

THE FORESTRY RECLAMATION APPROACH IN APPALACHIA

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The majority of the Appalachian region in the eastern United States was originally covered with rich hardwood forest. Over the years, surface mining reclamation has resulted in forest fragmentation and a net loss of productive forestland. With the advent of the Surface Mining Control and Reclamation Act of 1977 (SMCRA), special efforts were made to address land stability and sedimentation caused by past mining practices. Reclamation practices under SMCRA have been characterized by high soil compaction rates and aggressive ground covers. Many mined lands were restored as grasslands, but are not currently used for hay or pasture by their owners. Native forests will eventually be restored on such areas by natural succession, but this process is slow and centuries may be required.

Researchers began to notice that tree productivity on some pre-SMCRA sites actually had superior growth rates. Most of these sites were on areas with low soil compaction rates. Forestry researchers at Southern Illinois University conducted studies during the 1970s and 1980s to examine 30-year-old tree plantations on low compaction spoil piles in the mid-west region (Ashby et al., 1980). They found very high survival rates and growth rates for many hardwood species. They also documented far greater natural succession of native forest tree species in the areas planted to trees than on adjacent unplanted areas. Research at Virginia Polytechnic and State University, and the Powell River Project, confirmed that the site index, which is a measure of forest productivity, can be significantly increased by changing current reclamation practices and adopting a Forestry Reclamation Approach (FRA) (Burger et al., 1998). The FRA will increase forest productivity and timber value, increase diversity through natural succession, increase soil and water conservation, provide wildlife habitat, and carbon sequestration. It is for these reasons that the Appalachian Regional Reforestation

Initiative (ARRI) was formed in 2005.

ARRI is a broad-based citizen/industry/government group working to encourage planting of productive hardwood trees on reclaimed coal mined lands and abandoned mine lands. ARRI's vision is not only to plant more trees, but also to build a productive forest ecosystem that encourages natural succession of native forest plants by promoting the use of the FRA technology. The goals of ARRI are to plant more high-value hardwood trees on reclaimed coal mined lands in Appalachia, increase the survival and growth rates of planted trees, and accelerate the natural process of succession and reestablish forest habitat.

By using a combination of private and governmental resources, the program facilitates and coordinates the coal industry, university researchers, the environmental community, and the state and federal government agencies that have an interest in creating productive forestland on reclaimed mined lands (Angel et al., 2005). ARRI has identified a Core Team that includes members from each Office of Surface Mining Reclamation and Enforcement (OSM) Field Office, and members from each State Regulatory

Authority in the Appalachian Region. This Core Team has the responsibility to develop reforestation partnerships and promote ARRI. ARRI has also formed a Science Team which is drawn from Universities in nine states, and by other groups and agencies. It is the job of the Science Team to insure that state-of-the-science reforestation procedures are advocated by ARRI and that mined land reforestation research is advanced.

The FRA has taken lessons learned from past mining practices and modified current mining practices to create more productive forestland. The FRA discussed here is a general guideline. Each State is encouraged to develop a FRA that fits their unique environmental conditions.

FORESTRY RECLAMATION APPROACH

1. Create a suitable rooting medium for good tree growth that is no less than four feet deep and comprised of topsoil, weathered sandstone, and/or the best available material.

2. Loosely grade the topsoil or topsoil substitutes established in step one to create a non-compacted soil growth medium.



WHITE OAK REFORESTATION RESEARCH PLOTS IN EAST TENNESSEE WHERE AN ALTERNATE GROWTH MEDIA IS BEING LOOSELY GRADED TO FORM A SOIL MEDIUM SUITABLE FOR TREE GROWTH UNDER THE FRA.



TREE SEEDLINGS PLANTED IN LOOSELY-GRAD-ED SPOIL MATERIAL ON THE UNIVERSITY OF KENTUCKY'S BENT MOUNTAIN REFORESTATION RESEARCH COMPLEX IN PIKE COUNTY, KENTUCKY. FINAL GRADING THAT LEAVES A LOOSE MINE SOIL AND A ROUGH SURFACE INCREASES SURVIVAL OF PLANTED SEEDLINGS AND FOREST PRODUCTIVITY. SUCH PRACTICES ARE OFTEN LESS COSTLY THAN TRADITIONAL "SMOOTH GRADING" WHILE MEETING SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA) REQUIREMENTS.

