the country would benefit by making guideline, technique, and mindset changes to each of these seven issues.

1. *Make a Full Accounting of the Value of Forestland:* As I argued above, forests are an economic mainstay of the economies of many eastern states. In addition to the products they provide, their amenity values are becoming

increasingly important to local communities and the public at large. Forest land use is currently and adequately protected by the Code of Federal Regulations (1997). A paraphrase of the rule reads:

30 CFR-715.13 Postmining Use of Land

(a) General: ……restore land to conditions capable of supporting uses before mining……or to higher or better use.

(d) Criteria for approving alternative postmining use of land: ……approved by regulatory authority after consultation with landowner……show feasibility of proposed land use related to needs, markets, land-use trends……feasible plans for financing and maintenance of the land use.

Based on this clearly stated rule, the common practice in the Appalachians of converting forest land to alternate uses of hayland/pasture or wildlife habitat that is subsequently abandoned after bond release should not be allowed. Forest land is actually being converted to an alternate use of *lower* value if the grassland or wildlife habitat is not maintained. As described above, when these uses are abandoned, the land becomes worthless for the foreseeable future. The criteria for approving alternative postmining uses require a show of feasibility related to needs, markets, and land-use trends, and an assumption that the designated use will be financed and maintained. There is no way a reasonable person could conclude that forest land converted to grassland or wildlife habitat that is commonly abandoned after bond release due to the lack of need, markets, and maintenance feasibility, amounts to a higher or better use than a forest restored to its original level of productivity.

The "needs" associated with this issue are simple: regulatory authorities simply need to enforce the rule. Enforcing this rule would do more for reforestation in the Appalachian region than all other recommendations combined.

2. *Revise Success Standards Based on Forest Productivity:* Returning mined land to its original level of productivity, and to a condition capable of supporting premining uses, is a fundamental provision of the SMCRA. For areas developed for use as cropland, hayland or pastureland, crop production on the revegetated area must be at least equal to that of a reference area (30 CFR, 1997). In effect, the mined land must be returned to its original level of productivity for these crops. A simple example is given in Table 3: If cropland, prior to mining, produced 150 bushels of corn per acre on average, the land must be able to produce the same amount after mining and reclamation. Similiarly, if hayland prior to mining produced, on average, 6 tons of hay per acre, the land must be able to produce the same amount after mining and reclamation. A logical follow-on is that if forest land prior to mining produced, on average, 10,000 board feet of sawtimber per acre, the land must be able to produce the same amount after mining and reclamation. After all, the forest land owner is just as dependent on the postmining productivity of the land for timber production as the farmer is for corn and hay production. To the contrary, as Table 3 shows, the postmining standard for forest land is merely a stocking level of some minimum number of trees per acre. Therefore, it is perfectly legal to degrade the productivity of forest land in the process of mining because the only requirement is that trees be planted and live for several years. This is equivalent to requiring that corn be planted on reclaimed cropland but with no expectation that it be capable of producing a marketable crop.

The current standard for success for forest land reads as follows:

30 CFR-816.116-Revegetation: Standards for success

(a) (3) For areas to be developed for fish and wildlife habitat recreation, shelterbelts, or forest products, success of vegetation shall be determined on the basis of tree and shrub stocking and vegetation ground cover.

Table 3. Post-mining productivity standards.

Land Use	Premining Yield	Postmining Standard
Cropland	150 bu/acre	150 bu/acre
Hayland	6 tons/acre	6 tons/acre
Forest land	10,000 bd.ft./acre	400 seedlings/acre

Somehow, in the process of interpreting the law, the rule makers misunderstood the nature of forests and forestry: the fact that forest quality is a function of soil quality, and that forestry, like farming, is a business that depends on the productivity of the land.

The "needs" or "need" associated with this constraint to reforestation of mined land is a rules change. In a fashion similar to that for cropland and hayland, CFR 30 should require a postmining forest land productivity level comparable to a reference area. The success standard would have to be based on a minesoil quality standard for trees because a production standard for long-lived plants is not feasible. Tree growth and productivity as a function of soil and site quality is well established (Carmean, 1975; Stone, 1984), and there are a number of studies showing that forest productivity can be estimated using minesoil properties (Torbert et al., 1998; Burger et al., 1994; Andrews et al., 1998). Furthermore, Burger et al. (1992) and Torbert et al. (1994) show that adequate minesoil quality is easily achieved by selecting proper topsoil substitutes, an existing provision of the law.

We should not be deterred from making this important rule change based on the unfounded argument that it might create another disincentive against forestry postmining land uses. Restoring productivity to original levels is one of the most fundamental provisions of the SMCRA. Because the law was not interpreted properly for forest land, land degradation is commonplace (Ashby, 1998; Burger et al.,1998). Planting more trees in degraded land is not progress. As argued above, reforestation success is not only a matter of numbers of trees and acres planted; the trees must survive and produce products and services at premining levels.

3. *Use Topsoils and Topsoil Substitutes Specific for Trees and Forestry*: Part 715.16—Topsoil handling, under the General Performance Standards (715) of 30 CFR, requires that all topsoil be removed and salvaged unless use of alternative materials is approved by the regulatory authority. To paraphrase the regulations, this includes all of the A horizon, and where the A horizon is less than 6 inches, a 6-inch layer that includes the A horizon and the unconsolidated material immediately below the A horizon shall be removed and the mixture replaced as the surface soil layer. Where necessary to obtain soil productivity consistent with postmining land use, the regulatory authority may require that the B horizon or portions of the C horizon or other underlying layers demonstrated to have comparable quality for root development be segregated and replaced as subsoil. Selected overburden materials may be used instead of, or as a supplement to, topsoil where the resulting soil medium is equal to or more suitable for vegetation. In order to use topsoil substitutes, the permittee must demonstrate that the selected overburden material is more suitable for restoring land capability and productivity by the results of chemical and physical analyses, including pH, percent organic material, nitrogen, phosphorus, potassium, texture class, and water-holding capacity, and other such analyses as required by the regulatory authority.

This regulation has been carefully and appropriately written, and it fully accommodates the needs for restoring forest land capability and productivity. However, required minesoil quality for trees and forestry is different from that for agricultural and pasture crops, and it is poorly understood by most people in the mining and regu-

latory communities. Topsoils and topsoil substitutes are routinely selected for the performance of the temporary ground cover rather than the permanent forest cover. In the Appalachian region, where more than 90% of all mined land will ultimately become forested, a wide variety of deep overburden materials are allowed as topsoil substitutes because they support ground cover species when heavily fertilized. In a following paper in this proceedings, I show evidence that most of these overburden materials from deep in the mine profile are not suitable for trees and forestry. On the other hand, surface soil, subsoils, unconsolidated C and Cr material, surface weathered-sandstone overburden, and mixtures of any or all of the above, have been shown to be excellent growth media for native tree species. Furthermore, in the Midwest, replacing dense, acid, finely textured B and C horizons of some soils with selected overburden materials increases forest productivity, and should improve soil quality for most land uses.

The need associated with this issue is simply the realization that forest productivity is very much a function of minesoil quality; that suitable topsoil substitutes are not being used on most mined land in the Appalachian region due to an emphasis on the performance of temporary ground cover; that selected overburden materials may be better substitutes for some B horizons in the Midwest; and that current, well-written regulations dealing with topsoiling are not properly interpreted to insure that forest land productivity is restored.

