Mined Land Reforestation Efforts in the Daniel Boone National Forest
2019 Report

green forests work

BACKGROUND

Since 2016, Green Forests Work (GFW) has partnered with the United States Forest Service—Daniel Boone National Forest (USFS-DBNF) and others to reforest nearly 100 acres of surface mined land within the DBNF (Figure 1; Table 1).

The 2019 project area expanded upon previous efforts in 2017, adding an additional 31 acres of restored area (Figure 1). The site was forested prior to mining but was reclaimed to hay/pastureland. 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, Angel's Envy, Sheldon and Audrey Katz Foundation, Snowy Owl Foundation, Norfolk Southern Foundation, Philadelphia Insurance, and the Appalachian Regional Reforestation Initiative.

Year Planted	Number of Acres	Project Location	Land Manager
2016	29	Laurel County	USFS-DBNF
2017	14	Pulaski County	USFS-DBNF
2018	22	Pulaski County	Kentucky Department of Fish & Wildlife Resources
2019	31	Pulaski County	USFS-DBNF
TOTAL	96		

Table 1. Summary of annual reforestation projects in the Daniel Boone National Forest.

Highwalls, the exposed rock in the background, on both sides of the 2017 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.
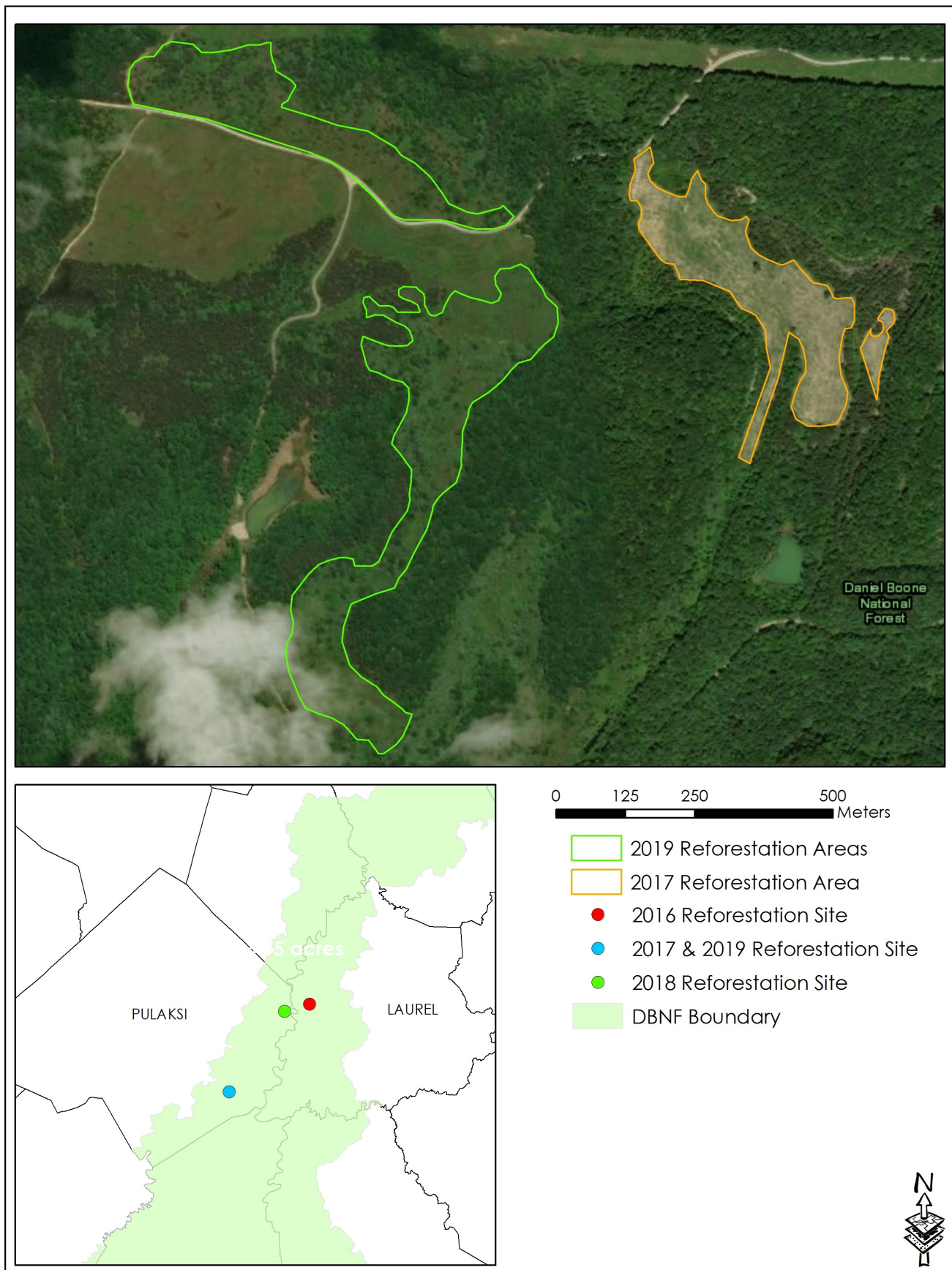
Figure 1. Locations of 2016-2019 sites and reforestation boundaries of 2017 & 2019 sites.

