The Appalachian Regional Reforestation Initiative –

Restoring Forests on Mined Land

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Virginia Tech
Powell River Project

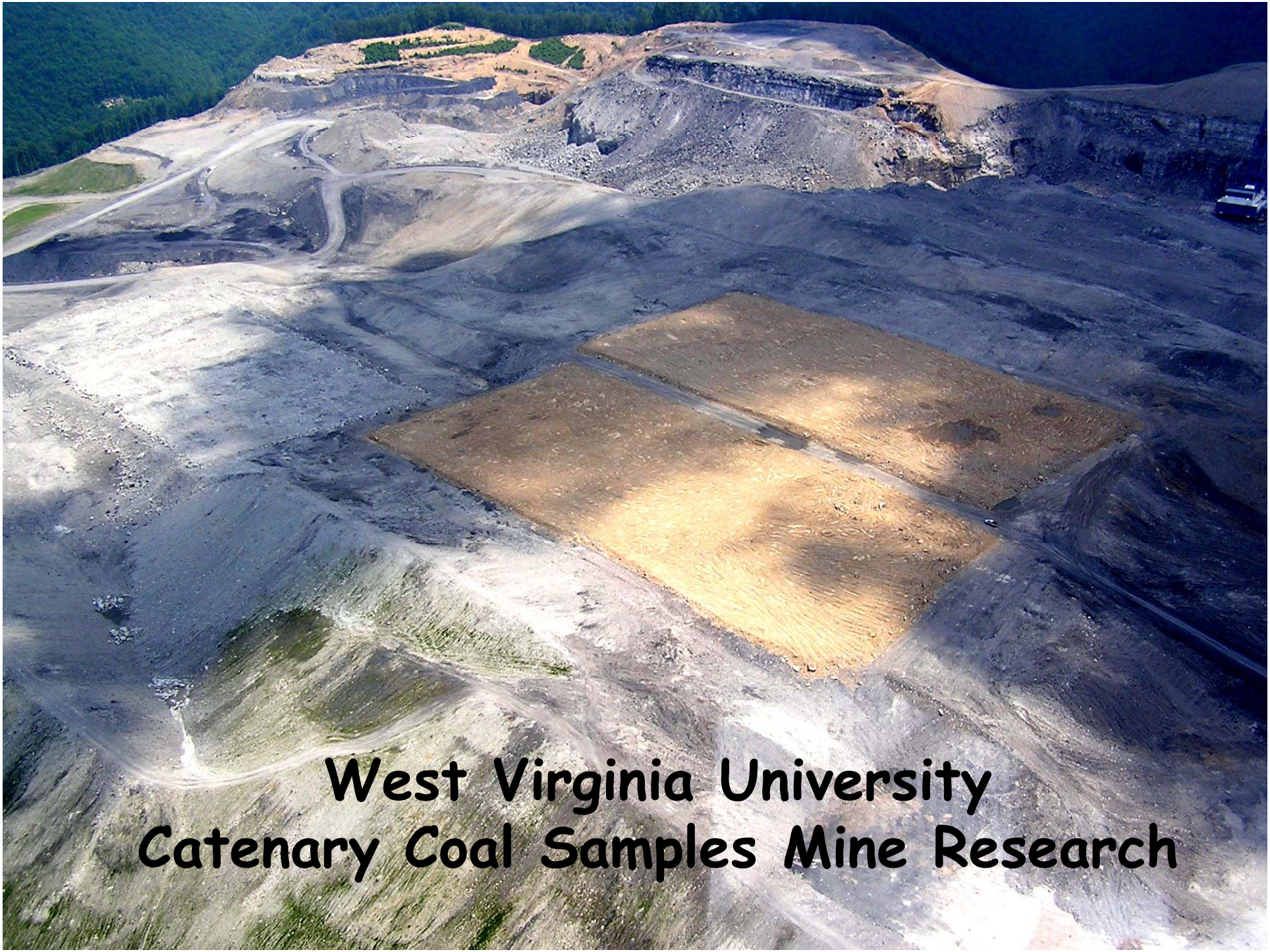
Unweathered Shale
Weathered Sandstone
Unweathered Sandstone
Forest Topsoil

