

# RESTORING SHORTLEAF PINE (*PINUS ECHINATA*) FORESTS IN THE CUMBERLAND PLATEAU

Final Report  
2021-2022







## GREEN FORESTS WORK 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.

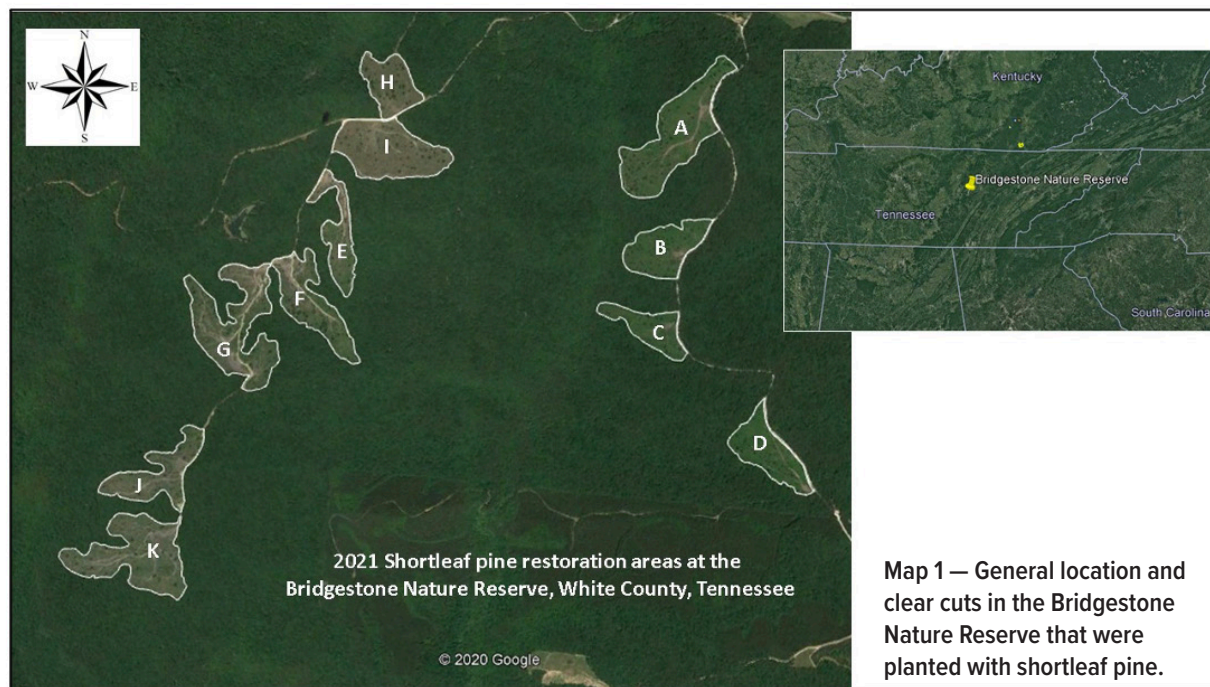
Our reforestation projects provide jobs for equipment operators, nursery workers, and tree planters, and improve the environment by eradicating exotic species and restoring ecosystem services. With the help of our partners and volunteers, this vision is quickly becoming a reality...

Since 2009, we have planted more than five million trees on more than 9,400 acres.

## BACKGROUND

Green Forests Work (GFW) is a 501(c)(3) nonprofit organization housed at the University of Kentucky. GFW's mission is to restore healthy, productive, native forests on lands that have been impacted by coal surface mining in the Appalachian region and beyond. For nearly a decade, GFW has been working with the US Forest Service, Kentucky Division of Forestry, Kentucky Department of Fish and Wildlife Resources, and many other partners to restore shortleaf pine-upland oak forest communities on public and private lands in the Cumberland Plateau region of eastern Kentucky and Tennessee. The short-term objectives of this project were to remove invasive species, de-compact soil, and restore native vegetation across 105 acres of formerly mined land on a property in Bell County, Kentucky that had been surface mined for coal and reclaimed as wildlife habitat prior to its acquisition by The Nature Conservancy (TNC). The long-term goal was to re-establish shortleaf pine/oak influenced forests to benefit a variety of sensitive wildlife species and to create demonstration areas for outreach and educational purposes. This report details GFW's reforestation efforts for the LSR grant on TNC's Cumberland Forest Ataya property and TNC's Bridgestone Nature Reserve in White County, Tennessee.





