SEWANEE

THE UNIVERSITY OF THE SOUTH

Domain Management Plan

2019-2029

FINAL DRAFT

12/20/2019

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Reviewed by:
The Nature Conservancy
Forest Stewards Guild

Tract Location: Franklin and Marion Counties, Tennessee
Centroid Latitude 35.982963 Longitude -85.344382

Tract Size: 13,036 acres | 5,275 hectares

Land Manager: Office of Environmental Stewardship and Sustainability, The University of the South, Sewanee, Tennessee

Executive Summary

The primary objective of this management plan is to provide a framework to outline future management and outline operations for the Office of Environmental Stewardship and Sustainability (OESS) over the next ten years. In this plan, we will briefly introduce the physical and biological setting, past land use, and current uses of the Domain. The remainder of the plan consists of an assessment of the forest, which has been divided into six conservation areas. These conservation areas contain multiple management compartments, and the six areas have similarities in topographical position and past land use. Finally, the desired future condition and project summary of each conservation area and compartment has been outlined.

Background

The University of the South consists of an academic campus (382 acres) with adjacent commercial and residential areas (783 acres) that are embedded within and surrounded by diverse natural lands (11,838 acres). The term "Domain" is used interchangeably to describe both the entire ~13,000 acres and the 11,800-acre natural land matrix (also referred to as the "Greater Domain"). What makes the landscape of the Domain such a unique educational asset for the study of the environment is the continuum that exists with the human-built environment extending into this natural environment context.

The size and complexity of land use on the Domain provides a unique opportunity to live and study where we wrestle with many of the environmental challenges that all communities face. Land-use planning, drinking water procurement, wastewater processing, food production, natural resource extraction, and biodiversity protection are all practiced on the Domain in microcosm. This juxtaposition of land use is leveraged by the Sewanee Integrated Program in the Environment to create innovative learning opportunities for all students.

Over the past 120 years, seven management plans, one white paper, and a sustainability master plan have guided decision-making for Sewanee's Domain, with the last management plan for the Domain having been produced in 2003. The intent of this document is to provide a framework for management for the next ten years. In the short-term (< 5 years), objectives for several upcoming management projects have been outlined with spatial information to avoid conflicts with ongoing research projects. In the long-term (> 5 years), potential projects are discussed that may or may not take place over time, but are included for long range planning These long-term projects will be further refined and solidified in an update to this plan in 2024.

Over the next ten years, strategies may be adapted as projects to be implemented on the ground. Adaptive management allows OESS to utilize ground level, site specific monitoring of species and ecological conditions to influence future practices. It is a process that deals with uncertainty and changing conditions over time. If aspects of the planned management are shown by monitoring or user feedback to conflict with our objectives, then we will collaboratively determine alternative courses of action.

In reviewing prior efforts to guide management on the Domain, many of the goals from the 2012 Domain White Paper developed by the now defunct Natural Resource Advisory Committee were carried forward (NRAC 2012). These goals and values will guide the OESS in managing the Domain over the next ten years. Beyond the first goal of communication, Goals are listed without order of priority.

Goals and Values

1. Maintain a transparent communication process where all stakeholders are involved or well informed of management and research activities on the Domain.
2. Employ adaptive management in a contemporary and exemplary fashion using the best available science and monitoring data.
3. Encourage cross disciplinary research and provide locations and logistical support to ensure that long-term research is protected.
4. Manage habitats to enhance, protect and promote biodiversity across the landscape.
5. Foster ecological communities that can be resilient in a changing climate.
6. Consider management to increase net carbon sequestration.
7. Integrate management into the curriculum so that student involvement is encouraged in all steps of the process from planning to implementation to ensure that the University's education mission is achieved.
8. Ensure that management increases the total value of the forest (economic and ecological) over time.
9. Mitigate the effects of land use and management on the Domain's culturally significant sites proactively.
10. Recognize that students of all disciplines can learn and understand the consequences of society's natural resource consumption through responsible and active management of Domain resources.
11. Support student recreational use of the Domain and integrate the academic program with outdoor opportunities.
12. Demonstrate a sustainable flow of natural resources that can be utilized directly on the Domain where appropriate (e.g., timber products, biomass) and which offsets consumption of the University where appropriate (i.e., paper, coal, natural gas).

Summary of Future Management Actions

Over the duration of this plan, the vast majority of the Domain's forests will remain undisturbed by timber management. The plan focuses active management on areas where management has occurred previously and where significant deviation exists between current forest condition and desired ecological conditions as articulated by The Nature Conservancy (TNC) in their climate resilience and vulnerability assessments. The plan includes strategic direction for habitat management using timber harvest, exotic species control, prescribed fire, and provides recommendations for recreational infrastructure improvements across the Domain.

In each section examining our Conservation Areas, we provide a broad overview of the desired future conditions followed by the compartment summaries with management prescriptions, if applicable. Over the next 5 years, we propose prescribed fire in portions of 16 compartments and timber management is proposed in portions of 11 compartments. Substantial exotic species control is proposed in 4 compartments though some other exotic species control is anticipated throughout the property. Similarly, recreational infrastructure upgrades are anticipated in a number of compartments with major upgrades in at least 6 compartments. Exact acreages of all prescribed fires and harvests will be determined through collaboration with University personnel and our external collaborators.

Domain Collaborative Group and Domain Research Approval Process

This document should be viewed as a curricular tool as much as a land management one. The plan gives faculty the necessary lead time to more fully realize the potential of the Domain in their course offerings, and gives them the necessary context to integrate monitoring and research on the Domain. To facilitate this integration, The Domain Collaborative Group has been created to lead efforts to integrate more fully the management of the Domain into the academic curriculum and maximize opportunities for faculty discussion and student engagement and communication across the institution. The group consists of faculty and staff chosen to represent a broad spectrum of environmental disciplines, and will meet monthly to discuss collaborative opportunities and communicate OESS activities across the campus.

Additionally, there is a review process for ALL research projects that are to take place on the Domain. All outside entities, faculty, staff, and students are required to submit a short notification email to OESSresearch@sewanee.edu or utilize the proposal form at http://www.sewanee.edu/offices/oess/domain/research/ . This notification and review is intended to minimize user conflicts with other activities and investigators and allow the Domain Collaborative Group to be informed about partnership opportunities.

Credits for Authorship

Most of the text of this document was written or compiled by Amy Turner and Nate Wilson of the Office of Environmental Stewardship and Sustainability and Ken Smith of the Department of Earth and Environmental Systems. Sarah Sherwood, University Archaeologist, authored the sections about cultural resources, and Chris Van de Ven, Molly Elkins, and Will Godsey of the Landscape Analysis Laboratory (LAL) developed many of the maps found throughout the document. Ann Bradley of the LAL provided several historical documents from the Domain History Project. Trisha Johnson, Stuart Hale, Sally Palmer and Joey Wisby of TNC provided comments, suggested edits, and mapping support. Mike Lynch from the Forest Stewards Guild provided additional comments and suggestions. Sewanee's Biology Department provided input and guidance on species locations, research and teaching priorities, and habitat mapping. Finally, Matthew Costello (C'84) provided valuable editorial input.

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Section 1. The Domain's Physical and Biological Setting

The Domain of the University of the South comprises approximately 13,036 acres located on the southern Cumberland Plateau in Franklin and Marion Counties, Tennessee, and is divided into 53 compartments for management purposes (Figure 1). Conservation Area 0 is our urban zone and not included in the plan; Conservation Area 1 is in Lost Cove; Conservation Area 2 includes upland compartments to the south and east of the urban core; Conservation Area 3 includes south facing slopes; Conservation Area 4 is the upland compartments on both sides of Breakfield Road; Conservation Area 5 is north facing slopes; and Conservation Area 6 includes the two compartments surrounding Lake Dimmick and the Cheston Farm.

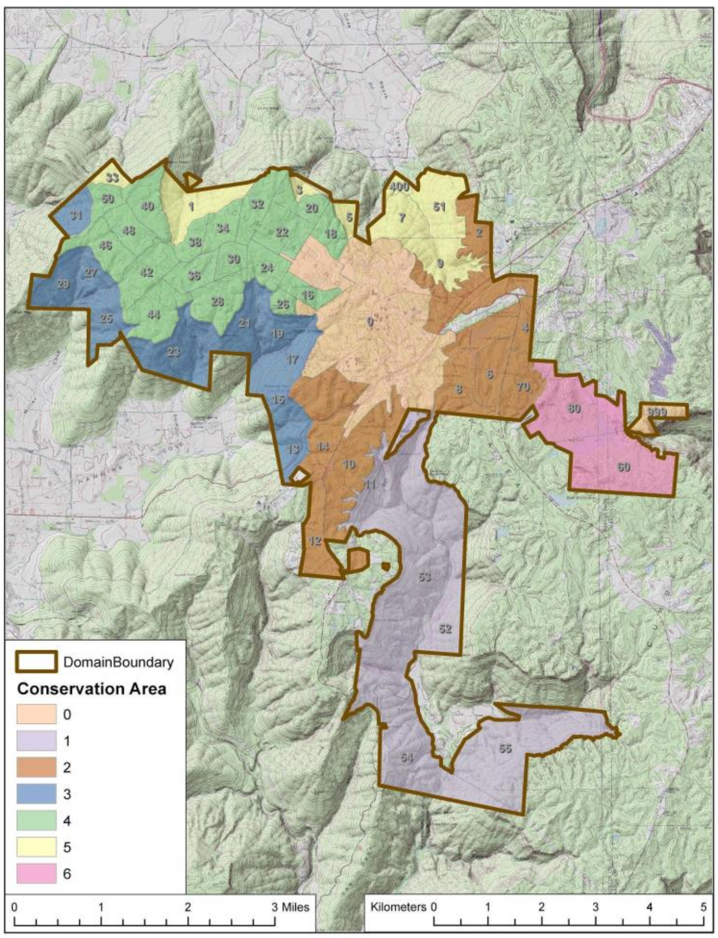


Figure 1. The current Domain compartment map with designated Conservation Areas. The current numbering system of compartments was adopted in 1970 and Lost Cove compartments were numbered in 2012.

Ecological Values and Management Goals- Desired Conditions Overview

The University of the South, recognizes the importance of the planet and its resources and the Office of Environmental Stewardship and Sustainability (OESS) serves as a resources to the University community to shepherd awareness about stewardship and sustainability, as well as catalyzing action throughout the campus, the Domain and the community.

The OESS Vision of "*Empowered Human Communities. Resilient Natural Communities*" and the Mission of "*Provide natural resource and societal experiences that foster understanding of our place in the world*" provides a platform for engaging the University community in conservation, education, research, and collaboration.

As stated in the 2012 Natural Resources Advisory Committee White Paper, "Our relationship with the ecosystem is interdependent, so we are consumers as well as cultivators" (University of the South 2012). Desired conditions describe the vision or pathway for achieving our vision and mission on the Domain. They depict the ecological, recreational, teaching, social, and sometimes economic conditions that the Domain should and does provide. Some of these conditions apply across the broad geographic landscape, while others are more specific to a Conservation Area or Compartment, or broad area managed for a specific habitat or species.

A recurring theme that runs throughout the desired conditions for the Domain is the focus on sustaining a diverse terrestrial, aquatic, and vegetative communities unique to the Cumberland Plateau, through the foundation of healthy watersheds and productive soils. In some cases, our desired condition matches the current condition, so our goal is to maintain what we have and we will state this in the Conservation Area Summary or Compartment Discussion. In other cases, we need to work toward meeting the desired conditions and success in achieving them can only be measured over the long term.

Additionally, adjustments may need to be made in the desired conditions if monitoring results indicate that our goals are not achievable in the long-term or if there is an imbalance in what we are accomplishing. By painting a picture with the desired conditions, we describe the appearance and condition that one might expect.

In an effort to work towards achieving these desired conditions, we have defined the following Outcome Goals and Process Goals to guide the direction of the management decisions laid out in the management planning process:

Outcome Goals

a) Manage habitats to enhance, protect, promote, and maintain animal and plant biodiversity across the landscape; (In part measured using the KEEAs in Appendix G, specifically: 2, 4, 5, 6, 7, & 9. Additional efforts will be completed with ongoing collaborations with faculty and new collaborative research.)

b) To maintain a diverse, functioning, resilient, and healthy forest ecosystem that promotes native biota, structure, and natural processes characteristics of the forests in the region; (In part measured using the KEEAs in Appendix G, specifically:1, 2, 3, 4, 5, 6, 7, 8 & 9. Additional efforts will be completed with ongoing collaborations with faculty and new collaborative research.)

c) To promote successional diversity of forest conditions on the Domain, and promote components of early successional forests. (In part measured using the KEEAs in Appendix G, specifically:1, 2, 3, 4, 5, 6, 7, 8 & 9. Additional efforts will be completed with ongoing collaborations with faculty and new collaborative research.)

d) To fully evaluate the ecological characteristics of each Conservation Area using ecological indicators (Section 2, Table 5);

e) Set aside, from active management, areas that have unique biological characteristics (e.g., Shakerag Hollow, Dick's Cove); These areas are identified as part of the High Conservation Value Forests (Appendix F) and throughout the Management Plan.

f) Address the impacts of white-tailed deer on forest composition through planned actions that include project sequencing and targeted population management. In part measured through pre- and post-harvest surveys, harvest results/hunter effort, analysis conducted by the University Herbarium, KEEAs in Appendix G, specifically: 2, 3, 4, 6, 7, 8 & 9. Additional efforts will be completed with ongoing collaborations with faculty and new collaborative research.

Process Goals

a) To demonstrate a robust and comprehensive project planning process with independent review through the Domain Collaborative Group and the Research Review process on the OESS website;

b) To integrate input from the University community and facilitate scientific research, and/or educational learning opportunities, and recreational amenities;

c) To anticipate and address current and potential threats to forest viability, including but not limited to, climate change, impacts of white-tail deer browsing, invasive species, recreational overuse and land use change, and potentials threats to forest health (e.g., emerald ash borer). In part measured using the KEEAs in Appendix G, specifically:1, 2, 3, 4, 5, 6, 7, 8 & 9. Additional efforts will be completed with ongoing collaborations with faculty and new collaborative research.

Objectives

The following are some *overall management objectives* to help achieve the outcome and process goals for the the Domain, these are not all inclusive as each section of the Introduction includes specific objectives for each topic:

a) Promote early successional (young) forests and their associated plant and animal species through timber harvesting and prescribed burning, with special emphasis on retaining uncommon species, and retaining complex structural elements within a young forest.
b) Promote the development of more complex structure, age class, and species diversity within hardwood and oak forests through a combination of selective harvesting, snag retention, and gap creation and management.
c) Address the impacts of white-tail deer on forest composition through planning and actions that include project sequencing, brush and slash management, and hunting.

Ecological Resources

The biologically rich hardwood forests of the Cumberland Plateau are considered to be among the highest of the ecologically valued forests remaining in North America today. This is partly due to the fact that this region contains some of the largest remaining tracts of privately owned forest in the region.

These forest tracts represent critical neotropical migratory songbird habitat and serve as the headwaters to biologically diverse freshwater stream systems. The Cumberland Plateau is considered a global hotspot for amphibian and terrestrial snail diversity and contains some of the most diverse plant communities in the eastern United States. The land holdings of the University of the South are highly diverse as well and is home to over 1,000 species of plants identified to date (Evans et al. 2016, Appendix H)). This diversity is due to a number of factors including the varied topographic relief, parent materials, soils, and history of land use.

The rich biodiversity of the Domain is a function of the variety of habitats that can be found. The Domain habitats are comprised of upland plateau forests, streams and riparian habitat, glade and barrens, and cove forests. The forest ecosystems associated with the coves are distinctly different from the upland forest types found on top of the plateau, 1,800 - 1950 feet above sea level.

The southern Cumberland Plateau region is considered a nationally important hotspot of biological diversity and is located in the Central Appalachian Ecoregion (Griffith et al. 2002). The Natural Resource Defense Council included our region as part of their “Biogem” designations. Recently, the Open Space Institute in collaboration with The Nature Conservancy (TNC) selected the southern Cumberland Plateau (including the Domain) as the initial focus area in the launch of their Southeast Resilient Landscapes Fund. One of our two old-growth cove forest sites on the Domain, Dick Cove, is registered with US National Park Service as a National Natural Landmark. Our other old-growth forest site, Shakerag Hollow, was the recent subject of the prize-winning book, The Forest Unseen, by Biology Professor David Haskell.

Ecological Systems Diversity of the Domain

Ecosystem diversity is defined as the extent and variety of ecological systems or the shape, size, and patterns of the whole landscape, including species composition, structures (successional stages and canopy conditions of that system across a landscape) and associated process (Lapin and Barnes 1995). By evaluating, conserving, and preserving the entire structure rather than focusing on the individual species, actions will ensure the restoration and maintenance of the key characteristics, conditions, and functionality of the native ecosystems found on the Domain (Lapin and Barnes 1995; Barnes 1993; Rowe 1989).

Ecological systems are recurring groups of biological and vegetative communities found in comparable physical environments and are influenced by analogous ecological processes, geological substrates, and/or environmental gradients (Josse et al 2003). Vegetation, wildlife, soils, water, geology, climate, fire and other natural disturbances all contribute to ecosystem diversity. Focusing on the broader ecosystem diversity allows for a more holistic, sustainable approach to the management of the resources of the Domain (Lapin and Barnes 1995).

Ecological Systems of the Domain

There have been many attempts to classify ecological systems on the Domain over the past several decades. For this plan, previous system designations from various facuty were evaluated against the system designations included in the 2015 update to the Tennessee State Wildlife Action Plan (SWAP). Species listings from SWAP are now being used to provide conservation planning, standardized habitat classification, and linking SGCN habitat preferences on the Domain (Dixon and Zigler 2011, Evans et al. 2016, TWRA 2015, J. Wisby pers. communication). The framework for classifying terrestrial ecological systems and the previous mapping efforts utilized landcover mapping and then were crosswalked the land cover classes to NatureServe's International Ecological Classification Standards unique identifier (CES number) and the Tennessee Wildlife Resource Agency vegetation community types which serve as the habitat types for terrestrial species. (Evans et al. 2016, TWRA 2015).

For this forest management plan, TNC, using the same methodologies utilized in the 2015 SWAP, evaluated the landcover of the Domain using the 2011 GAP/LANDFIRE data and determined that the following 17 ecological systems occur on the Domain (Figure 2, Table 2, Table 3):

Plateau Surface:
Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359),
Southern Appalachian Low- Elevation Pine Forest (CES202.332);
Sandstone Cliff Face and Rockhouse:
Cumberland Acidic Cliff and Rockhouse (CES202.309);

Upper Slope Dry:

Southern Interior Low Plateau Dry- Mesic Oak Forest (CES202.898);

Upper Slope Mesic:

South-Central Interior Mesophytic Forest (CES202.887);

Lower Slope Dry:

Southern Ridge and Valley/ Cumberland Dry Calcareous Forest (CES202.457);

Floodplain:

South-Central Interior Small Stream and Riparian;

Anthropogenically-modified habitats:

Forest Plantation,
Old Field/Successional,
Pasture,
Cropland,
Excavated Land,
Developed Open Space,
Low- High Intensity Developed,
and Open Water.

After review of the available literature (Evans et al. 2016), known SGCNs, and habitat resources, we have added the following 16 habitats in our review. Locally field-identified additions to the Domain's habitat list are an important consideration for the forest management plan, as some ecological systems are expressed at spatial scales more difficult to discern from satellite imagery interpretation:

Sandstone Outcrop & Bluff:

Cumberland Sandstone Glade and Barrens (CES202.337);

Plateau Wetlands:

Central Interior Highlands and Appalachian Sinkhole and Depression Pond (CES 202.018),
Cumberland Seepage Forest (CES202.361);

Limestone Outcrop and Glades:

Central Interior Highlands Calcareous Glade and Barrens (CES202.691),
Southern Interior Calcareous Cliff (CES 202.356);

Floodplain:

South-Central Interior Large Floodplain (CES202.705).

The Naturserve description of each habitat type can be found in Appendix A.

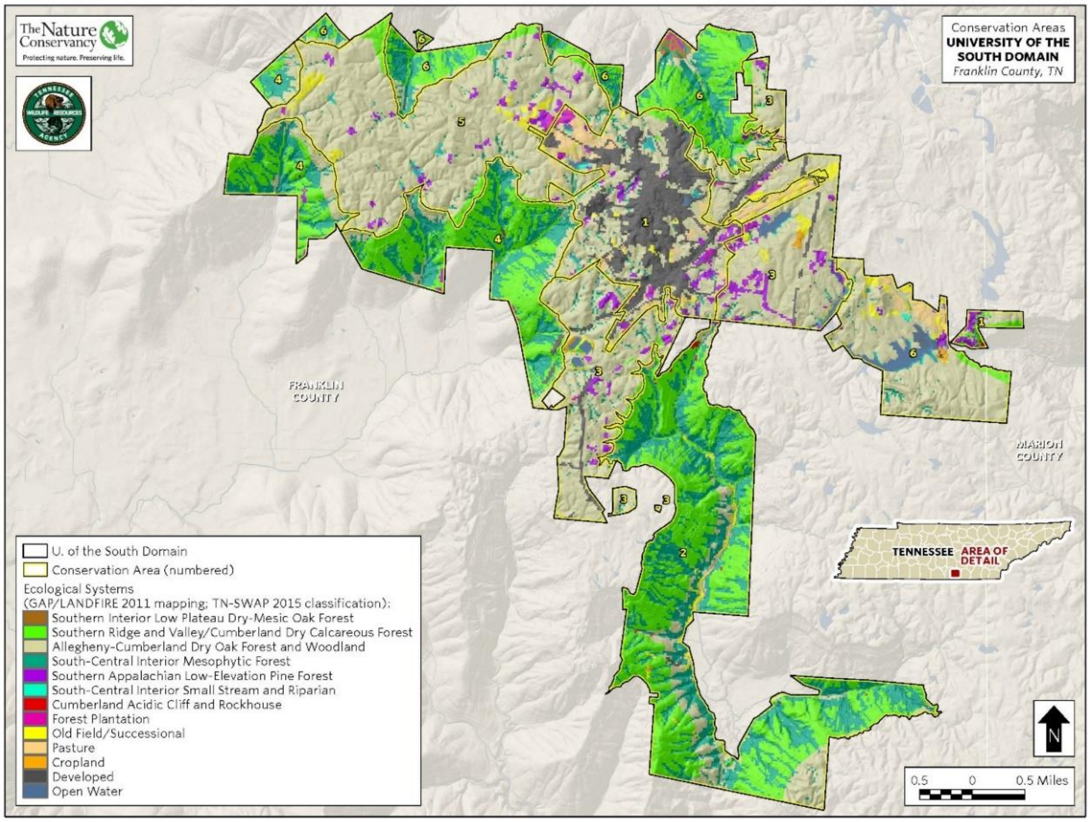


Figure 2. Ecological Systems of the Domain using the GAP/LANDFIRE 2011 mapping TN-State Wildlife Action Plan (SWAP) 2015 classification.

Table 1. The habitat types of the Domain and acreages for the 16 habitat by Conservation Areas of the Domain that are mapped on Figure 2.

		Acres by Conservation Area						
Habitat Type	**Acres**	**CA 0**	**CA 1**	**CA 2**	**CA 3**	**CA 4**	**CA 5**	**CA 6**
Southern Interior Low Plateau Dry-Mesic Oak Forest	24.0					0.9		23.1
Southern Ridge and Valley / Cumberland Dry Calcareous Forest	3,030.8		52.5	1,501.8	56.7	803.3	109.4	507.1
Allegheny-Cumberland Dry Oak Forest and Woodland	5,783.4	21.8	625.4	352.9	1,716.2	274.2	1,989.3	803.5
South-Central Interior Mesophytic Forest	2,225.9		40.9	1,053.7	75.2	622.7	48.9	384.5
Southern Appalachian Low-Elevation Pine Forest	369.2	1.6	104.5	5.3	143.2	13.8	75.2	25.6
South-Central Interior Small Stream and Riparian	52.9		18.9	0.2	5.8		13.1	14.9
Cumberland Acidic Cliff and Rockhouse	10.5		1.3	6.4		1.8		0.9
Forest Plantation	32.9		14.9		8.2		6.9	2.9
Old Field / Successional	230.4	17.1	23.1	39.8	56.9	0.2	56.5	36.7
Pasture	211.3	34.0	105.9	9.1	5.3		8.9	48.0
Cropland	18.5	0.4		1.1	11.1			5.8
Excavated Land (Strip Mine / Road Cut / Rock Quarry / Gravel Pit)	3.6				3.6			
Developed Open Space	671.2	5.1	491.0	4.7	130.3	14.5	5.8	19.8
Low Intensity Developed	168.1	0.9	156.8		9.1		1.3	
Medium Intensity Developed	27.8	2.2	24.5		1.1			
High Intensity Developed	1.8		1.8					
Large River	97.9		6.4		40.3			51.2

Since ecological systems may have similar key attributes, indicators, species associates, the 24 ecological systems were grouped into 11 for discussion and are shown in Table 2, with acreages in Table 1.

Table 2. Ecological Systems and Systems Group.

Ecological Systems Group	Ecological System
Plateau Surface	Allegheny- Cumberland Dry Oak Forest and Woodland
	Southern Appalachian Low-Elevation Pine Forest
Sandstone Outcrop and Bluff	Cumberland Sandstone Glade and Barrens
Plateau Wetland	Central Interior Highlands and Appalachian Sinkhole and Depression Pond
	Cumberland Seepage Forest
Sandstone Cliff Face and Rockhouse	Cumberland Acidic Cliff and Rockhouse
Upper Slope Dry	Southern Interior Low Plateau Dry-Mesic Oak Forest
Upper Slope Mesic	South-Central Interior Mesophytic Forest
Limestone Outcrop and Glades and Cliff	Central Interior Highlands Calcareous Glades and Barrens
	Southern Interior Calcareous Cliff
Lower Slope Dry	Southern Ridge Valley/ Cumberland Dry Calcareous Forest
Floodplain	South-Central Interior Small Stream and Riparian
	South-Central Interior Large Floodplain

Anthropogenically-modified habitats	Forest Plantation
	Old Field/ Successional
	Pasture
	Cropland
	Excavated LandBedrock
	Developed Open Space
	Low-High Intensity Developed
	Open Water

Forest Structure

All forested ecosystems require structural diversity in the form of successional stage and canopy conditions which are also important to the non-forested components of the systems. A balance within the community of vertical structure to weather loss from climate change, storm events, pest infestations, wildfires, and biological age provides habitat for the terrestrial species that utilize these ecosystems at some point in their life cycle. Managing for a variety of vertical and horizontal structures can provide habitat for the terrestrial species that utilize these ecosystems at some point in their life cycle. For example, it has been shown that bat activity generally increases in disturbed habitat, thus properly designed forest management can provide suitable habitat and a reliable prey base for foraging bat species (Loeb and O'Keefe 2011, Titchenell et al. 2011, Lacki and Dodd 2011, Brooks 2009, Grindal and Brigham 1999, Panzer and Schwartz 1998). For the purposes of this plan we use the definitions of structural classes as defined by the USFS (2011) (Table 3).

Table 3. Definitions of Structural Classes. Adapted from the USFS George Washington Jefferson Forest (USFS 2011)

Open	Land with less than 10 percent canopy cover in permanent or long-term open condition (grasslands, barrens, etc.; not newly cut forest regeneration.)
Early Successional or Regenerating Forest	Stands developing after a major disturbance, generally less than 11 years in age in the most common systems, but can be up to 20 years.
Mid-Successional or Open Canopy Forest	Stands beyond regeneration that stay in a relatively open canopy (canopy closure of 25-60%).
Mid-Successional Closed Canopy Forest	Stands beyond regeneration where the canopy closes (canopy closure of 61% or greater).
Late Successional Closed Canopy Forest	Stands reaching older ages of mature trees (50-100 years or greater) and more lasting structural conditions with a largely closed canopy (all layers) greater than 60 percent. Includes natural canopy gaps.
Late Successional Open Canopy Forest	Stands reaching older ages of mature trees (50-100 years or greater) and more lasting structural conditions with overall open canopy (canopy closure of 25-60 percent; typical of an area being thinned.)

Ecological Systems Descriptions

Desired Conditions for Ecological Systems Diversity

Native ecological systems occupy appropriate sites and continue to occupy those sites. Native ecosystems sustain strong resilient populations of associated terrestrial and aquatic species.

A mix of closed canopy forest, intermittent canopy, and open canopy conditions. Forest and woodland ecological systems support a diversity of tree ages, from regeneration to old growth, providing a relatively stable mix of ecological conditions across the landscape over time. Openings occur in individual tree-sized gaps and larger. Structure within patches of regenerating forest and woodland is diverse due to the presence of snags and live overstory trees. Forested systems are dominated by hardwoods, pines, or combinations of both. Non-forested systems are primarily dominated by shrubs, forbs, and grasses. Snags, downed wood, stumps, and other organic matter occur in sufficient abundance to support native species.

Ecological systems are intact and as resilient as possible to absorb negative effects associated with various natural and human-caused stresses. Forest ecosystems are in their natural state with limited infestations of invasive species to the fullest extent possible. Diversity in the form of structure and composition occurs throughout the forest.

Plateau Surface

The forests on the plateau surface are the most common forest systems on the Domain, and comprise approximately 6720 acres of the Domain's land. These forests are comprised of second and third growth oak and hickory, interspersed with more mesic areas of yellow poplar and red maple. Plantations of white and yellow pines and various hardwoods are interspersed in this system. In general, the ecological character and natural distribution of these system has been obscured over the years by human settlement, universal logging, invasive species outbreaks (pine beetle), and fire suppression. In the absence of fire, white pine or other less than desirable species may become established and we see a loss in shrub layers and natural succession.

Current and Desired structural conditions are as follows:

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Closed Canopy
% of Ecological System Current	4%	2	2	92
% of Ecological System 2025	9	4	2	85

Sandstone Outcrop and Bluff

These important ecological systems encompass a complex of sparsely vegetated rock outcrops, perennial grasslands, and woodlands on shallow soils on the CumberlandPlateau. On the Domain, these systems generally occur near the bluff edge, though interior occurances of this system appear sparsly throughout the interior domain where soils are thin. Mapping of this system on the Domain is incomplete. Herbaceous plants, including *Diamorpha smallii* and *Minuartia glabra*, are typical in these outcrops. Management is generally limited to protection from soil disturbance and prescribed fire where appropriate.

Plateau Wetland

Overstories are typically dominated by a variety of species depending on whether the water based system is seepage forest or sinkhole and depression pond. Common species are *Quercus species*, *Platanus occidentalis, Fraxinus pennsylvanica, Acer saccharinum*, or *Nyssa species*, or a combination of these the same trees occupying the oak and cove forest types. Midstories and understories are often well developed and diverse depending on the level of deer browse impact. These systems often support populations of associated rare amphibian species, but can also provide foraging habitat for forest bat species. Regenerating forests (0-10 years old) are uncommon, though small openings are present and are important for key species. Late successional forest is common and makes up most of the canopy. Fire in these ecological systems is rare. Management in these systems is generally limited to protection, with examples excluded from most active management.

Sandstone Cliff Face and Rockhouse

The cliff system typically is sparsely vegetated to partially wooded cliffs and talus slopes and consists of extremely steep or vertical rock faces exposed along bluffs. The aspect is variable but best developed on south- and west-facing sites. These areas are also prone to harsh climatic conditions; frequent disturbances include drought stress and wind and storm damage. As a result, examples are characterized by sparse herbaceous cover and few, if any, trees. Vegetation consists of scattered individuals of *Asplenium montanum*, *Silene rotundifolia*, and other species rooted in crevices and erosion pockets. In some parts of its range, this system is the primary or sole habitat for rare endemic species, such as *Minuartia cumberlandensis* and *Ageratina luciae-brauniae*.

Upper Slope Dry

The upper slope dry system is a continuation of the plateau surface with additional complexity provided by large boulders and their associated microclimates. This system consists of upland hardwood-dominated forests occurs along ridgetops and slopes of various aspects. The floristic expression of different stands included in this habitat varies considerably with aspect and soil type. Overstory is dominated by oaks and Hickories, with some sugar maple and yellow poplar in the more mesic areas.

Current and Desired structural conditions are as follows:

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Closed Canopy
% of Ecological System (current)	0	5	7	87
% of	0	5	9	85

Ecological System (current)				

Upper Slope Mesic

This ecological system has a high-diversity of predominantly hardwood forest that occurs on deep and enriched lowland soils or in somewhat protected landscape positions such as coves or lower slopes. Typical dominant overstory species include sugar maple, beech, tuliptree, basswood, red oak, and black walnut. These forest systems make up some of the most productive forest systems on the Domain, and are also some of the most species rich. The herb layer is rich, often with abundant spring ephemerals. Understory species of concern in this system include *Silphium brachiatum*, and *Panax quinquefolius*.

Structural conditions are as follows:

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Closed Canopy
% of Ecological System Current	1	3	0	96
% of Ecological System 2025	No management			

Limestone Outcrop and Glades and Cliff

This system occurs along moderate to steep slopes and steep valleys on primarily southerly to westerly facing slopes. Limestone and/or dolomite bedrock typify this system with shallow, moderately to well-drained soils interspersed with rocks. These soils often dry out during the summer and autumn, and then become saturated during the winter and spring. *Schizachyrium scoparium* dominates this system and is commonly associated with *Andropogon gerardii*, *Bouteloua curtipendula*, and calcium-loving plant species. Stunted woodlands primarily dominated by *Quercus muehlenbergii* interspersed with *Juniperus virginiana* occur on variable-depth-to-bedrock soils. Fire is the primary natural dynamic, and prescribed fires could help manage this system by restricting woody growth and maintaining the more open glade structure.

This cliff system is nearly unvegetated, however, *Asplenium ruta-muraria* and *Pellaea atropurpurea* may be characteristic plants. On the Domain, the federally listed *Clematis morefieldii* is found mostly in this system. These cliffs are typically dry but may contain relatively small embedded seepage patches. Both wet and, more commonly, dry expressions are included. This system also covers a narrow zone of vegetation, often herbaceous, at the horizontal clifftop where growing conditions are harsh and often gladelike.

Lower Slope Dry

This system includes calcareous forests on lower escarpments of the Cumberland Plateau and other related areas. High-quality and historic examples are typically dominated by combinations of *Quercus* spp. and *Carya* spp., sometimes with *Pinus* spp. and/or *Juniperus virginiana* as a significant component in certain landscape positions. This system occurs in a variety of topographic and landscape positions including valley floors, sideslopes, and lower to midslopes. On the Domain, most acreage in this system is composed of successional foreste that have arisn after repeat cutting. Due to the low productivity of these systems, many remain open decades after harvest. Fire exclusion has likely increased the proportion of *Juniperus virginiana* in the system and reduced the extent of grasses and forbes.

Desired structural conditions are as follows:

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Closed Canopy
% of Ecological System Current	5	20	25	50
% of Ecological System 2025	No Management			

Floodplain

The streams of the Domain consist of several perennial and intermittent streams and numerous ephemeral streams, which are described in more detail in the Surface Water section below. The vegetation is a mosaic of forests, woodlands, shrublands, and herbaceous communities. As described by Ilhardt *et* al. (2000) and the National Research Council (2002) riparian stream zones serve as transitional areas between terrestrial and aquatic ecosystems that extend in multi directions including down into the groundwater, up above the canopy, outward across the floodplain and expanse in which surface and subsurface hydrology connect. The stream corridors on the Domain have distinctive uses and standards so these ecological systems are managed specifically through best management practices as described in the Water Resources section.

Anthropogenically-modified habitats

The ecological systems that have been modified include: Forest plantation (32.9 acres), Old Field/ Successional (230.4 acres), Pasture Areas (211.3 acres), Cropland (18.5 acres), Excavated Land (3.6 acres), Developed Open Space (671.2 acres), Low-High Intensity Developed (168.1 acres), and Open Water. These ecological systems have all been modified in recent past for difference purposes. For example, forest plantation systems are areas that have been planted by direct seeding often in White pine. They consist of even-aged, single species monocultures. And developed land contains some mixture of intensity of development depending on the category.

Figures 3, 4, and 5 provide a visual representation of the habitat priorities on the Domain for SGCN terrestrial, karst, and aquatic species respectively. These maps demonstrate the landscape context significance of the Domain lands within the Southern Cumberlands in particular. The forests of the Domain contain headwater systems which flow down the escarpment into biologically significant watersheds, provide direct habitat for many terrestrial species, and overlay extremely rich cave and karst resources with documented biodiversity. This type of mapping is important to the Domain and OESS as it provides an evaluation of the Domain in each habitat category and allows us, as land managers, to evaluate our resources for future research, conservation, and management priorities.

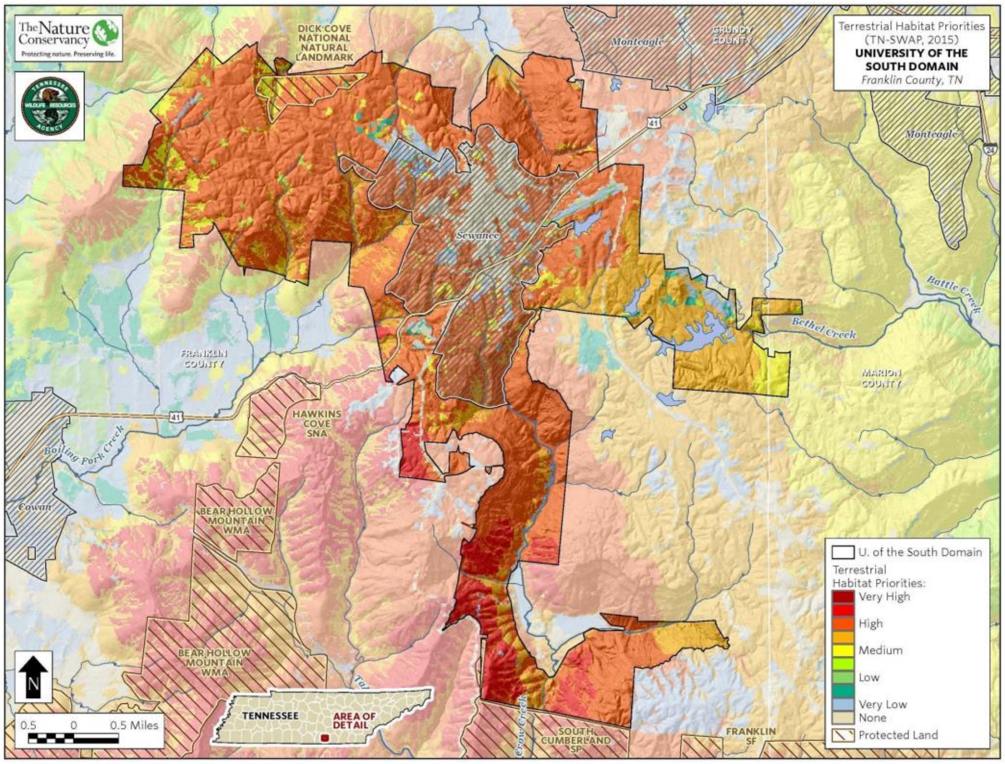


Figure 3. Terrestrial habitat priorities for SGCN species based on 2015 SWAP analysis for the University of the South, Tennessee.

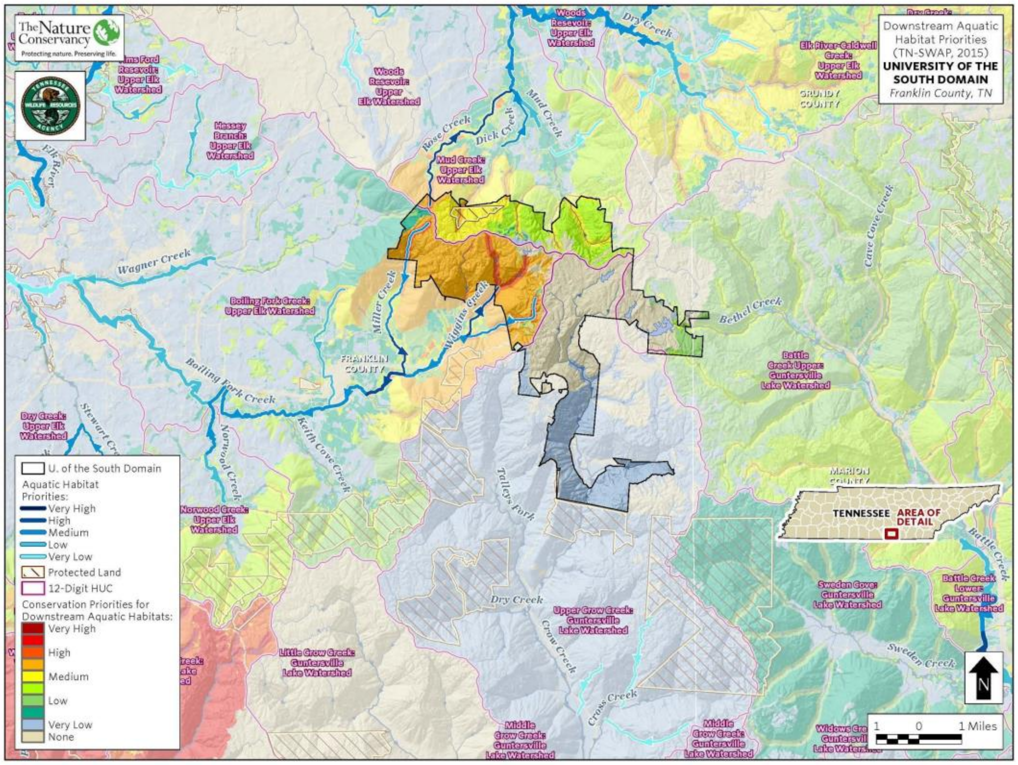


Figure 4. Aquatic habitat priorities and associated land conservation priorities upstream of instream habitat priorities for SGCN species based on 2015 SWAP analysis, for the University of the South, Tennessee. This map is drawn to show the relationship of Sewanee's headwaters to nearby aquatic habitats and their relevant priorities.

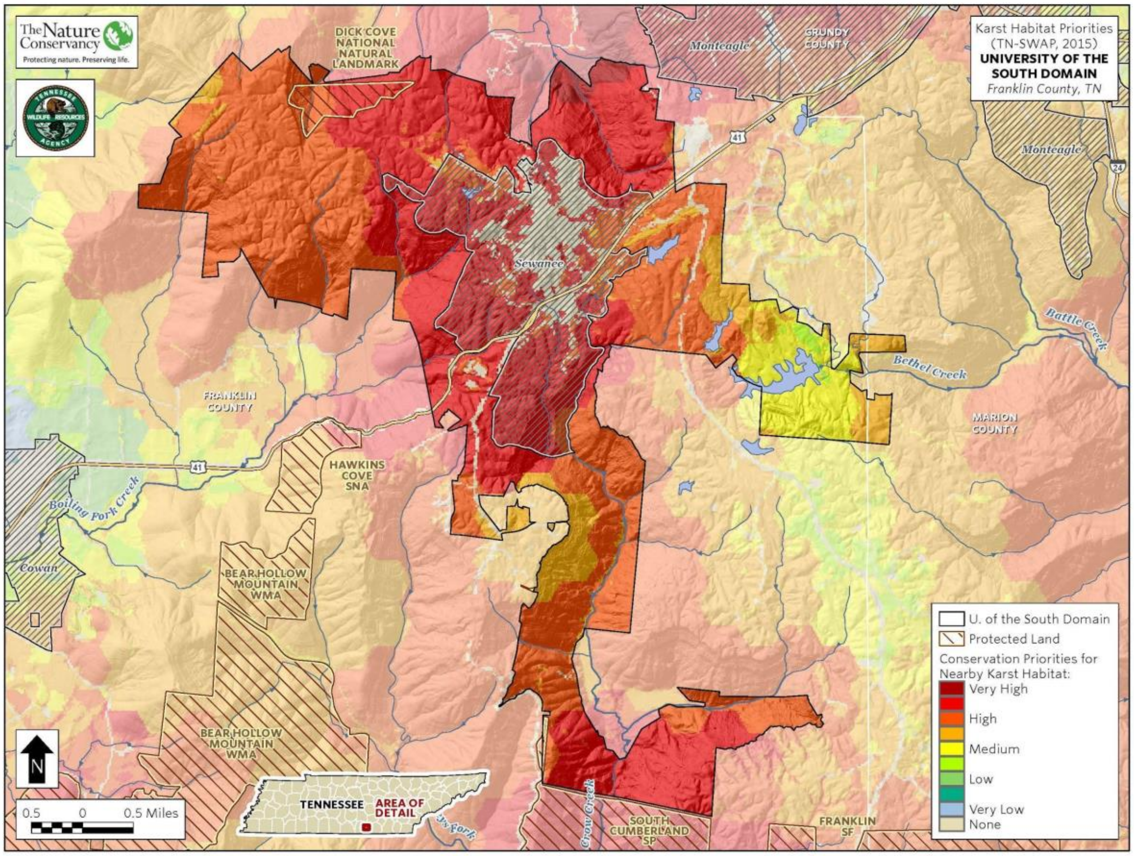


Figure 5. Karst Habitat Priorities map of karst (cave) habitat priorities for SGCN species and associated surface land conservation priorities nearby, based on analysis for 2015 SWAP for the University of the South, Tennessee. A detailed description on the methodology can be found in Wisby and Palmer (2015).

Management Approach for Ecological Systems

The main strategy for moving toward desired conditions for ecosystem diversity is to manage vegetation structure and composition to support healthy, functioning ecological systems. However, for the rare communities the main strategy involves establishment of Special Biological Areas where the primary goal is to restore and maintain the rare community. Implementation strategies will be developed for some Special Biological Areas to identify any needed management actions and monitoring. Most of the ecological systems are represented on the landscape where they would be expected. Outside of the farm and developed parts of compartment 0, the Domain does not have major ecotypes that were converted to other forest types from previous activities. Forest vegetation structure and composition of the understory, however, are often key features in need of restoration. Part of the vision of this Plan is to create open woodland settings and forest structures to support native plant and animal species by mimicking disturbances within the natural range of variability. Management is directed at developing landscapes that represent typical disturbance regimes for each ecological system. For instance, restoration of historic fire regimes, including appropriate return intervals, seasonality, and intensity, is inherent to sustaining native ecological systems found on much of the plateau surface. While it may take many decades to completely achieve these ecosystem conditions, actions initiated during the next 10 years covered by this Plan will set the stage for continued progress.

Forest strategies for restoring, maintaining, and enhancing the upper slope mesic ecological system should emphasize maintaining this system on the lands where it occurs. Some regeneration could take place, but it would not be a high priority. The greatest stresses and threats to this system include climate change, acid deposition and invasive species (emerald ash borer). The long-term management strategy for the upper slope dry systems is to utilize limited timber harvest to approach the early successional habitat objective since fire is not a common disturbance or one that is easily implemented. The greatest stresses and threats to this system are associated with climate change and mesification from lack of disturbance. Forest strategies for maintaining and enhancing the lower slope dry systems will integrate the use of timber harvest and fire. These management tools can occur independently or together on the same acres. The greatest stresses and threats to the lower slope dry systems are the lack of open conditions needed to maintain oak reproduction and the competition of faster growing species due to the exclusion of fire or infestations of non-native invasive species.

Interspersed withing the lower slope dry system is often the Limestone Outcrop and Glades. These systems will be managed primarily by protection, though prescribed fire is beneficial to these systems and may be used as opportunities arise. Grassland/shrublands will also be maintained through direct creation and maintenance activities. Timber harvest will be another frequent technique of creating regenerating forests and creating desired more open canopy conditions. Given its importance as a food source for many wildlife species, maintaining a high percentage of oak in ages that produce mast is also important. Planting American chestnut that is resistant to the Asian chestnut blight is an important restoration activity that would occur mostly in these systems. Restoration of shortleaf pine by planting is a restoration strategy that would be focused on where it historically occurred on the landscape. The greatest stresses and threats to this system are lack of disturbance to create regeneration and open woodland structure and invasive species including the native pine bark beetle and climate change that could reduce rainfall and make insect outbreaks more common.

Forest strategies for maintaining, and enhancing the Sandstone outcrop and bluff and Sandstone cliff face and rockhouse systems include prescribed fire and managing wildfire, control of non-native invasive plants, and monitoring and managing recreation use in the areas. These systems are uncommon on the Domain so their limited distribution is a stress. Other important stresses and threats to these systems include the lack of fire, non-native invasive plants, and trampling from excessive recreation use.

Forest strategies for maintaining, and enhancing the Mafic and Alkaline Glade systems include prescribed fire and managing wildfire, control of non-native invasive plants, and monitoring and managing recreation use in the areas. These systems are uncommon on the Forest so their limited distribution is a stress. Other important stresses and threats to these systems include the lack of fire, non-native invasive plants, and trampling from excessive recreation use.

Forest strategies for maintaining, and enhancing the plateau wetland and floodplain system are focused on protection. Stressors to these systems include non-native invasive plants, problematic native species (deer browsing), and trampling from excessive recreation use.

Objectives for Ecological Systems Diversity

Regeneration
Approximately 800 acres of forest will be in the 0-10-year age class from regeneration harvest by the end of the first decade. Of this regeneration:

- Only a small portion of this is expected to be created in the upper slope mesic system, and it would be less than 200 acres.

- A portion of this is expected to be created in the upper slope dry system, and it would be less than 200 acres.

- More than half of this is expected to be created in the Plaeau surface system.

Mid-Late Successional Habitat
The following percentage of acreage of each ecological system will be in mid-late successional stages by the end of the first decade:

- Approximately 99% of the upper slope mesic system
- Approximately 96% of the upper slope dry system
- Approximately 95% of the lower slope dry system
- Approximately 91% of the plateau surface system
-

Sandstone Outcrop and Bluff
The current acreage is expected to be maintained. A portion of the acreage will be enhanced with prescribed fire.

Plateau Wetland
Two man made impoundments will be removed, reducing the open water on the Domain but increasing lotic riparian zones.

Plateau Surface Ecological System
The area of the Forest represented by the Allegheny-Cumberland Dry Oak Forest and Woodland ecological system remains essentially the same; however, there will be a slight shift in acres from oak-pine systems to pine-oak and pine systems as the use of fire increases. By the end of the first decade:

- Approximately 400 acres of previously closed canopy stands are in an open canopy condition to maintain forest health and sustain foraging and nesting opportunities for species.
- Approximately 700 acres of forest are in open canopy conditions.
- An estimated 1000 acres of this fire-dependent ecosystem have received a fire return interval of 5-15 years.

Sandstone Cliff and Rockface Ecological System
Maintenance of this system will consist of protection and proactive management of recreational climbing to reduce impact to the resource.

Species Diversity

The diversity of habitats for all species on the Domain, especially threatened or endangered or rare species, and enhancing wildlife habitat are important desired conditions. Our plant and animal species are part of our natural heritage and unique value to the community and provides opportunities to recreate, view, and study in their natural settings. The Domain serves as an important linkage between other blocks of forested land and area that provides refugia for animal species.

A number of wildlife species found on the Domain are designated species of special conservation value by Tennessee Wildlife Resources Agency (TWRA) in the State Wildlife Action Plan (TN SWAP). The Tennessee Wildlife Resources Agency is the lead state agency for writing and updating the Congressionally-mandated State Wildlife Action Plan (SWAP). In 2005, and with the 10-year update in 2015, the TWRA collaborated with The Nature Conservancy as lead partner to deliver the SWAP. The SWAP effort focuses on identifying "Species of Greatest Conservation Need" (SGCN), with the overarching goal to focus collaborative conservation efforts that will prevent the necessity of future federal threatened and endangered species listings. The 2015 planning effort included an evaluation of terrestrial, aquatic and karst species and their associated habitats of Tennessee for vulnerability to several conservation challenges including habitat loss and climate change. The Nature Conservancy also designed and deployed an integrated relational database and Geographic Information System (GIS) tool to manage, analyze and facilitate conservation priority mapping statewide

(TWRA 2015). Of the 1449 terrestrial, karst and aquatic species identified as SGCNs (TWRA 2015), there are 78 known records of SGCNs that occur on the Domain as existing populations, in historical records, or as breeding or migratory species (Table 4).

Table 4. Known list of Species of Greatest Conservation Need compiled from records from Sewanee Integrated Program for the Environment faculty and collaborators on the Domain. The Description of the Federal and State Ranks and Status Codes can be found in Appendix E.

Taxa Group	**Scientific & Common names**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Amphibian	*Aneides aeneus* (Green Salamander)	G3G4	S3S4		Rare, Not State Listed
Amphibian	*Hemidactylium scutatum* (Four-toed Salamander)	G5	S3		D
Bat	*Corynorhinus rafinesquii* (Rafinesque's Big-eared Bat)	G3G4	S3		D
Bat	*Myotis austroriparius* (Southeastern Bat)	G4	S3		Rare, Not State Listed
Bat	*Myotis grisescens* (Gray Bat)	G4	S2	LE	E
Bat	*Myotis leibii* (Eastern Small-footed Bat)	G4	S2S3		D
Bat	*Myotis lucifugus* (Little Brown Bat)	G3	S3		T
Bat	*Myotis septentrionalis* (Northern Myotis)	G1G2	S1S2	LT	T
Bat	*Myotis sodalis* (Indiana Bat)	G2	S1S2	LE	E
Bat	*Perimyotis subflavus* (Tri-colored Bat)	G2G3	S2S3		T
Bird	*Cardellina canadensis* (Canada Warbler)	G5	S3BS 4N		
Bird	*Chaetura pelagica* (Chimney Swift)	G4G5	S5		
Bird	*Chordeiles minor* (Common Nighthawk)	G5	S4		
Bird	*Circus cyaneus* (Northern Harrier)	G5			
Bird	*Cistothorus platensis* (Sedge Wren)	G5	S3N		
Bird	*Geothlypis formosa* (Kentucky Warbler)	G5	S4		
Bird	*Hylocichla mustelina* (Wood Thrush)	G4	S4		
Bird	*Melanerpes erythrocephalus* (Red-headed Woodpecker)	G5	S4		
Bird	*Setophaga cerulea* (Cerulean Warbler)	G4	S3B		D
Bird	*Setophaga discolor* (Prairie Warbler)	G5	S3S4		
Bird	*Setophaga dominica* (Yellow-throated Warbler)	G5	S4		
Bird	*Setophaga fusca* (Blackburnian Warbler)	G5	S3B,S 4N		

Bird	*Vermivora chrysoptera* (Golden-winged Warbler)	G4	S2B		T
Bird	*Vermivora cyanoptera* (Blue-winged Warbler)	G5	S4		
Bird	*Colinus virginianus* (Northern Bobwhite)	G4G5	S2S3		
Bird	*Helmitheros vermivorum* (Worm-eating Warbler)	G5	S4		
Bird	*Icteria virens* (Yellow-breasted Chat)	G5	S4		
Bird	*Icterus spurius* (Orchard Oriole)	G5	S4		
Bird	*Sturnella magna* (Eastern Meadowlark)	G5	S5		
Bird	*Calidris subruficollis* (Buff-breasted Sandpiper)	G4	S3N		
Mammal	*Ochrotomys nuttalli* (Golden Mouse)	G5	S5		
Mammal	*Neotoma magister (Allegheny Woodrat)*	G3G4	S3		D
Plant	*Allium burdickii* (Narrow-leaf Ramps)	G4G5	S1S2		T-CE
Plant	*Berberis canadensis* (American Barberry)	G3	S2		S
Plant	*Castanea dentata* (American Chestnut)	G4	S2S3		S
Plant	*Clematis morefieldii* (Morefield's Leather-flower)	G2	S2	LE	E
Plant	*Danthonia epilis* (Bog Oat-grass)	G3	S1S2		S
Plant	*Diamorpha smallii* (Small's Stonecrop)	G4	S1S2		
Plant	*Helianthus eggertii* (Eggert's Sunflower)	G3	S3	DL	
Plant	*Hydrastis canadensis* (Goldenseal)	G3G4	S4		
Plant	*Juglans cinerea* (Butternut)	G4	S3		T
Plant	*Liatris cylindraceae* (Slender Blazing-star)	G5	S2		T
Plant	*Lilium canadense* (Canada Lily)	G5	S3		
Plant	*Panax quinquefolius* (American Ginseng)	G3G4	S3S4		S-CE
Plant	*Silphium brachiatum* (Cumberland Rosinweed)	G3	S3		E
Plant	*Solidago auriculata* (Eared Goldenrod)	G4	S3		
Plant	*Symphyotrichum pratense* (Barrens Silky Aster)	G4?	S1		E
Plant	*Thermopsis mollis* (Allegheny Mountain golden banner)	G3G4	S2S3		S
Plant	*Trichomanes boschianum* (Bristle-fern)	G4	S1S2		T
Plant	*Viola tripartita var. tripartita* (Three-parted Violet)	G5	S3		
Reptile	*Crotalus horridus* (Timber Rattlesnake)	G4	S4		
Reptile	*Heterodon platirhinos* (Eastern Hognosed	G5	S4		

	Snake)				
Reptile	*Pituophis melanoleucus melanoleucus* (Northern Pinesnake)*	G4T4	S3		T
Reptile	*Terrapene carolina* (Eastern Box Turtle)	G5	S4		
Subterranean - Amphibian	*Gyrinophilus palleucus* (Tennessee Cave Salamander)	G2G3	S2		T
Subterranean - Arachnid	*Anthrobia mammouthia* (a cave obligate spider)	G5	S1		
Subterranean - Arachnid	*Hesperochernes mirabilis* (Southeastern Cave Pseudoscorpion)	G5	S3		Rare, Not State Listed
Subterranean - Arachnid	*Kleptochthonius magnus* (a cave obligate pseudoscorpion)	G1	S1		Rare, Not State Listed
Subterranean - Arachnid	*Kleptochthonius tantalus* (a cave obligate pseudoscorpion)	G2	S2		
Subterranean - Arachnid	*Liocranoides archeri* (Archer's two-clawed spider)	G2	S2		
Subterranean - Arachnid	*Nesticus barri* (a cave obligate spider)	G3	S3		Rare, Not State Listed
Subterranean - Arachnid	*Phanetta subterranea* (Subterranean sheet-web spider)	G5	S4		
Subterranean - Crustacean	*Caecidotea bicrenata whitei* (a cave obligate isopod)	G3G4T3T4	S1?		
Subterranean - Crustacean	*Miktoniscus barri* (a cave obligate isopod)	G2G4	S2?		
Subterranean - Crustacean	*Orconectes australis* (Southern Cave Crayfish)	G5	S3		Rare, Not State Listed
Subterranean - Crustacean	*Stygobromus sp*. (cave amphipods)	G3	S3		
Subterranean - Flatworm	*Sphalloplana percoeca* (a cave obligate planarian)	G5			
Subterranean - Insect	*Litocampa cookei* (Cooke's Cave Dipluran)	G5	S3		
Subterranean - Insect	*Litocampa valentinei* (a cave obligate bristletail)	G5	S2		Rare, Not State Listed
Subterranean - Insect	*Pseudanophthalmus humeralis* (a cave obligate beetle)	G2	S2		
Subterranean - Insect	*Pseudanophthalmus intermedius* (Intermediate cave beetle)	G2	S2		
Subterranean - Insect	*Pseudosinella hirsuta* (Hirsute Cave Springtail)	G5	S3		
Subterranean - Insect	*Pseudosinella pecki* (Peck's cave springtail)	G2G3	S2		

Subterranean - Insect	*Pseudosinella spinosa* (Spinose Cave Springtail)	G5	S2		Rare, Not State Listed
Subterranean - Insect	*Ptomaphagus hatchi* (Hatch's cave fungus beetle)	G3	S3?		
Subterranean - Insect	*Spelobia tenebrarum* (Cave dung fly)	G5	S4S5		
Subterranean - Insect	*Subterrochus ferus* (cave ant beetle)	G1G2	S1S2		
Subterranean - Millipede	*Pseudotremia minos* (Russell cave milliped)	G1	S1		
Subterranean - Millipede	*Scoterpes ventus* (Eastern Tennessee Cave Millipede)	G3	S1		

*Indicates that we are part of the presumed range with suitable habitat but have not been confirmed on the Domain.
**The Description of the Federal and State Ranks and Status Codes can be found in Appendix E.

In Appendix H, a list of plants developed by the Sewanee Herbarium summarizes the common, uncommon, and rare, threatened, and endangered species by habitat (as described in Evans et al. (2016) that occur on the Domain. The Herbarium indicated 10 species in each habitat that represent species of conservation concern value for them (highlighted), however this designation does not necessarily mean the species is a Species of Greatest Conservation Concern as designated by the state of Tennessee (J. Evans personal communication).

The 2015 SWAP planning included a process for prioritizing habitats according to their importance for GCN species. More information on the prioritization and mapping methodology and the complete 2015 SWAP, can be found at the TN SWAP Website. For more detailed information on GIS analysis methods, see Palmer and Wisby (2015).

Desired Conditions for Species Diversity

- Natural ecological communities exist in amounts, arrangements, and conditions capable of supporting native and desired non-native species.

- Natural disturbances such as fire, wind, insects, and diseases, ice storms, and floods, modify the landscape, providing habitat for disturbance dependent species.

- Diverse habitats exist that range from early successional forests to late successional forests, in both open and closed overstory conditions. These, early, late, closed, and open conditions will provide habitat structure for a wide range of native plant and animal species.

Management Approach for Species Diversity

Habitat diversity is integral to providing ecological conditions appropriate for a diversity of plant and animal species. In addition to relying on strategies for ecosystem diversity, species habitat conditions are dependent on a variety of integrated resources and management activities. Strategies for soils, water, fire regimes, vegetation management, infrastructure, and other resource areas also contribute to healthy conditions for a diversity of plants and animals.

Our goal is to manage habitat to provide for a variety of species requiring a mosaic of forest types and structures for their life cycle needs, including black bear, cotton-tailed rabbits, bats, woodland salamanders, woodpeckers, wild turkey, and white-tailed deer. A mosaic of habitats to provide for the diversity of species that utilize the Cumberland Plateau is required. This includes early to late successional forests with plenty of snags, downed wood, stumps, and other organic matter in sufficient abundance to support wildlife species.

Objectives for Species Diversity

- Maintain and enhance open canopy, woodland and savannah habitat through the use of fire.
- Manage 300 acres of early successional habitat over 5 years using approved practices to emphasize habitat for early-successional obligates.
- Restore and maintain 100 acres of forest in open woodland conditions through the use of wildland fire on an average annual basis.

Non-Native and Native Invasive Species

As in most areas, the Domain is under risk from forest pest and non-native/invasive species (NNIS). Frequently, once these species become established, there is significant damage to native ecosystems and species that is expensive and challenging to eliminate (McGrath and Binkley 2009). Current forest pest and pathogen threats include the Hemlock wooly adelgid (*Adelges tsugae*), Emerald ash borer (*Agrilus planipennis*among others. Under- and mid-story species that pose significant risk include multi-flora rose (*Rosa multiflora*), garlic mustard (*Alliaria petiolata*), tree of heaven (*Ailanthus altissima*), privet (*Ligustrum* spp.), kudzu (*Pueraria montana*), bush honeysuckle (*Lonicera maackii*), stiltgrass (*Microstegium vimineum*), Japanese spirea (*Spiraea japonica*), and oriental bittersweet (*Celastrus orbiculatus*). Large invasive mammals such as feral hogs pose significant long-term risk to forests in the region and should also be controlled when they are found on the Domain. Occurrences of other NNISs such as autumn olive and Paulownia, have been noted on the property. Eradication methods should be planned on a stand level in conjunction with other activities, and in consideration of long-term goals for the property.

Options to control these pests, include containment, mechanical/or manual treatment, herbicide treatment, and biological controls. Some treatment options, such as chemical and/or biological control, are available however are frequently prohibitively expensive and yield marginal success. For many of these pests, and to prevent spread or additional infestations, best practices such as not moving infected or infested wood to and from the property, inspecting and washing equipment, and otherwise maintaining healthy and vigorous forest stands is a suitable course of action and will all serve to limit non-native and invasives.

White-Nose Syndrome (WNS) is a fungus caused disease that was first discovered in New York during the winter of 2006-2007 and causing a decline in cave hibernating bat species. The fungus *Geomyces destructans* grows on the muzzle, ears, and wings of the affected bats has been affecting six bat species: little brown bat (*Mytotis lucifugus*), big brown bat (*Eptesicus fuscus*), tri-colored bat (*Perimytois subflavus*), the threatenend northern long-eared bat (*Myotis septentrionalis*), eastern small-footed bat (*Myotis leibii*), and the endangered Indiana bat (*Myotis sodalist*) (Bat Conservation International 2019, Gargas et al. 2009). In affected caves mortality ranges from 80 to 97% and certain species, such as the little brown bat are the hardest hit (Blehert et al. 2009). How the disease spread is not clear, it is thought to be spread bat to bat, however there is a possibility that human spread through is a mechanism (TNBWG 2019).

To reduce the spread of the disease we encourage all cave users to utilize decontamination procedures for their equipment and not carry equipment from the Domain to areas that are WNS free.

Desired Conditions for Native and Non-native Invasive Species

On the Domain, the desired conditions for Native and Non-Native Invasive Species are:

- To minimize introduction of new invasive species by monitoring the Domain’s forest and ecological systems for threats that occurring in the region;
- Minimizing the establishment of new and existing species infestations, where feasible;
- Targeted invasive species are eradicated, controlled, or contained, such as kudzu and ailanthis (tree of heaven);
- Maintain healthy native ecosystems, particularly those that support rare, threatened, endangered, or SGCNs;
- Protect the integrity of natural communities.

Management Approach

Management of all non-native invasive species will focus on four components:

1) Reduction of current infestations;
2) Prevention of new infestations;
3) Containment or reductions before they become established; and
4) Reclaiming native habitat.

Objectives for Non-native and Native Invasive Species

- Treat targeted invasive species annually.
- Monitor for new invasive species annually.

Climate Change and Climate Vulnerability

Changes in the earth's climate will impact the natural resources on the Domain directly via temperature rise and change in precipitation patterns and indirectly including changes to patterns in wildfire, disease, and pest outbreaks which will become more variable and extreme (TWRA 2015, USEPA 2019). These changes will interact with and complicate other challenges that we may face, making resource conservation and management decisions even more complex. For example, forests will be increasingly vulnerable to mortality through invasive species outbreaks, disease, and drought (Joyce et al. 2014). We could see some of these changes in the near term, such as increased precipitation, however others such as changes in wildfire could take much longer (Joyce et al. 2014, TWRA 2015). Changes in forest habitats types including to more savanna-like conditions are predicted for the parts of the southeast United States due to hotter and drier conditions (Hansen et al. 2001, McNulty et al. 2013, TWRA 2015). Using processes previously outlined (Janowiak et al. 2014), an adaptive management process includes constant monitoring and the need to change tactics as conditions change. Key to this process will be an understanding of the current vulnerabilities of key species and habitats to climate change drivers (Table 5).

Table 5. Key Vulnerability for species and habitats on the Domain. Adapted from the Climate Change Vulnerability Assessment for TN Wildlife and Habitats (TWRA 2015).

Climate Change Drivers	**Potential Impacts**	**Key Vulnerabilities**
Changes in precipitation timing and duration	• Changes to the seasonal timing, frequency, and magnitude of rain events including the frequency and duration of drought events. • Instream flow management issues and impacts to water quality conditions. • Changes to habitat availability for different life history stages.	• Alteration in flow patterns could result in reduced or modified habitat quality and loss of connectivity for aquatic species. • More-extreme flood events could lead to habitat destabilization (especially in headwater/smaller order streams) and increases in stormwater runoff are likely to exacerbate input of excess nutrients and impact water quality. • Extreme droughts could alter habitat availability, including breeding habitat and food sources for birds, and vernal pools for amphibians.
Increasing temperatures	• Contributions to terrestrial habitat shifts • Relationship to pest and pathogen spread • Changes to freshwater and cave habitat suitability • Interactions with water quality conditions • Contributions to phenological mismatch	• Thermal habitat suitability is likely to be reduced for a number of aquatic species. • Increased evaporation is expected to cause drying of vernal pool habitats. • Higher temperatures in caves could harm certain cave species and bat hibernacula. • Significant shifts in forest habitat types are projected, particularly at higher elevations. • Spread of pests and pathogens are likely to affect plant and animal species both directly and indirectly. • Phenological mismatch could lead to disruptions in species interactions and mutualisms (e.g., timing of insect emergence and other food sources for birds, fish, and other species).
Altered disturbances (e.g., fire, wind damage, ice storms)	• Contributions to terrestrial habitat shifts • Relationship to spread of invasive species • Damage to habitat	• Increasingly extreme events could have adverse effects on habitat quantity and quality, especially in forest communities. • Altered fire regimes could pose significant challenges for fire management practices.

Landscape Resiliency to Climate Change Effects

The variety of plant and animal species found on the Domain have different life history strategies and habitat requirements that will be impacted by changes to temperature and precipitation in different ways. In addition to the concepts of species and habitat vulnerabilities to these changes, the 2015 SWAP incorporated geospatial analyses of attributes demonstrated to promote overall landscape resiliency to change. These analyses, pioneered by Nature Conservancy scientists, help identify natural and geophysical features of landscapes that are likely to serve as climate refugia and provide habitat niche diversity within a connected landscape. Although species ranges and habitat types may shift, these underlying geophysical features will support landscape transitions over time and are considered important drivers in maintaining overall biodiversity. These landscape resiliency assessments have already been adopted in conservation investment decision-making by other entities such as the Doris Duke Charitable Foundation and the Open Space Institute.

In addition to the 2015 SWAP species and habitat mapping information, The Nature Conservancy applied this landscape resiliency assessment data to the Domain for this forest management plan (Figure 6). More detailed descriptions of the methodology utilized can be found in Glick et al. (2015) and Palmer and Wisby (2015) producing these maps can be found in Wisby and Palmer (2015). The diversity of geologic and topographic features on the Domain will be key attributes helping maintain habitat and species diversity over time as these climate-related drivers affect the landscape. Figure 6 also demonstrates the important context of Domain properties within the Southern Cumberlands. Conservation oriented management of Domain resources will be critical to maintaining the health and diversity of the overall connected forest resources of the Southern Cumberland region in the future.

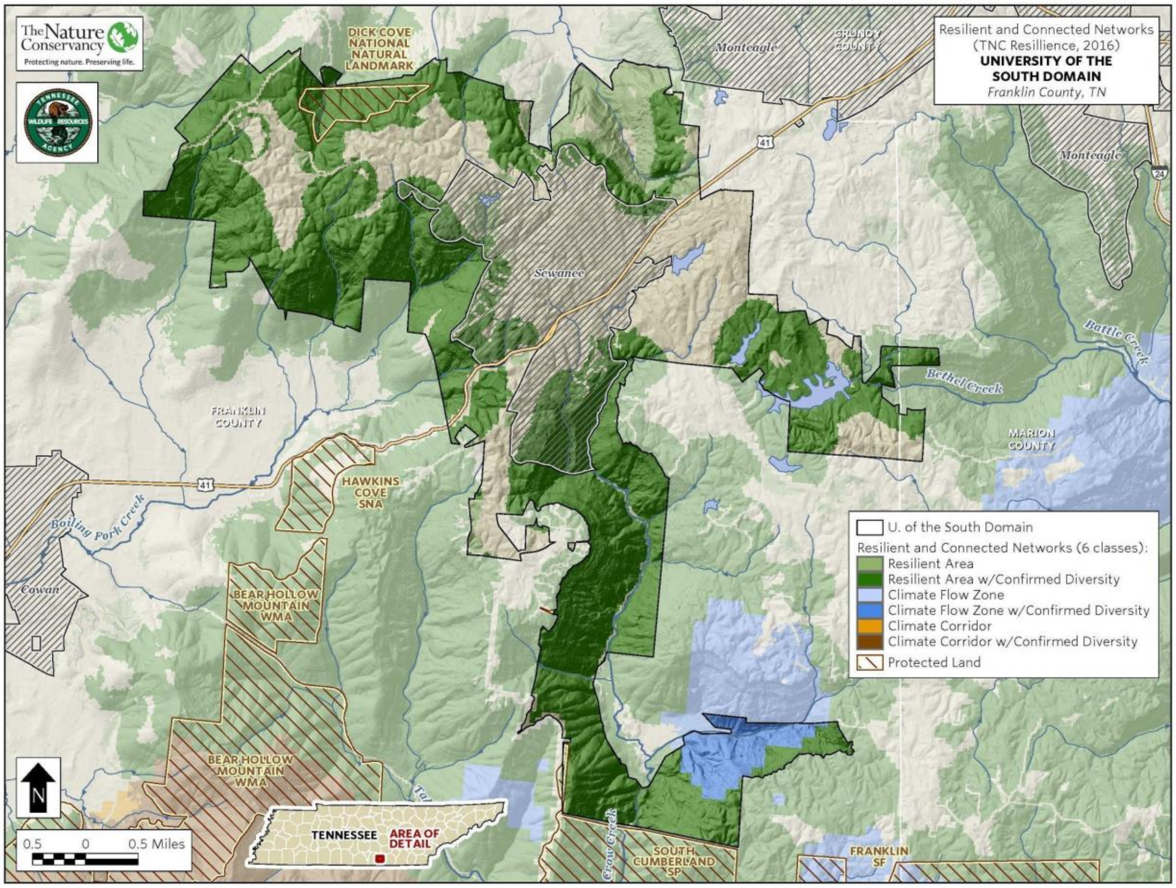


Figure 6. Map of the University of the South's terrestrial resilient and connected networks, as defined by TNC's 2016 Resilient and Connected Landscapes Project. This effort builds on the results of the 2014 Southeast Resilience Project.

