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Draft Environmental Impact Statement

AP Loblolly Pine Removal and Restoration Project

Andrew Pickens Ranger District, Sumter National Forest
Oconee County, South Carolina

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Draft Environmental Impact Statement
Oconee County, South Carolina

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Abstract: The objective of this project is to restore native vegetation typical of the Southern Appalachian Mountains by removing non-native loblolly pine plantations. This would improve ecosystem health and increase habitat diversity. The majority of the project area (77%) falls within the Shortleaf Pine-Oak Ecological Zone, which in the absence of loblolly pine consists of shortleaf pine- and Virginia pine- and oak-hickory dominated forests in the lower elevation Southern Appalachians. Examples of this zone can occur on a variety of topographic and landscape positions, including ridge tops, upper and mid-slopes, as well as low elevation mountain valleys. Pitch pine (and Table Mountain pine) may sometimes be present and hardwoods are sometimes abundant, especially dry-site oaks such as southern red oak, post oak, blackjack oak, chestnut oak, scarlet oak, but also pignut hickory, red maple, and others. Frequent, low-intensity fires, coupled with severe fires, can influence the occurrence of pines in this zone, particularly shortleaf pine, pitch pine, or Table Mountain pine, rather than hardwood forests or even Virginia pine, under natural conditions (Natureserve, 2011). Other ecological zones in the project area include dry-mesic oak, dry oak evergreen heath and rich cove/acidic cove.

Emphasis would be placed on improving habitat conditions for a variety of native plants and wildlife species. Commercial and non-commercial treatments would be used to remove loblolly pine trees and native trees would be planted. Emphasis would be place on restoring, enhancing and maintaining habitat conditions for the federally endangered smooth coneflower (*Echinacea laevigata*) within the species known habitat. Three alternatives were evaluated in detail:

Alternative 1 - No Action
Alternative 2 - Proposed Action
Alternative 3 - An action alternative that meets the purpose and need and also addresses issues that were raised by the public during scoping for this project.

The preferred alternative is alternative 3.

Notice:
It is important that reviewers provide their comments at such times and in such a way that they are useful to the Agency's preparation of the EIS. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. The submission of timely and specific comments can affect a reviewer's ability to participate in subsequent administrative review or judicial review.

Comments received in response to this solicitation, including names and addresses of those who comment, will be part of the public record for this proposed action. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative review or judicial review.

Date Comments Must Be Received By: 45 days following publication of the Notice of Availability in the *Federal Register*.

SUMMARY

I. Introduction

(Underlined words and acronyms are defined in the glossary)

The Andrew Pickens Ranger District, Sumter National Forest proposes to remove non-native loblolly pine and restore native pines and hardwoods in their place on approximately 5,542 acres. The district is situated in the Blue Ridge Mountain Physiographic Province, in the mountain foothills. Stands in the project area were converted to loblolly pine plantations 20 to 50 years ago by clear-cutting more diverse native stands. In some locations loblolly pine has seeded in from these planted trees in either adjacent stands or previous stands. Current species composition is outside the natural range of variability (NRV), consisting mostly of non-native loblolly pine with few native hardwoods or native pines growing in the overstory. Hardwood sprouts and saplings are common in the understory.

The majority of the project area (77%) falls within the Shortleaf Pine-Oak Ecological Zone, which in the absence of loblolly pine consists of shortleaf pine- and Virginia pine-dominated forests in the lower elevation Southern Appalachians. Examples of this zone can occur on a variety of topographic and landscape positions, including ridge tops, upper and mid-slopes, as well as low elevation mountain valleys. Pitch pine (and Table Mountain pine) may sometimes be present and hardwoods are sometimes abundant, especially dry-site oaks such as southern red oak, post oak, blackjack oak, chestnut oak, scarlet oak, but also pignut hickory, red maple, and others. Frequent, low-intensity fires, coupled with severe fires, can influence the occurrence of pines, particularly shortleaf pine, pitch pine, or Table Mountain pine, rather than hardwood forests or even Virginia pine, under natural conditions (Natureserve, 2011).

Other ecological zones in the project area include dry-mesic oak, dry oak evergreen heath and rich cove/acidic cove.

II. Purpose and Need for Action

The purpose and need for this project is to restore native forest vegetation that is more representative of the ecological zones that occur here. This change in condition would improve ecosystem health and increase the diversity of habitat for native plants and wildlife.

Current Condition

The overstory is comprised mostly of loblolly pine. The understory is comprised mostly of shade tolerant tree species such as red maple, black gum, dogwood and sourwood. Shade intolerant native species such as shortleaf pine, pitch pine, Table Mountain pine, oaks and hickories are poorly represented. Shortleaf pine, Table mountain pine, and pitch pine have been declining in abundance on the District, primarily due to lack of disturbance. White pine and Virginia pine are also native pines, but have been steadily increasing in abundance.

Loblolly pine tree density in most of the project stands is high, typically ranging from 120 to 160 square feet of basal area per acre.

These high density stands inhibit the growth of other trees and understory vegetation. These stands are susceptible to insect and disease damage, and they lack diversity in the overstory and understory vegetation. Loblolly pine in the overstory of some stands is sparse due to past southern pine beetle (SPB) mortality or from poor planting success. SPB-related mortality was widespread across the district in 2002 and 2003 with variable impacts to stands in the project area. The disturbance caused by SPB would normally provide a variety of native species the opportunity to regenerate. However, with the presence of the surrounding loblolly pine overstory, these small-scale disturbances have perpetuated loblolly pine followed by shade tolerant hardwoods. Shade intolerant oaks, hickories, shortleaf pine, pitch pine, and Table mountain pine have not been able to establish in significant amounts in these areas.

Early successional habitat and woodlands are two of the most limited types of available plant and wildlife habitats on the Andrew Pickens District. The endangered plant, smooth coneflower has been restricted in its distribution as a result of lack of disturbance and growth of shade tolerant species. The species is known to occur in and adjacent to several loblolly stands. Plant surveys have identified current locations of the plant and potential habitat areas have also been identified. The Sumter National Forest proposed, endangered, threatened and sensitive species (PETS) list includes other plant species that require disturbance in order to thrive. These species generally have been restricted to along roadsides and utility right-of-ways (ROWs) because of the disturbance frequency on these sites.

Desired Condition

Loblolly pine is replaced by native tree species matched to each ecological zone. A blight resistant American chestnut (once native to this area) has been reintroduced to stands where the site is suitable for their growth and trees from this species are dominant or co-dominant in those stands. New woodlands have been established and existing ones maintained in order to provide additional habitat diversity for a variety of disturbance-dependent, early successional game and nongame wildlife species in all stages of their lifecycles. Habitat conditions have been developed that are conducive to disturbance-dependent plants including the federally endangered smooth coneflower and other species that are typically associated with the ecological zones that have been identified. The proportion of early successional stage and woodlands habitats have increased and is closer to the target proportion in the Forest Plan.

III. Public Involvement and Identification of Issues

Public involvement began on February 24, 2010 with a scoping letter mailed to public contacts on the district mailing list and with publication of the Notice of in the Federal Register (Vol. 75, No. 44/Notices (at page10457).On September 26, 2012, a corrected NOI was published in the Federal Register / Vol. 77, No. 187 / Notices (at page 59163). The corrected notice provided information on expected timeframes for completion of the Draft and Final EIS. Acreage for treatments and road miles were also updated based on more accurate information.

The Andrew Pickens Ranger District received 19 individual letters, e-mails, personal and telephone comments. These came from private individuals, businesses, other governmental agencies and organizations.

Using the comments from the public, and other agencies, the interdisciplinary team developed a list of issues to address.

Public comments were reviewed by the Interdisciplinary Team (IDT) and categorized as significant and non-significant issues. Significant issues were used to identify other alternatives, mitigation measures or to help frame the effects analysis in Chapter 3 of the Environmental Impact Statement (EIS). Non-significant issues are not relevant to the proposal or represent an opinion. Content analysis of the public comments can be found in the project file.

The following significant issues were used to develop an additional action alternative:

1) System Road Construction
2) Planting Species Selection and Spacing
3) Vegetation Diversity

Other issues that were used to frame the effects analysis are:

- herbicide use
- insect pollinators
- climate change and carbon storage
- economics
- soil and water
- wildlife
- ecosystem health
- aesthetics and naturalness
- fuel loading

IV. Alternatives Considered in Detail

Alternative 1 – No Action

This alternative provides a baseline against which impacts of the action alternatives can be measured and compared. Under this alternative, none of the specific management activities proposed would occur. Ongoing activities such as recreation, prescribed fire, wildlife opening maintenance, already approved timber management activities and road maintenance would continue at current levels. Management activities proposed by other environmental documents may still occur.