DIAGRAM 1. AREA MINING OR MOUNTAINTOP REMOVAL METHODS

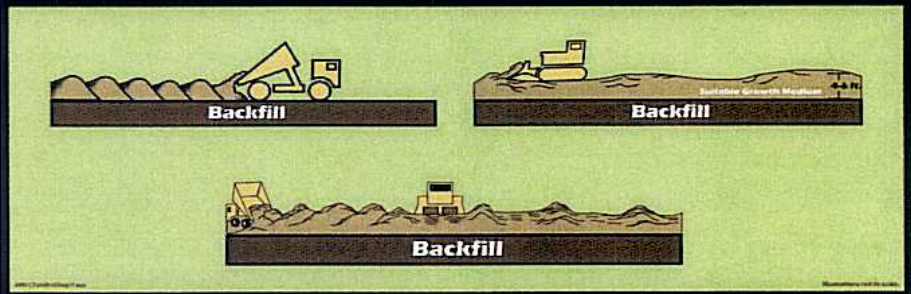
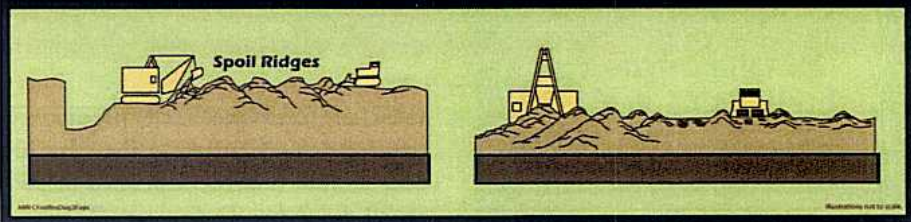


DIAGRAM 2. AREA MINING OR MOUNTAINTOP REMOVAL BY DRAGLINE METHOD.



IN AREA MINING, HAUL TRUCKS ARE USED TO DUMP THE GROWTH MEDIUM IN A TIGHT ARRANGEMENT, AND FINAL GRADING IS ACCOMPLISHED WITH ONE OR TWO LIGHT PASSES WITH A DOZER TO STRIKE OFF THE TOPS OF THE DUMP PILES (DIAGRAM 1). LIKewise, IN A DRAGLINE OPERATION, THE GROWTH MEDIUM IS PLACED IN PILES AND A DOZER LIGHTLY GRADES THE AREA LEAVING A ROUGH, NON-COMPACTED GROWTH MEDIUM (DIAGRAM 2).



GROUND-COVER VEGETATION USED WITH THE FRA REQUIRES A BALANCE BETWEEN EROSION CONTROL AND COMPETITION FOR THE LIGHT, WATER AND SPACE REQUIRED BY TREES. GROUND COVERS SHOULD INCLUDE GRASSES AND LEGUMES THAT ARE SLOW-GROWING, HAVE SPRAWLING GROWTH FORMS, AND ARE TOLERANT OF A WIDE RANGE OF SOIL CONDITIONS. LOOSE-GRADED SPOIL IS TYPICALLY CHARACTERIZED BY INCREASED WATER INFILTRATION AND DECREASED RUNOFF, EROSION, AND SEDIMENTATION COMPARED TO COMPACTED MINE SPOILS. THUS, VEGETATIVE COVER DOES NOT HAVE TO BE AS DENSE AS ON CONVENTIONALLY GRADED SURFACE MINES.

3. Use native and non-competitive ground covers that are compatible with growing trees.

4. Plant two types of trees – early succession species for wildlife and soil stability, and commercially valuable crop trees.