Management Approach

Climate change effects are multiple, varied, and interact with many other variables/stressors. There has been a history of extreme weather events, disease, insects, and gradual movement in the ranges of flora and fauna. Our management strategies are focuses on enhancing the health and resiliency of the Domain to withstand the future changes and stresses through the unpredictability of climatic influences and human-induced pressure. Therefore, the use of adaptive management, including the use of monitoring of conditions, to allow for these changing conditions will allow us to proactively adjust our strategies or adopt new ones as needed.

Our strategies for climate change on the Domain focuses on adaption (e.g. maintain healthy ecosystems, diversity, resilience [defined as the ability of the system to absorb impacts and return to the pre –condiction state while maintaining essential characteristics (Holling 1973)], and productivity) and mitigation (carbon sequestration to reduce our carbon footprint as outlined in the Sustainability Master Plan). We will focus on 1) watershed health; 2) sustainable operations and providing carbon sink for sequestration; 3) maintaining and restoring vulnerable ecosystems, as appropriate, and reducing vulnerability.

Management strategies that are that will be used on the Domain to address the conservation and management of aquatic resources in the context of climate change are:

- Protect and enhance stream riparian corridors/forests to provide instream habitat and maintain bank stability.
- Maintain the Best Management Practices (BMPs) outlined in the Water Resources section to maintain riparian habitat.
- As soon as feasible, revegetate bare soil to minimize or prevent erosion or sedimentation.
- Repair, close, or reroute roads or recreational amenities that are causing elevated sedimentation levels or loss of soil productivity.

Sustainable Operations and Carbon Sink for Sequestration

The Domain has the opportunities for 1) biomass sequestration and storage of CO_2 2) practicing sustainable forestry through certification with the Forest Stewardship Council and proposed management in this plan. Management of the forest resources that is done with sustainable practices will allow us to increase our ability to sequester carbon while enhancing the ecosystems.

Basic habitat management practices including, prescribed burning and selective thinning to allow habitats to regenerate and carbon to increase benefiting both species diversity and the atmosphere. Providing a diversity of age structure in the forest composition will enhance carbon sequestration as the harvest and regeneration of young to middle-age forests provides opportunity for carbon sequestration compared to older growth forests as they serve as carbon sinks (Ryan et al. 2008, Ryan 2008, Körner et al. 2005, Harmen et al. 1990).

Maintain and Restore Vulnerable Ecosystems, where appropriate, to Reduce Vulnerability

Our focus on the Domain has been around supporting ecosystem diversity and viability that will support ecological health, ecosystem robustness, and species viability. The restoration and management of ecosystems, including critical vulnerable resources, to support or adapt to changing environmental conditions will allow this to occur.

- In coordination with our partners we will identify critical vulnerable ecosystems and outline the objectives and desired conditions to maintain these systems and the markers for success.
- Additionally, we will identify the desired conditions of the ecological systems on the Domain outline the disturbance regime, such as prescribed fire or management, to maintain or enhance these ecosystems.
- Utilize prescribed fire as a tool for achieving the desired future conditions outlined in the Conservation Area/Compartment descriptions to enhance the ecological system diversity of the Domain.
- Maintain the unique and rare ecosystem or habitats on the Domain that have high ecological value.

Surrounding Land Use

The Domain is located close to the Franklin State Forest, The Nature Conservancy's Carter Lands, and several state protected areas, thus our property is a key component of land conservation in the South Cumberland region (Figure 7).

The forests in the Cumberland Plateau have undergone considerable changes in the last few decades due to parcelization, exurban housing development, and conversion to intensively managed pine plantations and pasture (McGrath et al. 2004, Clatterbuck et al. 2006). There is an active forest industry in the region, and Sewanee is in the sourcing radius of several sawmills. Due to changing market conditions, hardwood forest conversion to pine has greatly diminished in the southern Cumberland Plateau in recent years, while exurban housing has once again started to increase in the region. The towns surrounding the University of the South include: Monteagle, and Tracy City, and the unincorporated University owned town of Sewanee, , and although they are not rapidly expanding, housing developments near these towns continue to develop (e.g., Clifftops and Cooley's Rift).

Mineral Rights and Rights Held by Others

There are two tracts in Sewanee's ownership with conservation easements, a 208 acre forever wild easement in Compartment 51 and a 2,926 acre working forest easement in Compartments 52, 53, 54, and 55. The mineral ownership for the majority of the property is intact on 10,110 acres. The minerals have been acquired through quiet title action or donation throughout the majority of the Domain, with the exception being the Lost Cove tract (Compartments 52—55). The mineral rights for this entire 2,926-acre tract is owned by an LLC and according to a Mineral Remoteness Evaluation completed for the Land Trust for Tennessee and the University of the South at the time of the conservation easement found that sub-surface mining would be unlikely.

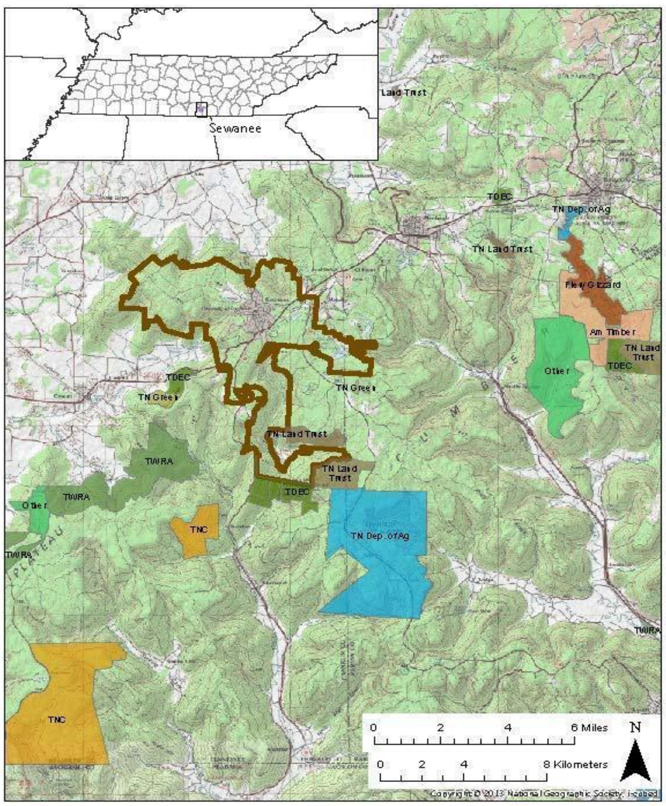


Figure 7. Location of the University of the South, in Tennessee, in relation to regional protected lands on the South Cumberland Plateau.

Climate and Weather

Sewanee typically experiences long, moderately hot summers and short mild winters, with a humid mesothermal climate (Thornthwaite 1948). Average annual temperature is 56º F (13°C) and average annual rainfall averages 59- in (150 cm). The frost-free period in Sewanee is approximately 200 days, and the study area falls into Bailey's (2016) ecoregion humid temperate domain, hot continental division, and eastern broadleaf province. The plateau surface is gently rolling and ranges in elevation from 1,800 to 2,000 feet, and Sewanee's property extends down to 900 feet elevation in Lost Cove.

Watershed Resources (Water, Soils, Air, & Geology)

Geology, Topography, and Soils

The geologic formations of the Cumberland Plateau that lie beneath the Domain originated from two distinct environmental settings and geologic ages with the upper slopes and the surface of the Plateau composed of clastic sedimentary rocks including shale, siltstone, sandstone and conglomerate (Figure 8). These rock formations are all of the Pennsylvania age, and were not deposited in a marine environment, but rather were deposited in deltaic and fluvial environments (Knoll and Potter 1998). The Raccoon Mountain Formation and the Whitwell Shale are located at the base and the top, respectively, of the Pennsylvanian deposits, and include discontinuous seams of coal (Knoll and Potter 1998). These coal seams attracted settlers to this region, and this coal was mined and used by Sewanee residents for heat and cooking purposes for several decades.

The Warren Point sandstone, which is exposed along all Domain bluffs, was used as a source of building stone at Sewanee throughout the 19th and 20th centuries, however this practice has ceased and new building material is procured off the Domain. The intermittent streams of the plateau form shallow drainages that deepen as they enter the coves. The coves that lead down from the plateau to the valley floor are steeply sloped, and range in elevation from 1,000 — 1,900 feet. The lower slopes of the Plateau are composed of limestone, dolomite and shale. These formations are of Mississippian age, and were produced in a variety of marine environments including marine shelves and tidal mudflats (Knoll and Potter 1998).

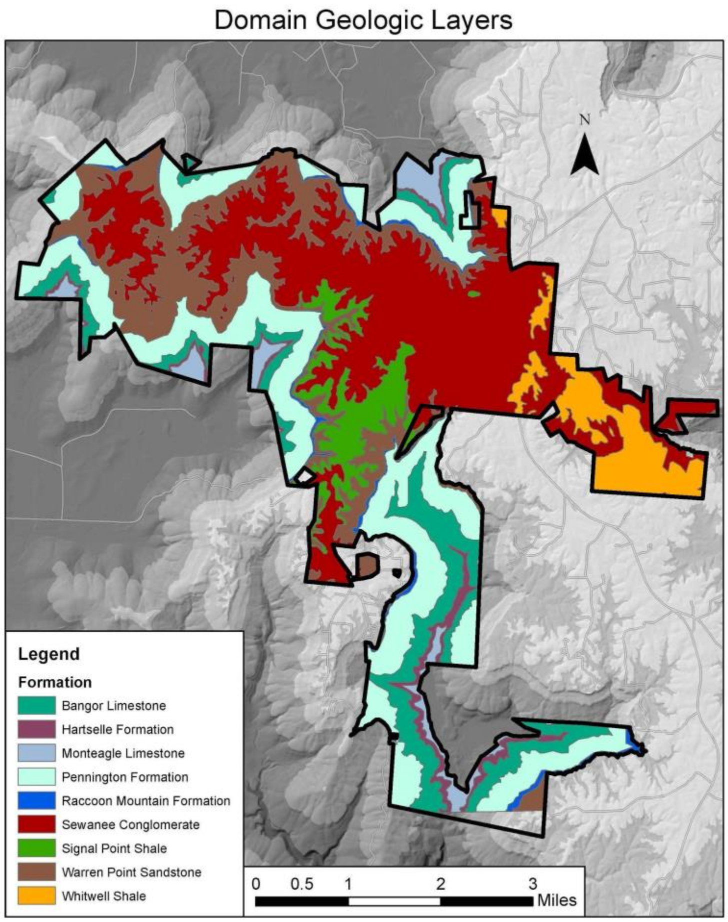


Figure 8. Geologic layers of the Domain, The University of the South, Tennessee.

The soils of the Domain vary according to their topographic position and are highly influenced by the local bedrock or colluvium (Figure 9). In general, the soils on top of the plateau are acidic, coarse textured (sandy), well drained, two to four feet deep, and generally classified as Ultisols, one of the world's more highly weathered soil orders. In the coves, the soils are affected by the sandstone debris from the bluff, the soils that have eroded from higher elevations, and limestone bedrock. These soils tend to be very rocky, of variable depth, and have a varied texture, pH, and nutrient status depending on the slope position and prior land use.

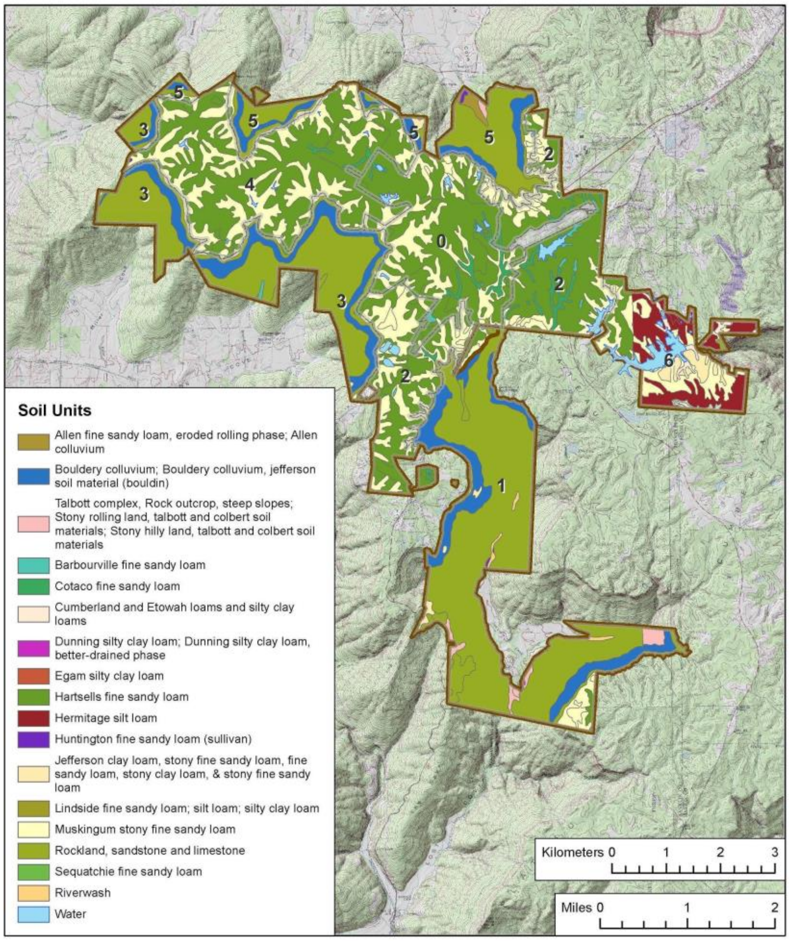


Figure 9. Soil units of the Domain, The University of the South, Tennessee.

Desired Conditions for Soils

On the Domain, our desired condition for the forest soils is that there is adequate biological, chemical, and physical properties to maintain or improve hydrologic function, nutrient cycling, vegetative growth, and minimal erosion and sedimentation. Best management practices will be utilized during management activities to strive towards minimizing erosion and sedimentation as well as identifying areas of high risk in recreation and roads.

Desired Conditions for Geological Resources

On the Domain our geologic resources have been identified as having great value for educational, ecological, interpretive, recreational, and archaeological resources. As such our goal is to collaboratively identify and manage these resources for the benefit of the users and the ecological systems and species that utilize these resources. Management activities that would occur in areas of karst would be coordinated within the University but also with relevant outside expertise to minimize impact to karst resources, species that utilize these resources, groundwater, and streams associated with karst habitat. In the event that management would take place in karst habitat, to ensure any impacts would be minimized would implement the BMPs in Appendix E. Additionally, other groundwater dependent systems such as spring seeps would be protected and sustained.

Land Classification

The Domain of the University of the South is located within the strongly dissected southern portion of the Cumberland Plateau. The Domain's land type associations were divided into 23 land types that correspond to the bedrock geology, soil depth, slope, aspect, drainage, and other characteristics (Figure 10). Each land type is rated based on its productivity, management challenges (competition, mortality, operational limitations, erosion, and wind-throw), and species desirability based on productivity (Smalley 1982). Smalley's land type maps are useful for land management planning when used in coordination with a knowledge of plant and animal habitat and cultural resources.

Domain Land Types 2017

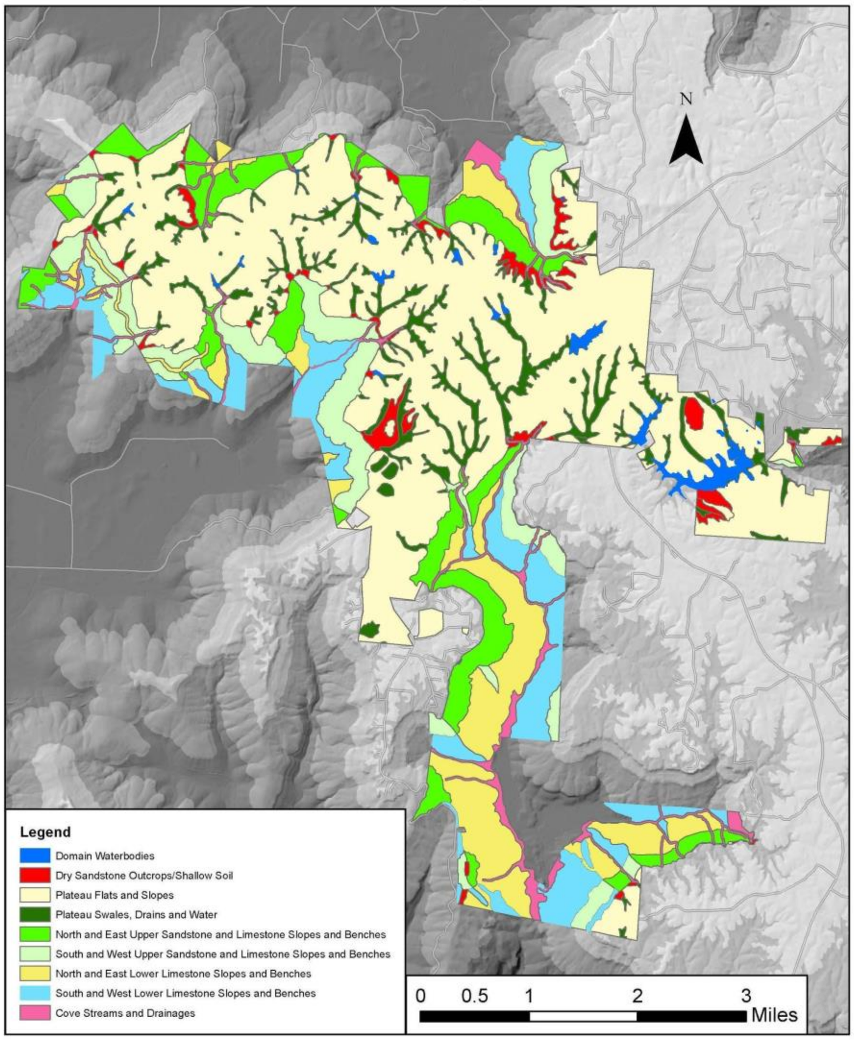


Figure 10. Smalley's land classification of the Domain, The University of the South, Tennessee.

Water Resources

Water and the watersheds on the Domain are an important resource in Tennessee and one that the Domain provides to the University and the surrounding community (Figure 11). Currently there are 17 ponds, lakes, reservoirs, and numerous wetlands on the Domain that range in size from less than one acre to over 80 acres. Water supplies are plentiful at this time, however, that has not always been the case. Prior to the 1950s, all the water on the Domain was provided by spring and wells, as there are no natural lakes on the plateau, but water shortages were experienced during the driest months of the year, August through October. In 1953, Farm Pond was constructed with the help of what was then referred to as the Department of Forestry through the construction of a small earthen dam. The purpose of this project was to determine the feasibility of constructing and maintaining a reservoir on the Cumberland Plateau. With no natural lakes on the plateau it was uncertain whether the bedrock and soil conditions would sustain an earthen dam to retain water throughout the year. The dam proved a success in terms of construction and economics, and soon more projects would follow.

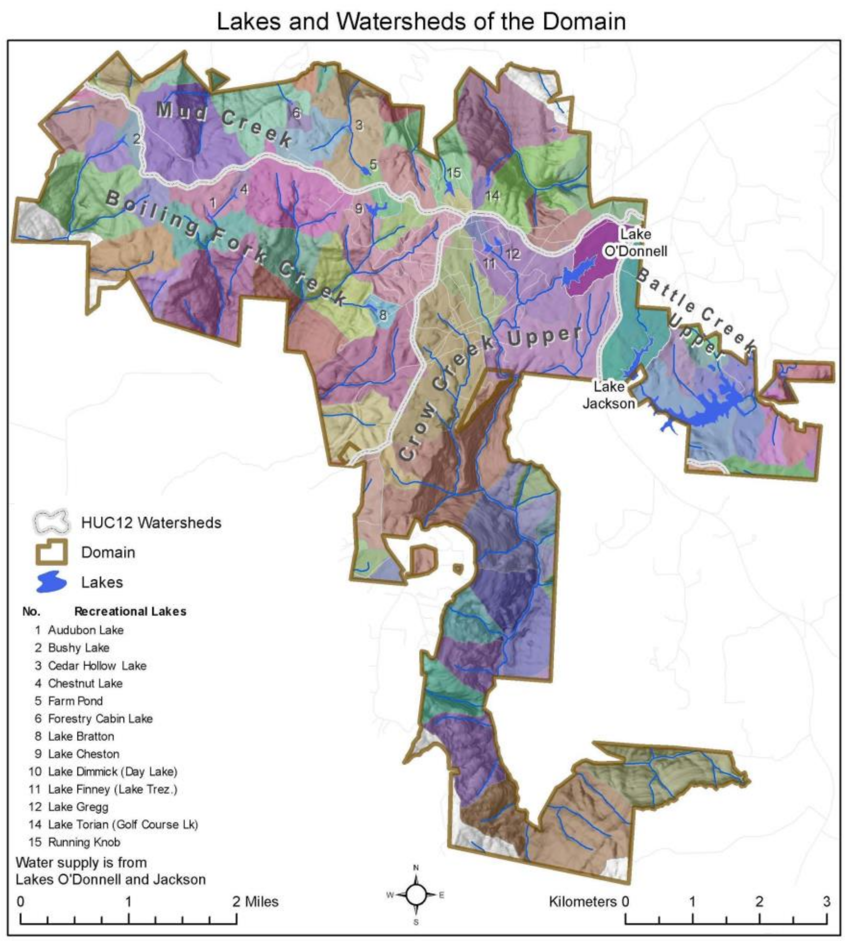


Figure 11. Lakes and watersheds of the Domain within the 4 Hydrologic Unit Code (HUC) 12 sub-watersheds: named Crow Creek, Battle Creek, Elk River, and Boiling Fork Creek, respectively, University of the South, Tennessee.

The success of Farm Pond led to the planning of much larger projects to act as a water supply. In 1955, due in large part to the generosity of Peter O'Donnell, construction of Lake O'Donnell began, followed by construction of a filtration plant. Lake O'Donnell went online as a water source for the University in 1958, and in 1963, the last spring and all the deep wells were eliminated from the system. Additional capacity was needed, so in 1965, the dam was raised to allow for this need (Burckle and Smith 2003). During this time the University and surrounding community continued to grow, adding to concerns that Lake O'Donnell could not maintain future demands, which subsequently resulted in the construction of Lake Jackson in 1968 on lands donated by Dr. Harold P. Jackson. Currently, water from Lake Jackson is used as a backup for Lake O'Donnell and when levels in O'Donnell reach a critical level, water is pumped from Jackson into Lake O'Donnell by the Sewanee Utility District (SUD).

The role of the SUD is to provide high quality drinking water and wastewater collection, treatment, and disposal service to customers in Franklin and Marion Counties. The drinking water for these communities including the university is provided by SUD and Lake O'Donnell.

Surface Waters

The Domain falls within:

the four 12 HUC sub-watersheds:

- 060300010301,
- 060300010102,
- 060300030203, and
- 060300030303;

    four 10 HUC watersheds:

    - 0603000103,
    - 0603000101,
    - 0603000302,
    - 0603000303 (named Crow Creek, Battle Creek, Elk River, and Boiling Fork Creek, respectively);

        two HUC 8 watersheds:

        - 06030001,
        - 06030003 - Middle Tennessee-Elk Basin, Guntersville Lake and Upper Elk Sub Basins (respectively);

- the HUC 6 watersheds: 060300 Middle Tennessee-Elk; the HUC 4 watershed: 0603 - Middle Tennessee-Elk; and the HUC2 watershed: 06 - Tennessee Region

Several perennial and intermittent streams, approximately 273,250 linear feet or 83 km, and numerous ephemeral streams are wholly or partially contained within the Domain's boundaries. This includes approximately 106 linear feet of fourth-order streams, 33,522 linear feet of third-order streams, 65,245 linear feet of second-order stream and 174,296 linear feet of first-order streams.

Stream Best Management Practices (BMPs)

The OESS commits to adhering to all Tennessee regulations regarding road maintenance, skid trail maintenance, and stream crossings. These regulations can be found at this website. For streamside management zones, we will at a minimum adhere to the Forest Stewardship Council (FSC)-US Forest Management Standards, which have rules for inner and outer Streamside Management Zones (SMZ's) for non-high quality and high quality streams. However, we are choosing to adopting more stringent standards for our streams and aquatic habitat. Around our perennial streams, reservoirs, and recognized ephemeral ponds, we commit to a basic core, 60 meter no harvest area, and then commit to a secondary maintenance area of 164-m that would allow thinning and group selection, while maintaining an average of at least 50 percent preharvest basal area. Intermittent streams, (defined as having a clear valley channel with a drainage of not less than 14 acres) will be excluded from equipment traffic and harvest, and be buffered by a minimum of 30 meters. Ephemeral streams (defined as having a clearly defined valley channel area with drainage of 6 - 14 acres) will be buffered according the state of Tennessee BMPs for perennial streams. Roads, landings, and other similar mechanically intense disturbances are constructed outside of the core and secondary SMZ, except for designated stream crossings or when placement of disturbance-prone activities outside of the SMZ would result in more environmental disturbance than placing such activities within the SMZ. Exceptions may be made for stream restoration.

Before any manipulation is taken in a proposed buffer or core habitat zone (including biomass removal, fire, restoration, bridge building, road construction, etc.) collaboration with stakeholders will take place.

Subterranean Waters

In addition to the surface water resources as described above, the Domain is unique due to its underlying karst and geology. Karst is any landscape based on soluble rock. Much of Tennessee is underlain by limestone which has been dissolved by water to create a variety of underground spaces. This creates underground space rich with life and notably filled with underground waterways discretely diverting surface water to groundwater. Karst landscapes are typified by reduced surface waterways, sinkholes, caves, springs, and sinking streams.

Karst terrains complicate water protection and erosion inhibition as water does not generally flow across the surface landscape following topography and creating surface drainage features. Karst terrains can be extremely variable and complex, but in general surface water travels underground having entered the subsurface either through diffuse infiltration or very often through discrete points where surface streams, often intermittent, sink into sinkholes and swallets (where surface streams sink underground). In contrast to most other groundwater, once water goes underground within karst terrains there is less opportunity for filtering or other amelioration of contaminants.

BMPs related to protection of waters entering karst have not been actively developed, nor significantly studied for public and private lands in North America to this date, but have been highlighted as a need by karst and conservation professionals to ensure water quality and habitats are being protected to the maximum extent possible. In 2017, The Nature Conservancy worked with karst experts and used the best available science to develop a document entitled Forest Management Considerations and Best Management Practices on Karst Landscapes: A Lesson in Evidence-Based Management Guidelines (Appendix E). Our goal will be to test these recommendations to continue to develop the science and applicability of the management considerations and BMPs as they related to our desired management and ecological conditions.

Water Quality

Water quality and stormwater management is an important aspect of water resources protection. With future population growth and proposed development, the management of the water resources and stormwater should focus on holistic and be landscape scale rather than reactive. In 2018, a Stormwater Management Master Plan was presented that focused on the protection of natural resources, upstream and downstream, and the sustainability of future projects. This process ultimately provided projects that would ameliorate runoff, sedimentation, erosion, flooding, and generally offset the impacts from the vast amounts of impermeable surfaces that exist in the Urban Core (Stormwater Management Master Plan 2018). These projects would have a positive impact downstream on the Domain as the velocity of water would be reduced, thereby reducing the potential for sedimentation downstream and pollutants in pristine habitats. Water quality is also impacted by land use, particularly undeveloped non-agricultural forestland which typically yields the highest water quality of any land use or vegetation cover.

In addition to our reservoirs, there are over 83 kilometers of perennial and intermittent streams and wetlands that feed our reservoirs and the surrounding landscape (Figure 11). These stream corridors provide habitat for a myriad of plants and animals and add greatly to the diversity on the plateau. Focusing on habitat and desired ecological conditions through management will increase the value of these corridors by eliminating siltation, restoration of degraded streams, and reducing the impact of impervious surface development in the watersheds. However, there are current issues that need to be addressed including the maintenance of older dams and the expense in maintaining these dams. As the dams of the older ponds start to leak, we need to prioritize which ponds should be maintained, which ponds should be drained and restored, and which should be removed. Additionally, several water bodies have growing populations of invasive aquatic plants that will require a commitment of resources to combat.

Desired Conditions for Watersheds

Our desired conditions for the watersheds on the Domain, is that they support the hydrologic function, are resilient, and provide the necessary water quality and quantity to support the biota and water supplies in the area. As stated above the minimization of sedimentation and erosion within watershed through the use of BMPs, restoration, and changing of practices will be in place. As we are considered the headwaters of a number of watersheds, it is our responsibility to ensure that we are not adversely impacting the downstream ecological components and habitats of these streams.

Management Approach for Watersheds

Our approach for achieving our desired conditions for the Domain's watersheds is through monitoring, maintenance, and restoration (as necessary) of our watersheds. By implementing BMPs, improving practices, collaborating with partners we will focus our efforts on maintaining habitat. We will evaluate all proposed activities, including recreation, research, and management to ensure that we minimize watershed impact watersheds and collaborate with education and research partners.

Objectives for Watershed Resources

- To monitor, maintain, and restore aquatic habitat to provide healthy biological communities for aquatic ecosystems.
- Maintain watersheds to improve or stabilize sedimentation in areas of erosion or management.

Forest Resources

History of Ownership, Forest Management and Planning

Sewanee’s archaeological record indicates that indigenous peoples inhabited the Domain for at least the last 10,000 years (Sherwood et al. 2012). Land management techniques likely used by Native Americans included small agricultural plots (and tree deadening) and the use of fire to promote game hunting or ease of nut collection (Chapman et al. 1982). Firewood gathering, particularly around rock shelters or temporary settlements, was likely important as well. After Native American extirpation in the 1830s, settlers moved into the region in larger numbers and wood, coal, and game were harvested as needed.

After the University was formed in 1857, and during the first forty years of the University’s history, the management of the Domain was largely a matter of unmanaged use and exploitation (Burckle and Smith 2003). Timber harvesting, livestock grazing, coal mining, quarrying, woods burning, and other activities went largely unregulated and uncontrolled. Beginning in 1897, Vice Chancellor Lawton Wiggins recognized the need for management of the timber resource, and began correspondence with Gifford Pinchot. In 1898, Gifford Pinchot, the first American forester and head of the nascent Division of Forestry, visited the Domain to begin a management plan. He enlisted the assistance of Dr. Carl Schenck, a German forester and founder of the Biltmore forestry school to conduct the work necessary to complete a management plan. Schenck visited the Domain with five of his students, and they submitted their first report in 1899. In the 1899 plan, Schenck reported that fire was commonly used throughout the Domain for grazing purposes, and that the condition of the forest on the plateau surface was poor. This initial planning on the Domain led to planned harvesting, and in the 1905 University Trustees report, the Vice Chancellor reported that the University had sold 2.7 million board feet of timber at a profit of $10,300. He also noted that he was invited to speak at the National Congress of Foresters which included President Theodore Roosevelt.

The first published map (the Hopkins map), was drawn in 1860 by Bishop J.H. Hopkins of Vermont (Figure 12). In 1903, the U.S. Bureau of Forestry published a report based on John Foley's work titled “Conservative Lumbering at Sewanee, Tennessee”, in Bulletin 39 (Foley 1903, University of the South 1953). This work contained the second published map of the Domain (Figure 13).

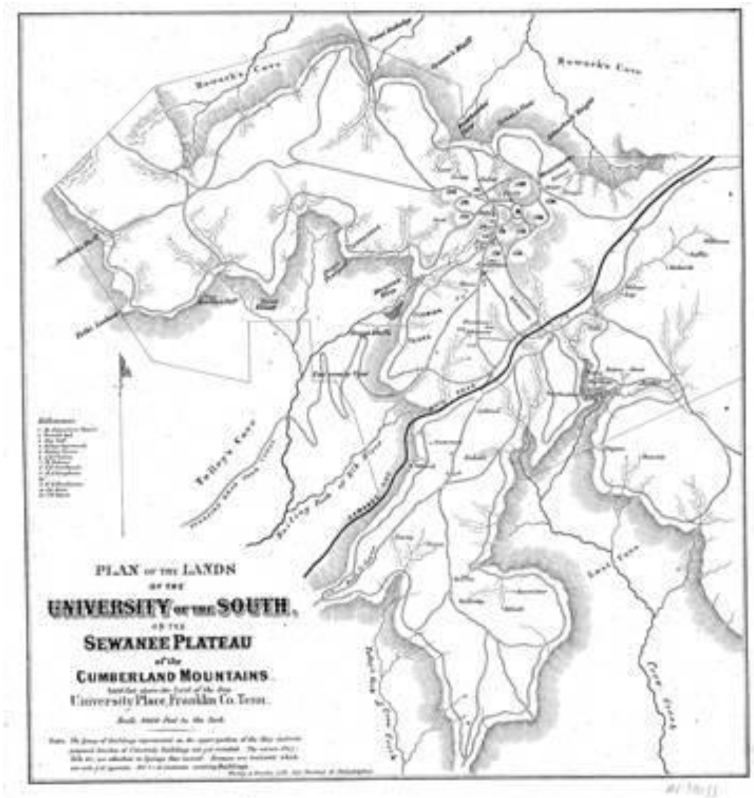


Figure 12. Hopkins map of the Domain (1860), the first published map of the University of the South, Tennessee.

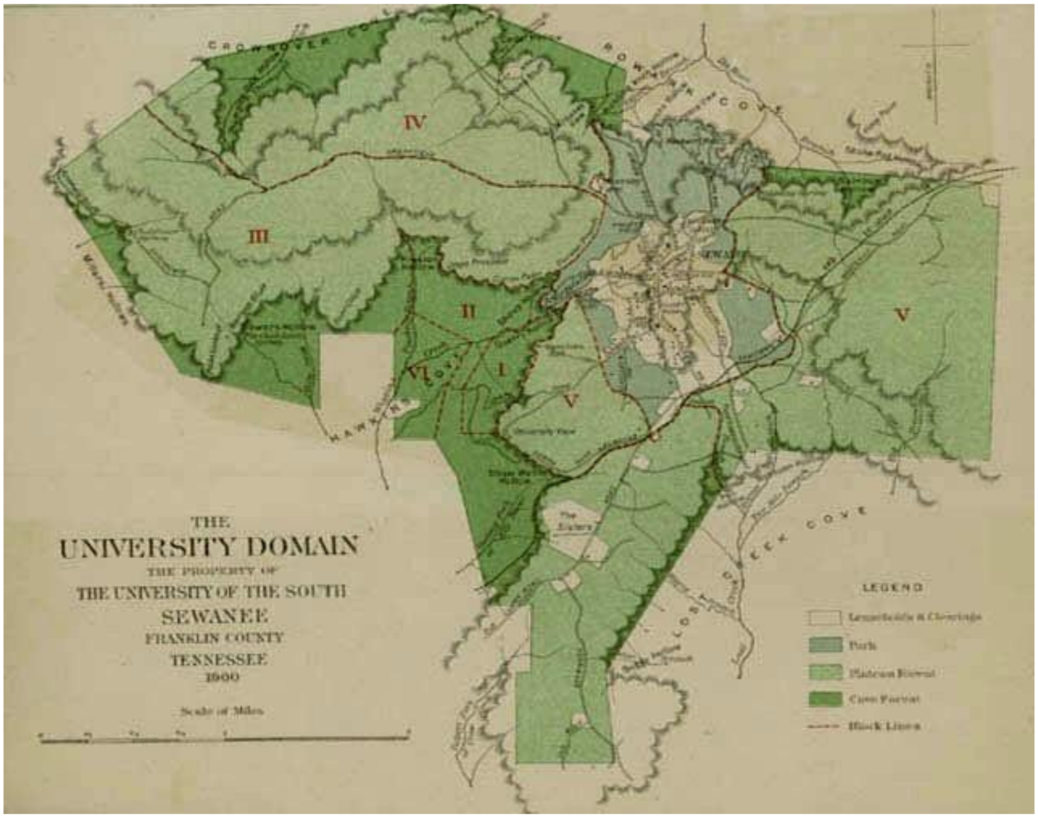


Figure 13. The second published map of the Domain, from 1900, was published in the U.S. Bureau of Forestry report “Conservative Lumbering at Sewanee, Tennessee”, the University of the South, Tennessee.

In the 1899 Schenck plan and the 1903 Foley publication, both authors focused on the timber resource, forest protection, and infrastructure improvements. Construction of roads for access and fire control was deemed necessary as was fencing the Domain to prevent grazing, trespass, and adverse possession of University lands. In subsequent years, the University wrote and adopted five other management plans, a white paper, the 2020 Domain Land Use study, and a sustainability master plan, all which have guided our actions over the past 120 years. All of these reports and plans can be found on the OESS web site.

Forest Health

Background

As described the Domain has been historically, heavily impacted by human activity, however there are other forces that can directly impact forest health including the removal of wildfire and the introduction and spread of non-native organisms. These disturbances have a numbers of sources from climatic events, to climate change, to human induced activities, and some disturbances can have positive impacts on various ecosystems due to gap creation allowing greater light penetration and soil regeneration (Grayson et al. 2011).

No matter the disturbance, our overarching principle is to foster resilient landscapes that will thrive, absorb, and survive, disturbance events. Disturbances events including: non-native invasive plants, insects, disease, and extreme weather events.

Current and Past Inventory and Tree Harvesting

Managed timber harvests on the Domain began in the early 1900s, and the last forest inventory conducted on the Domain was started in 1999 and completed in 2001 (Burckle and Smith 2003). As part of the Domain Management Plan process, we are completing a rapid inventory of each compartment to establish current conditions. These rapid inventories allow for future ecological conditions to be discussed for each conservation area.

Income generated timber harvesting has historically been an important objective of the University (Figure 14). This income was utilized to develop and maintain infrastructure including fire lanes, lakes, dams, and other recreational facilities. Historical timber harvests were also utilized as sources of income to fund construction projects and to provide funding sources for the general revenue (Burckle and Smith 2003). Current timber harvesting is undertaken for ecological and habitat management considerations within an income generating context, but never an expectation of achieving net profits in recent years to defray costs.

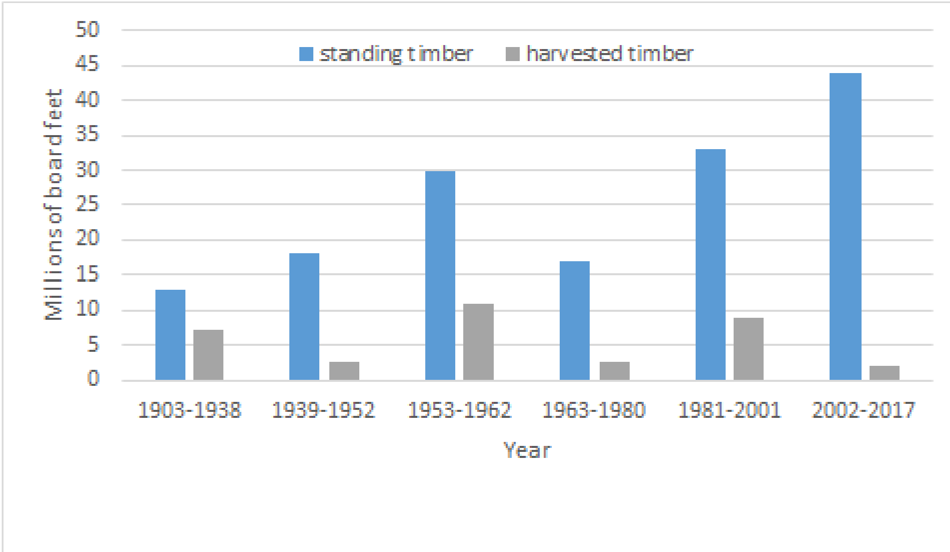


Figure 14. Summary of harvest on the Domain 1900 — Present. The standing timber estimates are drawn from previous management plans. Each previous inventory was conducted using a variety of methods and techniques.

Desired Conditions for Timber Management

The desired conditions for Timber Management consists of stands of healthy forests with desirable species composition; a variety of age classes; and a flow of sustainably harvested wood products to be used in local projects or to benefit local and regional economies. Additionally, timber harvest for each Conservation Area/Compartment will be well-planned and managed to allow for varied age classes, enhances ecosystem diversity and created wildlife habitat conditions.

Management Approach

Our timber management program is used as a valuable tool to achieve a number of objectives including, early successional habitat, varied forest structures, oak reproduction, conversion of pine plantation to native pine and hardwood forests, and open woodland. A variety of silvicultural systems and harvest methods are provided to allow flexibility to respond to need in a given situation or area.

To avoid erosion with timber management activities, erosion control measures will be implemented including the seeding of skid roads and landings with wildlife beneficial native grasses and wildflowers.

Annual Allowable Cut

On the Domain, the estimated standing volume is 100 million board feet with a measured annual growth of 3,810 million board feet/year. This growth is based on forest productivity of between 62 and 80 cubic feet per acre per year (depending on site) as published by Smalley in 1986 and 1989. The OESS recognizes that timber management is not the primary objective for management of the Domain. For that reason, OESS has set an annual allowable cut to not exceed 25% of growth. That number (approximately 952,500 board feet per year) ensures that the multiple ecological and economic assets of the Domain will continue to increase over time. No cumulative annual harvest outlined in this document is anticipated to come within 50% of our annual allowable cut. This conservative annual cut falls below the 5000 cubic meter maximum harvest allowed under the under the small and low intensity managed forest (SLMFs) designation (FSC-STD-01-003) which was developed to streamline certification procedures and provide consistency. Maintaining harvest levels under this threshold allows the University to maintain certification with minimum necessary compliance documentation.

Silvicultural Systems

Silviculture is generally defined as, "the art of producing and tending a forest through the application of silvics, and methods are referred to as silvicultural systems". Elements of a silvicultural system include:

- Harmony with goals and characteristics of ownership
- Provision for regeneration
- Efficient use of growing space and site productivity
- Control of damaging agencies
- Protection of soil and water resources
- Provisions for sustained yield
- Optimum use of capital and growing stock
- Concentration and efficient arrangement of operations
- Maintenance of desired plant and animal populations
- Execution of policies about landscapes, scenery, and aesthetic considerations

All silvicultural systems suggested in this plan strive to achieve the previously listed elements. Systems such as thinning, pre-commercial, and commercial timber harvest may be implemented and include shelterwood, group selection, and regeneration harvests. Each of these methods, described below, are prescribed to achieve the stated goals and objectives. Additionally, it is important to note that silvicultural systems are employed based on moving stand conditions to desired stand conditions therefore regeneration of the treated stand is often the primary focus of the timber management prescription.

Silviculture methods which may be employed on the property include the following:

- Shelterwood – Removal of the existing stand in a series of cuttings, which extend over a relatively short portion of the rotation (10 -15 years). This method encourages the establishment of a new cohort of advanced regeneration under the partial shelter of the residual stand. Once desired species are established by natural regeneration, the overstory stems can be harvested (usually in two successive harvests) to a basal area appropriate for desired goals. For quality timber production, basal area should remain above 60 square feet to reduce the risk of epicormic branching in younger stems. For understory development ideal for wildlife habitat and low browse, target basal area should be between 20 and 30 square feet. Removed trees should be across all diameters and product classes. Residual trees should be of desirable species and exhibit good geno- and phenotypes. These trees will mitigate visual impacts of the harvest, provide seed and genetic material, and optimize site conditions for future stands.

- Seed Tree – Removal of the existing stand in one cutting, except for a small number of seed trees left single or in small groups to provide for the establishment of advance regeneration. This method is similar to the shelterwood except that it is designed to be carried out over only two entries and the initial harvest leaves less in the overstory. Removed trees should be across all diameters and product classes. Residual trees should be of desirable species and exhibit good geno- and phenotypes.

- Regeneration – Removal of the entire stand in one cutting. This method of harvesting is most economically advantageous, and is often a very logical practice for stands which are degraded and contain a large percentage of unacceptable growing stock and less valuable species. This is the most effective means of rehabilitating an unhealthy stand to a productive and healthy forest. No regeneration harvest should exceed 10 acres in an individual unit. Furthermore, through the application of Variable Retention Forestry (VRF), a minimum of 20 ft^2 basal area should be maintained across all cut units. VRF is a method of leaving uncut forests or scattered trees throughout harvest units. This can be accomplished in the form of groups or linear strips, and has been shown to maintain many of the positive benefits of other ecosystem services while still allowing ecological forestry and commercial timber harvests. Extra care should be taken to minimize visual impacts. Advance regeneration of desirable species should be present (approximately 300 TPA) prior to any regeneration harvests. Advance regeneration is the existing growth of young, desirable tree species under the forest canopy. These saplings are generally high in the understory and approaching the mid-story. This frequently allows them to take advantage of openings in the canopy, growing in as the new forest stand. Harvest boundaries should have irregular shape designed to mitigate visual impacts and maximize edge for wildlife benefits.

- Group selection – Removal of small groups or clusters of trees. Group selection harvest involves creating patch-cuts with canopy opening of one half to 2.5 acres in size, resulting in overall forest structure being more diverse and uneven-aged. Under this system, canopy opening should not exceed 2.5 acres. Although more difficult to market and manage, the vertical structure maintained by this method has notable ecological benefits, as there is less habitat disturbance, soil compaction, and erosion. Additionally, this style mimics conditions frequently observed in natural regeneration dynamics of Appalachian forests.

- Individual tree selection – Removal of individual trees. This method creates and requires continual creation and maintenance of uneven or multi-cohort stands by means of occasional replacement of single trees with regeneration from any source. Caution should be applied with using this method because without care resultant conditions could be similar to those found in high-graded forests. These conditions often lead to less production and healthy forests over the long-term and multiple cohorts. Additionally, this method does not open large canopy gaps for regeneration of non-shade tolerant species, so further management of the stand is necessary to prevent shade-tolerant species from taking over harvest areas.

Prior to any silvicultural operation, a more rigorous inventory should be conducted, and an explicit silvicultural prescription should be generated by OESS staff. This prescription should include all details of current and future stand conditions, as designed to meet the landowner's goals and objectives.

Management recommendations are included to benefit these forests by removing poor or low-quality trees, encouraging hard mast species and habitat diversity for wildlife, diversifying timber forest products, restoring native forest conditions, and increasing overall vigor and vitality. In active management as prescribed, all tops and debris should be left on site in the forest providing micro-site for regeneration, maintaining soil moisture and stability, and providing habitat for wildlife species. Additionally, snags and other trees should be left within the harvest areas as roost and den trees. All BMPs must be followed.

Objectives for Timber Management

- A total timber sale program quantity that does not exceed 250,000 board feet per year. This equates to approximately 60 to 120 acres per year.
- Provide a source for local wood as necessary.

Planned Management by Conservation Area

The following is a summary of proposed management activities by Conservation Area for the years 2019-2020 through 2024- 2025, a spreadsheet documenting these activites can also be found in Appendix D.

Conservation Area 1 (Compartments 11, 53, 52, 54, & 55):

Prescribed Fire:

Prescribed fires ares scheduled for: Compartment 11: (2022).

Timber Management:

There are no proposed timber management activities at this time.

Conservation Area 2: (Compartments 2, 4, 6, 8, 10, 12, 14, and 70)

Prescribed Fire:

Prescribed fires are scheduled for: Compartment 2 (2021 and 2022) and Compartments 8 & 10 (2020, 2021, 2022, 2024, and 2025).

Timber Management:

Timber management is proposed in Compartment 2 in 2024, Compartment 6 in 2023, and Compartment 14 in 2021.

Conservation Area 3 (13, 15, 17, 19, 21, 23, 25, 27, 29, 31):

Prescribed Fire:

There are no scheduled prescribed fire activities at this time.

Timber Management:

There are no proposed timber management activities at this time.

Conservation Area 4:

Prescribed Fire:

Prescribed fires are scheduled for: Compartment 20 (2025) and Compartments 22 (2020, 2021, 2022, 2024, and 2025), Compartment 24 (2022), Compartment 28 & 32 (2021), Compartments 42, 44, 46, 48 & 50 (2021, 2022, 2024) and Compartment 46 (2025) and Compartment50 (2020 & 2025).

Timber Management:

Timber Management is proposed for: Compartments 22, 28, & 34 (2023), Compartment 30 (2020); Compartments 42 & 46 (2024).

Conservation Area 5 (Compartments 33, 1, 3 ,5, 7, 51, 400, 9):

Prescribed Fire:

There are no scheduled prescribed fire activities at this time.

Timber Management:

There are no proposed timber management activities at this time.

Conservation Area 6 (Compartments 80 and 60):

Prescribed Fire:

Prescribed fires are scheduled for Compartment 60 (2022, 2024, and 2025) and Compartment 80 (2020, 2021, 2022, 2024, & 2025).

Timber Management:

Timber harvest is proposed for Compartment 60 (2024).

Utilizing Prescribed Fire

Background

Over the past 20 years, researchers have made significant strides in understanding the role of fire in the eastern forests of the United States (Guyette et al. 2006, Stambaugh et al 2015). Some of this work has included local sites such the oak barrens near Tullahoma and on the Cumberland Plateau (Guyette and Stambaugh 2004, Hart et al. 2008). Since the late 1990s, land managers, particularly on public lands, have applied prescribed fire, sometimes in combination with mechanical treatments, to oak dominated forests on the Allegheny and Cumberland Plateaus, as well as the southern Appalachians (Blankenship and Arthur 2006, Iverson et al. 2008, Royce et al. 2010). When using repeated prescribed fire alone in hardwood dominated stands, results have varied, but common treatment responses include high mortality in the midstory and low overstory mortality (Arthur et al. 2012). Understory responses vary with each study, with some studies finding increased oak regeneration following treatments (Brose and Van Lear 1998, Iverson et al. 2017) and others not (Keyser et al. 2017).

In terms of oak regeneration, the most successful attempts to increase the ability of oak to grow into the sapling stage have included treatments with mechanical basal area reductions in the midstory and overstory combined with prescribed fire (Brose and Van Lear 1998, Iverson et al. 2017). This work inspired Sewanee’s original attempts at oak restoration in 2010 in Compartment 46, and continued with replications in Compartments 20 and 8. Results from these studies indicate that lowering basal area by 50% and following the mechanical treatment with three prescribed fires has resulted in no net change in the total number of tree seedlings and a 17% rise in the number of oak seedlings (from 10,000 per hectare pre-treatment to 18,000 per hectare post-treatment). Over the past nine years, most of the browse in these sites was focused on *Smilax spp*., and total tree seedling cover has increased from 13% to approximately 40% indicating increased seedling leaf area and vigor (Smith et al. 2020). We will no longer apply fire to these sites as we wait for the new seedling cohort to move into the sapling stages.

Following our work with oak regeneration and fire, we are now using the best available science to increase the acreage of shortleaf pine/hardwood stands on the Domain. There are numerous publications that outlined the decline of shortleaf pine in the southeastern United States (Guyette et al. 2007, Oswalt 2012), and the recent harvests and plantings in Compartments 22, 50, and 46 follow recommendations in the literature. These plantings have also been placed on a burn cycle according to recommendations in the literature (Sparks et al. 1998, Stambaugh et al. 2007).

In addition to the typical vegetation monitoring associated with mechanical treatments and prescribed fire, the OESS in coordination with students and faculty, have initiated mammal monitoring in many of oak and shortleaf pine treatments. Prior research on the Cumberland Plateau and elsewhere have found that lowered basal area resulted in higher bat activity, especially for large bodied bats (Cox et al. 2016, Silvis et al. 2016). In several of these studies, prescribed fire was used after the mechanical treatments, and several bat species responded favorably to these treatments (Cox et al. 2016, Silvis et al. 2016). In work at Sewanee, we have found that 11 bats species utilize our oak restoration sites (bat observations per trap night) more than adjacent forest controls. Replicated monitors in June and July 2019 found that eastern red and evening bats, big brown and silver haired bats, hoary bats, *Myotis spp*. and tri-colored bats in the thinned and burned sites had 53, 84, 9, 8 and 4 times the number of observations than unmanaged forest control. For rodents, annual summer trapping in 2017, 2018, and 2019 did not reveal any significant differences between thinned and burned sites and adjacent forest controls.

Small scale, frequent prescribed burns led to the oak/shortleaf pine (*Pinus echinata*) and hickory/pine old-growth forest that exists on the property today. However, in recent years, the lack of prescribed fire (or other means of controlling regenerative species composition in a midstory position) has led to the emergence of a red maple (*Acer rubrum*) dominated midstory that will eventually replace the oaks and hickories in the canopy. Prescribed fire is a beneficial tool for stand manipulation and habitat enhancement that enhances species diversity and richness but has only recently begun to come back in to practice in prescriptive applications toward management objectives (Vander Yacht et al 2017).

Prescribed fire has been shown as an effective and efficient way to:

- aid in the reduction of hazardous fuels
- dispose of logging debris
- prepare sites for seeding
- improve wildlife habitat
- manage competing vegetation
- control insects and disease
- improve forage and grazing
- enhance aesthetics and access
- perpetuate species and communities that require fire.

Common prescribed fire plans for the forests on the Domain included both dormant and growing season burns, often used in tandem to achieve management objectives; burns on both frequent (3-4 year cycles), and less frequent burns on long cycles (50+ years). Prescribed fires on the Domain are aggregated to create landscape scale spatially arranged fire management units that promote habitat connectivity and diversity in both condition and structure.

All prescribed fires are carried out by trained individuals from the University of the South, under a specific burn plan for each prescribed fire, and with strict supervision from a TN Certified Burn Manager. The University has a Wildland Fire program in which students have the opportunity to become certified in the National Wildfire Coordination Group standard courses for Wildland Fires (S-130 Firefighter Training and S-190 Introduction to Wildland Fire Behavior and RT-130 Wildland Fire Safety Training Annual Refresher). Pre- and post-treatment monitoring will be performed to ensure desired results are achieved and to quantify and track levels of tree mortality.

For more information, see the USFS's Introduction to prescribed fire in Southern ecosystems.

Desired Conditions for Prescribed Fire

The desired conditions for prescribed fire on the Domain, are ecological systems that are diverse, flexible, and well-adapted to prescribed fire. These systems will continue to have various oak and pine species that will play a major ecological role.

Prescribed fire is used in a well-planned, controlled manner to create desired habitat conditions for wildlife species, varied structure in forest systems, to reduce fuel loads, and to teach and train our students.

Management Approach for Fire

Each year, the number of acres based that will be managed by prescribed fire will be approximately 75-250, this number is depended upon a number of factors including weather, fuel load, and available resources including burn crew. Any change to these factors may affect the number of acres treated that year and the planned rotation. The number of acres treated each year by prescribed burning varies based on factors such as weather conditions, fuel conditions, budget, and available resources (staffing). We will coordinate all proposed burns prior to the season to ensure the most effective treatment and least disturbance to ecologically sensitive areas and research sites.

Objectives for Fire

- Utilize prescribed fire on approximately 75-250 acres of habitat per year.
- To increase or maintain structural diversity of forested habitat.
- Protect, train, and equip the burn team to ensure their safety and a safe and effective burn.

Management Priorities

Teaching and Research

There is a long history of the Domain serving as a resource for research and educational opportunities. Just as ecological sustainability and the protection of cultural heritage informs management, so does the promotion of educational opportunities. As a liberal arts college and a school of theology, the sustainable use of our land and engagement of students drives our core values and mission. Educational opportunities associated with the Domain reflect a variety of interests and needs including scientific research, forestry demonstration, environmental studies, outdoor lab exercises, recreation, leadership training in environmental stewardship, spiritual reflection and aesthetic appreciation.

Our biggest challenge in managing our land resources is to accomplish these education-related goals while sustaining the integrity of the ecological landscape and being proper stewards of the cultural landscape. We are committed to land management that allows us to optimize the wide diversity of educational opportunities and benefits associated with the Domain. In addition, a critical component to the successful educational use of the Domain is our commitment to ensuring its safe use and access. Management prescriptions are developed by OESS staff who are trained forestry and wildlife biologists who then collaborate with University researchers to evaluate the prescriptions and allow research and teaching to occur prior to the implementation.

The OESS is a partner with the University community in education and research, striving to support these efforts on the Domain. As part of these collaborative efforts we are responsible for the tracking of all existing and proposed research projects on the Domain. There is an existing review and an approval process for reviewing new project requests for thoroughness and to ensure that proposals will not conflict with each other. A list of current research projects can be found in Appendix D. This list does not include course utilization as the OESS the research approval process does not cover courses, however we collaborate with faculty and staff regularly to discuss any potential impacts and ways to ameliorate them. The review process can be found on the OESS website at the following location:
http://www.sewanee.edu/offices/oess/domain/research/.

Forest Certification

In order to demonstrate a commitment to sustainable forest management (SFM), we the landowners have agreed to enroll the property in TNC's Forest Stewardship Council's (FSC) Forest Management group certificate. This was commenced in 2019 and maintained as required by the US Forest Stewardship Council's Forest Management Standard and TNC's Group Certification member requirements. The property will be managed in accordance with and as committed to FSC Principles and Criteria and this Forest Management Plan is designed to address and ensure proper management of all resources as outlined by FSC and including environmental, economic, and social attributes. As a member of this program, this property will be FSC certified by Rainforest Alliance, as the Certifying Body, with Certificate code: NC-FM/COC-000238. Specifically, property managers/owners must report any of the following activities to the TNC TN Forest Program Director as the primary group contact and manager, currently Trisha Johnson at (931) 265-1637 or trisha_johnson@tnc.org:

- Any changes in size of the property due to sales or acquisitions
- Any significant changes in staffing or deviations from the management plan
- The use of any non-native plant seed mixture on the property
- The use of any chemical or biocontrol agents on the property
- Forest products harvested
- Operational plans and inspections
- Any complaints, violations, stakeholder issues
- Any theft, timber trespass, or damages
- Significant weather events resulting in impacts to natural resources
- And any other significant changes

Major changes or events on the property should be reported to TNC within two weeks, while other typical management actions shall be reported annually. Should additional issues, questions, or reporting be required, or if Ms. Johnson is unavailable, the landowners/managers may correspond with the FSC Group Manager at TNC – Fran Price, fprice@tnc.org.

Additional information related to the FSC certification can be found in Appendix F and G.

Aesthetics and Outdoor Recreation

Sewanee's Domain offers recreational experiences unparalleled on any other campus in the country. The forests of the Domain are used extensively for outdoor recreation. The most popular activities include hiking, biking, swimming, rock climbing, caving, horseback riding, and camping. As with other activities, recreation has impacts on the landscape that must be accounted for and at times ameliorated. There are also user conflicts to work through as varying user groups can view resource needs differently and at times be in direct conflict with one another.

Recreation like all other activities has impacts on the land and overuse can be detrimental. In some of the most popular recreational areas issues such as erosion, soil compaction, litter, and damage to vegetation has been significant and has resulted in changes to hiking routes, parking, access as well as education of the user groups. As the availability of the Domain's resources becomes more widely known, the potential increased recreational use will need to be managed in a way that minimizes user conflicts and benefits the resources. This increased use will require continued maintenance of trails, fire lanes, scenic overlooks, portals, climbing areas, and other recreational areas on the Domain.

Hunting

Populations of white-tailed deer have fluctuated widely on the Domain over the last 100 years. Pre-settlement densities are little more than speculation, but by the turn of the 20th century deer had been largely extirpated from the plateau by human hunting. Reintroduction efforts from the 1950s-80s re-established the population, and absent natural predators and sufficient hunting, the population rebounded such that a 2010 sample in and around campus estimated approximately 148 animals per square mile. This population explosion led to detrimental impacts on habitat, with a reduction in understory species such as American beautyberry (*Callicarpa americana*) (Evans et al. 2016). In an effort to manage the effects of the deer herbivory and manage safety implications in residential areas, a hunting program was established in 2010. In 2010, 1284 acres were available for hunting and in 2017 approximately 3,000 acres were available for hunting. Since 2010, at least 970 deer have been harvested from the Domain, and 85% of those were female. The harvest has been successful in a number of areas, primarily by allowing habitats that have been over-browsed to begin to recover. For detailed information about deer management on the Domain, see the University of the South White-tailed Deer Management Plan completed January 2016 on the OESS website.

Section 2. Analyses of Conservation Areas

Current Resource Conditions

Management plans have historically divided the Domain into individual compartments. The 2019 management plan is taking a landscape approach and grouping compartments into habitat units, or Conservation Areas, which are based on similar ecological conditions (Figure 15). Within each Conservation Area, features and attributes specific to individual compartments will still be discussed, but the focus is going to be on larger land areas with ecological similarities. For example, all four compartments that compose Lost Cove are one Conservation Area and will be addressed in one section in the Management Plan. North and South facing escarpment compartments are grouped respectively and will be discussed accordingly. The plateau consists of three additional Conservation Areas. Within conservation areas, the compartment boundaries will remain intact and specific recommendations may still be grouped by compartment but may also cross historic compartment lines to create more ecologically appropriate recommendations. Compartments combined into a single conservation area will not necessarily have similar management trajectories, but will share some ecological characteristics. In this plan, we will summarize what we know about the conservation area in the following categories and in each of the Chapters of the Conservation Areas we will go into further detail. We then address each compartment individually identifying history and prescriptions for the future, if applicable.

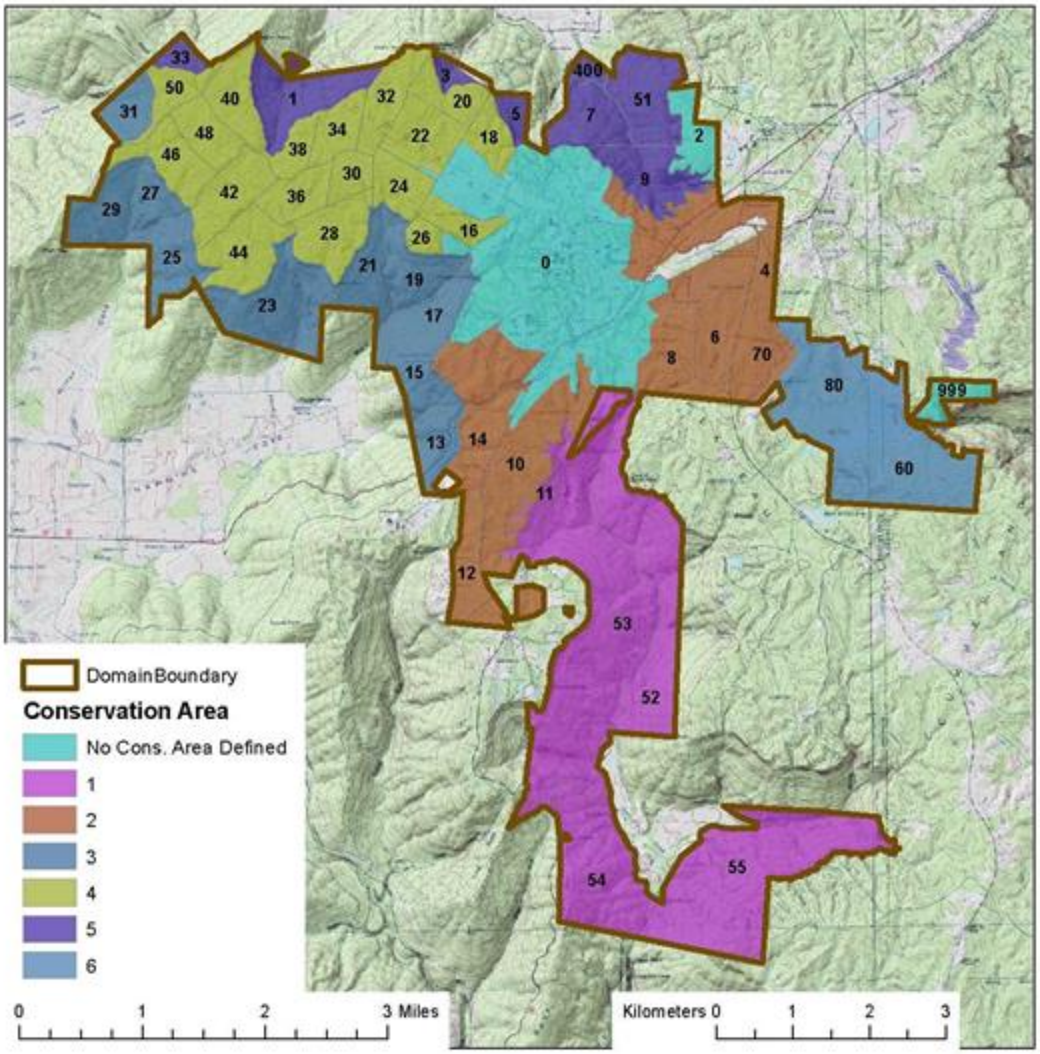


Figure 15. Map defining the Conservation Areas of the Domain, the University of the South, Tennessee.

History and Current Use

The past informs the present, and prior land use has greatly affected the current condition of much of the Domain. Recent efforts by the Landscape Analysis Lab, students that major in environmental fields, and the University Archaeologist are giving us a clearer picture of what has happened on the Domain over time. Though the history of many sites will always remain incomplete, this section is intended to build a narrative for the compartment's current condition and includes current recreational assets.

In 2003, Domain Manager Joe Burckle compiled a spreadsheet of harvesting records from the Domain Management historical files from 1950—2000. In 2011, Sean McKenzie C' 11created maps and compiled an additional spreadsheet based on historical documents for his honor's thesis in the Biology Department. At that same time, Nicole Kunz Nunley, the Laboratory Coordinator in Snowden Hall, made several maps detailing harvest histories with forestry students that were working on independent studies. Finally, Ann Bradley of the Landscape Analysis Lab provided us with historical documents that she has catalogued for the Domain History Project. Based on these efforts, we were able to compile a brief history of management in our conservation areas.

Current Condition of Forest Communities

This section outlines the ecological condition of each compartment's forest community. It includes general descriptions of forest overstory, understory, stand density and age.

Rare, Threatened, or Endangered Species

This section is intended to highlight what we know about rare plants and animals within the Conservation Areas, and to help identify gaps in our knowledge using the TN SWAP habitat types. The presence of a species can sometimes provide clues to previous land use, give insight to the pre-European ecological conditions, or help shape desired future conditions. The absence of a species does not mean that it is not there, only that it has not been found yet, and should help guide future botanical surveys toward under-sampled areas of the Domain.

Soils

Soils play a key role in understanding past land use and current productivity on a site and are critical in understanding species composition and the determination of desired future condition.

Water Resources

Springs, ephemeral ponds and streams are often the hotspots for biodiversity and past human activity in a compartment. They should be protected and highlighted for research opportunities.

Cultural Resources

The University of the South has a long history of researching the cultural use and history of the Domain. Significant cultural resources are protected from loss. Our overall strategy for sustaining the cultural resources, which are a desirable part of the setting and character of the Domain, involves continuing to identify significant sites and stabilizing them, additionally the University of the South's Archeologist review sites prior to implementation of any activities and appropriate measures are employed to protect them from damage, and preserving them for future scientific research and interpretation opportunities. Surveys are conducted prior to site disturbance activities. Any significant site that is noted will be buffered from activities.

Letters were sent December 11, 2018 to all known Native American Tribes (6 total) informing them of the Forest Management Planning process and requesting input and suggestions (Appendix J). These tribes are: Cherokee Nation, Eastern Shawnee Tribe of Oklahoma, United Keetowah Band of the Cherokee Indians in Oklahoma, Shawnee Tribe, Muscogee Creek Nation, and the Eastern Band of the Cherokee Indians. At this time, we have received no feedback.

In some ways this section is similar to the Rare, Threatened, and Endangered Species (RTE's). Presence of above- and below-ground archaeological remains can provide clues regarding previous land use, and depending on their significance, indicate areas for protection or avoidance. As is the case with RTE's, an absence of archaeological sites documented in an area is not necessarily an indication of a lack of resources, but may indicate an area where surveys are needed. Some level of cultural resource inventory should be conducted prior to most long-term compartment activities.

Non-native/Invasives

As described in the introduction, the Domain faces a number of risks due to invasive species. This section will outline known non-native/invasive populations and if a course of action is known or determinable will be addressed.

Recreation

This section describes the recreational assets of the conservation areas and the user groups and uses of these resources.

Desired Future Condition

This section evaluates the desired future conditions of the Conservation Area as a whole based on an evaluation of current conditions of biological communities, how those current conditions coincide with ecological systems, habitat parameters, SGCN species, cultural resources and university capacities and priorities. This section provides a short summary of the future conditions of the area with individual compartment recommendations to follow in the section: Compartment Summaries and Management Recommendations.

Compartment Summaries and Management Recommendations

This section is intended to provide direction from a management and ecological perspective therefore recommendations may vary widely from compartment to compartment within a conservation area. Some areas where current condition deviate widely from the desired condition, prescriptions may be outlined. For other compartments, the desired future condition may be already at hand and management should or could be limited to monitoring. For other compartments, the desired future condition may be a completely changed land use or a long-term cultural resources project tied to research and teaching projects. There are no limits to the possibilities for the Sewanee community. To guide decision making, we utilized available literature and input from the Sewanee community and then developed the indicators seen below in Table 6 as guidance to evaluate present and desired conditions of the habitat in each compartment.

Table 6. Ecological indicators that help guide management decisions in Conservation Areas. As appropriate, these characteristics were considered in the Conservation Areas when making management decisions for the foreseeable future.

Indicator	Description
Presence of Forest Regeneration	Numbers of seedlings of desired species on a site
Presence of amphibian/reptile habitat	Amphibian habitat is characterized by moist environments. Reptile habitat is characterized by dry environments.
Karst Habitat	Cave habitat
Wetland/Riparian Habitat	Area covered by water either permanently or seasonally. Riparian habitat are the plant communities along stream corridors.
Neotropical Migrant Songbird Habitat	Grasslands, mature forests, understory, edge, and streams.
Presence of Invasive species	Invasive aquatic and terrestrial flora and fauna.

Small Mammal Habitat	Characterized by downed woody debris, thinning, burning, and canopy openings.
Evidence of Deer Herbivory	Removal of species from understory, little regeneration, and overbrowse
Bat Habitat	This varies from season and by species. During the winter, can be karst. Suitable roost trees, openings within canopy, and nearby water sources.
Presence of Meso-mammal habitat	Mammals larger than rodents that require a variety of habitats: downed woody vegetation, denning habitat, wooded vegetation, snags.

Section 3. Conservation Area 1

Conservation Area 1 consists of the area known as Lost Cove and is comprised of Compartments 11, 52, 53, 54, and 55 (Figure 16). This Conservation Area consists of 3,032 acres and is found in the southeastern portion of the Domain.