Alternative 2 - Proposed Action

Alternative 2 responds to the Purpose and Need for the project. The alternative consists of regeneration harvest with reserves (cut-and-remove) and regeneration cutting with reserves (cut-and-leave) treatments and the establishment/maintenance of woodlands. Reforestation would be

accomplished by natural regeneration or artificial regeneration. Herbicide site preparation and subsequent release treatments would help facilitate reforestation. In woodlands, manual, mechanical and herbicide treatments would be used to reduce woody competition in regenerated stands to help establish or maintain native plant communities including smooth coneflower. Prescribed burning, which is already covered under existing project decisions, would continue in a coordinated manner with the implementation of this project. Alternative 2 would move forest stand composition and structure toward the natural range of conditions that would be found in the Blue Ridge Mountain Physiographic Province. Connected actions would include system road construction, reconstruction and maintenance. Temporary roads would also be used for access.

Alternative 3

The alternative addresses public concerns identified as issues 1-3 relative to system roads, pine plantations and vegetation diversity. To meet the objective of establishing or maintaining a mixed pine/hardwood species composition over time, instead of using a pre-determined, fixed species cutting preference list for all stands, the species selection for cutting/retention, planting, and herbicide application during site preparation and release treatments would vary from one stand to the next. One constant is that loblolly pine would always be targeted for removal. Selection preference for other species would be based on comparing existing species composition with the natural range of variability for species composition in each stand. Ecological zone information would be used to help define the natural range for species composition. Species that are above their natural abundance would be targeted for cutting or herbicide application. Species that are below their natural abundance would be retained; some of these species would be planted.

Alternative 3 consists of regeneration harvest with reserves (cut-and-remove), regeneration cutting with reserves (cut-and-leave) treatments, and the establishment or maintenance of woodlands. Reforestation would be accomplished by natural regeneration or artificial regeneration. Herbicide site preparation and subsequent release treatments would help facilitate reforestation. In woodlands, manual, mechanical and/or herbicide treatments would be used to reduce woody competition in regenerated stands to help establish/maintain native plant communities including smooth coneflower. Prescribed burning which is already covered under existing project decisions would continue in a coordinated manner with the implementation of this project. Alternative 3 would move forest stand composition and structure toward the natural range of conditions that would be found in the Blue Ridge Mountain Physiographic Province. Connected actions would include system road reconstruction and maintenance. Temporary roads would also be used for access.

Proposed Management Activities by Alternative

Table S-1 displays proposed management activities by alternative.

S-1. Summary of Proposed Management Activities for All Alternatives

Activities	Alternative 1	Alternative 2	Alternative 3
FORESTLAND Regeneration Cut with reserves – Cut & Remove (Acres)	0	3,566	3,172
FORESTLAND Regeneration Cut with reserves – Cut & Leave (Acres)	0	1,774	1,587
WOODLAND Cut & Remove (Acres)	0	75	413
WOODLAND Cut & Leave (Acres)	0	126	371
Herbicide Site Prep and/or Release (Acres)	0	3,421	5,542
Reforestation by Planting	0	3,061	2,833
1. System Road Construction (miles).	0	6.5	0
2. System Road Reconstruction and Maintenance (miles)	0	60	60
3. Temporary Roads	0	21.7	24.9

V. Environmental Consequences

Impacts to the physical, biological and social environment are described in Chapter 3 of the EIS. Other elements of the environment evaluated included effects to Chauga River and Cedar Creek, both which are eligible for inclusion in the National Wild and Scenic River System. Effects of the project on the Chattooga Wild and Scenic River were also evaluated. The project tiers to the *Revised Land and Resource Management Plan Sumter National Forest* FEIS and the effects of this project are within the effects described in that document. The *Revised Land and Resource Management Plan* (Forest Plan) provides overall management direction and standards that would be followed to reduce adverse effects to resources. This project is consistent with the Forest Plan. In addition to Forest Plan standards, the interdisciplinary team (IDT) evaluated comments from the public and the various resource specialists developed site-specific mitigation measures to reduce or minimize adverse impacts. The mitigation measures are listed in Chapter 2 of this EIS and will be incorporated into the final decision for this project.

The following subject areas were evaluated for direct, indirect and cumulative effects.

Physical Environment

Soils

Water, Riparian Areas, Wetlands, Floodplains, Prime Farmlands

Air

Climate Change and Carbon Storage

Biological Environment

Vegetation, Ecological Communities and Non-Native Invasive Species

Wildlife

Migratory Birds

Aquatic Communities

Social Environment

Cultural Resources

Scenery and Recreation

Economics

Human Health and Safety

Environmental Justice and the Protection of Children

Civil Rights

Other Elements

Rivers Eligible for Inclusion in the National Wild and Scenic River System

Chattooga Wild and Scenic River

Table S-2 compares the issues raised by the public during scoping for each of the alternatives that were developed and analyzed in the EIS. Each of these alternatives results in different environmental effects which have been evaluated in Chapter 3 of the EIS.

S-2. Comparison of Alternatives Relative to Issues

Issue/Elements	Alternative 1	Alternative 2	Alternative 3
Issue 1 – System Road Construction			
• System road construction	0	6.5 miles	0
• Temporary roads needed	0	21.7 miles	24.9 miles
• Some commercial stand treatments changed to non-commercial treatments to eliminated need for some roads?	NA	NA	Yes
• Seek right-of-way agreements with adjacent landowners to reduce need for new temporary roads?	NA	NA	Yes
Issue 2 – Pine Plantations			
• Pre-defined tree planting spacing of 12 X 12 foot?	NA	Yes	No
• Tree species selection for planting and spacing would be made on site potential considering ecological zone classification?	NA	No	Yes
• Tree planting would not occur when there is existing adequate stocking of natural regeneration?	NA	Yes	Yes
Issue 3 – Vegetation Diversity			
• Would a species targeted for cutting and herbicide treatment be the same for all stands?	NA	Yes	No
• Would species targeted for cutting and herbicide treatments be based on the natural range of species composition according to the ecological zone for each stand?	No	No	Yes
• Diversity of habitats as measured by the number of acres to be managed and maintained as woodland habitat	0	202 acres	783 acres
• Would woodland understories be enhanced with plantings of native herbaceous species?	No	No	Yes
• Would woodland densities be adjusted to account for post-implementation tree mortality?	NA	No	Yes

VI. Identification of the Preferred Alternative

Alternative 3 is the Agency preferred alternative.

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CHAPTER 1. PURPOSE OF AND NEED FOR ACTION

1.1 Document Structure

The Forest Service has prepared this Environmental Impact Statement in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This EIS discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the environmental effects of implementing the proposed action and other alternatives.
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies consulted during the development of the environmental impact statement.
- *Appendices:* The appendices provide more detailed information to support the analyses presented in the environmental impact statement.

Additional documentation may be found in the project documents located at http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=28634.

1.2 Purpose and Need for Action

The purpose and need for this project is to restore the current landscape condition within the area to more native forest vegetation, specifically by replacing non-native loblolly pine with native mixed hardwood/pine forests and woodlands. This change in condition would improve ecosystem health; increasing species diversity of native vegetation and would provide greater variety of habitat; increasing viability of plant and animal species. Diverse native forests are more resilient to natural disturbances than a plantation comprised primarily of one non-native species. Outside its natural range, loblolly pine is more susceptible to freeze and ice damage, and to pathogens. Native tree species have evolved with these local disturbances, and greater species diversity provides more substitute options in the event that one species gets impacted by a species-specific disturbance agent.

Treated stands would be naturally or artificially regenerated (planted) to a native species composition, mostly shortleaf pine, pitch pine, Table Mountain pine, oaks, and hickories. A blight resistant strain of American chestnut (once native to this area) would also be planted on suitable sites, depending on seedling availability. These native tree species are ecologically

suited to the proposed treatment stands, provide mast for wildlife, and provide socio-economic benefits. All of these species, most notably the native pine species, have been declining in abundance on the District for the past several decades, primarily due to lack of disturbance. Felling newly-regenerated loblolly pine trees in recently harvested stands that were part of other project decisions would help facilitate the development of native species in those stands.

