Mined Land Reforestation Efforts in the Daniel Boone National Forest

2017 Report

Mission

Green Forests Work's (GFW) mission is to re-establish healthy and productive forests on formerly mined lands in Appalachia.

Vision

GFW's vision is to create a renewable and sustainable multi-use resource that will provide economic opportunities while enhancing the local and global environment by converting reclaimed, non-native grasslands and scrublands into healthy, productive forestland.

Our reforestation projects provide jobs for equipment operators, nursery workers, and tree planters, and improve the environment by eradicating exotic species and restoring ecosystem services. With the help of our partners and volunteers, this vision is quickly becoming a reality…

Since 2009, we have planted more than two million trees on more than 3,200 acres,

but there are nearly one million acres left to reforest.

Michael French
Director of Operations
812.447.3285
michael.french@greenforestswork.org

Green Forests Work
T.P. Cooper Building
730 Rose Street
Lexington, KY 40546

Kylie Schmidt
Reforestation Coordinator
859.421.9222
kylie.schmidt@greenforestswork.org

Twenty year old research plots on a surface mine in Breathitt County Kentucky show how the Forestry Reclamation Approach allows native forests to be re-established after reclamation.

Front Cover: Volunteers follow the trail past a stand of native pines.

Table of Contents

BACKGROUND

In 2016, Green Forests Work (GFW) partnered with the United States Forest Service—Daniel Boone National Forest (USFS-DBNF) and others to reforest approximately 29 acres of surface mined land in the London District of the DBNF. This partnership led to a second reforestation project in the London District on nearly 14 acres in 2017 (Figure 1).

The 2017 project site was once forested, but was reclaimed to hay/pastureland following mining. Since the site was not managed for its intended use, it quickly transformed to an early successional habitat dominated by exotic plant species and remained as such for approximately 30 years due to the excessive soil compaction that was required by reclamation regulations at that time. Without intervention, the site was likely to stay in this state of arrested natural successional for decades if not centuries.

The goal of this project was to improve ecosystem services by restoring native forest cover to benefit wildlife and improve soil health and water quality.

This project was a collaborative effort between GFW, USFS-DBNF, the Arbor Day Foundation, Angels Envy, American Forests, Treecycler, Art For Trees, The American Chestnut Foundation, Brad and Shelli Lodge-Stanback, and the Appalachian Regional Reforestation Initiative.

Highwalls, the exposed rock in the background, on both sides of the project site are remnants of the site's mining history. Current regulations require that highwalls be backfilled and landscape be restored to the approximate original contour.