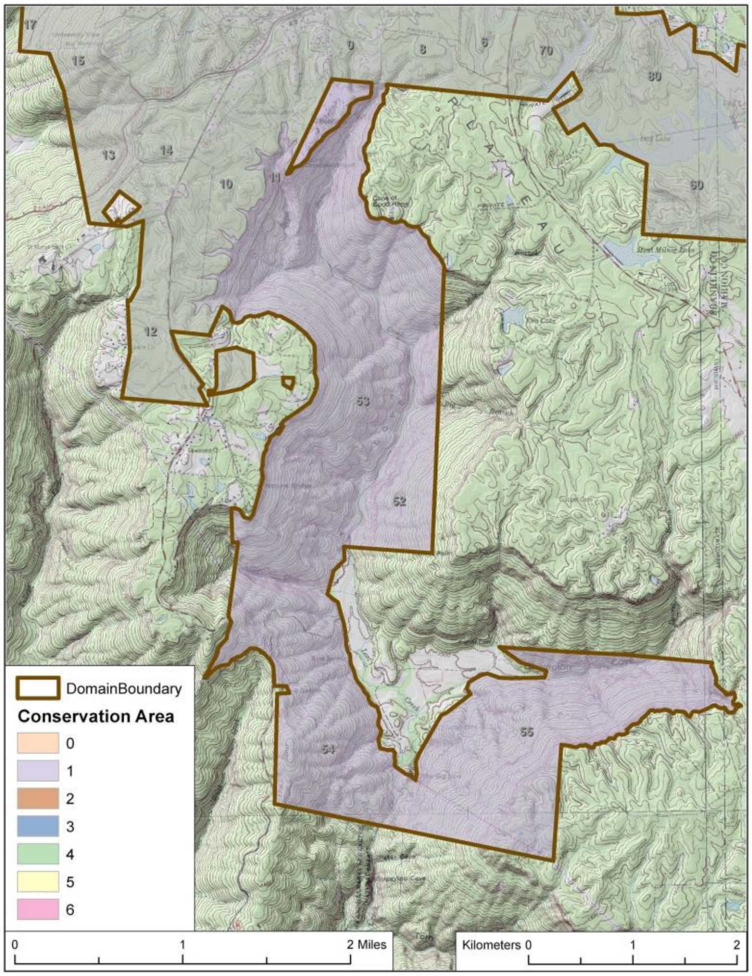


Figure 16. Map of Conservation Area 1, the University of the South, Tennessee. Conservation Area 1 consists of the area known Lost Cove.

History and Current Use

Lost Cove has a long and rich history of human use, including long-term Native American occupation followed by settlers in the 1820s. In the late nineteenth and early twentieth centuries, eight families lived in Lost Cove, with Episcopal mission church and a school. It has been uninhabited since the 1950s. In 2008, the University acquired Lost Cove as part of a conservation easement in cooperation with the Land Trust for Tennessee and the State of Tennessee. The conservation agreement allows for future timber harvests after approval of a forest management plan by the Land Trust for Tennessee.

Current Condition of Forest Communities

Lost Cove consists primarily of mesic cove forests that are the headwaters of Crow Creek. The forests are dominated by oak and hickory, with beech and sugar maple dominating in limited protected coves. The northern third of the property (much of Compartments 52 and 53) was harvested selectively with some clearcutting in 2005. The central third of the property (Compartment 54) was high-graded in the 1970s. The southern third of the property (Compartment 55) was harvested in 1998. The last inventory of Lost Cove was competed in 2008 and 234 plots across the cove were inventoried at that time (10 BAF prism cruise). In 2008, average volumes of 2,475 board feet/acre were found in the cove with hickory (*Carya* spp.), white oak (*Quercus alba*), yellow poplar (*Liriodendron tulipifera*), chestnut oak (Q*uercus prinus*), red oak (*Quercus rubra*) (multiple species) and sugar maple (*Acer saccharum*) as the top six in terms of volumes. At the bottom of Lost Cove near the Big Sink, there is a significant canebrake consisting of giant cane (*Arundinaria gigantea*), which is rare on the Domain. Switch cane (*Arundinaria tecta*) also exists in Lost Cove, particularly on east facing slopes.

Conservation Area One contains numerous karst resources. Several of these caves provide critical bat habitat, some of which are known to contain rare species of arachnids, insects, and crustaceans. Most of Conservation Area One is considered a conservation high priority for karst habitat based on TNC evaluation (Figure 5) and the numerous cave resources in the area. This provides a unique opportunity for ecological monitoring of karst and forest resources of the cove. Conservation Area One is part of the ongoing bat acoustic monitoring program with a monitor deployed year round in Compartment 54 and rotational surveys in 54 and 53 during the summer. Winter roost surveys are conducted for presence of bat species in karst resources and to document the presence of white nose syndrome (WNS) in Domain bats.

Winter surveys were conducted in 2018, in Lost Cove, and the species documented were Tri-colored bat (*Permyotis subflavus*) and Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*). Surveys in Lost Cove will continue on a biennial basis.

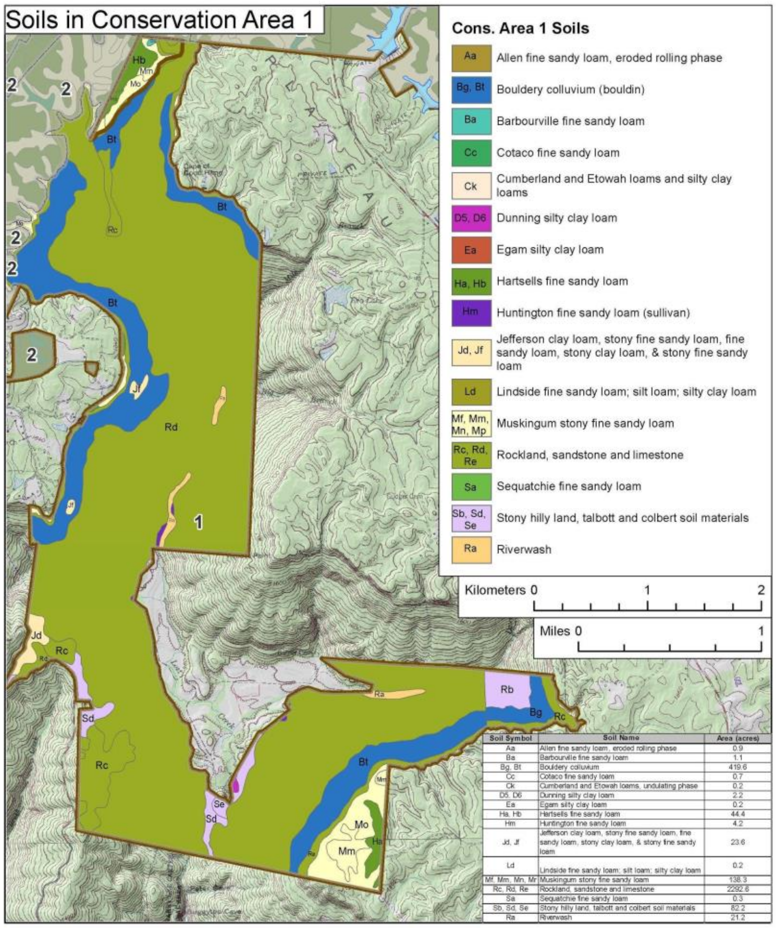
Rare, Threatened, or Endangered Species

Tri-colored bat (*Permyotis subflavus*)
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*)
Yellow-billed cuckoo (*Coccyzus americanus*)

Eastern Wood Pewee (*Contopus virens*)
Eggert's sunflower (*Helianthus eggertii*)
Goldenseal (*Hydrastis canadensis*)
Cumberland Rosinweed (*Silphium brachiatum*)
American Butternut (*Juglans cinerea*)
Alabama Grape Fern (*Sceptridium jenmanii*)
Sharp wedge (*Xolotrema obstrictum*)
Southeastern Cave Pseudoscorpion (*Hesperochernes mirabilis*)
a cave obligate pseudoscorpion (*Kleptochthonius tantalus*)
a cave obligate spider (*Nesticus barri*)
a cave obligate isopod (*Caecidotea bicrenata bicrenata*)
a cave obligate bristletail (*Litocampa valentinei*)
Hirsute Cave Springtail (*Pseudosinella hirsuta*)
Spinose Cave Springtail (*Pseudosinella spinosa*)
Hatch's cave fungus beetle (*Ptomaphagus hatchi*)
Cave dung fly (*Spelobia tenebrarum*)
Russell cave millipede (*Pseudotremia minos*)

Soils

Soils in Lost Cove are dominated by two Natural Resource Conservation Service (NRCS) categories (Figure 17); Rd, limestone rock outcrops and the Talbott soil series (silty clay loams 20-40 inches deep), and Bt which is colluvium of sandstone, limestone and shales on slopes of 12-60%. These latter soils are in the Jefferson/Bouldin series.



Soil Symbol	Soil Name	Area (acres)
Aa	Allen fine sandy loam , eroded rolling phase	0.9
Ba	Barbourville fine sandy loam	1.1
Bg, Bt	Bouldery colluvium	419.6
Cc	Cotaco fine sandy loam	0.7
Ck	Cumberland and Etowah loams, undulating phase	0.2
D5, D6	Dunning silty clay loam	2.2
Ea	Egam silty clay loam	0.2
Ha, Hb	Hartsells fine sandy loam	44.4
Hm	Huntington fine sandy loam	4.2
Jd, Jf	Jefferson clay loam, stony fine sandy loam, fine sandy loam, stony clay loam, & stony fine sandy loam	23.6
Ld	Lindside fine sandy loam; silt loam; silty clay loam	0.2
Mf, Mm, Mn, Mr	Muskingum stony fine sandy loam	138.3
Rc, Rd, Re	Rockland, sandstone and limestone	2292.6
Sa	Sequatchie fine sandy loam	0.3
Sb, Sd, Se	Stony hilly land, talbott and colbert soil materials	82.2
Ra	Riverwash	21.2

Figure 17. Soils of the Conservation Area 1, the area known as Lost Cove, the University of the South, Tennessee.

Water Resources

Depot Branch, Barnes Branch, and several other ephemeral streams drain into Lost Cove Creek. Under Lost Cove Creek, there is a large underground river flowing beneath the surface that rises and falls during wet and dry periods. Lost Cove Creek plays a key role in the surrounding landscape, serving as the main provider of water for the globally imperiled salamanders and mussels that live directly downstream in Crow Creek.

According to Hearon et al. (2003), prominent sinks and springs in the Mississippian Monteagle Limestone on the floor of Lost Cove along Lost Creek were monitored to study the effects of a fluctuating water table. During periods of heavy rain, a rising water table activated ephemeral springs and streams found throughout the floor of Lost Cove. Most of the water ultimately reaches the Big Sink, where it drops 40- m over the next 1.2 km in the Buggytop Cave system and emerges as Crow Creek. Detailed subsurface maps of the Cove have not yet demonstrated that all surface water enters the Buggytop system. Dye tracing in major sinks and springs of a major tributary, Champion Cove, is underway but has already demonstrated there is no direct connection between Prince Spring and the major upstream sink to the northeast (M. Knoll, pers. comm.). Older dye traces on the eastern end of Champion Cove at Temple Sink suggest no direct connection to the Lost Cove, Big Sink, or Buggytop systems.

Cultural Resources

Conservation Area 1 encompasses Compartments 11, 52, 53, 54, 55 and includes the slopes of Lost Cove, Little Cove and the north facing slopes of Champion Cove. The well-known bluff line of the Southern Cumberland Plateau is clearly demarcated in the upper elevations of this area with the resistant Pennsylvanian Age sandstones that mark the upper slopes and create striking overlooks to the valley below. The lower half of the slopes are composed of Mississippian limestones that are well known for karst features such as caves and sinkholes as well as rich agricultural soils in the coves. Few sites are currently listed in the Tennessee State Site Files within Area 1. The University only took ownership of this area in 2010 and only a very small part of the cove has since undergone cultural resource survey. The only area to undergo systematic survey has been the upper eastern slope of Barnes Branch to the Cape of Good Hope, above the confluence of Barnes Branch with Lost Creek, and the western boundary of Compartment 11 above Depot Branch and the unnamed creek immediately south. Within these two sides up the upper part of Lost Cave, there are rockshelters formed both in the lower contact of the Sewanee Conglomerate and in the Warren Point Sandstone formations. In these rockshelters there are prehistoric habitation and rock art sites. The number of sites recorded in this limited survey area indicates the richness of the archaeological record concealed in Lost Cove.

The rockshelters form natural shelters against the bluff out of the elements and with their southern exposure absorb heat in the winter making these focal points on the landscape for prehistoric hunter-gatherers. During their seasonal rounds, following plant and animal resources, small family groups would reside in these shelters for weeks or months at a time (Walthall 1998). The results from three small excavations, two from sites in Area 3 and one in Area 2 indicate that these shelters were used during the fall and spring with a heavy focus on nut crops such as hickory and acorn as early as 9,000 years ago (Carmody and Sherwood 2014; Sherwood et al. 2012). Later in time, when groups began to reside in larger village sites, mostly in the valleys, these sites continued to be used as logistical foraging camps and likely as ritual or pilgrimage sites based on the presence of rock art in the area.

Both open air rock art sites on the bluff and the rockshelter habitation sites are well established as significant cultural resources. The rockshelters are significant because they are areas of early occupation (Early Holocene) and high potential organic artifact preservation. These circumstances make these sites the most endangered sites in the region since they are targeted by illegal looting (Simek et al. 2013a). Rock art sites are also especially significant on the Domain as the Southern Cumberland Plateau has an unusually high concentration for the Eastern Woodlands. Currently there are more than 40 documented sites and this number is growing annually with new discoveries. The Domain is currently known to have at least 5 of these sites from the Southern Cumberland Plateau. It is important to note that this concentration of prehistoric rock art (several are located in or adjacent to Lost Cove), mostly rendered with red pigment in simple anthropomorphic and zoomorphic figures and geometric shapes, has gained national and international attention in both the academic literature and popular media (Simek et al. 2013b, 2018). These rock art sites attest to the role this region likely played in ritual activities that appear to be make the southern Cumberland Plateau unique relative to adjacent physiographic regions and the upper reaches of the Plateau where these open-air cultural resources are rare.

Based on the preliminary results of the controlled excavations noted a short distance to the north in Conservation Areas 2 and 3, similar sites in Lost Cove have a high probability to contain significant intact deposits in rockshelters that span the Holocene, perhaps even into the Pleistocene. There is also a growing interest in the likelihood of small prehistoric garden plots on the mid-slope benches (many of them with limestone bedrock of slightly higher with soils composed of organic slopewash and colluvium). Such sites would be some of the earliest evidence of the process of plant domestication in the Eastern Woodlands (Carmody et al. 2017, Carmody and Sherwood 2014, Windingstad et al. 2008). Every effort should be made to protect these upland sites from further damage and/or salvage intact parts before they are destroyed further by looting. We are currently working to better inform climbers in the area about rock art and its fragility and significance.

In addition to the use of these sites by ancestors of the Native Americans these locales were also used in the 19th and 20th century by the local people for a range of activities including habitation sites, picnic and gathering places (based on historic graffiti), and cool storage. During prohibition local shelters helped hide clandestine moonshining operations. Several moonshine sites have already been recorded in Lost Cove. With reliable freshwater springs below the bluff, abundant firewood, and local corn crops with the added challenge of approaching these sites from the bluff above or the steep slopes from the valley, these were perfect places to produce what at the time was the most lucrative, albeit illegal, cash crops in the region (Ellis 2018, Durand 1956,).

Historically Lost Cove has always been considered a relatively unknown and secluded place, mostly due to the lack of easy road access directly into the cove. Instead of Lost Creek flowing along the Cove opening into a larger river as it moves down the watershed, it flows into the "Big Sink" in the center of Lost Cove. At this point the Creek flows underground for roughly a half mile before it resurges in Buggy Top Cave (Mr and Mrs. Harr Lee Carter Natural Area) and continues down Lost Cove and joins the Crow Creek Valley. The relative isolation within the upper end of Lost Cove, and the absence of modern utilities pushed into the area resulted in those residing in the cove continuing an 18th—19th century lifestyle well into the 20th century. These home sites are now abandoned and the floor of the cove protected by the current landowners. Small family cemeteries (many with unmarked or field stone marked graves) and architectural remnants in the form of stone chimney ruins and stone peer foundations are visible in areas of the cove where the lower slopes and benches meet the rich valley floor. The cove is known to historically flood so living on these slightly elevated terraces would have provided dry, well drained living sites for both historic and prehistoric people. These sites are often adjacent to springs at this elevation or small creeks draining the upland slopes.

Sites like those, currently known and many likely yet to be recorded, are especially significant since they represent an historically "invisible" part of Southern Cumberland Plateau history. And unlike many areas of the Plateau, Lost Cove in particular remains relatively unspoiled by looting. The lives lived in Lost Cove were part of the fabric of the community today and should be sought out and protected just as those belonging to Episcopal bishops. Knowledge about the region's 18th and 19th century Euroamerican, African American and Native American farmers and their related activities (small-scale mining and quarrying, moonshine production, farming, etc.) has the potential to inform early historically unrecorded land use practices as well as social and economic systems that local communities created to manage this changing social and natural landscape.

Recreation

Access to Lost Cove is very limited at this time. Hikers are able to descend into the northern section of the cove via the Ridge Trail. There are currently plans to construct a Lost Cove Camping Station that will provide a location for campers and classroom use that will be accessible via the Ridge Trail or the bottom of the cove. The station is proposed to be constructed and ready for use in 2019. At the bottom of Lost Cove's northern reaches, an old road provides hiking access to the entry road, which is accessible from a gate at the top of the cove off of Sherwood Road. Lost Cove has numerous old logging roads and trails that could easily be opened for further recreational development. Some of these trails could provide connections to both the Carter State Natural Area and Franklin State Forest. There is currently a five year hunting lease on Compartment 55.

Desired Future Condition

When Lost Cove was acquired by the University in 2007, one of the primary ecological justifications for its acquisition was the linkage as a conservation corridor between existing University of the South properties and several iconic state properties: The Carter State Natural

Area, Sewanee Natural Bridge State Natural Area, and Franklin State Forest. Additionally, the recent acquisition of the Gager Mine property to the south of Lost Cove allowing the expansion of the Carter State Natural Area and the Franklin State Forest has added additional significance of Lost Cove as an ecological corridor.

It is difficult to overstate the diversity of habitats within Lost Cove. The 2015 SWAP analysis of this area, lists the cove as mostly Southern Ridge and Valley/ Cumberland Dry Calcareous Forest and South Central Interior Mesophytic Forest. The SWAP lists 11 other ecological systems as present in the cove in lesser amounts, and at least three additional systems have been observed in the cove that have not yet been mapped (J. Evans pers. comm.).

Because almost all of the accessible cove except Compartment 11 has been logged since the 1970's, the majority of the property is in some form of succession. While most areas retain some oak hickory overstory, in most locations, the regeneration following harvest has mostly been yellow poplar (*Liriodendron tulipifera*), sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*). This regeneration represents a slow shift in the species composition. A shift that has the potential to accelerate over time as the residual overstory is removed by mortality or harvest.

No timber harvests are anticipated over the duration of this plan. If it is desired for oak and hickory to play a significant role in the species composition of the cove in the future, some provision for intermediate disturbance should be undertaken several years prior to harvest. Prescribe fire is a management tool that could be employed in a limited replicated manner in this conservation area to evaluate its effects on forest composition change.

Compartment Summaries and Management Recommendations

Compartment 11

Compartment 11 is comprised of approximately 82 acres, located at the northern end of Lost Cove (Figure 16). McKenzie (2011) noted 2-3 harvest entries in this compartment, Carey et al. (2013) found evidence of 1964 and 1966 mixed species harvests, and Brooks and Nunley (2013) recorded a 1955 white oak harvest in Compartment 11. Currently the stand is dense with a basal area in excess of 120 square feet per acre. The stand is comprised of an older age class of large white oak (*Quercus alba*), red oak (*Quercus rubra*), and yellow poplar 24-32 inches in diameter, and a younger cohort of yellow poplar and red maple (*Acer rubrum*), with some black walnut (*Juglans nigra*) and black cherry (*Prunus serotina*). Young regeneration of sugar maple is also present in the understory.

Recommendations:

While there is sufficient value in the older age class and a vigorous younger cohort of timber to release, no harvest is anticipated during the duration of this plan. Recent harvests in Compartments 53 and 10, along with an anticipated harvest in Compartment 10 mean that this stand will serve as an interior forest refuge for species in the area for the duration of this plan. Some prescribed fire to shift understory species composition may be appropriate, and can be considered but is not planned at this time.

Compartment 52

Compartment 52 is comprised of approximately 551 acres and is a primarily west facing slope on the eastern side of Lost Cove. The operable acres in this compartment were cut heavily in 2005. Today the compartment is mostly two aged, with some residual overstory and copious young regeneration from the last harvest. Residual overstory species composition varies with elevation, in lower areas it is primarily American beech, yellow poplar, and black locust (*Robinia pseudoacacia*) and in the upper elevations it consists of more hickory and oak residuals. Throughout the compartment the younger cohort is dominated by yellow poplar and sugar maple. Yellow poplar dominates areas of heavy cutting, while sugar maple dominates areas where there is more shade from residual timber. Young timber is all in the 4-8-inch diameter at breast height (dbh) class, while residuals vary with most in the 12-16 inch dbh. There is some very large diameter American beech scattered throughout the compartment and the Sewanee Herbarium has a report of American butternut (*Juglans cinerea*).

Access to this compartment is limited with no known easements from the top. There are several logging roads throughout the compartment left from the last harvest. Most are stable and could be used for recreational trails.

Recommendations:

Overall this compartment is recovering from the last harvest. Species composition of the regeneration is in line with the South-Central Interior Mesophytic Forest, though the absence of oak and hickory regeneration seems to indicate a shift in species composition is underway. No timber management is anticipated to occur in this compartment for the next 10-15 years. Prior to next anticipated harvest, advance regeneration in the understory should be assessed prior to selecting species composition for removal. At the next entry, residual oaks and hickories left from the 2005 harvest will have the highest value, but their removal may largely eliminate these species from the forest going forward, and any action would need to carefully planned and executed well. Some intermediate disturbance of the understory may encourage regeneration of these species prior to harvest.

Compartment 53

Compartment 53 is an approximately 1,162-acre tract primarily consisting of east facing slopes on the western side of Lost Cove. Known to contain several caves, one of which is known to contain endangered subterranean species. Compartment 53 contains Little Cove, a very steep drainage that was not harvested due to topographic constraints and supports a forest with old-growth characteristics. There are also several steep drainages in the northern part of this compartment that were not operable for the previous harvest and still contain mature forest.

Recommendations:

Outside of the areas mentioned above, most acres have been harvested heavily in the past with the northern sections having most merchantable timber removed in 2005. Species composition of the regeneration is in line with the South-Central Interior Mesophytic Forest though the absence of oak and hickory regeneration seems to indicate a shift in species composition is underway. There is no timber management in this compartment for the next 10-15 years.

Prior to any harvest, advance regeneration in the understory should be assessed prior to selecting species composition for removal. At next entry, residual oaks and hickories left from the 2005 harvest will have the highest value, but their removal may largely eliminate these species from the forest going forward. Some intermediate disturbance of the understory may encourage regeneration of these species prior to harvest.

Compartment 54

Compartment 54 is comprised of approximately 543 acres, of primarily east facing cove forest and appears to have been heavily cut in 1998. The overstory is primarily of white oak and hickory, though there are stands dominated by eastern red cedar (*Juniperus virginiana*) in several lower elevation locations that appear to have characteristics of calcareous glade habitat. The compartment seems to have less sugar maple in the understory than Compartments 52 and 53. In this compartment, the understory contains copious amounts of American beech.

Overall, the overstory seems to be of moderate or poor form and few areas are growing vigorously. This is probably due partially to high-grading during the last harvest and there is likely also an interplay of site quality in this condition. Though the soil data is quite similar for all compartments in the cove, this compartment is likely the driest, particularly on its southern aspects. This stand contains known occurrences of several glade loving early successional rare plants both inside and outside of the Tennessee Valley Authority (TVA) power line right of way.

Recommendations:

This compartment, more than others in the cove, seems to be a prime candidate for prescribed fire management. The species composition of the forest and glade areas seem to indicate a previous fire history. There is also an extensive ridge road running from the saddle down to the cove that could be used as a fire break. Prescribed fire, may be undertaken starting in 2021. Cooperation with adjacent landowners would be necessary in the cove, but preliminary conversations with them seem to indicate a willingness to have further conversations. There are no plans to conduct extensive management in this compartment for the duration of this plan. This compartment would also be the site of any primary recreational access to the Big Sink. This could occur via the road from the saddle, or any one of the numerous roads that traverse the side slopes of this compartment.

Compartment 55

Compartment 55 is approximately 694 acres and is primarily on a north facing slope and dips down into Champion Cove. Approximately 80 acres of this compartment sits on top of the bluff and directly connects to the Smith Tract, which is now part of the Franklin State Forest.

The entire compartment appears to have been harvested selectively in 1998. The plateau area consists of majority white oak, chestnut oak and red oak. Most of the overstory is 6-16 inches dbh and is a combination of regeneration following the 1998 harvest and timber too small or poorly formed to be harvested at that time. There are some large diameter hollow and poorly formed trees in the compartment as well. Regeneration is mostly sugar maple and yellow poplar, as would be expected on this site.

The cove portions of this compartment are the most mesic in Lost Cove. Much of the acreage in this compartment is fully or mostly northern facing slope, and the species composition reflects this. The overstory consists of sugar maple and yellow poplar, with hickory and black walnut in some areas.

The cove is mostly two aged like the top, with a scattered relic older age class and a younger class of timber growing since the last harvest. This site contains one of the Garner family cemeteries on the northern boundary with the Motlow property.

Recommendations:

No timber management is anticipated in this compartment for the duration of this plan. The forest is growing well throughout the tract. There are some roads that are used by the hunt lease that need to be repaired to correct drainage issues. These will be addressed by the leases.

The limits of the cemetery need to be delineated. Ground penetrating radar will likely be needed to accomplish this as there are no readily visible boundaries on the ground.

Section 4. Conservation Area 2

Conservation Area 2 consists of Domain Compartments 2, 4, 6, 8, 10, 12, 14, 70, and the eastern edges of Compartment 0 surrounding the Sewanee/Franklin County Airport airport (Figure 18), and is approximately 2,256 acres.

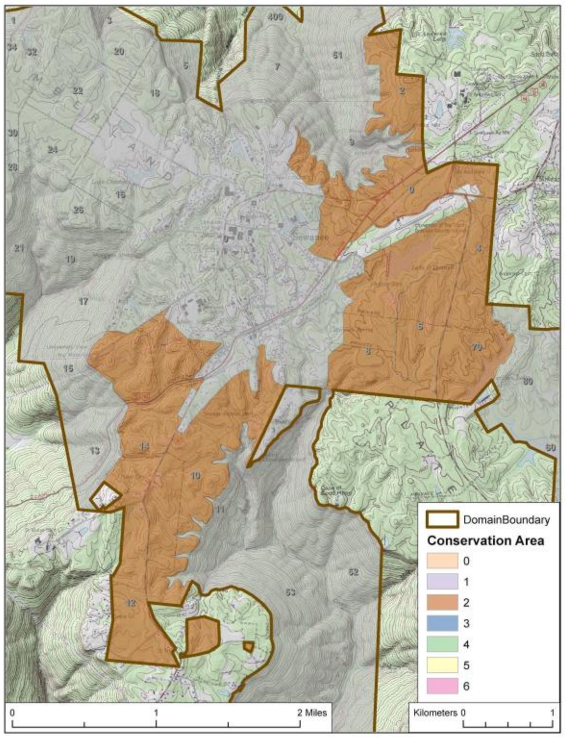


Figure 18. Map of Conservation Area 2, the University of the South, Tennessee.

History and Current Use

In 1886, George Fairbanks wrote that “thousands of unsightly stumps meet our view” and “we have rather impaired than improved the natural beauty of our mountaintop” (Fairbanks 1905). Although we can’t be certain where Mr. Fairbanks was looking when he wrote that comment, he was likely referring to the lands in and around eastern portions of Conservation Area 2 where early harvests for building construction were concentrated. In 1899, Carl Schenck reported that most of the plateau forest was negatively impacted by fire, overgrazing, and unmanaged harvesting (Schenck 1899). In 1903, John Foley reported that Block 5 (Lake O’Donnell and south) was heavily impacted by cutting, grazing, and fire. Foley remarked that intensive cutting took place in the area during the 1870s.

During the early 20th century, harvests occurred across the conservation area and varied widely in intensity from clearcuts to market thinning for a variety of products. Since 2000, there have been 7 hardwood and 5 pine harvests in Conservation Area 2 covering approximately 220 acres. There are currently 4 different areas of Conservation Area 2 where prescribed fires have occurred one or more times over the last decade.

Current Condition of Forest Communities

There are a variety of biological communities represented in Conservation Area 2. Near the airport, we have maintained early successional habitat of both uplands and wetlands. Portions of this area northeast of the runway are maintained by prescribed fire (9 fires in 10 years), while areas directly adjacent to the runway are mown. Conservation Area 2 also contains extensive areas regenerating following a tornado in 2010 in Compartment 8.

Outside of the areas mentioned in the previous paragraph, the majority of Conservation Area 2 is in a closed canopy mixed hardwood forest. White oak and chestnut oak dominate, but where there is a disturbance history, yellow poplar is quite common. Most of the fire lanes were lined with planted white pine.

Rare, Threatened, or Endangered Species

There is a record of elf orpine (*Diamorpha smallii*), state listed as Endangered, adjacent to the Piney Point trail but is found on rock outcrops in other locations. Any proposed projects would avoid exposed outcrops. In Compartment 8, Carolina oatgrass (*Danthonia epilis*) is known to occur on the rock outcrop under the Duck River powerline right of way. Rock outcrops at the top of the bluff may contain other species of interest and should be inventoried.

Soils

Most of Conservation Area 2 lies on top of the plateau and is dominated by the Hartsells series (sandy loams) that are typically 2-4 feet deep (Figure 19). The soils are comprised primarily of Hartsell sandy loams which are taxonomically defined as Hapludults and form the crests of the sandstone uplands. Inceptisols and Ultisols, mapped as Muskingum stony loams and Cotaco fine sandy loams, make up more minor components of side slopes and drainages. Much of this area has likely undergone some level of erosion, agriculture and ground disturbance during timber removal. This erosion is evident in multiple locations of old roads, fields and powerline right-of-ways. Smalley (1982) refers to these areas broadly as undulating sandstone uplands, and the LAL analysis of land-types shows this area to be mostly plateau flats with some ridge and swale and drainage areas (Figure 4).

There are several ephemeral drainages throughout the area (Barbourville and Cotaco series). Although not mapped by NRCS, the soil borrow pit in Compartment 6 is an unusually deep soil (8 feet and greater) that has been used as fill for a variety of campus projects over the past 15 years. This deep soil is rare on the plateau surface and has attracted the attention of the state soil scientist and others who are actively researching the origin of the soil. It is imperative that the remainder of this area be protected because this soil profile has a loess cap (more concentrated than normal for this area), interwoven sequences of horizons of relatively unique, color, texture and mineralogy, and an unusual gravel band near the lithic (bedrock) contact.

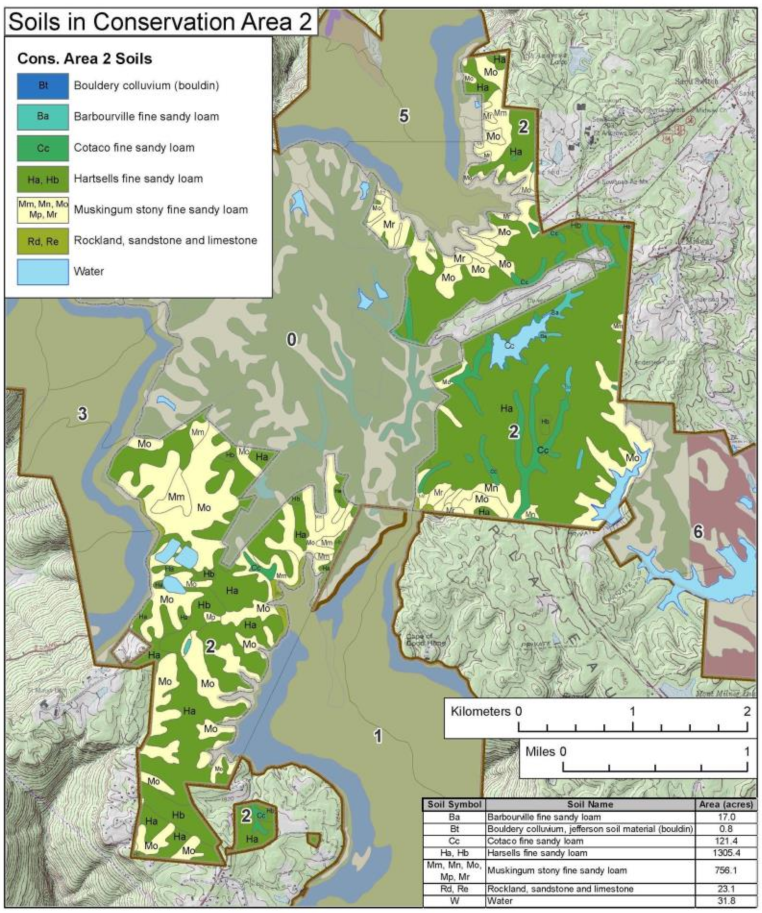


Figure 19. Soils of Conservation Area 2, the University of the South, Tennessee.

Water Resources

Part of Compartments 0 and 6 directly drains into Lake O'Donnell, Sewanee's primary drinking water reservoir. Compartments 70 and 4 drain into Lake Jackson, Sewanee's secondary drinking reservoir. Compartment 6 drains into Lost Cove via Rose Branch, and there are several ephemeral streams and a man-made vernal pool near the old Green Farm. There are several ephemeral streams that flow through all the compartments in Conservation Area 2, and there is a highly visited vernal pool in the eastern portion of Compartment 2. Several large springs occur in this conservation area, including Harrison Spring in Compartment 8 and Big Spring in Compartment 12.

Cultural Resources

Conservation Area 2 spans several different topographic microenvironments across Compartments 1, 4, 6, 8, 10, 12, 14 and 70 and therefore has the potential for different types of both historic and prehistoric sites. Currently there are 34 sites recorded within the Tennessee State Site Files within this area. This number minimally represents the actual archaeological sites present since some known sites have not yet been issued state site numbers and most compartments on the Domain have not undergone systematic archaeological survey, especially upland areas.

Historic sites include a wide range of site types consisting of habitation (farmsteads), historic roads, a section of rail bed, and special purpose sites such as localized coal mining and moonshine stills. Euroamerican, African American and/or Native American small scale farmsteads are recorded in several sectors of this Conservation Area. The Nashville & Chattanooga Railroad's Mountain Goat Spur rail bed is now part of the multiuse Mountain Goat Trail that passes through the center of the University property. This section includes railroad related archaeological habitation sites (small houses built along the line for employees), masonry structures (e.g. retaining walls) and other features that date to the original 1853 construction of the railroad. This section of the railroad carried passengers as well as coal from the mines of the Mountain down to Cowan and beyond. At the time of its construction it was the highest incline in the world for a railroad line (Arbuckle and Shook 1992).

Within Area 2 there is well documented Confederate and Union troop activity, both in the form of encampments and skirmishes associated with the Tullahoma Campaign (O.R., I, 22, pt. 1; Woodworth 1998). These actions are mostly linked to troops under the command of Maj. Gen. William Rosecrans of the Union army and Gen. Braxton Bragg leading the Confederate army. The battle on July 4, 1863 in this area was the last battle of the Middle Tennessee Campaign. It began on July 1, where Sherwood and Cowan Roads crossed in what is the vicinity of the western part of Area 2 in Compartment 14. The battle stretched through "University Place" along the Cowan Road to Old Cowan Road, in the vicinity of current day Saint Mary's and also out Jasper Road toward the Jump Off area (crossing near the east end of Hat Rock Rd and continuing out what is now a portion of Route 156) (O'Connell 2019), both of which pass through Conservation Area 2.

Documented evidence of small farms and hamlets occur in several areas of Conservation Area 2. The mention of the “Green Place” on the 1900 Foley Map suggests that the site was used at least as early as the late 19th century. The Wynn farm (now lease #823 in Compartment 8) was also a very early EuroAmerican farm. There is little known about this period in the region’s history beyond the lives of the University founders. Knowledge about the region’s 18th and 19th century Euroamerican, African American and Native American farmers and their related activities (small-scale mining and quarrying, moonshine production, etc.) has the potential to inform early historically unrecorded land use practices as well as social and economic systems that local communities created to manage this changing social and natural landscape.

Area 2 also integrates Pennsylvanian Age sandstone bluffs where there are documented and undocumented prehistoric rockshelter sites and rock art sites. Higher in the sequence, often above the bluffs in shallow creek drainages are rockshelters formed in the Sewanee Conglomerate. Both of these site types are established as significant cultural resources. The rockshelters are significant because they are areas of early occupation (Early Holocene) and high potential organic artifact preservation. These circumstances make these sites the most endangered sites in the region since they are targeted by illegal looting (Simek et al. 2013a).

The rockshelters form natural shelters out of the elements and become focal points on the landscape for prehistoric hunter-gatherers. During their seasonal rounds, following plant and animal resources, small family groups would reside in these shelters for weeks or months at a time (Walthall 1998). The results from three small excavations, two from sites in Area 3 and one in Area 2 indicate that these shelters were used during the fall and spring with a heavy focus on nut crops such as hickory and acorn as early as 9,000 years ago (Carmody and Sherwood 2014, Sherwood et al. 2012). Later in time, when groups began to reside in larger village sites, mostly in the valleys, these sites continued to be used as logistical foraging camps and likely as ritual or pilgrimage sites based on the presence of rock art in the area.

Rock art sites are especially significant on the Domain as the Southern Cumberland Plateau has an unusually high concentration for the Eastern Woodlands. Currently there are more than 40 site documented sites and this number is growing annually with new discoveries. The Domain is currently known to have at least 5 of these sites from the Southern Cumberland Plateau. It is important to note that this concentration of prehistoric rock art, mostly rendered with red pigment in simple anthropomorphic and zoomorphic figures and geometric shapes, has gained national and international attention in both the academic literature and popular media (Simek et al. 2013b; 2018).

The upper drainage of Rose Branch and its minor tributaries, along with the dissected upland area above Shake Rag Hollow to the north, these areas in particular contain large-scale Sewanee Conglomerate rock shelter sites. These sites have been damaged by illegal looting, evidenced in potholes and spoil piles. In 2003, then archaeological staff employees of the University attempted to stabilize one of these large shelters using heavy landscape cloth and sandbags. These efforts have had only limited success in deterring looting. Based on the preliminary results of controlled excavations in similar sites on the Domain there is a high probability that significant intact deposits remain in these shelters, in spite of the looting, that have the potential to span the last 9,000-10,000 years. Every effort should be made to protect these sites from further damage and/or salvage intact parts of these sites. The Piney Point area in Compartment 2 contains similar rockshelter and rock art sites that are known and integrated into preservation efforts in the controlled burn for shortleaf pine restoration efforts.

In addition to rockshelters, there are upland open-air prehistoric sites known across Conservation Area 2, many of which concentrate near large springs. Historic soil erosion has likely impacted the integrity of some of these sites but artifact scatters that appear on the upland surface above Harrison Spring suggest a large-scale prehistoric site. Those open-air sites that are documented are typically limited to areas of modern ground disturbance such as roads, and early logging where ground disturbance produces artifacts that are easily observed and documented. The unsystematic identification of these sites suggests that there are other such sites across the top of the Plateau, of which we have little knowledge. These sites are significant to our understanding of the land use change through time in relation to climate change and cultural change throughout the Midsouth’s prehistory. And as the rock art attests, the role this region may have played in ritual activities that appear to be make this region unique relative to adjacent physiographic regions and the upper reaches of the Cumberland Plateau.

Recreation

Conservation Area 2 contains several existing recreational assets. The Caldwell Rim and Ridge Trail both originate in Compartment 10 and the Lake Dimmick trail passes through Compartment 8, 6, and 70. Several sections of the perimeter trail pass through parts of Conservation Area 2 near central campus and where the perimeter trail and Mountain Goat Trail co-occur parallel to US 41-A. The Piney Point trail is completely located within Compartment 2, and the Beckwith Point Trail occurs just west of Compartment 2. The fire lanes are also heavily used in all compartments, and there is some unregulated use of off road vehicles (ORVs) in Compartment 12, 14, and 10. Both Lake O’Donnell and Lake Jackson also utilized for fishing and Lake Jackson is becoming a sunning and swimming spot for many students. Compartments 4, 6, 8, 10, 12, 14, and 70 are included in the annual deer hunt.

Desired Future Condition

The overall goal of Conservation Area 2 is to maintain and enhance uplands in an open native oak/hickory/pine mixture, maintain intact riparian areas while increasing the economic value of the standing timber resource. The pre-European settlement condition of this area (as is the case with the rest of the plateau) is unknown, but the landscape position, soils, topography and current condition lend themselves to a management regime designed to move the stand toward the Allegheny-Cumberland Dry Oak Forest and Woodland/South-Appalachian Low Mountain Pine type. Some portions of the area are not far from that trajectory, but could be improved through reduction of the white pine understory, general reduction in stand density, an increasing emphasis on regeneration of the oak components of the stand, and supplemental plantings of desirable species. Compartment 2 has our only significant stand of shortleaf pine (*Pinus echinata*) and work commenced in 2014 to encourage natural regeneration of this species through the use of prescribed fire. The proximity of this stand to campus and paved roads makes it an ideal candidate for demonstration work as it can easily be accessed by vehicle and trail. Several management tools including harvest, prescribed fire, and exotic species elimination can be used to carry out those goals. To the best of our ability, we will eliminate white pine regeneration throughout the conservation area.

Compartment Summaries and Management Recommendations

Compartment 0/6

Compartment 6 was the location of the "Green Place" home and farm, and this clearing is evident on the 1900 Foley map. On the 1950 imagery, this area has very low basal area, and signs of fire are evident in the photo. Harvesting records indicate that there was a dogwood harvest for shuttles and mallets in 1952, a white oak stave harvest in 1955, as well as oak, black gum, hickory, and maple removals in 1956.

The area encompassed by Lake O'Donnell was cleared in 1955, and the Sewanee airport clearing and construction occurred in the early 1960s. An 18-acre tract of forest just to the north of the airport was clear cut in 2011 as part of an effort to improve the flyway at the airport, and this site has been burned annually since 2010. Eastern white pine was planted along fire lanes in 1960s. A small landfill was created sometime in the 1960s just south of the lake. In the late 1990s, a 15 acre clearing was created south of Lake O'Donnell as a borrow pit for campus projects. Five of these acres are currently an open pit.

In the spring of 2004, Domain Management harvested 30 acres south of the old Green Place/firing range. This harvest removed trees of mixed diameters and the site was not burned following the harvest. Eastern white pine saplings were removed across the site. In the fall of 2006, Domain Management conducted a thin from below in the 70 acres due south of Lake O'Donnell. All trees <12" diameter were removed, the fire lane plantings of eastern white pine were removed, and 9 openings of ¼ to 1 acre (some which are burned) were created. This site was monitored on an annual basis from 2006 - 2010, and three of the clearings were burned once.

In January 2010, 15 acres adjacent to Jump Off Road were heavily damaged during an F1 tornado and all the downed trees were removed in May 2010. In the winter of 2013, 35 large-diameter red oak (4,000 board feet) were removed in the same 70-acre management area for campus construction projects.

South of Lake O'Donnell, the forest is two aged with an overstory dominated by oak (basal area 70-80 ft^2/acre). Farther to the south, the forest consists of mixed upland hardwood stands of varying ages and diameters (60-110 ft^2/acre). Occasional and heavy white pine regeneration still exists near the fire lanes. There is approximately 15 acres of mixed hardwood regeneration in the 2010 tornado blowdown. Tree of heaven and Paulownia (*Paulownia tomentosa*) are occasionally found throughout the compartment. The 5-acre area used as a soil borrow pit is in need of restoration.

In Compartment 6, the majority of the mature white pine along the fire lanes has been removed although there are patches of mature white pine in other locations (near the Green Farm).

Recommendations:

We will continue to use fire in three clearings inside the 70-acre management unit to examine fire effects on oak regeneration compared to other hardwood species in planning for USFS research plots and working with collaborators. A harvest is planned in this compartment in 2023 that will focus on removing remaining white pine, creating additional canopy openings in the area harvested in 2006, and using midstory removal in the southern section to promote oak and reduce white pine in the understory. Prescribed fire will also be expanded in the southern portion of this compartment in coordination with the burning in adjacent Compartment 8. The overall goal in Compartment 0/6 is to maintain oak as a dominant presence in the overstory and promote hardwood woodland habitat.

Compartment 2

Compartment 2 became part of the Domain in 1903 (Jones tract), thus it is not mentioned in early Domain reports or plans. A review of photos from 1950 indicated that very little harvesting activity took place in this compartment post-1950, and personnel at St. Andrews-Sewanee believe much of this compartment was once part of a pasture. There are stumps in the compartment, so trees were removed at some point in the past. This compartment is best known for Piney Point, and its associated hiking trail. Piney Point overlook on the western edge of the compartment provides one of the best views of Shakerag Hollow. In 2011, the forest restoration class established 3 controlled burn experimental areas. These areas were burned 2011 and 2014. In the Spring of 2018, all these small burn units were combined into one 45-acre unit and burned together.

Shortleaf pine is relatively abundant in Compartment 2 and is associated with a variety of understory species. Some of these plant associations are rare on the Domain. Although widespread in the overstory, shortleaf pine regeneration is very infrequent. Chestnut oak (*Quercus prinus*) is abundant and much of the compartment contains a variety of age classes and diameters of upland mixed hardwoods, sometimes in association with shortleaf pine. There are a small number of mature and juvenile white pine and loblolly pine dispersed throughout the compartment. Multiple classes visit this area each semester to look at rare plants on Sewanee conglomerate outcrops as well as a vernal pool.

In Compartment 2, the long-term maintenance of the shortleaf pine associations will be a priority.

Recommendations:

A harvest is planned in this compartment for approximately 75 acres north of Piney Point beyond the 5 year planning timeframe. The purpose of the harvest is to thin the existing stand and create gap openings to encourage regeneration of the existing shortleaf pine overstory and actively plant additional acreage to shortleaf pine while maintaining a mixed oak woodland. Prior to and following harvest, prescribed fire will be used to reduce the duff layer and create more favorable oak and pine regeneration conditions. Prescribed fire will be utilized on an annual basis with a 3 year return interval starting with burns in 2021. This trajectory will lower standing basal area, maintain the mixed oak pine species composition already present from previous land use, and incorporate prescribed fire and thinning to create a heterogeneous stand density condition.

Compartment 4

This compartment is part of the original Sewanee Mining Company tract given to the University in 1858. Though its history is long, its record of active management is scarce. According to the records we have, Compartment 4 had a single marked harvest in 1956. The volumes removed were not clear. Like many compartments along the outer edges of the Domain, Compartment 4 is covered in old roads and pathways that were used to access adjacent off-Domain properties and historic harvest records are lacking which may be due to persistent harvest for personal use by persons living adjacent to the stand. Today these access points are limited to Afton Lane and Laurel Brae Drive which are both active dead end roads crossing the compartment for access to adjacent lands.

Compartment 4 represents a typical maturing plateau upland oak-hickory forest. Current stocking is approximately 100 square feet per acre with an overstory dominated by white oak, red oak, hickory and yellow poplar. Some areas of the stand were affected by a tornado in 2010 which created several openings. There are two primary age classes in the overstory, an older cohort of poorly formed red and white oak passed over at last harvest, and a younger cohort recruited after that harvest. The midstory contains some species common to the overstory, but red maple, sourwood, and black gum are more common. One section just north of Afton Lane appears to have been planted to white pine and contains a white pine component in both the overstory and understory. There appears to be very little oak or hickory regeneration in the understory.

In areas where white pine is present, the understory is dense with seedlings, in other areas, red maple is dominant in the understory.

Recommendations:

To ameliorate this lack of desirable regeneration, it is recommended that the white pine overstory be removed where applicable (this would be an in-house operation of no more than 50 trees and could be utilized as wood for a sustainable locally sourced project) and one to three understory fires prior to any hardwood harvest be undertaken over the next 10 years, the intention of the fires would be to increase oak seedling recruitment to replace declining red oak overstory components.

Compartment 8

Compartment 8 lies just east of Hatrock Road and runs south from the Lake O'Donnell dam to the southern boundary of the University near CanTex road. The compartment has been part of the Domain since 1860, with the southern section being part of the original Sewanee Mining Company land grant, and the northern portion transferred to the University by the Shappard family in 1860.

Though the land use history for this section will likely remain incomplete, the first mention of this stand is in the 1903 Management Plan. The plan lists this stand as having been logged first in 1870 for sawlogs, with the lumber used to build university buildings (Foley 1903). Prior to 1903 it appears a second harvest in this area removed trees suitable for crossties. The 1903 plan lists this area as part of Block V and lists its current condition as "badly burned and grazed every year" with "improvement cuttings needed throughout the block".

The 1953 management plan map includes this area as "cutover plateau forest" indicating that its volume was still considered insufficient or subpar. Timber sales during this time period indicate that there was some volume present and cuttings are listed as "improvement harvests". Species harvested included dogwood, maple, gum, hickory, and oak staves.

In 1958, the USFS began using Compartment 8 in plantation research (USFS Study 2.3). Eastern white pine (*Pinus strobus*), loblolly pine (*Pinus taeda*), shortleaf pine (*Pinus echinata*), Virginia pine (*Pinus virginiana*), Scotch pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), Austrian pine (*Pinus nigra*) and yellow poplar (*Liriodendron tulipifera*) were planted in replicated ¼ acre plots in many areas. This study continued through the 1980s and included thinning of many of the stands. In January 2010, a tornado affected this compartment damaging approximately 14 acres of timber. Much of the timber affected by the tornado consisted of old Forest Service plantations and some hardwoods. This blowdown was mostly harvested in 2011, though wet weather conditions forced the sale to conclude before all volume was removed. Eleven acres were harvested, and an additional 7 acres were thinned to remove white pine encroachment. All remaining Eastern white pine, Virginia pine, Scotch pine, Norway spruce and Austrian pine was also removed. In 2011, shortleaf pine seedlings were planted in two sections of the tornado blowdown.

Adjacent to the blowdown, a forest restoration project was initiated in 2013, with a thinning of hardwoods and planted pine that was followed by three fires from 2013 - 2016. As part of this restoration project, an experimental planting of the northern subspecies of longleaf pine (*Pinus palustris montane*) was planted in a small section of Compartment 8. Several hundred shortleaf pines were also planted in a part of the area affected by the 2010 tornado in 2013 and 2014. This site is currently monitored for oak regeneration and deer browse.

Adjacent to this research is, another research project is located nearby that is investigating the use of fire and hand thinning to control white pine regeneration. In 2013, several small openings were created, and white oak from these patch cuts was used for flooring in the Sewanee Inn. The project created 12 openings in the compartment to study tree regeneration and resprouting dynamics of white oak.

This compartment also contains several firelanes used for recreation. The Lake Dimmick trail is routed along one of these firelanes. It is likely that a loop trail into Lost Cove, once constructed, could terminate in this compartment by tying into existing firelanes.

Recommendations:

Compartment 8 has seen three harvests over the last decade. These harvests have set the stage for a management regime involving mostly prescribed fire over the next 10 years. The compartment has been broken into several burn units, and the goal of this compartment will be to use fire annually through some portion of (with approximately 5 year return interval) the stand to promote recent shortleaf and longleaf pine plantings, increase native grass and forb components in thinned areas, and promote current young regeneration into the overstory allowing for additional canopy removals after year 10. Some site specific removal of white pine in this compartment may be appropriate in the next 10 years.

Compartment 10

The US Forest Service conducted many experiments in Compartment 10 and many of these have had a lasting legacy on the compartment. Experiments varied from small mammal seed dispersion studies, to large scale pine planting growth and yield studies. Though much of the pine was partially harvested in 2002 during the pine beetle outbreak (30 acres) and again in 2004 during a mixed diameter thinning, several areas of mature loblolly and shortleaf pine remain in this compartment. An F-1 tornado passed through the compartment at the end of the 2004 harvest, and most of the blowdown was salvaged.

In this compartment, one study of particular interest was USFS study 20.1 (1958) which was a replicated demonstration titled "Management of Small Forest Properties on the Cumberland Plateau." This study consisted of various treatment options for rehabilitating degraded plateau stands that included improvement cuttings and pine conversion. The exact location of these sites within the compartment are not known at this time, but should be located if possible for reinventory.

A recent inventory of the site (2017) indicated that basal area in the compartment ranges from 90 - 100 ft^2/acre. Outside of the residual plantations, the overstory is dominated by white and chestnut oaks with a lesser component of hickory and red maple. Some yellow poplar is present in the stand, but much of the poplar has crown damage and mortality assumed to be associated with droughts of the past 10 years.

In the summer of 2018, a harvest to remove white pine from the southern portion of the central firelane in the compartment removed approximately 93,000 board feet of lumber. Though the majority of this was white pine (65,000 feet), approximately 15,000 feet of damaged yellow poplar was also removed from directly adjacent to the firelane. Market limitations limited the amount of white pine that could be merchandised in a single sale. Approximately 50,000 board feet of white pine remain on the northern portion of the central firelane. These remaining pines will be removed in 2019 or 2020 depending on market conditions.

Recommendations:

Beyond the firelane thinning, this stand contains sufficient quality overstory volume to support an intermediate harvest that retains a quality sawlog residual, however the 2018 harvest has opened portions of the canopy, and additional firelane removals will do the same in 2019. These openings will creates enough stand heterogeneity that no further harvests are planned in this unit in the next 5 years. This compartment does contain ample trails and fire lanes for use as firebreaks and white pine seedlings are dense in many areas of the compartment. Two to three fires over the next 5 years focused on areas with highest white pine seedling density should occur to reduce pine density and shift understory regeneration composition toward oaks and fire resistant pines.

Compartment 12

Compartment 12 became part of the Domain in 1859. It is part of "Block V" in the 1903 management plan and is described then as being badly burned and grazed. Prior to the creation of Garnertown Road in the 1950s, Compartment 12 was used to access private property on the plateau west of the Domain. For this reason, it is covered with many old roads going both east to west, and north to south. Many of these roads are deeply eroded into the soil structure and are very obvious on the ground today. Many of those old roads are used by All Terrain Vehicles (ATV's) on a regular basis. Most of the compartment seems to have been grazed at least informally by the surrounding landowners. There is evidence of at least one open field that was associated with a now abandoned leasehold. Forest records indicate there was an oak stave harvest in the 1950s, and an oak saw log harvest in 1971. Plantings of loblolly pine were also installed in southern portions of Compartment 12 in the early 1960s. An F1 tornado blew through this compartment in 2004, and it also damaged trees in Compartments 10 and 11. University Forestry Professor Karen Kuers led a study to document the direction and extent of the blowdown in Compartment 12.

Compartment 12 today consists of four distinct stands. All are dominated by red and white oak in the overstory, with yellow poplar and pine interspersed. According to a 2016 inventory, this compartment has a basal area of 112 ft^2/acre, and 146 trees per acre > 4.5 inch dbh. There are 98 oak trees per acre (> 5 inch dbh), 32 oak saplings per acre (1-4.5 inch dbh), and 6,100 oak seedlings per acre in this stand as well. The 37 acres south of Garnertown Road has an overstory consisting mainly of red oak, white oak and yellow poplar. The red oak in the overstory is of poor quality and was likely left after the last harvest in 1971. Much of the white oak and yellow poplar is much younger and was likely released following that harvest. The site contains two drains that become part of the headwaters of Tally's Fork, and is more mesic than surrounding areas.

The 85 acres surrounded by Garnertown Road has much less declining red oak in the overstory than the southern section. Its overstory consists more of white oak, with some loblolly pine and yellow poplar interspersed. Some shortleaf pine is also present in the northern part of this area. This area contains at least one old homesite, an old field, and several dumps.

North of Garnertown road is a 69-acre tract consisting of a red and white oak overstory. Overstory age on much of this area is younger than the rest of the compartment indicating that it may have been harvested more heavily in the 1971 harvest. Aerial photos from the late 1960s show this portion of the compartment more heavily forested, meaning there was likely more volume to remove in 1971.

The fourth section of Compartment 12 consists of 35 acres north of Rattlesnake Springs Road. This is a portion of the McDowell tract purchased by the University for development in 1947. Most of this tract was sold as lots along what is now Rattlesnake Springs Road, but these 35 acres were withheld from the initial sale because of the presence of the large spring on the property that was used for municipal water. When the University moved to surface water collection for drinking water, plans were drawn up to dam the spring and create a large lake on the property to increase its value for residential development, but the lake was never built.

Perhaps because if its differing ownership history and designation for development, this area of Compartment 12 does not appear to have been harvested for timber in many decades. It is largely mesic bottomland with an impressive overstory of mature oak and hickory. One of the largest shortleaf pine known to the Domain is in the uplands of this area.

Recommendations:

The central section of Compartment 12 is well suited from site aspect, quality, and the current stand, to the creation of a more open woodland structure. There is sufficient volume present to support a pulpwood based harvest with limited sawtimber removal to open the canopy in anticipation of reintroduction of prescribed fire. Because the central portion of the stand is ringed by paved road, and broken up by historic roads throughout, it is well positioned for prescribed fire. A harvest based on midstory removal and limited marked sawtimber removal is anticipated in 2021. At this time, a portion of the red oak in the south part of Compartment 12 may be removed as well to improve the value of the residual stand. There is currently heavy trespass via ATV users in this compartment. No prescribed fire is anticipated in this southern section due to topographic constraints, but there is ample yellow poplar in the stand to fill gaps created through red oak removal. The northern section of Compartment 12 is growing well and no harvest is anticipated over the next 10 years.

The 35 acres surrounding the big spring represents a unique assemblage of mature upland and mesic plateau forest. Because of its unique character it should be preserved as an observation location for mature upland habitat. Some removal of exotic species and trash is appropriate for this location. Due to the value of the spring and its unique character the area has been designated as a High Conservation Value Forest (Appendix E, Figure 28).

Compartment 14

Compartment 14 is also a part of the original grant from the Sewanee Mining company in 1857. This compartment's proximity to the village, historic railroad line, and main highways has led to a long history of management, most of which was incidental and without good record. We have record of two white oak stave harvests in this compartment in the 1950s, a saw log oak harvest in 1971, and pulpwood harvests in the 1980s. The forest service installed at least two pine growth studies in the late 1950's that may have been associated with other harvests.

The stand is comprised of two stands, one south of US 41-A and one north of US 41-A. The stand south of US 41-A was transferred to the Sewanee Utility District (SUD) in the 1980s and is not currently under University control. The utility district does occasionally conduct thinnings and harvests in the forest spray fields and in the event the utility district ceases to exist, this property may revert back to the University.

Recommendations:

The northern portion of this compartment consists of 200 acres north of US 41-A and south of Tennessee Avenue. In the Domain 2020 plan, the northern area was identified as either dedicated conservation or single family residential development and as a result, no management recommendations have been created for this area. However, there are forest service plantations and ample white oak volumes to support active management.

Compartment 70

Compartment 70 is made up of properties acquired in 1860 from the Shappard family and then much more recent properties acquired from the Jackson family in the 1960s and 70s. The older western portions have a site history similar to Compartments 4 and 8, while the newer sections have no historic harvest records associated with them. The newer sections are all adjacent to and include Lake Jackson. The family gave the property with the intention that it be developed into low density residential properties around the lake so no inventory data has been found from that time. Compartment 70 is currently referred to as the chipper site because of an intensive study of woody biomass installed in the late 1970s (Kuers 2002).

The 37-acre study area was harvested in 1976 by shearing and in-woods chipping (a new process at the time) as part of a US Forest Service study on inexpensive land management options for small private landowners on the Cumberland Plateau (McGee 1980). Prior to harvest, the stand consisted primarily of culls and low quality hardwood stems. The dominant overstory species were white oak (*Quercus alba*) and scarlet oak (*Quercus coccinea*). The harvest removed a total of 1,200 tons of chips and 30 tie or sawlogs from the entire 37 acres. All stems $\geq$ 4 in dbh were removed from the site during the shearing.

After harvest, twenty-four 1-acre plots were established and 6 plots were randomly selected for each of the following: planting loblolly pine, eastern white pine, yellowpoplar, and natural regeneration. Trees were planted at an 8 x 10 ft spacing. In three plots of each treatment, residual stems up to 4 in dbh and over 4.5 ft tall were injected with herbicide during the winter after harvest. A central 0.25-acre measurement subplot was established in each plot. Six years after planting, half of each white pine plot was cleaned by manually or chemically removing only those trees essential to release the overtopped white pines.

This study was remeasured in 1994, and portions of the natural regeneration and loblolly pine sections were measured again in 2014. Basal area densities are in excess of 100 square feet per acre, and some density dependent mortality is occurring in both the white and yellow pine plantations.

Outside of this study area, no management has occurred since 1976. Current stocking is approximately 100 square feet per acre with an overstory dominated by white oak, red oak, hickory and yellow poplar. There are two primary age classes in the overstory, an older cohort of poorly formed red and white oak passed over at last harvest, and a younger cohort recruited after that harvest.

Recommendations:

While some management may be appropriate in this compartment in the next several years. The unique history and documentation of the chipper site means that any harvest should be coupled with a research objective to carry the research plots forward. There are no plans for harvest in the chipper research site at this time.

Section 5. Conservation Area 3

Conservation Area 3 consists of mostly south facing cove habitat and includes Compartments 13, 15, 17, 19, 21, 23, 25, 27, 29, and 31, is approximately 1,729 acres in size (Figure 20).

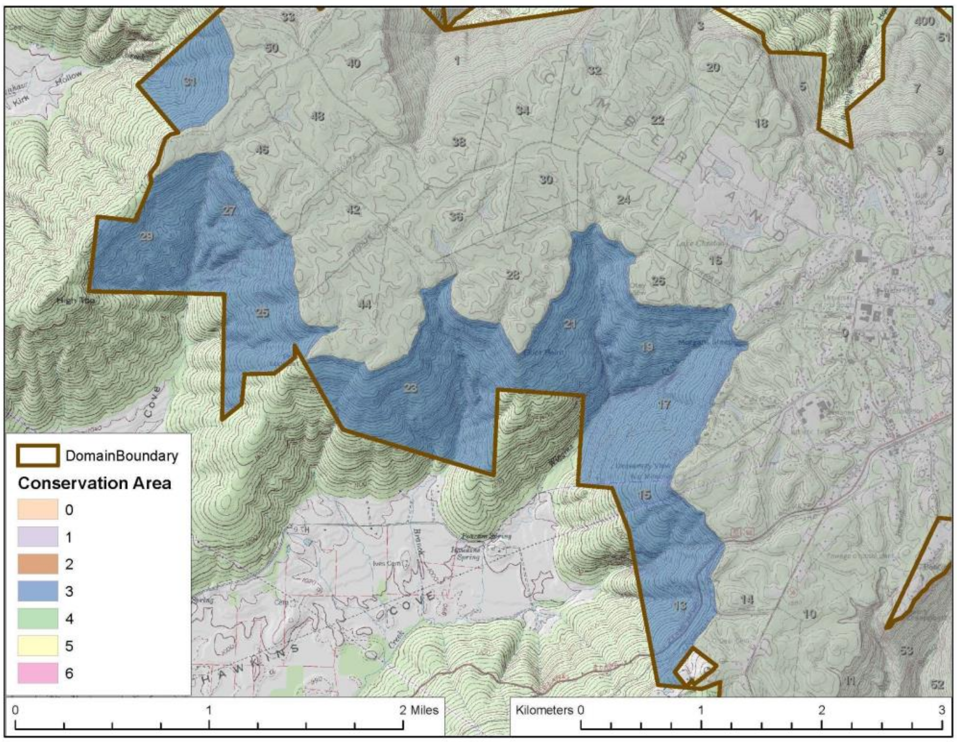


Figure 20. Map of the Domain's Conservation Area 3, the University of the South, Tennessee. Conservation Area 3 consists of south facing cove habitat.

History and Current Use

According to McKenzie (2011), Compartment 23 and Compartments 17, 19, and 21 were the most frequently harvested compartments on the Domain from 1945 to present. He documented 10 separate harvesting events in these compartments over this time. In separate work, Brooks and Nunley (2013) noted that some of these entries were very limited in what was removed, and that some harvests stretched across multiple compartments, so understanding exactly what was removed and the intensity of removals is difficult to interpret in some cases. McKenzie estimated that the northern reaches of Compartment 23 had high levels of biomass removed during this 60- year period. This may be partially due to a forest service experiment initiated in that area which involved a total clearcut of 68 acres near Kirby Smith Branch (Kuers 2006). White ash (*Fraxinus americana*) and hickory (*Carya* spp.) were frequently targeted in all of these compartments in the 1950s (Brooks and Nunley 2013). There are numerous cedar stumps throughout Compartments 25 and 27. Local lore is that a portable cedar sawmill was set up in the valley below these compartments in the 1960s and likely was the source of these stumps.

Compartments 13 and 15 were also subject to multiple entries in the 1950s (McKenzie estimates 6-7), and Brooks and Nunley (2013) found that white ash, hickory and white oak (*Quercus alba*) were removed at that time. Carey et al. (2013) and also found evidence of a yellow poplar (*Liriodendron tulipifera*) sale in Compartment 13 in 1961.

Compartments 25, 27 and 29 seemed to be treated as one management unit in past times, and McKenzie (2011) estimated 4-7 entries in these compartments. Brooks and Nunley (2013) found that white ash was targeted in the 1950s, and Carey et al. (2013) found that there were mixed hardwood harvests throughout the 1960s.

Compartment 31 was not part of the Domain until the 1960s. We do not have any record of timber harvesting in this unit, but 1968 aerial imagery shows a harvest just after University acquisition. Charles Cheston completed a record wildfire November 1952 on this part of the Domain, covering 2,400 acres.

Current Condition of Forest Communities

In general, Conservation Area 3 contains the majority of the University's south facing slopes. Though the SWAP ecological systems mapping puts most of this in the Southern Ridge and Valley/Cumberland Dry Calcareous Forest, there are extensive areas particularly in the lower elevations that may be better classified as Southern Ridge and Valley Calcareous Glades and Woodlands or Central Interior Highlands Calcareous Glades and Barrens. These areas contain a sparse canopy of eastern red cedar (*Juniperus virginiana*), and green ash (*Fraxinus pennsylvanica*), and contain numerous grasses and forbs in the understory. Several rare plants are found within this system including *Clematis morfieldii* and *Lonicera dionica*.

As the elevations increase in this area, there is a general increase in productivity of the site. A 2013 inventory of the upper benches of Compartments 19, 23, and 29 found basal areas ranging from 126 - 136 ft2/acre with the majority of stems in the 4 - 12-inch diameter classes (Mayer 2013). Oak and hickory were predominate in all three stands. The 2016 inventory of Compartment 31 found volumes ranging from 6800-7500 board feet/acre, and that oak and hickory dominated the overstory (Butler et al. 2016).

This portion of the Domain is noteworthy for the extent and diversity of karst. There are numerous caves in this compartment, with several containing SGCNs. This area also contains substantial limestone bluffs and outcroppings, many with SGCNs.

Rare, Threatened, or Endangered Species

Morefield's Leather-Flower (*Clematis morefieldii*)
Mountain Honeysuckle (*Lonicera dioica*)
American Ginseng (*Panax quinquefolius*)
Little Brown Bat (*Myotis lucifugus*)
Tri-colored Bat (*Perimyotis subflavus*)
Southeastern Cave Pseudoscorpion (*Hesperochernes mirabilis*)
a cave obligate pseudoscorpion (*Kleptochthonius tantalus*)
a cave obligate spider (*Nesticus barri*)
Subterranean sheet-web spider (*Phanetta subterranea*)
Hatch's cave fungus beetle (*Ptomaphagus hatchi)*

Soils

Soils in Conservation Area Three are dominated by NRCS categories Rd and Rc, which are limestone derived, steep to rolling, with a high percentage of exposed rock. Much of this is classified in the Talbott soil series (Figure 21). At the base of the bluff, Bt, or sandstone boulder colluvium, is common.

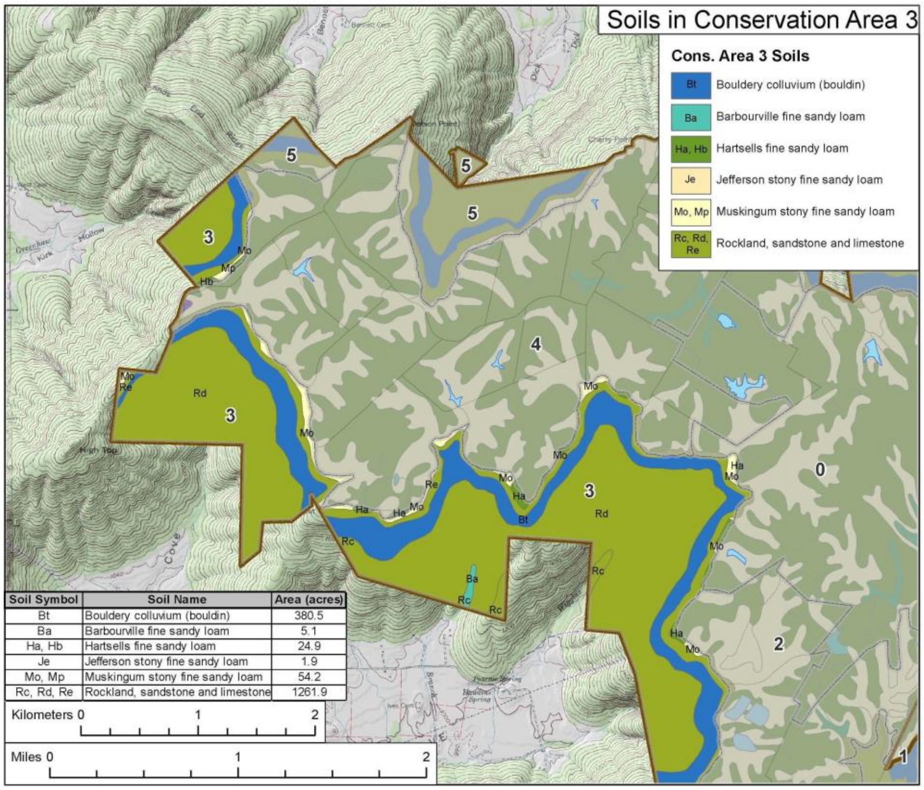


Figure 21. Soils of Conservation Area 3, the University of the South, Tennessee.

Water Resources

Conservation Area 3 serves as the headwaters for Wagner Creek and Boiling Fork Creek which both flow into the Elk River. Most headwater creeks in this conservation area become perennial in the lower elevations, though many are subterranean in portions of the karst layers.

Cultural Resources

Conservation Area 3 spans the south and east facing slopes of the western extent of the Domain across Compartments 13, 15, 17, 19, 21, 23, 25, 27, 29 and 31. The bluff line throughout the Southern Cumberland Plateau is well known for the resistant Pennsylvanian Age sandstones that mark the upper slopes and create striking overlooks to the valley below. Currently there are over 55 sites recorded within the Tennessee State Site Files within Area 3, over half of which are rockshelter sites, mostly in the Warren Point Sandstone. This number minimally represents the actual sites present since some known sites have not yet been issued state site numbers and most compartments on the Domain have not undergone systematic archaeological survey.

While other areas on the University Domain have a wide range of site types this distinctly steep topography is limited to rockshelters, used by historic Euroamerican, African American and/or Native Americans and historic roads that connect the top of the Plateau to the different valleys and coves below. Compartment 13 at the southeastern limit of Area 3 retains a section of the Nashville & Chattanooga Railroad's Mountain Goat Spur rail bed that is now part of the multiuse Mountain Goat Trail that passes through the center of the University property. This section includes railroad related archaeological habitation sites (small houses built along the line for employees), masonry structures (e.g. retaining walls) and other features that date to the original 1853 construction of the railroad. This section of the railroad carried passengers as well as coal from the mines of the Mountain down to Cowan and beyond. At the time of its construction it was the highest incline in the world for a railroad line (Arbuckle and Shook 1992).