Woodlands treatments would provide additional habitat diversity. Woodlands are forests with relatively low tree densities of 25-60% forest cover with understories that are dominated by native grasses and forbs. Management that promotes woodlands would serve a multitude of resources. Woodlands provide habitat for a variety of disturbance-dependent, early successional game and nongame wildlife species in all stages of their lifecycles. Populations of early successional bird species, such as northern bobwhite quail, ruffed grouse, field sparrow, and golden-winged warbler, have been declining on the Sumter National Forest because of a lack of suitable habitat. Woodlands also provide open stand conditions with ample sunlight and disturbance conditions conducive to certain plants including the federally endangered smooth coneflower.

The change in species composition and forest/woodland structure would create habitat more representative of natural habitats in Management Area 3 (Blue Ridge Foothills). Such habitats support existing native vegetation (including the federally endangered smooth coneflower) and bird species such as northern bobwhite, ruffed grouse, field sparrow and golden-winged warbler. These species have been declining on the District, due in part to a lack of suitable habitat.

1.3 Background

The Andrew Pickens Ranger District (the District) is comprised of 84,574 acres of National Forest land, located in the far northwest corner of South Carolina, in Oconee County. It is bounded on three sides by other National Forests: the Nantahala NF to the north in North Carolina, and the Chattahoochee-Oconee NF to the west and south in Georgia. The District is situated in the Blue Ridge Mountain Physiographic Province, in the mountain foothills.

To help meet demands for forest products in the early 1960s, the Forest Service began planting loblolly pine because it typically grows faster than the native pines found in Oconee County. Loblolly pine also produces good quality lumber. Stands in the project area were converted to pine plantations 20 to 50 years ago by clear-cutting more diverse native stands and planting them to loblolly pine (*Pinus taeda*) after intensive site preparation treatments.

Loblolly pine is a southern United States pine species native to most of South Carolina; however, it is not native to mountain regions in South Carolina's upstate region where the Andrew Pickens District is located. Loblolly pine does not occur naturally in any part of Oconee County, but is commonly planted on managed timberlands throughout the county. The closest known location of naturally occurring loblolly pine is found along the Savannah River in lower Anderson County, South Carolina.

Most of the loblolly plantation stands in this project are dense, with basal areas as high as 160 square feet per acre. Due to loblolly pine's prolific reproduction and fast growth characteristics, it tends to out-compete native species for growing space. The intensive site preparation treatments during establishment of the plantations gave the loblolly pine an even greater competitive advantage. Therefore, few hardwood or native pine trees exist in the overstory.

Hardwood sprouts and saplings are common in the understory, but their growth is restricted by loblolly pine.

Some of the stands proposed for treatment are less dense with loblolly pine due to poor seedling survival when the loblolly was initially planted, or from disturbance agents that have acted on the stands sometime during their development. The District has been impacted by southern pine beetle (SPB), with the most recent activity occurring in 2002 and 2003. Mortality from SPB has created 5 to 10-acre gaps within several of the loblolly plantations, opening up potential growing space for native species. However, without a larger-scale disturbance, loblolly pine reproduction usually out-competes the native tree species and re-occupies most of the available growing space.

The District, and the Sumter National Forest as a whole, has been focusing on native ecosystem restoration for several years. Since 2001, the District has been planning and implementing projects to remove non-native loblolly pine plantations and replace them with a mix of native tree species. These projects have been in the Upper Chauga River basin near Cedar Creek and Village Creek and also in the Ross Mountain / Tamassee Knob areas.

The previous loblolly removal projects have been successful. The District now proposes to continue these activities District-wide in the remaining loblolly pine plantations, on approximately 5,600 acres (40 compartments).

1.4 Forest Goals and Objectives

This proposal is consistent with the *Revised Land and Resource Management Plan, Sumter National Forest* (Forest Plan) that provides goals and objectives for the project area.

The project area would help meet the following goals and objectives in the Sumter Forest Plan:

Goal 8 - *Maintain and restore natural communities and habitats in amounts, arrangements, and conditions capable of supporting viable populations of existing native and desired non-native plants, aquatics, and wildlife species within the planning area*.

> Objective 8.01 - *Restore 2,000 – 6,000 acres of native communities on sites occupied by loblolly pine on the Andrew Pickens District over the 10-year planning period*.
>
> Objective 8.02 - *Provide 4,000 – 5,000 acres of woodlands on the mountains on dry-xeric sites in woodland, savanna, open grassland, or shrub land conditions*;

Goal 14 - Manage forest ecosystems and associated communities to maintain or restore composition, structure, function, and productivity over time.

Goal 18 - Provide a sustainable supply of wood products

The Forest Plan delineates management prescription units for the District. Each management prescription defines a set of resource management objectives, emphases, desired conditions, and standards that define the nature of management activities to occur in each unit.

Table 1.4-1 summarizes the loblolly plantation treatments by management prescription. Management prescription 11, Riparian Corridors is embedded within other prescription areas.

Table 1.4-1. Loblolly Pine Plantation Treatments Summarized by Management Prescription

Management Prescription Code	Management Prescription Name	Percentage of Project Area
4D	Botanical/Zoological Areas	1%
4F	Scenic Areas	3%
7E2	Dispersed Recreation Areas	20%
8A1	Mix of Successional Forest Habitats	76%

7E2 Management Prescription - Forest Plan Desired Conditions related to forest and woodland management

Loblolly pine stands will be replaced over time with openings and native species including, woodlands or native forest types. Permanent openings, savanna to woodland conditions and oaks, hickories, shortleaf pine and pitch pine dominate locations previously occupied by loblolly pine. An intermediate mix of forest successional stages characterizes these areas. Mid-and late successional forests are common, but 4 to 10 percent of the forested land is in early successional forest conditions. Fifty percent of the forest acres are in mid-to late successional forests conditions. Within this 50 percent, at least 20 percent are in late successional or old growth conditions.

The recreational opportunities are in roaded natural and rural settings. A flow of wood products is provided to local economies.

Forest management activities maintain the natural characteristics that make the area popular. They include restoring native vegetative communities, creating permanent openings, establishing a pleasing mosaic of tree species of various densities and stem forms, feature flowering trees, character trees and shrub species, enhance fall color species, enhance both game and non-game wildlife habitat for viewing, photography and hunting, minimize impacts from insect and disease outbreaks and rehabilitate areas damaged by insects and disease.

Aquatic and riparian protection measures found in Riparian Prescription 11 apply to this prescription.

Provide for tree diversity for current and future production of hard and soft mast and den trees. In addition, existing patches dominated by mast producing hardwoods, or scattered hard and soft mast or fruit producers, will be retained across the stand to the extent compatible with achieving desired conditions of open pine forests.

Retain soft mast producing species (dogwood, black gum, hawthorn, grapes, serviceberry, etc.) during vegetative treatments to the extent compatible with meeting treatment objectives.

This prescription provides habitat conditions for wild turkey, white-tailed deer, grey squirrels and other small mammals, tanagers, whip-poor-wills and a variety of passerine birds. Prescribed fire is used to reduce fuel buildup,

Prescribed fire is used to reduce fuel buildup, mimic natural disturbance, maintain pleasing open park-like views, create and maintain wildlife and plant habitat, and maintain and restore desired communities such as woodland conditions.

8A1 Management Prescription – Forest Plan Desired Conditions related to forest and woodland management

Loblolly pine stands will be replaced over time with more native habitats including openings, woodlands, or native forest types. Permanent openings, savanna to woodland conditions and oaks, hickories, shortleaf pine and pitch pine dominate locations previously occupied by loblolly pine.

A full range of wildlife habitats is provided with most of the forested stands in this prescription in mid- to late successional forest conditions. Develop and maintain high capacities for hard mast production across the landscape. Create and maintain woodland/savannah habitats on suitable sites. Hunting and wildlife viewing are emphasized recreation opportunities. A flow of wood products is provided to local economies.

Forests 40+ years of age dominate the landscape, occupying 50 percent or more of the prescription area. These forested stands will be maintained in more open forest conditions than currently exists, with an emphasis on oak and hickory mast production on appropriate sites, i.e., oaks and hickories with large, well-developed crowns.

An intermediate mix of forest successional stages characterizes these areas. Mid-and late successional forests are common, but 4 to 10 percent of the forested land is in early successional forest conditions. Fifty percent of the forest acres are in mid-to late- successional forests conditions. Within this 50 percent, at least 20 percent are in late successional or old growth conditions. Additional areas will be maintained in open woodland, savanna habitat conditions. On ridges, south and west facing slopes, and in pine, pine-oak, oak-pine or oak forest types, most of the stands in mid-to late-successional forest conditions will be maintained as moderately stocked, with a desirable level of 60 to100 square feet of basal area, and open crown conditions. Older trees will occur as individuals and inclusions in these stands to retain high canopy, late successional habitat characteristics.