4. *Minimize Grading to Reduce Minesoil Compaction:* Another major impediment to reforestation of mined land is surface soil compaction caused by excessive grading for final site preparation. Mined sites must be reclaimed in a way that assures mass stability; therefore, overburden on slopes is compacted to meet certain engineering standards. For the most part, these procedures are not the cause of compacted surface soils that impede reforestation success. The follow-up grading of surface-soil material and tracking-in procedures cause most of the minesoil compaction problems. 30 CFR 715.14—Backfilling and Grading simply requires: "Transport, backfill, grade, and revegetate to achieve an ecologically sound land use compatible with the prevailing land use in unmined areas surrounding the permit area." Graded slopes need not be uniform, and small depressions are allowed if compatible with the approved postmining land use. Therefore, the regulations do not require a smooth, compacted surface suitable for the traverse of farm machinery; nonetheless, there is a regulatory mindset that requires this condition, no matter what the postmining land use. We estimate that operators could save between $200 and $500, and that forest productivity could be increased severalfold, by reducing the amount of final grading consistent with forest land uses. Forest land is naturally more undulating and forest soils are deep and uncompacted. Infiltration is rapid and surface erosion is virtually nonexistent. Forest operations are done with rugged equipment designed for steep slopes and uneven surfaces.

   We need to change the mind-set that expects and requires reclamation that produces an agronomic land surface when the postmining land use is forestry – because in the process of creating this surface, soils are compacted, trees are difficult and sometimes impossible to plant, water runoff increases, erosion increases, operator costs increase, and long-term forest productivity and value are degraded.

5. *Rationalize the Cost of Reforestation:* Planting trees is perceived by many as an added cost when reclaiming mined land. Using that logic, one could argue that liming and heavy fertilization, not required by trees, is an added cost when establishing pastureland. A decision to plant or not to plant trees should be based on legal and desired postmining land-uses. If forestry is the legal and desired land use, then it will obviously require planting trees. Buying and planting trees is costly, especially for mined land which normally requires more species, better planting stock, and greater planting effort than are required for establishing familiar conifer plantations on natural soils. The "needs" associated with this issue are to show that the cost of reclamation with trees can be competitive with other land uses when the appropriate techniques are used. Compared to pastureland and wildlife habitat, reforestation is less expensive because it requires less grading and less ground-cover seed and fertilizer, and it eliminates the cost of liming by choosing acid-tolerant ground-cover species that are naturally more compatible with trees (Torbert et al. 1994).

6. *Use Tree-Compatible Ground Covers and Standards:* Very few grasses and legumes grow naturally as ground covers with forest trees in the eastern and midwestern parts of the United States. In no cases are covers of grasses and legumes sown or encouraged in new tree plantings. As a matter of fact, it is common reforestation

practice to harrow or use herbicides prior to tree planting with the express purpose of eliminating competitive grasses and herbs. OSMRE regulations requiring the planting of trees in ground covers are contrary to common and well-established silvicultural practice. Nonetheless, a balance between reforestation success and erosion control is needed. Our experience throughout the east and midwest indicates that erosion control is overemphasized at the expense of reforestation success. Complete erosion control requires a dense ground cover, and a dense ground cover causes reforestation failures due to excessive competition for light, water, and nutrients. Ground cover species mixtures have been developed that are more compatible with tree establishment (see the following paper by Burger and Torbert), nonetheless, percent coverage standards need to be relaxed if trees are expected to survive and grow. More surface erosion during the first and second years after reforestation must be tolerated, provided it does not compromise water quality. The "needs" associated with this reforestation constraint are both technical and educational. We need to find the proper balance between erosion control and tree survival and growth; we need to relax the cover standards and include as "cover" nonerosive areas covered by litter, mulch, and rocks so trees can survive; and we need to change the mind-set common among regulators that tall, dense ground covers are always best.

7. *Develop Bond Release Incentives to Use Trees:* The risk of reclaiming to forest is greater than that of reclaiming to pastureland. Standards for pastureland postmining land uses are unambiguous, and confirmation of success is seldom second-guessed by regulators and operators. The current standards for forestry are not very well understood, and measuring success is open to greater interpretation. There are several "needs" that would alleviate bond-release disincentives; greater clarification of standards and means of assessment are needed on a state-by-state basis. In addition to relaxed cover standards mentioned above, greater flexibility is needed for tree establishment than is currently allowed in most states. For example, certain species mentioned in the permit may not be available at the time of planting, so substitutions should be allowed. Random mixtures of species are better than block plantings provided the species are compatible. On many mined sites, tree monocultures are appropriate and should be allowed. Abnormal weather conditions should be taken into account when enforcing the 80-60 rule. And husbandry practices, including augmented seeding and planting, could be considered normal practice under many circumstances.

Summary

Reforestation of mined land prior to implementation of the SMCRA was commonplace and largely successful. A combination of regulatory requirements created disincentives for selecting forestry as the postmining land use. As landowners and local communities realized that forestland conversions to scrubland and abandoned grassland were degrading the value of the landscape, an effort was made by landowners, regulators, miners, and researchers to determine and resolve impediments to reforestation.

Based on academic research and observations since the Federal law was implemented, I believe landowners and the mining community need to change their outlook on forestland, recognize its full value, and realize that many traditional reclamation practices used for establishing crop and pastureland are not suitable for reforestation. In the past 20 years, large amounts of forestland have been converted to other uses of lesser value and, on average, forestland productivity has been degraded. To improve this situation in the future, several regulatory guidelines and rules need to be modified, techniques and practices specific for forest land should be used, and certain traditional approaches to reclamation should be changed through research and education.

The most important needs are 1) make a full accounting of the value of forestland; 2) revise forestland success standards based on forest productivity; 3) use topsoils and topsoil substitutes specific for trees and forestry; 4) minimize grading to reduce minesoil compaction; 5) rationalize the cost of reforestation; 6) use tree-compatible ground covers and standards; and 7) develop bond-release incentives to use trees.

Academic research has shown that reclaimed forest land can be as productive as it was before mining, and that it can serve the multiple functions of producing wood, improving water quality, providing wildlife habitat, creating diversity and ecosystem stability, sequestering carbon, and providing aesthetic landscapes. Further cooperation among landowners, miners, and regulators is needed to eliminate impediments and disincentives for reforesting

mined land. The OSMRE must take the leadership role in implementing changes that appear to be sound, find money to research them if they lack a scientific underpinning, develop and modify policies and procedures to effect desired change, and reach out to the mining community and show it why these changes are important.

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PERSPECTIVES ON CONSTRAINTS, EXPERIENCES, TRENDS, AND NEEDS RELATING TO THE ESTABLISHMENT OF QUALITY WILDLIFE HABITAT ON MINED LANDS IN KENTUCKY

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Introduction

The Kentucky Department of Fish and Wildlife Resources (KDFWR) is charged with the conservation and management of the fish and wildlife resources of the Commonwealth. In its simplest terms, maintaining these resources comes down to providing habitat of adequate quality and quantity for fish and wildlife to survive. Healthy and diverse forest land is high quality wildlife habitat and plays a critical role in the maintenance of healthy aquatic ecosystems. For these reasons, KDFWR maintains a keen interest in the reforestation of mined lands. KDFWR believes the goal of reclamation should be to return mined lands to their natural state of productivity.