15-year response of trees and forages

University of Kentucky
Starfire Research Complex

Non-compacted site

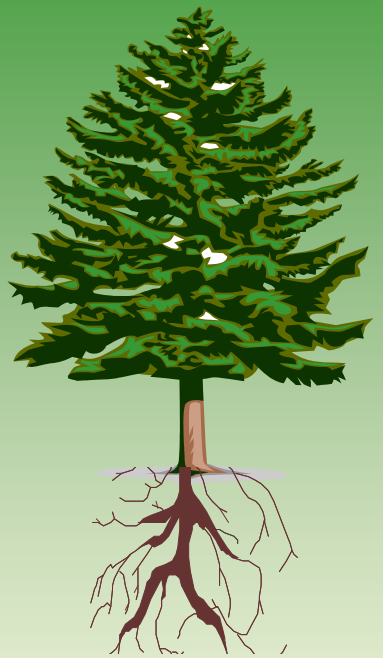
Compacted site


West Virginia University
Catenary Coal Samples Mine Research


University of Kentucky
Bent Mountain Research Complex

What do trees want?

- Physical properties
  - At least 4 feet deep
  - Non-compacted
  - Rocks easily weathered
  - A sandy loam texture
- Chemical properties
  - Low to moderate levels of soluble salts
  - An equilibrium pH of 5.5 to 6.5
  - Low pyritic sulfur
- Fertility
  - Adequate levels of N, P, K and other essential nutrients



The Forestry Reclamation Approach

STEP 1:

Create a suitable rooting medium for good tree growth that is no less than 4 feet deep and comprised of topsoil, weathered sandstone and/or the best available material

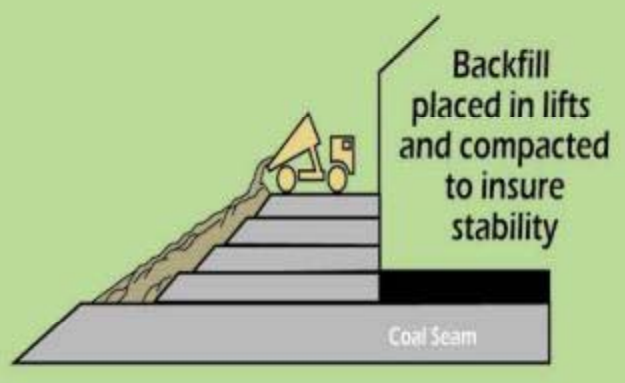
The Forestry Reclamation Approach

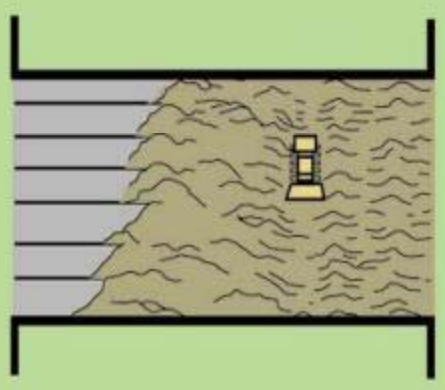
STEP 2:

Loosely grade the topsoil or topsoil substitute established in step one to create a non-compacted growth medium

ARRI CFoldBroDiag1F.eps

Illustrations not to scale.