5. Use proper tree planting techniques.

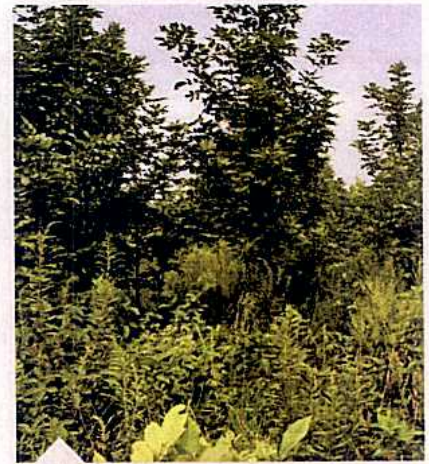
Since its creation in 2005, ARRI members and partners have been spreading the word about the FRA through numerous avenues. Each spring, every ARRI state has conducted one or more Arbor Day events, where coal companies, citizen volunteers, government workers, school children, and others get out on a mine site to plant trees, celebrate the



THIS DENSE STAND OF CLOVER PROVIDES TOO MUCH COMPETITION FOR NEWLY-PLANTED TREE SEEDLINGS TO SURVIVE AND GROW. ALSO, RODENTS THAT DAMAGE AND DESTROY TREE SEEDLINGS USE DENSE HERBACEOUS COVERS SUCH AS THIS TO HIDE FROM PREDATORS. FAST GROWING AND COMPETITIVE GRASSES SUCH AS KENTUCKY-31 TALL FESCUE AND AGGRESSIVE LEGUMES SUCH AS SERICEA LESPEDEZA AND CROWN VETCH SHOULD NOT BE USED WHERE TREES WILL BE PLANTED.



SLOWER-GROWING GRASSES SUCH AS RED TOP AND PERENNIAL RYEGRASS, AND LEGUMES SUCH AS BIRDSFOOT TREFOIL AND WHITE COVER, WHEN USED IN A MIX WITH OTHER APPROPRIATE SPECIES WILL INCREASE SEEDLING SURVIVAL WHILE CONTROLLING EROSION OVER THE LONGER TERM AS THE TREES AND ACCOMPANYING VEGETATION MATURE TO FORM A FOREST. FERTILIZER RATES SHOULD BE LOW IN NITROGEN, RELATIVE TO RATES COMMONLY USED TO ESTABLISH PASTURES, SO AS TO DISCOURAGE HEAVY GROUND COVER GROWTH WHILE APPLYING SUFFICIENT RATES OF PHOSPHORUS AND POTASSIUM FOR OPTIMAL TREE GROWTH.



A DIVERSE FOREST OF SHRUBS AND HIGH-VALUE NATIVE HARDWOODS ESTABLISHED ON AN ACTIVE MINE SITE IN TENNESSEE AS A DEMONSTRATION OF THE FRA.



TREE SEEDLINGS MUST BE CAREFULLY PLANTED BY HAND IN ORDER FOR THE FIFTH STEP OF THE FRA TO BE IMPLEMENTED PROPERLY. IF MINE SOILS ARE GRADED SMOOTH ENOUGH TO ACCOMMODATE A TRACTOR AND MECHANICAL TREE PLANTER, SOIL BULK DENSITIES ARE GENERALLY TOO HIGH TO ALLOW GOOD TREE SURVIVAL AND GROWTH.

value of forestland, and promote the reforestation of surface mines. In 2008, over 28,000 trees were planted at ARRI sponsored Arbor Day events. The events usually attract considerable media attention and as a result, ARRI, the industry, and the participants have enjoyed positive and upbeat local and regional news coverage.

ARRI 'Signing Ceremonies' is another avenue by which word of the FRA is being spread. These high profile events are associated with ARRI's Statement of Mutual Intent (SMI) which is a way for agencies, organizations, and individuals to pledge support for the FRA and ARRI's goals. The 276 SMI signatories that have been collected to date represent 143 different organizations, which include 49 government agencies, 49 industry organizations, 22 environmental

groups, 18 academic institutions, 5 citizen groups, and numerous individuals. The work of ARRI has attracted considerable international attention because the FRA is universal and applicable to all types of mining, in all places worldwide. Also, the development and execution of this science-based, multi-agency initiative is serving as an organizational model for other groups around the world whose goal is to restore disturbed landscapes through reforestation.