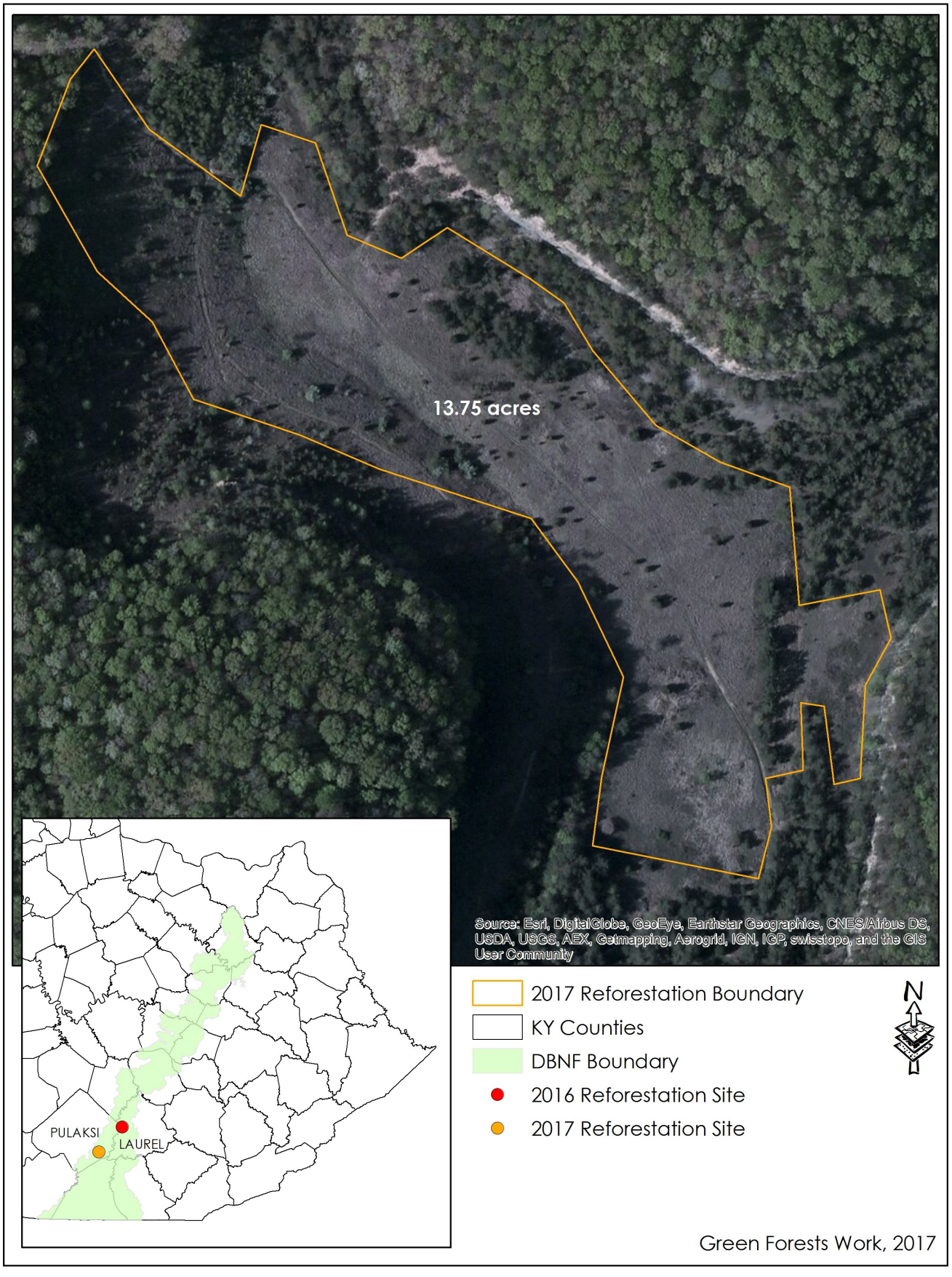

Figure 1. Locations of 2016 and 2017 sites and reforestation boundary of 2017 site.

SITE PREPARATION

GFW uses a modified version of the Appalachian Regional Reforestation Initiative's Forestry Reclamation Approach to re-establish forests on formerly mined lands where the site has already been reclaimed and the bond has been released. Further details on each step of this process are provided below.

Unwanted Vegetation Removal

The project site was primarily dominated by non-natives such as Autumn Olive (*Elaeagnus umbellata),* Sericea Lespedeza *(Lespedeza cuneata)*, and Tall Fescue (*Festuca arundinacea*). Most of the native vegetation consisted of brambles and small shrubs. The native trees, primarily White Pine (*Pinus strobus*), were severely stunted. Since the limiting factor to natural tree regeneration on many formerly mined sites is the soil compaction, the existing vegetation must be removed and controlled so deep ripping can occur. An effort was made to leave the few native trees that were not severely stunted, which included some Shortleaf Pine (*Pinus echinata*).

A combination of mechanical removal and targeted herbicide applications is often used to clear and control the vegetation. However, herbicide use was not permitted, so a D-6 dozer scraped off the top 2-3 inches soil, along with the vegetation, and pushed it to the project perimeter in the fall of 2016 (Figure 2). Removing the top 2-3 inches of soil removes the seedbank of the unwanted vegetation. The effectiveness of this method is unknown, but preliminary observations of the 2016 project in Laurel County, where the same method was applied, appear promising. Although removing the "topsoil" seems counterintuitive, the material is not the prime soil that this term traditionally refers to—it is mine spoil, a mix of overburden, that has experienced little soil development due to the lack of regeneration and water infiltration. The piles of soil and vegetation along the project perimeter quickly decompose and provide suitable medium for natural regeneration. In the meantime, the "soil"/brush piles also provide food and shelter for wildlife.

Figure 2. The unwanted vegetation is cleared and controlled using a dozer equipped with a blade attachment.

Soil Decompaction

To mitigate soil compaction, the ground was cross-ripped using a D-9 bulldozer equipped with two, 4-foot long ripping shanks mounted behind each track in the fall of 2016 (Figure 3). The rips were spaced approximately eight feet apart, creating an 8-foot by 8-foot grid after cross-ripping.

Figure 3. This picture highlights the difference in ripped (right) and un-ripped (left) after ripping in a single direction.

THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE: THE BEGINNING OF GREEN FORESTS WORK

Surface mining in Appalachia has replaced approximately one million acres of eastern deciduous forest, one the most diverse and valuable forests in the world, with primarily non-native grasses and shrubs. Understanding the reasons behind this requires a brief history of mine reclamation, starting with the Surface Mining Control and Reclamation Act (SMCRA) of 1977. This act created the U. S. Office of Surface Mining Reclamation and Enforcement (OSMRE), whose mission was to enforce a new set of reclamation guidelines that would standardize reclamation practices for the mining industry. Prior to SMCRA, some mining operations practiced "shoot 'n shove" mining, where overburden was "shot" off the coal seam and "shoved" downhill. Revegetation requirements were minimal and varied from state to state, as there was no national standard. The loose piles of overburden could support tree growth, but they were also highly unstable. As a result, large landslides occurred and created a hazard to public safety. SMCRA addressed this issue by requiring more intense grading. The overburden was used to backfill the mined area to achieve the approximate original contour, but the grading led to severe soil compaction. Native hardwood trees could not tolerate the compaction and competition from aggressive groundcovers, so mining operations moved away from forestry reclamation (i.e. planting trees) to establishing hayland/pasture to meet revegetation requirements. Without management, the pastures were quickly (within 10 years) overcome with invasive, exotic species and resided in a state of arrested succession. Researchers foresaw the unintended consequences of SMCRA and began developing a method of reclamation in the 1980s that would allow both stability and tree growth. By 2004, there were numerous scientific studies supporting what became known as the Forestry Reclamation Approach (FRA).

The OSMRE created ARRI in 2004 to coordinate the implementation of the FRA. After making progress with the active mining industry, ARRI members began to look back at the sites reclaimed under SMCRA that led to their establishment, so called "legacy" mines. Experimental re-reclamation of legacy mines by ARRI members revealed the need for increased scale to stimulate the economic development and environmental improvement Appalachia needed, thus the idea of Green Forests Work was born. Further research laid the groundwork for the modified version of the FRA that we use today.

TREE ESTABLISHMENT

Volunteerism

Although the majority of GFW's planting labor is performed by professionals, volunteer tree planting events provide a great opportunity for education and outreach. Volunteers are taught tree planting techniques, the history of reclamation, methods used to implement the reforestation project, as well as the benefits of reforestation. These events help raise awareness of environmental issues and empower people to take action. The diversity of volunteer groups exemplifies the many motives people have to plant trees; it is truly a uniting experience (Table 1; Figures 4-5; see Angels Envy Toasts the Trees). Volunteers planted all but two acres of the project site, so local professional landscapers were hired to complete the site (Table 2; see Local Job Creation).

Figure 4. Students from Drew, Rutgers, and Xavier Universities finished an Alternative Spring Break program that generates awareness about mountain top removal mining by participating in planting events.

Since 2009, GFW has engaged with 14,000 volunteers, half of which are adolescents

Volunteer Groups
Angel's Envy
Appalachian State University
Beinthewater
Berea College
Boy Scouts of America
Drew University
Radford University
Rutgers University
University of Kentucky
University of North Carolina at Chapel Hill
Xavier University

Table 1. Planting event volunteer groups.

Figure 5. A supporter of Beinthewater and her kids plant trees to improve water quality.

Event	Event Date	Event Type	Acres Planted	Trees Planted	Volunteer Participants	Professional Participants
1	3/8/2017	Volunteer	2.5	1,150	47	8
2	3/14/2017	Volunteer	1.75	840	34	7
3	4/1/2017	Volunteer	3.75	1,667	51	11
4	4/4/2017	Volunteer	3.75	2,113	42	22
5	4/19/2017	Professional	2	800	0	4
Total			**13.75**	**6,570**	**174**	**52**

Table 2. Planting events summary.

ANGELS ENVY TOASTS THE TREES

Angels Envy's Toast the Trees campaign provides funds for white oak reforestation to offset their bourbon barrel use and to improve company sustainability initiatives. Throughout the month of September, for every picture posted to social media of people enjoying Angels Envy with the hashtag #AE4theTrees, Angels Envy provides funds for a white oak seedling. The campaign, which is administered by the Arbor Day Foundation, supported the planting of nearly 7,000 white oaks in 2017.

#AE4theTrees

LOCAL JOB CREATION

Since only two acres remained unplanted after the volunteer events, four local (Barbourville, KY) landscapers were hired to finish planting the site, as hiring a professional planting crew was unfeasible for such a small job. The landscapers were thankful for the opportunity since their busy season had not quite begun. GFW tries to work with local contractors and support local business to put money back into these coal impacted communities.

Since 2009, GFW has provided over three million dollars to coal communities through contract services and supplies

TREE ESTABLISHMENT

Species Selection

More than 6,500 one-year-old bare root seedlings were planted in or near the intersections of the rips, resulting in a density of nearly 478 trees/acre (Table 3). Nut producing species were favored, as windblown seeds from the surrounding area are likely to establish their own.

Oaks

The project included an emphasis on oaks, primarily White Oaks (*Quercus alba)*, for their future timber value and the forage they provide to wildlife.