Sweetgum will be discouraged for future production of hard and soft mast and den trees. In addition, existing patches dominated by mast producing hardwoods, or scattered hard and soft mast or fruit producers, will be retained across the stand to the extent compatible with achieving desired conditions of open pine forests. Soft mast producing species (dogwood, blackgum, hawthorn, grapes, serviceberry, etc.) remains during vegetative treatments to the extent compatible with meeting treatment objectives.

Habitats in this prescription are weighted towards mid-to late-successional forest conditions in a forested landscape that includes young forested stands, grass/shrubland openings and woodland/savanna conditions. Principal beneficiaries of this management approach would favor species such as pileated woodpecker, red-eyed vireo, and Eastern wood peewee. With the

emphasis on hard mast, all species that consume acorns and hickory nuts (squirrels, turkey, deer, raccoon, black bear, etc.) would also benefit.

Well-developed crowns and multi-layered canopies within mature forest stands benefit most breeding forest-dwelling birds, i.e., black-and white warbler (*Mniotilta yaria*), wood thrush(*Hylocichla mustrlina*), vireos, flycatchers, and northern flicker (Colaptes auratus), and are extremely important to a majority of neotropical migrants that pass through the Sumter in the spring and fall.

The compliment of early successional habitat in a landscape dominated by mature forest in this prescription is important to species such as prairie warbler, yellow-breasted chat, Bobwhite quail, Swainson's warbler, ruffed grouse, wild turkey, white-tailed deer, and a variety of small mammals. Existing old fields and openings for wildlife may be present and maintained. Existing openings and linear strips may be expanded, and/or new openings may be present and maintained.

Additional open, park-like woodland conditions may be developed to improve habitat conditions in the area. Native species are preferred but non-invasive non-native species may be used when establishing food plants for wildlife. Permanent forest openings, woodland, and savanna conditions with a well-developed herbaceous layer, to a grass/shrub dominated area with scattered trees will benefit several other species of wildlife. These species include Bachman's sparrow, American kestrel, red-tailed hawk, Cooper's hawk, eastern cottontail, fox, cotton mouse, eastern bluebird, and mourning dove.

Aquatic and riparian protection measures found in Riparian Prescription 11 apply to this prescription.

Prescribed fire plays an important role in maintaining forest openings, woodland conditions, and many forested communities. Prescribed fire encourages oak sprouting and reduces competition from more shade tolerant species, creates conditions for developing an uneven canopy which stimulates shrubs as well as mid-story development and forage production, restores and maintains habitat for federally endangered smooth coneflower, restores and maintains habitat for sensitive species such as Fraser's loosestrife and sun-facing coneflower. Prescribed fire may also be used to reduce fuel build up and the risk of wildfire.

1.5 Proposed Action

This proposal is to replace non-native loblolly pine plantations with native pines, hardwoods, and associated understory plants on approximately 5,542 acres on the Andrew Pickens Ranger District, Sumter National Forest. The loblolly plantation stands are scattered across 40 compartments. (See maps in Appendix A). None of the stands are located within the Chattooga Wild and Scenic River corridor, the Ellicott Rock Wilderness, the White Rock Scenic Area or the Station Creek Cove Botanical Area. One stand is located in the Cedar Creek Botanical Area.

The summary of treatment actions proposed by the Forest Service to meet the purpose and need are summarized in Table 1.5-1. Treatments include regeneration harvests followed by site preparation and release treatments for reforestation. Both woodland and forest areas would be

treated, with woodland areas being managed for more open conditions. Natural or artificial regeneration (tree planting) would be prescribed on a stand-specific basis to achieve reforestation. A blight-resistant strain of American chestnut would be planted on suitable sites if viable seedlings become available. Approximately 6.5 miles of permanent system roads would be constructed for access.

Prescribed burning, manual, mechanical and herbicide treatments would be used to reduce woody competition in regenerated stands to help establish/maintain native plant communities including smooth coneflower. Prescribed burning is covered under existing project Decisions.

Table 1.5-1. Proposed Action Treatment Summary

PROPOSED ACTION TREATMENTS	ACRES	TREATMENT OBJECTIVES
Regeneration Harvest with Reserves (*Cut and Remove*)	3,566	Replace loblolly pine with native hardwood/pine species mix. Harvest merchantable wood for forest products.
Regeneration Cut with Reserves (*Cut and Leave*)	1,744	Replace loblolly pine with native hardwood/pine species mix.
Harvest for Woodlands Management (*Cut and Remove*)	75	Harvest loblolly and manage regeneration for open conditions.
Cutting for Woodlands Management (*Cut and Leave*)	126	Cut loblolly and manage regeneration for open conditions.
Total Cut	5,542	
CONNECTED ACTIONS	**ACRES**	
Site Preparation and/or Release	3,421	Herbicide would be used initially to prepare sites for regeneration and later to release trees from competition.
Reforestation by planting	3,061	Native species such as shortleaf pine, pitch pine, Table Mountain pine, and American chestnut would be planted on suitable sites depending on availability of seed sources.
New permanent system road construction	6.5 (miles)	For access (corrected from earlier estimate of 8.2)
Existing system road maintenance or reconstruction	60 (miles)	For access (corrected from earlier estimate of 59.2)
Temporary road construction/reconstruction/obliteration	21.7 (miles)	For access

1.6 Decision Framework

The Responsible Official for this decision is the District Ranger, Andrew Pickens Ranger District, Sumter National Forest.

The Responsible Official can:

- Select the no-action alternative.
- Select an action alternative that has been considered in detail.
- Modify an action alternative.
- Identify what mitigation and monitoring measures are necessary.
- Suspend all further action or direct that other actions be pursued.

1.7 Public Involvement

On February 24, 2010 a Scoping Letter / Notice of Intent (to prepare and environmental impact statement) were sent to 254 individuals, State, Federal and local agencies and organizations, informing them of the intent to prepare an environmental impact statement and inviting comments for developing action alternatives.

On March 8, 2010, a Notice of Intent (NOI) was published in the Federal Register / Vol. 75, No. 44 / Notices (at page 10457), with a deadline for scoping comments to be received by April 7, 2010.

On September 26, 2012, a corrected NOI was published in the Federal Register / Vol. 77, No. 187 / Notices (at page 59163).

The Andrew Pickens Ranger District received 19 individual letters, e-mails, personal and telephone comments. These came from private individuals, businesses, other governmental agencies and organizations.

Using the comments from the public, and other agencies, (see *Issues* section), the interdisciplinary team developed a list of issues to address.

1.8 Issues

Public comments were reviewed by the Interdisciplinary Team (IDT) and categorized as significant and non-significant issues. Significant issues were used to identify other alternatives, mitigation measures or to help frame the effects analysis in Chapter 3 of the EIS. Non-significant issues are not relevant to the proposal or represent an opinion. Content analysis of the public comments can be found in the project file.

Significant Issues

Issues Used to Develop Alternatives

Issue 1 - System Road Construction

Comment:

Concern was expressed with the amount of new system road construction proposed (6.5 miles) and future funding needed to maintain them. Adding additional system roads would result in an increase in funding needed for road maintenance in the future. Current road maintenance funding is insufficient to meet current maintenance needs. The Forest Service needs to maintain what roads it has and not keep building more system roads.

Response:

Alternative 3 was developed to respond to this issue. The alternative eliminates the building of new system roads and relies on using temporary roads where possible and seeking right-of-way agreements with adjacent private landowners for access to proposed units. Temporary roads would utilize pre-existing non-system roads in most cases, and would be closed and obliterated upon the completion of planned treatments. Units proposed for treatments were logged in the past and roads were constructed at that time. In some cases, access was through temporary road use agreements the Forest Service had with private landowners. Some of these old roads are not adequate for use today and new temporary roads would be needed. Alternative 3 would change some of the stand treatments from Cut & Remove to Cut & Leave where either temporary road access is not possible because of resource concerns or agreements with adjacent landowners could not be obtained.

Measure: Miles of new system road construction

Issue 2 – Pine Plantations

Comment:

There was concerned expressed that planting pine trees on a 12 x 12 foot spacing would result in the stands being too dense making them susceptible to pine beetle attack in the future. Also, the stands are so dense that nothing else grows and there is no food for wildlife and they lack diversity. The dense pine plantations are contrary to historic vegetation conditions where stands contained mixtures of native pines found on the ridges with mixtures of hardwoods that are more typical of native stands in the Southern Appalachian Mountains.