## PROJECT IMPLEMENTATION - BRIDGESTONE NATURE RESERVE

In the spring of 2021, GFW and the Arbor Day Foundation helped The Nature Conservancy to restore shortleaf pine dominated forest on the Bridgestone Nature Reserve. The property in White County, Tennessee was donated to TNC in 2018. TNC currently has botanists and biologists conducting surveys of the forest and they intend to use the property as a living laboratory for nature-based solutions to combat global warming. Before the 5,763-acre property was donated to TNC, some tracts of the Nature Reserve had been clear cut. TNC's plans for the clear cuts included conducting prescribed burns and restoring shortleaf pine at differing densities to create demonstration areas that they could use to promote shortleaf pine restoration and management throughout the region. Experimental plots were established by University of Tennessee researchers to determine the survival and growth rates of the plantings to help guide future management recommendations. Shortly after TNC conducted prescribed burns in March of 2021, GFW hired a planting contractor to plant 75,000 shortleaf pine seedlings across approximately 190 acres of clear cuts (Figs 1 & 2; Map 1).



Fig. 1 — Professional planters planting a shortleaf pine research plot on the Bridgestone Nature Reserve in 2021.



Fig. 2 — A shortleaf pine seedling shortly after planting in one of the clear cuts.





Fig. 3 — Scattered black locust and invasive exotic species such as autumn olive and bush honeysuckle growing within primarily non-native groundcover on the CF Ataya site in the summer of 2021.

## PROJECT IMPLEMENTATION - CF ATAYA PROPERTY

In July of 2021, staff from TNC, GFW, and Kentucky Division of Forestry toured the CF Ataya property to determine the current condition of the property and to develop a plan to restore native forest habitat on the surface mined areas. Much of the mined areas of the property were dominated by KY-31 fescue, sericea lespedeza, as well as other non-native and native forbs and grasses. Autumn olive (*Elaeagnus umbellata*) and other non-native woody plants were pervasive across the site. Native trees including black locust, black cherry, oaks, and other early successional trees that had been planted during mining reclamation were present in clusters or as individuals on some of the slopes, but they were not performing to their full potential (Fig. 3). Since the desired outcome was the restoration of shortleaf pine-upland oak forest on the site, GFW recommended focusing on areas that had virtually no native trees present and a plan was developed to remove the non-native vegetation and mitigate the compacted ground prior to planting a diverse mix of native trees and shrubs to restore an upland oak-shortleaf pine forest type that would much more closely resemble the vegetative community that would have been present on the site, prior the surface mining.

In the winter of 2021-22, GFW contracted a local company to use small bulldozers to remove the