Forest land contributes to the health of lakes and streams in a variety of ways. Perhaps the most important of these contributions is land stabilization. Trees do an excellent job of holding soil in place. Land that would otherwise be highly erodible is stable when forested. Trees growing along a stream bank stabilize the stream bank and filter sediment and other pollutants before they can enter the stream. They also provide shade that helps to moderate stream temperatures, an important habitat requirement for many species of aquatic life. Forest litter such as leaves and branches make their way into lakes and streams and are an important part of the food web.

Healthy forests also are important to terrestrial wildlife. For most areas in Kentucky, the natural land cover type is forest. This forest land is a naturally dynamic ecosystem and various wildlife species are adapted to utilize the habitat that results from the different stages of forest succession. For example, the species composition of a recently disturbed forest stand differs dramatically from that of a mature stand. Other species prefer the habitat that exists where two or more different habitat types come together. This type of habitat is commonly referred to as edge, and species that thrive in this type of environment are often called edge species. Many game species are considered to be edge species. Because different types of wildlife are uniquely equipped to live in different types of habitat, any forest disturbance benefits some wildlife species and is detrimental to others.

Wildlife Habitat on Mined Land

From the standpoint of wildlife habitat, mining can be viewed as a form of forest disturbance. Due to the nature of the disturbance, the effects are more severe than disturbances commonly considered such as timber harvest or fire. With these types of disturbance, the forest regenerates itself over time and the wildlife composition changes throughout the regeneration period. The major concern from a wildlife habitat perspective is that, since the passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977, techniques used to reclaim surface coal mines, in effect, limit the ability of the land to go through the stages of natural succession. Whereas, a forest stand disturbed through fire or harvest may return to mature forest in a period of 50 years, an area disturbed through modern mining and reclamation techniques will require considerably longer, if it recovers at all.

Such was not always the case. While pre-SMCRA mining techniques in Kentucky presented an array of environmental and other problems, the sites are, in many cases, now returning to or have already become productive forests. Because land that is capable of undergoing the natural process of succession is so important to maintaining healthy fish and wildlife populations, it is prudent to examine these prelaw sites and determine what gives them the capacity to grow trees that recently reclaimed mine sites lack.

Much can be learned from how these lands were reclaimed. The most important thing that productive prelaw mine sites have in common is a minimum of grading. Grading and shaping takes time on a dozer, and time on a dozer costs money. Therefore, this task was kept to a minimum. When we go back and look at these sites where good material was placed at the surface and little grading took place, we now typically find productive forests returning. Granted, these impacts have typically had the result that succession has taken a bit longer than is typical of other types of forest disturbance. They have not, however, precluded future forest production.

Another important aspect to consider about early mining impacts upon terrestrial ecosystems is their relatively small scale when compared to the impacts seen in more recent times. Increased mechanization and more efficient recovery techniques hastened the need for comprehensive, national mining legislation. This regulation of surface coal mining came about in the form of the previously mentioned SMCRA.

The enforcement of SMCRA has brought about drastic changes in the manner in which mined lands are reclaimed. The law sets forth standards on how land is to be reshaped and revegetated. Emphasis has been placed on smooth, well-shaped landscapes with vegetation that is thick, lush, and green. These gently rolling landscapes reclaimed with a thick grass and legume ground cover have become the industry standard.

This type of reclamation has long been viewed as a significant improvement over the type commonly seen during the prelaw era. In most ways it was. SMCRA addresses a multitude of extremely important issues. Water quality has been improved dramatically by the new standards. The law also mandates grading and shaping that eliminates many safety hazards such as highwalls and auger holes that were routinely left behind by prelaw mining operations. Perhaps just as importantly, since SMCRA, reclamation has simply looked better.

There is a downside to these well-manicured sights, however. Mined lands reclaimed in such a fashion have a heavily compacted surface layer that severely limits natural forest succession. Consequently, postlaw mining does not simply disturb existing forest land; it changes the existing habitat in a more permanent way. In most cases, postlaw reclamation has resulted in conversion of forest to grassland. As we have already discussed, conversion of forest land to another type of habitat benefits some wildlife species and harms others. This should, theoretically, increase the local populations of grassland dependent wildlife, and to some degree it does. Unfortunately, almost all of these reclaimed sites have been planted to Kentucky-31 tall fescue and sericia lespedeza. Both of these species are notorious for their limited value to wildlife for both food and cover. Consequently, the quality of this new habitat is much lower than it could be. The impact of systematic conversion of high quality forest land to low quality grassland is not desirable wildlife management.

Much of the land that has been converted from productive forest land has been reclaimed to a fish and wildlife postmining land use (PMLU). This land use type is allowed under current regulation and is primarily centered around providing habitat for edge species. As we have already discussed, many highly desirable game animals are considered to be edge species; therefore, it is easy to understand why the creation of edge habitat has been so prominently featured in the fish and wildlife PMLU. Mined lands reclaimed to fish and wildlife habitat are reclaimed as grassland and required to have at least 30 percent of the area planted to trees and shrubs. Additional wildlife habitat enhancement components such as shallow water depressions, nest boxes, and brush piles are encouraged. Unfortunately, mine sites reclaimed as fish and wildlife habitat have often been reclaimed in the same manner as sites having a hayland pasture PMLU. They are heavily compacted and in most cases the grass and legume components are dominated by Kentucky-31 tall fescue and sericia lespedeza.

New State Policies that Enhance Fish and Wildlife Habitat

An update to the fish and wildlife PMLU standards took effect in 1994 in the form of Technical Reclamation Memorandum (TRM) #21. These new standards allowed for a decrease in the stocking density of trees and shrubs from 450 stems per acre to 300 stems per acre on the 30 percent of the area required to have them. However, new specifications were put into place that required these species to be of higher quality to wildlife. Of the 300 now required, 90 stems are to be hard mast producing species, 30 stems must be conifers, and 30 stems each must be at least two soft mast producing trees or shrubs. These tree and shrub species are to be chosen from an approved list

included as Appendix A of TRM #21. Additionally, guidance is provided that steers operators to more wildlife friendly herbaceous species and away from fescue and sericia lespedeza.

The fish and wildlife PMLU has proven extremely popular with the industry. A major factor in this popularity is the absence of the productivity standards that exist with the hayland pasture PMLU. Just as is the case with both the commercial and noncommercial forest PMLUs, the fish and wildlife PMLU establishes success standards based solely on the establishment of ground cover and living stems at the time of bond release. The capacity for long-term productivity is not considered; therefore, there is no requirement that land be reclaimed in a way that allows forest regeneration or plant succession toward a mature, productive forest land.

Concerns over long-term forest productivity on reclaimed mine lands has been mounting for some time in the state of Kentucky. Many individuals feel strongly that reclaiming mined lands means more than grading the land smooth, establishing a thick carpet of something green, and keeping trees alive until bond release. Fortunately, measures have been undertaken to address this issue. Based on a recommendation to the Governor's Office by the Kentucky Environmental Quality Commission, a working group was established to review current reclamation techniques and provide guidance as to how to address the issue. KDFWR participated in and supported this process. The working group determined that existing surface mining regulations do not need to be revised to accomplish the goal of mined land reforestation and a reforestation initiative was issued in the form of Reclamation Advisory Memorandum (RAM) #124.