The rockshelters form natural shelters against the bluff out of the elements and with their southern exposure absorb heat in the winter making these focal points on the landscape for prehistoric hunter-gatherers. During their seasonal rounds, following plant and animal resources, small family groups would reside in these shelters for weeks or months at a time (Walthall 1998). The results from three small excavations, two from sites in Area 3 and one in Area 2 indicate that these shelters were used during the fall and spring with a heavy focus on nut crops such as hickory and acorn as early as 9,000 years ago (Carmody and Sherwood 2014; Sherwood et al. 2012). Later in time, when groups began to reside in larger village sites, mostly in the valleys, these sites continued to be used as logistical foraging camps and likely as ritual or pilgrimage sites based on the presence of rock art in the area.

Both open air rock art sites on the bluff and the rockshelter habitation sites are well established as significant cultural resources. The rockshelters are significant because they are areas of early occupation (Early Holocene) and high potential organic artifact preservation. These circumstances make these sites the most endangered sites in the region since they are targeted by illegal looting (Simek et al. 2013a). Rock art sites are also especially significant on the Domain as the Southern Cumberland Plateau has an unusually high concentration for the Eastern Woodlands. Currently there are more than 40 documented sites and this number is growing annually with new discoveries. The Domain is currently known to have at least 5 of these sites from the Southern Cumberland Plateau. It is important to note that this concentration of prehistoric rock art, mostly rendered with red pigment in simple anthropomorphic and zoomorphic figures and geometric shapes, has gained national and international attention in both the academic literature and popular media (Simek et al. 2013b, 2018). These rock art sites attest to the role this region likely played in ritual activities that appear to be make the southern Cumberland Plateau unique relative to adjacent physiographic regions and the upper reaches of the Plateau where these open-air cultural resources are rare.

Based on the preliminary results of the controlled excavations noted above, similar sites on the Domain have a high probability that significant intact deposits remain in these shelters, in spite of the looting, that have the potential to span the Holocene, perhaps even into the Pleistocene. There is also a growing interest in the likelihood of small prehistoric garden plots on the mid-slope benches (many of them with limestone bedrock of slightly higher with soils composed of organic slopewash and colluvium). Such sites would be some of the earliest evidence of the process of plant domestication in the Eastern Woodlands (Carmody and Sherwood 2014, Carmody et al. 2017, Windingstad et al. 2008). Every effort should be made to protect these upland sites from further damage and/or salvage intact parts before they are destroyed further by looting. We are currently working to better inform climbers in the area about rock art and its fragility and significance. One such place in Area 3 is particularly important where rock art is along the margins of the Big Chalybeate climbing wall, used frequently by students, visitors and the Sewanee Outing Program (SOP).

In addition to the use of these sites by ancestors of the Native Americans these locales were also used in the 19th and 20th century by the local people for a range of activities including habitation sites, picnic and gathering places (based on historic graffiti), and cool storage. During Prohibition local shelters helped hide clandestine moonshining operations. With reliable freshwater springs along the bluff, abundant firewood, and local corn crops with the added challenge of approaching these sites from the bluff above or the steep slopes from the valley, these were perfect places to produce what at the time was the most lucrative, albeit illegal, cash crops in the region (Ellis 2018, Durand 1956).

Further downslope into the Mississippian Age limestones, especially in Compartments 29, 27, 23, and 17, there are chert quarrying areas recorded and limestone caves with evidence of human occupation near the entrance. None of the known caves or pits in this area has been systematically surveyed for cultural resources. Since there is a well-documented rich record in the Southern Cumberland Plateau and the adjacent Eastern Highland Rim of ancestors of the Native Americans venturing into caves for resource collection (e.g. chert, gypsum, mirabilite, etc.), ritual activities or exploration in general (Dye 2008, Carstens and Watson 1996) Today, those entering the caves either for recreation or research should be mindful of the potential for fragile traces of use (e.g. stoke marks, art, etc.).

Recreation

Conservation Area 3 is heavily used for focused recreation. Almost all of the developed climbing and bouldering areas on the Domain occur within Conservation Area 3, but the sum total of used area comprises only about 4% of the total area, spread out over 5 compartments, similarly this area contains one of the longest stretches of the perimeter trail below the bluff. The trail traverses the northern portions of Compartments 25, 27, and 29 in a 1.4-mile stretch between King Farm and the old Cheek Farm. Additionally, there are several caves used by the

Sewanee Outing Program near Bridal Veil Falls, and a portion of the old Mountain Goat Trail line is located in Compartments 13 and 14.

Desired Future Condition

Conservation Area 3 contains the majority of southern aspect slopes of the Domain. The southern aspect tends to make these forests drier than other cove areas and the forest composition and growth does and should reflect this. Much of this area should be maintained as representative Southern Ridge and Valley Dry Calcareous Forests, Woodlands and Glades. Like many similar areas throughout the region, much of this compartment is recovering from prior harvests, and changing due to absence of fire. Good infrastructure exists in the form of bench roads to continue active management outside of the glade areas, while protecting the ecosystem services of this area. Management within the glade areas should encourage continuation of the woodland and glade habitats, and the rare species that occur there, many of which are disturbance dependent.

Exceptions to this desired future condition are the more northern mesic portions of this area in Compartments 17 and 31 where desired future condition will more closely match that of Conservation Area 5.

Compartment Summaries and Management Recommendations

Compartment 13

Compartment 13, a southwestern facing cove forest, has experienced 6-7 harvest entries according to McKenzie (2011). Brooks and Nunley (2013) found evidence of several 1950s harvests for white oak (*Quercus alba*), white ash and hickory (*Carya* spp.). Carey et al. (2013) found contracts for a 1961 harvest for yellow-poplar.

The current stand is two aged comprised of yellow poplar, sugar maple, and ash. White oak and chestnut oak are dominant in some areas. The interspersed residuals from the last harvest are 16-24 inches in diameter, while the majority of the basal area is comprised of regrowth from the last harvest that is 8-14 inches in diameter.

This compartment is bisected by US 41-A and the old Mountain Goat Railroad. Both of these travel corridors have impacted the resource by adding large amounts of trash and exotic species. *Paulownia tomentosa* and *Ailanthus altissima* are both present in the compartment and there are deposits of trash and tires both along the highway and the railroad. There is also a wrecked tractor trailer downslope from 41-A that has been there since the 1980s.

Recommendations:

No timber management is planned in this compartment for the duration of this plan. Exotic species control and trash removal should be attempted, but will be limited due to the height of the trees and their proximity to the highway. Future timber management should only be contemplated when exotic species are under control.

Compartments 15 and 17

Compartments 15 and 17 are part of what was considered Block one in the 1903 management plan, and were both part of compartment 11 prior to 1970. In the 1903 plan, these compartments were considered well stocked and some of the first for harvest after plan completion. The 1903 plan called for a series of bench roads for harvest, which were installed and remain open to hikers today. Both compartments are southwestern facing cove and have experienced 8-9 harvest entries since 1950 (McKenzie 2011). Brooks and Nunley (2013) found contracts for white oak, white ash and hickory throughout the 1950s. No records were found with evidence of harvesting after the 1950s in this compartment, but it is clear on the ground that harvests have occurred more recently. Former University professor Henry Smith wrote his Ph.D. thesis based on a yellow poplar seed source provenance study done in these compartments. That study, and associated patch clearcuts, were installed between 1962 and 1964. The 1962 aerial image shows heavy harvesting in this compartment as well.

Both stands are two aged and were selectively harvested in the 1960s. The overstory is dominated by yellow poplar, white oak and hickory, while the midstory is composed primarily of sugar maple.

There is more than enough volume in the overstory to sustain a timber harvest. Diameter distributions in the older cohort range between 16 and 30 inches dbh, however there is little regeneration of the overstory species. Any intermediate harvest of this older cohort is likely to shift the species composition sharply toward sugar maple. For some compartments in Conservation Area 3, recommendations included intermediate disturbance to promote oak regeneration prior to harvest, but for both these compartments the die may be already cast on this shift away from oak toward sugar maple. Both contain significant midstory of sugar maple in the 8-12 inch dbh. Corings indicate that the maple is growing well, with some intermediate crown class individuals adding an inch in diameter growth every 5 years.

Recommendations:

No timber management is recommended during the scope of this plan, but it is recommended that the logging roads built after the 1903 plan, be reconnected to US 41-A so that emergency access below the bluff can be achieved. There is a historic developed spring in Compartment 15 that should be protected during any road work and harvest.

Compartment 19

Compartment 19 is a southwest facing cove which has experienced 10 or more harvest entries since 1950 (McKenzie 2011). Brooks and Nunley (2013) found contracts for a 1950 ash harvest, a 1951 ash and hickory harvest, a 1952 white ash and hickory harvest, and a 1956 and 1959 white oak and yellow poplar harvest. Carey et al. (2013) recorded a 1966 hickory harvest in this compartment as well.

The productivity in this compartment is highly variable and correlated with elevation. The lower elevation areas are still recovering from the last harvest with basal areas range from 70-90 square feet per acre. Upper elevation areas have a current stocking of 110-130 square feet of basal area per acre and could sustain an intermediate harvest focused on yellow poplar and residual white oak and hickory, but like other compartments in this conservation area, any harvest at this time would financially necessitate removal of much of the remaining oak and hickory in the stand and remove that seed source from the compartment.

Recommendations:

No timber management is recommended in this compartment during the timeframe of this plan. Though removals are financially feasible in the upper elevation, the rest of the compartment should be allowed to mature so that any entry can preserve a portion of the oak hickory component in the stand.

From a recreational standpoint, it is recommended that a developed campsite be considered in the vicinity of Bridal Veil Falls. There is evidence of camping in this location and a developed camping spot would provide a mid-slope opportunity for camping that is currently missing from the Domain.

Compartment 21

Compartment 21 is largely a southeast facing cove, and McKenzie (2011) recorded 8-9 entries since 1950. Brooks and Nunley (2013) reported contracts for a 1951 ash and hickory harvest, a 1952 white ash and hickory harvest, and a 1956 and 1959 white oak and yellow poplar harvest. Carey et al. (2013) noted a 1966 hickory harvest as well.

Today the compartment is largely even aged and is dominated by white and red oaks. Basal area is in the 120-140 square feet per acre range. There is little regeneration of any species in the understory and evidence of heavy deer browse.

Recommendations:

No timber management is recommended in this compartment at this time. There is ample volume to support a commercial harvest, but access is limited and unless deer browse is controlled prior to harvest, there will be little advance regeneration to maintain oak presence in the next rotation.

Compartment 23

Compartment 23 is a large south facing cove that has experienced 8-9 harvest entries (McKenzie 2011). Brooks and Nunley (2103) reported contracts for a 1951 ash and hickory harvest, a 1952 white ash and hickory harvest, and a reported 1953-54 pine harvest that was likely a red cedar harvest. Carey et al. (2013) found evidence of a 1961 and 1966 hickory harvest. Most recently, harvests in this compartment have been clearcuts focused on the upper benches where the timber is most productive. The largest of these is a 68 acre clearcut on both sides of Kirby Smith Branch cut in 1978 as part of a USFS research project, that was subsequently taken over by the University of the South (Kuers 2006). This clearcut was inventoried intensively prior to harvest, and at years 5,10, and 18 year's post-harvest.

Based partially on the early results of the 1978 cut, two other clearcuts were done in this compartment in 1982, encompassing most of the first and second benches in this compartment. Today these cuts contain an overstory of mostly yellow poplar, along with hickories, sugar maple (*Acer saccharum*) and chestnut oak (*Quercus montana*).

Recommendations:

The majority of the upland portions of Compartment 23 were clearcut in 1978 and 1982, there is insufficient volume for carrying out commercial silvicultural harvests in most of this area. Merchantable timber in the upper benches is distributed throughout the compartment, but removal of this timber would complete the species composition shift currently underway by removing the remaining oak and hickory seed source.

Further down slope the same basic condition exists, with little merchantable timber, though the cause is more site productivity related than harvest history. The cedar glades in this area generally support an early successional forb suite that is rare in the area. Active management should be limited to promotion of these species and could include fire and harvest, but neither are contemplated during the scope of this plan in this area.

Compartments 25, 27 and 29

Compartments 25, 27, and 29 are summarized together because their history, current condition, and ecological prescriptions are all largely the same. Prior to 1971 these compartments were combined as Compartment 4. The area is largely a south and southwest facing cove and McKenzie recorded 6-7 harvest entries in the eastern portion of the compartments and 4-5 entries in the western half. Brooks and Nunley (2013) reported an ash harvest in 1950, an ash and hickory harvest in 1951 and 1952, an oak and black gum harvest in 1953, and a mixed hardwood harvest in 1955. Carey et al. (2013) found records of mixed harvests in 1961 and 1969.

The forest is mostly dry Southern Ridge and Valley Dry Calcareous Woodlands and Glades, with denser forest only in the highest elevation locations near the bluff. The majority of the historic logging removals appear to have occurred in these more productive forest areas near the bluff. The harvest of 1969 was focused in this area, and a harvest summary from 1954 indicates that over 300,000 board feet of timber were removed, but no red cedars were harvested indicating that the harvest likely stayed out of the cedar rich low elevations. The woodland and glade areas have a much lower forest density and appear to have historically supported less timber volume. Evidence of harvest in these areas appears to be concentrated on cedar removals.

In the most productive upper slopes, the forest is two aged following the last harvest with and overstory of red oak, yellow poplar, white oak and sugar maple. The older cohort are remnants of the 1969 harvest and are between 16-22 inches in diameter. The younger age class is white oak, hickory, sugar maple and yellow poplar 6-12 inches in diameter.

These most productive portions of the Southern Ridge and Valley dry calcareous forests are where commercial timber harvests have been concentrated since European settlement. Future harvests would likely be concentrated here as well. No harvest is anticipated in these compartments over the next 10 years. Though sufficient volume is present, much of this is in the older age classes that contain the majority of the oak remaining in the system. Though intermediate harvest would benefit several SGCN plants present, the values in the forest would force removal of the majority of remaining oaks, removing seed source for the future. Commercial harvest should be postponed until sufficient volume accrues in the younger age class so that a portion of the older oaks

Much of the rest of this area is in woodland and degraded glade condition. In Compartment 29, the limestone glade types run from the base of the mountain all the way over the saddle near high point. The overstory species are ash and cedar on top, shifting to sugar maple as elevations decrease below. In the glade and woodland areas, the productivity increases as elevation decreases, with white oak and red oak at lower elevations mixing with the cedar, ash and sugar maple.

The understory in many areas (particularly west and south) still contains some grasses and forbes. Though no harvest has occurred in many decades, the poor site quality has maintained a sparse overstory. Overstory diameters are 12-20 inches, thought the actual tree density per acre is fairly low, below 80 square feet per acre. The last harvest entry appears to have favored cedar removal. In the western portion of the stand, cedars were found felled and limbed that had never been removed. In areas of Compartment 25 there are many areas of dense cedar stumps under a sparse overstory of red oak, cedar, ash, and sugar maple. Most cedar stumps show charring from previous fire.

Recommendations:

The only management needed to maintain the majority of this compartment is fire, and its remoteness and relative inaccessibility makes prescribed fire difficult. There are numerous creeks throughout the area that could be used as firebreaks, but discontinuous fuels and topography would make fire difficult. Any wildfire in this area should be monitored but not suppressed. Logistically simpler than fire would be to selectively remove small areas of overstory from certain areas and monitor for vegetation change. Individual tree removal to increase light infiltration to Morefield's Leather-Flower (*Clematis morefieldii*) has been recommended (T. Crabtree pers. comm.). Any management of this nature should be associated with a specific research and monitoring protocol. Portions of Compartments 27 and 29 have been designated as High Conservation Value Forests (Appendix F, Figure 28).

Compartment 31

Compartment 31 is a western facing cove forest, and there are no harvest records for this compartment since its acquisition in the early 1960s, but historical aerial imagery shows a removal between 1963 and 1968. As previously mentioned, there was a 1952 wildfire in this compartment and adjacent compartments (Carey et al. 2013). A recent cruise of this compartment found that volumes ranged from 6800-7500 board feet/acre with an average diameter of more than 16 inches. The dominant species in the compartment is hickory, which makes up almost 20% of the basal area, followed by red oak, white oak, and chestnut oak. Ash makes up about 10% of the overstory. The understory in the stand is predominantly sugar maple, with limited hickory and ash in some areas.

This predominance of sugar maple in the understory is striking. Butler et al (2016) found more than 225 stems per acre of sugar maple in the understory, with all other species of regeneration found at less than 25 stems per acre. Of the current dominant overstory species, only hickory was found in quantities greater than 5 stems per acre.

The composition of the compartment is shifting strongly toward sugar maple. There is little light in the understory to support other species. Though hickory is classified as moderately shade tolerant, sugar maple seedlings outnumber 5 to one. In order to regenerate any of the species currently in the overstory, some manipulation of the overstory is necessary.

Recommendations:

This compartment is one of the more uniformly productive in this conservation area. Though harvested in the 1960s, it is fully stocked with large diameter sawtimber. This large diameter timber provides ample value to undertake limited silvicultural activities to influence species composition while maintaining a largely intact forest canopy.

The next entry in this stand should be timed with the spread of the Emerald Ash Borer. While it has been found in Franklin County, there are no known records yet on the Domain. A limited harvest removing predominantly ash and some limited oak and hickory would provide for some stimulation of regeneration in the understory while preserving much of the large diameter timber in the stand. Depending on spread of the ash borer, this entry might occur in 2024 or beyond. Any entry should remove no more than 25% of the total basal area to protect the ecological characteristics of the compartment and to prevent explosive growth of wild grape which could smother reproduction. If a harvest were to occur in this compartment a research project utilizing the Karst BMPs (Appendix E) partnering with TNC would be implemented.

Section 6. Conservation Area 4

Conservation Area 4 consists of all the compartments on top of the plateau that are adjacent to the graveled portion of Breakfield Road, and consists of Domain Compartments 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50 (Figure 22). This Conservation Area is approximately 2,312 acres.

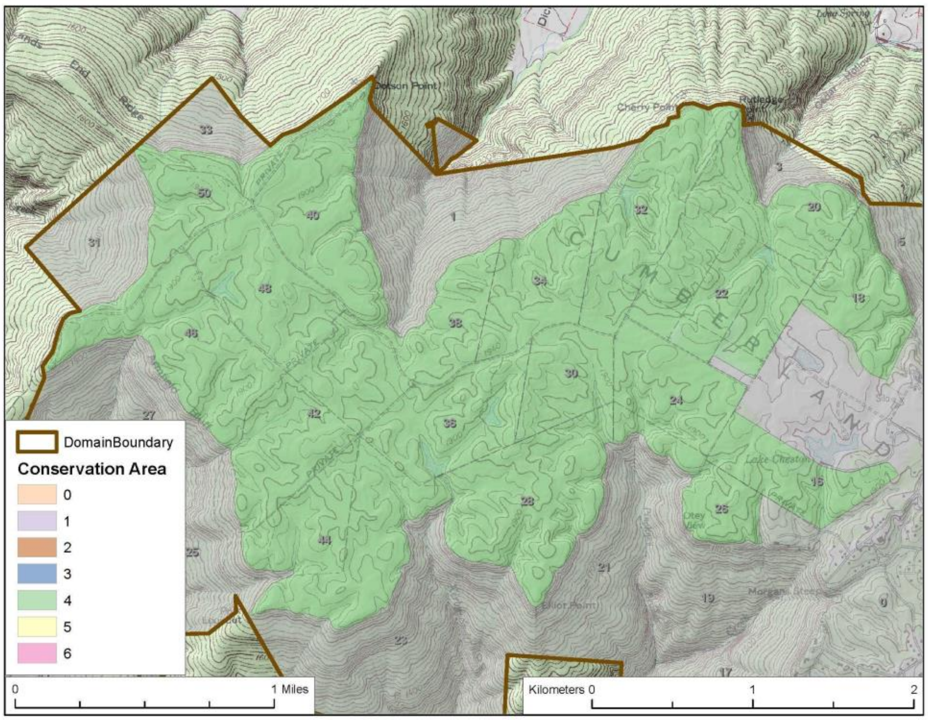


Figure 22. Conservation Area 4 consists of all the compartments on top of the plateau that are adjacent to the graveled portion of Breakfield Road.

History and Current Use

Conservation Area 4 was known as Blocks III and IV in the 1903 plan, as well as approximately 400 acres of plateau land that was acquired by the University between 1930 and 1960. This plan indicates that Block IV (nearest to central campus) was heavily cut over, grazed, and burned and that much of the 1500 cords of wood consumed annually at that time was cut from this area. In contrast the 1903 plan indicates that Block III had been comparatively less grazed and still contained some timber. No records have been found regarding the condition of the 400 acres added after the 1903 plan, but it is known to have contained a small settlement around 1900 with several farms. (see Cultural Resources below) There was a sawmill set up in what is now Compartment 40 in 1917 and there is also evidence of extensive quarrying in this same compartment. University Blocks III and IV also had homes and small farms scattered throughout, with known residences in Compartments 20, 22, and 44. The origins and details of many of these residents is being explored by various faculty, and remains a point of historical interest.

Much of the agricultural use of Conservation Area 4 continued into the 1940s and 1950s. The Cheek and King farms, located in what is now known as Compartments 50 and 44. King Farm was still actively farmed until it was abandoned in 1946 (Block 2013). The Cheek Farm, was still actively farmed until its abandonment in the late 1950s. Much of compartments 18, 20, 22, 24, and 32 were either pasture or grazed as part of the University Farm until the pastures were abandoned or planted in pine and other species in the 1960s. Both the King and Cheek farms were planted in pine after agriculture ceased. Since 1950, a series of harvests have occurred throughout this conservation area, and the details are included below. In addition, there are at least 7 quarries that dot the landscape in Conservation Area 4.

Current Condition of Forest Communities

The majority of Conservation Area 4 is in a closed canopy mixed hardwood forest. White oak and chestnut oak dominate, but where there is a disturbance history, yellow poplar is quite common. There are also yellow and white pine plantations remaining in portions of several compartments, though the plantation acreage in this conservation area has been significantly reduced by timber harvests since 2000. Beginning in 2010, 5 harvests have been carried out in this compartment with the goal of removing planted pines and restoring a mixed pine savannah system to the landscape. In these areas, basal area has been reduced and a series of prescribed fire has created early and mid-successional habitats. Most of the fire lanes have been lined with planted white pine.

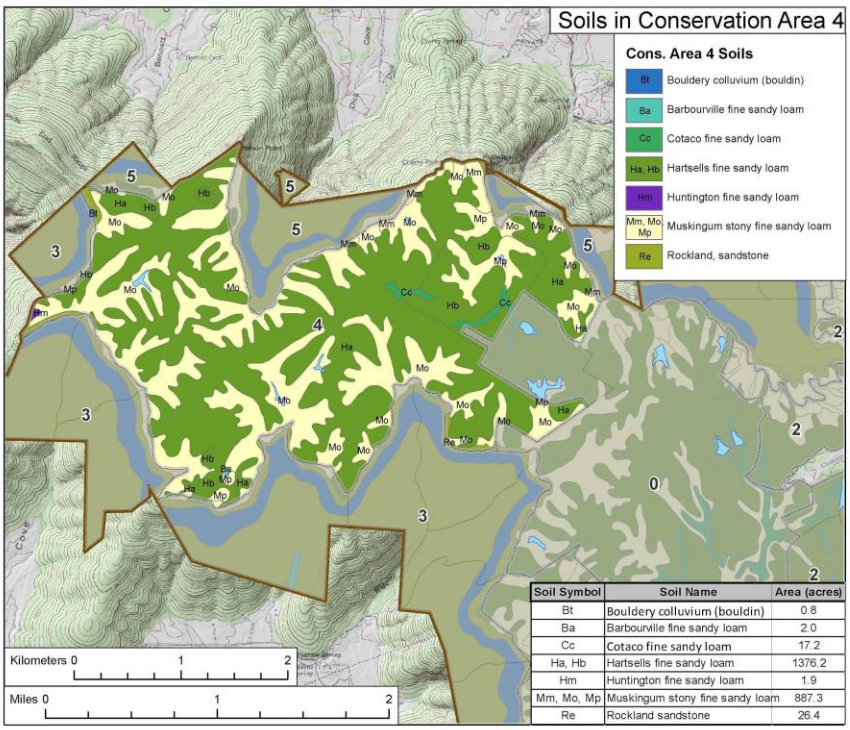
Rare, Threatened, or Endangered Species

Compartment 46 has a known occurrence of Soft bush pea (*Thermopsis mollis*), near the bluff edge. This species, rare on the Domain, is common to open woodlands and clearings. The desired future condition and recent activities in this compartment are consistent with conservation of this species, as it is a facultative seral species with intermediate shade tolerance. As well as recorded bat species, including: Little Brown Bat (*Myotis lucifugus*),
Tri-colored Bat (*Perimyotis subflavus*), Southeastern Bat (*Myotis austroriparius)* (), Gray Bat

(Myotis grisescens), Eastern Small-footed bat (*Myotis leibii*) (, Little Brown Bat (*Myotis lucifugus*), and Indiana Bat (*Myotis sodalist*).

Soils

Conservation Area 4 is dominated by soils in the Hartsell and Muskingum soil series which are well drained sandy loams of variable depth (Figure 23). In addition, there are multiple sandstone outcrops and very thin soils adjacent to the bluff. This conservation area has undergone extensive historic use (road travel, coal mining, habitation sites, farming) and likely has experienced high levels of soil erosion since the mid-19th century.



Soil Symbol	Soil Name	Area (acres)
Bt	Bouldery colluvium (bouldin)	0.8
Ba	Barbourville fine sandy loam	2.0
Cc	Cotaco fine sandy loam	17.2
Ha, Hb	Hartsells fine sandy loam	1376.2
Hm	Huntington fine sandy loam	1.9
Mm, Mo, Mp	Muskingum stony fine sandy loam	887.3
Re	Rockland sandstone	26.4

Figure 23. Soil map for Conservation Area 4 which is dominated by the Hartsell and Muskingum soil series, the University of the South, Tennessee.

Water Resources

Conservation Area 4 contains several reservoirs (Lake Audubon, Brushy Lake, Cedar Hollow Lake, Chestnut Lake, water tank in Compartment 46), natural ephemeral ponds (Compartment 48), and anthropogenic ephemeral ponds (drainages blocked by roads). In addition, there are multiple ephemeral streams with headwaters in this area, and the drainage flowing into Cedar

Hollow Lake is active most of the year.

Cultural Resources

Conservation Area 4 extends across the top of the Plateau on the western extent of the Domain integrating Compartments 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 43, 44, 46, 48, and 50. The area has the potential for open-air prehistoric sites (no rockshelters or cave) and historic sites dating to the 19th and 20th centuries. Currently there are 104 sites recorded within the Tennessee State Site Files within this area. This number minimally represents the actual archaeological sites present since this area has not undergone systematic archaeological survey. The majority of the sites recorded are based on artifacts scatters observed in disturbed and eroded areas associated with roads.

Historic sites include a wide range of site types consisting of habitation (farmsteads), a mission church and a school, historic roads, localized evidence for coal mining where it was belayed up from the mines to the top of the plateau where is was loaded and transported by horse and wagon. There are also small sandstone quarries across this area of the Plateau. Euroamerican, African American and/or Native American small scale farmsteads are recorded in several sectors of this Conservation Area. Breakfield Road, now barely a single lane gravel track that connects to Tennessee Avenue just beyond the Wiggins Creek neighborhood in the vicinity of the Equestrian Center was once a main road connecting Cowan (and towns and cities beyond to the Plateau). Now the road "T"s into two unnamed roads that follow the ridges to the north and south near the headwaters of Miller Creek, Greenhaw Creek and Dick Creek. Historic treks would have continued in these north-south directions but the road also continued straight and west, off the University property across the narrow Lands End Ridge ultimately joining what is today Greenhaw Road in the valley.

Since the early 19th century the "Stage Coach Road" was an important route since it was the shortest way across the plateau, connecting towns like Cowan and Winchester to Chattanooga, in addition to University Place and Tracy City. The road also passed through what might be called a community of sorts from the head of Thumping Dick Hollow to the west-northwest to the "end" of Breakfield Road. In this area small family owned farms were dispersed as well as a school house, and a mission church called Saint John in the Wilderness (see below). Confederate and Union troops both crossed the "Cumberland Mountains" using this road. There are well documented Confederate and Union troop activity, both in the form of encampments and skirmishes associated with the Tullahoma Campaign (O.R., I, 22, pt. 1; Woodworth 1998) in the area. These actions are mostly linked to troops under the command of Maj. Gen. William Rosecrans of the Union army and Gen. Braxton Bragg leading the Confederate army. The battle on July 4, 1863 in this area was the last battle of the Middle Tennessee Campaign. It began on July 1, where Sherwood and Cowan Roads crossed in what is now in the vicinity of the western part of Area 2 in Compartment 14. The battle stretched through "University Place" along the Cowan Road and the Stage Coach Road (O'Connell 2019).

Documented evidence of small farms and hamlets occur in several areas of Conservation Area 4. They appear to concentrate in three areas. At the end of Breakfield there were several known historic sites (as noted above) associated with Compartment 50 and the western portions of Compartments 40, 48, and 46. Past "Five Points", east of Polk Lookout in Compartment 44, and north of Cedar Hollow Lake in Compartment 20. We assume all were early Euroamerican farms but this is purely an assumption. In light of the fact that this upland area has not been systematically surveyed it is highly likely that other similar historic habitation sites are located elsewhere in Area 4.

Within Compartment 20, beyond Cedar Hollow Lake on either side of the Cedar Hollow Creek where it trends off the Mountain, there are numerous drift mines marking the north slope below Rutledge Point. Along the northern margins of Compartment 20, with approximately 50+ m of the bluff edge, there are several historic habitation sites. The assumption is that these sites are linked with the Drift Mine operation but it is also possible that they date to an earlier time period. Currently this remains a working hypothesis since preliminary archival work does not reveal any landowners directly linked to houses in this area causing us to speculate that these occupants were either renters or squatters. In 2013 Sherwood directed two small scale excavations on the Cedar Hollow Overlook Site (40FR608) and The Cook Site (40FR607) in Compartment 20. These were part of a student capstone project completed by Mason Niquette (Niquette et al. 2014). The Cedar Hollow Overlook Site was located on the edge of the bluff, overlapping the current Perimeter Trial. Artifacts were collected from only one small excavation unit that appeared to intersect a midden that contained various domestic and architectural debris including clothing artifacts related to both women and children. The artifact assemblage dates to the late 1860s through the 1870s.

The Cook Site produced evidence of a structure with a carved masonry fireplace pad filled with charcoal and wood ash (no coal or slag was recovered). The artifacts (various ceramics, glass, architectural pieces, etc.) support an occupation dating to the 1880s to 1910. Among the stones lying on the surface of the site is an apparent gravestone. This is a piece of local unshaped sandstone, crudely hand carved that reads "Sal Cook, Ded 1888". The stone does not appear to be related directly to a grave suggesting it may have been moved from its original place, by someone clearing the area that did not recognize it as such, or perhaps it was abandoned as insufficient since the carving appears to be incomplete. Early maps relating to the University Farm show a house in this vicinity suggesting that while there could have been earlier use of the site that the majority of the occupation debris are from the start of the 20th century.

In Compartment 44, the King Farm, past Five Points, lies above the south bluff. This area has been studied from different perspectives within the University including the forest succession, impact by deer browse, remote sensing and test excavations. The first known use of the area is

1825 when the area was cleared for agriculture. By the turn of the 20th century the land was being used to raise hogs and was further cleared. The farm expanded in the 1930s when it was a mixed use operation with pasture, row crops, a home site with associated farm buildings (Block et al. 2016, Block 2013;). At least four other house sites are known within about a 300- m radius. Two of these have undergone limited archaeological testing but little is known of who owned or occupied them. All four of these sites have local stone masonry fireplaces and chimneys. In the case of 40FR Snake Cabin, the house which would have overlooked Stage Coach Road which continued down into Miller Cove, had 2 large chimney pads far enough apart to suggest at the very least two single pin cabins with a dog trot in between. There is also the potential that the structure was not log but frame and could have been significantly larger (two story). Even less is known about this site and the other cabin sites nearby, to the east along the bluff. By the mid-century farming was abandoned in the area and pine plantations established.

Historic sites like those described here are significant since they represent an historically “invisible” part of the Sewanee community. Based on the masonry fireplace at 40FR607 it is clear these were not mere shacks for seasonal cattle herding as has been suggested. Further the grave stone recovered on the site, while it does not appear to mark a grave, is an important reminder that there were people living their lives in this area, completely separate of the growing community at University Place and its high profile occupants. Their lives also helped created the fabric of the community today and should be sought out and protected just as those belonging to Episcopal bishops. Knowledge about the region’s 18th and 19th century Euroamerican, African American and Native American farmers and their related activities (small-scale mining and quarrying, moonshine production, etc.) has the potential to inform early historically unrecorded land use practices as well as social and economic systems that local communities created to manage this changing social and natural landscape.

Recreation

Conservation Area 4 is one of the most highly used recreational areas on the Domain. The Perimeter Trail and fire lanes in this area are used daily by hikers, runners, mountain bikers, and horse riders. Breakfield Road provides easy access to the whole area, and contributes to the heavy use. Other recreational amenities include 7 developed camping sites including the Forestry Cabin, a reservation only rustic cabin open to students, faculty and alumni and traditional rock climbing areas along the margins of this conservation area near Armfield Bluff and King’s Farm. Additionally, the annual deer hunt utilizes multiple compartments in this area.

Desired Future Conditions

The overall goal of Conservation Area 4 is similar to Area 2, to maintain and enhance uplands in an open native oak/hickory/pine mixture, maintain intact riparian areas and increase the economic value of the standing timber resource. The landscape position, soils, topography and current condition lend themselves to a management regime to move the stand toward the Allegheny-Cumberland Dry Oak Forest and Woodland/South-Appalachian Low Mountain Pine type. Some portions of the compartment are not far from that trajectory, but could be improved through reduction of the white pine understory, general reduction in stand density, an increasing emphasis on regeneration of the oak components of the stand, and supplemental plantings of desirable species. The proximity of this stand to campus and paved roads makes it an ideal candidate for demonstration work as it can easily be accessed by vehicle and trail.

Several management tools including harvest, prescribed fire, and exotic species elimination can be used to carry out these goals. To the best of our ability, we intend to eliminate white pine regeneration throughout the conservation area.

Compartment Summaries and Management Recommendations

Compartment 16

According to McKenzie (2011), there have been 2-5 harvest in Compartment 16 since 1950. Carey et al. (2013) noted a 1950s sawmill harvest and the 1984 Mead thinnings. In 1984, mixed hardwood species in the pulpwood size class were removed in anticipation of development. That development, known as Wiggin's Creek, occurred throughout the 1990s and 2000s in the form of a residential subdivision. Because this compartment is mostly residential at this time, no compartment specific recommendations are included in this plan. Some forested areas on the margins of Compartment 16 may be included in management of adjacent compartments.

Compartment 18

McKenzie (2011) indicated 2 harvests since the 1950s, and Carey et al. (2013) found records of a sawmill harvest in the early 1950s and a 1986 harvest as well (Mead thinnings for pulp). Compartment 18's proximity to central campus means that it likely was the source for much community firewood during the early days of the Domain. It was part of Foley's 1903 Block IV, and he mentioned that both the plateau and coves had been heavily logged in this area. He also mentioned this block as a source of firewood for the town. In 1953, the management plan referred to this area as "cutover." The 1944 and 1950 aerial imagery shows very low amounts of tree canopy in parts of the compartment, though most of Compartment 18 is outside of what was then the farm. Today the eastern portion of the compartment is dominated by mature oak (basal area 100-120 ft^2/acre), and has a midstory of oak, gum, and sweetgum. The western portion was partially harvested in 1986 so the overstory has more yellow poplar and smaller diameter oak. Deer have largely decimated the understory. This compartment is favored for deer hunting and it appears it may be used by some of the more suburban herds as a refuge from the community. Browse remains intense even after many years of hunting. Adjacent to the farm and horse pasture, there is a large population of oriental bittersweet, bush honeysuckle, Chinese privet and kudzu growing into the forest.

Recommendations:

From a timber management standpoint, there is little to see here. The mature oak in the eastern section has value, but the midstory appears to be older suppressed stems that will not respond to release. Because of the severe deer browse, there is little desirable advanced regeneration in the understory so any harvest in the near term is likely to be detrimental to the long term viability of the stand for oak. The western portion of the stand has some density dependent mortality underway, with a combination of trees recruited after the 1986 harvest, and small diameter stems left at that time.

As resources become available, the western portion of the stand could benefit from low intensity prescribed fire. Fire in this area would further likely eliminate a portion of the midstory already stressed by a lack of light, and reset the understory vegetation. The remaining oak overstory is unlikely to respond to the reduced competition with growth, but would provide mast and an aesthetically pleasing woodland stand close to both the perimeter trail and the water tower trail. If sufficient oak regeneration is present after 2 or more fires in the next 10 years, it may be appropriate to remove a portion of the overstory.

Compartment 20

Compartment 20 has been heavily used and developed since the University's founding, and perhaps prior to the founding as well. On the Hopkins map (1860), two wagon roads are shown traversing this compartment towards Croom's Bluff (Figure 8). These roads led to coal mines located below Compartment 20 in Compartment 3 that supplied the University for many years. In Carl Schenck's 1899 report to Vice Chancellor Wiggins, he mentioned that this part of the Domain was heavily used for firewood (Schenck 1899). Compartment 20 is part of Foley's 1900 Block IV, and he mentioned that both the plateau and coves had been heavily logged in this area. He also mentioned this block as a source of firewood for the town. Foley's map displayed a lease and a house that corresponds with our current "Cook site" research area (Smith et al. 2019). During this study that examined soil legacies, the authors found numerous historical and prehistoric artifacts in this location.

McKenzie (2011) noted 2-3 harvests in Compartment 20 since 1950, although Carey et al. (2013) and Brooks and Nunley (2013) did not find any records of harvests during that time period. In the 1944 and 1950 aerial photos, multiple roads extend towards the bluff and there are visible openings in the forest, as well as a fence line in the southeast corner of the compartment (the University Farm extended to this area). The 1959 photo is similar to the 1950 image. In the 1962 photo, Cedar Hollow Lake and the fire lanes appear. In the 1968 photos, eastern white pine plantations and mixed pine plantings appear in southeast section of compartment, and active roads are visible throughout the compartment. In the 1977 photos, pine plantings are visible in the northwest corner of the compartment, and eastern white pine plantings on the fire lanes are visible. From 1997-2008, the old roads and openings fill in with vegetation over time.

In the fall of 2011, the pine plantings were removed from the southeast corner of the compartment as well as small diameter hardwoods. In the spring of 2012 and fall 2012, 8 B3F3 American chestnut trees (*Castanea dentata*) were planted in the openings of the 2011 harvest. This restoration unit was burned three times from 2013 to 2017.

Outside of the 2011 harvest, Compartment 20 is dominated by upland oak/hickory with mixed diameter and ages with basal areas ranging from 80-130 ft^2/acre. Diameter distribution in the overstory is generally between 10-16 dbh. Predominant species throughout the compartment is chestnut oak, followed by white and red oaks. Much of the hardwood area seems to be in old field succession. There is a small pine planting (loblolly and eastern white pine) near the bluff in the northwest section of compartment near Rutledge Point. There is very heavy white pine regeneration around Cedar Hollow Lake and white pine regeneration near the bluff towards Rutledge Point. There are high numbers of eastern red cedar and large diameter farkleberry near the bluff.

This compartment contains a portion of the Perimeter Trail and is bounded by several firelanes used frequently by bikers, joggers, and equestrian riders. KA Point, a prominent overlook is also located in this compartment.

Recommendations:

The overall trajectory of the compartment should be to maintain the existing mixed oak hickory woodland. The 2011 harvest in the eastern portion of the compartment, along with the three fires that have followed since 2011, have created early and mid-successional habitat in the area. Though the western portions of the compartment are beyond target density for oak woodland, the large diameter volume is not present in the stand to make an intermediate thinning of anything other than pulpwood feasible. The adjacency of other harvests in the area also lessen the negative impacts of this dense forest on the habitat matrix. For these reasons, the western portion of Compartment 20 (west of the creek draining Cedar Hollow lake) will be maintained as a reserve area (High Conservation Value Forest) for the next 10 years with no harvest management anticipated (Appendix F, Figure 28). East of Cedar Hollow Creek, prescribed fire may be used in year 2024 or beyond, depending on the state of the oak regeneration present in the 2011 harvest.

Compartment 22

Early history of Compartment 22 matches that of Compartment 20. In Sewanee's 1944 aerial photo, the entire compartment had a very low basal area at that time (visual estimate = 10- 20 ft^2/acre) and much of this compartment was part of a very large pasture. In the 1960s, plantings of yellow poplar, eastern white pine, Virginia pine and loblolly pine took place in coordination with the US Forest Service in the southern portion of the compartment where the pasture was most open, while the northern portion of the compartment which was mixed woodland pasture was abandoned and allowed to naturally regenerate. The plantations were thinned in 1986. Most of loblolly pine was removed in a 2001 pine beetle harvests, and areas were planted to either shortleaf pine, a mix of hardwoods and pine, or allowed to naturally regenerate. The majority of the Forest Service white pine was removed in 2016 and the yellow poplar was thinned from below at the same time. In addition, six openings of 1-2 acres were created in portions of the old field hardwood succession, 4 of which were planted in shortleaf pine in 2017.

The trajectory of the compartment is toward an oak pine mixed woodland. For management purposes, the compartment is separated into two stands, the area of natural regeneration after farm abandonment, and the planted and naturally regenerating areas from the Forest Service plantings of the 1960s. Silviculturally these stands will be managed with different tools toward the same goal. From a prescribed fire standpoint, the portions of the compartment will be managed as 5 separate burn units, managed with parts of Compartments 24 & 32, with prescribed fire in each unit annually.

The 65-acre northern stand of naturally regenerated old field consists of two distinct age classes. There is an oldest cohort of white and red oak that were mature when the area was still being actively grazed. These open grown large diameter trees are interspersed between younger trees that filled in after pasture abandonment. The younger trees are a mixture of maple, Virginia pine, oak and hickory, many with poor form and vigor.

From a sawtimber standpoint, this stand has fairly poor form and potential. It is for that reason the patch cuts were put in in 2016. The idea is that this stand will be gradually replaced over the next 30 years with a continuing series of patch cuts. A portion of these cuts will be planted to shortleaf to add diversity to the stand, but others will be allowed to naturally regenerate. No additional patch cuts are planned during the cycle of this plan. Prescribed fire on a roughly 5 year return interval should favor oaks throughout the stand.

The 70- acre southern portion of the stand consists of a 16-acre shortleaf pine plantation planted in 2001, and 57-acres that is a combination of loblolly pine and mixed hardwoods regenerated after the USFS plantations were removed in 2000 and remaining portions of yellow poplar plantations planted in the 1960s. The boundaries of these older and younger stands are not distinct due to the USFS tendency to mix plantings and because the yellow poplar has now been thinned at least twice.

Recommendations:

The next entry into this compartment will be around 2023, when the shortleaf plantation, naturally regenerated loblolly, and the naturally regenerated hardwood will be all commercially viable for thinning. It is anticipated that at that time, approximately ⅓ of the young volume will be removed as pulpwood, and the remaining portions of the yellow poplar plantations will also be removed. This should set all this compartment on a trajectory for mixed pine oak woodland for the foreseeable future.

Compartment 24

Compartment 24 is located just south of Breakfield Road near the Wiggins Creek subdivision. There are 6 homes from the subdivision in the eastern portion of this compartment, but the majority of it remains undeveloped.

The stand was last harvested in 1986 with a marked harvest that appears to have taken the majority of the merchantable sawtimber at that time, for the construction of Chen Hall. There was a student led understory white pine removal in 2014 and decaying white pines can be found on the ground in several areas of the stand. McKenzie (2011) noted 4-5 harvest entries and Brooks and Nunley (2013) reported white oak and black gum harvests in this compartment in the 1950s. Approximately 30% of the current stocking is white and chestnut oak left during the last harvest that is now moving into small diameter sawlogs.

The stand has evidence of significant deer pressure, with browse on most available twigs, but the understory also contains a wide variety of grasses and forbes where light allows. Butterfly pea (*Clitoria mariana*), *Desmodium* spp., St. John's-worts (*Hypericum* spp.), and bicolor lespedeza (*Lespedeza bicolor*) are all found in the understory, along with several species of Panic grass.

Recommendations:

From a habitat and forest growth standpoint, this compartment needs to be thinned to allow more light to the understory and reduce competition. Given the proximity of this compartment to development, the understory composition, and the current overstory stocking, thinning in this stand might be best accomplished with a low intensity prescribed fire in 2022. The headwaters of Wiggin's Creek separate most of the compartment from the developed areas and can be utilized as a firebreak.

Compartment 26

Compartment 26 is now a residential development and excluded from this plan, although the residents and the University should consider including this development a community wildfire protection plan.

Compartment 28

In Compartment 28, current conditions are highly variable and based mostly on when it was last harvested. Mckenzie (2011) found 10 harvest records in this compartment, and Brooks and Nunley (2013) reported oak and black gum harvests in 1951 and 1952. The whole compartment was cut in 1952 in two separate sales separated by the road that runs along the high ground to Elliott Point. The western half had approximately 22 tie logs per acre removed. No volumes are known for what came off of the eastern part of the compartment and records show the sale was stopped before being completed due to low revenue. In 1972, the northern 100 acres of Compartment 28 was cut again, with approximately 1,400 board feet per acre of oak and maple removed.

The 1968 aerial photo of this area shows a series of clearings throughout the compartment, mostly on north slope drainages. These are assumed to be small clearcuts that today have mostly regenerated to yellow poplar. Some appear to have been planted to yellow poplar as well. The most recent known harvest in Compartment 28 was 1986 when marked oaks were removed to use in the construction of Chen Hall.

The current conditions of Compartment 28 are highly variable. The southern portion of the compartment is mature oak hickory with no evidence of harvest over the last 50 years, while the northern portion of the compartment is a mixture of old plantations, small clearcuts, and naturally regenerated upland hardwoods. For management purposes, the compartment is split into a southern section of approximately 55 acres, and a northern section of approximately 130 acres.

The southern section is predominantly chestnut oak, with some white and red oak mixed in. The trees are quite large, with an average dbh between 16-20 inches. All appearances are that this is the area left off the 1952 harvest when it was concluded before completion. The stand features a closed canopy with very open stand structure. Exceptions to this are located on the northern aspect of a few drainages which appear to have been clearcut in the 1960s. These small cuts appear on the aerial photography of 1968 and may have been related to a forest service study on yellow poplar regeneration.

Recommendations:

The northern section contains portions of old pine plantations (loblolly and shortleaf) as well as some yellow poplar plantations. The northern portion of the compartment is scheduled for a variable density thinning in 2023 which could be split into 2 years with part occurring in 2020-2021 to minimize disturbance on recreational assets and users. This thinning may be split into two years depending on other harvest priorities for the year. In anticipation of that, at least one fire should be carried out in this area to enhance oak regeneration in the understory in 2021.

The southern portion of this stand is designated as a High Conservation Value Forest (Appendix

F, Figure 28) with no harvest management proposed. This late successional upland hardwood stand is relatively rare on the Domain and in the region. Some fire may be appropriate in the understory to enhance the habitat characteristics of the stand.

Compartment 30

The recent site history for Compartment 30 is very similar to Compartment 24. A marked harvest was carried out over the majority of the compartment in 1986, with the exception of one six acre clearcut near Breakfield Road that had occurred shortly before the marked harvest. The marked harvest in Compartment 30 does not appear to have removed as much timber as was removed in Compartment 24 and therefore the midstory is much less dense. The low density midstory was likely caused by the 1972 harvest.

Today the stand contains approximately 100 square feet of basal area, with oak dominating the overstory in most areas. Exceptions to the oak domination are along the southern boundary of the compartment where a series of loblolly pine plantations were planted in the 1960s and in the area clearcut in the 1980s which is dominated by yellow poplar. Some shortleaf pine was also found in the northeast corner of the compartment, but it was unclear whether this was planted or natural.

Recommendations:

For optimum wildlife habitat and oak pine woodland stocking, this stand is in need of thinning. Because of the lighter harvest in 1986, Compartment 30 contains sufficient volumes in many areas to commercially thin, and the presence of existing shortleaf and loblolly pine in the overstory make it a prime candidate for an oak woodland restoration harvest in Fall of 2020, followed by prescribed fire beginning 2020 to promote natural regeneration of shortleaf and suppress exotic species. In such a harvest, the broad yellow poplar bottom near Breakfield Road should be excluded.

Compartment 32

Compartment 32 appears to have been just beyond the western boundaries of the old university farm. The 1952 compartment map shows it to be an “operable” plateau stand, which likely led to the oak harvest that occurred in this stand in 1954. No volumes were listed in that harvest. There were a series of USFS plantations installed in the mid-1960s in the middle of the compartment. The next known harvest in this compartment is in the mid-1980s. This was a marked thinning that appears to have covered much of the compartment outside of the plantations. Between 1952 and 1962, a landfill was created on the southern boundary of the compartment near Breakfield Road. This landfill was in operation for at least a decade. There is an ephemeral pond just north of the Forestry Cabin, which was built in 1950s.

Today the stand has a basal area of 80-120 ft^2/acre primarily in white, chestnut oak, and scarlet oak. We have also noted several unusually large black gum trees in this compartment. The USFS plantations remain unthinned and are suffering from density dependent mortality.

Recommendations:

For management purposes, this compartment is broken up into two stands separated by the firelane connecting Cedar Hollow Lake with the Forestry Cabin. The stand south of that line was harvested in the mid-1980s while north of there seems to have been left alone due to lower productivity.

The south part of the compartment, though harvested most recently, has the best potential for future management. The USFS pine plantations need to be thinned but would not financially support themselves. The hardwood sections contain white and chestnut oak in the small sawlogs stage that is growing well and without significant density dependent mortality due to the 1980's thinning. The hardwoods could be thinned from an economic standpoint, but do not need it.

On the northern stand, the overall soil productivity appears to be much lower. The stand is dominated by chestnut oak and black gum. While the diameter distribution of the chestnut oak would make a harvest feasible, there is little midstory ready for release. The black gum in the stand is of large diameter, but mostly hollow. This section has been designated as a High Conservation Value Forest (Appendix F, Figure 28).

From a habitat standpoint, the overall density of the south stand is too high, while the lower productivity of the northern stand has kept its density lower, though still above woodland densities. The large cavities in the black gum are providing excellent habitat for several species of birds and mammals. Because there is adjacent thinning and harvest happening in Compartments 22 and 20, the higher densities in this compartment can be carried into the future. Over the next 5 years it is recommended that the northern portion of the compartment receive at least one fire to further reduce woody stem densities. The majority of the southern compartment should be allowed to grow, though a small harvest might be feasible in an arc south of the forestry cabin around into the northern portions of Compartment 34, however this project is outside the scope of this plan and will coincide with the next harvest in Compartment 22. The purpose of such a harvest would be to thin the USFS plantations in Compartment 32 and thin the white pines in Compartment 34. Such a harvest would need to be done in coordination with the researchers working in the Split Creek watershed of Compartment 34.

Compartment 34

Compartment 34 has been harvested at least twice since 1900. It was selectively harvested for high quality oaks in the early 1950s as part of a 350-acre harvest. From March to April of 1952, 8,000 board feet of white oak was harvested for stave bolts and 43,672 board feet of white oak logs were taken from the entire harvest area. Harvesting continued until 1954, and scarlet oak, black oak, black gum, hickory, chestnut oak, white oak, and red maple were removed. A total of

418,518 board feet were harvested representing an average removal of 1,200 board feet and 17 trees per acre.

Approximately 150 acres including the compartment was logged again in 1976. The primary species harvested were scarlet oak, black oak, chestnut oak, and hickories. There was also removal of some yellow-poplar, black gum, and maple. During this harvest a total of 235,630 board feet were removed, an average of 1,570 board feet and 18 stems per acre.

The three areas in the compartment that contain pines have been established since 1970. Two eastern white pine (*Pinus strobus*) stands were planted in the early 1980s. The dense eastern white pine stand surrounding the weather station on the eastern edge of the compartment is approximately 3 acres. This stand was originally maintained as a Christmas tree plantation but has been unmanaged for the past 15 years. The Virginia pine stand on the south end of the watershed was planted in the mid-1970s, possibly after the completion of the 1976 harvest period.

Today the 111 acres that make up Compartment 34 are dominated by the 54 acre Split Creek watershed located in the middle of the compartment. The Split Creek watershed is part of the University's multidisciplinary study of Tennessee streams and watersheds, and has been managed by University Forestry Professor Karen Kuers for over a decade. A flume and electronic weather station were installed in the watershed by Sewanee Forestry and Natural Resources students and faculty in 2001, allowing students and faculty across environmental disciplines to use the watershed in their courses and research projects. Projects in the watershed have analyzed factors such as streamflow patterns, groundwater flow through soils, soil nutrient cycling, litterfall dynamics, and the effects of urbanization and development on stream flow and water quality. Permanent vegetation plots established in the watershed (part of a national undergraduate science collaboration called the Ecological Research as Education Network - EREN) are regularly inventoried by Forestry students to monitor changes in forest structure and species diversity, calculate tree biomass accumulation in the oak-hickory dominated forest, and estimate carbon storage capacity for comparison with patterns in forests located in other regions of the US.

Recommendations:

Because of this rich research source within this compartment, no active management will occur within the compartment outside of the Split Creek research context. There has been some conversation about removal of the old Christmas tree plantation, but it is not economically feasible as a standalone project and would need to be coupled with another adjacent harvest. The balance of this compartment (40 acres south of the Split Creek watershed and 24 acres north) contain typical mixed upland hardwoods and could be managed with adjacent compartments, but are likely too small for standalone harvest.

Compartment 36

The 1903 management plan has this area in Block III which is referred to as the area with the best plateau timber. The first known harvest record is the 1951 oak harvests that was begun by Huntland stave company and terminated due to low revenues. This is the same harvest referred to in the Compartment 28 summary. At that time Compartments 28 and 36 were considered a single compartment (7). A harvest in 1952 removed approximately 22 tie logs per acre. The most recent harvest record is from 1986, where marked black oak and maple were removed. Notes indicated that the timber quality in that stand were very poor at that time.

Today the stand is dominated by chestnut oak and scarlet oak. There appears to be more scarlet oak in this stand than many others on this part of the plateau, likely a relic of harvest history. The stand has over 110 feet of basal area on average, made up of mostly two age classes. There is an older cohort of chestnut oak, scarlet oak, and white oak with diameters ranging from 16-26 dbh. These are the trees left after the harvest in 1986. Much of the scarlet oak is of poor quality from a timber standpoint, but has excellent cavities for wildlife. The balance of the stand is mostly regrowth following the 1986 harvest. Trees in this cohort are white and red oaks, maples and sassafras ranging from 4-10 inches in diameter. There is also white pine scattered throughout the compartment.

Compartment 36 has two lakes within its relatively small 122-acre boundary. These lakes (Chestnut and Audobon) provide multiple year round water sources in close proximity to one another. This fact, coupled with a relative abundance of cavity trees from the low quality timber means that this compartment may be providing opportunities for several species of wildlife.

Recommendations:

Future management should capitalize on these existing habitat opportunities. The timber quality is low. A thinning harvest would have little to harvest in a viable manner and still leave value in the stand, leaving patch cutting as the most viable option. While no harvest is planned within the timelines of this document, a corridor based harvest that connected water source to each other and connected disparate sections of the compartment to water could be a unique opportunity to create habitat corridors in the stand that reduce midstory clutter and enhance connectivity. As a less invasive maneuver, a series of prescribed fire could reduce the midstory clutter and white pine and improve the habitat characteristics.

Compartment 38

Though Compartment 38 is part of the Block IV that Foley described as cutover in 1903, it is the westernmost extreme of the block and appears to have been harvested with a lower frequency early in the Domain's history. A timber sale in 1954 harvested 1,223 board feet per acre, though less than one tree per acre was grade one. A harvest in 1976 removed almost the same volume (1,178 board feet/acre) and was cut to a minimum diameter of 14" dbh. Following the 1976 harvest, the Forest Service set up a long-term white oak study in this compartment that examined growth and epicormic branching. The trees originally marked in 1977 have been remarked and re-examined in recent years by University Forestry Professor Ken Smith. The original research was done by Dr. Wayne Clatterbuck of the University of Tennessee as part of his graduate research. He brings students to Sewanee every year to examine portions of the study.

Today the stand is dominated by white oak and chestnut oak in the overstory (100-130 ft^2/acre). Because of the Forest Service study, we know that a significant portion of these oaks are portions of a suppressed midstory left after the harvest in 1976. There does not appear to be a vigorous midstory of desirable species for release, though the understory does contain a significant oak component, particularly chestnut oak near the bluff.

Recommendations:

The history of high-grading in this stand makes it a poor candidate for a release thinning from a growth standpoint, but the stand density is above optimum from a habitat standpoint, and the lack of planned management in adjacent stands makes this a good candidate for management through harvest and fire. Dr. Smith would like to do another complete inventory of the 1976 overtopped oak study prior to any harvest. A harvest of patch cuts along the ridge tops and southern aspects for shortleaf planting and a thinning focused on mid-diameter suppressed stem removals would be appropriate.

Compartment 40

The majority (approximately 90 acres) of Compartment 40 was acquired by the University in 1962 from Martin Johnson. Before this time, it was part of the community known then as Lands End. It is known from early maps that lands end had several houses, a school and a sawmill around the turn of the last century. At least one farm and associated homestead was located completely within Compartment 40. This site was used as part of a soil legacy study that will be published in 2019 (Smith et al. 2019). A 1914 map shows a sawmill set up centrally in the compartment with a road leading into the cove from the mill. This mill was shown on a second map made in 1917 indicating it was there for some time. The 1950 aerial image shows a clearing and appears to show very thin forests along the northern portion of the compartment, likely from grazing.

The southern part of the compartment is part of the original Block IV from Foley's plan, though it was far from the community of Sewanee, its proximity to Lands End made it likely that harvests were early and heavy. The first known commercial harvest in the area was a white oak harvest that occurred in 1951. There were also several harvests in the 1960s for oak and gum that occurred in this area.

In the early 1980s a four acre clearcut was done in the southern portion of the compartment. Black cherry was planted in the opening, and though they remain, the opening is dominated by yellow poplar at this time.

There were at least three quarries in this compartment. Two of them were located in the northwest corner of the compartment and the stone was used to create Dupont Library. A third large quarry was located in the center of the compartment and may have also served as the sawmill site. That quarry does not show up in any aerial images, but is clear on the ground.

Today the compartment is dominated by a mature overstory primarily of white oak, red oak and Chestnut oak. Stocking and quality varies greatly depending on previous land use, but in general timber quality is best on the northern portion of the compartment. There is also a white pine plantation at the southern end of the compartment. It appears to have been planted in part to reclaim some heavily eroded portions of Breakfield Road.

Recommendations:

Compartment 40 is situated in an area where active management is or will be occurring in many of the nearby compartments or has already occurred recently. Because of this, and do to the long term research in ecology, soil science and archaeology occurring in this compartment, it is not anticipated to receive any active management over the course of this plan.

Compartment 42

McKenzie (2011) noted 4-5 harvest entries in this compartment since 1950, Carey et al. (2013) found records of harvest in 1968 and 1983, and Brooks and Nunley (2013) recorded harvests in 1951 and 1953 for white oak and black gum. In addition, there were multiple small clearings made in the 1960s and 70s for Forest Service tests of black cherry and other species throughout this compartment (McDonnell et al. 2013).

Today the compartment shows the heavy harvesting done in the 1970s and 1980s. The stand is two aged, with an older cohort of oaks and hickories passed over during the last harvest and a younger cohort of red maple and yellow poplar that came in after the last harvest. This species shift is especially prevalent east of the parallel trail, where significant mortality is occurring in the young yellow poplar, likely from a combination of density and historic drought.

West of the parallel trail, some harvesting from 1983 is present and appears similar to the eastern part of the compartment, but it also contains a series of clearcuts from the 1970s which are planted to yellow poplar and black cherry. These cuts also have significant mortality in all upland sites. The clearings in the lower topographic areas support good yellow poplar growth and high basal areas. The far western portion of the compartment seems to have been missed completely in the 1983 harvest and contains a mature white oak, chestnut oak, and hickory forest with some poplar and cherry cuts from the 1970s interspersed.

Recommendations:

Many of the upland portions of this tract are shifting in species composition away from the dry oak pine woodland that would be most desired. Portions of this forest remain in the remnants oaks left but the regrowth is shifting strongly toward more mesic species. To reverse this trend, the compartment should be added to the area wide burning rotation with other areas of Compartment 46, 48, and 44, starting in 2021. This will serve to shift the species composition back toward oak and hickory in the uplands, and should not harm the lowland poplars and maples. A series of low intensity fires should also lower the basal area overall and increase mid and understory growth. The only area that may be appropriate for some harvest within the scope of this plan is the far western end, where dying upland poplar and cherry plantations could be replaced with shortleaf pine. This would be done in conjunction with a possible harvest in the northern portion of Compartment 44 around 2025.

Compartment 44

Compartment 44 is best known for an inholding to the University which today is known as Kings Farm. Originally owned by Christian Ruef, it was sold to an ex-slave Rufus Mosley and was then later acquired by the University of the South. It was an open farm until the late 1940s. The King farm appears to have been at one point an African American farm that may have had several homesteads at one time. Historical reports indicate that post-civil war, there was a separate route into the valley that was used by freed slaves and may have been in the vicinity of the King Farm. The University ceased farming operations around 1946 and the property was planted in plantation white and yellow pines and some yellow poplar.

Outside of King's Farm, the compartment was part of what Foley's Block III. There have been 4-5 harvest entries in this compartment since 1950 (McKenzie 2011). The whole compartment was cut heavily in 1953. In 1968, a series of clearcuts were made in the northern half of the compartment to make way for a series of USFS research plantings. Most of this research was centered around the artificial planting of southern red oak, black oak, black cherry, yellow poplar, loblolly pine, and white ash. Relics of those plantings can be seen today throughout this area.

The farm itself was planted in plantations of white pine, loblolly and shortleaf pine, and yellow poplar. Today these plantations are in various states of condition, with many needing thinning and removal. Forestry activities around these plantations have been delayed in order to facilitate historical research by several faculty in this area.

East of the farm, the forest is dense with average stocking in excess of 100 BA. The overstory is generally red oak, followed by chestnut oak and white oak to lesser extent. This area appears to have been high graded in the past so many older stems are of poor form, though some quality white oak is present. This part of the compartment also contains several historic access roads to the farm. These roads have all been planted to white pine creating several long strips of white pine throughout the compartment.

Recommendations:

Soil disturbance intensive management (timber harvest) in the eastern part of the compartment should be avoided until an archaeological review can be completed. The remains of several buildings are located in this area, and the old roads likely contain artifacts from the areas early African American residents. Hand thinning of white pine, along with some prescribed fire to control white pine is appropriate, especially in the northeast portion of the compartment where natural creeks make for an easy burn unit.

Opportunities for active harvest management occur in the plantations of the old farm and in the compartment west and north of the farm. On the farm proper, there is a plantation of white pine that may be appropriate for harvest. Adjacent to this and in the same vicinity are relic loblolly, shortleaf, and yellow poplar plantations which are all past optimum density for both wildlife and tree growth. A harvest centered on the farm that favored removal of white pine and yellow poplar, while thinning yellow pine and oaks would improve wildlife habitat and ecology in this area. This harvest can occur at any time, but should be done in coordination with faculty researching historic land use in the area.

West and north of the farm, the forest is dense following the harvests and plantings of the 1970s. Though there is little value economically in the stands, a midstory removal that focused on the removal of the failed upland yellow poplar and black cherry plantings and an overall thinning of the forest matrix would benefit the habitat and move the compartment toward its desired future condition. Given the size of the area in question, it would be best to do this thinning in two operations over two or three years. The first entry could be accessed using the firelane separating Compartment 44 from 42 and would remove black cherry and yellow poplar from the western portions of Compartment 42 at the same time. The second entry would be centered just north of the old farm and could include removal of some of the northern white pines from the farm proper. These thinnings could begin as soon as 2023.

Compartment 46

This compartment is adjacent to the Big Chalybeate Springs and rock shelters, thus, long-term human presence and occupation of this site is likely. Both the Hopkins and Foley maps show the Chalybeate Springs wagon road traversing this compartment. In the Foley report of 1903, this compartment was part of Block III, which Foley mentioned was mostly spared from heavy logging, use of fire and grazing by 1900, except in nearby compartment 44.

Old roads are visible towards Chalybeate Springs with low tree densities near the bluff in the 1950 imagery. Harvest records indicate a 1951 white oak stave harvest and a 1954 oak, hickory, black gum harvest. In the 1960s, eastern white pine was planted on the fire lanes, and loblolly pine was planted in 20 harvested acres in the southeast corner of the compartment. Loblolly pine was planted in northwest corner as well (adjoining Compartment 50 on the old Cheek farm). In 1986, a pulp thinning of small diameter hardwoods took place in the old Cheek farm in the far north of the compartment.

In 2001, the loblolly plantings from 1960 were removed in the northwest section of compartment (part of a larger harvest on Compartment 50). In 2010, the loblolly pine in the southeast section was removed, as was some of the eastern white pine on the fire lane. The 30-acre restoration site has large diameter oaks that dominate the overstory at basal area of 10-70 ft^2/acre, and openings are dominated by a variety of warm season grasses and forbs. In 2017, following three prescribed fires in 2010, 2013, and 2015, there were an average of 18,000 oak seedlings per acre at this site, with very low levels of deer browse (Smith et al. 2017). Fires have been temporarily halted in this portion of the stand to allow the oak seedlings to grow into saplings.

In 2018, 102 acres of this compartment just north of the 2010 harvest was identified as a location for a shortleaf pine/oak woodland project as part of a partnership with the National Fish and Wildlife Federation. Within this 102-acre harvest area, 11 acres of clearcut were distributed across the area in approximately one acre openings for shortleaf planting. The openings were placed along ridgelines and high ground in an attempt to identify the driest sites for shortleaf regeneration. Between the openings, 62 acres of upland hardwood forest were thinned with a strategy intended to leave a residual basal area around 50 square feet per acre made up of oaks and hickories in the 10-16-inch diameter class. A 10-acre section of the stand was marked with leave trees painted, while the remaining 52 acres were thinned as operator select. The harvest also contains 12 acres of riparian protection and 17 acres of unthinned upland hardwood forest north of the creek that drains Brushy Lake. The overall goal of the harvest includes the following: 1) increase shortleaf pine in the stand, 2) reduce overall basal area by harvesting suppressed midstory trees as well as mature sawtimber, 3) reduce midstory clutter to improve bat foraging, and 4) remove white pine along the firelane as well as advanced white pine regeneration.

In the northwest section of the compartment on the border with compartment 50, the forest is in the stem exclusion phase following the 2001 harvest with a mixture of young pine, yellow poplar, and assorted other hardwood species.

This compartment, like many of the plateau compartments on Breakfield Road, is used heavily for recreation. It is bounded by firelanes open to joggers, bikers, and equestrians, contains a section of the Perimeter Trail, and is used to access climbing areas in Compartment 27.

Recommendations:

Following the conclusion of the 2018/2019 harvest, the majority of the compartment will be on a trajectory toward the desired oak/pine woodland. No further harvest is anticipated in the stand for the next 10 years. Fire will likely remain absent from the 2010 harvest through 2025 while the oak regeneration moves into the sapling stage. In the 2018/2019 harvest, shortleaf pine was planted in the spring of 2019. Fire will be reintroduced in this area in 2021 and be maintained on a 3-5 year return interval, though the 100-acre unit will likely be split into four burn areas, including the 2010 harvest area. Fire use may pause in this are as it has in the 2010 harvest to facilitate oak growth once fire use resumes in the 2010 harvest area. The northern portion of this stand harvested in 2001 will be added to the burns associated with Compartment 50.

Compartment 48

This compartment was part Block III, and in the Foley report of 1903, Foley mentioned this area was mostly spared from heavy logging, use of fire and grazing by 1900, except in nearby Compartment 44. In the 1950s this compartment was combined with compartment 46 and called Compartment 3.

Harvest records indicate a 1951 white oak stave harvest, a 1953 crosstie harvest, and thinning in 1986 and 1987. In the 1960s, eastern white pine was planted on the fire lanes adjacent to Compartments 46 and 42. The forest is composed of two main age classes, an older cohort in the 16-20 inch dbh range made up of mostly white, red, and chestnut oak left after the harvest in the 80s. The balance of the timber is mostly white, red, and chestnut oak in the 6-10-inch diameter class. There are some areas in the same age and diameter class dominated by yellow poplar where the 1980s harvest was most intense. Basal area across the stand is between 90-110 square feet per acre, dominated by the younger forest cohort.

Recommendations:

From a habitat standpoint the stand is overly dense to provide optimum dry oak habitat, but the diameter distribution is such that there is insufficient value in the stand to support a thinning harvest at this time. This compartments proximate location to Compartment 46 means that prescribed fire in the compartment could not only improve mid and understory characteristics for some target wildlife, it could also be used in the adjacent compartments fire rotation to provide fresh fire in proximate areas during rest years in Compartment 46. An intermediate thinning harvest should be appropriate after 2025, but should be undertaken in coordination with amphibian research that may be in progress due to the water resources in the compartment.

There are three significant bodies of water in Compartment 48, Brushy Lake and two ephemeral ponds. Brushy Lake is a 1.6-acre manmade lake built by the University for fire protection in the mid-1960s. Its dam is in very poor condition with a large amount of seepage and poor vegetation coverage. The two ephemeral ponds in the compartment are both visible in aerial photos from 1950. They are of unknown original origin, but the northernmost one appears to have been created by an old road. The central compartment pond may be natural as it is a depression near the top of the watershed.

The northernmost ephemeral pond has been studied for the past 5 years recording nearly 4,500 captures of spotted salamanders and 16 species of amphibians. Student-led research has identified that mass breeding migrations of spotted salamanders are associated not with temperature but with interactions between time of year and precipitation. Long-term data built at this site will allow researchers to evaluate potential effects of shifting temperature and rainfall patterns on breeding efforts and timing of reproduction for a number of local amphibian species. Data already suggests that amphibians use the pond uplands non-randomly preferring to move towards areas closest to the coves and that prolonged summer droughts reduce breeding effort but may not negatively impact adult survival.

Conventional wisdom and the majority of scientific literature indicate that dams disrupt stream function and impair stream communities leading to widespread calls for the removal of dams. However, most of the studies of the negative effects of dams have taken place on large dams while ignoring the more common small dams like those that dot the top of the Cumberland Plateau. Research on the Domain has contributed to a growing understanding that the role of small dams is complex and can have positive attributes. In this region, the hydrologic stability offered by small dams in a region otherwise dominated by ephemeral streams may promote the persistence of stream communities particularly through prolonged drought. Stream transitions from ephemeral to permanent also disrupt may common stream functions such as carbon processing and nutrient retention. Given the national context promoting dam removal and a management challenge in sustaining the Brushy Lake dam, this provides an opportunity to study the impacts of dam removal and transitioning of streams from permanent to ephemeral, which is likely to become more common in our future climate. A study has been initiated using a before-after control-impact (BACI) design to characterize amphibian and macroinvertebrate diversity, stream conditions like substrate and temperature, and stream functions like nutrient export and carbon breakdown rates. The Brushy Lake Dam is scheduled to be removed in 2021.

Compartment 50

Much of this compartment was a private farm (Cheek Farm) until the early 1950s when the farm was given to the university by the chancery court following a boundary lawsuit with the Cheek family. Most of this area appears as a pasture in the 1950 aerial photo. Following acquisition, the Cheek pasture was planted in loblolly pine (37,000 seedlings) in 1958-59. Hardwood regeneration was girdled in 1959, and the plantations were thinned in the late 1980s. The plantation was cleared in 2001 during the pine beetle harvest. Four small areas dominated by hardwoods (less than an acre) were maintained during the cut. Six acres in the middle of the compartment were burned. In 2002, shortleaf pine obtained from a Tennessee state nursery was planted in the 6-acre burn area (provenance likely in Arkansas).

The Cheek pasture plantation is currently in the stem exclusion phase and is dominated by small diameter yellow poplar, an assortment of other hardwoods, loblolly pine (naturally regenerated) and the planted shortleaf pine. The old farm area has been burned twice since 2012 in an effort to lessen the hardwood competition for the pines.