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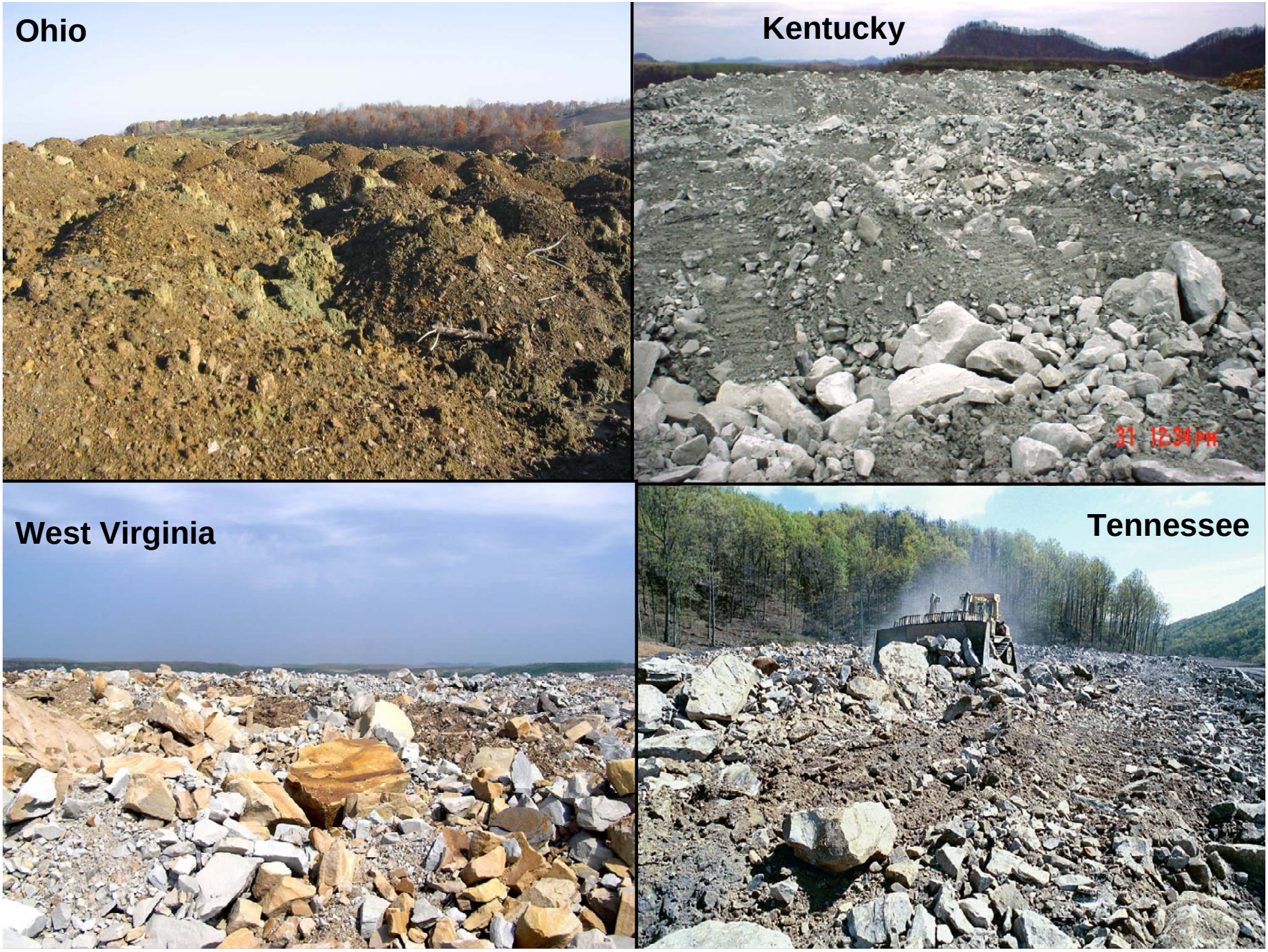

Ohio
Kentucky
31 12:34 PM
West Virginia
Tennessee

The Forestry Reclamation Approach

STEP 3:

Use ground covers that are compatible with growing trees

The Forestry Reclamation Approach

STEP 4:

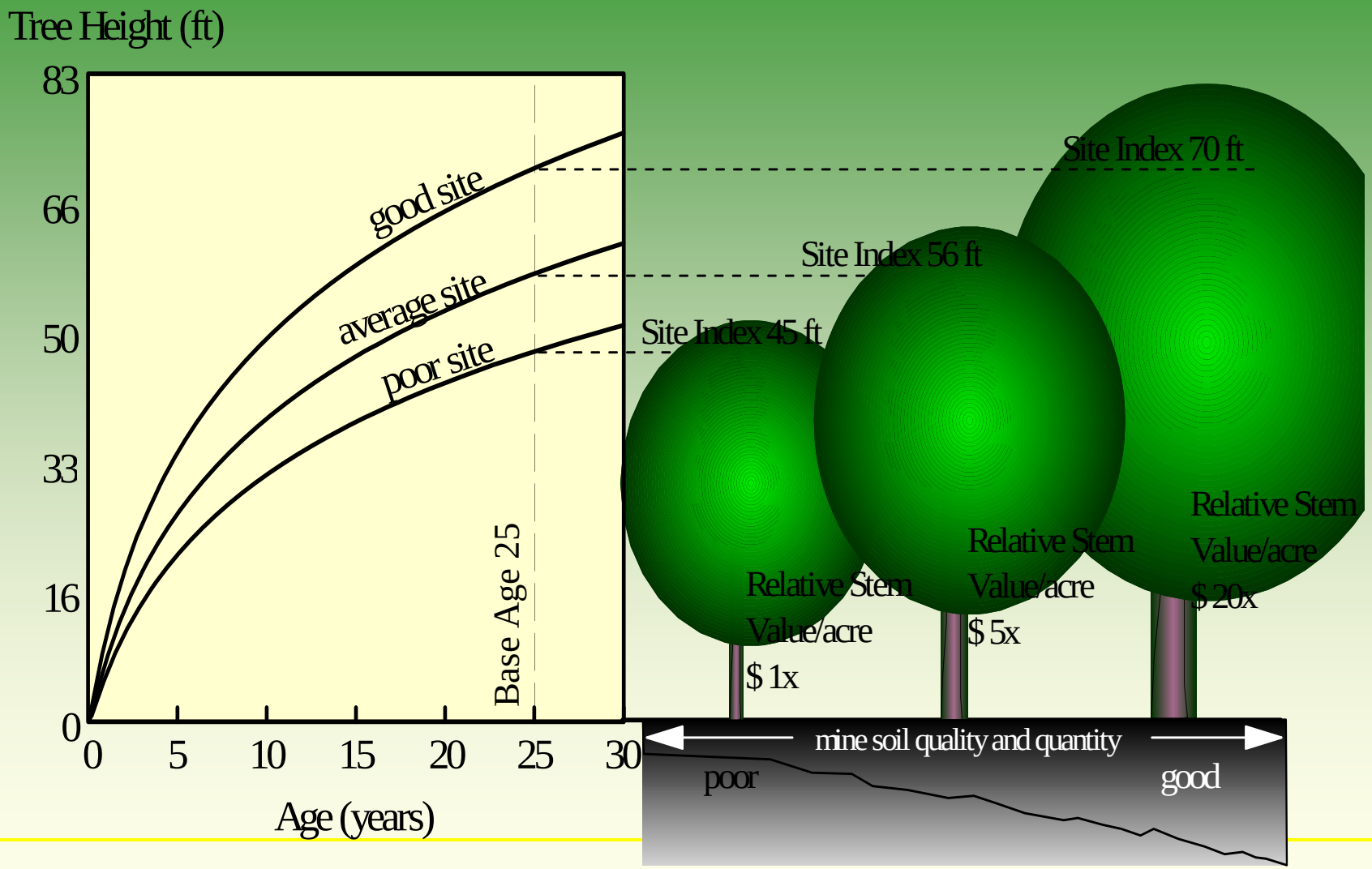
Plant two types of trees – early successional species for wildlife and soil stability, and commercially valuable crop trees

The Forestry Reclamation Approach

STEP 5:

Use proper tree planting techniques

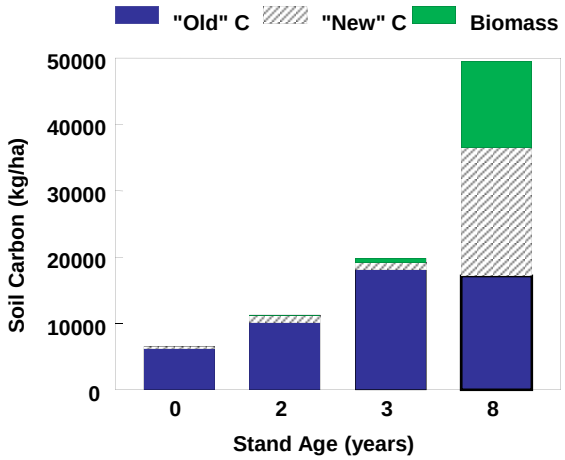
Mined land reforestation productivity potential