RAM #124 outlined reclamation techniques that are in compliance with current regulations and when employed will provide for the reforestation of mined lands. Recommendations include selection of appropriate spoil material for utilization as growth medium, decreased compaction, and proper selection of vegetation. Use of the methods outlined in RAM #124 provide a landscape that is more capable of undergoing normal forest succession and, therefore, more adequately addresses long-term habitat needs.

KDFWR supports the implementation of RAM #124. When sites are to be reclaimed under the existing fish and wildlife PMLU, the single most important aspect of the reclamation should be to establish a good rooting medium. Species established as herbaceous cover should be chosen based on usefulness as food and cover for wildlife, as well as compatibility with tree growth. Tree and shrub species with food and cover value to wildlife should continue to be selected. Of particular importance is the planting of hard mast species which require a much longer period of time to invade a site naturally. Species of trees with wind borne seeds, such as sweet gum, tulip poplar, and the maples, will invade the site on their own, given (1) time, (2) an appropriate rooting medium, and (3) a less aggressive species as ground cover. The invasion of native vegetation should be encouraged. Current regulation does stipulate that invading trees and shrubs be counted toward meeting success standards. This same attitude should be taken when considering ground cover requirements. There is, in some cases, a mind-set that a reclaimed area should meet ground cover requirements based solely on planted vegetation. An area dominated by native weeds, such as goldenrod, ironweed, and broom sedge, can be as beneficial to wildlife as an area with a weed-free stand of orchard grass and clover.

Another issue to consider with planted vegetation is the creation of edge. Planning for optimal edge habitat is called for in the Kentucky surface mining regulations. In an attempt to accomplish this goal, companies often simply plant all trees and shrubs in long linear plantings a few rows wide throughout the entire permit area. Rows of trees and shrubs do serve an important function as travel corridors and should certainly be used to connect important habitat components such as water sources and undisturbed (unmined) forest. Scattered trees and shrubs also can be beneficial to some species; however, KDFWR recommends that sites reclaimed to a fish and wildlife PMLU also should consider other important aspects of reclamation. The primary objective should be to speed up the natural process of forest succession. Planting tree and shrub species in larger clumps will allow these areas to grow more quickly into young stands of woods. Planting them adjacent to existing woodland will provide more of a "feathered edge" an area where one habitat type (mature forest) intergrades into another (grassland). This type of edge habitat is much more beneficial to edge adapted species than a "hard edge" such as mature woods bordered by grassland. At the same time, it more accurately imitates the process of forest succession. For example, when a

farm field is abandoned, woody growth encroaches from the outside edges until the entire field eventually becomes a young woodland.

In addition to providing a growth medium and planting to encourage natural succession, wildlife habitat enhancement practices should be included to the extent practicable. Brush piles and rock piles can be important cover components for many species. Shallow water depressions left randomly scattered on the landscape provide breeding areas for frogs, toads, and salamanders, as well as watering sites for other species. Retention of dugout and on-bench sediment structures also provides sorely needed sources of water for wildlife. KDFWR supports the modification of existing regulation to allow operators to partially regrade and leave such structures anytime they do not pose a serious hazard.

Perhaps as important as changing the current methods of reclaiming to a fish and wildlife PMLU is to realize that any PMLU creates a new type of habitat. It has been a common misconception that KDFWR would prefer all mined land be reclaimed to a fish and wildlife PMLU. This is not the case. As has been stated earlier, forest land is excellent wildlife habitat. If the premining habitat type is forest land, KDFWR recommends the area be returned to forest unless the landowner specifically desires another land use type. This statement, as well as any requiring reclamation of undisturbed forest back to forest land, tends to lead to the discussion of the landowners' right to choose his desired PMLU. KDFWR is not proposing infringement upon the rights of private landowners that currently exist in the surface mining regulations. However, it is common knowledge that quite often surface owners simply allow the mining company to return the land to whatever PMLU they desire. When the company does not own the land, they typically choose the reclamation option that is cheapest. Often these areas are hayland pasture or fish and wildlife PMLUs. If it can be shown that reclamation to forest land will save the operator money because of decreased grading, and bond release is possible because trees will survive, we may hear fewer arguments that the landowner has a right to a hayland pasture PMLU. If then, the landowner truly does desire a pasture, he has that right under existing regulation. The problem is that, until now, the forest land PMLU has not been a truly practicable option.

The success of implementing RAM #124 is contingent upon the education of both mine operators and the enforcement community. A wealth of information exists that indicates that decreasing the amount of final grading can result in a substantial savings to the mining company. Significant cooperation among engineers, operators, and mine inspectors must occur for operators to make sure that surfaces needing heavy grading to maintain stability are graded adequately and areas not needing such treatment are identified and handled appropriately.

Future Efforts

KDFWR supports the establishment of cooperative projects between the (1) Kentucky Department for Surface Mining Reclamation and Enforcement, (2) Office of Surface Mining, (3) Kentucky Division of Forestry, (4) KDFWR, (5) University of Kentucky (UK), and (6) the mining industry to establish demonstration areas for the practices outlined in RAM #124. These demonstration areas should be set up on mine sites that are permitted, bonded, mined, and reclaimed in the standard manner. Work such as that being done by Dr. Don Graves on UK's Starfire project provides invaluable information about the effects of various levels of soil compaction on tree growth and on the tree species that grow best on mined lands. Unfortunately, but understandably, many people in the coal industry may simply view this as "research." Therefore, it is desirable that demonstrations be set up throughout both the eastern and western coalfields of Kentucky that use RAM #124 in a variety of geographic locations and reclamation scenarios. Efforts are already underway to do this type of work. These endeavors should be continued and increased because they can accomplish the important goal of demonstrating that decreased grading and reforestation is practicable.

KDFWR supports all efforts to reclaim mined lands in a more environmentally responsible manner. Certainly providing for long-term forest productivity fits this description and is important to the goal of improving the quality of wildlife habitat on reclaimed lands. It is crucial to remember that mining is in most cases a form of forest disturbance and the goal of forest land reclamation should be to reestablish sites with the capacity to undergo natural forest succession. This requires reclamation to be considered much more than a process resulting in a certain

number of stems per acre and adequate ground cover five years after mining ceases. We must begin to view reclamation as a process that allows us to restore the future productivity of our land.

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[1] Steve Beam, Wildlife Biologist, Kentucky Department of Fish and Wildlife Resources, Somerset, Kentucky. Beam has worked in the environmental section and on environmental concerns related to mining. He was a member of the Kentucky Department of Fish and Wildlife Working Group that drafted the Kentucky Reforestation Initiative.

OHIO'S PERSPECTIVES ON CONSTRAINTS, EXPERIENCES, AND NEEDS: A PRACTITIONER'S VIEW

Jim Stafford[1]
Ohio Division of Forestry
Zanesville, Ohio

History

On AEP land in 1967, a combination of pioneer species, interim species, and climax species was planted. The pioneers would include black locust because it was aggressive and would quickly die out. The interim species are those that are disseminated by air like cherry, white and green ash, and elm. The climax species in southeast Ohio would be oaks and hickories. They began with a stocking level of over 1,000 trees per acre. The first year survival was about 70 percent. By 1992, the survival rate had dropped to 307 stems per acre. That would be about what would be expected in a natural state based on the climate and soils of southeast Ohio. We expect at the maturity of the stand (an age of about 80) that this site will carry about 100 trees per acre. This tract would represent a successful planting. Just as important as the number of trees per acre is their growth rate. Our growth rate for yellow poplar was 1.4 feet per year. The white ash was about 1.0 foot per year. Typically on soils in southeast Ohio, yellow poplar would be expected to grow 80 to 90 feet tall in 50 years. So this site would have had a site index of around 70 for yellow poplar. That would be within an acceptable range for growth of yellow poplar.