Response:

Alternative 3 was developed to respond to this issue. To meet the objective of establishing or maintaining a mixed pine/hardwood species composition over time, instead of using a fixed species preference list and fixed spacing for planting for all stands, the species selected for planting and the spacing would vary from one stand to the next. Following cutting treatments, species selection for planting and spacing determination would be made based on site potential along with the residual species composition and stocking for each stand. The ecological zone information for each stand would be used to help determine site potential.

In some project stands, the density of loblolly pine precludes a sufficient amount of advance regeneration or seed source from mature native species to successfully regenerate the stand by natural means. For both Alternative 2 and Alternative 3, the objective of planting native pines is not to replace one pine plantation with another. In naturally regenerated stands with mixed pine/hardwood, the hardwood species usually out-compete pines unless fire intensity is high enough to top-kill the hardwoods. The establishment of a native pine stand (possibly mixed with American chestnut) would provide initial tree cover to occupy the site and to give the pines more of an equal competitive footing with the naturally regenerated hardwoods. Natural regeneration of other native pines and hardwoods would occur over time, leading to a mixed pine/hardwood composition. Both alternatives provide for planting any of three native pine species and/or American chestnut. Alternative 3 provides the option for planting other species as well.

For Alternative 2 and Alternative 3, tree planting would not occur where there is existing adequate stocking of natural regeneration. The final target stocking would be for an average of 300 trees per acre (planted + existing trees). Tree spacing would vary when planted trees and natural regeneration are factored in together.

Some of the project stands already contain a variety of native tree species in the understory that would be retained. For both Alternative 2 and Alternative 3, cutting treatments would release these trees. Site preparation and tree planting would take place in the gaps created by the cutting treatments. The result would be a two-aged stand structures with more species composition in such stands.

Measure: Species composition by percentage of total trees per acre, pre and post-treatment

Issue 3 – Vegetation Diversity

Comment:

There was concern expressed that there would be a loss of vegetation diversity as a result of implementing the proposed action. Pine trees provide shading and allow oaks, hickories and other native understory vegetation to grow. Removing them would impact growth of these more shade tolerant species. Yellow-poplar should be left in coves since it is a fast grower and Virginia pine should be left. It would take a long time for the diversity of the vegetation to recover once the pine trees are cut.

Response:

Alternative 3 responds to this issue. To meet the objective of establishing or maintaining a mixed pine/hardwood species composition over time, instead of using a fixed species cutting preference list for all stands, the species selection preference for cutting/retention would vary from one stand to the next. One constant is that loblolly pine would always be targeted for removal. Selection preference for other species would be based on comparing existing species composition with the natural range of variability for species composition in each stand. Species that are above their natural abundance would be targeted for cutting; species that are below their natural abundance would be retained. Ecological zones would be used to help define the range of potential natural conditions.

In addition to looking at within-stand species composition, consideration would be given to the current and potential natural abundance of each species at multiple geographic scales, giving

retention preference to those species that are declining and/or lower in abundance than their natural potential.

EXAMPLE: a stand that is located on a dry upland site contains loblolly pine, chestnut oak, scarlet oak, shortleaf pine, Table Mountain pine, yellow-poplar and Virginia pine. Preferred species for retention would be the chestnut oak, scarlet oak, shortleaf pine, and Table Mountain pine. Table Mountain pine would be given the highest preference for retention because it is the rarest species on the District, and was more common historically. oaks and shortleaf pine have been declining in abundance from their natural levels. Yellow-poplar and Virginia pine of merchantable size would be cut. The yellow-poplar is off-site; it is more suited to mesic sites. Virginia pine is appropriate to the site, but it is higher in abundance than its natural levels.

Under Alternative 3, these types of considerations would result in a species selection preference that is ecologically-based and specific to each stand. In the previous example, yellow-poplar was to be removed. However, on mesic sites (cove locations); it would be a preferred species for retention, because it is ecologically more suited to such sites.

Species such as, but not limited to, Virginia pine, red maple and sourwood are native tree species that provide some ecological benefit. However, they tend to displace most other native species on some sites during early stages of stand development. For both Alternative 2 and Alternative 3, the objective of cutting or targeting these species with herbicide would be to balance competition, not to eliminate Virginia pine, red maple, or sourwood completely.

Follow-up silviculture treatments, such as planting, herbicide, and thinning, would be used to maintain or increase the diversity and site-appropriateness of the species composition.

Alternative 3 provides additional acres of woodland treatments compared to Alternative 2. Woodlands would retain the best characteristics of a mixed open stand (healthy oaks, hickories, pitch pine and Table Mountain pine). Establishment of woodland habitats would promote diverse stands that have early seral native species in the understory, including the endangered smooth coneflower. This species has been limited in its distribution on the District because of the lack of early seral habitat conditions in the area. The proposal would create suitable habitat conditions for the species in the short and long term. Woodland stand understories would be enhanced by the planting of native herbaceous species.

For both Alternative 2 and Alternative 3, rare plant communities are identified and conserved wherever they occur based on Forest Plan Standard FW-30. These areas contribute significantly to plant and animal diversity on the Forest.

The effects of the proposed action and alternatives on vegetation diversity will be disclosed in the EIS.

Measure: Species composition by percentage of total trees per acre, pre and post-treatment

Issues used to Frame the Effects Analysis and to Develop Mitigation Measures

Issue 4 - Herbicide Use

Comment:

There is a concern that the use of herbicide for site preparation and crop tree release treatments would have adverse impacts on water quality, vegetation diversity and wildlife. Herbicide applications are expensive and control of competing vegetation can be accomplished by mechanical methods or by taking no action at all.

Response:

The effects of herbicide use are considered in the environmental consequences section of the EIS. It includes analysis of effects relative to water quality, vegetation diversity and wildlife. An herbicide risk assessment has been completed for herbicide use and mitigation measures have been developed to reduce adverse impacts to resources. Mechanical and manual treatments alone are not effective at reducing competition from species that are already established, particularly shade tolerant hardwood species. They sprout readily from stumps and out-compete other species. It is possible that herbicide treatments may not be needed for site preparation in dense loblolly pine treatment units because the understory is sometimes sparse and sufficient ground disturbance may be achieved during logging to provide places to plant trees. Prescribed burning may be an option in lieu of herbicide in some stands for site preparation, although operational limitations on the timing and intensity of prescribed burns would preclude it from being used for site preparation in all cases. Monitoring would be used to determine the amount of area that would be treated with herbicide in any given treatment unit.

Measure: Acres to be treated with herbicide

Issue 5 – Insect Pollinators

Comment:

There is a concern that the removal of native trees, in particular sourwood and yellow-poplar, can affect the source of pollen for insect pollinators (honey bees and bumblebees). Also, planting tree species like shortleaf pine, pitch pine and Table Mountain pine would not provide a good diversity of trees for insect pollinators.

Response:

Under Alternative 2 and Alternative 3, some flowering trees would be retained for their ecological benefit. Dogwood and redbud trees would usually be retained.

Alternative 3 responds to this issue by retaining yellow-poplar where it is ecologically suited to the site, for example, on mesic sites. Alternative 3 would also retain sourwood where it is ecologically suited to the site, but only in amounts that would not present a competition problem to other species. Sourwood tends to displace other native species following a regeneration harvest, so sourwood regeneration needs to be controlled to ensure a high species diversity in the stand over the long term, especially to establish and perpetuate intolerant species such as oaks, hickories, shortleaf, pitch, and Table mountain pine (all of which provide different kinds of ecological benefits). A few scattered mature sourwood trees can usually be retained in the stand without presenting a competition problem to other species.

Proposed harvest units represent a small percentage (approximately 7%) of the Andrew Pickens Ranger District proposed for treatment. Sourwood and yellow-poplar are abundant in most areas surrounding treatment stands. On a landscape scale, these species would remain abundant even if they diminish in abundance in the treatment stands.

The effects on insect pollinators will be evaluated in Chapter 3 of this EIS.

Measure: Percent of habitat impacted

Issue 6 – Climate Change and Carbon Storage

Comment:

There was concern that harvesting loblolly pine trees would release carbon dioxide into the air from decomposing wood and subsequent prescribed burning to reduce fuel loadings. There was also concern that a warming environment would make native species more susceptible to insect attack. Also, concern was raised that pine trees would be needed as a nurse crop to allow desirable hardwoods to grow and survive in the stands.

Response:

Impacts of climate change on meeting the purpose and need for the project will be evaluated in the environmental consequences section of the EIS. It will include a vulnerability assessment for native species such as shortleaf pine, pitch pine and Table Mountain pine as well as the ability of the environment to support a variety of native tree species. An analysis will also be completed for the impact the project will have on climate change and carbon storage.