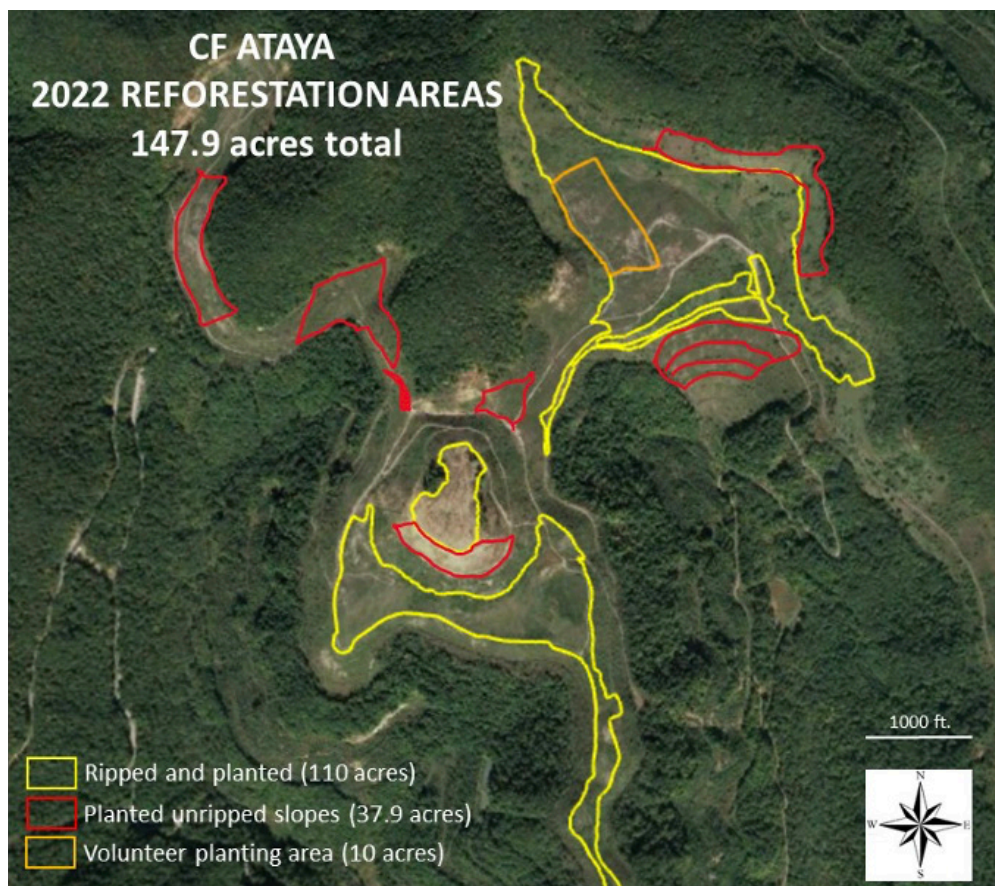
thick groundcovers and unwanted woody vegetation by pushing it into piles and “weep berms” within the reforestation areas and at the project perimeters (Fig. 4). The objective was to remove the unwanted vegetation, as well as the top few inches of soil that contains the seedbank which is composed primarily of seeds of non-native, undesirable species. However, the sod and soil that was removed is not topsoil in the conventional sense. The soil that was removed is largely composed of rock overburden that was used as a growth medium during mining reclamation. The berms that were created at the project perimeter are composed of the sod, soil, and woody vegetation and they serve as habitat for insects, birds, amphibians, reptiles, and mammals as they settle and the vegetation decomposes. The weep berms also act as dams, slowing the release of water from the areas and preventing offsite erosion and sedimentation of downstream watersheds. In some areas, the berms will allow water to pond in small areas on the upslope, creating numerous vernal pools and wetlands within the project area. GFW instructed the contractor to focus on flat and gentle slopes, not only to prevent potential erosion issues, but also because flatter areas tended to be more compacted and lacked native trees.

After the vegetation removal was completed, a large bulldozer equipped with two, three-foot ripping shanks mounted directly behind each track was used to loosen the ground, which



Fig. 4 — A small bulldozer removes autumn olive as well as the sod and seedbank prior to cross-ripping.

had been excessively compacted during mining reclamation (Figs. 5 & 6). Soil decompaction was accomplished by pulling the ripping shanks, fully immersed into the soil, behind each track of the bulldozer. The project area was cross-ripped by first ripping back and forth across the site on 8' spacing between rips. Wherever possible, the bulldozer operator then oriented the bulldozer perpendicularly to the first rows of rips and ripped the entire site a second time on 8' spacing to create a cross-hatch pattern. Vegetation removal and cross-ripping was conducted on a total of approximately 110 acres (Map 2).



Map 2. — 2022 reforestation areas on the Cumberland Forest Ataya property.





Fig. 5 — A bulldozer rips compacted soil in preparation for planting.