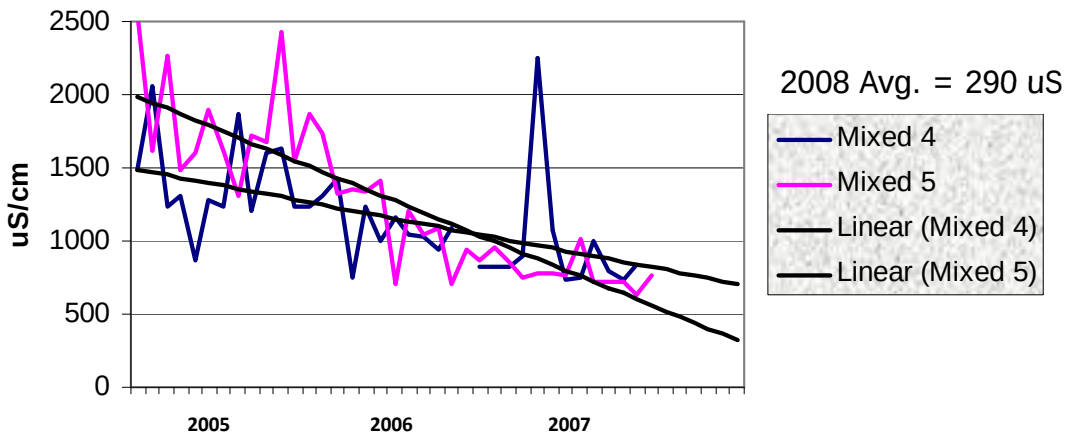


Study conducted by Jim Burger, Virginia Tech

The FRA as EPA's BMP for HFs and MTRs?

- Carbon sequestration rates of 3 Mg/ha/yr (Maharaj et al., 2007)
- Reduced runoff and erosion (Taylor et al., 2009)
- Improved water quality (Angel et al., 2008)
- Accelerated natural succession (Hall et al., 2009; Angel et al., 2007; Cook, 2007)
- American Chestnut restoration (French et al., 2008)
- Cost savings and economic returns (Michels, 2008)





The Appalachian Regional Reforestation Initiative

Restoring healthy productive forests on mined land

ARRI is a joint effort between… OSM and the Appalachian coal states

ARRI's goals:

- Plant more high-value hardwood trees...
- increase the survival rates and growth rates of planted trees...
- and expedite the establishment of forest habitat through natural succession

Appalachian Regional Reforestation Initiative

ARRI's Science Team

- Ohio University
- Ohio State University
- Pennsylvania State University
- Purdue University
- Southern Illinois University
- University of Kentucky
- University of Maryland
- University of Tennessee
- Virginia Polytechnic Institute
- West Virginia University
- West Virginia State University
- US Forest Service
- US Geological Survey
- TACF
- OSM

ARRI's Science Team

APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI)

FOREST RECLAMATION ADVISORY

FRA Number 2 December 2005

THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE

Jim Burger[1], Don Graves[2], Patrick Angel[3], Vic Davis[4], Carl Zipper[5]

The Forestry Reclamation Approach (FRA) is a method for reclaiming coal-mined land to forest under the Surface Mining Control and Reclamation Act (SMCRA). The FRA is based on knowledge gained from both scientific research and experience (Photo 1). 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.

The purpose of this Advisory is to describe the FRA, which is considered by state mining agencies and US Office of Surface Mining to be an appropriate and desirable method for reclaiming coal-mined land to support forested land uses under SMCRA (Angel and others, 2005). The FRA is also supported by members of the ARRI's academic team, which is drawn from Universities in nine states, and by other groups and agencies.

The FRA's Five Steps

The FRA can be summarized in five steps:

1. Create a suitable rooting medium for good tree growth that is no less than 4 feet deep and comprised of topsoil, weathered sandstone and/or the best available material.
2. Loosely grade the topsoil or topsoil substitute established in step one to create a non-compacted growth medium.
3. Use ground covers that are compatible with growing trees.
4. Plant two types of trees–early successional species for wildlife and soil stability, and commercially valuable crop trees.
5. Use proper tree planting techniques.

Step 1. Create a suitable rooting medium.

Tree survival and growth can be hindered by highly alkaline or acidic soils. During mining and reclamation, all highly alkaline materials with excessive soluble salts and all highly acidic or toxic material should be covered with a suitable rooting medium that will support trees. The best available growth medium

Photo 1. A white oak stand that grew on a pre-SMCRA surface mine in Southern Illinois. Observations by reclamation scientists and practitioners of soil and site conditions on reclaimed mines such as this, where reforestation was successful, have contributed to development of the Forestry Reclamation Approach.

should be placed on the surface to a depth of at least four feet to accommodate the needs of deeply rooted trees.

Growth media with low to moderate levels of soluble salts, equilibrium pH of 5.0 to 7.0, low pyritic sulfur content, and textures conducive to proper drainage are preferred. However, where such materials are not available, an equilibrium pH as low as 4.5 or as high as 7.5 is acceptable if tree species tolerant of those conditions are used.