Measure: effects on forest species composition relative to resistance and resiliency and silvicultural impacts on carbon storage

Issue 7 – Economics

Comment:

The project should disclose all costs associated with implementing the proposal (e.g. road construction, herbicide use, erosion control, etc.). The proposal is not cost effective.

Response:

A cost/benefit analysis will be completed for the proposal and the alternatives. The purpose and need for the project forms the basis for the proposal and economic effects will be considered in Chapter 3 of the EIS.

Measure: Present net value and costs

Issue 8 – Soil and Water

Comment:

Concern was expressed that timber harvesting would cause erosion and flooding and would carry herbicide into rivers and lakes and impact watersheds. Concern was also expressed that removal

of the loblolly pine trees would remove nutrients that would otherwise be recycled into the soil leading to a decline in soil productivity that would affect future trees on the site.

Response:

The effects of the proposed action and alternatives on soil and water will be disclosed in the EIS. Mitigation measures would be included to reduce adverse impacts to soil and water.

Measure: Soil erosion and sedimentation estimates

Issue 9 – Wildlife

Comment:

Concern was expressed that the proposal would have impacts on wildlife including threatened and endangered species. Road construction/reconstruction would impact forest interior species.

Response:

The effects of the proposed action and alternatives on wildlife will be disclosed in the Biological Evaluation and the EIS. The US fish and Wildlife Service will be consulted on this project concerning impacts to federally listed species. Mitigation measures would be included to reduce adverse impacts to federally listed species. Forest interior species would be evaluated in the wildlife section under Management Indicator Species (MIS) and Migratory Birds.

Measure: Effects to PETS, MIS and migratory birds

Issue 10 – Ecosystem Health

Comment:

The proposal should disclose how ecosystem health would be improved.

Response:

The effects of the proposed action and alternatives on components of the ecosystem will be disclosed in the EIS.

Measure: Acres of restored native species/forest types

Issue 11 – Aesthetics and Naturalness

Comment:

There was a concern that the project would impact aesthetic quality and the natural appearance of the landscape.

Response:

The effects of the proposed action and alternatives on aesthetics will be evaluated in the EIS.
Measure: treatment units affected and mitigation proposed

Issue 12 - Fuel loading

Comment:

Cut and leave treatments will increase the fuel material in the stand and increase the fuel hazard and be an impediment to stand development.

Response:

This issue will be addressed with the use of standards found in the Forest Plan and site-specific mitigation measures to reduce adverse effects.

Measure: effects analyzed and mitigation proposed

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 Introduction

This chapter describes and compares the alternatives and includes a description of each alternative considered. This section also presents the alternatives in comparative form.

2.2 Alternatives Considered in Detail

The Forest Service developed three alternatives, including the No Action and Proposed Action alternatives. The three alternatives are described below.

2.2.1 Alternative 1

No Action

Under the No Action alternative, current management activities would continue in the project area. No activities as presented in this proposal would be implemented to accomplish project goals.

The natural resources and ecological processes within the project area would continue at existing levels of the human influence. The characteristic of the forest environment would be affected primarily by natural disturbances such as insects, disease and weather. Custodial management of recreation areas, roads, prescribed burning and other projects already approved under prior decisions will continue under this alternative.

2.2.2 Alternative 2

Proposed Action

Table 2.2.2-1 summarizes treatments proposed by compartment and stand. The following treatments would be prescribed:

Regeneration Harvest with Reserves (Cut & Remove)

Timber harvest would occur in stands where operable volumes now exist. This would include establishing log landings and loading areas, skid trails and road access in the form of temporary roads, reconstructed existing roads or newly constructed forest system roads. In addition to loblolly pine, harvest would also include Virginia pine, white pine, red maple, yellow-poplar and other hardwoods to reduce competition. Oaks, hickories, shortleaf pine, Table Mountain pine, pitch pine would be retained where possible unless removal is necessary for safety or for equipment operability reasons. Selected soft mast producers and some flowering tree species would also be retained for their wildlife food or ecological benefit.

Regeneration Cutting with Reserves (Cut & Leave)

The term "Cut and Leave" signifies that loblolly pine would be felled and left on site. There are various reasons when a cut and leave decision would be made. For example, if there are not a sufficient number of merchantable-sized trees to harvest on a per acre basis (stocking), to make a commercial logging operation viable, the trees would be cut and left on site. Also, if the economical or environmental costs to access the stand outweigh the value of the timber to be harvested, a cut and leave decision would be made.

Cut and leave treatments would also occur in stands where harvest of loblolly pine has already occurred and loblolly pine regeneration has come in. Cutting methods would include manual methods that use hand tools or chainsaws. In addition to cutting loblolly pine, Virginia pine, white pine, red maple, yellow-poplar and other hardwoods would be felled to reduce competition. Oaks, hickories, shortleaf pine, Table Mountain pine and pitch pine would be retained. Selected soft mast producers and some flowering tree species would also be retained for their wildlife food or ecological benefit.

Additional Treatments

Site Preparation for Reforestation (Natural and Artificial Regeneration) and Release

In stands where reforestation by planting is proposed, herbicide would be used to prepare the site for planting by controlling competition with planted or naturally growing native shortleaf pine, Table mountain pine, pitch pine, oak, American chestnut, and hickory. Selected soft mast producers and some flowering tree species would be retained for their wildlife food or ecological benefit.

Site preparation and release treatments would include foliar spray, and cut-surface methods using the herbicides imazapyr and triclopyr that would be used in identified regeneration units. Cut-surface methods (also known as frill girdle or hack and squirt) would be applied with hatchets and squirt bottles, or similar application devices, using a mixture of 64 oz. water, 64 oz. Garlon 3A or equivalent (triclopyr amine) and 6 oz. Arsenal AC or equivalent (imazapyr). Cut-surface treatment would be applied to target vegetation that is too large to treat with a foliar spray. This application would be made between the first of July and the end of September when the herbicide is likely to be most effective.

Directed foliar spray would be applied using backpack sprayers. The application would be a low volume direct spray applied to targeted vegetation by speckling the leaf surface. This application would be made between the first of July and the end of September. Per gallon of mix water, the herbicide mixture for this application is: 0.5 ounce Arsenal AC or equivalent (imazapyr), 2 ounces of Garlon 4 or equivalent (triclopyr ester), ½ ounce surfactant, and spray pattern indicator.

An herbicide crop tree release treatment would be done after trees are planted. The treatment would reduce competition to oaks, hickories, shortleaf pine, Table Mountain pine, pitch pine and American chestnut (if planted) so that they could become the dominant species in the treated stands over the long term. Selected soft mast producers and some flowering tree species would be retained for their wildlife food or ecological benefit.

Reforestation by Planting (artificial regeneration)

In stands where reforestation by planting is proposed, native shortleaf pine would be planted on a majority of the sites on 12x12 foot spacing to augment natural regeneration of native pines and hardwoods.

Where suitable habitat exists and if seedlings are available, Table Mountain pine and pitch pine would be planted. Known suitable habitat for pitch pine and/or Table Mountain pine exists in the following stands, and additional habitat would be identified during implementation:

Compartment 15, stand 8

Compartment 25, stands 2 and 23*

Compartment 48, stand 5

*Pitch and Table Mountain pine

Also depending on site conditions and seedling availability, a blight resistant strain of American chestnut would be planted to re-establish this species.

Plantings would take advantage of growing space created by timber harvest and site preparation. Areas of the stand would not be planted where sufficient stocking exists from overstory trees that were not harvested or where seedlings and saplings of desired species are already present. This would result in a two-aged structure in some stands.

Woodland Treatments

The woodland treatments would cut all loblolly pine. Virginia pine, white pine, red maple, yellow-poplar, and other species would be cut as needed to achieve the desired overstory density. All pitch pine and Table Mountain pine would be retained unless removal is necessary for safety or for equipment operability reasons. The treatment would include thinning oaks, hickories, and shortleaf pine to a basal area (BA) of 30-40 ft^2/acre. To the extent possible, all healthy oak, hickory, shortleaf pine, Pitch pine and Table Mountain pine would be left where (BA) is currently less than 30-40 ft^2/acre. Three of these stands would be managed to benefit smooth coneflower.

Once treatments are completed, the areas would be prescribe-burned on a periodic basis, (estimated within 1-5 years of initial treatment). Prescribed burning is covered under existing NEPA decisions. Herbicide, manual and mechanical methods would be applied to sprouts/seedlings within 1-2 years after the initial post-harvest prescribed burn to reduce competition. These methods would be applied up to two more times after the initial treatment if needed to reduce competition. For woodlands management, the type of herbicide, method of application, and timing of application would be the same as that proposed for site preparation and release treatments.