Shortleaf Pine

Shortleaf Pine (*Pinus echinata*) was included in the planting mix as part of a regional initiative to restore this declining ecosystem, which has lost 50 percent of its former range over the last 30 years due to pine beetle outbreaks, altered fire regimes, and land use changes. Including shortleaf pine helps improve the diversity of the forest and will make it more resilient to climate change, as it is an adaptable species.

Mesic Species

A poorly drained section of the site was planted with River Birch (*Betula nigra),* Roughleaf Dogwood *(Cornus drummondii*), Grey Dogwood (*Cornus racemosa),* and Black Walnut (*Juglans nigra*) since these species will fare better than oaks in the fine textured soil (Figure 6). The dogwoods will provide a food source for pollinators and songbirds, while the black walnut will provide food to other wildlife and become a valuable timber tree.

Figure 6. Students from Berea College planted a poorly drained section of the site with species that can tolerate the moist soil conditions.

Species	Number Planted	Source	Percent of Total
White Oak	3,855	Kentucky Division of Forestry	59%
Chestnut Oak	600	Kentucky Division of Forestry	9%
Northern Red Oak	600	Kentucky Division of Forestry	9%
Shortleaf Pine	600	Kentucky Division of Forestry	9%
Black Oak	300	Kentucky Division of Forestry	5%
River Birch	180	Kentucky Division of Forestry	3%
Virginia Pine	100	Kentucky Division of Forestry	2%
Roughleaf Dogwood	100	Kentucky Division of Forestry	2%
Grey Dogwood	100	Kentucky Division of Forestry	2%
Black Walnut	89	Kentucky Division of Forestry	1%
American Chestnut	46	The American Chestnut Foundation	1%
TOTAL	**6,570**		

Table 3. Species planted and corresponding source and percentage of total.

American Chestnut

This project also included The American Chestnut Foundation's (TACF) most advanced generation of potentially blight-resistant American Chestnuts (*Castanea dentata*). The American Chestnut used to be a major component of Appalachian forests and was also one of the most valuable species. A fungal disease that was brought to North America on Asian chestnut trees in the early 1900s eradicated American Chestnut from the eastern United States by the 1950s. Asian chestnuts evolved with the fungus and developed a resistance to the disease. Over the last three decades, TACF has been backcrossing the Chinese Chestnut (*Castanea mollissima*) with the American Chestnut to produce trees that are approximately 15/16 American Chestnut in character, but retain resistance to the blight fungus from Chinese Chestnut ancestors.

The former range of the American Chestnut directly overlaps with the Appalachian coal region, making mined lands a great place reintroduction. Furthermore, chestnuts were once a dominant component of upper slopes and ridge top positions, where it is economically feasible to surface mine for coal, so by including chestnuts in the species mix, we are attempting to recreate the forest type that would have been present before the mining.

Planting buckets with the appropriate mix of species are prepared for the volunteers prior to every event. The trees' roots are kept moist by saturated peat moss.

DISCUSSION

Monitoring at the 2017 site will begin in the summer of 2017. The first year of monitoring will establish permanent plots and record baseline data. These plots will be monitored periodically to measure survival, growth, and volunteer seedlings. These results help inform species prescriptions in the future and may assist with future management decisions, such as thinning, determining the effectiveness of scraping off the seedbank to minimize competition from groundcover, or whether some groundcover may improve tree survival. The first year of monitoring results will be collected at the 2016 site in the summer of 2017 as well, but these results are too preliminary to form any conclusions.

Conducting mined land reforestation projects on public lands could arguably be one of the best locations for these efforts, as large, contiguous forests provide more and better quality ecosystem services. Replacing invasive species with native trees and shrubs will protect the surrounding forest's health while creating an early successional habitat that will provide numerous wildlife benefits in the short term and help close canopy gaps in the long term to better service habitat specialists such as the Cerulean Warbler. Public land reforestation projects also provide great opportunities for research, education, and outreach. The 2016 reforestation site has already been utilized by the USFS-DBNF for such purposes. GFW is thankful for the opportunity to partner with the USFS-DBNF and others (see next page) on these projects and looks forward to continued partnership in the future.

Members of the USFS-DBNF kindly promote their partnership with GFW.

PARTNERS

AMERICAN FORESTS

ANGEL'S ENVY
BOURBON WHISKEY
FINISHED IN PORT WINE BARRELS

ARRI

Arbor Day Foundation®
arborday.org

Art For Trees

Brad and Shelli Lodge-Stanback

coal country BEEWORKS

KENTUCKY DIVISION OF FORESTRY

U.S. DEPARTMENT OF THE INTERIOR
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