After 1970, AEP was no longer faced with tree planting on ungraded spoils and was now faced with planting trees on compacted graded soils. This resulted in a very low success rate with attempts at reforestation with the species mixtures that had been planted prior to 1970. On post 1972 plantings at AEP when the trees faced heavy competition from herbaceous species and heavy soil compaction, they reduced the initial number of trees planted and experienced a reduced first year survival rate of 50 percent. This results in too few trees to change the soil environment into a forest soil. You will not get the necessary microbial activity typical of a forest soil. Also the trees will not grow straight and be self pruning at these low numbers of trees per acre. Also, the growth rates were much reduced. White ash was down to 0.6 feet per year and yellow poplar dropped to about 0.3 feet per year. This reduced the site index to below 30 feet per 50 years, which would not be an acceptable forest production rate. As a forester, if a landowner talked to me about planting trees on land with a site index of 30, I would tell him not to bother.

Conclusion

I am now working with landowners who have had their final bond release and are telling me that they want their woods back. We need to get back to reclamation with trees. The native climax community in southeast Ohio is not grasslands, it is and oak/hickory forest. The creation of thousands of acres of grassland is of no benefit to the wildlife as they are adapted to forest not grassland. Ohio has a $7 billion dollar a year timber industry and grasslands do not help them. Grasses and trees do not mix. The result of planting trees in grass is that the tree growth is much reduced. You must eliminate the grasses in order to get tree growth. We need to find a better way to place the top 6 feet of plant growth material in place so that compaction is minimized. I do not see any significant difference between how coal mines are reclaimed and highways are built. They use the same equipment and the same methods and get the same results, maximum compaction. I know I would never be able to establish trees in an interstate highway right of way. I can not comment on how this should be done, but we need to find a way to replace the root zone so that compaction is reduced. We need to continue to look at seed sources to ensure that we get adapted species that would do well on the sites on which they are planted.

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[1] James P. Stafford, Forester, Ohio Department of Natural Resources, Zanesville, Ohio. Forester since 1981. Stafford graduated in 1976 from Ohio State University with B.S. in forest resources management. He worked for

Champion International at a plywood mill in Cordova, Alabama until 1978. He supervised the Alabama State Nursery in Autaugaville, Alabama until 1981. He supervised Green Springs Nursery until 1984. He supervised the Tree Improvement program until 1994. Currently, he is an Ohio Service Forester assisting landowners in Muskingum, Coshocton, Guernsey, and Belmont counties since 1981. He also is a member of the Ohio Chapter of the Society of American Foresters, the Ohio Mine Land Partnership, and the Ohio Nurseryman's Association.

REFORESTATION CONSTRAINTS, EXPERIENCES, TRENDS, AND NEEDS: A LANDOWNER'S PERSPECTIVE

Timothy Probert[1]
Pocahontas Land Co.
Bluefield, West Virginia

Through decades of research by Clark Ashby, Don Graves, Jim Burger, and many others, science has shown us that we can create a productive site to grow commercially valuable hardwood and pine species on reclaimed surface mine sites throughout most of the United States. Using the guidelines and techniques described in research, it is time we as landowners take a more active roll and have more input into the reclamation process.

Landowners – Get involved!!!

If landowners want a productive commercial forest following surface mining, they need to be involved in the reclamation process from the beginning of the permitting process and follow through to vegetation establishment and tree planting. A landowner can't be forced into taking an active role in the reclamation of his land, but if he wants to insure the productive potential of his land is reached, he best **get and stay involved.** A landowner must first be convinced that a commercial forest is his best land use alternative. If surface mined land can be commercially developed to give the landowner a greater return on his land than forest land, he will more than likely lean toward that use. In the Midwest, farmland may be more valuable to the landowner, but for the most part, in the Appalachian coalfields of West Virginia, Kentucky and Virginia, the best use for the majority of reclaimed surface mined land is commercial forestry. Whether the landowners' objectives are to create wood for fiber, quality saw timber or to create a forest for aesthetics, and increase wildlife habitat, the same type of quality site must be created during the reclamation process to insure the greatest survival, growth, and value of timber is realized.

Some landowners will need to be educated in some basic forestry to learn what the potential value of an acre of reclaimed land could be. Even large landholding companies that regularly harvest timber off their nonmined lands may need to be shown the economic incentives to persuade management to invest in commercial forests following surface mining. A landowner will have a sizeable amount of money invested in his future forest and also has the risk of forest fire, insects and disease, deer browse damage, and ATV damage during the time the trees are growing from seedlings and saplings into the pole stage and on to mature saw timber. Landowners need to be aware that growing timber is a long-term investment. But the long-term benefits not only provide a future income from timber production, they also add to the aesthetics of the land, benefit wildlife with food and cover, better stabilize the mine spoil, reduce erosion, improve water quality, and generally improve the quality of the land.

Some good things happening

Several years ago, it seemed like we were banging our heads against the wall when we advocated less compaction, less competitive groundcover**,** burying the shales and putting the brown sandstone on the surface, and recommending coal operators use a reputable tree planting contractor to plant the trees. The coal operators and contractors didn't seem to pay much attention and reclaimed the sites the way they always had**S**Kentucky 31 tall fescue, red and yellow clover, and compaction. But through several years of repeating the same story over and over in workshops and seminars, I believe we are beginning to see some progress. With our company assisting with the cost of reforestation, many of our coal lessees are now utilizing the techniques shown through research to create good sites for commercial forestry.

Planted in 1986, a site in West Virginia was left uncompacted. Where tree compatible ground cover was used and brown sandstone was the dominant spoil material, the area now has trees over 30 ft tall and 8 inches in diameter. This stand is well on its way to becoming a productive forest once again.

Another site, planted in 1990 in eastern Kentucky, shows trees growing in the uncompacted sandstone had a three times better growth rate than trees in areas where conventional reclamation procedures were used, with yellow poplar 12 feet tall and sycamore 20 feet tall. Again, these areas are showing great promise for the future. These sites have been used over the years to show coal operators that productive sites and productive forests can be created after mining. Over the last few years, several positive changes have been made within the states of Kentucky, Virginia, and West Virginia's regulatory agencies that make it more practical and affordable to use commercial forest land as the preferred postmine land use.

Rate of return

By creating the most productive site possible for trees following surface mining, a site index of 75 or better can be attained. (Site index is used as a measurement of sited quality, estimating tree height at a given age based on soil and physiographic variables.) This site should be able to generate a stand of yellow poplar pulpwood by year 20 and small saw timber, utilized for peeler logs in the plywood market, by year 30. With fast growing species like poplar and sycamore, it is likely to have a commercially harvestable stand of timber in 30 years. If the stand was planted with 545 trees per acre and had an 80 percent survivial rate, these trees could generate 33,540 board feet of timber per acre and be worth $3,857.10 per acre. With an initial planting cost of $218.00 per acre, and including an annual management fee and taxes, this stand of timber could generate a **10.2 percent return** on investment. If the landowner was sharing the cost of tree establishment, the rates of return would be even higher. A 10 percent return looks like a good enough reason for a landowner to want to establish commercial forests after mining.