Manual and mechanical methods including but not limited to hand tools (chainsaws, brush saws), and/or heavy equipment (tractor with mower, gyro-track) would be used to control sprouts and seedlings of tree species to maintain the woodland condition. Mechanical treatments would grind up or masticate undesirable understory vegetation.

Table 2.2.2-1. Proposed Action (Alternative 2) Stand-Specific Treatments

COMPARTMENT	STAND	ACRES	CUTTING TREATMENT	REFORESTATION METHOD	HERBICIDE FOR SITE PREP / RELEASE
15	6	43	Cut & Leave	Natural Regeneration	No
15	8	37	Cut & Remove	Plant Trees	Yes
15	19	22	Cut & Remove	Plant Trees	Yes
15	35	10	Cut & Leave	Natural Regeneration	No
16	2	25	Cut & Remove	Plant Trees	Yes
16	6	6	Cut & Remove	Natural Regeneration	No
16	9	28	Cut & Remove	Plant Trees	Yes
16	12	32	Cut & Remove	Plant Trees	Yes
16	27	44	Cut & Leave	Plant Trees	Yes
16	32	9	Cut & Remove	Plant Trees	Yes
16	33	24	Cut & Remove	Natural Regeneration	No
16	04A	20	Cut & Remove	Natural Regeneration	No
16	04B	21	Cut & Remove	Natural Regeneration	No
16	07A	16	Cut & Remove	Plant Trees	Yes
16	07B	12	Cut & Remove	Plant Trees	Yes
17	18	36	Cut & Remove	Plant Trees	Yes
18	4	42	Cut & Leave[1]	Already Reforested[1]	No
18	10	13	Cut & Leave[1]	Already Reforested[1]	No
18	17	29	Cut & Leave[1]	Already Reforested[1]	No
19	18	20	Cut & Leave[1]	Already Reforested[1]	No
24	14	24	Cut & Leave[1]	Already Reforested[1]	No
24	16	30	Cut & Leave[1]	Already Reforested[1]	No
25	2	49	Cut & Remove	Plant Trees	Yes
25	8	15	Cut & Remove	Natural Regeneration	No
25	9	23	Cut & Remove	Natural Regeneration	No
25	23	22	Cut & Remove	Plant Trees	Yes
25	24	32	Cut & Remove	Plant Trees	Yes
25	25	6	Cut & Remove	Natural Regeneration	No
25	31	32	Cut & Remove	Plant Trees	Yes
27	23	44	Cut & Leave[1]	Already Reforested[1]	No
28	2	35	Cut & Leave[1]	Already Reforested[1]	No
28	5	6	Cut & Leave	Natural Regeneration	No
28	10	37	Cut & Leave[1]	Already Reforested[1]	No
28	12	9	Cut & Remove	Plant Trees	Yes
28	16	5	Cut & Leave[1]	Already Reforested[1]	No
28	19	15	Cut & Leave[1]	Already Reforested[1]	No
28	24	35	Cut & Remove	Plant Trees	Yes

28	26	8	Cut & Leave	Natural Regeneration	No
28	30	42	Cut & Leave	Plant Trees	Yes
28	31	17	Cut & Leave	Plant Trees	Yes
28	32	12	Cut & Leave[1]	Already Reforested[1]	No
28	34	49	Cut & Remove	Plant Trees	Yes
28	35	10	Cut & Leave	Plant Trees	Yes
28	37	16	Cut & Leave	Plant Trees	Yes
28	38	21	Cut & Leave[1]	Already Reforested[1]	No
28	42	15	Cut & Leave	Plant Trees	Yes
28	44	3	Cut & Leave	Natural Regeneration	No
29	1	16	Cut & Remove	Plant Trees	Yes
29	4	28	Cut & Remove	Plant Trees	Yes
29	7	12	Cut & Remove	Plant Trees	Yes
29	8	13	Cut & Remove	Plant Trees	Yes
29	9	31	Cut & Remove	Plant Trees	Yes
29	12	17	Cut & Remove	Plant Trees	Yes
29	14	11	Cut & Remove	Plant Trees	Yes
29	17	29	Cut & Remove	Plant Trees	Yes
29	19	8	Cut & Remove	Plant Trees	Yes
30	1	34	Cut & Leave[1]	Already Reforested[1]	No
30	5	22	Cut & Remove	Plant Trees	Yes
30	6	10	Cut & Leave[1]	Already Reforested[1]	No
30	16	6	Cut & Leave[1]	Already Reforested[1]	No
30	19	7	Cut & Leave	Plant Trees	Yes
30	26	95	Cut & Remove	Plant Trees	Yes
30	27	100	Woodland-Cut & Leave[2]	N/A[2]	Yes
30	34	24	Cut & Leave	Natural Regeneration	No
30	41	94	Cut & Remove	Natural Regeneration	No
30	42	8	Cut & Remove	Plant Trees	Yes
31	1	13	Cut & Remove	Natural Regeneration	No
31	2	173	Cut & Remove	Natural Regeneration	No
31	17	11	Cut & Remove	Natural Regeneration	No
31	18	21	Cut & Remove	Natural Regeneration	No
32	8	71	Cut & Leave	Plant Trees	Yes
32	15	153	Cut & Remove	Plant Trees	Yes
32	17	49	Cut & Remove	Plant Trees	Yes
32	19	15	Cut & Leave	Natural Regeneration	No
32	26	15	Cut & Leave	Natural Regeneration	No
32	29	12	Cut & Remove	Plant Trees	Yes
32	30	32	Cut & Leave	Natural Regeneration	No
33	4	32	Cut & Leave	Natural Regeneration	No

34	20	52	Cut & Remove	Plant Trees	Yes
36	1	28	Cut & Remove	Plant Trees	Yes
36	12	10	Cut & Leave[1]	Already Reforested[1]	No
36	17	6	Cut & Remove	Plant Trees	Yes
36	19	22	Cut & Remove	Plant Trees	Yes
36	23	36	Cut & Leave[1]	Already Reforested[1]	No
36	26	45	Cut & Remove	Plant Trees	Yes
36	32	16	Cut & Leave	Natural Regeneration	No
36	34	4	Cut & Remove	Plant Trees	Yes
36	35	41	Cut & Remove	Natural Regeneration	No
36	36	29	Cut & Remove	Natural Regeneration	No
36	37	21	Cut & Remove	Plant Trees	Yes
37	2	56	Cut & Leave[1]	Already Reforested[1]	No
37	16	18	Cut & Leave[1]	Already Reforested[1]	No
37	22	43	Cut & Leave[1]	Already Reforested[1]	No
37	24	40	Cut & Leave[1]	Already Reforested[1]	No
37	27	27	Cut & Leave[1]	Already Reforested[1]	No
37	34	5	Cut & Leave[1]	Already Reforested[1]	No
37	45	25	Cut & Leave[1]	Already Reforested[1]	No
37	46	14	Cut & Remove	Natural Regeneration	No
37	64	8	Cut & Remove	Plant Trees	Yes
38	3	27	Woodland-Cut & Leave[2]	N/A[2]	Yes
38	9	32	Cut & Remove	Plant Trees	Yes
38	11	28	Woodland-Cut & Remove[2]	N/A[2]	Yes
38	40	33	Cut & Remove	Plant Trees	Yes
38	42	3	Woodland-Cut & Remove[2]	N/A[2]	Yes
39	7	16	Cut & Remove	Plant Trees	Yes
39	18	12	Cut & Remove	Plant Trees	Yes
39	20	20	Cut & Remove	Plant Trees	Yes
39	34	4	Cut & Remove	Plant Trees	Yes
39	35	5	Cut & Remove	Natural Regeneration	No
41	12	245	Cut & Leave[1]	Already Reforested[1]	No
42	1	87	Cut & Remove	Plant Trees	Yes
42	23	29	Cut & Remove	Plant Trees	Yes
42	24	24	Cut & Remove	Plant Trees	Yes
42	25	21	Cut & Remove	Plant Trees	Yes
42	26	21	Cut & Remove	Plant Trees	Yes
43	2	18	Cut & Remove	Plant Trees	Yes
44	33	2	Cut & Remove	Plant Trees	Yes