Outside of the Cheek Farm proper, there is approximately 70 acres that was part of the Lands

End community in the last century. This land was acquired by the University around the same time as the Cheek Farm. There was at least one farm, currently referred to as Pott's Place, that was used as part of a soil legacy study (Smith et al. 2019). Shortly after acquisition, the farm fields were planted to loblolly and white pines. The two known old home sites near the bluff were not planted and today are surrounded by a mixed hardwood forest. These homesites are the site of an ongoing soil chemistry research project looking at the effects of the homesite on long term soil chemistry and forest composition (Smith et al. 2019).

In 2017, a harvest was initiated to remove the white pine plantation, thin the existing loblolly plantations, and create six 1/2 to 1 acre openings in the forest for shortleaf pine planting. The openings were planted in the spring of 2018 with shortleaf seedlings from the Georgia Forestry Commission. Funding for this planting was provided by the National Fish and Wildlife Foundation. Approximately 16 acres of hardwoods were also thinned in a marked sale to reduce the basal area to approximately 50 feet. Acoustic bat monitoring is currently underway in the thinned hardwoods as part of the overall efforts to assess the effects of the forest management practices on bat utilization on the Domain.

Recommendations:

The management goals of Compartment 50 are to create and maintain a mixed pine oak woodland. The first prescribed fire post-harvest is planned for the Spring of 2020. Over the next 10 years, the whole compartment will be managed primarily with fire. Now that the Perimeter Trail has been rerouted to the northern boundary of Compartment 50, the whole compartment has external firebreaks and internally will be split into four burn units with one unit burning on an annual basis. Further removals in the hardwood matrix of the northern section and removals of the remaining loblolly pine will be contemplated in 10-15 years once the shortleaf has become established. Thinning in the Cheek Farm portion may also be necessary. Further hardwood removals will be based on the viability of advance oak regeneration in the understory.

Section 7. Conservation Area 5

Conservation Area 5 contains many of our north facing coves and includes compartments 1, 3, 5, 7, 9, 33, 51, and 400, and consists of approximately 1,036 acres (Figure 24).

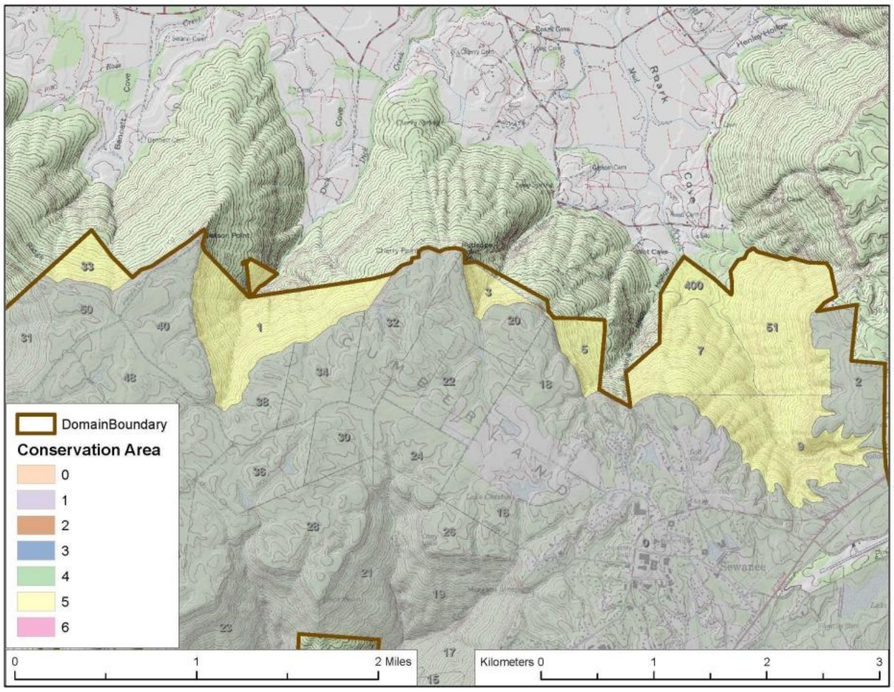


Figure 24. Map of Conservation Area 5 which contains most of our north facing coves.

History and Current Use

Conservation Area 5 consists of most of our north facing cove forests. The historic human use and management in these compartments vary widely, with some having little known timber harvest at all, and others that were heavily harvested and mined in the last century. Today many of these areas are protected from harvest through conservation easement and tacit university policy. Compartment 51 is under a Forever Wild conservation easement held by the Land Trust for Tennessee, Compartment 1 (Dicks Cove) has been designated as a National Natural Landmark by the National Park Service, and Shakerag Hollow (Compartment 7) is a protected area primarily used for education, recreation, and research. According to a Light Detection and Ranging (LIDAR) analysis by Nunley (2016), Compartments 1, 3, 7, 9, and 33 have tall canopy heights (100-150 feet) indicating both their productivity and their maturity.

Today, Compartments 7 and 9 contain the Shakerag Hollow portion of the Perimeter Trail, the most heavily used section of the entire Perimeter Trail. Dicks Cove trail is also heavily used for recreation as well as old growth research.

Current Condition of Forest Communities

Conservation Area 5 is composed of almost exclusively late successional hardwood forest. Exceptions to this generalization include areas of loblolly pine and poplar plantations in the lower elevations of Compartment 7 and Compartments 5 and 400 which were harvested heavily in 1982 and 2001 respectively.

NatureServe classifies the majority of this conservation area as a mixture of Southern Ridge and Valley Cumberland Dry Calcareous Forest and South-Central Interior Mesophytic Forests. The designations are strongly associated with aspect, with the most north and east facing portions falling mostly within the Mesophytic designation, and the more western facing north slope trending drier.

This continuum can be clearly seen on the ground, with drier areas containing more oak and the more mesic areas dominated by yellow poplar, basswood, and maple.

This conservation area, more than any other, is known for spring ephemeral wildflowers. This characteristic is typical of mesophytic forests and is on its best display in the spring in Shakerag Hollow.

Rare, Threatened, or Endangered Species

Compartment 7 has a population of Goldenseal (*Hydrastis canadensis*) and Compartment 9 has a population of Narrow-leaf Ramps (*Allium burdickii*). As well as recorded bat species, including Gray Bat (*Myotis grisescens*), Little Brown Bat (*Myotis lucifugus*), Northern long-eared Bat (*Myotis septentrionalis*), Tri-colored Bat (*Perimyotis subflavus*). The presence of Little Brown and Tri-colored bats has been confirmed in karst resources in Conservation Area 5 during winter WNS surveys.

Soils

Conservation area 5 is dominated by NRCS series Rd and Re, which is primarily rocky limestone outcrops (Figure 25). Sandstone boulder colluvium (Bt) is common at the base of the bluff. Compartment 400 or the Walker Springs tract, is rare for Sewanee because it is at base of the Cumberland Plateau. The soils on this tract consist primarily of fine loams (Aa).

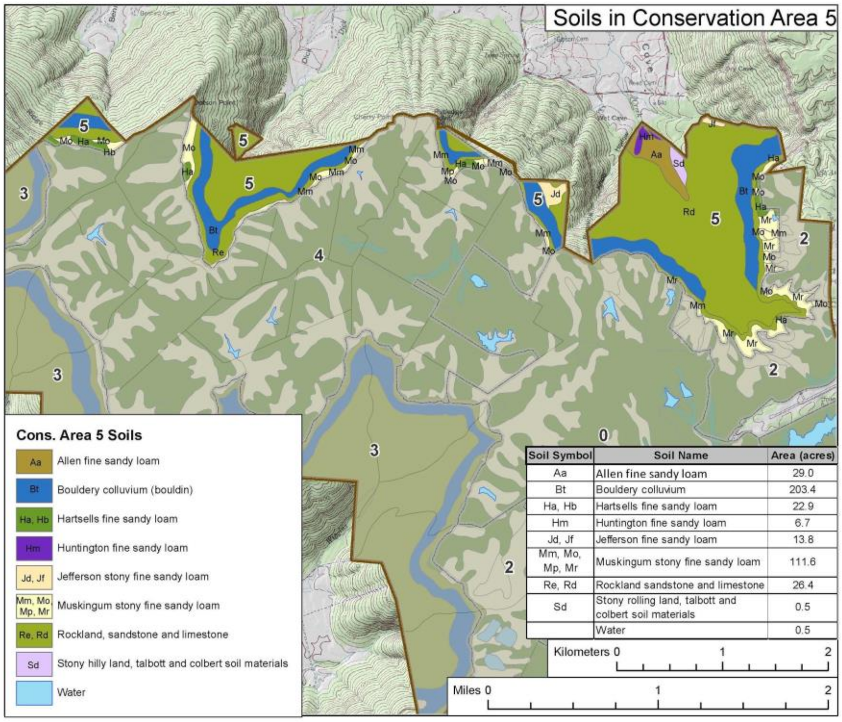


Figure 25. Soil map for Conservation Area 5, which contains most of our north facing coves and includes Compartments 1, 3, 5, 7, 9, 33, 51, and 400.

Water Resources

In the winter and spring, many of the streams flowing through Conservation Area 5 have high flow, particularly after storm events. Cedar Hollow Creek, Dick Cove Creek, and Shakerag Hollow Creek (which becomes Mud Creek) and Running Knob Hollow Creek retain water for much of the year, although they frequently dry up in early fall, depending on weather patterns. Compartment 400 is adjacent to Wet Cave, a year round spring and an important hydrologic feature.

Cultural Resources

Conservation Area 5 includes the north facing slopes of the Cumberland Plateau in Compartments 1, 3, 5, 7, 9, 33, 51 and 400. Currently fewer than 10 sites are recorded within the Tennessee State Site Files in this area. Area 5 integrates Pennsylvanian Age sandstone bluffs where there are documented and undocumented prehistoric rockshelter sites and rock art sites. Both of these site types are established as significant cultural resources. The rockshelters are significant because they are areas of early occupation (Early Holocene) through to historic contact and contain a high potential organic artifact preservation. These circumstances make these sites the most endangered sites in the region since they are targeted by illegal looting (Simek et al. 2013a). Rock art sites are also especially significant on the Domain as the Southern Cumberland Plateau has an unusually high concentration for the eastern Woodlands. Currently there are more than 40 documented sites and this number is growing annually with new discoveries. The Domain is currently known to have at least 5 of these sites from the southern Cumberland Plateau. It is important to note that this concentration of prehistoric rock art, mostly rendered with red pigment in simple anthropomorphic and zoomorphic figures and geometric shapes, has gained national and international attention in both the academic literature and popular media (Simek et al. 2013b; 2018).

Based on their reduced sun exposure, especially during the winter months, rockshelters that have a northern aspect are colder and darker and are less frequently occupied by prehistoric peoples relative to those with a more southern aspect where there is more light and higher temperatures. Even with this limitation there is a surprising number or northern aspect sites recorded elsewhere on the Plateau suggesting that none of these areas can be discounted until systematically surveyed.

Dick Cove (Compartment 1) has rockshelter sites, chert quarrying areas recorded and limestone caves with evidence of human occupation near the entrance. Solomon’s Temple Cave, towards the lower elevations of Compartment 1, has never been systematically surveyed for evidence of prehistoric use. While the cave has a relatively wet environment year round and therefore a lower potential for preservation, the cave should be surveyed since there is a rich record in the southern Cumberland Plateau and the adjacent Eastern Highland Rim of ancestors of the Native Americans venturing into caves for resource collection (e.g. chert, gypsum, mirabilite, etc.), ritual activities or exploration in general (Dye 2008, Carstens and Watson 1996) Today, those entering the caves either for recreation or research should be mindful of the potential for fragile traces of use (e.g. stoke marks, art, etc.). Dick Cove, also well known for its spring wildflower species and other relatively rare plants, likely contains historic sites as well, but like much of this Conservation Area, it has not been systematically surveyed.

Finally, Shakerag Hollow and its slopes to the edge of Roark’s Cove contains both significant prehistoric and historic sites. Compartments 9, 7 and 51 are well known for their plant composition but little known for cultural resources although at least 2 rock art sites are documented in this area along with rockshelter habitation sites and known historic farmsteads with extensive rockwork.

Recreation

Portions of Conservation Area 5 are heavily used for recreation. Shakerag Hollow can see as many as 500 visitors every weekend during wildflower season during the spring. The trail loop created with the Beckwiths Point trail (Conservation Area 2) and the Shakerag Hollow Trail is one of the most popular on the Domain. Beyond Shakerag Hollow, the Perimeter Trail also traverses portions of Compartments 7 and 5 before climbing back to the top of the plateau near KA point.

Dick’s Cove is used for both hiking and caving; the Dick Cove Trail provides direct access to several caves used by the Sewanee Outing Program and the broader community. In all Conservation Area 5 contains at least 6 caves with some recreational use.

Desired Future Condition

This Conservation Area contains some of the most diverse cove forests on the Domain. The desired condition is maintenance and enhancement of the resource. Compartment 1 and Compartment 9 both have tacit protection from commercial harvest.

Compartment Summaries and Management Recommendations

Compartment 1

Compartment 1, known locally as Dick Cove, has no recorded harvest history and has the characteristics of an old-growth forest. In the 1980s, McGee (1986) found trees that were 400 years or older in this stand. There have been several long-term studies on this site and this forest is currently in a rapid state of change. There was a large mortality event in the 1980s in the overstory oak and hickory component (McGee 1986), and Clark et al. (2005) speculated that the forest is likely to be dominated by sugar maple in future years due to a lack of oak and hickory regeneration. Hiers and Evans (1997) also documented the loss of dogwood in this forest due to anthracnose, a fungal disease.

A recent inventory (S. Torreano, personal communication) of Compartment 1 found total basal areas ranging from 100-125 ft^2/acre, with oak basal area comprising 26-39% of total basal area. Sugar maple, which has steadily increased its presence in the stand since the 1970s, now composes 26-32% of total basal area. As previous studies noted, the stand is rapidly losing its oak/hickory component in the overstory, and oak regeneration is negligible.

Recommendations:

No management activities other than trail maintenance will be performed in Compartment 1, this compartment is designated as a High Conservation Value Forest (Appendix F, Figure 28).

For decades, this compartment has been recognized for its unique old growth character, yet this office was unable to find any direct public declaration from the University about its value and need for conservation. It is recommended that as part of adoption of this management plan, the University make a public declaration of the protection of Compartment 1. This declaration should be public and complete, but not legally binding. A legally binding prohibition on timber harvest would preclude any possible future sale of sequestered carbon from this compartment.

Compartment 3

Compartment 3 is a small northeast facing cove forest. It is part of the original parcel acquired by the University at its founding. Though McKenzie (2011) found evidence of one harvest in this compartment and Brooks and Nunley (2013) and Carey et al. (2013) did not report any harvests in this compartment it has been heavily impacted by the University over time. Archive records indicate that much of the coal burned by the University in the late 1800s came from this compartment. Black's 1920 survey of the domain shows multiple roads in this area. The mining was extensive and it is likely that the area was largely deforested at that time. The last harvest appears to have been 50-60 years ago. The 1968 aerial photo shows evidence of recent harvest.

Today the forest overstory is comprised primarily of yellow poplar and red and white oaks. The basal area is between 100-120 square feet per acre made up of overstory trees in the 16-26-inch diameter range. There is an extensive road network in most areas, left from the coal mines and historic timber harvest, but there is limited access to the compartment from the domain. The main road that used to connect this compartment to Rutledge Point is severely eroded.

The entrances to all the mines have collapsed at this point and are inaccessible. Water flows from the old entrances and at least one has been used in the past as a spring for a downstream landowner. This effort was found abandoned in 2011, and remained abandoned when visited in 2019.

It should be noted that the northern boundary of this compartment was incorrect for several decades on all maps. Former University Forestry Professor Charles Cheston in his 1946 survey of the Domain left off about 11 acres in this compartment. For this reason, the line remained unmaintained for several decades, but was rediscovered and repainted in 2017 with the line based on the survey by Black in 1920. For that reason, some compartment summaries and maps of the area may be incorrect.

Recommendations:

No timber harvest is recommended in this compartment during the duration of this plan. Though sufficient volume exists, like with many other compartments a commercial harvest would likely largely remove the oak from the stand because of financial constraints. Any future harvest should preserve the oak component. As the yellow poplar matures in the stand more fully, preserving the oak will become more feasible.

Compartment 5

Compartment 5 is another small northeastern facing cove forest that has been in university ownership since its inception. Compartment 5 is bisected by Roark's Cove Road, part of which was formerly known as Gipson's Switch Road, one of the earliest roads in Sewanee. Because of this proximity to the road, this compartment was likely heavily impacted by early settlers. McKenzie (2011) reported 2-3 harvests in this area since 1945. Brooks and Nunley (2013) found evidence of a 1953-1954 mixed variety harvest, while Carey et al. (2013) recorded a 1950s Sewanee sawmill harvest as well as a 1982 Mead thinning harvest. There are also several coal adits below the bluff.

The current condition of this compartment calls into question the "1982 thinning harvest" found in the records by Carey et al. (2013). From the conditions on the ground, it appears this compartment was almost completely clear cut north of Roark's Cove Road, and heavily harvested south of the road around 1982. The stand is primarily composed of paulownia, tree of heaven, and yellow poplar in diameters between 6-16 inches in diameter. Some areas are exclusively Tree of Heaven and shoots of this species compose the majority of the understory.

Many parts of the compartment north of the road has had severe soil disturbance as well. Sandy Gilliam (pers. comm.) reported that the University may have harvested surface stone from the site after the last harvest.

Regardless of the origin of the disturbance, this compartment is in poor condition. There are a few black cherry and black walnut trees interspersed with the exotics which may a hint of the former forest on this compartment.

Recommendations:

This compartment needs to be managed for exotic species. Currently, at least half of the total overstory is exotic species and it is recommended that a harvest that removes all the exotic species be undertaken as soon as financially feasible. That will likely be 2022. At that time, native species can be marked for leave in the harvest to provide some shade to slow the resprouting of tree of heaven and paulownia. At least three seasons of foliar exotic control will be needed to get the tree of heaven under control. If enough overstory can be kept at harvest time, paulownia control can be at least partially accomplished with shade, but some chemical control will also be needed.

Compartment 7

Compartment 7 is a north - northeast facing cove that was acquired by the University partially from the Walker heirs in 1903, and partially from the Snowden family in 1986. McKenzie (2011) reported 1-3 harvests in this unit and a large amount of volume removed. Carey et al. (2013) found contracts for a 1962 harvest. All of these harvests would have been for the western portion of the compartment after acquisition in 1903. The University has never harvested timber in the portion of Compartment 7 donated in 1986. According to donation records, that area had been completely logged of merchantable timber in 1971 by the Campbell Lumber Company. There are several old coal mines at the base of the bluff in Compartment 7.

Today the whole compartment is recovering from historic harvest. Much of the eastern section is predominantly yellow poplar in the areas that were accessible for logging, with some white oak and sugar maple in the less accessible drains. The forest is dense with basal areas in excess of 140 square feet per acre The logging roads on the Snowden property were not properly closed after the last harvest and severe erosion is evident. Some soil movement still persists in the old logging roads in this area.

There are also pieces to at least two cars located in this compartment below Green's View that were left there after they were driven off of the bluff.

Recommendations:

No management is recommended in this compartment during this time period. Though some erosion persists in the historic logging roads, remediation at this point is likely to be more destructive than the minimal erosion that persists.

Compartment 9

Compartment 9 is a heavily visited tract of forest that covers the higher elevations of Shakerag Hollow. McKenzie (2011) noted 1-3 harvests in this compartment, while Carey et al. (2013) found contracts for a harvest in 1960, as well as two harvests in 1961. McKenzie (2011) noted that high volumes were removed from this area. Carey et al. (2013) also reported an early 1950 fire that burned through most of this compartment. In addition, there are several coal adits in this compartment at the base of the sandstone bluff.

Today the tract is commonly referred to as old growth, though there has been significant harvest history, some old growth relic trees do remain in the compartment. The stand is dominated by yellow poplar, basswood, sugar maple and hickory, with white oak and northern red oak in drier sections. Some individual trees have diameters in excess of 40" at breast height. There is also a significant stand of mixed oak and shortleaf pine on the dry west facing slope below Compartment 2

Recommendations:

No management activities other than trail maintenance will be performed in Compartment 9, this compartment is designated as a High Conservation Value Forest (Appendix F, Figure 28). For decades, this compartment has been recognized for its old growth character and spring wildflower display. This area is also featured for its biological diversity in Sewanee Professor David Haskell's bestselling book The Forest Unseen. It is recommended that as part of adoption of this management plan, the University make a public declaration of the protection of Compartment 9. As with Compartment 1, this declaration should be public and complete, but not legally binding. A legally binding prohibition on commercial harvest would preclude any possible future sale of sequestered carbon from this compartment.

Further recreation management may be needed in this compartment during the duration of this plan. The section of the Perimeter Trail that passes through this compartment sees up to 250 users per day during spring wildflower season. If usage of this area continues to grow, it may be necessary to limit off trail access to this compartment during some times of the year.

Compartment 33

Compartment 33 is a north facing cove forest and was acquired by the University through a series of purchases in the late 1950s and early 1960s. Aerial imagery seems to indicate that the University harvested this compartment shortly after its acquisition. The 1968 aerial image shows significant harvest, mostly directly below the bluff, though no records were found for this harvest. Today the forest has recovered extensively. A recent inventory (Butler et al. 2016), found between 7200 - 8200 board feet/acre with most of the volume in yellow poplar, hickory and red oak. Butler et al. (2016) placed a total value of the timber in the compartment of $114,000. There is a heavy vine component in the compartment.

Recommendations:

No harvest is planned for this compartment during the duration of this plan.

Compartment 51

Compartment 51 was donated to the University in 2004 by the South Cumberland Community Land Trust. That organization purchased the property, donated a Forever Wild easement to the Land Trust for Tennessee and then donated the remainder interest to the University. It appears to have been heavily harvested around 1980, and has had no management since that time. University records indicate a wildfire in this area in the early 1950s.

Recommendations:

The Forever Wild nature of this easement precludes any management. This compartment does have an extensive road network left over from historic logging which could be used for trail development at a later date and in coordination with the easement holder.

Compartment 400

Compartment 400 was planted in loblolly pine in the 1970s after it was obtained by the University via a gift from Robert and Florence Snowden. This pine was harvested in 2004 during the last southern pine beetle outbreak. After the harvest, the site was replanted with a mix of oak species (bare root seedlings), but no control of the regeneration on the site or protection of the seedlings was attempted.

Today the majority of the stand is dominated by yellow poplar that naturally regenerated after the last harvest. Some areas are dominated by sweetgum and loblolly pine natural regeneration as well. No sign of the planted oaks was found during an inspection for this plan. The understory is dominated by Chinese privet. In some areas the privet is so extensive that it is the only species present. Wisteria and Japanese honeysuckle are found throughout the compartment as well.

Recommendations:

This compartment will be ready for timber harvest at the end of or just beyond the time horizon for this plan. Just after thinning, a commercial mulching machine should be brought in to control the exotic species between the remaining trees. At least two years of herbicide control will be required in this compartment post thinning to control the exotic species. This compartment is part of an old farm and contains hand stacked walls that could serve as a focal point, however they are currently covered by exotic species.

Section 8. Conservation Area 6

Conservation Area 6 is the 910 acres surrounding Lake Dimmick and includes the Cheston Farm, and consists of Compartments 60 and 80 (Figure 26).

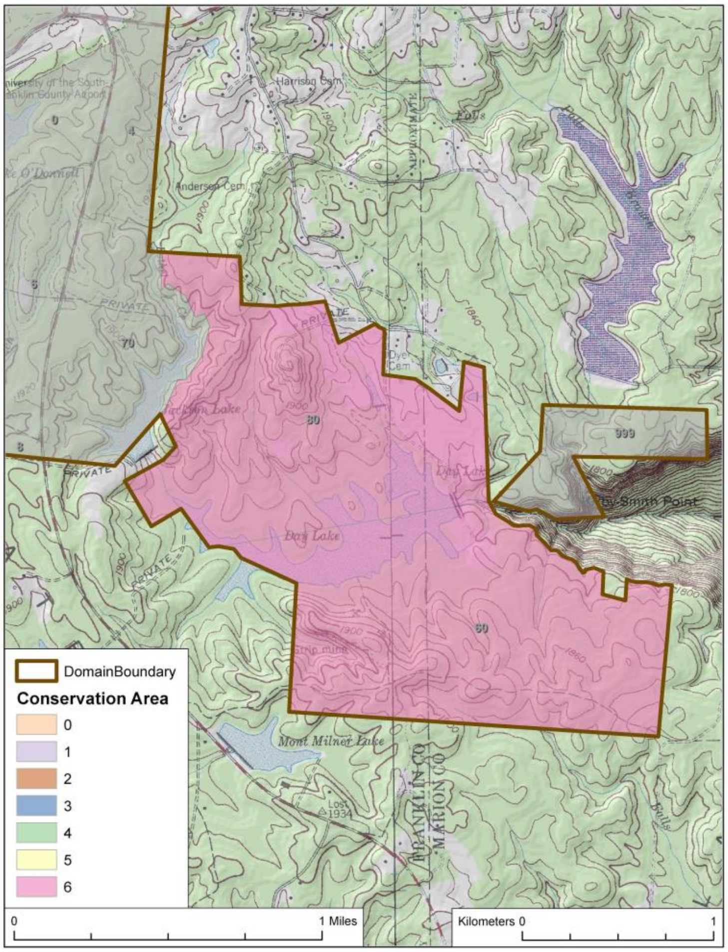


Figure 26. Conservation Area 6 are the lands surrounding Lake Dimmick and includes the Cheston Farm, consisting of Compartments 60 and 80, approximately 910.1 acres.

History and Current Use

This conservation area was the site of early European settlement and use. The area was known as the Tickbush community and some coal mines in this conservation area are thought to have been excavated before the civil war. This area was acquired by the University through a series of donations and purchases beginning in the 1960s and continuing through the late 1990. The oldest sections are the northeastern portion of Compartment 80, which were donated by the Jackson family for residential development around lake Jackson. Clarence Day made the donation of Day Lake (now Lake Dimmick) in 1988 after donating lands around the lake in 1980. The university then purchased property from Charles Cheston in 1993 and the Cravens family in 1996. Both purchases were to enhance residential and development possibilities around Lake Dimmick.

The focal and activity center of this conservation area is Lake Dimmick, a 93-acre impoundment that separates Compartment 60 and Compartment 80. The lake was built in 1971 and renovated significantly in the early 1990's.

Lake Dimmick dominates the current use in the area. The lake is used by students, faculty, and community members for many types of recreation. The University crew team is based on the Lake and their dock is popular for swimmers. There is a second dock associated with a camping area on the north shore of the lake. It is accessible via the Lake Dimmick trail.

Conservation Area 6 also contains Little Mountain, the tallest point of the Domain. Little Mountain is one of the few areas of the Domain where the Whitwell Shale formation can still be observed and contains several coal mines dating back to the 1800s. On top of Little Mountain is the Cheston Cabin, a camping location used frequently by students. Strip mining also occurred in the southwest portion of Compartment 80 in the early 1960s.

Much of the property acquired by the University from Charles Cheston was a cattle farm. The portion of that farm east of the Lake Dimmick road is leased for cattle to a local farmer. Much of Compartment 80 is leased for hunting rights.

Current Condition of Forest Communities

Aside from Lake Dimmick and its associated riparian and wetland habitat, Conservation Area 6 consists of a closed canopy hardwood forest, abandoned pasture, and open pasture. The pasture areas are all part of Compartment 80 that was formerly owned by Former University Forestry Professor Charles Cheston. Aerial photos indicate that some portions of this farm had been cleared since at least 1950, but Cheston expanded the clearing in 1987.

The hardwood forest throughout this conservation area has been heavily impacted by humans. Records of harvest come mostly from courthouse records. Cheston sold all his merchantable timber to Mead in 1987, while the Cravens heirs sold all of their merchantable timber in 1969. The Jackson tract was also heavily harvested in the 1960s. There are a few remnant shortleaf pines in Compartment 80, and aerial photos from 1968 indicate that pines were much more common in this conservation area at one time.

Today the forests are dense and dominated by pole and small sawlog timber. Some large diameter oaks remain that were passed over in previous harvest, but the majority is regeneration from prior harvests. The overstory contains more red oak than other areas of the Domain, probably due to historic logging which favored the more valuable red oak. There is also a high proportion of red maple throughout the area, particularly in areas where old agricultural fields were located. There is some planted white pine along the western edge of the compartment near Lake Jackson.

Rare, Threatened, or Endangered Species

Conservation Area 6 contains three plants either listed as threatened or of special concern by the State of Tennessee. There are no known federally listed plants in this area. Compartment 80 contains an occurrence of Quill Fameflower (*Phemeranthus teretifolius*), Heavy Sedge (*Carex gravida*), and Foxtail Clubmoss *(Lycopodiella alopecuroides*). All three of these species are forbes that prefer open fields and woodlands, which will be improved throughout the conservation area as part of our desired future condition.

Soils

Conservation Area 4 is dominated by soils in the Hartsell and Muskingum soil series which are well drained sandy loams of variable depth (Figure 27). Hermitage (Hc, Hd) silt loams are also widespread in this area, primarily due to the presence of the Whitwell Shale, which is not common on the Domain. In addition, there are multiple sandstone outcrops and very thin soils adjacent to the bluff. This conservation area has undergone extensive historic use (road travel, coal mining, habitation sites, farming) and likely has experienced high levels of soil erosion since the mid-19th century. There are also several small strip mines in this area (coal).

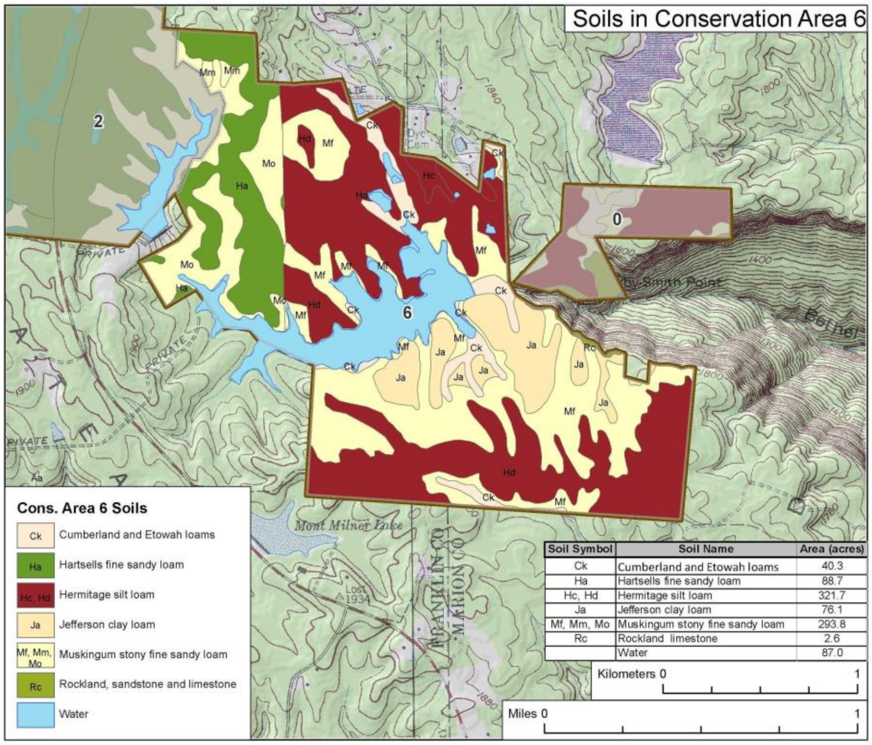


Figure 27. Soil map for Conservation Area 6, the area surrounding Lake Dimmick, Compartments 60 and 80.

Water Resources

The most unique water feature of Conservation Area 6 is that all waters flow into Bethel Creek. No other part of the Domain drains in this direction. Though Lake Dimmick is the dominant water feature in this area, it actually contains five additional ponds and is bounded on the west by Lake Jackson, Sewanee's secondary drinking reservoir. All of the ponds were built by Charles Cheston to water cattle. They vary in size between ¼ and 1.5 acres. Some are in poor condition and at this time only three of them hold water year round. The pond in the northeast corner of Compartment 60 is home to many beavers that live in and below the pond. There are also two small streams that flow unimpeded off of the property from Compartment 80.

The only two lakes that receive use beyond an occasional fishing trip is Lake Dimmick, Lake Jackson, and Leaky Pond. Leaky Pond was a .8-acre pond in Compartment 60 that has a large leak. Though it fills during large rain events, it rarely holds water for more than a month and therefore contains no fish. Its ephemeral nature has led to a unique assemblage of amphibians.

Lake Dimmick, though large in surface area, is quite shallow for the most part. This gives the lake a large littoral zone that is used by waterfowl and animals alike. It also provides an excellent location for the growth of *Brasenia schreberi* an exotic pond plant which covers a good portion of the surface area during the summer. 120 hybrid grass carp were released into Lake Dimmick in 2012 to control the Brasenia, and some spraying of herbicide is done to keep areas used by the crew team clear.

Lake Jackson is Sewanee's secondary drinking water reservoir, and was built in 1968. Water is pumped from Lake Jackson regularly into Lake O'Donnell (Conservation Area 2). The lake is used sporadically for fishing and some limited swimming.

Cultural Resources

Conservation Area 6 incorporates Compartments 60 and 80 on the eastern side of the upland area of the Domain, centering on Day Lake (also called Lake Dimmick). This area, divide by the Marion and Franklin County line is located just south of the Midway community. During the late 19th and early 20th century most of Compartment 80 was referred to as "Tick Bush." This largely Euroamerican community consisted of around 30 houses (Grundy County Newspaper 1995) between today's Day Lake and Jackson Lake (both of these are human made, dammed lakes). This community likely developed around the coal mining that took place, and is still visible across the area. This community is mentioned several times in Ely Green's (2004) autobiography and his avoidance, as a young African American man, of the community and those who live there.

Day Lake was created by an earthen dam that likely dates to the early, mid-20th century. An historic road passes along the north eastern edge of the two compartments, following the current access road and then continuing across the creek below the current dam. This road cuts along the eastern side of Compartment 80 where a systematic shovel testing survey was carried out by the University in 2014, prior to improvements in the existing cleared field to prepare it for cattle. This survey revealed no prehistoric sites but it did indicate where a late 19th or early 20th century structure had been bulldozed and burned on the western side of the pasture. Portions of the rest of Compartment 80 have undergone surface mining, significantly impacting the surface, decreasing the potential for the preservation of open air prehistoric sites. There are however three prehistoric rockshelters listed in the Tennessee state site files in Compartment 80. These are Sewanee Conglomerate shelters meaning they are high in the local geological sequence, so are typically found away from the bluff edge. One of these sites in particular has been heavily looted. There is also a high probability that similar sites, open air and Sewanee Conglomerate rockshelter sites exist away from the strip mine areas in Compartment 60.

The Sewanee Conglomerate rockshelters form natural shelters, typically in the upper reaches of creeks formatting at or near springs on top of the plateau. These sites were focal points on the landscape for prehistoric hunter-gatherers. During their seasonal rounds, following plant and animal resources, small family groups would reside in these shelters for weeks or months at a time (Walthall 1998). The results from three small excavations, two from sites in Area 3 and one in Area 2 (a Sewanee Conglomerate shelter) indicate that these shelters were used during the fall and spring with a heavy focus on nut crops such as hickory and acorn as early as 9,000 years ago (Carmody and Sherwood 2014; Sherwood et al. 2012). Later in time, when groups began to reside in larger village sites, mostly in the valleys, these sites continued to be used as logistical foraging camps and likely as ritual or pilgrimage sites based on the presence of rock art in the area.

Confederate and Union troops both crossed the “Cumberland Mountains” using the roads at the time. There are historic roadbeds that cross the Area and could have been used during the mid-19th century for troop movements and obviously earlier to access Bethel Creek Cove and the Battle Creek area beyond. Confederate and Union troop activity is well documented, both in the form of encampments and skirmishes in the areas in and around Sewanee, associated with the Tullahoma Campaign (O.R., I, 22, pt. 1; Woodworth 1998). These actions are mostly linked to troops under the command of Maj. Gen. William Rosecrans of the Union army and Gen. Braxton Bragg leading the Confederate army. The battle on July 4, 1863 in this area was the last battle of the Middle Tennessee Campaign. It began on July 1, where Sherwood and Cowan Roads crossed in what is now in the vicinity of the western part of Area 2 in Compartment 14. The battle stretched through “University Place” along the Cowan Road and the Stage Coach Road (O'Connell, 2019).

Historic sites like those described here are significant since they represent an historically “invisible” part of the Sewanee community. Tick Bush, populated by low income people of Euroamerican descent, was just such a community. They appear to have been a tight knit community, socially and economically separate from the higher income community growing up around the University. Their lives tell a story that is an important part of the fabric of the community today and should be sought out and protected just as those sites belonging to Episcopal bishops. Knowledge about the region’s 18th and 19th century Euroamerican, African American and Native American farmers and their related activities (small-scale mining and quarrying, farming, moonshine production, etc.) has the potential to inform early historically unrecorded land use practices as well as social and economic systems that local communities created to manage this changing social and natural landscape.

Recreation

The centerpiece of recreation in this area is Lake Dimmick. It is the home of the University Crew team which practices there throughout the fall. The lake is also used by the Sewanee Outing Program for canoeing and swimming, and community members can check out a key to the gate from police dispatch for daily boat launch.

The Lake Dimmick trail was completed in 2014 and provides walking access from central campus to the Lake. It terminates at the Lake Dimmick camping area which features its own dock and fire ring. From the Lake Dimmick trail users can also access the Cheston Cabin, a reservation only cabin on top of Little Mountain. More than 700 acres of compartment 80 is leased for bow hunting every year. The boundary of the hunt lease is kept well away from the shore of Lake Dimmick to maximize the safety of the lake users.

Desired Future Condition

The overall goal of Conservation Area 6 is to maintain and enhance uplands in an open native oak/hickory/pine mixture, maintain intact riparian and littoral areas in water bodies while increasing the economic value of the standing timber resource. Many areas that are or were in open pasture at University purchase may be maintained that way to provide continuous open early successional habitat. The pre-European settlement condition of this area (as is the case with the rest of the Cumberland Plateau) is unknown, but the landscape position, soils, topography and current condition lend themselves to a management regime designed to move the compartment toward the Allegheny-Cumberland Dry Oak Forest and Woodland/South-Appalachian Low Mountain Pine type. Some portions of the area are not far from that trajectory, but many areas could be improved general reduction in stand density, an increasing emphasis on regeneration of the oak components of the stand, and supplemental plantings of desirable species. The entire area could be improved with the reintroduction of prescribed fire.

Management tools focusing on prescribed fire with some limited harvest to lower stand density can be used to carry out those goals.

Compartment Summaries and Management Recommendations

Compartment 60

Compartment 60 was acquired by the University in 1996. Before its acquisition, portions of the property were strip mined for coal, and the compartment was heavily harvested for timber in 1969 (courthouse records). The stand’s current condition reflects this prior management. Currently, Compartment 60 has a basal area that ranges from 90-130 ft^2/acre, and the canopy has a mix of smaller diameter oak, red maple, and scattered hickory and yellow poplar. There are small pockets of Virginia pine near the bluff and a few scattered shortleaf pine. There is an area of very high quality hardwood timber near the old strip pits in the northwest corner of the compartment. This area was likely left out of the 1969 harvest due to proximity to the strip mines.

Recommendations:

A 100-acre harvest associated with the National Fish and Wildlife Foundation Shortleaf Pine Restoration Project is scheduled to take place here beginning in late summer 2019. The goal of this project is to create conditions to allow the re- establishment of shortleaf pine on the Domain using harvest and prescribed fire. The harvest conditions are very similar to conditions faced throughout privately owned lands on the Cumberland Plateau. The tract has previously high-graded several times and subsequently the stand low ecological function and economic potential. The 2019 harvest will utilize patch clearcuts for shortleaf replanting, along with variable retention thinning in areas where sufficient volume of oak exists. Riparian areas will be protected using the stream BMPs outlined above to provide legacy trees and refugia for numerous species including amphibians, avian species, small mammals during harvest.

Two years following the completion of harvest and shortleaf planting in early 2020, prescribed fire will be reintroduced to the harvest area. An additional harvest of the same nature could occur in this compartment in 2023 or beyond depending on the ecological success of the 2019 harvest. Regardless of subsequent harvest, the area will be managed with prescribed fire beginning in 2023.

Compartment 80

Compartment 80 consists of the forest surrounding the northern edge of Lake Dimmick, west of Lake Jackson, and the Cheston Farm. Harvest histories for these areas are sparse, but the Lake Jackson property was harvested in the late 1960s prior to donation to the University. Charles Cheston clearcut 22 acres in 1987 which was the westernmost portion of pasture at the foot of Little Mountain. We have no harvest history for the Lake Dimmick tract, but it appears to be still recovering from a harvest in the 1960s. On the Cheston Farm, much of the former pasture is secondary forest consisting of sweetgum, eastern red cedar, red maple and yellow poplar. The eastern portion of the Cheston Farm was cleared in 2011 and again in 2018 for use as pasture.

Recommendations:

The trajectory for this compartment is to maintain oak hickory woodland where currently present, and preserve the early successional habitat provided by the old Cheston Farm. The forest areas are currently red oak dominated, white, chestnut, and post oak to lessor extents. The site quality is generally poor on the ridgetops, with higher quality forests in the drains. In the old farm area, the westernmost portion of the farm will be allowed to regenerate to forest, pasture areas east and north of Little Mountain can be preserved with prescribed fire and perhaps harvest as timber reaches pulpwood size. This compartment is divided into three burn units and one unit was burned in January of 2019 as part of the National Wildfire Coordinating Group (NWCG) wildland firefighter training and these units will continue to be burned on an annual rotation basis.

Any harvest in the old farm fields is likely more than 5 years away unless a whole tree pulpwood operator can be found to chip trees onsite. The forests of Little Mountain proper should not be harvested within the time frames of this plan. The ground is uneven and unstable from the historic mining activity. Any potential future harvest in this area should be done in coordination with a mine reclamation plan to stabilize the old pits.

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Appendices

Appendix A. Natureserve Description of Domain Habitats

Table 3: The habitat types of the Domain as described by NatureServe and The Nature Conservancy. Habitat types that are bolded are mapped on Figure 2.

Habitat Type	Description
Plateau Surface	
Allegheny-Cumberland Dry Oak Forest and Woodland	A forest system that is dominated by white oak, southern red oak, chestnut oak, scarlet oak and black oak, with lesser amounts of red maple, pignut hickory, mockernut hickory, and sometimes sprouts of American chestnut. Scattered and small inclusions of shortleaf or Virginia pine may occur, particularly along to escarpments or following fire. In the absence of fire, white pine may become established.[1,2]
Southern Appalachian Low-Elevation Pine Forest	This ecological system consists of *Pinus echinata*- and *Pinus virginiana*-dominated forests. Vegetation is dominated by Virginia and shortleaf pine; occasionally with pitch pine. Hardwoods may be abundant, especially dry-site oaks such as southern red oak, chestnut oak, and scarlet oak, but also pignut hickory, red maple, and others. A heath shrub layer may be well developed. Herbs are usually sparse, though communities of this system may have been grassy when fires were more frequent. The ecological character and natural distribution of this system has been obscured over the years by human settlement, universal logging, pine beetle outbreaks, and fire suppression. Pine-dominated forests have been both created and destroyed in different places by these disturbances. [1,3]
Sandstone Outcrop and Bluff	
Cumberland Sandstone Glade and Barrens	This system encompasses a complex of sparsely vegetated rock outcrops, perennial grasslands, and woodlands on shallow soils on the Cumberland Plateau of Kentucky, Tennessee, Alabama, and Georgia. Herbaceous plants, including Diamorpha smallii and Minuartia glabra, are typical of the outcrops in Tennessee.[2]
Plateau Wetland	
Central Interior Highlands and Appalachian Sinkhole and Depression Pond	Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. Ponds vary from open water to herb-, shrub-, or tree-dominated. Tree-dominated examples typically contain Quercus species, *Platanus occidentalis*, *Fraxinus*

	pennsylvanica, *Acer saccharinum*, or *Nyssa species*, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.[2]
Cumberland Seepage Forest	Examples of this seepage-influences, primarily forested wetlands are most often occurring in streamhead swales or on broad sandstone ridges where soils are sandy and saturated due to a combination of perched water table and seepage flow. Examples range in condition from open woodlands to forests, and some may lack a canopy and then will be dominated by shrubs or herbs. Typical woody species, when present, include *Acer rubrum, Nyssa sylvatica, Liriodendron tulipifera, Liquidambar styraciflua, Ilex opaca var. opaca, Oxydendrum arboreum*, and *Kalmia latifolia*. Typical shrubs include *Ilex verticillata, Alnus serrulata, Rhododendron maximum, Aronia melanocarpa, Vaccinium simulatum, Viburnum nudum*, and *Cornus foemina*. Typical herbaceous species include *Osmunda cinnamomea, Osmunda regalis var. spectabilis, Chasmanthium laxum, Thelypteris noveboracensis, Woodwardia areolata, Oxypolis rigidior, Carex intumescens, Carex debilis*, and *Carex crinita*. Patches of *Sphagnum* spp. are common and *Sphagnum lescurii* is typical.[2]
Sandstone Cliff Face and Rockhouse	
Cumberland Acidic Cliff and Rockhouse	This system typically consists of extremely steep or vertical rock faces exposed along bluffs often associated with rivers. The aspect is variable but best developed on south- and west-facing sites. Plants are infrequent due to the lack of crevices capable of accumulating soil, the highly acidic nature of the bedrock, and the frequent weathering and erosion of the substrate. Lichen cover may be extensive in places, especially on the more exposed portions. These cliffs are also prone to harsh climatic conditions; frequent disturbances include drought stress and wind and storm damage. As a result, examples are characterized by sparse herbaceous cover and few, if any, trees. Vegetation consists of scattered individuals of *Asplenium montanum, Silene rotundifolia*, and other species rooted in crevices and erosion pockets. In some parts of its range, this system is the primary or sole habitat for rare endemic species, such as *Minuartia cumberlandensis* and *Ageratina luciae-brauniae*. This system includes a mosaic of cavelike features (often called "rockhouses") and associated sandstone box canyons in the western Appalachian foothills regions.[2]
Upper Slope Dry	
Southern Interior Low Plateau Dry-Mesic Oak Forest	This habitat of upland hardwood-dominated forests occurs in the Interior Low Plateau region of the southeastern United States along ridgetops and slopes of various aspects. The floristic expression of different stands included in this habitat varies considerably with aspect and soil type. Included are a variety of associations ranging along a moisture gradient from submesic to drier ones. The submesic to dry-mesic expressions tend to be found on midslopes with northerly to easterly aspects, and the drier ones on southerly to westerly aspects and on broad ridges. Parent material can range from calcareous to acidic

	with very shallow, well- to excessively well-drained soils in the drier expressions and moderately well-drained soils in the submesic to dry-mesic ones. The canopy closure of this system ranges from closed to somewhat open in the drier examples. Historically, these examples may have been more open under conditions of more frequent fire.[4]
Upper Slope Mesic	
South-Central Interior Mesophytic Forest	A high-diversity, predominantly hardwood forests that occurs on deep and enriched lowland soils or in somewhat protected landscape positions such as coves or lower slopes. Dominant species include sugar maple, beech, tuliptree, basswood, red oak, cucumber tree, and black walnut. Hemlock which may be a component of some stands, is being rapidly reduced by the hemlock woolly adelgid (*Adelges tsugae*) in some stands. Trees may grow very large in undisturbed areas. The herb layer is rich, often with abundant spring ephemerals. The core distribution of this system lies in the unglaciated Cumberland and Allegheny plateaus. [2,5]
Limestone Outcrop and Glades	
Central Interior Highlands Calcareous Glades and Barrens	This system occurs along moderate to steep slopes and steep valleys on primarily southerly to westerly facing slopes. Limestone and/or dolomite bedrock typify this system with shallow, moderately to well-drained soils interspersed with rocks. These soils often dry out during the summer and autumn, and then become saturated during the winter and spring. *Schizachyrium scoparium* dominates this system and is commonly associated with *Andropogon gerardii*, *Bouteloua curtipendula,* and calcium-loving plant species. Stunted woodlands primarily dominated by *Quercus muehlenbergii* interspersed with *Juniperus virginiana* occur on variable-depth-to-bedrock soils. Fire is the primary natural dynamic, and prescribed fires help manage this system by restricting woody growth and maintaining the more open glade structure.[2]
Southern Interior Calcareous Cliff	This system includes vertical to near-vertical rock faces of limestone and dolomite. These cliffs are typically dry but may contain relatively small embedded seepage patches. Both wet and, more commonly, dry expressions are included. Due to harsh edaphic conditions, including verticality, these cliffs are nearly unvegetated, however, *Asplenium ruta-muraria* and *Pellaea atropurpurea* may be characteristic plants. Some cliffs have scattered *Thuja occidentalis* trees which may be very old (>800 years) and more genetically diverse than northern populations. This system also covers a narrow zone of vegetation, often herbaceous, at the horizontal clifftop where growing conditions are harsh and often gladelike.[2]
Lower Slope Dry	
Southern Ridge	This system includes dry to dry-mesic calcareous forests of the Southern Ridge and Valley

Valley/ Cumberland Dry Calcareous Forest	region of Alabama and Georgia, extending north into Tennessee, Kentucky, Virginia and adjacent West Virginia. It includes calcareous forests on lower escarpments of the Cumberland Plateau and other related areas. Examples occur on a variety of different landscape positions and occur on generally deeper soils than glade systems of the same regions. This system is distinguished from those farther north in the Ridge and Valley by its relatively southern location in the region, in an area which is transitional to the "Oak-Pine-Hickory" region. High-quality and historic examples are typically dominated by combinations of Quercus species and Carya species, sometimes with Pinus species and/or Juniperus virginiana as a significant component in certain landscape positions and with particular successional histories. These forests occur in a variety of habitats and are the matrix vegetation type that covers portions of the landscape under natural conditions. Examples can occur on a variety of topographic and landscape positions including valley floors, sideslopes, and lower to midslopes. Fire frequency and intensity are factors determining the relative mixture of deciduous hardwood versus evergreen trees in this system. Much of this system is currently composed of successional forests that have arisen after repeated cutting, clearing, and cultivation of the original forests. The range of this system is primarily composed of circumneutral substrates, which exert an expected influence on the composition of the vegetation.[2]
Floodplain	
South-Central Interior Small Stream and Riparian	Examples of this system occur along small streams and floodplains with low to moderately high gradients. There may be little to moderate floodplain development. Flooding and scouring both influence this system, and the nature of the landscape prevents the kind of floodplain development found on larger rivers. Cobble bars with adjacent wooded vegetation and rarely any marsh development, except through occasional beaver impoundments are typical. The vegetation is a mosaic of forests, woodlands, shrublands, and herbaceous communities. Canopy cover can vary within examples of this system, but typical tree species may include *Platanus occidentalis, Acer rubrum var. trilobum, Betula nigra, Liquidambar styraciflua*, and *Quercus* spp. Shrubs and herbaceous layers can vary in richness and cover.[2]
South-Central Interior Large Floodplain	Examples occur along large rivers or streams where topography and alluvial processes have resulted in a well-developed floodplain. A single occurrence may extend from river's edge across the outermost extent of the floodplain or to where it meets a wet meadow or upland system. Many examples of this system will contain well-drained levees, terraces and stabilized bars, and some will include herbaceous sloughs and shrub wetlands resulting, in part, from beaver activity. A variety of soil types may be found within the floodplain from very well-drained sandy substrates to very dense clays. It is this variety of substrates in combination with different flooding regimes that creates the mix of vegetation. Most areas, except for the montane alluvial forests, are inundated at some point each spring; microtopography determines how long the various habitats are inundated. Although vegetation is quite variable in this broadly defined system, examples may include *Acer saccharinum, Platanus occidentalis, Liquidambar styraciflua, Populus*

	deltoides, and *Quercus* spp. Understory species are mixed, but include shrubs, such as *Cephalanthus occidentalis* and *Arundinaria gigantea* (= ssp. gigantea), and sedges (Carex spp.). This system likely floods at least once annually and can be altered by occasional severe floods. Impoundments and conversion to agriculture can also impact this system.
Anthropogenically-modified habitats	
Forest Plantation	A plantation forest may be afforested land or a secondary forest established by planting or direct seeding. A gradient exists among plantation forests from even-aged, single species monocultures of exotic species with a fibre production objective to mixed species, native to the site with both fibre and biodiversity objectives. This gradient will probably also reflect the capability of the plantation forest to maintain "normal" local biological diversity.[6]
Old Field/ Successional	Ecological succession that occurs on abandoned farmland and represents new habitat for plant and animal species to colonize.[7]
Pasture	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.[8]
Cropland	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled. [8]
Excavated Land	Bedrock, gravel pits and other accumulations of earthen material. Vegetation generally accounts for less than 15% of total cover.[8]
Developed Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses, and impervious surfaces accounting for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.[8]
Low-High Intensity Developed	Areas with a mixture of low to high intensity developed areas where people live and work in high numbers, including single-family to multifamily residences, apartment complexes, commercial, constructed materials and vegetation, impervious surfaces accounting for 20-100% of total cover.[8]
Open Water	All areas of open water, generally with less than 25% cover of vegetation or soil.[8]

Sources (see references for full citation)
1: NatureServe
2: The Nature Conservancy. A.
3. The Nature Conservancy C.

4. Greater Appalachian Conservation Partnership
5. The Nature Conservancy. B.
6. Convention on Biological Diversity
7. The Virtual Biology Labs (Rutgers)
8. NLCD 2011 Land Cover

Appendix B. Chart of Historical Activities on the Domain by Compartment

Historic Activities on the Domain

			1800's		1900-1920		1920-1940		1940-1960		1960-1980		1980-2000		2000-2019	
CONSERVATION AREA	COMPARTMENT	Acquired by the University	1860-1890	1890's	1900-1910	1910-1920	1920-1930	1930-1940	1940-1950	1950-1960	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	2010-2019
Conservation Area 1																
	Compartment 11	1860								**H** H/P H/P	H/D H/P H/P H/P H/P	H/P H/P H/P H/P				
	Compartment 53	2007												H H H H	H	
	Compartment 52	2007												H H H H	H	
	Compartment 54	2007												H H H H		
	Compartment 55	2007												H H H H		
Conservation Area 2																
	Compartment 2	1903								H		H				F F F
	Compartment 4	1858								H/D	H	D				
	Compartment 6	1860			D					H/A H D/H D	D P D			D D D	H H/P F ND/H/PF	H/ND/PF **PF/H** PF PF PF
	Compartment 8	1860	H H		H					H H H/P H/P	H/P H/P H/P H/P H/P	H/P H/P H/P H/P H/P				ND/H /P H/PF/ P PF/ P PF/P
	Compartment 10	1860								**H** H	P	P	H		H H H	
	Compartment 12	1859			D					D/H H	P P	H			ND	
	Compartment 14	1857								H H			H			
	Compartment 70	1860								D		D H/P				
Conservation Area 3																
	Compartment 13	1860								H H H H	H	H				
	Compartment 15	1860								H H H H/P	H/P P P H/P H/P	H/P H/P H/P H/P H/P	H/P			
	Compartment 17	1860								H H H	P P P P					
	Compartment 19	1860								H H H H	H P H					
	Compartment 21	1860								H/F H H	H H					
	Compartment 23	1860								F H H	H H	H H	H H			
	Compartment 25	1933								H/F H H	H H	P				
	Compartment 27	1860								H/F H H	H H	P				
	Compartment 29	1933								H/F H H	H H	P				
	Compartment 31	1958								F F						
Conservation Area 4																
	Compartment 16	1860								H H			H H	D D D D	D D D D D	
	Compartment 18	1860	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	H	P P		H H			
	Compartment 20	1860	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	H	H/P P P	P P	ND			H P P P
	Compartment 22	1860	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	H	P P		H		H/P	
	Compartment 24	1860	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	H H H H	P P D	P	H			H
	Compartment 26	1860														
	Compartment 28	1860								H	H P P	H	H			
	Compartment 30	1860								H	P P	H	H H			
	Compartment 32	1860	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	H/D D D P	D D P H	H	H			
	Compartment 34	1860								H	H	H/P	P			
	Compartment 36	1860								H H		P	H			
	Compartment 38	1860									P H/P	P H				
	Compartment 40	1962								H H P P			H			
	Compartment 42	1860				D H D				H H	P P HP	HP HP	H			
	Compartment 44	Late 1880's			D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	H H P	P P P P HP	HP H				
	Compartment 46	1962								H H H P	P P P P P		H		H	H/P P H/P
	Compartment 48	1962								H H H P	P P P P P		H H			
	Compartment 50	1958	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D D D D	D D ND P P			H		H	H/P
Conservation Area 5																
	Compartment 33	1958														
	Compartment 1	1860											ND			
	Compartment 3	1860								H	H					
	Compartment 5	1860								H	H	H	H			
	Compartment 7	1903								H F	H	H				
	Compartment 51	1986								F						
	Compartment 400	1903														
	Compartment 9	1860								H H	H P P	P H				
Conservation Area 6																
	Compartment 80	1987									H	D	H			
	Compartment 60	1980									H	D				D D

H= Harvest
D=Disturbance (Manmade)
P=Planting
F=Fire (Prescribed or Natural)
ND= Natural Disaster Disturbance

Appendix C. Chart of Proposed Management Activities by Conservation Area/Compartment

Proposed Future Management on the Domain

		2019	2019-2020			2020-2021			2021-2022			2023-2024			2024-2025			Notes
CONSERVATION AREA	COMPARTMENT	Easter/ Summer	Advent	Easter	Summer	Advent	Easter	Summer	Advent	Easter	Summer	Advent	Easter	Summer	Advent	Easter	Summer	
Conservation Area 1																		
	Compartment 11																	
	Compartment 53																	
	Compartment 52																	
	Compartment 54									F F F F F								
	Compartment 55																	
Conservation Area 2																		
	Compartment 2						F F F F F			F F F F F								
	Compartment 4																	REMOVE 50 WHITE PINE
	Compartment 6	F F F F F									H H	H H H H						
	Compartment 8			F F F F F			F F F F F			F F F F F			F F F F F			F F F F		WHITE PINE REMOVAL IN NEXT 10 YRS
	Compartment 10	F F F F F	H H H H H	F F F F F			F F F F F			F F F F F			F F F F F			F F F F		
	Compartment 12								H H H H H									
	Compartment 14																	
	Compartment 70																	
Conservation Area 3																		
	Compartment 13																	Exotic Control
	Compartment 15																	
	Compartment 17																	
	Compartment 19																	
	Compartment 21																	
	Compartment 23																	
	Compartment 25																	
	Compartment 27																	
	Compartment 29																	Site specific C. morefieldii work
	Compartment 31																	Any harvest would coincide with Emerald Ash Borer entering this stand.
Conservation Area 4																		
	Compartment 16																	
	Compartment 18																	WOULD BENEFIT FROM 2+FIRES IN NEXT 10 YEARS
	Compartment 20															F F F F		
	Compartment 22	F F F F F		F F F F			F F F F F			F F F F F	H	H H H H	F F F F F			F F F F		
	Compartment 24									F F F F F								PROPOSED LOW INTENSITY Rx FIRE
	Compartment 26																	
	Compartment 28						F F F F F				H	H H H H						
	Compartment 30					H H H H H												FOLLOWED BY FIRE 1-2 YRS LATER
	Compartment 32									F F F F F								
	Compartment 34										H H	H H H H						
	Compartment 36																	
	Compartment 38																	
	Compartment 40																	
	Compartment 42	F F F F F					F F F F F			F F F F F			F F F F F		H H H H			
	Compartment 44						F F F F F			F F F F F			F F F F F		H H H H			
	Compartment 46	P P P P P					F F F F F			F F F F F			F F F F F			F F F F		Comprtment 42-50 consists of a rotation unit burn system. Not all will be burned each year. Please refer to the text.
	Compartment 48						F F F F F			F F F F F			F F F F F					
	Compartment 50			F F F F F			F F F F F			F F F F F			F F F F F			F F F F	F	
Conservation Area 5																		
	Compartment 33																	
	Compartment 1																	
	Compartment 3																	
	Compartment 5																	Exotic Species Control
	Compartment 7																	
	Compartment 51																	
	Compartment 400																	Exotic Species Control (Privet)
	Compartment 9																	
Conservation Area 6																		
	Compartment 80	F F F F F		F F F F			F F F F			F F F F			F F F F			F F F F		
	Compartment 60		H H H H P	P P P						F F F F F			F F F F F	H	H H H	F F F F		

H= Harvest
P=Planting
F=Fire (Prescribed or Natural)
E= Exotic Species Removal

Appendix D. List of Known Current Research Activities on the Domain by Faculty, Staff, and External users

Domain Project Title	Lead Sewanee Investigator (name)	Collaborating Sewanee Faculty/ Staff (names)	Outside Collaborator (name, institution)	Study Initiated (year)	Expected Completion Date (year or ongoing)	Project Objectives	Location	Size of Study Area (ha)	Propsal Tier/Impacts to the Domain	Plot Markers (indicate how to identify)
Bear Surveys	A. Turner	N. Wilson	Dan Gibbs (TWRA), J. Clark (UTK)	May-18	Jul-18	The study objective is to estimate population size and density of bears in the Secondary range Tennessee. Population estimates over large areas can benefit from economies of scale which will result in improved estimation results compared with piecemeal estimates; thus a region-wide approach is recommended.	Caldwell Rim Area		Tier 2	OESS Tags
Small mammal surveys of the Domain	A. Turner	K. Smith, K. Fouts	J. Campbell	2017	Ongoing	To establish a record of small mammals on the Domain and evaluate the effects of forestry treatments and habitat conditions on small mammal populations.	Domain wide		Tier 2	None
Acoustic Bat Monitoring	A. Turner	K. Smith, K. Fouts	J. Campbell, D. Thames, TWRA	2017	Ongoing	To establish a record of bat populations on the Domain and evaluate the effects of forestry treatments and habitat conditions on bat populations.	Domain wide		Tier 3	Tagged with OESS tags
Effect of sewage exposure on gambusia sexual morphology	B. Moore	Edwards	Brain Langerhans, NC State	2015	Ongoing	Use the Natural design of Lake O'Donnell as a reference site and the SUD lagoons as a treatment/polluted site to investigate the effects enviromental contaminate exposure on the sexual phenotype of Gambusia (mosquitofish).	?	Lake O'Donnell and the DUB lagoons	N/A	?
A geology for walkers on the Southern Cumberland Plateau	B. Potter	Knoll	UTC,	1980	2018	Book for public audience on geology of plateau	na	entire domain	na	none
Plateau hydrology and deformation on Cumberland Plateau	B. Potter	knoll, van de ven	n	1994	ongoing	understanding mechanics of cumberland overthrust	none	20, 46, shakerag, Dotson point,	na	none
Sewanee Perspectives, Chapter 2 How firm a foundation	B. Potter	G, Smith and Williamson	n	1980	complete	Layman's introduction to Domain Geology and History	none	all	incomprehensible	none
Mass Wasting on the Domain	B. Potter	Knoll	n	1994	ongoing	Understaning Patterns of Mass Wasting	none	south east, lost cove, other sinks	observational	none
Hardwood pine conversion	D. Mcgrath	several								
Public perceptions of water and wastewater management in Sewanee	D. Mcgrath		Laurie Fowler	2016	ongoing	Assess perspectives on water use and wastewater treatment				
C,N,P cycling in effluent-treated and natural upland forest	D. Mcgrath	Torreano, White	SUD	2015	ongoing	Compare nutrient storage and cycling between treated and untreated forest	SUD watershed	10 10x10 plots	storm water samplers	

A comparison of water chemistry and invertebrate communities among ephemeral ponds	D. Mcgrath			2011						
Soil chemistry and microinvertebrate populations in response to Japanese Stiltgrass Invasion	D. Mcgrath			2005						
Ecosystem service modeling/valuation Haiti and Domain	D. Mcgrath	Van de Ven	David Saah (USF)							
Clematis morefieldii Inventory	J. Evans	A. Turner, N. Wilson	T. Crabtree, TN Nat Heritage	2009	Ongoing	To monitor a small set of plants for fecundity and vigor.	17,19,21,23	Lower portions of these compartments	Tier 2	None
Population Ecology of Hill Cane	J. Evans			2014	2019	(1) Examine the effects of burning on hill cane populations located at two different distances from streams. (2) Examine clone structure and rates of clonal growth in these populations	28,36,34,38	Cane populations in these 4 compartments	Burn treatment on selected circle plots	Flags and rebar marking plot centers. Culms tagged with slit straw pieces and metal tags
Effect of Agricultural Legacies on Ecological Change at the King Farm	J. Evans			2010	Ongoing	(1) Compare forest community composition and soil properties of a 60 year old abandoned farm with that of an adjacent old growth, oak-hickory stand. (2) Combine historical research with ecological fieldwork in a novel approach to understand how agricultural practices can influence trajectories of plant succession	44	Southern half of Compartment 40 - about 30 hectares	None	Blue flags and rebar marking plot centers
Vernal Pools and Landscape Change	J. Evans	K. Cecala	N. Hollingshead, Cornell Univ. B. Scheffers, Univer of Florida	2004	2016	(1) Identify locations of all vernal pools on Domain (and throughout the rest of the southern Cumberland Plateau). (2) Examine terrestrial habitat loss and land ownership change around these ponds. Domain ponds serve as a control in this large landscape study.	17,24, 48, 55, 40	Domain wide	None	No

Long-term Chestnut Oak Demography	J. Evans			1997	Ongoing	(1) Examine long-term temporal and spatial changes in the size class distribution and density in a chestnut oak population. (2) Parameterize a demographic model in order to forecast future population change. (3) Examine seed rain, seedling survival, and sapling success spatially within the population relative to biotic and abiotic drivers. (4) Investigate the role of sprouting as a mechanism for persistence through times of environmental stress or damage.	40	1 Hectare	Tree tags and measuring tape on ground marking sub plot boundaries	All 20m x 20m corners in hectare marked with pvc pipe. Trees over 1.5m tall tagged with metal numbered tag and breast ht. All individuals .5m to 1.5m marked with red or blue flag and tagged with metal numbered tag. 200 circle plot centers marked with pink flags
Dick Cove - 20 yrs of Forest Dynamics	J. Evans	K. Hiers	Leighton Reid - MOBOT	1995	Ongoing	(1) Examine changes in composition and structure between adjacent cove and upland forest communities. (2) Test whether theories of landscape resiliency for the Cumberland Plateau are supported by long-term data.	38,1,40	20 - 0.1 Hectare Circle plots. 10 in Cove and 10 on Plateau	None	Labelled PVC Pipe and Leaf Litter Box
Anthracnose Impact on Dogwood Populations	J. Evans	K. Hiers	Leighton Reid - MOBOT	1995	Ongoing	Track long-term change in dogwood populations due to the invasion of anthracnose blight			None	
Vascular Flora of the Domain	J. Evans	M. Priestley Y. Gottfried G. Ramseur	D. Estes, Austin Peay Univ. N. Hollingshead, Cornell Univ.	1994	Ongoing	(1) To document the vascular flora of the Sewanee Domain, (2) document rare or threatened plants, (3) document non-native plants, (4) document new state and Franklin county records, (5) list characteristic habitats for each taxon, and (6) compare floristic similarity of five Tennessee Cumberland Plateau floras to the the Domain flora.	Domain wide	Domain wide	None	No
Landscape Effects of Deer Browse	J. Evans	K. Cecala K. Hiers C. Van de Ven		2010	Ongoing	(1) Assessed the effectiveness of different metrics to quantify the impacts of deer herbivory. (2) Examine spatial heterogeneity in deer herbivory patterns across an upland oak-hickory forest as a function of habitat edge, portals that faciltiate deer movement and other landscape features.	16,18,26,24,22,20,28,30,34,36,38,44,42,40,48,46,50	Plateau surface east of campus out Breakfield road. 1242 Hectares	None	Rebar marking begining and end of 50 m transects
Coarse Woody Debris	J. Evans			2013	Ongoing	Inventory changes in coarse woody debris in compartments on the Domain that have experienced different logging histories.	40,42,36,30	Portions of each compartment	None	None
Land-Use Mapping of the Domain	J. Evans			2008	Ongoing	Track past, present and future land-use on and around the Domain using remote sensing and GIS.	Domain Wide	Domain Wide	None	None
Japanese Spirea Invasion Ecology	J. Evans			2015	Ongoing	Examine the spread of this invasive as a function of water dispersal , habitat edges and limestone run-off.	24	East half of compartment 24	None	Rebar marking transect endpoints

Mountain Laurel Mortality	J. Evans			2013	Ongoing	Track mortality in mountain laurel populations response to drought.	0,2	5 ha	None	Rebar marking plot centers
Sandstone outcrop endemic plant monitoring	J. Evans			2013	Ongoing	Track changes in density of Minuartia and Diamoprha populations	2	12 sandstone outcrops north of Piney Point	None	Metal tag nailed in rock at plot center
Long-Term Vegetation Plots	J. Evans			2010	Ongoing	Track changes in plant community composition and structure in 15 community different types.	18, 0, 52,20,80,17,19,9, 2, 23, 54	Circle plots located throughout the Domain in representative locations of each plant community	None	Rebar and flags marking plots
Sassafras Demography	J. Evans			1999	Ongoing	Determine temporal and spatial change in size class distributions within a sassafras population.	40	1 ha	None	Pink flags marking 200 1m diameter circle plots.
Chestnut Oak Woodland Restoration	J. Evans			2013	Ongoing	Track understory response to white pine removal in a chestnut oak woodland site.	0,2	4 permanent plots in 2 ha area cleared of white pine compared to equivalent area without white pine	White pine removal	Rebar marking plot centers
Deer Browse in Dick Cove	J. Evans			2013	Ongoing	Track long-term understory recovery to deer browse in Dick Cove through the use of deer exclosures.	1	5 Exclosures with a 5m x 5m permanent plot in center. Paired control plots outside exclosures.	Mesh fence stapled to trees around exclosure plots	Rebar marking plot centers
White Pine Control Fire-Clipping Study	J. Evans			2011	Ongoing	Examine the interactive effects of clipping and burning on White Pine control and hardwood recovery.	8	6 ha study area - 3 blocks of 4 plots each Plot size: 50m x 100m with 70m box transect inside plot.	Fire and/or pine clipping treatments	Rebar marking start and end of box transects
Behavioral associations with thermal regimes	K. Cecala			2017		Evaluate if movement and exploration behaviors are associated with temperature and if they affect interactions between competitors.				?