Cross-ripping loosens soils to create a better rooting medium for trees, allowing tree roots to extend in multiple directions and improving sites' hydrologic characteristics. The loosened soil increases infiltration rates, so that precipitation is absorbed and more slowly released from the area. Ripping the compacted land immediately creates a rough ground surface and exposes large rocks, creating microsites that will provide cover for insects, small mammals, reptiles, and amphibians. Some exposed soil results temporarily after vegetative clearing and cross-ripping, which reduces herbaceous competition and allows planted seedlings to establish. However, the bare soil is quickly colonized by native plant species (and some non-native plant species), increasing species richness and initiating the natural succession process. The exposed soil allows additional woody colonizers to take hold, including many native trees and shrubs that are not included in the species prescription. Many of our projects show a flush of native flowering herbaceous species after ripping which benefits pollinators, including butterflies, moths, and bees. However, for this project, a mix of 525 lbs. of native warm season grasses and wildflower seeds was purchased that was to be broadcast across the ripped areas. Although project partners had initially planned to restore 105 acres, Green Forests Work was able to raise additional funding and a total of 110 acres were prepared for planting

in 3 areas and enough trees were purchased so that approximately 40 additional acres of un-ripped slopes that lacked trees could also be planted.

From February 28 – March 6, 2022, a planting crew from Williams Forestry and Associates hand-planted 95,900 bare-root tree and shrub seedlings purchased from Kentucky Division of Forestry and Native Forest Nursery. The professional planters planted a total of 137.9 acres, including 100 acres of ripped ground and 37.9 acres of slopes that were not planted during mining reclamation. A diverse mix of seedlings was planted on an approximate 8' x 8' spacing in the ripped ground, with trees planted at the intersections of the cross-rips, when those areas could be identified. The un-ripped slopes were planted with a mix of half white oak and half shortleaf pine seedlings, mostly on an 8' x 10' spacing. During the tree planting, the Williams Forestry crew also broadcast the 525 lbs of native warm season grasses and wildflower seeds across the ripped ground (Table 2).

After the ripping, wetlands and vernal pools of varying depths and sizes are created on the landscape (Fig. 7). More than a dozen wetlands were created using an excavator based on



Fig. 6 — Professional tree planters plant a mix of seedlings in ripped ground on February 28, 2022.





Fig. 7 — Wetlands were created throughout the project area.

observed wetness and evaluation of soils and sub-surface conditions. The wetlands are created to intercept and retain precipitation and groundwater and trap sediment. They provide habitat for amphibians and other wildlife species, and they provide suitable conditions for state rare plant species known to be associated with wetlands in the Cumberland Plateau.

On April 12 & 13, approximately 111 volunteers from Beam Suntory and Independent Stave participated in volunteer tree planting events in 10 acres of ripped ground. After all of the plantings had been completed, 102,775 seedlings had been planted across 147.9 acres (Table 1 and Fig. 8).



Fig. 8 — Volunteers from Beam Suntory enjoy a day of tree planting.



# OUTCOMES AND FUTURE WORK

190 acres of clear cuts at the Bridgestone Nature Reserve were planted with 75,000 shortleaf pine plugs and 147.9 acres of surface mined land were prepared and planted to restore upland oak-shortleaf pine forest on the CF Ataya property in 2022. These areas will be monitored in the coming years to evaluate survival and growth rates of the planted seedlings as well as the colonization by volunteer species, both native and non-native. Wetlands will also be monitored for utilization by amphibians and other wildlife. It is likely that future maintenance work will be required to ensure that the desired forest composition is achieved and TNC has plans to conduct prescribed burns to help achieve the desired stocking rate and forest composition. Future management actions may include invasive species control, vine removal, thinning, as well as potentially additional planting(s) to bring up the stocking rate, among other management actions.

Table 1. Species, number of species, and percentage of planting mix of each species.