Where we're missing opportunity

Unfortunately, landowners, especially ones owning smaller acreage, often do not take the initiative, but let the coal operator or mining contractor handle all phases of the mining and reclamation operation—from permitting to mining, grading, and seeding. Some landowners and coal operators are in it for the short-term gains of coal royalties and coal sales and not interested in the long-term investment of timber. Often, when a landowner decides to plant trees after the fact, he may find the postmine land use in the mining permit will make it difficult for him to establish trees or he may have to amend his permit.

If a landowner decides on a postmine land use of commercial woodland, and then has little interaction with his coal operator or contractor and does not follow-up with inspections to the mine site, he might be in for a big surprise. Even though many more surface mines in Kentucky, Virginia, and West Virginia are using forests as the postmine land use, mine sites are still being reclaimed to have the manicured "golf course" look. A landowner must take the time to work with the operators of the mining equipment **on the job** to be sure they understand his desire to leave the surface as uncompacted as possible and, also, what is the best spoil material available on site to be used for establishing trees. It is hard to get a dozer operator who has been used to compacting spoil material for the last 20 years to now leave it uncompacted with minimal grading, or ask a hydroseeding contractor to change to a new tree compatible seed mix when he knows he can get the required ground cover with the "old standard" mix. Attitudes must change and the landowner must be willing to get involved to make this happen.

I have had coal operators tell me they can't get trees to grow and have given up trying to establish commercial woodland on reclaimed mine land. An inspection of the site usually reveals that they are inadvertently doing everything possible to create the worst site for tree survival and growth, including overcompacting flats and gentle slopes, not using enough spoil material to cover the hardpan in flat areas, using the wrong spoil type, and using a too aggressive ground cover. Even when the operator does create a pretty good site, he may still have a problem with tree establishment. We've had instances where a tree planting contractor used some "bargain basement" seedlings to save himself some money and ended up with very high mortality. The same contractor root pruned the seedlings until there was nothing left to stick in the ground; all to make it easier for his crew to plant seedlings in compacted ground. It only takes a few times with poor results to have a coal operator and landowner convinced that tree planting is too hard and costly compared with hayland/pasture or fish and wildlife habitat.

Over the last 20 years since SMCRA, landowners are losing what could have been productive forest land created during surface mining reclamation. Through ignorance, operator attitude, interpretation and enforcement of SMCRA, and lack of landowner involvement, thousands of reclaimed acres of potentially productive timberland actually have been degraded, with a loss of site productivity and lowered site index due to the old standard of mining reclamation practices used. This has cost landowner reduced productivity on reclaimed surface mined sites and reduced future income and value from timber grown on this land.

Loss of return

In contrast to our productive site, a poorly created site after mining that has a site index of 45 might generate 45 tons of pulpwood per acre in 30 years and have a value of $90.00 per acre. With initial planting costs of $218 per acre and the associated management fee and taxes, a landowner would stand to lose his money trying to establish a forest, having a rate of return of **- 4.1 percent**. No wonder so many coal operators say they can't get trees to grow and opt for the fish and wildlife option. Too many times in mining reclamation this type of situation has occurred in the past**S**and it's still occurring !

This kind of site degradation must not be allowed to continue. As landowners we are losing productivity and future income off our property, which must be used to offset the tax burden of owning land. If we are going to reclaim mine land to productive forests, we need to **promote** ways to create the best possible growing medium and do what is necessary to help the landowner and coal operator accomplish this task.

What can we do? Some suggestions for discussion

According to most state groups that responded to the OSM letter, they do not believe any regulations or policies need to be changed. I believe most of all, the attitudes and mind-sets of all those involved need to be changed. We need to stop preaching "golf course" landscape reclamation and preach that rills and rocks and loose, rough terrain is better for growing trees.

Get the word out. Finds from research and proven reforestation techniques must transfer from academia to the regulatory agencies and to the field inspectors on the federal and state level. Get the word out to the coal operators, too, through state mining associations and to the landowners through state landowners and forestry associations. Let's get everyone on the same wavelength too, so a state inspector isn't worried about what a federal inspector might say or do when the landowner opts for commercial woodland.

There needs to be some cost savings to the landowner or operator who is bearing the additional cost of reforestation. One way would be to reduce the stems per acre required for bond release. After all, if a good site is created, survival will be higher and less trees per acre would need to be planted. Who determines optimum spacing of seedlings anyway? If as a professional forester I felt that a spacing of 12' x 12' between seedlings was desirable to meet my planting objectives, I would only need 302 trees per acre. To guarantee this survival, I may plant 400 per acre, but not the 600 seedlings as is required by many states for commercial forest land.

Let's give a break to the guys out there trying to do it right. Why must we go back and disturb a site that has stabilized erosion and is growing trees because of a few exposed rills that are deeper than 18 inches. If the site is stable and no sediment is moving off the site, is it necessary to destroy several hundred trees with equipment to "fix" an area? Can less destructive measures be used to address the problem? Or what about giving a break for a small "hot spot" where trees will not grow for one reason or another. Leave it as an open area instead of making an operator go back and plant it again and again and again.

Are our ground cover requirements too heavy? We definitely need to make sure Kentucky 31 tall fescue and red and yellow clover stay out of the seed mix, for they are too aggressive when establishing trees. One planting contractor mentioned to me that he noticed a higher mortality of seedlings in areas that were planted in a heavy cover crop of winter rye. Areas void of the cover crop had much better survival.

Could we offer an incentive to the coal operator to get more trees planted? A cost share program with the states or federal government? How about lowering the amount of bond required per acre if the operator or landowner goes to commercial forestry? In West Virginia, a tax incentive is already in place which reduces the tax on land that is under long-term forest management. This can be quite a savings in taxes over time and should have most landowners favoring forestry over fish and wildlife.

I think the fish and wildlife land use is one that may even need to be eliminated. It has been used by many because it was the cheapest option. We get a lot of pastureland with a few rows of noncommercial species growing out there. Most of the varieties wildlife biologists request for these sites are too demanding and die within a few years, leaving autumn olive thickets and rows of european alder, with a block of pine here and there. If you create a good forest, with diverse species, the site will provide food and cover for wildlife habitat anyway. If we don't eliminate the fish and wildlife option, how about requesting that 100 oak trees per acre be planted on 20' centers to insure that some **commercially valuable** timber will be established for the future, while giving wildlife extra mast?
Maybe we need a law to protect the landowner's property rights when it comes to reclaiming mine land. If a poor site is created through improper reclamation, and the landowner's potential productivity of land for growing timber is reduced, he stands to lose future income from the timber on his land when it is harvested. The site quality has been reduced to a point where the timber investment may not be economically feasible. This should not be happening.

I look forward to a day when our state and federal inspectors visiting a reclaimed mine site with a postmine land use of forest land say, "If this is to be commercial forest land the spoil needs to be less compacted, and if you don't loosen it up and get more brown sandstone on the surface, I'll have to write up a violation. Instead of the violation, I'd like to show you how to create a better site for growing trees. It should help increase seedling survival and growth rates, and help you to meet the bond requirements.