Distributions and Body Condition of Stream Salamanders on the Cumberland Plateau	K. Cecala			2015		Assess body condition and distribution of stream salamanders on the Cumberland Plateau		Bethel Creek, Greenhaw Creek, Abbo's Alley, Roark's Cove	None	None
Forest Management Effects on Terrestrial Salamanders	K. Cecala			2015	2020	Assess changes in population density, biomass, diet, and activity associated with microclimates	0, 6, 8, 16, 20, 24, 46		Placement of 192 cover boards	None
Distributions of crevice dwelling salamanders	K. Cecala			2015		Assess distribution of salamander inhabiting bluff habitat on the Domain			None	None
Effects of tail autotomy on terrestrial salamander habitat selection	K. Cecala			2015		Determine how tail autotomy affects future habitat selection	19		None	None
Competitive outcomes between a native salamander and invasive fish	K. Cecala			2016	2016	Evaluate relative growth rates and change in body condition between a native salamander and non-native fish		Rattlesnake Springs	Permanent removal of 72 P. ruber larvae	None
Effects of small dams on stream salamanders	K. Cecala	Haskell, White		2013		Determine abundance of stream salamanders below small impoundments relative to undammed streams			None	None
Diets of Eastern Red-Spotted Newts	K. Cecala			2014		assess diet of Notophthalmus viridescens in three ponds on the Domain		Lakes Cheston, Torian, Cedar Hollow	None	None
Growth to Metamorphosis in Eastern Red-Spotted Newts	K. Cecala			2014		Assess growth rates and size at metamorphosis for caged larval Notophthalmus viridescens at the golf course		Lake Torian	None	None
Effects of Glyphosate on Stream Salamander Anti-Predator Behaviors	K. Cecala			2014		Evaluate how salamander behaviors change after exposure to low concentrations of glyphosate		Abbo's Alley	None	None
Ambystomatid Salamander Migrations	K. Cecala			2015	2025	Assess timing and abundance of salamander migrations through time relative to local climate	48		Installation of drift fence	None
Capture-mark-recapture of stream salamander larvae	K. Cecala			2014	2020	Assess movements and abundane of stream salamanders following rain events		Abbo's Alley and Rattlesnake Springs	None	None
Turtle Capture-Mark-Recapture	K. Cecala			2014		Evaluate turtle occupancy and abundance on campus - Typical pond relative to SUD		Farm Pond, SUD	None	None

Desmognathus Surveys	K. Cecala		Alex Pyron, David Beamer	October 22-26, 2018		To genetically identify a currently undescribed (apparently) species on the Domain, we will survey and sample stream salamander species of the genus Desmognathus. Specifically, we will collect no more than 2 individuals per site per species. Specimens will be euthanized with MS-222 and preserved for accession into a natural history museum (Alex Pyron). Genetic analyses will identify this lineage and specimens will be used to morphologically characterize the species. Given our current understanding of the species, Sewanee will be the holotype and currently the only land-owner where we find the species. To identify and describe a species that does not morphologically resemble known species in the region.	Depot Branch, Unnamed Tributary of Depot Branch, Bethel Creek, Bridal Veil Falls		None	
Georgie's Honors Thesis is investigating stream ecosystem function in the Boiling Fork Watershed.	K. Cecala			11/1/17-09/01/18		To assess if streams below wastewater spray fields demonstrate different functional properties.	SUD Stream 1, SUD Stream 2, SUD Stream 3, SUD/MGT Stream, P-Trail Stream, Clara's Point Stream, Upper Abbos Alley		Tier 3 / All tiles, leaf litter bags, and flagging tape will be removed at the end of the study.	
Effects of wastewater on anuran development and carryover effects	K. Cecala	McGrath		2018	Ongoing	Evaluate in- and ex-situ development of tadpoles in native ponds, secondary and tertiary wastewater treatment ponds		SUD, Lake O'Donnell, Lake Cheston	Tier 4. Removal of 10 partial egg clutches of S. Leopard frogs	
Project SEEP - Stream Ecosystem Evaluation Project on the CP	K. Cecala	McGrath		2018	Ongoing	Describe major stream characteristics (physical, chemical, & biological) for permanent, ephemeral, forested, urban and SUD streams		Below Brushy Lake, Surprise Creek, Split Creek, Abbos Alley, Rose Branch, Depot Branch, Rattlesnake Springs, SUD streams		
Effects of dam removal on stream function	K. Cecala	Watson		2018	Ongoing	Using BACI design, evaluate effects of dam removal on stream function.		Brushy Lake, Surprise Creek, Back Cheston Farm Lake, Unnamed Stream?/Bethel Creek		
Abbo's Alley water sampling	K. Kuers	kuers and knoll	USFS, Northern Research Station	2001	ongoing	monthly	water flow and nutrient qualities	0	monthly grab samples	reduced flow by 1 liter per month
Kirby smith regeneration	K. Kuers	Kuers	USFS	1976	1997	na	growth diameter, height, species compositon	23	1/100th acre plots at 4 chain intervals	none

emerald ash borer	K. Kuers	Wilson	Tennessee Division of Forestry	2016	ongoing	TBD	mortality, residual stand composition and growth	23	20x20 meter plots	none
overtopped oak study	K. Kuers	K. Smith	Wayne Clatterbuck, UTK	1995	ongoing					
Urban forest	K. Kuers	kuers, W. Shealey, N.Wilson		1996	ongoing	biannual	growth, health, diameter, height and species composition	0	individual tree assessment	none
Gap Size regeneration	K. Kuers	Wilson, Smith	USFS, Bent Creek	2013	ongoing	Analysis of the tree regeneration in and immediately adjacent to the gaps;	8			
Ecological Research as Education Network	K. Kuers		multiple collaborators	2010	ongoing	20x20 m plots revisited every 1 to 2 years for vegetation monitoring				
split creek watershed	K. Kuers		Collaboration Through Appalachian Watershed Studies	2001	ongoing	monthly water samples, annual vegetation samples, annual leaf litter collection				
Chipper site	K. Kuers	Torreano		1995	ongoing	To access the long-term effects of species conversion on biomass production and soil properties following silvicultural clearcuts	15 ha	RCB	Wooden boundary, PVC center	see Kuers
american chestnut planting	K. Smith	n wilson	american chestnut foundation	2014	2018	progeny test of b3f3 chestnut seedlings	50	3 acres	clearing created	y
comp 46, 8, 20 oak regen	K. Smith	n wilson		2009	ongoing	thinning, fire, reponse of oak seedlings, understory	46,20,8	125 acres	positive	y
Piney Point regeneration	K. Smith	a nunley		2011	2020	shortleaf restoration	2	10 acres	positive	y
compartment 10 harvest recovery	K. Smith	a nunley		2005	2020	post-harvest recovery	10	60 acres	positive	n
Soil legacy 20, 40, 50	K. Smith	sherwood		2012	2017	soil dynamics	20, 40, 50	10 acres	big time	y
Shortleaf pine restoration	K. Smith	A. Turner, N. Wilson, Van de Van, Nunley	TNC, FSG, Berea	2017	2020	The use of thinning and fire to create conditions conducive to shortleaf pine regeneration and growth.			Tier 4. thining, planting, burning, restoration	
Ant Diversity on the Southern Cumberland Plateau	K. Zigler									
Brood size of the stygobiotic asellid isopod *Caecidotea bicrenata bicrenata* from Franklin County, Tennessee, USA	K. Zigler									
Chemical defense of a troglobiont milliped, *Tetracion jonesi*	K. Zigler		Bill Shear, Hampden-Sydney							
Molecular phylogeography of the troglobiotic millipede *Tetracion*	K. Zigler		Bill Shear, Hampden-Sydney							

Caves as islands: Mitochondrial phylogeography of the cave-obligate spider *Nesticus barri*	K. Zigler		Marshal Hedin, San Diego State							
Cave Biodiversity on the Domain	K. Zigler									
Reproductive seasonality in *Nesticus* cave spiders	K. Zigler		Patty Perlaky, Alan Cressler (USGS)	2012						
Phylogenetics of *Ptomaphagus* cave beetles	K. Zigler		Markus Friedrich, Wayne State Univ							
Gis and SMZ	Lemoine	ksmith, jevans								
rebels rest	S. Sherwood	G. Smith, Torreano, Carmody								
cook site	S. Sherwood	K. Smith								
Comp 40 homesite	S. Sherwood	K. Smith								
Walker Springs Homesite	S. Sherwood	Potter								
King Farm	S. Sherwood	Evans								
Michael's Shelter	S. Sherwood	Carmody, Knoll								
Uzelles Shelter	S. Sherwood	Carmody, Knoll								
Ongoing rock face art survey	S. Sherwood	Carmody	Simek, UT, Herrmann MS State							
All the above	S. Sherwood	Carmody								
Chipper site regeneration	S. Torreano	Kuers	USFS, name unk	1996	ongoing	To access the long-term effects of species conversion on biomass production and soil properties following silvicultural clearcuts				
Tree allometry on the Domain	S. Torreano	Wilson								
Deer vegetation Monitoring (Transects and exclosures)	S. Torreano	Torreano, Wilson, Hiers, Kuers		1997	ongoing	To access browse on vegetation in fixed area plats. Possibly link with Distance program analysis of transect data (spotlighting)	Compartment wide		browse plots have 2 aluminum stakes	42309
Stand structure and mortality	S. Torreano	Torreano	Justin Hart, Univ of Alabama and Stacy Clark, USFS, Knoxville	1994	ongoing		0	grid of 100 plots	brass tags buried at base of center plot tree	38991
Rebel' Rest dendro work	S. Torreano	Torreano, Sherwood	Maegen Rochner and Laura Smith, University of Tennessee, Justin Hart, University of Alabama, Patrick Vestal	Dec-14	ongoing	Date construction of Rebel's Rest, Investigate forest canopy disturbance and infer climatatic conditions in local forests suing tree-ring record	Rebel's Rest research site	varies by objective	none	

Torreano compartment 31/33 work	S. Torreano	Torreano, Van de Ven, Wilson		Advent 2015						
Old Growth Dynamics	S. Torreano	Torreano	Justin Hart, Univ of Alabama, Stacy Clark. US Forest Service							
Plantation Growth and Yield (Loblolly Pine)	S. Torreano	Smalley, Nunley	John Rennie, UTK	1958	closed, plantation harvested	Acess the potential of *Pinus taeda* on high productivity sites of the Highland Rim physiographic province	6 hectares	CRD	obliterated	2003
Dendrochronology work	S. Torreano									
Climate research - dendrochronology	S. Torreano		Justin Hart, Univ of Alabama and Stacy Clark, USFS, Knoxville							
Shortleaf pine planting	S. Torreano	K Smith, Wilson		2014	ongoing	To test practical silvicultural techniques to regenerate native pines on sites formerly in hardwoods. Emphasis is on providing students opportunities to observe shortleaf pine communities				
Montane Longleaf planting	S. Torreano	K Smith, Wilson		2013	ongoing	To test practical silvicultural techniques to regenerate a pine of significant cultural and botanical value on sites formerly in hardwoods. The montane variety of long-leaf pine is regionally important in conservation. To examine the survival and growth of hand-planted long-leaf pine in areas harvested and burned to favor rgeneration of fire-conditioned tree and understory species.	several areas less than 0.5 hectare (actual planted areas)	100% sample of planted areas, replicated in space but subject to burn schedule and other logistics	flagging	2014
American Chestnut	S. Torreano	S Smith, Wilson	Stacy Cark, Schweitzer, USFS, Scott Schlarbaum, UTK	2006	ongoing	Access the efficacy of planting and silvicultural practices in establishing native American chestnut n Cumberland Plateau forests. Seed source/genetics are an important research question by Schlarbaum	approximately 5 hectares	RCB 3x2 with burning and thinning as split plots		
Burn research/demonstration	S. Torreano	K Smith		2013	ongoing	Provide data sets for students and Torreano to use in accessing the role of fire on the soil characteristics. Previous pine stand was salvaged harvested and restored with mostly shortleaf pine	approx 8 hectares	CRD	none	none
Sewanee Utility District (SUD) research	S. Torreano	McGrath	Sewanee Utility District, Ben Beavers, Pamela Edwards, USFS	1993	ongoing	Access the effects of appled sewage effluent on forest vegetation, soil, surface, and ground water	approx 28 hectares	CRD	Lysimeters and well heads are used for spatial control	

Sewanee Utility District (SUD) constructed wetland research	S. Torreano	McGrath, White	Sewanee Utility District, Ben Beavers, Laurie Fowler, UGA, Pamela Edwards, USFS	2012	ongoing	Access the efficacy of relatively small wetlands to treat human sourced compounds.	0.5 hectare	various	TBD	none
Plantation Growth and Yield (White Pine)	Smalley	Torreano, Nunley	Henry McNab, USFS , Asheville	1964	closed, plantation harvested	Access the productivity of *Pinus strobus* on sites of former agricultural use on the Cumberland Plateau	1 hectare	complete sampling on 2 plots (2 Landtypes)	obliterated	2008
This project will look at the effects of pharmaceuticals, mainly estrogens, in the population of Gambusia affinis that exist in Lake O'Donnell, the Sewanee Utility District (SUD) sewage treatment lagoon C, and the constructed wetland at the SUD.	T. Edwards	Brandon Moore, Carrie Martin		9/15/17 - 9/14/18		The objective is to test for elevated blood glucose levels and changes in reproductive physiology, and histological and skeletal anatomy in Gambusia affinis from three different locations with variable water quality on the Domain. We expect that fish from Lake O'Donnell will exhibit normal blood chemistry, tissue histology and reproductive physiology. Conversely, we expect fish from the SUD to exhibit elevated blood glucose and altered histology and reproductive physiology. If the constructed wetland is being successful at removing estrogenic pharmaceuticals from treated wastewater, then fish from the constructed wetland should exhibit phenotypes more similar to those from Lake O'Donnell than those in the SUD.	Lake O'Donnell, the Sewanee Utility District (SUD) sewage treatment lagoon C, and the constructed wetland at the SUD.		Tier 4	
Stormwater quality and erosion	Knoll			2000	ongoing	Determine impact of stormwater on water quality and soil erosion in local watersheds	entire Domain		none	
Monitoring extent and change of hydrocarbon plume at PPS shop	Knoll			1996	ongoing	Determine extent and attenuation of petroleum plume in groundwater over time	PPS shop area	2 hectares	none	
Dye tracing in Lost Cove	Knoll	Watson		20016	ongoing	Determine patterns of groundwater flow in a karst terrane of Lost Cove	Lost Cove , including Motlow property		none	
Microplastics in waters of Domain and vicinity	Knoll			2019		Determine levels of microplastic contamination in streams, lakes, wetlands and springs of Domain	Domain			

Appendix E. Forest Management Considerations and Best Management Practices on Karst Landscapes: A Lesson in Evidence-Based Management Guidelines

Forest Management Considerations and Best Management Practices on Karst Landscapes: A Lesson in Evidence-Based Management Guidelines

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In 2016 The Tennessee Chapter of The Nature Conservancy (TNC) initiated a forest management project, Working Woodlands, targeting large (3000+ acres) privately owned tracts in Tennessee. The Working Woodlands project is designed to increase sustainable forestry in the region by employing preferred conservation-based silviculture techniques on these lands. This project enables landowners to offset the cost of potentially reduced forestry revenues by enrolling in the private carbon market.

Much of Tennessee consists of a significant karst landscape. Tennessee is known regionally as the cave state, containing over 10,000 known caves according to the Tennessee Cave Survey. With caves come other karst features such as sinkholes, sinking streams, swallets, springs, etc. The Tennessee Chapter of The Nature Conservancy performed an international review of forest management plans with karst considerations and found very limited consistency within those plans and almost no documentation of evidence to support management prescriptions and guidance.

Plans are written with a variety of circumstances, objectives, and resources in mind, so variability in plans is certainly expected and acceptable. However, without stated supporting evidence of guidance rationale and reasoning, implementers and future planners are likely to experience reduced acceptance and long-term implementation may suffer. Certainly, by including evidence-based rationale, planners will give significant resonance and increased buy-in to any plan.

With that being said, the landscape of research and literature specific to forestry conservation practices and techniques associated with karst features is limited. Through this project, TNC identified what is likely a well-known research gap, specifically in reducing erosion and sediment loss on karst as a result of forest management. There is considerable research, comparatively, on bat responses to silviculture, and some evidence of trogloxene foraging ranges significant to cave and karst ecology, as well as other evidence to support conservation of karst features. TNC used what supporting evidence it could find, along with existing karst-based forestry plans, to create forestry management recommendation on karst landscapes for the Working Woodlands Program.

The following guidance is designed to be part of a larger forest management plan, so a lot of generalized language and some definitions will be noticeably absent, as they are covered in the general forest management plan. This plan does provide supporting evidence when possible, but some recommendations for which we could not find sufficient evidence are inspired by other forest management plans, notably those created for the United States Forest Service-AZ (2015), British Columbia-Canada (2003), and Tasmania (2002). This document will be continually updated as new research and information become available and supported in scientific literature. TNC's Working Woodlands karst recommendations are presented here to support and provide evidence for conservation forestry recommendations on karst, and to raise awareness of the value of evidence-based management, and the leverage provided by documenting rationale within resource management plans.

for contaminants to be filtered, and the fact that sediment can be carried into and through the subsurface. Karst areas contain what are among the most environmentally sensitive of terrains and ecosystems, and among the most complex and least understood hydrologic and geomorphic systems (Veni, 1999). They therefore require specialized management considerations.

Karst systems are often typified by an overall reduction in surface water and a suite of topographic and geologic features specific to surface and groundwater interactions. These features include caves, sinkholes, sinking streams, swallets, and springs. The presence of these features on a landscape are often indicative of karst terrain and indicators of complex surface and groundwater relationships. Groundwater can move very rapidly through karst terrain, carrying contaminants and sediment with it.

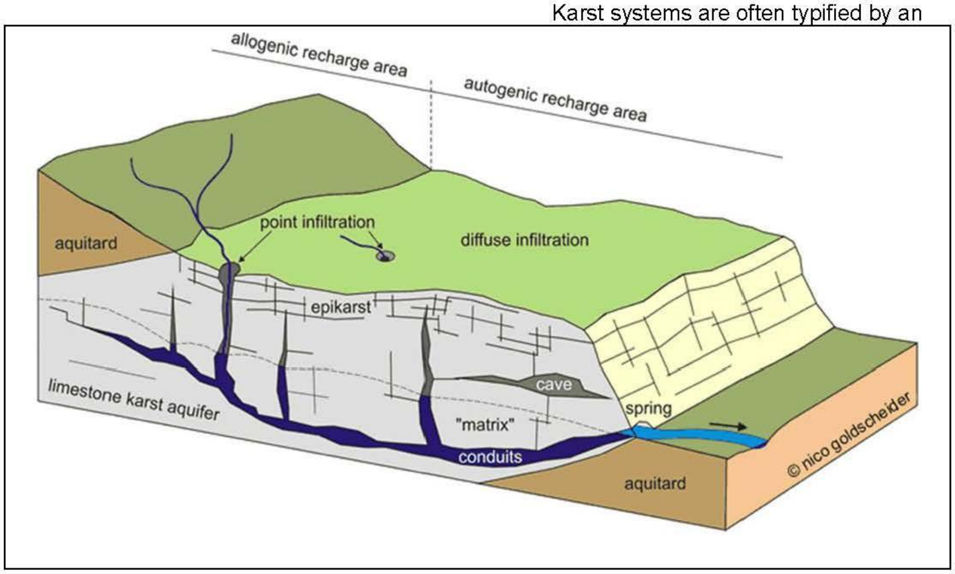

Figure 1. Typical features found with karst landscapes (Goldscheider and Drew, 2007).

Forest management considerations and best management practices on karst landscapes

Karst landscape/aquifer systems are formed from the dissolution of soluble rocks such as limestone, dolomite, and gypsum. Karst topography is characterized by underground drainage systems with sinkholes, caves, underground rivers, and large springs (**Figure 1**). Karst aquifers are often cavernous and can have very high permeability, resulting in groundwater that is, typically, highly vulnerable to contamination. This comes from high groundwater velocities, reduced opportunity

Surface aquatic resource protection and erosional processes on non-karst terrains are generally well understood with existing guidance and acceptance from forestry professionals, such as widely implemented state Best Management Practices (BMPs). Karst terrains complicate water protection and erosion inhibition as water does not generally flow across the surface landscape following topography and creating surface drainage features. Karst terrains can be extremely variable and complex, but in general surface water travels underground having entered the subsurface either through diffuse infiltration or very often through discreet points where surface streams, often intermittent, sink into sinkholes and swallets. In contrast to most other groundwater, once water goes underground within karst terrains there less opportunity for filtering or other amelioration of contaminants; therefore, it is necessary to take extra precaution to prevent hazardous contamination and sediment loss in the first place.

Key objectives while conducting active forest management on karst landscapes include efforts to:

- Maintain the ability of karst landscapes to regenerate healthy and productive forests after harvesting
- Maintain the quality of surface and subsurface habitats of karst ecosystems to ensure biodiversity
- Maintain the natural flows and water quality of the impacted karst hydrologic systems
- Reduce soil erosion around karst features and into the subsurface
- Provide/maintain quality roosting habitat for bats
- Maintain the natural rates of air exchange between surface and subsurface atmospheres
- Manage and protect significant surface karst features (e.g., sinkholes, sinking streams, springs, and cave entrances) and subsurface karst resources (e.g., caves, underground streams, and subterranean fauna); and
- Provide recreational opportunities where appropriate.

Prominent Karst Features
As mentioned, there are a variety of features associated with karst landscapes and aquifers, each with unique considerations and risks for active management operations. The primary, and most frequently impacted features include:

- caves
- sinkholes
- swallets: where surface streams sink underground

A **cave** is often considered any underground space large enough for a human to fit into. The National Speleological Society does not specify size limits for cave classifications or sizing. Many state speleological groups define cave qualifications, but there do not seem to be broadly accepted standards currently. For natural resource management purposes, the following definition of a cave, largely borrowed from the Kentucky Speleological Survey, seems appropriate: "*any humanly enterable natural void or cavity, which may be horizontal or vertical, and has a length or depth equal to or greater than 10 meters (32.8 feet). A feature which is wider than it is long and has a width equal to or exceeding 10 meters (32.8 feet) will be documented as a shelter*." This is a good starting point; however, cave definitions can be adjusted within a forest management plan to conform with regional, organization, or agency standards.

Caves are incredibly unique habitats and can be home to a myriad of organisms. These can range from surface dwellers that exploit the cave climate to fully adapted animals who survive just fine in complete darkness and generally live nowhere else. Ecologically, caves are void of sunlight and are largely allelopathic, or dependent on external energy sources (Poulson and Culver, 1969). Those energy inputs come from sources including dissolved organic carbon seeping in through porous rocks, sinkholes and sinking streams washing in organic material, and trogloxenic organisms—or “part time” cave utilizers—such as bats and crickets foraging outside caves and bringing energy in.

Most North American caves do not have large populations of bats, however cave crickets are a reliable source of energy through guano deposition, eggs, and carcasses (Mohr and Poulson, 1966; Barr, 1967). Cave crickets are considered a keystone species for caves as they maintain cricket guano communities, egg predators, and provide dispersed energy inputs that increase biological diversity in caves (Lavoie et al., 2007). Cave crickets are vulnerable to changes within their foraging radius (Lavoie, 2007; Taylor et al., 2007) and impacts to crickets will have direct effects on cave ecology. Crickets are known to forage regularly within a 105m radius of cave entrances (Taylor et al., 2005). They are also extremely sensitive to changes in vegetation and microclimate (Studier and Lavoie, 1990), especially warming and decreases in relative humidity.

In addition, many caves do provide habitat for bats. There are 45 species of bats in The United States (Hammerson et al., 2017). These bats are among the most imperiled terrestrial vertebrates on the continent (Hammerson et al., 2017). 21 species of North American bats utilize caves as roost sites and many North American bats breed in the forested areas immediately surrounding cave entrances in the fall (Barbour and Davis, 1989; Dalton, 1985, 1987; Furey and Racy, 2015). Forest management considerations for bats should not be limited to caves and karst features, and should be addressed more generally in any forest management plan in a landscape with rare, threatened, or endangered bat species.

Figure 2. River sinking into a karst aquifer at a swallet. In this case significant quantities of sediments, fecal bacteria and agricultural chemicals are being washed into the aquifer with little filtering or other attenuation. Photo by Chris Groves.

Sinkholes are natural, closed depressions found on the surface in karst landscapes. They are often semicircular in shape and are extremely variable in dimensions. Sinkhole sides range from gently sloping to vertical, and their overall form can range from saucer-shaped to conical or even cylindrical. Sinkholes are extremely variable in size ranging in area from just a few square feet to over 5 square miles in North America.

A **swallet** is a distinct area or hole into which a surface stream sinks into the karst aquifer (**Figure 2**). Swallets can be discrete features, within closed depressions, or beneath alluvial streambeds where water sinks incrementally through the sediment into fractures in the rock below as the stream flows along the channel. Swallets can be within sinkholes and are distinguished by being a much smaller point feature on the landscape, often, but not always, with a visible open space where water flows underground.

Sinkholes and swallets are considered significant components of a hydrologic system as they harbor great potential as contaminant and sediment loss zones. Surface water is generally captured within these features and once underground there is little to no process for filtration or other contaminant attenuation processes. Within karst terrains, sinkholes and swallets are therefore critical points for aquatic resource protection. They are the interface where surface water becomes groundwater and are critical points for watershed protection.

organisms seeking specific microclimate conditions provided by karst features (Batori et al 2012). These karst features often create habitat islands for remnant species. These same habitat islands and refugia may well provide added landscape resiliency in the face of changing climate conditions where the overall trend is increased temperature and/or decreased humidity (Batori et al 2014). In addition, the epikarst, caves, and myriad of underground spaces within a karst terrain provide additional habitat for a wealth of organisms specially adapted to these environments (Culver and Pipan 2009).

Waltham and Fookes (2003) along with many others have created classifications of sinkholes, generally based on geologic processional origin of the feature (**Figure 3**). For the purposes of sustainable forest management operations, geologic derivation of the feature is less important and the concern is more with natural resource protection; specifically, potential

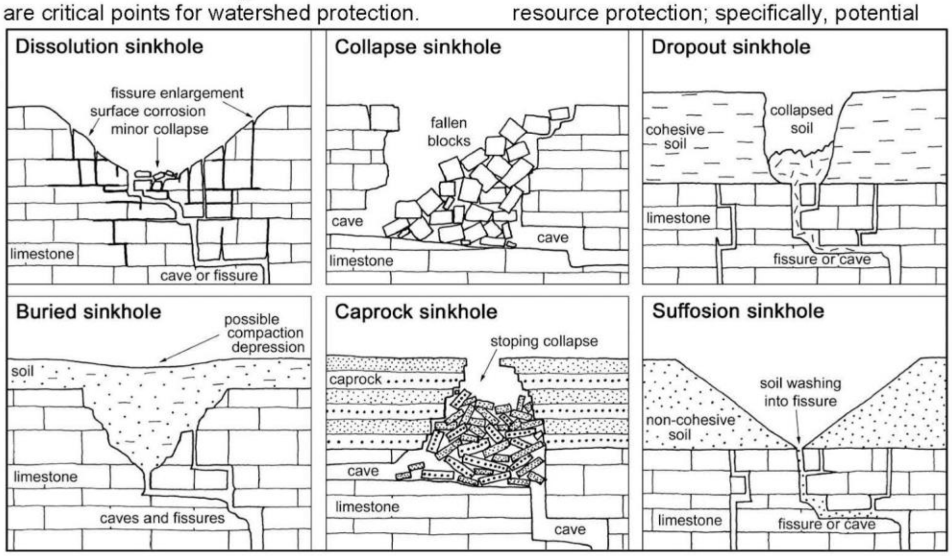

Figure 3. Sinkhole types from Waltham and Fookes (2003).

Karst terrains also contain considerable “bonus” habitats that generally don’t occur elsewhere. Sinkholes, swallets, and cave entrances are often refugia for a myriad of for exacerbated erosion and functional ability to maintain natural karst feature microclimates. The following guidelines and best management practices should apply to all karst features to some extent but are primarily targeted at those with the highest environmental risk associated with forestry activities: caves, sinkholes, and swallets.

Best management practice recommendations for forest management on karst landscapes

Given the sensitive and unique nature of karst landscapes, appropriate, specialized Best Management Practices should be implemented. Analogous to Streamside Management Zones (SMZs) as part of common water quality BMPs, it is recommended that Karst Management Zones (KMZs) with additional surface protections be established where applicable. Below is a collection of non-regulatory karst BMPs designed to supplement current water quality BMPs in areas of karst topography. These recommended BMPs are designed to protect karst systems and limit impacts caused by surface disturbances.

General best practices for karst landscapes

The following practices are generally recommended when operating on karst landscapes and are designed to limit negative impacts resulting from forest management operations:

- Ensure that the activities of forest management do not result in observable siltation of karst features
- Minimize exposing mineral soil as much as possible and the potential for erosion of any exposed soil should be minimized through appropriate mitigation measures including seeding, mulching, and/or covering with slash
- Ensure that roads, skid trails, landings, and other similar silviculturally disturbed areas are constructed outside of KMZs
- Keep the wheels or tracks of equipment at least 25-feet from the slope breaks of karst features. If not possible, keep wheels or tracks parallel to the edge of features
- Soil erosion and siltation is a primary concern therefore mitigation measures such as placement of soil barriers, traps, dips, slash distribution, and others to reduce disturbance and siltation should be implemented. Take additional measures as necessary to correct inadvertent water diversions to prevent sediment transfer into subsurface environments
- Fell and transport timber away from karst features and drainages
- Restrict harvesting to periods when the likelihood of heavy rains and high runoff are low
- Avoid locating roads over sinking streams, noting that some of these may only be active during rain events or snow runoff
- Remove any slash and debris that falls in or around a karst feature, provided removal does not cause further soil or feature disturbance
- Leave understory vegetation along buffer boundaries and live trees in and around harvest areas to help maintain interior microclimatic conditions and inhibit the encroachment of edge species into the buffer
- Retain non-merchantable trees, snags, advanced regeneration, wildlife trees, and other native vegetation within the KMZs
- If previously unidentified karst features are encountered, modify or cease operations until the features or values can be assessed and risks mitigated
- Locate storage areas for fuel and other hazardous materials off karst terrain or at least on low vulnerability areas and in appropriate containers

- Avoid fueling or servicing machinery near surface karst features and take appropriate measures should a spill occur
- Take measures to ensure human waste, petroleum products, herbicides, litter, and other pollutants do not contaminate karst landscapes by following proper storage and transport procedures
- Invasive and exotic species can be managed within KMZs
    - Invasive tree cuttings, trees should be felled away from karst feature
    - Chemical applications should be a last resort and applied with extreme care

Measures for specific karst features

For well-developed karst features, such as those described above, additional mitigation measures specific to karst systems are recommended. Management guidelines are minimum recommendations and forest managers are encouraged to go beyond these when appropriate, especially in low karst density project areas. In well-developed karst landscapes, sinkholes can be so large that they are not easy to identify as karst features in the field. Topographic maps, digital elevation models, remote sensing, and LiDAR technologies can be very useful in defining sinkhole boundaries.

Sometimes landscape features may align with multiple management recommendations. Default management action should always be to the highest level of minimum protection recommended when a feature falls into more than one definable resource protection category. For example, if a swallet is within a small Class 1 sinkhole, with classes defined in Table 1 below, there will be management recommendations for both the swallet and the sinkhole. The swallet management recommendations may be more protective and will therefore supersede the Class 1 sinkhole management recommendations.

Caves. Given the overall significance of caves and cave entrances, the following minimum protection recommendations are prescribed:

- Maintain a minimum no-cut buffer extending 200 feet from cave entrances
  For buffers around entrances of caves known to contain significant bat hibernacula or maternity colonies, or threatened or endangered species, contact local U.S. Fish and Wildlife Service biologists for potential species-specific criteria for that micro-site

Sinkholes, Sinkholes can be extremely variable in nearly all aspects, thereby making definition of management considerations challenging. Additionally, karst development, sometimes measured by sinkhole density, varies greatly, often within a forest management unit. Indeed, above some well-developed karst aquifers there may be little or no surface expression. To find the right balance between appropriate resource protection and minimizing managed acreage loss the incorporated sinkhole classification system and associated management guidelines for sinkholes is recommended. This is designed to give the greatest specificity for landscapes with very high karst development, but can also be simplified for regions with lower sinkhole density or less sinkhole diversity. All karst landscapes should be treated with additional care and be considered as sensitive areas, as described in local forestry BMPs guidelines.

In order to classify sinkholes, it is necessary to calculate their depth to area or diameter to depth ratio. This is conducted to determine a relationship between the area of the sinkhole and its depth as an indicator of sinkhole characteristics and the sink's erosional vulnerability and micro-climate refugia status. Sinkholes with a depth to area greater than 33% (or <3:1 diameter to depth) are expected to be more vulnerable to erosion and more likely to create a micro-climate that serves as habitat refugia.

Table 1 below describes the three classes of sinkholes, with each having different management recommendations. Diameters are estimated as an average for the sinkhole opening measured from the discernable rim. Depths are to be estimated from the lowest point of the sinkhole "rim" to the lowest point of the sink. The rim of a sinkhole is not always a watershed divide, especially on well-developed karst on steep slopes. The rim is often an observable boundary defined by an obvious change in slope, surface expression or soil/rock stability. A sinkhole rim may be vertically separated, especially when a sinkhole is on an extreme slope, or adjacent to a bluff or outcrop.

Table 1. Sinkhole class definitions.

Class	Description	Example
Class 1	• Traditional closed depression sinkhole of any shape • Less than 10 acres • Diameter to depth ratio >3	Diameter: 100' Depth: 32' Ratio: 3.1:1 or 3.1 (100/32) Therefore CLASS 1
Class 2	• Traditional closed depression sinkhole of any shape • Less than 10 acres Diameter to depth ration <u><</u>3	Diameter: 100' Depth: 34' Ratio: 2.9:1 or 2.9 (100/34), Therefore CLASS 2
Class 3	• Traditional closed depression sinkhole of any shape greater than 10 acres • Class 3 sinkholes often contain recognizable ephemeral stream courses ending in swallets	Larger than 10 acres Therefore CLASS 3

Like streamside management zones, karst management zones will often have Inner and Outer management zones with varying levels of activity allowed within each zone. The inner KMZ for Class 1 and Class 2 sinkholes extends 25 feet <u>from the rim of the sinkhole</u> in all directions. To maintain the integrity of the sinkhole, no harvesting is allowed in the Inner KMZs. The Inner margin of the sinkhole buffer should be located at the drainage divide, outside of which run-off will no longer flow into the sinkhole. That may not be practical for all projects, in which case the innermost boundary of the KMZ can be placed where the inflowing slope is 5 degrees or less.

An additional outer KMZ will be designated on CLASS 2 sinkholes. Harvesting in outer KMZs should be limited to single-tree and group selection, while maintaining at least 50 percent of the overstory. Roads, skid trails, landings, and other similar silviculturally disturbed areas are constructed outside of the outer KMZ, except when placement of disturbance-prone activities outside of the KMZ would result in more environmental disturbance than placing such activities within the outer KMZ. Outer KMZ's begin where inner KMZ's end. Inner and Outer KMZ minimum recommendations can be found in Table 2. Slope calculations in Table 2 for Outer KMZ widths <u>only apply upslope of the sinkhole being considered</u>. Erosional and microclimate risk associated downslope from the sinkhole rim is considered to be negligible.

Due to their larger size, Class 3 sinkholes have high potential for greater sediment loss and erosion. The highest level of consideration should be paid to road construction, ditch and stream crossings, skid trail erosion, log landings, closeouts, concentrated flow paths, etc. Chemicals such as hydraulic oil and/or herbicides should not be stored within Class 3 sinkholes unless sinkhole size and parcel dynamics prohibit storage elsewhere (Class 3 sinkholes can be hundreds of acres in size).

Swallets. Because swallets can be located within sinkholes, within stream courses, or as standalone features on the landscape, they will be managed for separately and in combination with other karst features. Care should be taken not to artificially direct runoff into a swallet. If a swallet is located within a sinkhole, whichever recommendation has the highest level of minimum protection recommended should be applied. Swallets should have an Inner KMZ of 50' and any recognizable stream course leading to a swallet should be treated as a perennial SMZ upstream of the swallet.

Table 2. Karst management zone buffers. Measurements are from the lowest point or elevation.

Karst Management Zones – Minimum Buffers						
Feature	Inner KMZ	Outer KMZ (<10% slope)	Outer KMZ (<20% slope)	Outer KMZ (<30% slope)	Outer KMZ (<40% slope)	Outer KMZ (>40% slope)
Cave	200'	N/A	N/A	N/A	N/A	N/A
Class 1 Sinkhole	25'	N/A	N/A	N/A	N/A	N/A
Class 2 Sinkhole	25'	55'	75'	105'	110'	140'
Class 3 Sinkhole	300'	N/A	N/A	N/A	N/A	N/A
Swallet	50'	Perennial SMZ	Perennial SMZ	Perennial SMZ	Perennial SMZ	Perennial SMZ

Class 3 sinkholes often contain swallets at their lowest elevation and the Class 3 KMZ recommendations will supersede swallet KMZ recommendations. Class 3 sinkholes should have a minimum Inner KMZ of 300' measured from the lowest elevation of the sinkhole in which harvesting should not occur. This may be one discrete point or it could be a larger area of relatively even elevation at the bottom of the sinkhole. Class 3 sinkholes do not require an outer KMZ if all other recommendations are met. All recognizable ephemeral stream courses within, and leading to a Class three sinkhole should have SMZ's applied consistent with perennial streams for the region.

Karst features described should be buffered as summarized in **Table 2** below. Note, Class 2 buffer widths correspond with FSC Appalachian Region guidance for SMZ buffer widths.

Conclusion

The above management recommendations are designed as minimum thresholds for adequate resource protection specific to karst. Where possible, the included management recommendations are created from supporting literature. Where specific published evidence could not be found, this guidance is inspired by existing forest management plans specific to karst landscapes: notably Apache-Sitgreaves National Forest - Cave and Karst Management Guide (2015), Forest Sinkhole Manual (2002), and the Karst Management Handbook for British Columbia (2003). Overall, the collective literature available relating to karst features and karst landscapes provides ample evidence of the environmental vulnerability of karst compared to non-karst landscapes. Each surface karst feature is a portal that represents an imaginary line between surface water and groundwater and the surface and subsurface habitats. This interaction represents the simplest perception of karst vulnerability and reasoning for increased resource protection. Karst landscapes are inherently complex and associated hydrology can be extremely hard to define. These management recommendations are generalized conservation minimum practices for any karst landscape. In landscapes with less karst development and/or fewer karst features, implementers are encouraged to expand these recommendations.

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Appendix F. Forest Stewardship Council Certification

The following information in the appendix is to supplement the Forest Stewardship Council (FSC) certification.

This plan is designed to address ecological, environmental, social, and economic considerations of forest management on the Domain. In addition to conforming with the guidance of this forest management plan, all operations on the Domain will be within all laws and rights, including local, national, and international laws, and worker, community, and indigenous peoples' rights. Should any violations and/or complaints occur, all will be documented, and efforts taken to resolve any issues. There are no known conflicts with FSC Principles and Criteria and relevant laws and regulations.

Monitoring and Adaptive Management

Adaptive management allows OESS and others to utilize ground level, site specific monitoring of species, ecological and forest conditions, yields and chain of custody of forest products, and social and environmental impacts of management. This process allows for the uncertainty of chaining conditions that occur over time to be factored into the decisions making process.

Monitoring of forest and forest condition occurs periodically during timber harvest, ecological, and Key Ecological and Economic Attributes (KEEA) inventories and annually for High Conservation Value Forests (HCVFs). Additional monitoring occurs at the regional scale for threats or other items that could impact the health and management of the Domain. The Nature Conservancy (TNC) will visit the property at a minimum annually to monitor the Working Forest Conservation Easement.

Monitoring activities are increased during harvest operations to ensure the safety of multiple user groups and to ensure compliance with University of the South restrictions and FSC requirements. Managers will visit sites regularly to ensure best management practices are observed. Monitoring post-harvest will also occur to assess forest road systems, site rehabilitation, and conditions. Additionally, any special, unique, or cultural sites will be monitored as well.

The results of the monitoring will be used to assess management practices and determine if changes or other adaptive measures should be taken. This iterative process known as adaptive management is designed to monitor and meet changing conditions over time. Results of monitoring and adaptive management will be incorporated into future management plans and documents.

OESS will ensure that all activities meet or exceed the State of Tennessee's Best Management Practices for protected water resources and unprotected resources. And ensure that all activities meet or exceed legal and regulatory requirements. Additionally, the management plan demonstrates and conform with all applicable laws and regulations. Domain wide policies including camping, parking, gate key and road use can be found at on the Provost's website.

Representative Forest Types and Representative Sample Areas

In order to meet FSC Principle 6 Environmental Impacts, Criteria 6.4, representative samples of existing ecosystems within the landscape will be protected in their natural state and recorded on maps, appropriate to the scale and intensity of operations and the uniqueness of the affected resources.

In addition to the large public lands in proximity to the Domain that serve as Representative Sample Areas (RSAs), mentioned earlier in this document, additional analysis and RSA designations were conducted. Across the Domain approximately 231 acres were designated as RSAs (Figure 28). These areas collectively serve as representative samples of existing and viable ecosystems within the landscape and are designated to serve various purposes including:

- To establish and/or maintain ecological reference condition
- To create or maintain an under-represented ecological condition
- To serve as a set of protected areas or refugia for species, communities, and community types.

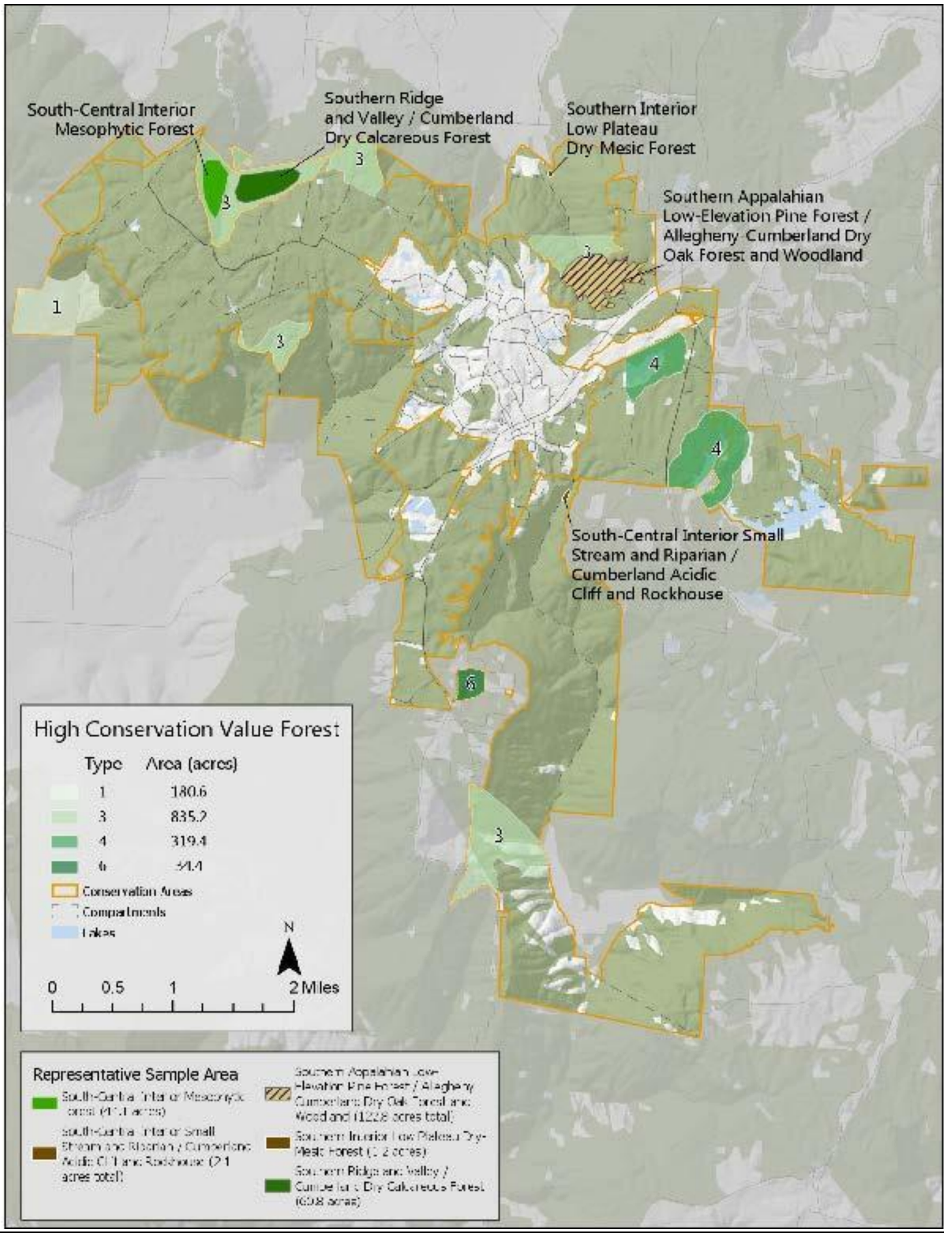

Figure 28. High Conservation Value Forests and Representative Sample Areas on the Domain.

Given the suitability of the earlier described representative forest and ecosystem types, as naturally existing on the Domain, these were additionally used to assess the adequacy of their representation and protection on the landscape. The forest cover types on the Domain were further analyzed by distribution and forest characteristics such as diameter distribution. Since forest types and conditions across stands are generally uniform as mid- to late-successional and with similar stocking, areas were selected and designated to serve as RSAs. See Table 6 and Figures 28 above. Note, areas with higher representation on the landscape practically have less RSA acres; conversely areas with less representation on the landscape, and often rarer ecosystems, have larger proportions as RSAs.

TABLE 7. REPRESENTATIVE SAMPLE AREAS				
COVERTYPE	**TOTAL ACRES**	**% OF TOTAL ACRES**	**RSA DESIGNATED ACRES**	**% OF TOTAL COVERTYPE**
Allegheny-Cumberland Dry Oak Forest and Woodland	5,783.4	44	114	2
Cumberland Acidic Cliff and Rockhouse	10.5	.08	1	2
South-Central Interior Mesophytic Forest	2,225.9	1.74	44.1	2
South-Central Interior Small Stream and Riparian	52.9	0.4	1.1	2
Southern Interior Low Plateau Dry- Mesic Oak Forest	24.0	0.18	1.2	2
Southern Appalachian Low Elevation Pine Forest	369.2	2.84	7	2
Southern Ridge and Valley/ Cumberland Dry Calcareous Forest	3,030.8	23.31	60.8	2
TOTAL		72.19	231	

*No data available due to inventory intensity.

Areas designated as RSAs will serve as baseline, or control, environmental conditions for the forests on the Domain. Any operations in RSAs will be limited to low impact activities as compatible with the protected RSA objectives. RSAs will generally not be managed for timber harvests alone, unless to create and/or maintain conditions that emulate an intact, mature, or other successional phases that may be underrepresented in on the landscape. Threats such as fire, natural pests, and/or pathogens may warrant management measures and are suitable as required in RSAs.

RSA assessment and designations will be conducted as required or at the minimum of FMP revisions every 10 years.

High Conservation Value Forests (HCVFs)

The HCVF identification process involved using the FSC US HCVF Assessment Framework, and vetting those areas with appropriate experts, including University and Conservancy ecologists and outside experts. A few types of HCVF have been identified on the property through a combination of biological database reviews, internal expertise, and review of ecological priorities of the University (Figure 28). Specifically, occurrences of rare species were identified through data provided University research.

The HCVF framework includes the following six categories and 1369.6 acres have been identified (Figure 28):

HCV 1: Forest areas containing globally, regionally or nationally significant concentrations of biodiversity (e.g., endemism, endangered species, refugia)

1.1 Portions of Compartments 27 and 29 are designated HCVF for the populations of Morefield's Leather-Flower (*Clematis morefieldii*), the presence of karst habitat, and associated rare species. Recommended management for this species is the utilization of prescribed fire, however the remoteness and relative inaccessibility makes prescribed fire difficult. There are numerous creeks throughout the area that could be used as firebreaks, but discontinuous fuels and topography would make fire difficult. Any wildfire in this area should be monitored but not suppressed. Logistically simpler than fire would be to selectively remove small areas of overstory from certain areas and monitor for vegetation change. Individual tree removal to increase light infiltration to Morefield's leather-flower (*Clematis morefieldii*) has been recommended (T. Crabtree pers. comm.). Any management of this nature should be associated with a specific research and monitoring protocol. If any management were to take place in this designated area, the Karst BMPs would be utilized.

Total Acres of HCV 1: 180.6 acres

HCV 2: Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.

2.1 Much of the property has been harvested in the past, as dictated by historic forest management plans.

2.2 The forests on the property are generally typical of the region showing influence of past disturbance and management.

Total Acres of HCV 2: 0 acres

HCV 3: Forest areas that are in or contain rare, threatened or endangered ecosystems

3.1 There are pockets of forest on the property that are in late successional stages likely demonstrating climax, or old growth, forest characteristics. Compartment 1, also known as Dick's Cove, has no recorded harvest history and has the characteristics of an old-growth forest and karst habitat. Compartment 9 has been recognized for its old growth characteristics and wildflower display. The southern portion of Compartment 28 is designated due to its late successional upland hardwood stand that is relatively rare on the Domain and in the region. And a portion of Compartment 53 is designated.

Total Acres of HCV 3: 835.2 acres

HCV 4: Forest areas that provide basic services of nature in critical situations (e.g., watershed protection, erosion control)

4.1 The reservoirs on the property contribute to the local community drinking water supply, thus will be buffered and extra precautions will be used if activities are prescribed for these areas. These areas include areas around Lake Jackson and Lake O'Donnell.

4.2 There are no areas on the property that would be considered critical to prevent erosion, landslides, avalanches, etc. that would threaten local communities.

Total Acres of HCV 4: 319.4 acres

HCV 5: Forest areas fundamental to meeting basic needs of local communities (e.g., subsistence, health)

5.1 The property would not be considered fundamental to meeting basic needs of local communities.

Total Acres of HCV 5: 0

HCV 6: Forest areas critical to local communities´ traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities)

6.1 The forest changes that may occur due to the forest management plan are not crucial to the local community.

6.2 The big spring portion of Compartment 12 is protected as it has unique character and represents a unique assemblage of mature upland and mesic plateau forest.

6.3 No landscapes that have evolved due to the properties social, economic, or religious imperatives.

6.4 No features' natural properties protected due to significant cultural or religious association, exceptions are covered in 6.2.

Total Acres of HCV 6: 34.4 acres

II. Consultation with appropriate experts for the purposes of this assessment:

For the purposes of this assessment and more generally, OESS staff regularly consults with internal faculty and staff, and biologists from the TN Natural Heritage Program, TN Wildlife Resources Agency, TN Department of Forestry, and cultural experts from the within the University and the TN State Historic Preservation Office. Further, the University has deeply invested in hiring conservation staff and faculty and consults throughout the organization on various aspects of this assessment, from identifying HCVs to implementing any management activities in identified HCV areas, to monitoring the impacts of those activities over time.

III. Approach to Managing HCV Areas

HCV 1.1, 1.2-Globally, regionally or nationally significant concentrations of biodiversity

The management approach to these HCVF parcels is to monitor these habitats and provide exotic species control, as appropriate. Additionally, we proposed to apply any management recommendations described in the compartment summaries in collaboration with faculty and external partners, as appropriate.

HCV 3.1, 3.2, 3.3 – Rare, Threatened or Endangered Ecosystems

The basic management approach to HCV Areas on the 835.2 acres of Compartments 1, 9, 28, and 53 is a precautionary, hands-off approach because of the types of values to be maintained and/or enhanced. The values present (HCV 3.1) are not typically conducive to active management. The exception to this is the management of invasive species control. And, in the future, there may be additional cases where invasive species are affecting the identified values and where efforts will be needed to limit their spread. Additionally, future management may be considered where determined necessary to protect/preserve HCVs as identified.

HCV 4.2 – Source Water Buffers

The management of SMZs will follow BMPs that are identified in the management plan which are more stringent than FSC and state guidance on intermittent, perennial streams, and other water features.

HCV 6.1-6.2 –Areas Important for Cultural Identity

If any culturally important areas are identified, they will be protected and buffered from management as previously stated in Section 2. Cultural Resources. The archeologist will be consulted with and a plan for the sites will be developed.

IV. Monitoring HCV Areas

Monitoring of HCVFs will be conducted annually. Monitoring approaches will vary according to the types of HCVs to be maintained and/or enhanced and the resulting management approach. In HCV Areas where a hands-off approach is appropriate, there will be a less intensive monitoring approach taken, but will include changes in species composition, structure, etc., and further captured in periodic inventories. OESS will also use the most up-to-date aerial imagery and other remote sensing technology to compare with older imagery to assess changes or activities within or adjoining the property that may be of concern, particularly within HCV areas. Areas where concerns arise will be visited and checked, and any issues followed up on. HCV areas are also visited during periodic inventory procedures and changes tracked through the Key Ecological and Economic Attributes (KEEAs) which are updated at 10 year intervals (Appendix G). Further monitoring will be conducted through frequent visits and inspections by TNC staff, OESS staff, and University faculty. Any negative or potentially adverse impacts to HCVs will be addressed as determined appropriate.

Non-Timber Forest Products

In addition to timber resources there are non-timber forest products (NTFPs) on the Domain. American ginseng is probably one of the most iconic and well known wild herbs, which has unfortunately suffered near 99% loss in eastern North America due to the ginseng market featuring prices from $800-1000/lb. at present (or ~40-50 dried, mature roots). The plant is ranked as bordering on globally and state “vulnerable” (S3S4/G3), but bordering on “apparently secure” in the state. Two locations have been identified, though many more locations and plants likely occur, as the species was observed throughout the Property. Populations of less than 50 individuals are suspected to be unable to replace themselves; however, the total number of stems per location was not completely reviewed due to the nature of surveys, and it is likely that many viable, large colonies still exist on the Property.

Currently the only known non-timber forest products being harvested from the property are wildlife, including white tailed deer; which are lawfully hunted by private individuals who are a part of the university wide hunt program or the two private hunt leases during appropriate hunting seasons.

There are other potential non-timber forest products on the property such as pawpaw, mushrooms, grapevines, and pine straw. However, the landowner has no intention to harvest any non-timber forest products from the property. If it seems desirable in the future to harvest such products, the impacts on the ecosystem would be carefully assessed and an amendment to this management plan would be written before beginning any harvest. Additionally, should the landowner desire to commercially harvest any NTFPs as FSC certified, the certifying body will be consulted prior.

Chemical Use

In treating NNIS, chemical use, including herbicides and pesticides may be required in order to be effective. Chemical use will be minimized in the management of the Domain. In cases where it is the best option, best practices will be employed. Additional care should be taken when using chemicals on the Property due to groundwater entry points via the karst features speckling the western portion of the property.

While chemical use will be minimized, and if needed used to the best industry application standards, it is generally accepted as a management practice. In some cases, chemical use might be the only option as with many invasive pest and plants. Given this the Society of American Foresters released an official position on the use of herbicides is as follows: “The Society of American Foresters (SAF) supports the availability and judicious use of herbicides as an effective and vital tool for controlling undesired vegetation on forest lands. SAF believes that the use of herbicides, when properly applied according to federal and state regulations, is a safe and effective approach for managing undesired vegetation. In addition to helping improve reforestation and forest productivity, herbicide use is now a particularly important management option for addressing the serious and growing problem of native and non-native invasive species on forest lands.” (Society of American Foresters 2008).

All herbicides will be used according to package instructions, follow state and federal regulations, and will be applied by certified professionals. Efforts will be taken to utilize the least impactful herbicide possible for desired outcome of forest management practice. All pesticide use will be documented with relevant data as standard with records maintained. Additionally, records will be supplied to TNC annually for FSC reporting. No chemicals used on the Domain will be listed on FSC’s list of Highly Hazardous Pesticides (HHPs). Should a listed herbicide or pesticide need to be used for research or some limited use, permission will be obtained via the FSC Certifying Body and FSC prior to any application.

Harvest Administration Procedures

Proper harvest administration procedures should be employed in the Domain to ensure the best possible outcome meeting the management goals and objectives, while protecting environmental and social considerations. This includes market sales to achieve the highest and best uses of products while choosing contracts that can safely and effectively fulfill contract obligations. All operations should be accompanied by an adequate contract outlining all terms and conditions including safety, worker rights, and landowner expectations.

All harvesting on the Property should be conducted by trained and competent contractors. This includes those that support workers' rights, fair wages, and safety. As part, all workers should be skilled and trained through proper logging practices such as those provided in the state Master Logger program or comparable program. Forest management on the Domain will be conducted in a safe manner, including meeting and/or exceeding health and safety laws/regulations. All forest workers should be well-qualified to safely and effectively implement the management plan as included in operational contracts.

Contractors working on the Property should be local, or regional, allowing positive economic and social impacts to be realized by the area, when suitable and available. Furthermore, forest products generally serve local markets compounding area benefits. Forest industry is a significant part of the region's economy. Forest industry is a significant contributor to the economy of Tennessee and provides stable, well-paying jobs for area livelihoods. Should any negative impacts be realized or noted, measure will be taken to avoid such losses, damages, or issues.

Harvest documents, including treatment maps, silvicultural prescriptions, contract requirements, and special or unique situations should be clearly discussed and understood by contractors prior to activity commencement. Additionally, operations should be regularly monitored while ongoing to ensure contract compliance. Any areas of needed improvement will be reported to the contractor so efforts can be taken to resolve the issue.

All forest products and operations should be documented and accounted for in both the short- and long term. This includes maintaining property chain of custody procedures, reconciling cutouts with pre-harvest inventories, and updating inventories as required due to inventory drain.

Operations

Forest operations on the Domain generate multiple benefits with wide-ranging uses for the region and local economy. Timber products include grade saw-timber, low-grade saw-timber, peelers, and pulpwood. Given sufficient market conditions, all products are sold at their highest and best use. Waste of forest products is minimized through effective utilization during harvest operations. For example, all stumps are cut low and all merchantable products are removed from the forest. Unmerchantable tops and limbs are left onsite, or scattered across site if pulled to landing. Additionally, harvest practices on the property protect residual trees and other resources including soil health, vegetation, and water to ensure long-term health and viability of the ecosystems.

Harvesting methods employed should be appropriate to site condition, limitations, and stand characteristics. Chosen methods should minimize negative impacts and be the best system to match operational goals and objectives. Most harvesting on the Property will be conducted conventionally with small logging crews hand felling trees and skidding with either cable or grapple skidders. In areas with particularity high values and prohibitive terrain or other limitations for conventional logging helicopter and cable systems may be employed. For areas where equipment operations would have significant negative impacts on site qualities or other characteristics, animal systems such as horse logging may offer options.

Harvest systems likely to be employed on the Domain:

- Conventional – Trees are hand felled using chainsaws or felled using a rubber-tired cutter. Transportation includes use of cable and/or grapple skidders to move trees to log landings.
- Cable (High-lead) – Used in very steep areas, such as gulf sites, and operations involve cutting with a chainsaw and skidding with a high-lead cable system, which is operationally difficult in areas with several rises and depressions.
- Helicopter – This method has extremely high overhead and is reserved for areas of timber with over 10,000 board feet per acre of high-value species. This system is only economically feasible for low acreage, high value, high volume areas.
- Animal systems – In this area, mules were historically used for logging as late as the 1950s. However, animals risk leaving deep ruts on cove sites, causing a distinct impact in the landscape, and can only haul a minimal number of logs at one time, therefore should be monitored closely.

The transportation system of the Domain serves management operations on the property as well as recreation. Most log hauling is conducted by rubber tired trucks including both straight and tandem trailers. Hauling logs on county and state roads is common and accepted in the region however care should be taken to not have negative impacts, including mud on the roads and/or damaging surface or shoulders.

Other transportation on the Property includes extensive trails and abandoned roads. When appropriate, these existing roads/trails should be used and improved with modern construction and BMP standards except when doing so would result in greater environmental impacts to building a new road. Any new improved roads will be laid out and assessed for need and environmental impacts. All negative results of new roads will be mitigated through the application of BMPs and best construction practices. Due to the extensive recreational use on the property, all existing roads, and any new roads will be created with a final use as recreational trail in mind. No decommissioning of roads are anticipated, though historic skid trails experiencing continued erosion will be rehabilitated.

Boundaries and Resource Protection

The Property is well controlled, through the use of main access points, gates, and minimal roads.

Firelanes are gated and property lines are posted. Additionally, the OESS maintains a full time Domain Ranger to patrol and resolve boundary and safety issues as they arise. Gates will be maintained and remained locked, as it is likely the most effective method of preventing trespass and associated risks. Any instances of trespass, including illegal harvesting, settlement, and other unauthorized activities, will be recorded and efforts taken to curtail future activities.

Wildfire, though not high, is a risk for the Domain. Frequent fire starts in the southeast United States occur from arson, therefore controlling property boundaries is essential. Furthermore, all regulations and recommendations (including burn permits) from Tennessee Department of Forestry will be followed.

Additionally, it is important for overall resource protection, and steps should be taken, to monitor and record all listed resources, both physical and biological. This can occur through periodic inventorying/mapping and other methods such as geo-located photo points.

Appendix G. Key Ecological and Economic Attributes to Assess Forest Condition on the Domain Working Woodlands Project

Introduction

The Domain property, located in Franklin and Marion Counties Tennessee is being enrolled in The Nature Conservancy's Tennessee Working Woodlands Program. A major goal of the program is to improve the health and condition of the forest over time- thus providing economic benefits to landowners and ecological improvements to the forest. To track our success towards these outcomes, we have elected to utilize an approach developed by the Conservancy's Virginia Chapter in 2015 to periodically measure a set of Key Ecological and Economic Attributes (KEEAs). The Conservancy has incorporated similar measures into its Pennsylvania Working Woodlands program, as well as other FSC-certified properties.

Key Ecological and Economic Attributes (KEEAs) are critical components of a forest related to its life history, physical or biological processes, composition, and/ or structure. We consider the KEEAs described in this report as essential to our effort to assess ecological health and economic productivity over time. KEEAs are further defined and measured through specific Indicators. Indicator Ratings define thresholds of Very Good, Good, Fair, and Poor condition for each KEEA; and are scaled by expected ranges of variation (as determined by literature reviews, FIA data, and expert opinions). These KEEAs and their Indicators were adapted from Indicators selected by TNC's Clinch Valley staff as the most important and logistically-feasible forest attributes to use in their measurement of forest composition, structure, and regeneration. Through routine measurement of these KEEAs, we will maintain a robust and concise diagnostic scorecard that rates the quality of forests under our management. KEEA indicators will be measured in the field on a 10-year cycle.

Our selection of the KEEAs described in this report meets the standards of the Forest Stewardship Council (FSC) and TNC's organizational monitoring requirements. While these KEEAs can provide early warning of failing ecosystems or evidence of strengthening ecosystems, they are not suggested to be a comprehensive list of ecosystem factors. That said, our KEEA concept has already proven effective as a management and monitoring tool.

Use Of USFS Forest Inventory Analysis Data To Inform KEEA Indicator Ratings

Forestry professionals rely on the U.S. Forest Service (USFS) Forest Inventory and Analysis Program (FIA) data to characterize forest conditions at a landscape scale. FIA data is collected across the United States by the USFS in a uniform manner on both public and private lands, and serves as the nation's census data for forests. Permanent FIA plots are visited periodically for data collection. The data serves as the foundation of most national and regional forest analyses, to include trends, utilization, growth, drain, and other important ecological and economic attributes. Additionally, many national, state, and local policy makers rely on FIA data to inform their decisions. Additional information about FIA data can be found at: http://www.fia.fs.fed.us.

Several of the reference values and indicator metrics developed for the monitoring protocol will be determined based on assessing data quartiles and standard deviations found in the regional FIA data (collected from 1977 through 2012). For example, to develop our Indicator Ratings for measuring oak dominance on CFP lands, we will statistically analyze the distribution of oaks across the region from the FIA data, and then tailor our rating ranges accordingly.

To examine FIA data ranges for those indicators which are informed by FIA data, an analysis will be performed using 4 counties in Tennessee (Franklin, Grundy, Warren, and Van Buren). These counties lie wholly or in part in the Cumberland Plateau Province; and they share similar forest types with those found on Domain. Because this is the best available reference we have to the Domain, we are comfortable with using it as a template for our monitoring effort.

3 Classes of Key Ecological and Economic Attributes (KEEA)

The KEEAs are divided into three classes: (1) Composition Attributes, (2) Structure Attributes, and (3) Regeneration Attributes. For each individual KEEA, we first explain its relevance and then specifically how we intend to measure it.

Composition

Forest composition refers to the diversity and condition of plant species found in a stand or landscape, including trees, shrubs, forbs, and grasses. Tree composition is more narrowly defined as the proportion of each tree species in a stand, expressed as a percentage of the total number, basal area, or volume of all trees in a stand. Monitoring the composition of the forest is important for several reasons. Ecologically, it is critical to understand overall species diversity; and the presence/absence and relative abundance of keystone species. It is also important to measure the degree to which native species occupy any given stand or tract in comparison to non-native and/or invasive species. Economically, it is important to know if growing space is being utilized in an optimal manner by desirable tree species capable of becoming high quality forest products.

We have selected 4 KEEAs and are developing Indicators to measure/ monitor forest composition on the Domain including: (1) Acceptable Growing Stock (% stocking for AGS), (2) Tree Species Diversity (Shannon-Weiner Index), (3) Keystone Species Abundance (% Oak Quartile), and (4) Invasive Plant Coverage (Invasives Weighted Score).

KEEA 1: Acceptable Growing Stock (AGS)

Indicator: Percent Stocking for Acceptable Growing Stock

Indicator Ratings:

Poor <40% AGS
Fair ≥40-53%
Good >53-69%
Very Good ≥70%

Relevance

Acceptable growing stock (AGS) is an economic measure of forest stand quality that refers to stems that are currently of good to high quality and can be expected to maintain/improve their quality into the next harvesting cycle. More narrow a measure than total stocking; AGS provides information on the potential economic performance of a stand or tract. Before this attribute can be measured, a reasonable definition of AGS must be established. This is best done at a local level, given variable market conditions and regional variations of acceptable species and quality. In our region Acceptable Growing Stock is defined as "a commercially-acceptable species, exhibiting good form," with good form further defined as "being over 50% sound, containing at least 8 feet that is sound and reasonably free of defect, and has currently or will produce a USFS Grade 3 sawlog." Trees also must have a reasonable chance of survival in the next 15 years. If a tree cannot meet these criteria, it is considered Unacceptable Growing Stock (UGS).

How We Will Measure

We will measure and record %AGS across stands during our 10-year field inventories. At each inventory plot, AGS will be estimated and a %AGS score recorded. For this KEEA, Indicator Ratings have been developed according to Gingrich's (1967) guidelines.

Gingrich, S.F. 1967. Measuring and evaluating stocking and stand density in upland hardwood forests in the Central States. For. Sci. 13:38-53.

Roach BA, Gingrich SF. 1968. Even-Aged Silviculture for Upland Central Hardwoods. Agricultural Handbook No. 355:1-39, illus.

KEEA 2: Tree Species Diversity (Shannon-Wiener Diversity index)

Indicator: Shannon-Wiener Diversity Index

Indicator Ratings:

Poor H' <1.1
Fair 1.11< H'<1.6
Good 1.61< H'<2.1
Very Good H' ≥2.1

Relevance

Tree species diversity is an important indicator of forest health, as species diversity within an Appalachian forest stand promotes greater resiliency to environmental stress, increased habitat variability, and temporal variances in shading and fruit production. A variety of tree species also creates a diversified portfolio of valuable timber products and a hedge against economic risks associated with species specific pests and fluctuating timber prices. Therefore, some measure of species diversity is a logical choice for monitoring the condition and integrity of our managed forest stands.

How We Will Measure

We have selected the Shannon-Wiener Index (H’) (Shannon and Weaver, 1949) to represent this variability in tree species diversity within forest stands. The H’ incorporates both the total number of species present and the relative population density of each species to calculate a diversity index. This measure has been widely used in ecological assessments and accounts for the uncertainty of identifying the next specimen sampled given the species distribution present. One could simply use a species richness index as a metric, but this provides no information about the relative abundance of each species (as occurrences of a single specimen are considered as equally valuable as the occurrence of many individuals of another species). The H’ is calculated as:

$$H' = \sum_{i=1}^{n} p_i \ln(p_i)$$

Where H’ is the Shannon-Wiener Index, n is the total number of species encountered in the sample, pi is the proportion of the total number of trees sampled that belong to species i, and ln is the natural logarithm.

FIA data will be used in the development of our Indicator Rating ranges for H’ scores. First, all available FIA plot data characterizing individual tree species will be combined to calculate the distribution of H’ scores across the 4-county reference region in Tennessee. Then, we four Indicator Rating classes will be developed using standard deviations. H’ values from the FIA mean to one standard deviation above the mean will be established as the Good Indicator Rating. FIA values greater than one standard deviation above the mean set the threshold for a Very Good rating. Any score falling between the mean and one standard deviation below it equates to a Fair rating. Any score falling more than one standard deviation below the mean equates to a Poor indicator rating.

H’ scores for stands will be determined and recorded through the analysis of our property specific inventory data. An H’ score will be recorded for each inventory plot and the data aggregated to stand and tract levels as needed. If sample size is adequate the Diversity Index will be calculated on the stand level, otherwise tract or strata level will be utilized.

Shannon, C. E., and W. Weaver. 1949. The Mathematical Theory of Communication. University of Illinois Press, Urbana, IL. 117 pp.

KEEA 3: Dominant/Keystone Species Abundance (% Oak Quartile)

Indicator: Percent Oak

Indicator Ratings:

Sub-Xeric Sub-Mesic/Mesic

Poor	<31% Oak	<14% Oak
Fair	≥31-50%	≥14-30%
Good	>50-66%	>30-45%
Very Good	>66%	>45%

Relevance

One of the changing characteristics of southern Appalachian forests is the percentage of oak trees within forest stands. Oaks are a very desirable species from both an ecological and economic standpoint. From an ecological standpoint, oaks provide mast for a wide range of wildlife, fire resistant overstory, and long-lived stability for forest communities. Economically, oak species are among the most valuable saw-timber products. However, in recent years' evidence shows that oak regeneration is suffering due to over-competition from other less desirable species. For example, various species of maple, particularly red maple (*Acer rubrum*), are frequently more prevalent in the understory and mid-story of regenerating forests than historical estimates suggest they should be. Increasing oak dominance in ecologically appropriate sites is a major priority for the program. Therefore, assessment of the percentage of oak species within forest stands is a key ecological indicator that helps us understand if we are meeting our forest compositional goals.

How We Will Measure

Percent oak is a straightforward calculation that can be made from our 10-year timber inventory data. At each inventory plot, all oak species will be summed and divided by the total number of individual tallied trees. The data will then be aggregated at the stand and tract levels as appropriate.

To develop our Indicator Ratings, we are examining the regional FIA data spread for this attribute. Based on the 4 county regional FIA data in TN, the mean percentage of oak species will be calculated along with the upper and lower quartiles in each physiographic setting. To determine the physiographic setting of stands (i.e., classify all stands into mesic/sub-mesic vs. sub-xeric), we will rely on the ecological systems mapping included in the TN-State Wildlife Action Plan (SWAP) 2015. When a particular stand is characterized by more than one ecological zone, we will rely on expert knowledge to determine the majority physiographic classification for a particular stand.

KEEA 4: Invasive Plant Coverage (Invasives Weighted Score)

Indicator – Weighted Score of Percent Cover of Invasive Plants within the Stand

Indicator Ratings (Based on Weighted Stand Score)

Poor >2

Fair	>1.0-2.0
Good	>0-1.0
Very Good	0

Relevance

One of the most important and overarching forest composition goals is to maintain appropriate mixes of native species and minimize the presence of non-native and/or exotic species. Invasive species are widely viewed as a threat to ecological-based forest management. Invasives can also have a tremendous economic impact as low value non-native species replace our valuable native species. Invasive herbaceous plants and shrubs can also lead to regeneration issues for trees by forming dense mats of vegetation that native species are not adapted to overcome. The National Invasive Species Council defines an invasive species as "a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health." The USFS has created an invasive species program, and the USFS Chief identified invasive species as one of four critical threats to the health of America's forests. Additionally, nearly every state has created an invasive species task force or similar group, and there are innumerable NGOs, regional and local groups working to address the threat.

With National Management Plans and countless other groups involved in invasive species management, it would be easy to assume that the problem is being effectively addressed and controlled. However, recent evidence suggests that numerous invasive species are expanding their range and influence in forestland (Asaro, 2015). Monitoring their coverage allows us to understand the total impact and to steer our limited resources to the most critically threatened areas on the property.

How We Will Measure:

This KEEA and its Indicator will measure the current percent overall cover (per forest stand) of ten common invasive plants of concern in the region, to include:

1. Tree of Heaven
2. Garlic Mustard
3. Oriental Bittersweet
4. Autumn Olive
5. Japanese Stilt Grass
6. Multiflora Rose
7. Paulownia (Princess Tree)
8. Kudzu
9. Privet (American or Chinese)
10. Mimosa

Other known invasive plants listed as a significant or severe threat by the Tennessee Exotic Plant and Pest Council may be added and tracked at any monitoring event.
http://www.tneppc.org/invasive_plants

There are certainly other invasive species that we could try to monitor, but these have been selected because they are common or becoming common in our area, pose significant forest health issues, and can indicate the need for management or action. Autumn olive and multiflora rose can become established as old-fields transition to forest. In these situations, they can form dense populations and inhibit afforestation. Understory species such as garlic mustard and Japanese stilt grass can interfere with native groundcover. Tree of heaven can aggressively populate a recently harvested stand and reduce its ecological and economic value.