Each year ARRI has presented the Excellence in Reforestation Awards to individuals, operators, and/or organizations for their exemplary efforts in forestry reclamation on Title IV and Title V mine sites that utilize the FRA in Appalachia. Two very successful annual Mined Land Reforestation Conferences have been held so far drawing upwards of



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VOLUNTEER TREE PLANTERS AT AN ARRI ARBOR DAY TREE PLANTING EVENT ON A FRA COMPLIANT SURFACE MINE IN EAST TENNESSEE.

200 interested participants. The first conference was held in Abingdon, Virginia in 2007, and the second in Logan, West Virginia in 2008. The third conference will be held in Prestonsburg, Kentucky in 2009, and the fourth will be held jointly with the American Society for Mining and Reclamation in Pittsburgh, Pennsylvania in 2010. Several very fine instructional videos featuring the FRA have been produced by ARRI partners. One goal of the ARRI Science Team is to generate a series of guidance documents called Forest Reclamation Advisories, which will describe state-of-the-science procedures for coal mine operator and other mine reforestation practitioners, agency personnel, and mine land owners. Five Advisories have been published,

distributed, and made available on ARRI's website to date, and several others are expected to be released very soon.

ARRI has been most successful in spreading the FRA by building partnerships with groups and individuals that share the common goal of science-based surface mine reforestation. One good example of a very successful ARRI partnership is centered on the American chestnut tree. ARRI and The American Chestnut Foundation (TACF) have formed a strong partnership to use FRA compliant surface mines as the 'springboards' for disease-resistant chestnuts back in the forests of Appalachia. Under the joint ARRI/TACF project called 'Operation Springboard', 11,809 American chestnuts were planted in 2008 on surface mines that will aid



ONE YEAR OLD DISEASE-RESISTANT AMERICAN CHESTNUT ON AN OHIO MINE SITE PREPARED WITH THE FRA. THE FRA CAN ACHIEVE COST-EFFECTIVE REGULATORY COMPLIANCE FOR COAL OPERATORS WHILE CREATING PRODUCTIVE FORESTS THAT GENERATE VALUE FOR THEIR OWNERS AND PROVIDE WATERSHED PROTECTION, WILDLIFE HABITAT, AND OTHER ENVIRONMENTAL SERVICES.

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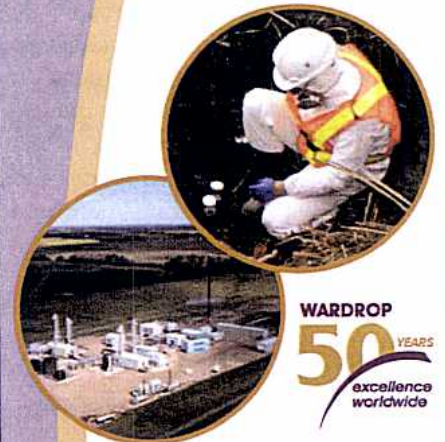
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both the research and repopulation of these monarchs of the eastern forest.

Another example of a successful ARRI partnership that is spreading the FRA involves the Cerulean warbler. This small, neo-tropical, migratory songbird breeds throughout the central and eastern US and relies on large tracts of mature deciduous hardwood forests during the breeding season. Cerulean populations have declined at about 3% each year since 1966, prompting a petition in 2000 to the U.S. Fish and Wildlife Service asking it to be listed as threatened under the Endangered Species Act. ARRI is actively facilitating partnerships between the coal industry and conservation groups like the Cerulean Warbler Technical Group, the American Bird Conservancy, the Appalachian Mountains Joint Venture, numerous South American groups, and government agencies and university researchers. The conservation groups win by addressing habitat needs, the industry wins by voluntarily addressing habitat needs outside of a regulatory mandate, and ARRI wins by getting more trees planted. ARRI is also helping to facilitate

a three-way coal/coffee/Cerulean partnership between conservation groups, the coal industry in North America, and the coffee industry in South America.

Forestland enriches us all by providing numerous environmental and economic benefits. Forestland is also a renewable resource. By working together, State and Federal government agencies, the coal industry, landowners, university researchers, and local citizens, can indeed create highly productive forestland on reclaimed mine land by using the FRA. We invite any and all interested parties to join the Appalachian Regional Reforestation Initiative and become Reforestation Champions. To learn more about ARRI and the FRA, visit our website at <http://arri.osmre.gov>. ■

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