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.

To avoid the use of herbicides, 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 2018 (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 and act as weep berms that collect runoff from the project area.

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 2018 (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.

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 Corporate Responsibility). Volunteers planted all but nearly 10 acres of the project site, so local professional landscapers were hired to complete the site.

Figure 4. Students from several colleges and universities participating in an Alternative Spring Break program that generates awareness about mountain top removal mining volunteered to plant trees.

Since 2009, GFW has engaged with nearly 17,000 volunteers. More than half of which are adolescents.

Volunteer Groups
Berea College
Boy Scouts of America
Franklin and Marshall College
Marian University
Radford University
Sierra Club
University of Kentucky Lewis Honor College
University of North Carolina (Chapel Hill)
Angel's Envy
Catholic Diocese of Lexington
Kentucky Writers and Artists for Reforestation
Philadelphia Insurance
University of Maryland
Xavier University

Table 1. Planting event volunteer groups.

Figure 5. A group of Boy Scouts camped at the planting site the night before volunteering to plant trees. We hope these types of experiences help mold future stewards of our planet.

Number of Volunteer Events	Acres Planted	Trees Planted	Volunteer Participants	Professional Participants
8	31	18,740	320	59

Table 2. Planting events summary.

CORPORATE RESPONSIBILITY

This year's project in the Daniel Boone National Forest was supported by two corporate sponsors: Angel's Envy and Philadelphia Insurance. Angels Envy has supported Green Forests Work reforestation projects for four consecutive years (2016-2019) through their Toast The Trees campaign. They have provided 42,700 white oaks in total, 6,400 of which were planted at this site. Not only has Angels Envy helped provide the white oaks for the projects, but they have also helped plant them during an annual volunteer event. This year marked the first year of Philadelphia Insurance's support of our projects, a connection made possible through the Arbor Day Foundation. Philadelphia Insurance provided 80,000 trees to reforestation projects. Employees from Philadelphia Insurance also joined us for two days of tree planting. These corporate partnerships represent growth in our organization and we hope to continue to foster these relationships and cultivate new ones with other conscientious companies such as these.

Species Selection

Nearly 19,000 one-year-old bare root seedlings were planted in or near the intersections of the rips, resulting in a density of more than 600 trees/acre (Table 3).

White Oak

White oak (*Quercus alba*) is a dominant species of many eastern forests, but it is especially prevalent in the central, northern, and Appalachian hardwood regions of the mid-south and mid-west. Its acorns provide food to more than 180 different types of wildlife, including deer, turkey, racoons, and red-headed woodpeckers to name a few. White oaks are one of the most sought-after lumber trees, and it plays a critical role in the distilling industry, as white oaks are the preferred species for barrels used to age spirits. Thus, maintaining enough white oak stock is

critical for the health of our forest ecosystems and the people who depend on the economies they support. While there is currently enough stock to meet demand, research and long-term growth projections show that there will likely be a shortage of large, high-quality white oaks in the future. Some of the suspected reasons for this future shortage include fire suppression, lack of forest management, and unsustainable timber harvesting.

The White Oak Initiative is attempting to address this concern by uniting industries, agencies, universities, and non-profits by developing a strategic plan for monitoring, research, and education. This reforestation project supported the Initiative by planting 6,400 white oaks, which was the most significant component of the planting mix (34%).

Species	Number Planted	Source	Percent of Total
White Oak	6,400	Kentucky Division of Forestry	34%
Shortleaf pine	2,300	Kentucky Division of Forestry	12%
Northern Red Oak	1,500	Kentucky Division of Forestry	8%
Chestnut Oak	1,200	Kentucky Division of Forestry	6%
Black Cherry	1,200	Kentucky Division of Forestry	6%
Black Locust	1,000	Kentucky Division of Forestry	5%
Hazelnut	900	Kentucky Division of Forestry	5%
Black Oak	800	Kentucky Division of Forestry	4%
American Chestnut	500	The American Chestnut Foundation	3%
Persimmon	500	Kentucky Division of Forestry	3%
Black Walnut	500	Kentucky Division of Forestry	3%
Silky Dogwood	500	Kentucky Division of Forestry	3%
Roughleaf Dogwood	500	Kentucky Division of Forestry	3%
Sycamore	300	West Virginia Division of Forestry	2%
River Birch	300	West Virginia Division of Forestry	2%
Gray Dogwood	200	Kentucky Division of Forestry	1%
American Elm	140	United States Forest Service	1%
TOTAL	**18,740**		

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

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*), Silky Dogwood (*Cornus ammomum),* 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.

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 re-introduction. 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 will begin in the summer of 2019. 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.

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

Green Forests Work

United States Forest Service—Daniel Boone National Forest

Arbor Day Foundation

Angel's Envy

Sheldon and Audrey Katz Foundation

Snowy Owl Foundation

Norfolk Southern Foundation

Philadelphia Insurance

Office of Surface Mining Reclamation & Enforcement

Appalachian Regional Reforestation Initiative

The American Chestnut Foundation