At each 11.78ft-radius (1/100th acre) inventory plot, a cumulative percent cover for each of the ten invasive species will be assessed via ocular cover estimates, and then assigned to one of the following four Percent Cover Categories:

Note – the assigned metric points Score System for each Percent Cover Category are also listed, and are used to determine the Weighted Stand Scores, as described below. A stand may have more than one invasive species. We will calculate percent cover for each of the species.

Percent Cover Categories Score System

0% Cover	0 Points
1-33% Cover	1 Point
34-66% Cover	2 Points
>66% Cover	3 Points

The scores (points) for all plots within each stand are then averaged to determine an overall Weighted Stand Score and Indicator Rating (Poor, Fair, Good, Very Good), representing the estimate of the percent overall invasive species cover in that stand.

Asaro, C. (2015, March 16). Virginia Forest Health Program Manager, Virginia Department of Forestry. Telephone Interview.

"National Invasive Species Council | U.S. Department of the Interior." National Invasive Species Council | U.S. Department of the Interior. N.p., n.d. Web. 26 Aug. 2015.

Structure Attributes

Stand structure is the distribution of live and dead tree sizes across the stand, encompassing tree diameter, height, and foliage distribution, and reflecting the physical complexity of the stand and associated wildlife, floral, and fungal habitats. The physical vertical structure of a stand is critical to monitor when managing for more than just the sustained output of wood products, as stands with more complex structures are thought to be more resilient, provide broader ecological functions, and are potentially even more economically productive.

We have selected 4 KEEAs and developed Indicators to measure/ monitor forest structure on the domain compartments including: (1) Density of Standing Snags (Snags # per acre), (2) Density of Coarse Woody Debris (CWD cubic ft), (3) Live Tree Structural Diversity (# of 4 inch DBH), and (4) Total Stocking (SDI).

KEEA 5: Density of Standing Dead Trees (Snags # per acre)

Indicator Average number of snags per acre

Indicator Ratings

Poor	<2.0 snags
Fair	≥2.0 – 4.0
Good	>4.0-10.0
Very Good	>10.0

Relevance

Standing dead trees or "snags" have historically had little economic value. However, with the evolution of forest carbon offset programs, these features have become somewhat more financially important. On the ecological front, the value of snags is immense. They contribute critical habitat for mammals, birds, reptiles, amphibians, arthropods, and gastropods (Evans, 2012). Once the standing dead trees fall, they continue to provide these benefits as the primary source of coarse woody debris. The Shafer-Tuuk property is rich in caves and karst features that are highly likely to support bats of conservation concern. Ensuring that habitat created by snags is in place, aids in the conservation value of the forest.

How We Will Measure

Indicator ratings have been determined by TNC Virginia for their working woodland projects using FIA data from Federally managed forests in VA in conjunction with reviewing the literature on snags in Appalachian old growth forests. Since typical commercial timber management tends to reduce deadwood accumulation, only the FIA data from plots on federally-managed land was used for metric calculations. Federal lands tend to have longer rotations and extensive "no harvest" areas. This creates a setting for standing snags that is more approximate to our conservation goals in comparison to what is generally found on private lands. Since significant federal land is missing from the 4 county FIA data we are using for our other KEEA analyses, the University will adopt the indicator ratings developed by TNC in VA. The mean number of snags on federal lands (3.6 rounded up to 4) is represented by the break in Good and Fair indicator ratings. The Very Good indicator rating was determined by adding one standard deviation to the mean. The Fair and Poor indicator ratings were informed by the FIA data, but neither quartiles nor standard deviation yielded satisfactory indicators. Since current evidence suggests that snags are underrepresented in the forest, and literature values for snags in old-growth hardwood forests are much higher, we selected values with a breakpoint between fair and good at the mean of FIA values on federal lands and assigned the fair to poor breakpoint at halfway to 0 and the good to very good breakpoint at one standard deviation above the mean.

Standing snag Indicator scores for stands will be determined and recorded during our 10-year timber inventories. A score will be recorded for each inventory plot and the data aggregated to stand and tract levels as needed. Snags will be calculated on the compartment level.

Evans, A.M. 2012. Ecology of Dead Wood in the Southeast. Forest Guild, Research Publication: 39pp.

KEEA 6: Density of Coarse Woody Debris (CWD cubic ft)

Indicator: Cubic feet Volume per Acre of Wood >3" Diameter and 5' Length, Lying Partially or Entirely at Ground-level.

Indicator Ratings

Poor	<250 ft^3/ac
Fair	≥250 – 500 ft^3/ac
Good	>500 – 900 ft^3/ac
Very Good	>900 ft^3/ac

Relevance:

Coarse woody debris (CWD), similar to snags, offers numerous benefits to wildlife, flora, and fungi, such as providing refuge, food, and primary habitat for a diverse mix of species. Over 100 species of animals are estimated to depend on CWD in some way in the Southeast (Evans 2012), including large mammals such as black bear all the way down to saproxylic insects. Additionally, many fungi, mosses, and liverworts rely solely on downed wood for their food and habitat needs. CWD also serves as a nutrient recharge to the forest soil as it decomposes. Significant carbon is also sequestered in CWD, and is often calculated in forest carbon offset projects. Excessive removal of CWD would lead to a decrease in carbon, impacting important ecological values.

How We Will Measure:

We have adopted the Indicator ratings developed by TNC VA because of their access to FIA data from federally-managed land since active commercial management tends to reduce deadwood accumulation, similar to the Standing Snag Indicator. Indicators are broken out by quartiles, as the FIA data is too variable to yield satisfactory indicators using standard deviations.

Coarse Woody Debris Indicator scores for stands will be determined and recorded during our 10-year timber inventories. A score will be recorded for each inventory plot and the data aggregated to stand and tract levels as needed. If sample size is adequate CWD will be calculated on the stand level, otherwise tract or strata level will be utilized.

*Note: This protocol is comparable to swinging prism in plot center to get basal area. At the plot center, look at CWD and evaluate only pieces you can draw perpendicular line through axis of log or wood. If tree fell directly away or even 45-degree angle, and you can't draw right angle through it, you can't count it. Once you determine the right angle trees, then you determine the size (see chart). Measure at point of intercept to wood and determine its limiting distance. Approach has been modified to have 66ft maximum distance.

Evans, A.M. 2012. Ecology of Dead Wood in the Southeast. Forest Guild, Research Publication: 39pp

KEEA 7: Live Tree Structural Diversity (# of 4inch)

Indicator Number of 4" Diameter at Breast Height (DBH) Classes Represented in the Stand, beginning at 4" DBH.

Indicator Ratings

Poor	1 – 3 classes
Fair	4 – 6
Good	7 – 9
Very Good	≥10

Relevance

Live Tree Structural Diversity can be thought of as vertical diversity in a forest stand. Economically, high structural diversity is a likely indicator that multiple commercial harvests will be possible over a period of years. Ecologically, structural diversity indicates a mix of successional stages that creates a habitat mosaic of older forest, younger forest, openings or gaps in canopy and edges (Stand Level Biodiversity Web Based Training Course, British Columbia Ministry of Forests and Range). A structurally-diverse forest provides multiple habitats within a relatively small area, with multiple canopy heights, which can have a localized effect on microclimate conditions to further provide habitat, foraging, or resting areas for the maximum number of biota. Stands with a greater variety of diameters will likely have a more complex canopy arrangement, thus providing habitat for a greater variety of wildlife and plants. Some species (raptors) thrive in high canopies, while others (small mammals) rely on understory trees and shrubs. Additionally, natural forest stands in our region typically exhibit a more complex structural diversity as they age.

How We Will Measure

We have selected the number of 4" DBH classes present in the compartment as our measure structural diversity, since there is a strong correlation between diameter and height. The indicator ratings were selected from literature values (Tyrell et al., 1998). Scores for this KEEA will be measured during our 10-year timber inventories. A score will be recorded for each inventory plot and the data aggregated to compartment level.

Tyrell, L. E., G. J. Nowacki, D. S. Buckley, E. A. Nauertz, J. N. Niese, J. L. Rollinger, and J. C. Zasada. 1998. Information about Old Growth for Selected Forest Type Groups in the Eastern United States. USFS Technical Report NC-197. St. Paul, MN. 507 pp.

Kimmins, JP. 1987. Forest Ecology. New York, NY. Macmillan Publishing Company

KEEA 8: Total Stocking (Stand Density Index)

Indicator: Stand Density Index

Indicator Ratings

Poor	<90 SDI
Fair	90 – 125.99, > 225 SDI
Good	126 – 145.99, 201 – 225.99 SDI
Very Good	146 – 200.99 SDI

Relevance

Stand Density Index (SDI) is a way to measure the amount of live trees on a given area in relation to what is considered optimum. SDI indicates how well the growing site is being utilized, and can be useful in making management decisions.

How We Will Measure

The most common method of measuring SDI in hardwood stands is to utilize a stocking chart developed by Gingrich (1968). As shown in Figure 1, the stocking chart defines A, B, and C-level stocking categories, with measures between A and B considered "fully-stocked," measures between B and C considered to be "fully-stocked within 10 years," measures above A considered "overstocked," and measures below C considered "understocked." These distinctions are important to forest managers for ecological and economic purposes. Overstocked forests may pose risks for significant economic losses through excessive mortality. They may also present a forest health concern as overstocked stands are generally more susceptible to insect and disease threats. On the other hand, understocked forests may languish for extended periods without meeting potential economic yields, while also signaling a potential forest health issue related to regeneration or invasive species.

One drawback of using the stocking charts developed by Gingrich is that they require visual interpretation which becomes a significant effort for large properties with a high number of field sampling plots. In response to this, a more efficient approach has been developed by Williams (2003) that is strongly correlated to the Gingrich stocking charts, but can be automated in a post-hoc desktop analysis of timber inventory data once it is collected. For this KEEA, Indicator Ratings for SDI have been developed based on the A, B, and C scales of the Gingrich stocking chart, which is an accepted and familiar protocol.

Roach BA, Gingrich SF. 1968. Even-Aged Silviculture for Upland Central Hardwoods. Agricultural Handbook No. 355:1-39, illus.

Williams RA. 2003. Use of Stand Density Index as an Alternative to Stocking Percent in Upland Hardwoods, Northern Journal of Applied Forestry, No 20: 137-142.

Regeneration Attributes

Regeneration, the act of renewing tree cover by establishing new trees after the canopy has been removed, is an important consideration for any managed forest. We propose employing natural regeneration where possible, which the Tennessee Department of Forestry describes as using both natural seeding and vegetative reproduction. We have selected the KEEA Desirable Regeneration to maintain information on regeneration trends and patterns on the property.

KEEA 9: Desirable Regeneration (% desirable)

Indicator Percent of Current Regeneration Comprised of Favorable Species.

Indicator Ratings

Poor	<50% favorable species
Fair	≥50-75%
Good	>75-90%
Very Good	>90%

Relevance

Hardwood regeneration is one of the most complex and important aspects of forestry. Strong regeneration of desirable species is critical to the long term economic and ecological sustainability of a managed forest. Thus, tracking regeneration patterns is fundamentally important to the success of the program. Many hundreds of pages have been written on how to assess, quantify, grade, monitor, and predict what type of species will be regenerated post-harvest. Oak regeneration is particularly complex; and our understanding of what leads to a successfully regenerated oak stand continues to evolve.

The literature and our own surveys of regeneration on harvest sites suggest that there are typically thousands to tens of thousands of young trees per acre after just a couple of growing seasons. After 12 growing seasons, Smith (1976) reported that there can still be over 4,000 trees per acre on most sites- certainly a fully-stocked stand.

There is little doubt that when subjected to regeneration treatments that disturb the canopy, the stands will respond with robust regeneration. Therefore, sheer quantity of regeneration is not in doubt. The more important characteristic that we want to track is the species composition of the regeneration pool. The best Indicator currently available to measure is the percent of total regeneration comprised of desirable species. For our purposes, desirable species include any oak, sugar maple, black cherry, yellow poplar, basswood, hickory, birch, beech, walnut, ash, and cucumber. The species represent both the most economically and ecologically important species in our forests. Arguably there are additional species that could be added to the list, however statistically they occur at a very low frequency and would have no discernable impact on the calculations.

How We Will Measure

Over half of the trees in most Appalachian hardwood forests originated from stump sprouts (Wendel & Trimble, 1968). Fully assessing forest stand regeneration potential is possible, but one must consider a mix of key factors. We have adopted the indicator ratings developed by TNC Virginia using a hybrid approach of examining the mean, standard deviation, and quartile information for the FIA data along with professional judgement. These rankings will be monitored over time and compared to actual post-harvest regeneration surveys and adjusted as necessary.

KEEA's will be calculated using regeneration plots that will be sampled as part of the 10-year inventory process.

Wendel, G. W.; Trimble, G. R. Jr. 1968. Early reproduction after seed-tree harvest cuttings in Appalachian hardwoods. U.S. Forest Service Research Paper. Northeast Forest Experiment Station No. NE -99, 1968. pp. 16

Smith, H.C. 1976. Reproduction 12 years after Seed-tree Harvest Cutting in Appalachian Hardwoods. U.S. Forest Service Research Paper. Northeast. Forest Experiment Station. No. NE-350, 1976. pp. 11

Results & Discussion

Once baseline conditions are assessed for the property, the University will reassess KEEAs after 10 years, in order to track our progress and adaptively manage towards the desired outcomes of enhanced ecological forest improvements (health and condition) and economic productivity. If we choose to continue the FSC certification, the monitoring will be a part of the agreement with FSC and TNC.

Once our initial measurement is complete, these KEEAs will provide a robust and concise diagnostic scorecard that rates the quality of the forest.

In addition to using the KEEA monitoring results to capture a snapshot of the current forest conditions and document trends overtime, we also intend to use results as a proactive guide to prioritize forest management and restoration activities.

Although beyond the scope of this document the KEEA results will feed into a stewardship prioritization process. The process will take a pragmatic approach balancing available resources along with the ability to improve a KEEA. For example, if the KEEA 5 which is Density of Standing Dead Trees (Snags), shows that many areas are in the poor category. One logical approach would be to allow the forest to age which will eventually result in additional snags, while another would be in some areas take a proactive role in creating snags.

Limitations

It is important to note that this monitoring approach has some limitations. The KEEA monitoring system relies on standard inventory collection as much as possible, which is an advantage and limitation. By pairing the collection of monitoring data to a required forest inventory effort, the cost is very low and will occur at regular intervals.

The KEEA report card will classify each compartment on equal footing, whereas in reality the compartments vary considerably in size. For instance, compartments vary from 78 acres to 1,162 acres (mean = 213 acres). With this discrepancy in stand size, the KEEA report card could be misleading or misinterpreted, particularly in table form. The majority of the composite or individual KEEA scores could be in the Fair or Poor range, leading a reader to make the assumption that the majority of the property was in that condition. In reality, a relatively small number of compartments could represent a majority of the tract area. In these cases, a spatial representation of the KEEA report card would likely offer a more representative view of how the overall tract is performing.

While the KEEA monitoring approach primarily relies on traditional timber inventories, it will be difficult to apply this approach as an afterthought. Careful design and planning should be implemented to ensure the correct metrics are captured while conducting the inventory. Several of the KEEAs require planning above and beyond the typical timber cruise. For instance, Invasive Species, Coarse Woody Debris and Snags are usually not captured during typical inventory collection. Acceptable Growing Stock is occasionally collected, but not universally, and basic regeneration information is collected only sporadically.

Additionally, users should be careful with an assumption that stands in high quality condition (i.e., Good or Very Good Indicator Ratings) have reached their desired status and therefore may not require additional intervention to continue or maintain health and productivity into the future. In fact, stands may require significant management action each decade in order for their Indicator Ratings to remain in high quality condition. For example, Invasive species can creep into a stand and downgrade the overall status.

Appendix H. Herbarium's List of Plants of the Domain

Appendix H serves as a list of plants developed by the Herbarium that summarizes the common, uncommon, and rare, threatened, and endangered species by habitat, as described in Evans et al. (2016), that occur on the Domain. The Herbarium indicated the top 10 species that represent species of conservation concern (highlighted in yellow), to the Herbarium; however this designation does not necessarily mean the species is a Species of Greatest Conservation Concern as designated by the state of Tennessee (J. Evans personal communication, TN SWAP 2015).

Plateau Surface: Allegheny-Cumberland Dry Oak Forest and Woodland (202.359) & Southern Appalachian Low Elevation Pine Forest (CES 202.332)							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**State Status**	**Federal Status**
Eudicots	Ericaceae	*Epigaea*	*repens*	G5	S?		
Basal Dicots	Calycanthaceae	*Calycanthus*	*floridus*	G5	S?		
Eudicots	Adoxaceae	*Viburnum*	*cassinoides*	G5T5	S?		
Eudicots	Apocynaceae	*Asclepias*	*quadrifolia*	G5	S?		
Eudicots	Apocynaceae	*Asclepias*	*variegata*	G5	S?		
Eudicots	Aquifoliaceae	*Ilex*	*ambigua*	G5	S?		
Eudicots	Aquifoliaceae	*Ilex*	*montana*	G5	S?		
Eudicots	Aquifoliaceae	*Ilex*	*verticillata*	G5	S?		
Eudicots	Asteraceae	*Antennaria*	*solitaria*	G5	S?		
Eudicots	Asteraceae	*Arnoglossum*	*atriplicifolium*	G4G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*serotinum*	G5	S?		
Eudicots	Asteraceae	*Hieracium*	*gronovii*	G5	S?		
Eudicots	Asteraceae	*Hieracium*	*venosum*	G5	S?		
Eudicots	Asteraceae	*Ionactis*	*linariifolia*	G5	S?		
Eudicots	Asteraceae	*Lactuca*	*canadensis*	G5	S?		
Eudicots	Asteraceae	*Prenanthes*	*serpentaria*	G5	S?		
Eudicots	Asteraceae	*Solidago*	*odora*	G5	S?		
Eudicots	Caryophyllaceae	*Silene*	*stellata*	G5	S?		
Eudicots	Caryophyllaceae	*Silene*	*virginica*	G5	S?		
Eudicots	Ericaceae	*Monotropa*	*hypopithys*	G5	S?		
Eudicots	Fabaceae	*Clitoria*	*mariana*	G5	S?		
Eudicots	Fabaceae	*Desmodium*	*nudiflorum*	G5	S?		

Eudicots	Fabaceae	*Galactia*	*volubilis*	G5	S?		
Eudicots	Fabaceae	*Lespedeza*	*violacea*	G5	S?		
*Eudicots	Fabaceae	*Thermopsis*	*mollis*	G3G4	S2S3	S	
*Eudicots	Fabaceae	*Castanea*	*dentata*	G4	S2S3	S	
Eudicots	Hamamelidaceae	*Hamamelis*	*virginiana*	G5	S?		
Eudicots	Orobanchaceae	*Melampyrum*	*lineare*	G5	S?		
Eudicots	Plantaginaceae	*Penstemon*	*canescens*	G4	S?		
Eudicots	Polemoniaceae	*Phlox*	*amoena*	G4	S?		
Eudicots	Rosaceae	*Aronia*	*arbutifolia*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*pruinosa*	G5	S?		
Eudicots	Rosaceae	*Fragaria*	*virginiana*	G5	S?		
Eudicots	Rosaceae	*Malus*	*angustifolia*	G5	S?		
Eudicots	Rosaceae	*Malus*	*coronaria*	G5	S?		
Eudicots	Rosaceae	*Rosa*	*carolina*	G5	S?		
Eudicots	Rubiaceae	*Galium*	*lanceolatum*	G5	S?		
Eudicots	Rubiaceae	*Houstonia*	*caerulea*	G5	S?		
Eudicots	Rubiaceae	*Houstonia*	*canadensis*	G5	S?		
Eudicots	Rubiaceae	*Houstonia*	*longifolia*	G5	S?		
Eudicots	Rubiaceae	*Houstonia*	*pusilla*	G5	S?		
Eudicots	Santalaceae	*Phoradendron*	*serotinum*	G5	S?		
Eudicots	Theaceae	*Stewartia*	*ovata*	G4	S?		
Eudicots	Violaceae	*Viola*	*hastata*	G5	S?		
Eudicots	Violaceae	*Viola*	*hirsutula*	G4	S?		
Monocots	Commelinaceae	*Tradescantia*	*ohiensis*	G5	S?		
Monocots	Cyperaceae	*Carex*	*nigromarginata*	G5	S?		
Monocots	Juncaceae	*Luzula*	*bulbosa*	G5	S?		
Monocots	Liliaceae	*Medeola*	*virginiana*	G5	S?		
Monocots	Orchidaceae	*Isotria*	*verticillata*	G5	S?		
Monocots	Orchidaceae	*Malaxis*	*unifolia*	G5	S?		
Monocots	Poaceae	*Arundinaria*	*appalachiana*	G4	S?		
Monocots	Poaceae	*Chasmanthium*	*laxum*	G5	S?		
Monocots	Poaceae	*Dichanthelium*	*commutatum*	G5	S?		
Monocots	Poaceae	*Dichanthelium*	*dichotomum*	G5	S?		

Monocots	Poaceae	*Elymus*	*villosus*	G5	S?		
Monocots	Poaceae	*Panicum*	*anceps*	G5	S?		
Monocots	Poaceae	*Piptochaetium*	*avenaceum*	G5	S?		
Pteridophytes	Dennstaedtiaceae	*Dennstaedtia*	*punctilobula*	G5	S?		

*Denotes Species of Greatest Conservation Need listed in the 2015 TN SWAP

Sandstone Outcrop And Bluff- Cumberland Sandstone Glade and Barrens (CES 202.332)							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Edium	Cactaceae	*Opuntia*	*humifusa*	G5	S?		
Eudicots	Asteraceae	*Ionactis*	*linariifolia*	G5	S?		
Eudicots	Asteraceae	*Liatris*	*microcephala*	G3G4	S?		
Eudicots	Asteraceae	*Liatris*	*scariosa*	G5?	S?		
Eudicots	Asteraceae	*Packera*	*anonyma*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*concolor*	G5	S?		
Eudicots	Caryophyllaceae	*Minuartia*	*glabra*	G4	S3		
*Eudicots	Crassulaceae	*Diamorpha*	*smallii*	G4	S1S2		E
Eudicots	Ericaceae	*Epigaea*	*repens*	G5	S?		
Eudicots	Euphorbiaceae	*Croton*	*willdenowii*	G5	S?		
Eudicots	Fagaceae	*Quercus*	*marilandica*	G5	S?		
Eudicots	Lamiaceae	*Scutellaria*	*integrifolia*	G5	S?		
Eudicots	Montiaceae	*Phemeranthus*	*teretifolius*	G4	S2		T
Eudicots	Rosaceae	*Amelanchier*	*laevis*	G5	S?		
Eudicots	Rosaceae	*Malus*	*angustifolia*	G5?	S?		
Eudicots	Rosaceae	*Rubus*	*allegheniensis*	G5	S?		
Eudicots	Rubiaceae	*Diodia*	*teres*	G5	S?		
Eudicots	Saxifragaceae	*Heuchera*	*americana*	G5	S?		
Eudicots	Violaceae	*Viola*	*sagittata*	G5	S?		
Gymnosperms	Pinaceae	*Pinus*	*echinata*	G5	S?		
Monocots	Cyperaceae	*Carex*	*longii*	G5	S?		
Monocots	Cyperaceae	*Carex*	*rugosperma*	G5T5	S?		
Monocots	Cyperaceae	*Cyperus*	*squarrosus*	G5	S?		
Pteridophytes	Polypodiaceae	*Polypodium*	*appalachianum*	G4G5	S?		

Plateau Wetland- Central Interior Highlands and Appalachian Sinkhole and Depression Pond (CES 202.018) & Cumberland Seepage Forest (CES 202.361)							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Basal Dicots	Calycanthaceae	*Calycanthus*	*floridus*	G5	S?		
Eudicots	Adoxaceae	*Viburnum*	*alabamense*				
Eudicots	Adoxaceae	*Viburnum*	*nudum*	G5	S?		
Eudicots	Adoxaceae	*Viburnum*	*rufidulum*	G5	S?		C
Eudicots	Adoxaceae	*Viburnum*	*recognitum*	G4G5	S?		
Eudicots	Anacardiaceae	*Toxicodendron*	*vernix*	G5	S?		
Eudicots	Apiaceae	*Oxypolis*	*rigidior*	G5	S?		
Eudicots	Asteraceae	*Conoclinium*	*coelestinum*	G5	S?		
Eudicots	Asteraceae	*Doellingeria*	*umbellata*	G5	S?		
Eudicots	Asteraceae	*Erigeron*	*annuus*	G5	S?		
Eudicots	Asteraceae	*Pluchea*	*camphorata*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*lateriflorum*	G5	S?		
Eudicots	Campanulaceae	*Lobelia*	*cardinalis*	G5	S?		
Eudicots	Cornaceae	*Cornus*	*amomum*	G5	S?		
Eudicots	Ericaceae	*Lyonia*	*ligustrina*	G5	S?		
Eudicots	Ericaceae	*Rhododendron*	*canescens*	G5	S?		
Eudicots	Ericaceae	*Vaccinium*	*fuscatum*	G5	S?		
Eudicots	Fabaceae	*Orbexilum*	*pedunculatum*	G5	S?		
Eudicots	Fabaceae	*Senna*	*marilandica*	G5	S?		
Eudicots	Gentianaceae	*Bartonia*	*virginica*	G5	S?		
Eudicots	Gentianaceae	*Gentiana*	*saponaria*	G5	S?		
Eudicots	Iteaceae	*Itea*	*virginica*	G4	S?		
Eudicots	Melastomataceae	*Rhexia*	*virginica*	G5	S?		
Eudicots	Onagraceae	*Circaea*	*lutetiana*	G5	S?		
Eudicots	Parnassiaceae	*Parnassia*	*asarifolia*	G4	S?		
Eudicots	Penthoraceae	*Penthorum*	*sedoides*	G5	S?		
Eudicots	Phrymaceae	*Mimulus*	*ringens*	G5	S?		
Eudicots	Plantaginaceae	*Chelone*	*glabra*	G5	S?		

Eudicots	Plantaginaceae	*Gratiola*	*neglecta*	G5	S?		
Eudicots	Plantaginaceae	*Gratiola*	*virginiana*	G5	S?		
Eudicots	Ranunculaceae	*Anemone*	*quinquefolia*	G5	S?		
Eudicots	Ranunculaceae	*Trautvetteria*	*caroliniensis*	G5	S?		
Eudicots	Ranunculaceae	*Xanthorhiza*	*simplicissima*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*macrosperma*	G5	S?		
Eudicots	Rosaceae	*Geum*	*vernum*	G5	S?		
Eudicots	Rubiaceae	*Cephalanthus*	*occidentalis*	G5	S?		
Eudicots	Rubiaceae	*Houstonia*	*caerulea*	G5	S?		
Eudicots	Urticaceae	*Pilea*	*pumila*	G5	S?		
Eudicots	Violaceae	*Viola*	*cucullata*	G5	S?		
Monocots	Alismataceae	*Sagittaria*	*australis*	G5	S?		
Monocots	Colchicaceae	*Uvularia*	*sessilifolia*	G5	S?		
Monocots	Commelinaceae	*Commelina*	*virginica*	G5	S?		
Monocots	Cyperaceae	*Carex*	*albolutescens*	G5	S?		
Monocots	Cyperaceae	*Carex*	*crinita*	G5	S?		
Monocots	Cyperaceae	*Carex*	*frankii*	G5	S?		
Monocots	Cyperaceae	*Carex*	*glaucescens*	G4	S?		
Monocots	Cyperaceae	*Carex*	*gynandra*	G5	S?		
Monocots	Cyperaceae	*Carex*	*intumescens*	G5	S?		
Monocots	Cyperaceae	*Carex*	*joorii*	G4G5	S?		
Monocots	Cyperaceae	*Carex*	*louisianica*	G5	S?		
Monocots	Cyperaceae	*Carex*	*lurida*	G5	S?		
Monocots	Cyperaceae	*Carex*	*mitchelliana*	G4	S1S2		
Monocots	Cyperaceae	*Carex*	*styloflexa*	G4G5	S?		
Monocots	Cyperaceae	*Carex*	*swanii*	G5	S?		
Monocots	Iridaceae	*Sisyrinchium*	*atlanticum*	G5	S?		
Monocots	Juncaceae	*Juncus*	*canadensis*	G5	S?		
Monocots	Juncaceae	*Juncus*	*debilis*	G5	S?		
Monocots	Juncaceae	*Juncus*	*diffusissimus*	G5	S?		
*Monocots	Liliaceae	*Lilium*	*canadense*	G5	S3		
Monocots	Liliaceae	*Medeola*	*virginiana*	G5	S?		
Monocots	Melanthiaceae	*Amianthium*	*muscitoxicum*	G4G5	S?		

Monocots	Melanthiaceae	*Chamaelirium*	*luteum*	G5	S?		
Monocots	Melanthiaceae	*Stenanthium*	*gramineum*	G4G5	S?		
Monocots	Nartheciaceae	*Aletris*	*farinosa*	G5	S?		
Monocots	Orchidaceae	*Isotria*	*verticillata*	G5	S?		
Monocots	Orchidaceae	*Platanthera*	*clavellata*	G5	S4?		
Monocots	Poaceae	*Andropogon*	*glomeratus*	G5	S?		
Monocots	Poaceae	*Glyceria*	*striata*	G5	S?		
Monocots	Poaceae	*Leersia*	*virginica*	G5	S?		
Monocots	Xyridaceae	*Xyris*	*torta*	G5	S?		
Pteridophytes	Blechnaceae	*Woodwardia*	*areolata*	G5	S?		
Pteridophytes	Onocleaceae	*Onoclea*	*sensibilis*	G5	S?		
Pteridophytes	Ophioglossaceae	*Ophioglossum*	*pycnostichum*	G5	S?		
Pteridophytes	Osmundaceae	*Osmunda*	*claytoniana*	G5	S?		
Pteridophytes	Osmundaceae	*Osmunda*	*regalis*	G5	S?		
Pteridophytes	Woodsiaceae	*Athyrium*	*filix-femina*	G5	S?		

*Denotes Species of Greatest Conservation Need listed in the 2015 TN SWAP

Sandstone Cliff Face and Rockhouse-Cumberland Sandstone Glade and Barrens (CES 202.337)							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Eudicots	Caryophyllaceae	*Silene*	*rotundifolia*	G4	S?		
Eudicots	Ericaceae	*Rhododendron*	*maximum*	G5	S?		
Eudicots	Ranunculaceae	*Thalictrum*	*clavatum*	G4	S?		
Eudicots	Ranunculaceae	*Thalictrum*	*dioicum*	G5	S?		
Eudicots	Ranunculaceae	*Xanthorhiza*	*simplicissima*	G5	S?		
Eudicots	Rosaceae	*Aruncus*	*dioicus*	G5	S?		
Eudicots	Saxifragaceae	*Heuchera*	*americana*	G5	S?		
Eudicots	Saxifragaceae	*Heuchera*	*parviflora*	G4	S?		
Eudicots	Saxifragaceae	*Micranthes*	*careyana*	G3	S3		
Eudicots	Solanaceae	*Physalis*	*heterophylla*	G5	S?		
Eudicots	Violaceae	*Viola*	*blanda*	G5	S?		
Monocots	Iridaceae	*Iris*	*cristata*	G5	S?		
Monocots	Poaceae	*Diarrhena*	*americana*	G4G5	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*montanum*	G5	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*pinnatifidum*	G4	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*rhizophyllum*	G5	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*trudelli*				
*Pteridophytes	Hymenophyllaceae	*Trichomanes*	*boschianum*	G4	S1S2		T
Pteridophytes	Lycopodiaceae	*Huperzia*	*porophila*	G4	S?		
Pteridophytes	Pteridaceae	*Vittaria*	*appalachiana*	G4	S?		
Pteridophytes	Woodsiaceae	*Cystopteris*	*protrusa*	G5	S?		
Pteridophytes	Woodsiaceae	*Cystopteris*	*tennesseensis*	G5	S?		

*Denotes Species of Greatest Conservation Need listed in the 2015 TN SWAP

Upper Slope Dry- Southern Interior Low Plateau Dry-Mesic Oak Forest (CES 202.898)							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Eudicots	Apiaceae	*Thaspium*	*trifoliatum*	G5	S?		
Eudicots	Apocynaceae	*Asclepias*	*quadrifolia*	G5	S?		
Eudicots	Aquifoliaceae	*Ilex*	*longipes*	G5	S?		
*Eudicots	Araliaceae	*Panax*	*quinquefolius*	G3G4	S3S4		C

Eudicots	Asteraceae	*Cirsium*	*altissimum*	G5	S?		
Eudicots	Asteraceae	*Doellingeria*	*infirma*	G5	S?		
*Eudicots	Asteraceae	*Silphium*	*brachiatum*	G3	S3		E
Eudicots	Asteraceae	*Smallanthus*	*uvedalia*	G4G5			
Eudicots	Boraginaceae	*Myosotis*	*macrosperma*	G5	S?		
Eudicots	Brassicaceae	*Cardamine*	*parviflora*	G5	S?		
Eudicots	Caryophyllaceae	*Silene*	*stellata*	G5	S?		
Eudicots	Euphorbiaceae	*Euphorbia*	*corollata*	G5	S?		
Eudicots	Fabaceae	*Gymnocladus*	*dioicus*	G5	S?		
Eudicots	Gentianaceae	*Frasera*	*caroliniensis*	G5	S?		
Eudicots	Gentianaceae	*Obolaria*	*virginica*	G5	S?		
Eudicots	Juglandaceae	*Carya*	*ovalis*	G5	S?		
Eudicots	Lamiaceae	*Callicarpa*	*americana*	G5	S?		
Eudicots	Lamiaceae	*Hedeoma*	*pulegioides*	G5	S?		
Eudicots	Lamiaceae	*Pycnanthemum*	*tenuifolium*	G5	S?		
Eudicots	Oleaceae	*Chionanthus*	*virginicus*	G5	S?		
Eudicots	Orobanchaceae	*Orobanche*	*uniflora*	G5	S?		
Eudicots	Phrymaceae	*Phryma*	*leptostachya*	G5	S?		
Eudicots	Polemoniaceae	*Phlox*	*divaricata*	G5	S?		
Eudicots	Polygalaceae	*Polygala*	*senega*	G4G5	S?		
Eudicots	Ranunculaceae	*Anemone*	*acutiloba*	G5T5	S?		
Eudicots	Ranunculaceae	*Delphinium*	*tricorne*	G5	S?		
*Eudicots	Ranunculaceae	*Hydrastis*	*canadensis*	G3G4	S4		
Eudicots	Rosaceae	*Crataegus*	*berberifolia*	GNR	S?		
Eudicots	Rosaceae	*Crataegus*	*pruinosa*	G5	S?		
Eudicots	Rosaceae	*Prunus*	*mexicana*	G4G5	S?		
Eudicots	Rutaceae	*Ptelea*	*trifoliata*	G5	S?		
Eudicots	Sapotaceae	*Sideroxylon*	*lycioides*	G5	S?		
Eudicots	Saxifragaceae	*Astilbe*	*biternata*	G4G5	S?		
Eudicots	Ulmaceae	*Ulmus*	*rubra*	G5	S?		
Eudicots	Ulmaceae	*Ulmus*	*serotina*	G4	S3S4		
Monocots	Alliaceae	*Allium*	*canadense*	G5	S?		
Monocots	Araceae	*Arisaema*	*dracontium*	G5	S?		

Monocots	Colchicaceae	*Uvularia*	*perfoliata*	G5	S?		
Monocots	Commelinaceae	*Tradescantia*	*subaspera*	G5	S?		
Monocots	Cyperaceae	*Carex*	*caroliniana*	G5	S?		
Monocots	Cyperaceae	*Eleocharis*	*erythropoda*	G5	S?		
Monocots	Iridaceae	*Sisyrinchium*	*albidum*	G5?	S?		
Monocots	Iridaceae	*Sisyrinchium*	*angustifolium*	G5	S?		
Monocots	Liliaceae	*Prosartes*	*lanuginosa*	G5	S?		
Monocots	Liliaceae	*Prosartes*	*maculata*	G3G4	S?		
Monocots	Poaceae	*Dichanthelium*	*ovale*	G5	S?		
Monocots	Poaceae	*Vulpia*	*octoflora*	G5	S?		
Pteridophytes	Thelypteridaceae	*Phegopteris*	*hexagonoptera*	G5	S?		
Pteridophytes	Woodsiaceae	*Diplazium*	*pycnocarpon*	G5	S?		

*Denotes Species of Greatest Conservation Need listed in the 2015 TN SWAP

Upper Slope Mesic- South- Central Interior Mesophytic Forest (CES 202.887)

Group Name	**Family**	Genus	Species	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Basal Dicots	Aristolochiaceae	*Asarum*	*canadense*	G5	S?		
Basal Dicots	Aristolochiaceae	*Isotrema*	*macrophyllum*	G5	S?		
Eudicots	Apiaceae	*Cryptotaenia*	*canadensis*	G5	S?		
Eudicots	Apiaceae	*Erigenia*	*bulbosa*	G5	S?		
Eudicots	Apiaceae	*Osmorhiza*	*claytonii*	G5	S?		
Eudicots	Apiaceae	*Sanicula*	*odorata*	G5	S?		
Eudicots	Apiaceae	*Sanicula*	*trifoliata*	G5	S?		
Eudicots	Araliaceae	*Aralia*	*racemosa*	G5	S?		
*Eudicots	Araliaceae	*Panax*	*quinquefolius*	G3G4	S3S4		C
Eudicots	Asteraceae	*Ageratina*	*altissima*	G5	S5		
Eudicots	Asteraceae	*Arnoglossum*	*reniforme*	G4	S?		
Eudicots	Asteraceae	*Doellingeria*	*infirma*	G5	S?		
Eudicots	Asteraceae	*Prenanthes*	*altissima*	G5	S?		
Eudicots	Asteraceae	*Silphium*	*brachiatum*	G3	S3		E
Eudicots	Asteraceae	*Solidago*	*curtisii*	G4G5	S4		
Eudicots	Asteraceae	*Solidago*	*speciosa*	G5	S?		

Eudicots	Berberidaceae	*Caulophyllum*	*thalictroides*	G5	S?		
Eudicots	Betulaceae	*Corylus*	*americana*	G5	S?		
Eudicots	Boraginaceae	*Hydrophyllum*	*appendiculatum*	G5	S4S5		
Eudicots	Boraginaceae	*Hydrophyllum*	*macrophyllum*	G5	S4S5		
Eudicots	Boraginaceae	*Phacelia*	*bipinnatifida*	G5	S?		
Eudicots	Brassicaceae	*Dentaria*	*laciniata*	G5	S?		
Eudicots	Brassicaceae	*Dentaria*	*multifida*	G4?	S4S5		
Eudicots	Cannabaceae	*Celtis*	*laevigata*	GNR	S?		
Eudicots	Caprifoliaceae	*Lonicera*	*sempervirens*	G5	S?		
Eudicots	Ericaceae	*Monotropa*	*uniflora*	G5	S?		
Eudicots	Euphorbiaceae	*Euphorbia*	*mercurialina*	G4	S?		
Eudicots	Fabaceae	*Gymnocladus*	*dioicus*	G5	S?		
Eudicots	Fabaceae	*Cladrastis*	*kentukea*	G4	S4		
Eudicots	Fagaceae	*Quercus*	*rubra*	G5	S?		
Eudicots	Gentianaceae	*Obolaria*	*virginica*	G5	S?		
Eudicots	Hydrangeaceae	*Hydrangea*	*arborescens*	G5	S?		
Eudicots	Hydrangeaceae	*Hydrangea*	*cinerea*	G4	S?		
Eudicots	Montiaceae	*Claytonia*	*caroliniana*	G5	S?		
Eudicots	Moraceae	*Morus*	*rubra*	G5	S?		
Eudicots	Onagraceae	*Circaea*	*lutetiana*	G5	S?		
Eudicots	Onagraceae	*Epilobium*	*coloratum*	G5	S?		
Eudicots	Oxalidaceae	*Oxalis*	*illinoensis*	G4Q			
Eudicots	Papaveraceae	*Dicentra*	*cucullaria*	G5	S?		
Eudicots	Papaveraceae	*Stylophorum*	*diphyllum*	G5	S?		
Eudicots	Passifloraceae	*Passiflora*	*lutea*	G5	S?		
Eudicots	Platanaceae	*Platanus*	*occidentalis*	G5	S?		
Eudicots	Polemoniaceae	*Phlox*	*divaricata*	G5	S?		
Eudicots	Polemoniaceae	*Phlox*	*pilosa*	G5	S?		
Eudicots	Polygonaceae	*Persicaria*	*virginiana*	G5	S?		
Eudicots	Ranunculaceae	*Actaea*	*pachypoda*	G5	S?		
Eudicots	Ranunculaceae	*Anemone*	*acutiloba*	G5T5	S?		
Eudicots	Ranunculaceae	*Delphinium*	*tricorne*	G5	S?		
Eudicots	Ranunculaceae	*Thalictrum*	*dioicum*	G5	S?		

Eudicots	Rosaceae	*Agrimonia*	*microcarpa*	G5			
Eudicots	Rosaceae	*Aruncus*	*dioicus*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*collina*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*pruinosa*	G5	S?		
Eudicots	Rosaceae	*Potentilla*	*canadensis*	G5	S?		
Eudicots	Saxifragaceae	*Micranthes*	*careyana*	G3	S3		
Eudicots	Saxifragaceae	*Tiarella*	*cordifolia*	G5	S?		
Eudicots	Scrophulariaceae	*Scrophularia*	*marilandica*	G5	S?		
Eudicots	Urticaceae	*Laportea*	*canadensis*	G5	S?		
Eudicots	Urticaceae	*Pilea*	*pumila*	G5	S?		
Eudicots	Violaceae	*Hybanthus*	*concolor*	G5	S?		
Eudicots	Violaceae	*Viola*	*blanda*	G5	S?		
Eudicots	Violaceae	*Viola*	*canadensis*	G5	S?		
Eudicots	Violaceae	*Viola*	*hastata*	G5	S?		
Eudicots	Violaceae	*Viola*	*rostrata*	G5	S?		
*Monocots	Alliaceae	*Allium*	*burdickii*	G4G5	S1S2		T
Monocots	Alliaceae	*Allium*	*cernuum*	G5	S?		
Monocots	Araceae	*Arisaema*	*dracontium*	G5	S?		
Monocots	Colchicaceae	*Uvularia*	*grandiflora*	G5	S?		
Monocots	Colchicaceae	*Uvularia*	*perfoliata*	G5	S?		
Monocots	Commelinaceae	*Tradescantia*	*subaspera*	G5	S?		
Monocots	Cyperaceae	*Carex*	*albursina*	G5	S?		
Monocots	Cyperaceae	*Carex*	*careyana*	G4G5	S?		
Monocots	Cyperaceae	*Carex*	*communis*	G5	S?		
Monocots	Cyperaceae	*Carex*	*lurida*	G5	S?		
Monocots	Cyperaceae	*Carex*	*nigromarginata*	G5	S?		
Monocots	Cyperaceae	*Carex*	*plantaginea*	G5	S?		
Monocots	Cyperaceae	*Carex*	*prasina*	G4	S?		
Monocots	Cyperaceae	*Carex*	*seorsa*	G5	S?		
Monocots	Iridaceae	*Iris*	*cristata*	G5	S?		
Monocots	Iridaceae	*Sisyrinchium*	*angustifolium*	G5	S?		
Monocots	Liliaceae	*Erythronium*	*americanum*	G5	S5		
Monocots	Liliaceae	*Prosartes*	*lanuginosa*	G5	S?		

Monocots	Liliaceae	*Prosartes*	*maculata*	G3G4	S?		
Monocots	Melanthiaceae	*Melanthium*	*parviflorum*	G4?	S?		
Monocots	Melanthiaceae	*Trillium*	*grandiflorum*	G5	S?		
Monocots	Melanthiaceae	*Trillium*	*sulcatum*	G4	S3		
Monocots	Orchidaceae	*Aplectrum*	*hyemale*	G5	S?		
Monocots	Orchidaceae	*Cypripedium*	*pubescens*	G5T5	S?		
Monocots	Orchidaceae	*Galearis*	*spectabilis*	G5	S4		
Monocots	Orchidaceae	*Isotria*	*verticillata*	G5	S?		
Monocots	Poaceae	*Muhlenbergia*	*tenuiflora*	G5	S?		
Monocots	Poaceae	*Poa*	*autumnalis*	G5	S?		
Monocots	Smilacaceae	*Smilax*	*hugeri*	G4	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*resiliens*	G5	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*rhizophyllum*	G5	S?		
Pteridophytes	Dryopteridaceae	*Dryopteris*	*goldiana*	G4G5	S?		
Pteridophytes	Dryopteridaceae	*Dryopteris*	*marginalis*	G5	S?		
Pteridophytes	Polypodiaceae	*Polypodium*	*virginianum*	G5	S4S5		
Pteridophytes	Pteridaceae	*Adiantum*	*pedatum*	G5	S?		
Pteridophytes	Thelypteridaceae	*Phegopteris*	*hexagonoptera*	G5	S?		
Pteridophytes	Woodsiaceae	*Cystopteris*	*bulbifera*	G5	S?		
Pteridophytes	Woodsiaceae	*Cystopteris*	*protrusa*	G5	S?		
Pteridophytes	Woodsiaceae	*Diplazium*	*pycnocarpon*	G5	S?		

*Denotes Species of Greatest Conservation Need listed in the 2015 TN SWAP

Limestone Outcrop and Glades- Central Interio Highlands Calcareous Glades and Barrens (CES 202.691) & Southern Interior Calcareous Cliff (CES 202.356)							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Basal Dicots	Aristolochiaceae	*Isotrema*	*macrophyllum*	G5	S?		
Eudicots	Acanthaceae	*Ruellia*	*caroliniensis*	G4	S?		
Eudicots	Apiaceae	*Eryngium*	*yuccifolium*	G5	S?		
Eudicots	Apiaceae	*Taenidia*	*integerrima*	G5	S?		
Eudicots	Apiaceae	*Thaspium*	*chapmanii*	GNR	S?		
Eudicots	Apocynaceae	*Asclepias*	*tuberosa*	G5	S?		
Eudicots	Apocynaceae	*Asclepias*	*verticillata*	G5	S?		
Eudicots	Apocynaceae	*Matelea*	*carolinensis*	G4	S?		
Eudicots	Asteraceae	*Eupatorium*	*sessilifolium*	G5	S?		
*Eudicots	Asteraceae	*Silphium*	*brachiatum*	G3	S3		E
Eudicots	Asteraceae	*Symphyotrichum*	*laeve*	G5?	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*patens*	G5	S?		
Eudicots	Asteraceae	*Verbesina*	*virginica*	G5?	S?		
Eudicots	Asteraceae	*Vernonia*	*flaccidifolia*	G4	S?		
*Eudicots	Berberidaceae	*Berberis*	*canadensis*	G3G4	S2		S
Eudicots	Brassicaceae	*Boechera*	*canadensis*	G5	S?		
Eudicots	Brassicaceae	*Boechera*	*laevigata*	G5	S?		
Eudicots	Caprifoliaceae	*Lonicera*	*dioica*	G5	S2		S
Eudicots	Fabaceae	*Clitoria*	*mariana*	G5	S?		
Eudicots	Fabaceae	*Galactia*	*volubilis*	G5	S?		
Eudicots	Fagaceae	*Quercus*	*shumardii*	G5	S?		
Eudicots	Gentianaceae	*Obolaria*	*virginica*	G5	S?		
Eudicots	Hydrangeaceae	*Hydrangea*	*cinerea*	G4	S?		
Eudicots	Hydrangeaceae	*Philadelphus*	*hirsutus*	G5	S?		
Eudicots	Hypericaceae	*Hypericum*	*frondosum*	G4	S?		
Eudicots	Lamiaceae	*Monarda*	*fistulosa*	G5	S?		
Eudicots	Oleaceae	*Forestiera*	*ligustrina*	G4G5	S?		
Eudicots	Onagraceae	*Circaea*	*lutetiana*	G5	S?		
Eudicots	Orobanchaceae	*Aureolaria*	*virginica*	G5	S?		

Eudicots	Polygalaceae	*Polygala*	*senega*	G4G5	S?		
Eudicots	Ranunculaceae	*Anemone*	*virginiana*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*calpodendron*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*collina*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*crus-galli*	G5	S?		
Eudicots	Rutaceae	*Ptelea*	*trifoliata*	G5	S?		
Eudicots	Sapotaceae	*Sideroxylon*	*lycioides*	G5	S?		
Eudicots	Saxifragaceae	*Heuchera*	*villosa*	G5	S?		
Eudicots	Solanaceae	*Physalis*	*heterophylla*	G5	S?		
Eudicots	Ulmaceae	*Ulmus*	*serotina*	G4	S3S4		
Monocots	Agavaceae	*Manfreda*	*virginica*	G5	S?		
Monocots	Alliaceae	*Allium*	*cernuum*	G5	S?		
Monocots	Colchicaceae	*Uvularia*	*perfoliata*	G5	S?		
Monocots	Colchicaceae	*Uvularia*	*sessilifolia*	G5	S?		
Monocots	Orchidaceae	*Liparis*	*liliifolia*	G5	S?		
Monocots	Poaceae	*Arundinaria*	*gigantea*	G5	S?		
Monocots	Poaceae	*Piptochaetium*	*avenaceum*	G5	S?		
Monocots	Poaceae	*Sporobolus*	*clandestinus*	G5	S?		
Monocots	Smilacaceae	*Smilax*	*hugeri*	G4	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*resiliens*	G5	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*rhizophyllum*	G5	S?		
Pteridophytes	Aspleniaceae	*Asplenium*	*ruta-muraria*	G5	S?		
Pteridophytes	Polypodiaceae	*Pleopeltis*	*polypodioides*	G5	S?		
Pteridophytes	Pteridaceae	*Cheilanthes*	*lanosa*	G5	S?		
Pteridophytes	Pteridaceae	*Pellaea*	*atropurpurea*	G5	S?		
Pteridophytes	Woodsiaceae	*Cystopteris*	*bulbifera*	G5	S?		
Pteridophytes	Woodsiaceae	*Cystopteris*	*tennesseensis*	G5	S?		

*Denotes Species of Greatest Conservation Need listed in the 2015 TN SWAP

Lower Slope Dry : Southern Ridge and Valley/Cumberland Dry Calcareous Forest (CES 202.457)							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Eudicots	Apiaceae	*Taenidia*	*integerrima*	G5	S?		
Eudicots	Apiaceae	*Zizia*	*aptera*	G5	S?		
Eudicots	Asteraceae	*Fleischmannia*	*incarnata*	G5	S?		
*Eudicots	Asteraceae	*Helianthus*	*eggertii*	G3	S3	DM	S
Eudicots	Asteraceae	*Helianthus*	*hirsutus*	G5	S?		
Eudicots	Asteraceae	*Rudbeckia*	*fulgida*	G5	S?		
Eudicots	Asteraceae	*Solidago*	*rigida*	G5	S?		
Eudicots	Asteraceae	*Vernonia*	*flaccidifolia*	G4	S?		
Eudicots	Brassicaceae	*Boechera*	*laevigata*	G5	S?		
Eudicots	Brassicaceae	*Dentaria*	*laciniata*	G5	S?		
Eudicots	Fabaceae	*Vicia*	*caroliniana*	G5	S?		
Eudicots	Lamiaceae	*Callicarpa*	*americana*	G5	S?		
Eudicots	Menispermaceae	*Cocculus*	*carolinus*	G5	S?		
Eudicots	Oleaceae	*Chionanthus*	*virginicus*	G5	S?		
*Eudicots	Ranunculaceae	*Clematis*	*morefieldii*	G2	S2	LE	E
Eudicots	Rosaceae	*Crataegus*	*calpodendron*	G5	S?		
Monocots	Colchicaceae	*Uvularia*	*grandiflora*	G5	S?		
Monocots	Colchicaceae	*Uvularia*	*perfoliata*	G5	S?		
Monocots	Cyperaceae	*Carex*	*cephalophora*	G5	S?		
Monocots	Cyperaceae	*Carex*	*kraliana*	G5	S?		
Monocots	Poaceae	*Arundinaria*	*gigantea*	G5	S?		
Monocots	Poaceae	*Muhlenbergia*	*sobolifera*	G5	S?		

*Denotes Species of Greatest Conservation Need listed in the 2015 TN SWAP

Floodplain- South Central Interior Large Floodplain (CES 202.705)							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Eudicots	Apocynaceae	*Gonolobus*	*suberosus*	G5	S?		
Eudicots	Asteraceae	*Ageratina*	*altissima*	G5	S5		
Eudicots	Asteraceae	*Arnoglossum*	*reniforme*	G4	S?		
Eudicots	Asteraceae	*Rudbeckia*	*laciniata*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*lateriflorum*	G5	S?		
Eudicots	Boraginaceae	*Mertensia*	*virginica*	G5	S?		C
Eudicots	Boraginaceae	*Phacelia*	*bipinnatifida*	G5	S?		
Eudicots	Brassicaceae	*Cardamine*	*pensylvanica*	G5	S?		
Eudicots	Cornaceae	*Cornus*	*alternifolia*	G5	S?		
Eudicots	Fagaceae	*Quercus*	*shumardii*	G5	S?		
Eudicots	Juglandaceae	*Carya*	*cordiformis*	G5	S?		
*Eudicots	Juglandaceae	*Juglans*	*cinerea*	G4	S3		T
Eudicots	Lamiaceae	*Agastache*	*nepetoides*	G5	S?		
Eudicots	Lamiaceae	*Blephilia*	*hirsuta*	G5	S?		
Eudicots	Orobanchaceae	*Epifagus*	*virginiana*	G5	S?		
Eudicots	Plantaginaceae	*Veronicastrum*	*virginicum*	G4	S?		
Eudicots	Ranunculaceae	*Anemone*	*acutiloba*	G5T5	S?		
*Eudicots	Ranunculaceae	*Hydrastis*	*canadensis*	G3G4	S4		
Eudicots	Saxifragaceae	*Astilbe*	*biternata*	G4G5	S?		
Eudicots	Saxifragaceae	*Mitella*	*diphylla*	G5	S?		
Eudicots	Saxifragaceae	*Tiarella*	*cordifolia*	G5	S?		
Eudicots	Theophrastaceae	*Samolus*	*valerandi*	G5	S?		
Eudicots	Urticaceae	*Pilea*	*pumila*	G5	S?		
*Eudicots	Violaceae	*Viola*	*tripartita*	G5	S3		
Monocots	Agavaceae	*Camassia*	*scilloides*	G4G5	S?		
Monocots	Commelinaceae	*Tradescantia*	*subaspera*	G5	S?		
Monocots	Cyperaceae	*Carex*	*careyana*	G4G5	S?		
Monocots	Cyperaceae	*Carex*	*texensis*	G5	S?		
Monocots	Cyperaceae	*Carex*	*venusta*	G4	S?		
Monocots	Iridaceae	*Iris*	*cristata*	G5	S?		

Monocots	Juncaceae	*Luzula*	*acuminata*	G5	S?		
Monocots	Liliaceae	*Prosartes*	*lanuginosa*	G5	S?		
Monocots	Melanthiaceae	*Trillium*	*grandiflorum*	G5	S?		
Monocots	Poaceae	*Festuca*	*subverticillata*	G5	S?		
Pteridophytes	Dryopteridaceae	*Dryopteris*	*celsa*	G4	S?		
Pteridophytes	Dryopteridaceae	*Dryopteris*	*marginalis*	G5	S?		
Pteridophytes	Ophioglossaceae	*Ophioglossum*	*pycnostichum*	G5	S?		
Pteridophytes	Woodsiaceae	*Cystopteris*	*protrusa*	G5	S?		
Pteridophytes	Woodsiaceae	*Deparia*	*acrostichoides*	G5	S?		

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Lower Slope Mesic- South-Central Interior Mesophytic Forest (CES 202.887)

Group Name	Family	Genus	Species	Global Rank	State Rank	Federal Status	State Status
Eudicots	Apiaceae	*Sanicula*	*odorata*	G5	S?		
Eudicots	Asteraceae	*Brickellia*	*eupatorioides*	G5	S?		
Eudicots	Asteraceae	*Lactuca*	*floridana*	G5	S?		
Eudicots	Asteraceae	*Prenanthes*	*serpentaria*	G5	S?		
*Eudicots	Asteraceae	*Silphium*	*brachiatum*	G2G3	S2		E
Eudicots	Asteraceae	*Symphyotrichum*	*patens*	G5	S?		
Eudicots	Berberidaceae	*Caulophyllum*	*thalictroides*	G5	S?		
Eudicots	Berberidaceae	*Jeffersonia*	*diphylla*	G5	S?		C
Eudicots	Boraginaceae	*Nemophila*	*aphylla*	G5	S?		
Eudicots	Campanulaceae	*Campanula*	*americana*	G5	S?		
Eudicots	Euphorbiaceae	*Euphorbia*	*mercurialina*	G4	S?		
Eudicots	Fabaceae	*Desmodium*	*glabellum*	G5	S?		
Eudicots	Fabaceae	*Galactia*	*volubilis*	G5	S?		
Eudicots	Fabaceae	*Phaseolus*	*polystachios*	G5	S?		
Eudicots	Lamiaceae	*Blephilia*	*hirsuta*	G5?	S?		
Eudicots	Onagraceae	*Circaea*	*lutetiana*	G5	S?		
Eudicots	Orobanchaceae	*Epifagus*	*virginiana*	G5	S?		
Eudicots	Passifloraceae	*Passiflora*	*lutea*	G5	S?		
Eudicots	Phrymaceae	*Phryma*	*leptostachya*	G5	S?		

Eudicots	Polygonaceae	*Persicaria*	*virginiana*	G5	S?		
Eudicots	Primulaceae	*Primula*	*meadia*	G5	S4S5		
Eudicots	Ranunculaceae	*Actaea*	*pachypoda*	G5	S?		
Eudicots	Ranunculaceae	*Anemone*	*acutiloba*	G5T5	S?		
*Eudicots	Ranunculaceae	*Hydrastis*	*canadensis*	G3G4	S4		C
Eudicots	Rosaceae	*Agrimonia*	*rostellata*	G5	S?		
Eudicots	Sapindaceae	*Aesculus*	*glabra*	G5	S?		
Eudicots	Sapotaceae	*Sideroxylon*	*lycioides*	G5	S?		
Eudicots	Ulmaceae	*Ulmus*	*rubra*	G5	S?		
Monocots	Cyperaceae	*Carex*	*gravida*	G5	S1		
Monocots	Iridaceae	*Sisyrinchium*	*sp. nov.*	G5	S?		
Monocots	Liliaceae	*Prosartes*	*lanuginosa*	G5	S?		
Monocots	Orchidaceae	*Spiranthes*	*ovalis*	G5?	S3		
Monocots	Poaceae	*Arundinaria*	*gigantea*	G5	S?		
Monocots	Smilacaceae	*Smilax*	*hugeri*	G4	S?		
Pteridophytes	Hymenophyllaceae	*Trichomanes*	*intricatum*	G4G5	S?		
Pteridophytes	Thelypteridaceae	*Phegopteris*	*hexagonoptera*	G5	S?		
Pteridophytes	Woodsiaceae	*Woodsia*	*obtusa*	G5	S?		

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Plateau Open							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Eudicots	Acanthaceae	*Ruellia*	*caroliniensis*	G5	S?		
Eudicots	Amaranthaceae	*Amaranthus*	*spinosus*	G5	S?		
Eudicots	Anacardiaceae	*Rhus*	*glabra*	G5	S?		
Eudicots	Apiaceae	*Chaerophyllum*	*tainturieri*	G5	S?		
Eudicots	Apiaceae	*Eryngium*	*yuccifolium*	G5	S?		
Eudicots	Apiaceae	*Zizia*	*aurea*	G5	S?		
Eudicots	Apocynaceae	*Apocynum*	*cannabinum*	G5	S?		
Eudicots	Apocynaceae	*Asclepias*	*amplexicaulis*	G5	S?		

Eudicots	Apocynaceae	*Asclepias*	*exaltata*	G5	S?		
Eudicots	Apocynaceae	*Asclepias*	*syriaca*	G5	S?		
Eudicots	Apocynaceae	*Asclepias*	*tuberosa*	G5	S?		
Eudicots	Apocynaceae	*Asclepias*	*variegata*	G5	S?		
Eudicots	Araliaceae	*Aralia*	*spinosa*	G5	S?		
Eudicots	Asteraceae	*Ageratina*	*altissima*	G5	S?		
Eudicots	Asteraceae	*Ambrosia*	*trifida*	G5	S?		
Eudicots	Asteraceae	*Bidens*	*aristosa*	G5	S?		
Eudicots	Asteraceae	*Bidens*	*bipinnata*	G5	S?		
Eudicots	Asteraceae	*Bidens*	*frondosa*	G5	S?		
Eudicots	Asteraceae	*Chrysopsis*	*mariana*	G5	S?		
Eudicots	Asteraceae	*Cirsium*	*discolor*	G5	S?		
Eudicots	Asteraceae	*Conoclinium*	*coelestinum*	G5	S?		
Eudicots	Asteraceae	*Conyza*	*canadensis*	G5	S?		
Eudicots	Asteraceae	*Coreopsis*	*tinctoria*	G5	S?		
Eudicots	Asteraceae	*Elephantopus*	*tomentosus*	G5	S?		
Eudicots	Asteraceae	*Erigeron*	*annuus*	G5	S?		
Eudicots	Asteraceae	*Erigeron*	*strigosus*	G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*album*	G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*altissimum*	G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*capillifolium*	G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*hyssopifolium*	G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*perfoliatum*	G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*pilosum*	G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*rotundifolium*	G5	S?		
Eudicots	Asteraceae	*Eupatorium*	*serotinum*	G5	S?		
Eudicots	Asteraceae	*Eurybia*	*hemispherica*	G4	S?		
Eudicots	Asteraceae	*Eurybia*	*surculosa*	G4G5	S?		
Eudicots	Asteraceae	*Eutrochium*	*fistulosum*	G5?	S?		
Eudicots	Asteraceae	*Gaillardia*	*pulchella*	G4G5	S?		
Eudicots	Asteraceae	*Gamochaeta*	*argyrinea*				
Eudicots	Asteraceae	*Helenium*	*amarum*	G5	S?		
Eudicots	Asteraceae	*Helenium*	*flexuosum*	G5	S?		

Eudicots	Asteraceae	*Helianthus*	*annuus*	G5	S?		
Eudicots	Asteraceae	*Helianthus*	*divaricatus*	G5	S?		
Eudicots	Asteraceae	*Helianthus*	*microcephalus*	G5	S?		
Eudicots	Asteraceae	*Helianthus*	*strumosus*	G5	S?		
Eudicots	Asteraceae	*Helianthus*	*tuberosus*	G5	S?		
Eudicots	Asteraceae	*Heterotheca*	*camporum*	G5	S?		
Eudicots	Asteraceae	*Hieracium*	*gronovii*	G5	S?		
Eudicots	Asteraceae	*Hieracium*	*venosum*	G5	S?		
Eudicots	Asteraceae	*Ionactis*	*linariifolia*	G5	S?		
Eudicots	Asteraceae	*Iva*	*annua*	G5	S?		
Eudicots	Asteraceae	*Krigia*	*biflora*	G5	S?		
Eudicots	Asteraceae	*Lactuca*	*canadensis*	G5	S?		
Eudicots	Asteraceae	*Lactuca*	*floridana*	G5	S?		
Eudicots	Asteraceae	*Liatris*	*squarrulosa*	G4G5	S?		
Eudicots	Asteraceae	*Mikania*	*scandens*	G5	S?		
Eudicots	Asteraceae	*Packera*	*anonyma*	G5	S?		
Eudicots	Asteraceae	*Packera*	*glabella*	G5	S?		
Eudicots	Asteraceae	*Parthenium*	*integrifolium*	G5	S?		
Eudicots	Asteraceae	*Pityopsis*	*aspera*	G5	S?		
Eudicots	Asteraceae	*Pityopsis*	*graminifolia*	G5	S?		
Eudicots	Asteraceae	*Prenanthes*	*serpentaria*	G5	S?		
Eudicots	Asteraceae	*Pseudognaphalium*	*obtusifolium*	G5	S?		
Eudicots	Asteraceae	*Ratibida*	*pinnata*	G5	S?		
Eudicots	Asteraceae	*Rudbeckia*	*hirta*	G5	S?		
Eudicots	Asteraceae	*Rudbeckia*	*triloba*	G5	S?		
Eudicots	Asteraceae	*Sericocarpus*	*asteroides*	G5	S?		
Eudicots	Asteraceae	*Sericocarpus*	*linifolius*	G5	S?		
Eudicots	Asteraceae	*Silphium*	*asteriscus*	G5	S?		
Eudicots	Asteraceae	*Solidago*	*arguta*	G5	S?		
Eudicots	Asteraceae	*Solidago*	*erecta*	G5	S?		
Eudicots	Asteraceae	*Solidago*	*hispida*	G5	S?		
Eudicots	Asteraceae	*Solidago*	*nemoralis*	G5	S?		
Eudicots	Asteraceae	*Solidago*	*patula*	G5	S?		

Eudicots	Asteraceae	*Solidago*	*rugosa*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*dumosum*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*lanceolatum*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*ontarionis*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*patens*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*pilosum*	G5	S?		
Eudicots	Asteraceae	*Symphyotrichum*	*undulatum*	G5	S?		
Eudicots	Asteraceae	*Verbesina*	*virginica*	G5?	S?		
Eudicots	Asteraceae	*Vernonia*	*gigantea*	G5	S?		
Eudicots	Asteraceae	*Xanthium*	*strumarium*	G5	S?		
Eudicots	Betulaceae	*Betula*	*nigra*	G5	S?		
Eudicots	Boraginaceae	*Myosotis*	*macrosperma*	G5	S?		
Eudicots	Boraginaceae	*Nemophila*	*aphylla*	G5	S?		
Eudicots	Brassicaceae	*Lepidium*	*virginicum*	G5	S?		
Eudicots	Campanulaceae	*Lobelia*	*inflata*	G5	S?		
Eudicots	Campanulaceae	*Lobelia*	*puberula*	G5	S?		
Eudicots	Campanulaceae	*Triodanis*	*perfoliata*	G5	S?		
Eudicots	Cannabaceae	*Celtis*	*laevigata*	GNR	S?		
Eudicots	Caprifoliaceae	*Lonicera*	*sempervirens*	G5	S?		
Eudicots	Caryophyllaceae	*Cerastium*	*brachypodum*	G5	S?		
Eudicots	Caryophyllaceae	*Silene*	*antirrhina*	G5	S?		
Eudicots	Cistaceae	*Lechea*	*racemulosa*	G5	S?		
Eudicots	Convolvulaceae	*Calystegia*	*catesbeiana*	G3	S?		
Eudicots	Cucurbitaceae	*Melothria*	*pendula*	G5?	S?		
Eudicots	Euphorbiaceae	*Acalypha*	*rhomboidea*	G5	S?		
Eudicots	Euphorbiaceae	*Chamaesyce*	*nutans*	G5	S?		
Eudicots	Euphorbiaceae	*Chamaesyce*	*prostrata*	G5	S?		
Eudicots	Euphorbiaceae	*Croton*	*monanthogynus*	G5	S?		
Eudicots	Euphorbiaceae	*Euphorbia*	*corollata*	G5	S?		
Eudicots	Euphorbiaceae	*Euphorbia*	*cyathophora*	G5	S?		
Eudicots	Fabaceae	*Amorpha*	*fruticosa*	G5	S?		
Eudicots	Fabaceae	*Apios*	*americana*	G5	S?		
Eudicots	Fabaceae	*Chamaecrista*	*fasciculata*	G5	S?		

Eudicots	Fabaceae	*Desmodium*	*glabellum*	G5	S?		
Eudicots	Fabaceae	*Desmodium*	*perplexum*	G5	S?		
Eudicots	Fabaceae	*Desmodium*	*viridiflorum*	G5?	S?		
Eudicots	Fabaceae	*Lespedeza*	*intermedia*	G5?	S?		
Eudicots	Fabaceae	*Lespedeza*	*repens*	G5	S?		
Eudicots	Fabaceae	*Lespedeza*	*violacea*	G5	S?		
Eudicots	Fabaceae	*Mimosa*	*microphylla*	G5T5	S?		
Eudicots	Fabaceae	*Robinia*	*hispida*	G4	S?		
Eudicots	Fabaceae	*Stylosanthes*	*biflora*	G5	S?		
Eudicots	Fabaceae	*Tephrosia*	*virginiana*	G5	S?		
Eudicots	Hydrangeaceae	*Philadelphus*	*inodorus*	G4G5	S?		
Eudicots	Hypericaceae	*Hypericum*	*canadense*	G5	S?		
Eudicots	Hypericaceae	*Hypericum*	*hypericoides*	G5	S?		
Eudicots	Hypericaceae	*Hypericum*	*mutilum*	G5	S?		
Eudicots	Hypericaceae	*Hypericum*	*nudiflorum*	G5	S2		
Eudicots	Hypericaceae	*Hypericum*	*prolificum*	G5	S?		
Eudicots	Lamiaceae	*Collinsonia*	*canadensis*	G5	S?		
Eudicots	Lamiaceae	*Lycopus*	*virginicus*	G5	S?		
Eudicots	Lamiaceae	*Monarda*	*fistulosa*	G5	S?		
Eudicots	Lamiaceae	*Pycnanthemum*	*muticum*	G5	S?		
Eudicots	Lamiaceae	*Trichostema*	*setaceum*	G5	S?		
Eudicots	Linaceae	*Linum*	*medium*	G5	S?		
Eudicots	Linaceae	*Linum*	*striatum*	G5	S?		
Eudicots	Melastomataceae	*Rhexia*	*mariana*	G5	S?		
Eudicots	Molluginaceae	*Mollugo*	*verticillata*	G5	S?		
Eudicots	Onagraceae	*Epilobium*	*coloratum*	G5	S?		
Eudicots	Onagraceae	*Ludwigia*	*alternifolia*	G5	S?		
Eudicots	Onagraceae	*Oenothera*	*biennis*	G5	S?		
Eudicots	Onagraceae	*Oenothera*	*laciniata*	G5	S?		
Eudicots	Onagraceae	*Oenothera*	*speciosa*	G5	S?		
Eudicots	Orobanchaceae	*Agalinis*	*gattingeri*	G4	S2S3		
Eudicots	Orobanchaceae	*Aureolaria*	*pectinata*	G5?	S?		
Eudicots	Orobanchaceae	*Aureolaria*	*virginica*	G5	S?		

Eudicots	Phyllanthaceae	*Phyllanthus*	*caroliniensis*	G5	S?		
Eudicots	Plantaginaceae	*Mecardonia*	*acuminata*	G5	S?		
Eudicots	Plantaginaceae	*Penstemon*	*brevisepalus*	GNR	S?		
Eudicots	Plantaginaceae	*Penstemon*	*canescens*	G4	S?		
Eudicots	Plantaginaceae	*Penstemon*	*laevigatus*	G5	S?		
Eudicots	Plantaginaceae	*Plantago*	*virginica*	G5	S?		
Eudicots	Polemoniaceae	*Phlox*	*maculata*	G5	S?		
Eudicots	Polemoniaceae	*Phlox*	*subulata*	G5	S1		T
Eudicots	Polygonaceae	*Fallopia*	*scandens*	G5			
Eudicots	Polygonaceae	*Persicaria*	*sagittata*	G5	S?		
Eudicots	Rhamnaceae	*Ceanothus*	*americanus*	G5	S?		
Eudicots	Rosaceae	*Agrimonia*	*parviflora*	G5	S?		
Eudicots	Rosaceae	*Agrimonia*	*pubescens*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*iracunda*	G5	S?		
Eudicots	Rosaceae	*Porteranthus*	*trifoliatus*	G4G5	S?		
Eudicots	Rosaceae	*Prunus*	*angustifolia*	G5	S?		
Eudicots	Rosaceae	*Prunus*	*munsoniana*	G5	S?		
Eudicots	Rosaceae	*Rubus*	*longii*	G4?Q			
Eudicots	Rosaceae	*Rubus*	*occidentalis*	G5	S?		
Eudicots	Rubiaceae	*Galium*	*tinctorium*	G5	S?		
Eudicots	Salicaceae	*Populus*	*deltoides*	G5	S?		
Eudicots	Salicaceae	*Salix*	*caroliniana*	G5	S?		
Eudicots	Salicaceae	*Salix*	*humilis*	G5	S?		
Eudicots	Santalaceae	*Phoradendron*	*serotinum*	G5	S?		
Eudicots	Sapindaceae	*Cardiospermum*	*halicacabum*	G5	S?		
Eudicots	Scrophulariaceae	*Scrophularia*	*marilandica*	G5	S?		
Eudicots	Solanaceae	*Solanum*	*ptychanthum*	G5	S?		
Eudicots	Ulmaceae	*Ulmus*	*americana*	G5	S?		
Eudicots	Urticaceae	*Parietaria*	*pensylvanica*	G5	S?		
Eudicots	Valerianaceae	*Valerianella*	*radiata*	G5	S?		
Eudicots	Verbenaceae	*Phyla*	*lanceolata*	G5	S?		
Eudicots	Verbenaceae	*Verbena*	*urticifolia*	G5	S?		
Eudicots	Violaceae	*Viola*	*bicolor*	G5	S?		