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[1] Timothy Probert, Pocahontas Land Corporation, Bluefield, West Virginia. Probert is Senior Forester with Pocahontas Land Corporation, a subsidiary of Norfolk Southern Corp, and manages over 500,000 acres of forest land in West Virginia, Virginia, and Kentucky. Part of his responsibility is to coordinate reforestation activities on the company's reclaimed surface mine lands. Working with mine and environmental engineers from several of Pocahontas' coal lessees, he has overseen the planting of over 6,800 acres that were returned to forest land. He has been involved with three cooperative reforestation projects with Virginia Tech and has coauthored papers on some of that research.

WILDLIFE PERSPECTIVES OF RECLAMATION

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Preface

I am a wildlife biologist with 20 years of field experience. I am going to discuss fish and wildlife resources and their resulting recreational use. I do not pretend that I am going to offer a series of new ideas or methods to make reclamation practices more wildlife friendly. I am sure that we all know of practices which are successful and provide for productive habitats. So, for all of those in the audience who expect me to stand up here and present the cure-all for fish and wildlife resource reclamation ills, well, you are going to be sadly disappointed.

Introduction

I will present the issues of what happens to the fish and wildlife resources as a result of mining and the postmine uses of the land and what I see that can be done to improve the situation. However, to do this there are a few things that we are all going to have to agree on before we begin this discussion. One is that forest lands, wetlands, and grasslands all hold unique communities of fish and wildlife resources. Some of those species and communities are prized from a recreational standpoint; some for their potential future production values; others are valued because of their unique diversity and mix of species; some are of serious concern because of their apparent declines in the overall landscape; and still others could be considered as indicator species of what we as humans have done to the landscape. Also, when I speak of wildlife during this presentation I am including both fish and wildlife resources in the term of "wildlife."

Grasslands in general and Kentucky in particular are of high value to wildlife, especially to upland game, neotropical birds and some small mammal species. Also, these habitat types are greatly diminished in both quantity and quality due primarily to conversion to agricultural production and the broad scale planting of fescue. The biggest problem with grassland habitat is not the lack of acreage, but the overall decline in the quality of the habitat.

Wetlands, especially shallow, seasonally flooded forest habitats are probably some of the most prized, complex, and diverse communities on the earth. Wetlands are the transitional habitats between the terrestrial and the aquatic worlds. Therefore, these habitats benefit both the upland and the aquatic communities. Species such as waterfowl, frogs, turtles, shorebirds, fishes, aquatic invertebrates, and others all live in, migrate to and from, feed in, escape to, and reproduce in wetlands. Wetland habitats are of concern due to their reduced acreage through their con-version and declines in quality due to human impacts. Over 80% of Kentucky's wetlands are gone and they are not likely to be replaced or restored. This is the reason why these habitats are of such interest.

Obviously, forest land communities also are very species rich from both a recreational and consumptive aspect. These communities produce wildlife species such as white tailed deer, squirrels, raccoons, wild turkey, and a host of nongame bird life, as well as forest products and other unique communities of plant life. These communities produce natural resource forest products such as lumber, food, and herbaceous materials, all of which have other values to humans. Concerns about forest land habitats center around their decline in quality and declines in present and future production potential. This is due to shifts in age structure and communities by ill planned harvest and conversion to other habitats. This, however, is a habitat that is actually growing in acreage in Kentucky, according to Kentucky Division of Forestry records, but the quality and future production potential appears to be going down.

I am here to discuss reforestation and wetland reclamation practices. What is needed to provide more of these

valued wildlife friendly habitats? How do we improve the resulting quality for wildlife communities?

Present Situation

Coal mining in Kentucky, the Midwest, and the country is a fact of life. The real issues, from a wildlife perspective, are (1) what habitat types are going to remain after reclamation, and (2) what will the quality of that habitat be? It is pretty much a given that wildlife resources will utilize the available and quality habitat if allowed to and when it is present.

I mentioned earlier that the biggest question of wildlife habitat centers around what type of habitat will remain as a postmine cover. In many instances reclamation practices do not "restore" the original habitats but simply replace them with other more easily and economically restorable habitats. Now we cannot condemn the companies for exercising their available reclamation options; however, I feel that we do need to review the intentions of the reclamation laws and see if they address the issues of reclamation. This must be reviewed in a present and future generational light to determine what effects these practices really have had.

Now by textbook definition to reclaim or to perform reclamation requires actions that provide for the "return of, or restoration of, use. " My questions are: Do the present reclamation practices really address the "restoration" of habitats? Is the conversion of quality forest to low quality pasture habitat restoration? Does the conversion of seasonally flooded and shallow water wetlands to deep water habitats and uplands qualify as reclamation? I realize that it depends on where you sit for the answers to those questions. In many instances present "reclamation" by legal definition has been accomplished; however, from a wildlife resource perspective there have been significant, long-term and in many cases, nonreversible changes in the habitats and a resulting decline in wildlife use of those habitats. Most, if not all, of these situations lead to reductions in biological viability and diversity due to losses of species and the resulting decline in their use. There also are losses in other natural resource products for both present and future generations and these too will result in losses in recreational opportunities for the populace.

Now I am not an all or nothing type of person. I can accept that with mining there are going to be changes in the landscape. Anyone who thinks that the surface layers of the earth can be turned upside down, the coal veins removed, and the overburden put back so that it is going to look like it did prior to mining is living in a fantasy world. I also will admit that reclamation activities have changed greatly since I began my career 20 years ago. However, have the changes been the best for wildlife or future forest production? I think most will agree there have been significant improvements in water quality from mined lands and there has been increased vegetation covers applied to the landscape. However, many of these situations have come with the application of low quality fescue grasslands and at the expense of future forest production. There has not been universal acceptance or application of practices that will ultimately restore forest communities or the wildlife resources that utilize them.

The next big question is, what is the quality of habitat after reclamation? Quality can be described in many ways, such as (1) accessability to wildlife, (2) diversity of vegetative communities, (3) interspersion of habitat types, and (4) diversity of both topography and hydrology. Conversion of a productive upland forest to a smooth graded, gently rolling, mono-culture fescue stand is similar to a limited nuclear war treatment of the landscape from a wildlife perspective. Not much survives! The trees are gone and not likely to be back in our lifetimes, if ever. The resulting grassland community is not receptive to most species of wildlife and is actually toxic to some, and it would cost millions of dollars to put it back to a valued mix of habitat types, if it can be converted back. A seasonally flooded forest that is a levee away from the stream or headwater source that seasonally flooded it, recontoured into 20 foot slopes rather than the 5 foot slopes it once had, or has a final cut lake of 30 feet deep, bears little resemblance to the original bottomland topography and hydrology of the lands prior to mining. The shape of the reclaimed landscape, the final cut lake, and the contours of the resulting hydrology all affect the resulting natural resource potential of the land. A final cut lake with side slopes the shape of the walls of this building offers little in the ways of transitional habitats, temperature and dissolved oxygen bands, and accessability for many species of wildlife or for human use. In each case, all of these losses in habitat and wildlife resources are mirrored as losses in recreational opportunities, for things such as hunting, fishing, bird watching, etc.

So now that I have condemned much of what has been done in the past, it is about time to present what I see that needs to be done to improve the situation. First, we need to determine what our reclamation objectives are. Do we want to restore the land? Do we want to restore the land use? Do we want to provide vegetative cover for erosion control? Or, do we simply want to apply a given set of prescribed practices to obtain bond release?

Second, we need to review what reclamation practices were done, or are being done, and identify what needs to be done to obtain the desired resulting habitats.