Since 2004…
about 70 million trees have been planted
on about 103,000 acres

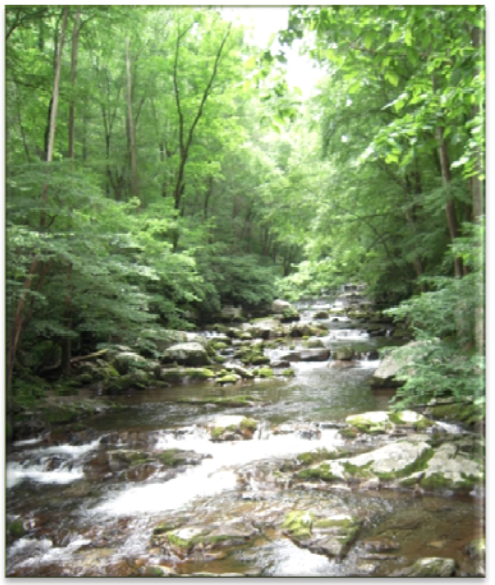
ARRI's work on legacy mines…

- 177,500 trees
- over 2,500 volunteers
- 250 acres
- 22 sites in 6 states

MISSION: To restore ecosystem services on disturbed lands through reforestation to enhance the quality of life for American citizens.

green forests work…..

….to mitigate climate change,



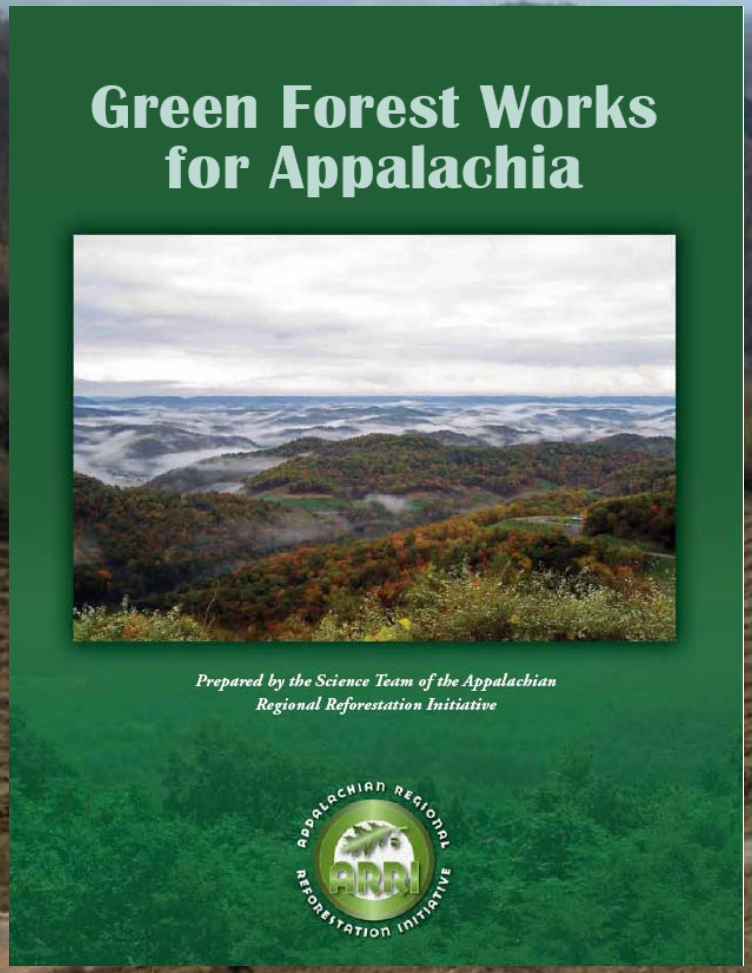
….to improve water quality,

….to restore habitat,

….to create economic opportunities.

green forests work….for Appalachia

(≈1 million acres of reclaimed grass/shrub lands in Appalachia)



- **CCC modeled program to stimulate economy, create jobs and improve the environment**
- **Plant millions of trees on several hundred thousand acres of barren mine land**
- **Create much needed jobs in Appalachia**

planting for the future

…one tree at a time

green forests work

coming soon: www.greenforestswork.org

http://arri.osmre.gov