Common Name	Scientific Name	Number Planted	% of mix
Shortleaf pine	<i>Pinus echinata</i>	27,900	35.7
Shortleaf pine (slopes)	<i>Pinus echinata</i>	12,250	-
White oak	<i>Quercus alba</i>	23,750	30.4
White oak (slopes)	<i>Quercus alba</i>	12,250	-
Chestnut oak	<i>Quercus prinus</i>	6,100	7.8
Northern red oak	<i>Quercus rubra</i>	6,350	8.1
Black oak	<i>Quercus velutina</i>	1,800	2.3
Scarlet oak	<i>Quercus coccinea</i>	2,000	2.6
Shagbark hickory	<i>Carya ovata</i>	2,000	2.6
Mockernut hickory	<i>Carya tomentosa</i>	1,000	1.3
Yellow poplar	<i>Liriodendron tulipifera</i>	2,200	2.8
Black cherry	<i>Prunus serotina</i>	1,700	2.2
Persimmon	<i>Diospyros virginiana</i>	200	0.3
Sweet birch	<i>Betula lenta</i>	200	0.3
Sycamore	<i>Planatus occidentalis</i>	200	0.3
Black locust	<i>Robinia pseudoacacia</i>	1,200	1.5
Red maple	<i>Acer rubrum</i>	200	0.3
Wild plum	<i>Prunus americana</i>	200	0.3
Eastern redbud	<i>Cercis canadensis</i>	200	0.3
Washington hawthorn	<i>Crataegus phaenopyrum</i>	200	0.3
American hazelnut	<i>Corylus americana</i>	300	0.4
Buttonbush (wetlands)	<i>Cephalanthus occidentalis</i>	100	0.1
Gray dogwood (wetlands)	<i>Cornus racemosa</i>	75	0.1
Silky dogwood	<i>Cornus amomum</i>	400	0.5
<b>TOTAL</b>		<b>102,775</b>	<b>100</b>



Both areas will be utilized for research and we anticipate that they will both be used as demonstration/education areas. The CF Ataya property has already been utilized to foster greater support for mined land reforestation within TNC. TNC staff from multiple states toured the site on February 10, 2022 and learned from GFW, TNC staff, and the site preparation contractor about the project and other similar efforts undertaken by GFW throughout the region. The CF Ataya reforestation site was also utilized for education/coalition building during the TNC-KY's Board Meeting on May 19-20, 2022.

Table 2. Species and rates of native grasses and forbs that were broadcast across the ripped areas.

Common Name	Botanical Name	oz/ac	lbs/ac	lbs
<b>Grasses</b>				
Indian Grass	<i>Sorghastrum nutans</i>		1.000	105
Big Bluestem	<i>Andropogon gerardii</i>		0.750	78.75
Little Bluestem	<i>Schizachyrium scoparium</i>		1.500	157.5
Switchgrass	<i>Panicum virgatum</i>		0.500	52.5
Fall Panicum	<i>Panicum anceps</i>		0.250	26.25
<b>Subtotal Grasses</b>			<b>4.00</b>	
<b>Forbs</b>				
Illinois Bundleflower	<i>Desmanthus illinoensis</i>	3.00	0.188	19.688
Partridge Pea	<i>Cassia fasciculata</i>	1.75	0.109	11.484
Ragweed	<i>Ambrosia artemisiifolia</i>	1.00	0.063	6.563
Blue False Indigo	<i>Baptisia australis</i>	1.00	0.063	6.653
Lance Leaved Coreopsis	<i>Coreopsis lanceolata</i>	2.00	0.125	13.125
Blackeyed Susan	<i>Rudbeckia hirta</i>	2.00	0.125	13.125
Downy Sunflower	<i>Helianthus mollis</i>	1.25	0.078	8.203
Greyheaded Coneflower	<i>Ratibida pinnata</i>	2.75	0.172	18.047
False Indigo Bush	<i>Amorpha fruticosa</i>	1.50	0.094	9.844
<b>SUBTOTAL FORBS</b>		<b>16.25</b>	<b>1.016</b>	



## ON THE COVER

Volunteers plant at the TNC Ataya property in Bell County, Kentucky.

CHRIS BARTON

PRESIDENT

859.257.2099

BARTON@GREENFORESTSWORK.ORG

MICHAEL FRENCH

DIRECTOR OF OPERATIONS

812.447.3285

MICHAEL.FRENCH@GREENFORESTSWORK.ORG