Third, we need to ask ourselves, do the present reclamation practices meet our goals of reclamation and restoration of the landscape from a wildlife view? In many instances, I think the answer is yes; but in some cases we have lost sight of our goals and objectives or the goals and objective are conflicting. If we want smooth grades, solid vegetative cover, and future forest we have to give up something, in most cases it is our future resources! Or do we need to fine tune the application of some techniques or policies? We all can sit here and second guess what was done or would have been better done back then, but now we can only address what should be done or will be done better in the future.

Needs

So now the issue from a wildlife perspective is how do we put the landscape back together in a form that will (1) allow for good water quality; (2) provide for wildlife resources; (3) provide for future natural resource (forest) production; and ultimately, (4) will provide for recreational opportunities. I feel that if you accomplish the objectives of protection of water quality and provide for the future forest production you will likely meet the goal of providing for wildlife resources, and this will in turn allow for the recreational use of the land.

The question is how do we get there from here? I would suggest that we begin by better describing our goal of reclamation. Is it restoration, reclamation, or replacement? If the goal is restoration, we have a long way to go on many techniques and policies. We need to work aggressively on things which are proven to produce more future timber production even if the result is not as eye appealing in the short-term.

Secondly, we should bracket or frame what reclamation practices are acceptable for a given habitat type. Conversion of dominantly forest land to all pasture, should simply not be acceptable. Just as conversion of all pastureland to all forest land should be just as unacceptable. Conversion of seasonally flooded wetlands and forested wetlands to a mix of rolling uplands and a permanent final cut lake should not be acceptable either. To do this we need to focus reclamation activities on what habitats were on the land prior to mining, and determine in con-sultation with the regulatory and managing agencies if restoration of those same percentages of forest, water, and grassland are really in the best interest of reclamation and the resources. This would take agreement with reg-ulatory agencies and mining companies when any changes in habitats were proposed.

Third, I feel that we must look at the habitats that resulted from some of the reclamation practices of 20 to 30 years ago. If we look at some of the resulting forest lands from older reclamation sites, we will see that rough grading does result in a better reforestation substrate and ultimately will result in a better future forest, and this will be better wildlife habitat. Ultimately, we may have missed out on an opportunity for future natural resource, forest production, fish and wildlife habitats, and the resulting recreational opportunities by requiring smooth grading, uniform vegetative covers, and elimination of shallow sediment basins. However, the methods employed to preserve and enhance water quality have benefitted all wildlife resources and should be maintained!

We need to propose changes that will result in the improvement of the quality of reclaimed lands in terms of water quality, future timber production, and the resulting wildlife resources of the land. These conditions and habitats would all allow for recreational use of the land.

Specific items that I would like to see addressed include (1) reduced grading for reduced compaction and enhanced reforestation efforts; (2) permit designs that leaves permanent water bodies with a variety of depths; (3) shallow and seasonally flooded silting basins, again with variations in water depths; (4) access points to allow for improved

recreational use; and (5) restored “normal” hydrology (overflow) of the property where areas had been levied off from mining by breaching the levees as one of the last reclamation activities.

We also need to discuss the issue of what really costs more in reclamation dollars. Lots of grading and a smooth grassland or less grading and a future forest. I think you will have to agree that dozer time is expensive and any reduction in it saves dollars.

Future

The future begins with planning, and this begins before the property is permitted and mined. This involves determination of what reclamation practices will be employed as a postmine land use treatment and future uses of the property. It is obvious by many of the resulting habitats that we have restored that we can make good quality wildlife habitats and restore future natural resource production of the lands, if we try. We have to accept that many practices take time to realize the results.

Reforestation is a practice that takes 50 to 100 years to generate a viable harvestable natural regenerating forest. The goals of forest reclamation should be to reestablish a forest on the land that will be capable of producing forest products, sustaining hard mast production for wildlife use, and ultimately natural regeneration of the stand for future production. This can only be accomplished if there is adequate substrate in a suitable condition, not com-pacted to the point where root growth is restricted, and successfully planted to a mix of species which will provide for a future forest. Will this happen with the present grading and shaping practices? It is doubtful! It may require that the surface layers be left rougher than traditionally accepted to be successful. It requires planting with a mix of hard seed plant species, leaving islands of native forest to act as a seed source, and allowing light seeded species to move in on their own. This maybe the best approach for future forest production.

Water quality is important and is dependent on the types of spoil material, slope, and hydrology of the area. Ideally, access points should be designed into any permanent water bodies that are left on mined land. This does not have to be an elaborate concrete ramp but simply sites of adequate rock substrate to reduce erosion and provide a stable platform.

All of this happens only if (1) there is interest from the company for reclamation other than the cheapest recla-mation options available; (2) there is an involvement of what the final mining use of the property will be prior to the permitting process; (3) there is an openness in the process from both the company’s side, to tell what they want to do and the regulatory agency side, to determine what the resource needs are of the site, region, and state; and (4) the key element for any reclamation process to work, involvement of the staff involved in the mining and recla-mation. Let’s face it. If the equipment operators can see the goals, they can see the reasoning behind doing certain practices. This all happens only if there are changes in philosophy from the company’s staff and regulatory agency sides to make any significant change in reclamation practices for increased and successful reforestation efforts.

It may sound like I am proposing significant changes in the process and, in some ways, I am; however, we can not lose sight of certain objectives in the reclamation process. While many of these issues such as reforestation, per-manent water, fisheries resources, etc., may take years to develop, in the short-term we must protect the envi-ronment from erosion, further damage, and degradation of water quality, and preserve the physical stability of the land.

Wildlife friendly reclamation can only happen if the reclamation options provided to the companies are habitats that are ultimately restorable, potentially productive, and economically viable. Temper all of that with the reality of dealing with the physical conditions of the site given the spoil, hydrology, grade, and compaction of the materials.

Wildlife as Indicators of Successful Reclamation

Wildlife has been termed many times as being indicators of the overall health of habitats and environmental conditions. Years ago, miners used canaries in shaft mines to determine air quality; in many fisheries, invertebrate life can be and is used as indicators of water quality in streams and lakes. Grassland birds are indicators of overall habitat quality in grassland. Wetland species such as the copperbelly watersnake (species of special concern) are indicators of man's impacts on the availability and quality of wetland habitats. We need to look at the quality and quantity of wildlife to assist us in answering the question of "did we restore the land?"

Summary

The final reality is that mining will happen; that is given! We should attempt to obtain the best possible habitats after land is mined and put it back into a condition to provide for future natural resource production.

However, we must remember that a mix of habitats is diversity. The question is how do we have that diversity, allow for the interspersion of habitats, and provide for the protection of water quality, and still meet the reclama-tion bond requirements? Leaving a final cut lake will provide for a permanent fisheries resource and recreational opportunities; it simply needs to be designed into the landscape prior to mining. Something as simple as leaving the silting basins as permanent features allows for seasonal variations in water depths, interspersions of habitat types, and increased wildlife, as well as recreational uses of the land.

To accomplish the goal of reclamation, we need to (1) restore quality habitat; (2) prescribe and use techniques that are realistic; (3) be adaptable; and (4) involve the organization's company executives, engineers, supervisors, equipment operators, and regulatory agency staffs.

We have to accept that mining will cause some environmental problems, but with proper management we can still protect it from undue damage. We must maintain water quality protection in the short- and long-term and focus on the long range future conditions and potential productivity and uses of the land.

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