Eudicots	Violaceae	*Viola*	*subsinuata*	G3G5	S?		
Eudicots	Vitaceae	*Ampelopsis*	*arborea*	G5	S?		
Monocots	Alismataceae	*Alisma*	*subcordatum*	G5	S?		
Monocots	Alliaceae	*Nothoscordum*	*bivalve*	G4	S?		
Monocots	Cyperaceae	*Carex*	*atlantica*	G5	S?		
Monocots	Cyperaceae	*Carex*	*cephalophora*	G5	S?		
Monocots	Cyperaceae	*Carex*	*cherokeensis*	G4G5	S?		
Monocots	Cyperaceae	*Carex*	*crinita*	G5	S?		
Monocots	Cyperaceae	*Carex*	*longii*	G5	S?		
Monocots	Cyperaceae	*Carex*	*vulpinoidea*	G5	S?		
Monocots	Cyperaceae	*Cyperus*	*flavescens*	G5	S?		
Monocots	Cyperaceae	*Cyperus*	*strigosus*	G5	S?		
Monocots	Iridaceae	*Iris*	*virginica*	G5	S?		
Monocots	Iridaceae	*Sisyrinchium*	*atlanticum*	G5	S?		
Monocots	Juncaceae	*Juncus*	*anthelatus*				
Monocots	Juncaceae	*Juncus*	*coriaceus*	G5	S?		
Monocots	Juncaceae	*Juncus*	*debilis*	G5	S?		
Monocots	Juncaceae	*Juncus*	*diffusissimus*	G5	S?		
Monocots	Juncaceae	*Juncus*	*marginatus*	G5	S3S4		
Monocots	Nartheciaceae	*Aletris*	*farinosa*	G5	S?		
Monocots	Orchidaceae	*Platanthera*	*ciliaris*	G5	S?		
Monocots	Orchidaceae	*Spiranthes*	*cernua*	G5	S?		
Monocots	Orchidaceae	*Spiranthes*	*lacera*	G5	S?		
Monocots	Orchidaceae	*Spiranthes*	*vernalis*	G5	S?		
Monocots	Poaceae	*Aristida*	*dichotoma*	G5	S?		
Monocots	Poaceae	*Cinna*	*arundinacea*	G5	S?		
*Monocots	Poaceae	*Danthonia*	*epilis*	G4	S1S2		S
Monocots	Poaceae	*Dichanthelium*	*clandestinum*	G5	S?		
Monocots	Poaceae	*Dichanthelium*	*depauperatum*	G5	S?		
Monocots	Poaceae	*Dichanthelium*	*scoparium*	G5	S?		
Monocots	Poaceae	*Digitaria*	*ciliaris*	G5	S?		
Monocots	Poaceae	*Elymus*	*glabriflorus*	G5			
Monocots	Poaceae	*Eragrostis*	*hirsuta*	G5	S?		

Monocots	Poaceae	*Eragrostis*	*spectabilis*	G5	S?		
Monocots	Poaceae	*Glyceria*	*striata*	G5	S?		
Monocots	Poaceae	*Hordeum*	*pusillum*	G5	S?		
Monocots	Poaceae	*Leersia*	*oryzoides*	G5	S?		
Monocots	Poaceae	*Muhlenbergia*	*schreberi*	G5	S?		
Monocots	Poaceae	*Panicum*	*flexile*	G5	S?		
Monocots	Poaceae	*Panicum*	*philadelphicum*	G5			
Monocots	Poaceae	*Panicum*	*rigidulum*	G5	S?		
Monocots	Poaceae	*Panicum*	*verrucosum*	G4	S?		
Monocots	Poaceae	*Paspalum*	*laeve*	G4G5	S?		
Monocots	Poaceae	*Paspalum*	*pubiflorum*	G5	S?		
Monocots	Poaceae	*Saccharum*	*alopecuroides*	G5			
Monocots	Poaceae	*Sorghastrum*	*nutans*	G5	S?		
Monocots	Poaceae	*Sporobolus*	*vaginiflorus*	G5	S?		
Pteridophytes	Dennstaedtiaceae	*Pteridium*	*aquilinum*	G5	S?		
Pteridophytes	Equisetaceae	*Equisetum*	*arvense*	G5	S?		
Pteridophytes	Lycopodiaceae	*Lycopodiella*	*alopecuroides*	G5	S2		T

*Denotes Species of Greatest Conservation Need listed in the 2015 TN SWAP

Cove Open							
Group Name	**Family**	**Genus**	**Species**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
Eudicots	Acanthaceae	*Ruellia*	*caroliniensis*	G5	S?		
Eudicots	Acanthaceae	*Ruellia*	*humilis*	G5	S?		
Eudicots	Anacardiaceae	*Rhus*	*glabra*	G5	S?		
Eudicots	Apiaceae	*Sanicula*	*smallii*	G5	S?		
Eudicots	Apiaceae	*Taenidia*	*integerrima*	G5	S?		
Eudicots	Apiaceae	*Zizia*	*aptera*	G5	S?		
Eudicots	Apocynaceae	*Amsonia*	*tabernaemontana*	G5	S3S4		
Eudicots	Apocynaceae	*Asclepias*	*verticillata*	G5	S?		
Eudicots	Apocynaceae	*Matelea*	*carolinensis*	G4	S?		
Eudicots	Asteraceae	*Ageratina*	*altissima*	G5	S5		
Eudicots	Asteraceae	*Bidens*	*frondosa*	G5	S?		
Eudicots	Asteraceae	*Bidens*	*polylepis*	G5			
Eudicots	Asteraceae	*Brickellia*	*eupatorioides*	G5	S?		
Eudicots	Asteraceae	*Cirsium*	*altissimum*	G5	S?		
Eudicots	Asteraceae	*Coreopsis*	*tripteris*	G5	S?		
Eudicots	Asteraceae	*Eurybia*	*hemispherica*	G4	S?		
Eudicots	Asteraceae	*Fleischmannia*	*incarnata*	G5	S?		
Eudicots	Asteraceae	*Helenium*	*flexuosum*	G5	S?		
Eudicots	Asteraceae	*Helianthus*	*sp. nov.*				
*Eudicots	Asteraceae	*Liatris*	*cylindracea*	G5	S2		T
Eudicots	Asteraceae	*Packera*	*obovata*	G5	S?		
Eudicots	Asteraceae	*Ratibida*	*pinnata*	G5	S?		
Eudicots	Asteraceae	*Silphium*	*pinnatifidum*	G3Q	S2		T
Eudicots	Asteraceae	*Smallanthus*	*uvedalia*	G4G5			
Eudicots	Asteraceae	*Solidago*	*curtisii*	G4G5			
Eudicots	Asteraceae	*Solidago*	*rigida*	G5	S?		
*Eudicots	Asteraceae	*Symphyotrichum*	*pratense*	G4?	S1		E
Eudicots	Asteraceae	*Verbesina*	*alternifolia*	G5	S?		
Eudicots	Asteraceae	*Verbesina*	*virginica*	G5?	S?		
Eudicots	Asteraceae	*Vernonia*	*flaccidifolia*	G4	S?		

Eudicots	Campanulaceae	*Campanula*	*americana*	G5	S?		
Eudicots	Campanulaceae	*Lobelia*	*inflata*	G5	S?		
Eudicots	Caprifoliaceae	*Lonicera*	*sempervirens*	G5	S?		
Eudicots	Convolvulaceae	*Calystegia*	*silvatica*	G5	S?		
Eudicots	Convolvulaceae	*Cuscuta*	*pentagona*	G5	S?		
Eudicots	Cucurbitaceae	*Sicyos*	*angulatus*	G5	S?		
Eudicots	Fabaceae	*Desmodium*	*cuspidatum*	G5	S?		
Eudicots	Fabaceae	*Vicia*	*caroliniana*	G5	S?		
Eudicots	Gentianaceae	*Frasera*	*caroliniensis*	G5	S?		
Eudicots	Gentianaceae	*Gentiana*	*villosa*	G4	S?		
Eudicots	Gentianaceae	*Sabatia*	*angularis*	G5	S?		
Eudicots	Hydrangeaceae	*Hydrangea*	*cinerea*	G4	S?		
Eudicots	Hypericaceae	*Hypericum*	*sphaerocarpum*	G5	S4		
Eudicots	Lamiaceae	*Agastache*	*nepetoides*	G5	S?		
Eudicots	Lamiaceae	*Hedeoma*	*pulegioides*	G5	S?		
Eudicots	Lamiaceae	*Physostegia*	*virginiana*	G5	S?		
Eudicots	Lamiaceae	*Trichostema*	*dichotomum*	G5	S?		
Eudicots	Lythraceae	*Cuphea*	*viscosissima*	G5?	S?		
Eudicots	Menispermaceae	*Cocculus*	*carolinus*	G5	S?		
Eudicots	Onagraceae	*Gaura*	*filipes*	G5	S?		
Eudicots	Onagraceae	*Ludwigia*	*alternifolia*	G5	S?		
Eudicots	Onagraceae	*Oenothera*	*biennis*	G5	S?		
Eudicots	Orobanchaceae	*Aureolaria*	*virginica*	G5	S?		
Eudicots	Phrymaceae	*Mimulus*	*alatus*	G5	S?		
Eudicots	Plantaginaceae	*Penstemon*	*calycosus*	G5	S?		
Eudicots	Plantaginaceae	*Penstemon*	*canescens*	G4	S?		
Eudicots	Plantaginaceae	*Plantago*	*rugelii*	G5	S?		
Eudicots	Plantaginaceae	*Veronicastrum*	*virginicum*	G4	S?		
Eudicots	Polemoniaceae	*Phlox*	*amplifolia*	G3G5	S?		
Eudicots	Polemoniaceae	*Phlox*	*carolina*	G5?	S?		
Eudicots	Polygonaceae	*Persicaria*	*virginiana*	G5	S?		
Eudicots	Primulaceae	*Primula*	*meadia*	G5	S4S5		
Eudicots	Ranunculaceae	*Anemone*	*virginiana*	G5	S?		

Eudicots	Ranunculaceae	*Clematis*	*catesbyana*	G4G5	S?		
Eudicots	Rosaceae	*Agrimonia*	*pubescens*	G5	S?		
Eudicots	Rosaceae	*Agrimonia*	*rostellata*	G5	S?		
Eudicots	Rosaceae	*Crataegus*	*intricata*	G5	S?		
Eudicots	Rosaceae	*Prunus*	*americana*	G5	S?		
Eudicots	Rosaceae	*Rosa*	*setigera*	G5	S?		
Eudicots	Scrophulariaceae	*Scrophularia*	*marilandica*	G5	S?		
Monocots	Agavaceae	*Manfreda*	*virginica*	G5	S?		
Monocots	Alliaceae	*Allium*	*canadense*	G5	S?		
Monocots	Cyperaceae	*Carex*	*aggregata*	G5	S?		
Monocots	Cyperaceae	*Carex*	*albicans*	G5	S?		
Monocots	Cyperaceae	*Carex*	*communis*	G5	S?		
Monocots	Cyperaceae	*Carex*	*frankii*	G5	S?		
Monocots	Cyperaceae	*Carex*	*glaucodea*	G5T5	S?		
Monocots	Cyperaceae	*Carex*	*granularis*	G5	S?		
Monocots	Cyperaceae	*Carex*	*kraliana*	G5	S?		
Monocots	Cyperaceae	*Carex*	*meadii*	G4G5	S?		
Monocots	Cyperaceae	*Carex*	*vulpinoidea*	G5	S?		
Monocots	Iridaceae	*Sisyrinchium*	*atlanticum*	G5	S?		
Monocots	Poaceae	*Muhlenbergia*	*sobolifera*	G5	S?		
Monocots	Poaceae	*Panicum*	*anceps*	G5	S?		
Monocots	Poaceae	*Panicum*	*flexile*	G5	S?		
Monocots	Poaceae	*Paspalum*	*pubiflorum*	G5	S?		
Monocots	Poaceae	*Saccharum*	*alopecuroides*	G5			
Monocots	Poaceae	*Sorghastrum*	*nutans*	G5	S?		
Monocots	Poaceae	*Sporobolus*	*compositus*	G5	S?		
Pteridophytes	Pteridaceae	*Pellaea*	*atropurpurea*	G5	S?		

Description of Federal and State Ranks & Status Codes

Description of Federal and State Ranks & Status Codes

GLOBAL RANK - The global or world-wide rank of a species which is a non-legal rank indicating the rarity and vulnerability of a species

G1	Extremely rare and critically imperiled in the world with five or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extinction
G2	Very rare and imperiled within the world, six to twenty occurrences, or few remaining individuals, or because of some factor(s) making it vulnerable to extinction
G3	Rare and uncommon in its range or found locally in a restricted range, generally from 21-100 occurrences
G4	Widespread, abundant, and apparently secure globally, but with cause for long-term concern
G5	Demonstrably widespread and secure globally
GH	Of historical occurrence throughout its range, e.g. formally part of the established biota, with the expectation that it may be rediscovered
GU	Can not be ranked using available information
GX	Believed to be extirpated throughout its range
HYB	Hybrid within its range in Tennessee
SSYN	Synonym for another species
_Q	Questionable taxonomy (GRANKs only)
_T#	Subspecific taxon rank (GRANKs only)

STATE RANK - The state rank of a species in Tennessee. Like the G_rank this is a non-legal rank indicating the rarity and vulnerability of a species at the state level.

S1	Extremely rare and critically imperiled in the state with five or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extinction
S2	Very rare and imperiled within the state, six to twenty occurrences, or few remaining individuals, or because of some factor(s) making it vulnerable to extinction
S3	Rare and uncommon in the state, from 21-100 occurrences
S4	Widespread, abundant, and apparently secure within the state, but with cause for long-term concern
S5	Demonstrably widespread and secure in the state
SH	Of historical occurrence in Tennessee, e.g. formally part of the established biota, with the expectation that it may be rediscovered
SU	Can not be ranked using available information
SX	Believed to be extirpated from the state
S#S#	Denotes a "range rank" because the rarity of the species is uncertain (e.g. S1S3)
S?, S_?	Unranked at this time or rank uncertain
SE	Exotic species established in the state
SE#	Exotic numeric (e.g. the Asian clam *Corbicula fluminea* would be SE5)
SP	Potentially occurring in Tennessee, but not yet documented by DNH
_N	Occurs in Tennessee in a non-breeding status (mostly applies to vertebrates)

Description of Federal and State Ranks & Status Codes

_B	Breeds in Tennessee
SA	Accidental or casual in the state (several birds)
SR	Reported from the state, but insufficient data to assign rank
SRF	Reported falsely from the state
HYB	Hybrid within its range in Tennessee
SSYN	Synonym for another species
_Q	Questionable taxonomy (GRANKs only)
_T#	Subspecific taxon rank (GRANKs only)

FEDERAL STATUS - The federal listing under the U.S. Endangered Species Act

LE, Listed Endangered	Taxon is threatened by extinction throughout all or a significant portion of its range
E/SA,Endangered by Similarity of Appearance	Taxon is treated as an endangered species because it may not be easily distinguished from a listed species
LT, Listed Threatened	Taxon is likely to become an endangered species in the foreseeable future
T/SA,Threatened by Similarity of Appearance	Taxon is treated as a threatened species because it may not be easily distinguished from a listed species
PE, Proposed Endangered	Taxon proposed for listing as endangered
PT, Proposed Threatened	Taxon proposed for listing as threatened
C, Candidate species* **	Taxon for which the USFWS has sufficient information to support proposals to list the species as threatened or endangered, and for which the Service anticipates a listing proposal
(PS) Partial Status (based on taxonomy)	Taxon which is listed in part of its range, but for which Tennessee subspecies are not included in the Federal designation
(PS:status) Partial Status (based on political boundaries)	Taxon which is listed in part of its range, but for which Tennessee populations are not included in the Federal designation e.g. (PS:LE)
(XN) Non-essential experimental population in portion of range	Taxon which has been introduced or re-introduced in an area from which it has been extirpated, and for which certain provisions of the Act may not apply

Description of Federal and State Ranks & Status Codes

STATE STATUS -The legal listing in Tennessee

E, Endangered	Any species or subspecies whose prospects of survival or recruitment within the state are in jeopardy or are likely to become so within the foreseeable future
T, Threatened	Any species or subspecies that is likely to become an endangered species within the foreseeable future
D, Deemed in Need of Management	Any species or subspecies of nongame wildlife which the executive director of the TWRA believes should be investigated in order to develop information relating to populations, distribution, habitat needs, limiting factors, and other biological and ecological data to determine management measures necessary for their continued ability to sustain themselves successfully. This category is analogous to "Special Concern."
S, Special Concern	Any species or subspecies of plant that is uncommon in Tennessee, or has unique or highly specific habitat requirements or scientific value and therefore requires careful monitoring of its status.

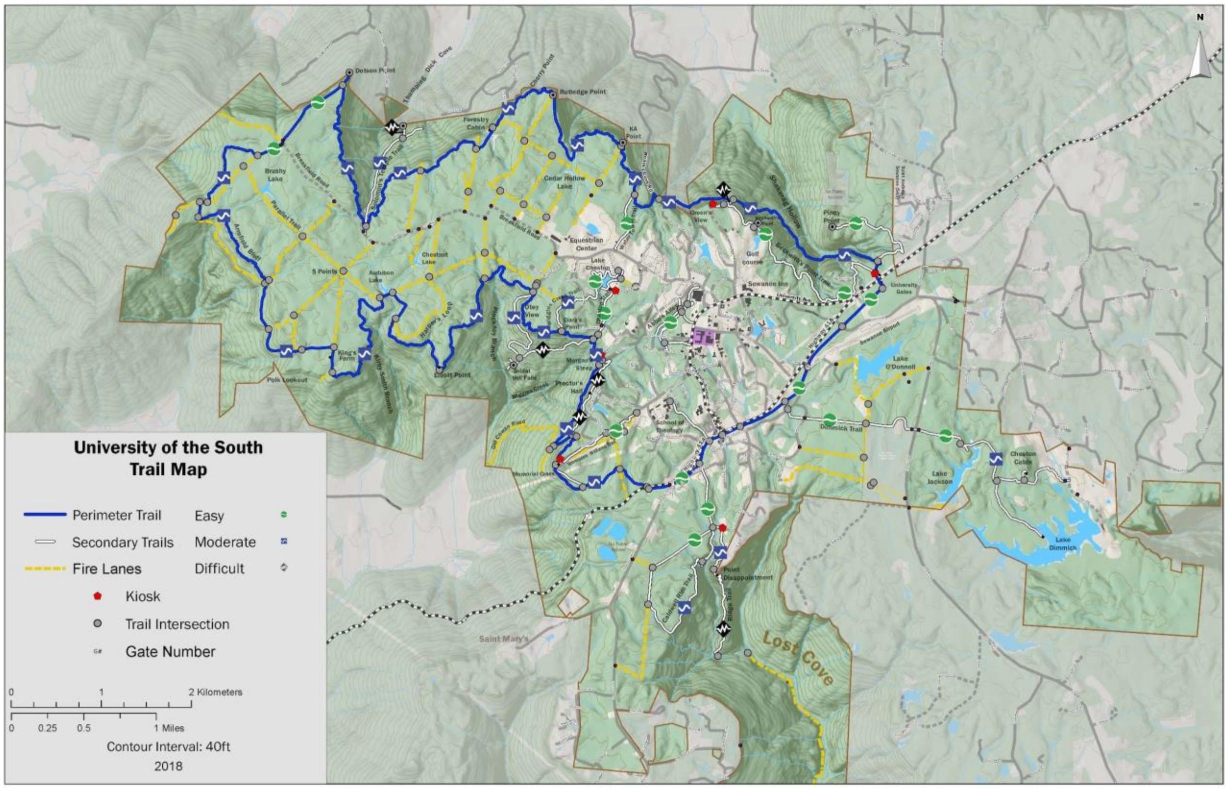
Additional Modifiers for Plants

PE, Proposed Endangered	Any species or subspecies of plant nominated by the Scientific Advisory Committee to be added to the list of Tennessee's endangered species. After approval by the commissioner of the Dept. of Environment & Conservation and the concurrence of the commissioner of Agriculture, these plants will formally become State endangered.
PT, Proposed Threatened	Any species or subspecies of a plant nominated by the Scientific Advisory Committee to be added to the list of Tennessee threatened species. After a public hearing, these plants will formally become State threatened.
E-PT, Endangered-Proposed Threatened	Species which are currently on the state list of endangered plants, but are proposed by the Scientific Advisory Committee to be down-listed to threatened. After approval by the commissioner of the Dept. of Environment & Conservation and the concurrence of the commissioner of Agriculture, these plants will formally become State threatened.
E-PS, Endangered Proposed Special Concern	Species which are currently on the state list of endangered plants, but are proposed by the Scientific Advisory Committee to be down-listed to special concern. After approval by the commissioner of the Dept. of Environment & Conservation and the concurrence of the commissioner of Agriculture, these plants will formally become State special concern.
T-PE, Threatened Proposed Endangered	Species which are currently on the state list of threatened plants, but are proposed by the Scientific Advisory Committee to be listed on the state endangered list. After approval by the commissioner of the Dept. of Environment & Conservation and the concurrence of the commissioner of Agriculture, these plants will formally become State endangered.

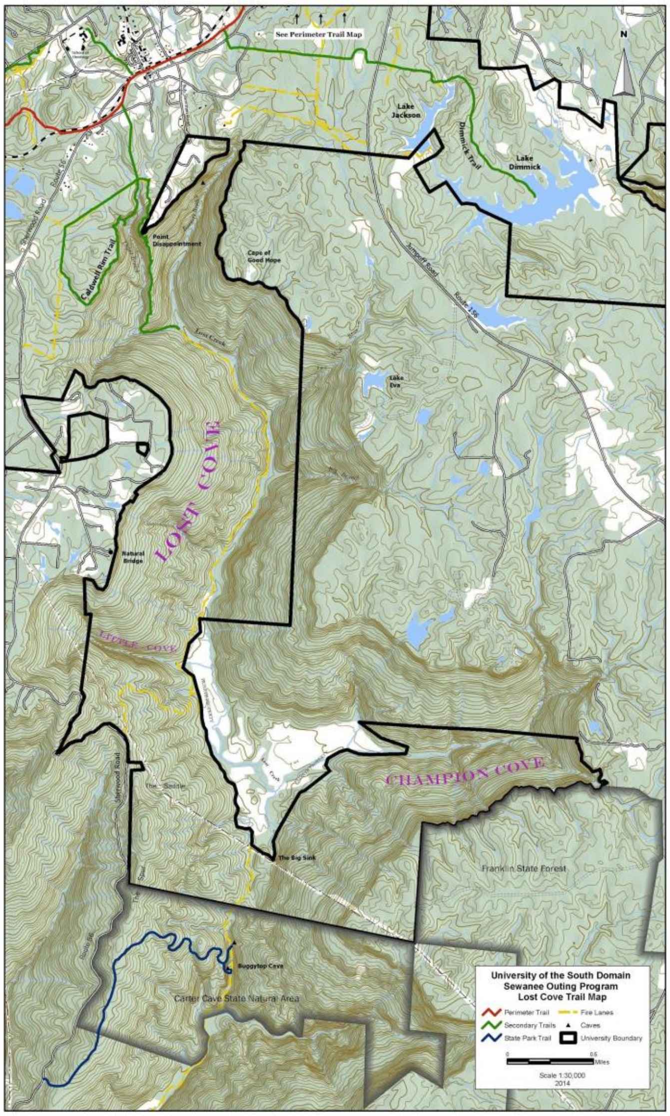
Description of Federal and State Ranks & Status Codes

T-PS, Threatened Proposed Special Concern	Species which are currently on the state list of threatened plants, but are proposed by the Scientific Advisory Committee to be down-listed to special concern. After a public hearing, these plants will formally become State special concern.
P, Possibly Extirpated	Species or subspecies that have not been seen in Tennessee for the past 20 years. May no longer occur in Tennessee.
C, Commercially Exploited	Due to large numbers being taken from the wild and propagation or cultivation insufficient to meet market demand. These plants are of long-term conservation concern, but the Division of Natural Heritage does not recommend they be included in the normal environmental review process.

Appendix I. Map of Recreation Opportunities on the Domain


University of the South
Trail Map
Perimeter Trail
Secondary Trails
Fire Lanes
Easy
Moderate
Difficult
Kiosk
Trail Intersection
Gate Number
0
1
2 Kilometers
0
0.25
0.5
1 Miles
Contour Interval: 40ft
2018
N
Lost Cove
Polk Lookout
Saint Mary's

Map of Recreation Resources in Lost Cove



Appendix J. Correspondence with Nations

SEWANEE
THE UNIVERSITY OF THE SOUTH

Ms. Elizabeth Toombs, THPO
Ms. Catherine Gray, History and Preservation Officer
Cherokee Nation
PO Box 948
Tahlequah, OK 74465

December 11, 2018

Dear Ms.Toombs and Ms. Gray

We are writing to the THPO of the Cherokee Nation to ask for your input and suggestions as the University of the South begins to develop a forest management plan certified by the Forest Stewardship Council (FSC). The FSC standards ensure that the landowner's operations maintain and enhance the natural, cultural, and social resources associated with the forests being managed. A benefit of certification is that it reminds us to go the extra step to consider both the environmental and social impacts of our management activities.

The University of the South is a private liberal arts college located on the southern Cumberland Plateau in Franklin and Marion Counties, Tennessee. The University land base is approximately 13,000 acres of primarily forested acreage privately owned by the university. Currently, cultural resources on the university lands are monitored and inventoried by the University Archaeologist.

The Tennessee Chapter of the Nature Conservancy is assisting the University of the South's Office of Environmental Stewardship and Sustainability in reviewing and writing their 10-year FSC certified forest management plan, planned for completion in 2019. We would greatly appreciate it if you could review the enclosed maps for identification of sites culturally significant to the Cherokee Nation. We would also welcome ideas or concerns about the effect of forest management impacts on those sites. Currently all the known historic and prehistoric sites (except for rock art sites), are listed with the Tennessee Division of Environment and Conservation's Division of Archaeology (SHPO) in the state site files. The few rock art sites, which we decided to keep out of the state site files to assure their protection, are located in rock shelters that are "off the beaten path" and are respected and preserved by the University community.

If you would like to request further information, please contact either Sarah or Amy at the information below. Thank you for your time and assistance, we look forward to hearing from you.

Sincerely,

Sarah C. Sherwood

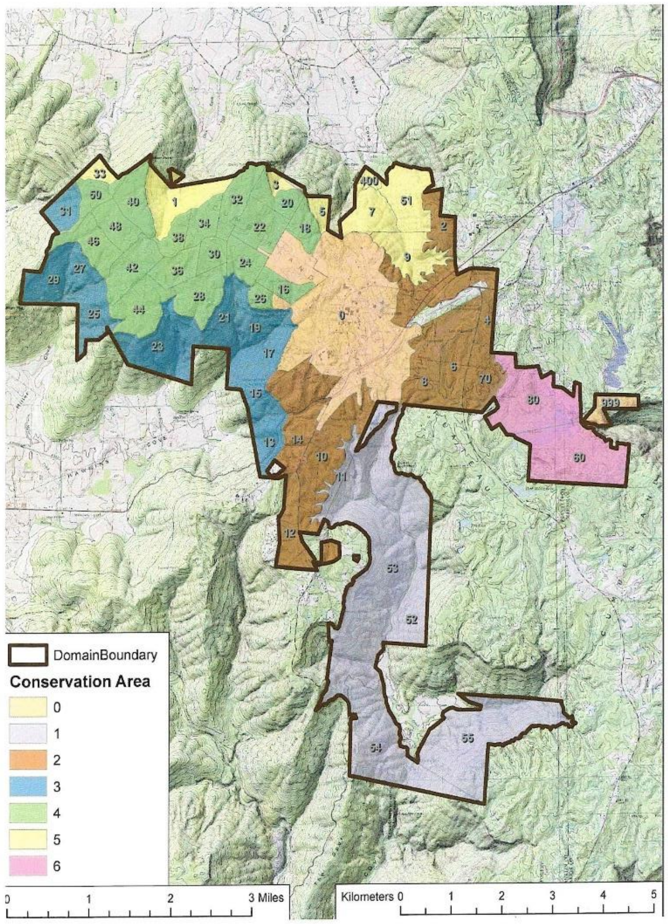
Dr. Sarah C. Sherwood
University Archaeologist &
Associate Professor
sherwood@sewanee.edu

Amy Turner

Dr. Amy Turner
Director of the Office of Environmental
Stewardship and Sustainability
ajturner@sewanee.edu

cc. Trisha Johnson, The Nature Conservancy

The University of the South
735 University Avenue
Sewanee, Tennessee 37383-10000



DomainBoundary
Conservation Area
0
1
2
3
4
5
6
0 1 2 3 Miles
Kilometers 0 1 2 3 4 5

Sewanee
TN Land Trust
TDEC
TN Dep. of Ag
TN Green
TWRA
TNC
Other
TN Dep. of Ag
0 2 4 6 Miles
0 2 4 8 Kilometers
N

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THE UNIVERSITY OF THE SOUTH

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University Archaeologist &
Associate Professor
sherwood@sewanee.edu

Amy Turner

Dr. Amy Turner
Director of the Office of Environmental
Stewardship and Sustainability
ajturner@sewanee.edu

cc. Trisha Johnson, The Nature Conservancy

The University of the South
735 University Avenue
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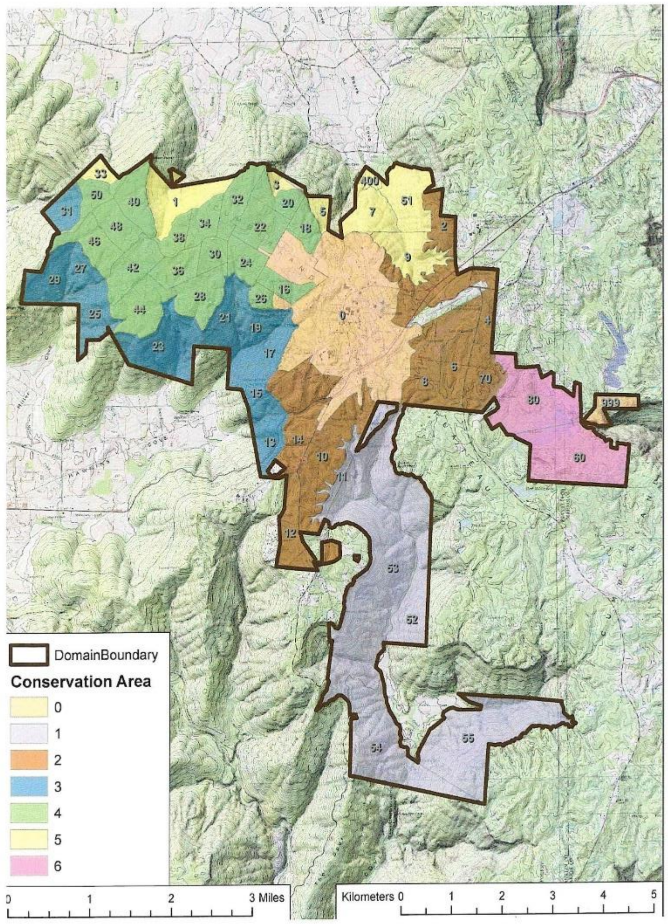
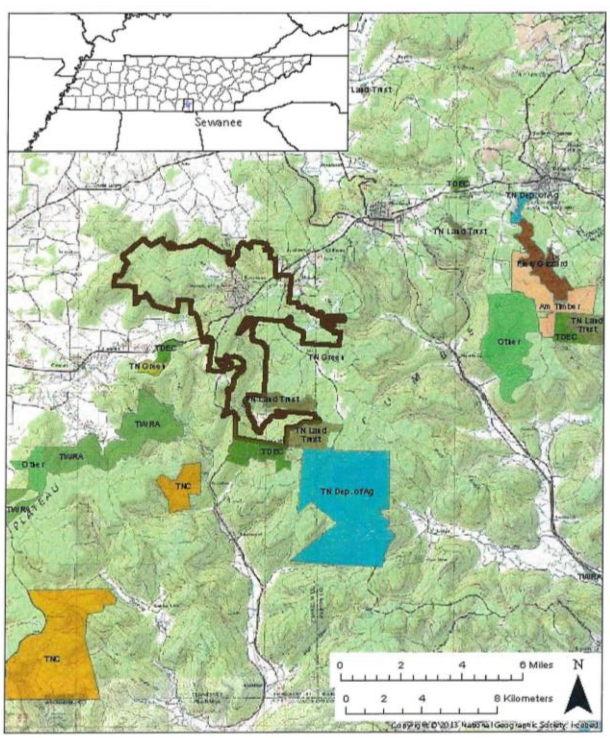

DomainBoundary
Conservation Area
0
1
2
3
4
5
6
0 1 2 3 Miles
Kilometers 0 1 2 3 4 5


Sewanee
TN Dep. of Ag
TN Land Trust
Am Timber
Other
TDEC
TWRA
TNC
0 2 4 6 Miles
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SEWANEE
THE UNIVERSITY OF THE SOUTH

Mr. Brett Barnes, THPO
Eastern Shawnee Tribe of Oklahoma
12705 S. 705 Road
Wyandotte, OK 74370

December 11, 2018

Dear Mr. Barnes,

We are writing to the THPO of the Eastern Shawnee Tribe of Oklahoma to ask for your input and suggestions as the University of the South begins to develop a forest management plan certified by the Forest Stewardship Council (FSC). The FSC standards ensure that the landowner's operations maintain and enhance the natural, cultural, and social resources associated with the forests being managed. A benefit of certification is that it reminds us to go the extra step to consider both the environmental and social impacts of our management activities.

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The Tennessee Chapter of the Nature Conservancy is assisting the University of the South's Office of Environmental Stewardship and Sustainability in reviewing and writing their 10-year FSC certified forest management plan, planned for completion in 2019. We would greatly appreciate it if you could review the enclosed maps for identification of sites culturally significant to the Eastern Shawnee Tribe of Oklahoma. We would also welcome ideas or concerns about the effect of forest management impacts on those sites. Currently all the known historic and prehistoric sites (except for rock art sites), are listed with the Tennessee Division of Environment and Conservation's Division of Archaeology (SHPO) in the state site files. The few rock art sites, which we decided to keep out of the state site files, to assure their protection, are located in rock shelters that are "off the beaten path" and are respected and preserved by the University community.

If you would like to request further information, please contact either Sarah or Amy at the information below. Thank you for your time and assistance, we look forward to hearing from you.

Sincerely,

Sarah C. Sherwood

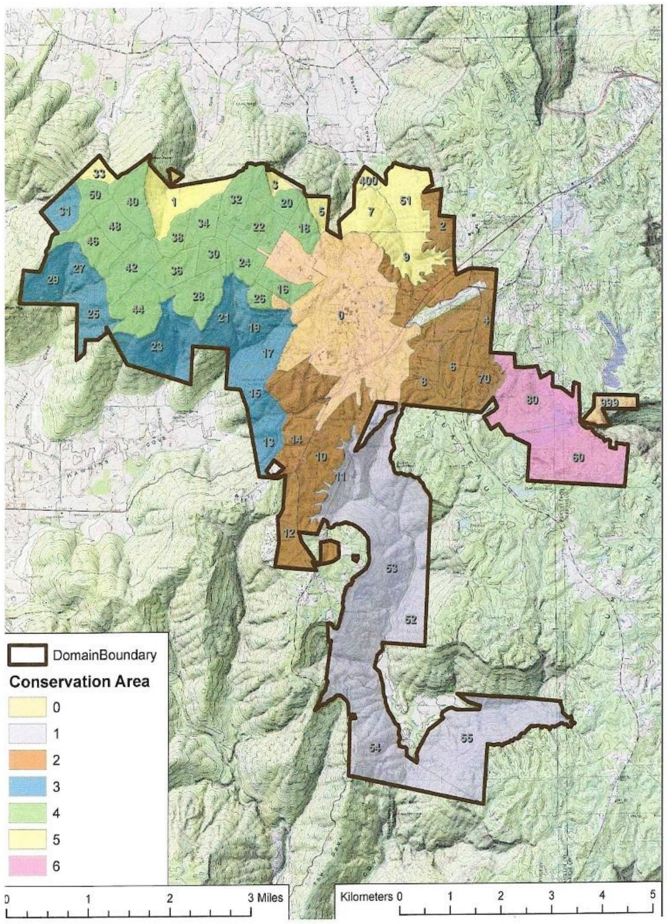
Dr. Sarah C. Sherwood
University Archaeologist &
Associate Professor
sherwood@sewanee.edu

Amy Turner

Dr. Amy Turner
Director of the Office of Environmental
Stewardship and Sustainability
ajturner@sewanee.edu

cc. Trisha Johnson, The Nature Conservancy

The University of the South
735 University Avenue
Sewanee, Tennessee 37383-10000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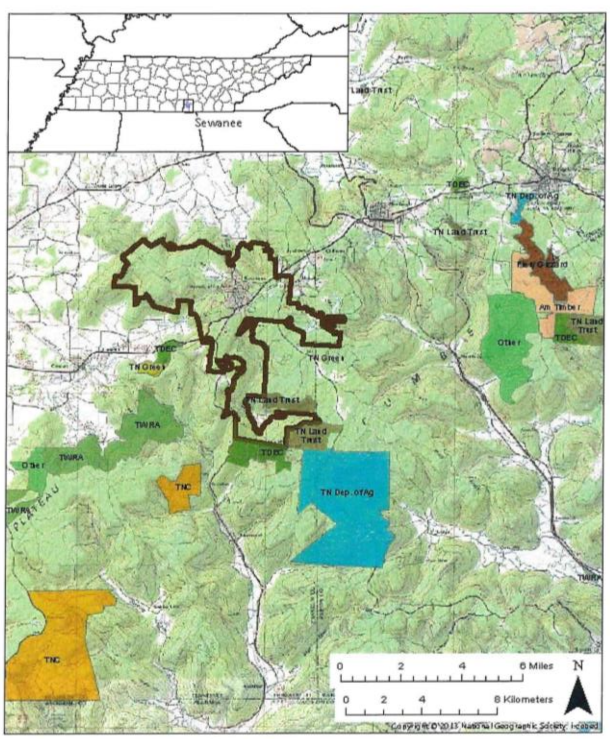
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SEWANEE
THE UNIVERSITY OF THE SOUTH

Ms. Sheila Bird, THPO and Director of Natural Resources
United Keetoowah Band of the Cherokee Indians in Oklahoma
PO Box 746, Tahlequah, OK 74465

December 11, 2018

Dear Ms. Bird,

We are writing to the THPO and the Director of Natural Resources of the United Keetoowah Band of the Cherokee Indians in Oklahoma to ask for your input and suggestions as the University of the South begins to develop a forest management plan certified by the Forest Stewardship Council (FSC). The FSC standards ensure that the landowner's operations maintain and enhance the natural, cultural, and social resources associated with the forests being managed. A benefit of certification is that it reminds us to go the extra step to consider both the environmental and social impacts of our management activities.

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University Archaeologist & Associate Professor	Director of the Office of Environmental Stewardship and Sustainability
sherwood@sewanee.edu	ajturner@sewanee.edu

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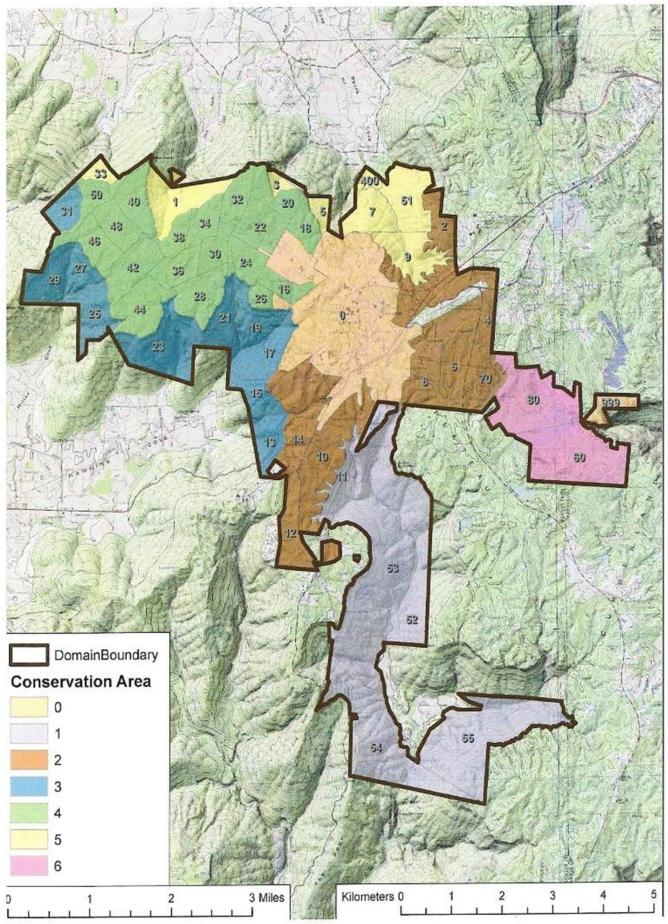
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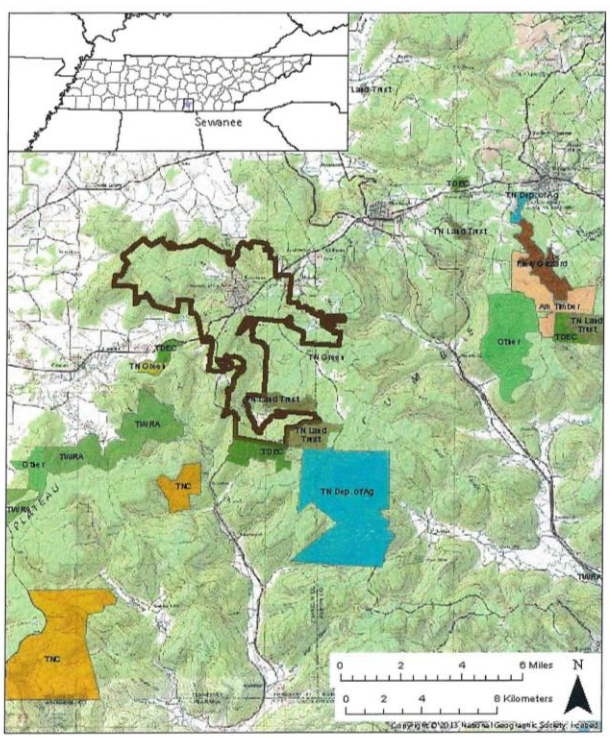
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SEWANEE
THE UNIVERSITY OF THE SOUTH

Ms. Erin Thompson
THPO Coordinator
Shawnee Tribe
2025 S Gordon Cooper Dr.
Shawnee, OK 7480

December 11, 2018

Dear Ms. Thompson,

We are writing to the THPO and the Director of Natural Resources of the Shawnee Tribe to ask for your input and suggestions as the University of the South begins to develop a forest management plan certified by the Forest Stewardship Council (FSC). The FSC standards ensure that the landowner's operations maintain and enhance the natural, cultural, and social resources associated with the forests being managed. A benefit of certification is that it reminds us to go the extra step to consider both the environmental and social impacts of our management activities.

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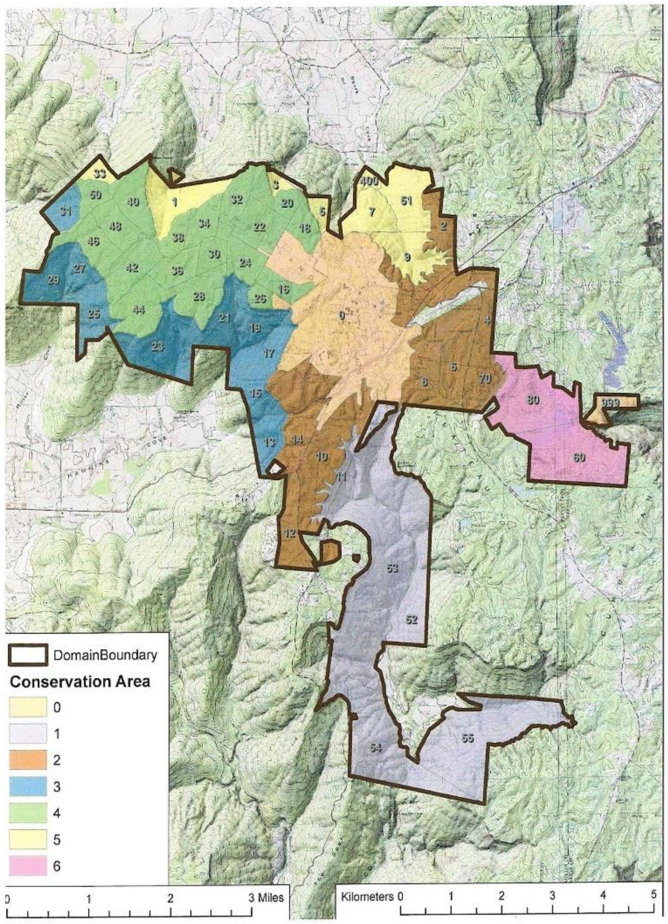
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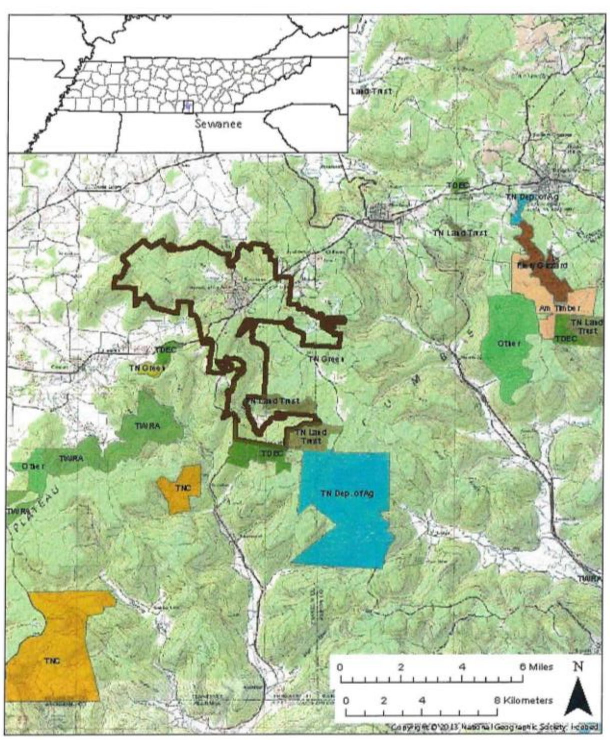
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SEWANEE
THE UNIVERSITY OF THE SOUTH

Ms. RaeLynn Butler, Historical and Cultural Preservation Manager
Ms. Corain Lowe-Zepeda, THPO
Muscogee Creek Nation
P.O. Box 580
Okmulgee, Oklahoma 74447

December 11, 2018

Dear Ms. Butler,

We are writing to the THPO and the Historical and Cultural Preservation Manager of the Muscogee Creek Nation to ask for your input and suggestions as the University of the South begins to develop a forest management plan certified by the Forest Stewardship Council (FSC). The FSC standards ensure that the landowner's operations maintain and enhance the natural, cultural, and social resources associated with the forests being managed. A benefit of certification is that it reminds us to go the extra step to consider both the environmental and social impacts of our management activities.

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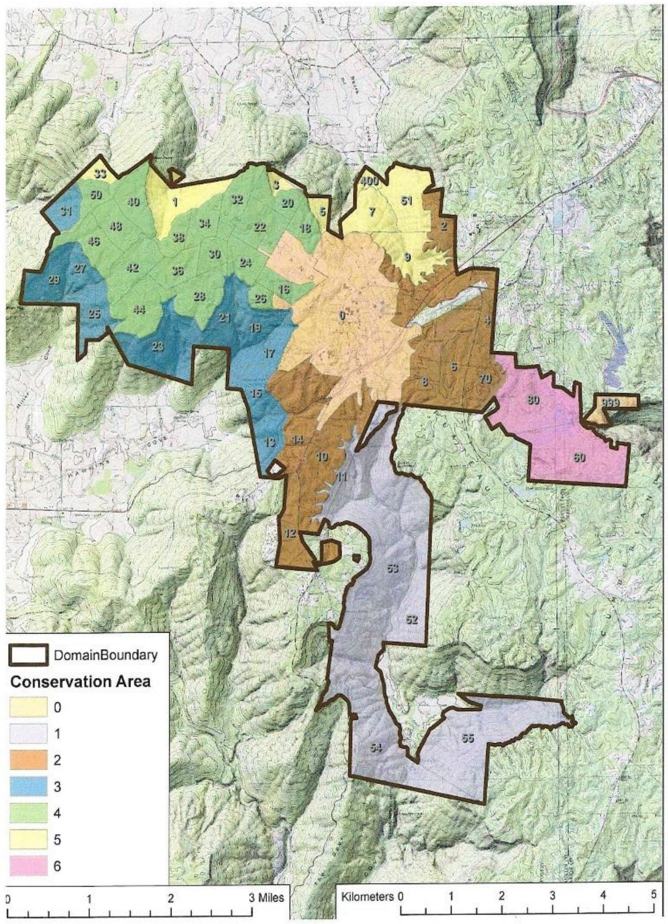
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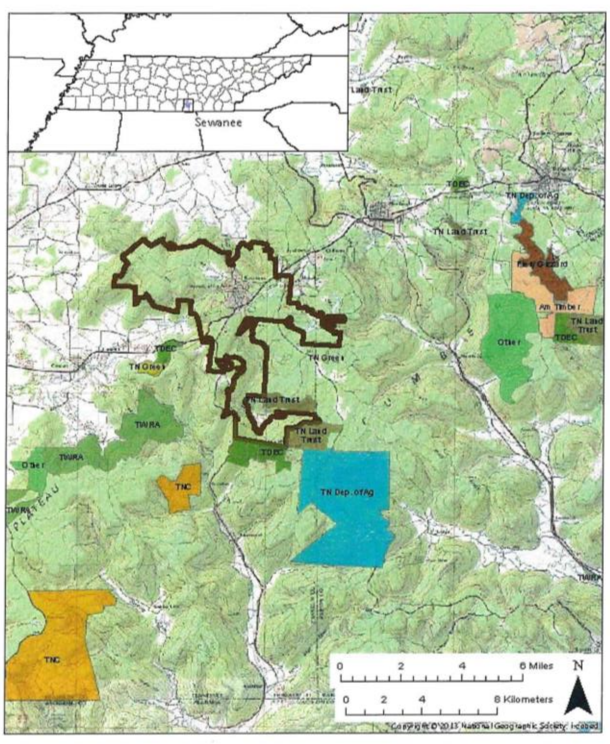
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Muscogee Creek Nation
P.O. Box 580
Okmulgee, Oklahoma 74447

December 11, 2018

Dear Ms. Lowe-Zepeda,

We are writing to the THPO and the Historical and Cultural Preservation Manager of the Muscogee Creek Nation to ask for your input and suggestions as the University of the South begins to develop a forest management plan certified by the Forest Stewardship Council (FSC). The FSC standards ensure that the landowner's operations maintain and enhance the natural, cultural, and social resources associated with the forests being managed. A benefit of certification is that it reminds us to go the extra step to consider both the environmental and social impacts of our management activities.

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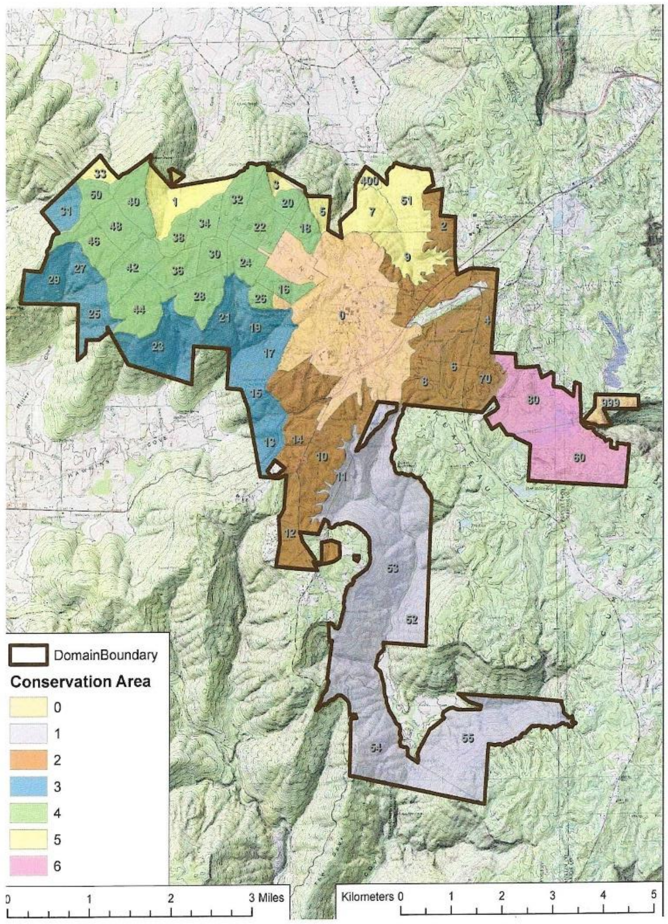
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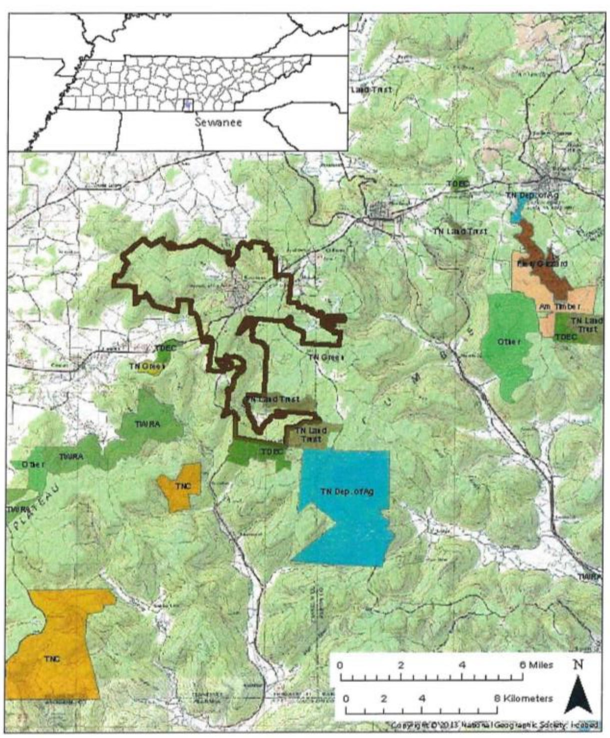
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SEWANEE

THE UNIVERSITY OF THE SOUTH

Eastern Band of Cherokee Indians
Mr. Tommy Cabe, Forest Resource Specialist
Mr. Russell Townsend, THPO
1840 Painttown Road
PO Box 455
Cherokee, NC 28719

December 11, 2018

Dear Mr. Cabe,

We are writing to the THPO and the Forest Resource Specialist of the Eastern Band of Cherokee Indians to ask for your input and suggestions as the University of the South begins to develop a forest management plan certified by the Forest Stewardship Council (FSC). The FSC standards ensure that the landowner's operations maintain and enhance the natural, cultural, and social resources associated with the forests being managed. A benefit of certification is that it reminds us to go the extra step to consider both the environmental and social impacts of our management activities.

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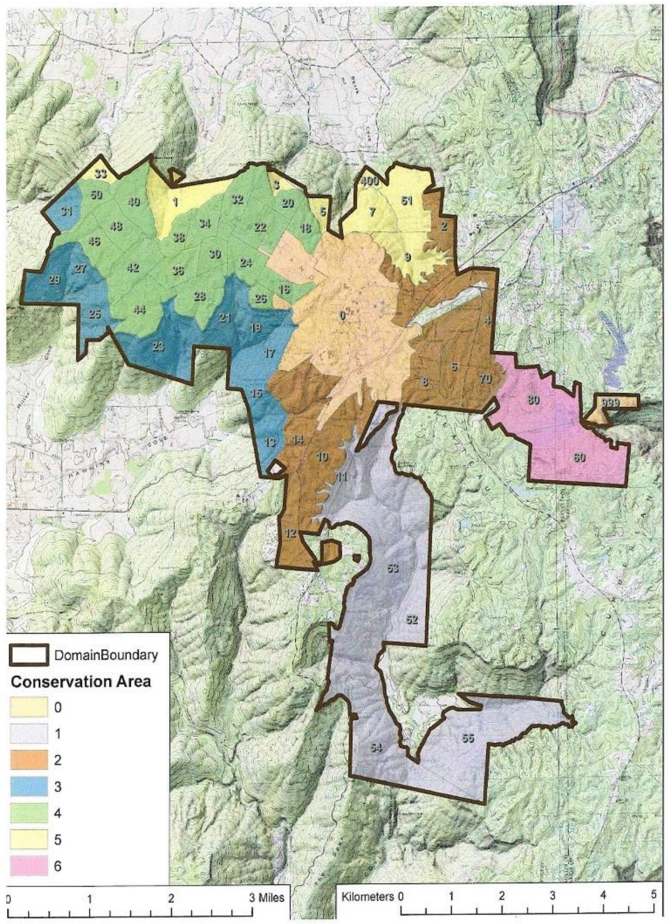
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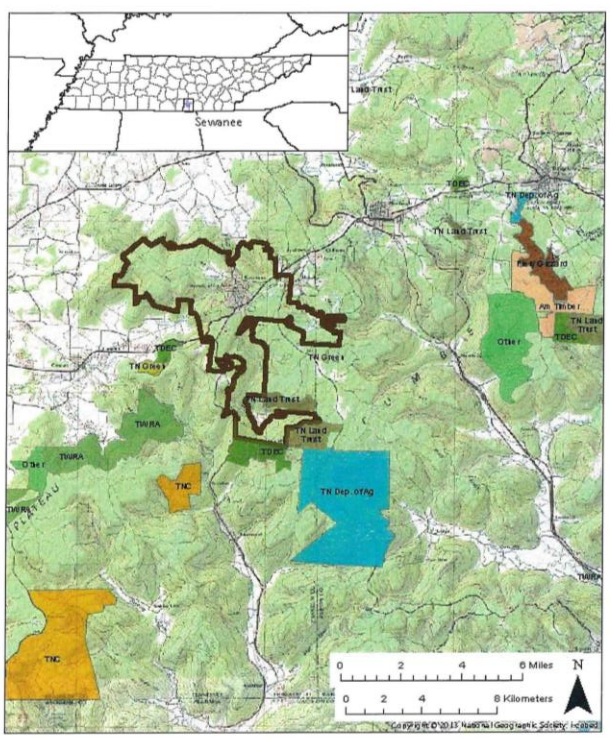
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THE UNIVERSITY OF THE SOUTH

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Mr. Russell Townsend, THPO
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Cherokee, NC 28719

December 11, 2018

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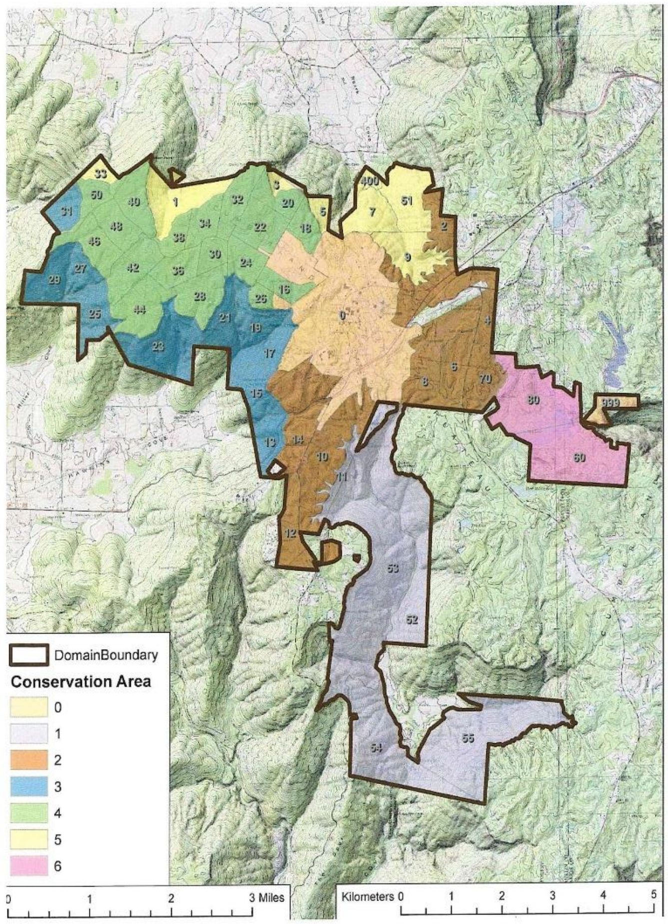

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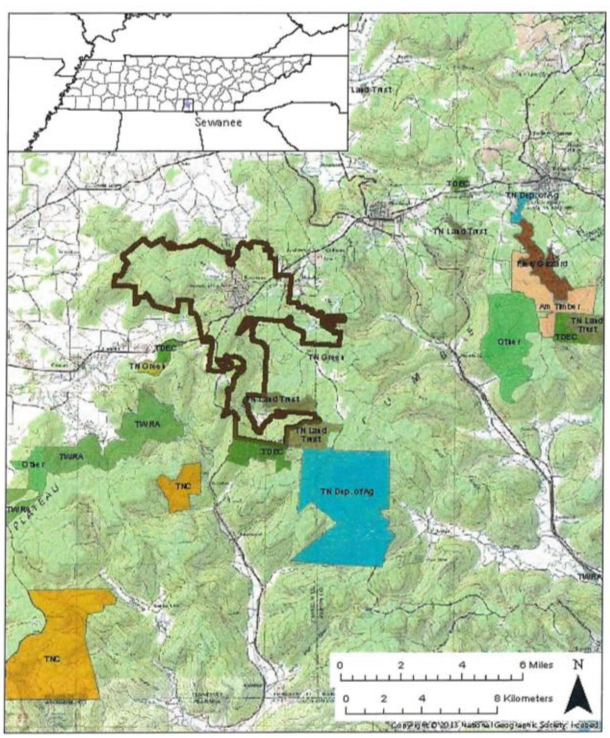

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Appendix K. Comments Received on the Draft Management Plan

1. A copy of the printed management plan with edits and comments was received from Matt Costello C ‘84 on 10/1/2019. Edits and suggestions were incorporated into the management plan.

Comments from the Biology Department were received on 09/04/2019 and are included in this appendix.

SEWANEE
THE UNIVERSITY OF THE SOUTH

DEPARTMENT OF BIOLOGY

Dear Director of the Office of Environmental Stewardship and Sustainability,

Thank you for your work on compiling all of this information into a single document. The Domain Management Plan will be a resource for the community to evaluate past, present, and future conditions of the Domain. As a foundational document for future management of the Domain, we have identified a few areas where we feel that more detail could help to set up procedures and protocols for how management will proceed in the near and distant future. In particular, we encourage the inclusion of more explicit connections, science, and details to improve the transparency and rationale behind management decisions.

Given that management is an adaptive process, we felt that there was a missed opportunity to review and evaluate whether goals proposed in the past still represent our shared vision for the future. Decision science for landscape management has expanded tremendously in the past few years, and repeated examples indicate that community involvement is critical to success. As written, it is assumed that the goals and values are ranked in order of importance. With the first goal being clear communication, it seems that there needs to be more information included in the plan to achieve this goal.

1. What are the scientific rationales provided to support the ecological outcome and process goals, and how do the proposed management actions meet those objectives in other areas and on the Domain? Which management plans support which management goals? How do these actions improve landscape resilience – how were the TNC landscape resilience models used to select locations for management? Why are these locations optimal for management? This approach would also support a deficiency in connecting management plans explicitly to the goals that they are designed to address.

2. There are many terms used like resilience, ecological condition, ecological integrity without clear metrics for defining what they mean and how they will be measured necessary to assess management success – the key component of adaptive management. To this end, management has been enacted in the last decade – what data indicate their success and therefore continued expansion? How has Domain specific research factored into supporting these and future management decisions?

3. Why is the College's mission for undergraduate education and research not considered more explicitly? How will management be integrated into the curriculum and vice versa? How are students involved in the adaptive management process such that our teaching and research benefits from the management process? How is support of the educational mission factored into assessing the economic and ecological value of the Domain as one of the primary assessments of management success? What are the

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teaching and research needs of Domain researchers including the Biology Department and how did they factor into the management plan? How will long-term projects be protected? In addition to forest condition management for each compartment, should there not also be a research and teaching management component? What actions are being taken to minimize conflict, vandalism, etc. of long-term teaching and research projects?

4. Management inherently involves balancing multiple goals, and a process must be in place for navigating conflicts among goals. In recent history, we have local examples of good and poor communication and coordination between management, teaching, research, and recreation. *Yet, the ranking of the goals suggests that management for the sake of management takes precedence over teaching, research, and recreation.* Is there a similar approval and consideration process for management as there is for research (of which the form is sporadically adhered to)? Should grants for land-manipulation on the Domain receive formal approval to ensure they are in line with our goals and values? How will it be determined if there is a conflict – even seemingly minor management activities could negatively impact a research or teaching program. How will it be determined who those stakeholders are? How will stakeholders be involved in decisions about these conflicts? Are there similar plans for how to support education and research on the Domain in the same way there is for management? We recommend formal consultation with an ombudsman or other neutral party to help resolve conflict among entities in our community.

   To elaborate further on this point, Sewanee evaluates its faculty by teaching success and research productivity. We are all encouraged strongly to use the Domain to facilitate these successes. Yet, when faculty invest time and energy into teaching and research on the Domain, they are assuming that their efforts are well-placed on private property that Sewanee controls. When conflict arises that negatively impacts faculty teaching and research, it also impacts future reviews and the ability of these faculty to remain at Sewanee. For example, loss or manipulation of a research site could result in the loss of a publication necessary to progress through promotion and tenure or loss of a teaching site will require faculty to spend considerable resources developing alternative teaching plans at the cost of time spent on other activities.

5. Decision science for management relies on open communication of all the goals and objectives of the stakeholders. It must be included that there are economic benefits from timber harvest. This places an additional priority on this management activity that is not clearly communicated and introduces a conflict of interest for the office managing the Domain. More information is needed about where the funds from timber harvest go, what they support, and how much is needed annually to support those budgets? How are these actions compatible with increasing carbon sequestration? Without this information, we are unable to assess the sustainability of future harvests.

6. Given recent conversations about enrollment and the long-term financial stability of our institution, has there been any consideration for whether consumptive management has an impact on prospective student perspectives about whether or not to attend Sewanee? Students regularly choose to attend Sewanee because of our commitment to undergraduate education and research, sustainability, and the Domain. While timber harvest is one mechanism for generating income and closing a supply loop, enrolled students are likely more valuable in a balance sheet and may be discouraged from attending by seeing these activities without appropriate context and explanation received in some classes at Sewanee. How does this management activity affect visitor perceptions of Sewanee's commitment to the environment?

7. Prescribed fire, herbicide use, and timber harvest are all included as proposed management actions, but what other activities are planned including road upgrades, changes to pond or dam infrastructure, etc. and when? Could separate threats to biodiversity and desired conditions be identified and addressed separately rather than their current organization into compartments? How is management addressing climate change, fire suppression, invasive species, deer overbrowse, etc? Should the plan include unique habitat conservation plans for declining and rare species?

8. Another concern that community input would help to assess is what percentage of our Domain should be allocated exclusively to different priorities. Via admittedly rough calculations, only 58% of the Domain is located on top of the plateau for which active management is proposed. Limited active management is proposed for the 42% of the Domain located below the bluff line. Of the area proposed for active management, more than 18% is required for central campus and the residential and commercial areas (see map for significant areas excluded from this calculation). Of the remaining 40% of campus, the land must support all of the management goals proposed here and the areas in protection for perpetuity (e.g. 100 ac timber harvests and burns are approximately 3% of the plateau habitat annually; please see the attached map for more information and caveats). Once this area is further subdivided by fire-lanes and trails that must be buffered to prevent intentional and unintentional interference, areas for diverse future management opportunities are limited in both size and spatial distribution as well as access. For example, we also should consider maintaining space for research on a diversity of past land-uses, implementation of new management strategies yet to be identified, and manipulations yet to be determined. An open conversation among stakeholders including the Biology Department about goals for the future should be conducted to ensure that we are not limiting our future potential.

9. We appreciated Appendix B as a mechanism for quickly identifying where and when management activities will occur, but could other activities (such as those above) be included as well as the maps (Figure 1.)that are associated with each type of activities (like those presented with the TNC)?

We appreciate your attention to these suggestions to improve the Domain Management Plan and hope that this process can set an example for how to work transparently in this community. We hope that you will continue to work with the Biology Department to resolve the issues highlighted above as well as current and potential conflicts with current projects underway. We are happy to provide additional feedback or offer suggestions for those engaged in decision science for the purpose of landscape management. We appreciate the opportunity to have this dialogue about the Domain, and we look forward to hearing from you about the evolution of the management plan.

Sincerely the Department of Biology,

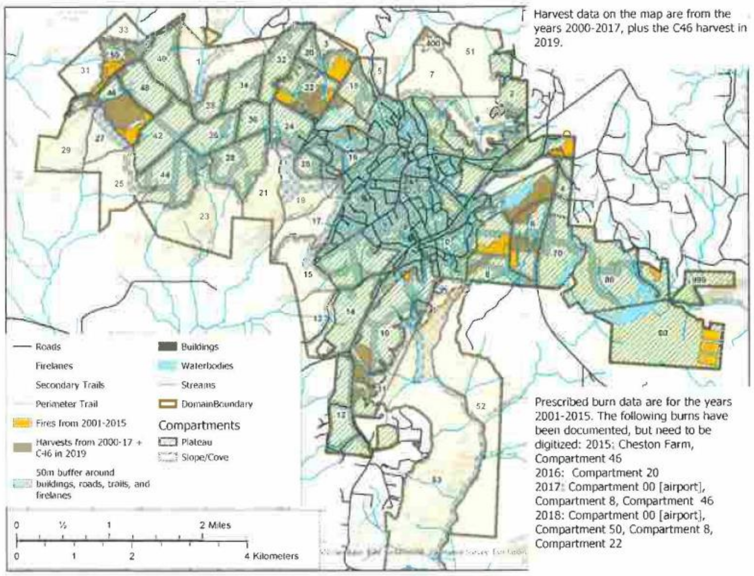

Figure 1. Map of the Domain with recent and proposed prescribed burns and timber harvests used to supplement maps in Domain Management Plan for the calculations provided above. Note that this map and our calculations do not include other land priorities including the golf course or agricultural fields (e.g. south of compartment 18, or compartment 80), past or current forest manipulations (e.g. compartment 40 white pine stand or historic harvest in compartment 60), active research sites (e.g. compartments 40 and 48), areas set aside in the Domain Management Plans for long-term absence of active management (e.g. areas of compartments 40 and 0 above Shakerag Hollow), the SUD (compartment 14), or inaccessible parcels (e.g. compartment 999). We also note that not all remaining areas are easily accessible for teaching and research with undergraduate students. Map generously provided by Chris Van de Ven.