45	1	67	Cut & Remove	Plant Trees	Yes
45	6	46	Cut & Remove	Natural Regeneration	No
45	7	104	Cut & Remove	Natural Regeneration	No
45	10	41	Cut & Remove	Natural Regeneration	No
45	27	19	Cut & Leave	Natural Regeneration	No
45	28	10	Cut & Leave	Natural Regeneration	No
46	26	26	Cut & Remove	Plant Trees	Yes
47	7	52	Cut & Remove	Plant Trees	Yes
48	1	96	Cut & Remove	Plant Trees	Yes
48	2	44	Woodland-Cut & Remove[2]	N/A[2]	Yes
48	3	50	Cut & Remove	Plant Trees	Yes
48	4	41	Cut & Remove	Plant Trees	Yes
48	5	42	Cut & Remove	Plant Trees	Yes
48	6	8	Cut & Remove	Plant Trees	Yes
49	1	29	Cut & Remove	Plant Trees	Yes
49	2	17	Cut & Remove	Plant Trees	Yes
49	9	19	Cut & Remove	Plant Trees	Yes
49	30	21	Cut & Remove	Natural Regeneration	No
49	32	24	Cut & Remove	Plant Trees	Yes
49	33	4	Cut & Remove	Plant Trees	Yes
50	2	98	Cut & Remove	Plant Trees	Yes
50	10	14	Cut & Remove	Plant Trees	Yes
51	1	12	Cut & Remove	Plant Trees	Yes
51	3	25	Cut & Remove	Plant Trees	Yes
51	4	43	Cut & Remove	Plant Trees	Yes
52	23	40	Cut & Remove	Plant Trees	Yes
52	24	48	Cut & Remove	Plant Trees	Yes
52	29	5	Cut & Remove	Plant Trees	Yes
53	5	43	Cut & Leave[1]	Already Reforested[1]	No
54	6	17	Cut & Remove	Plant Trees	Yes
54	13	43	Cut & Remove	Plant Trees	Yes
54	17	50	Cut & Remove	Plant Trees	Yes
54	27	96	Cut & Remove	Plant Trees	Yes
54	29	17	Cut & Remove	Plant Trees	Yes
54	31	7	Cut & Remove	Plant Trees	Yes
55	7	24	Cut & Leave	Natural Regeneration	No
55	8	47	Cut & Leave	Natural Regeneration	No
55	13	33	Cut & Leave	Natural Regeneration	No
55	14	14	Cut & Leave	Natural Regeneration	No
55	17	14	Cut & Leave	Natural Regeneration	No
55	18	14	Cut & Leave	Natural Regeneration	No

55	19	10	Cut & Leave	Natural Regeneration	No
56	3	33	Cut & Remove	Plant Trees	Yes
56	12	13	Cut & Remove	Plant Trees	Yes
56	15	8	Cut & Remove	Plant Trees	Yes
56	23	17	Cut & Remove	Plant Trees	Yes
56	32	19	Cut & Remove	Plant Trees	Yes
56	37	4	Cut & Remove	Plant Trees	Yes
56	38	7	Cut & Remove	Plant Trees	Yes
56	39	18	Cut & Remove	Plant Trees	Yes
56	40	3	Cut & Remove	Plant Trees	Yes
56	43	6	Cut & Remove	Plant Trees	Yes
56	44	9	Cut & Remove	Plant Trees	Yes
56	45	3	Cut & Remove	Plant Trees	Yes
56	91	2	Cut & Remove	Plant Trees	Yes
57	3	68	Cut & Remove	Plant Trees	Yes
57	7	44	Cut & Remove	Plant Trees	Yes
57	15	23	Cut & Remove	Plant Trees	Yes
57	16	35	Cut & Leave	Natural Regeneration	No
58	12	53	Cut & Leave	Natural Regeneration	No
58	14	40	Cut & Remove	Plant Trees	Yes
62	5	51	Cut & Remove	Plant Trees	Yes
65	16	17	Cut & Remove	Plant Trees	Yes
65	21	6	Cut & Leave	Natural Regeneration	No
65	22	40	Cut & Leave	Natural Regeneration	No
65	23	10	Cut & Leave	Natural Regeneration	No
65	24	9	Cut & Leave	Natural Regeneration	No
65	25	13	Cut & Remove	Plant Trees	Yes
65	26	31	Cut & Leave	Natural Regeneration	No
65	27	55	Cut & Leave	Natural Regeneration	No

[1]stands have been harvested and reforested as part of past projects. Loblolly pine that has regenerated and other regenerated species as needed to balance competition would be the cut/leave activity for these stands

[2]tree regeneration is not a primary objective for woodlands treatments

Notes about Table 2.2.2-1:

- Compartment/Stand 28/44 was previously included in comp/stand 28/5. Since they are two geographically separate areas, one of the areas was labeled as new stand 28/44.
- Compartment/Stand 32/27 was previously a separate stand, but because it was only three acres, it was merged into adjacent stand 32/26
- Compartment/Stand 37/45 was mistakenly left off of the original proposed action list. It was identified on the map.
- Compartment/Stand 46/25 on the original proposed action is actually 46/26. There is no stand 46/25.

Connected Actions
The following activities would be conducted in connection with vegetation management activities.

- **System Road Construction:** Twelve (12) system roads would be built providing access to 20 loblolly timber stands. These new roads are needed to provide access during timber harvest and to provide for long term resource management.

  These roads are designed by Forest Service engineers to specific standards that include designing drainage structures such as culvert installations, inside slope ditching, road crown specifications, widened turn-around, gates and signage. Total specified system road construction is estimated at 6.5 miles but would vary once actual design is completed. Information on roads is contained in the road analysis.

- **Road Reconstruction and Maintenance:** Road maintenance and/or reconstruction would be needed on approximately 60 miles of existing Forest Service system roads. Reconstruction work would consist of but not be limited to graveling road surfaces, replacing culverts – including replacements for aquatic organism passage, ditch cleaning, removing brush and trees along road rights-of-way, installing, repairing or replacing gates and correcting road safety hazards. Road maintenance would consist of spot gravel replacement, blading, cleaning culverts, light brushing and mowing.

- **Temporary Roads:** Log landings that have no access to existing roads would be accessed by a temporary road that connects to the forest transportation system. Temporary roads are generally under 10 percent grade and road widths less than 14 feet. Approximately 21.7 miles of temporary roads are needed for access. Most temporary roads would utilize existing undesignated "woods" roads that are in suitable locations and for the most part have stabilized cut and fill slopes that would not be disturbed. Upon completion of treatments, temporary roads would be closed, obliterated and adequate erosion and stormwater control measures completed and replanted with vegetation

- **Skid Trails:** Skid trails would be used to skid logs to log landings. They would be closed after use with adequate stormwater and erosion control measures.

- **Log Landings:** Log landings are locations where logs are piled and then loaded onto trucks. Existing landings sites would be used as practicable to limit soil effects (compaction). They would be closed after use with adequate stormwater and erosion control measures.

2.2.3 Alternative 3

Alternative 3 was developed to address significant issues 1, 2, and 3 identified in Chapter 1. The other issues will be used to help frame the effects analysis and to develop mitigation measures.

The proposed treatments for Alternative 3 are similar to the Proposed Action (Alternative 2), with the following exceptions:

1) No new system roads are proposed under Alternative 3. Access would be via existing system roads and through the use of temporary roads or by obtaining rights-of-way across private land, where agreed to by the landowner.

2) The acreage scheduled for treatment is different between Alternative 2 and Alternative 3. Some stands cannot be accessed without construction of new system roads, so in Alternative 3 those stands would become a cut & leave treatment. Additional reconnaissance conducted since the time of the proposed action located road access to some stands that were previously thought to not have road access, or vice versa.

3) Additional woodland acreage has been identified in response to the issue of vegetative diversity.

4) The number and length of temporary roads is different between Alternative 2 and Alternative 3 for the reasons mentioned in (1) and (2) of this section.

5) Species preferences for cutting, planting and herbicide treatments are pre-determined for Alternative 2. Planting spacing is also pre-determined. For Alternative 3, species preferences would vary by stand (see response to Issue 3). Planting density would also vary by stand in Alternative 3 (see response to Issue 2).

6) Herbicide use for Alternative 2 is prescribed for all site preparation and release activities in stands that will be artificially regenerated (planted) and for all woodland stands.

   Alternative 3 proposes a more adaptive management approach, to have the option to use herbicide for site preparation or release treatments, but to apply it only if needed to control species composition and reduce competition. In some cases, stands to be planted would not need herbicide site preparation for planted trees to get established. Likewise, in some cases naturally regenerated stands may need herbicide site preparation for the preferred species to get established. In stands where prescribed burning occurs, depending on the timing, vegetation and weather conditions at time of burning, site preparation and/or release treatment objectives may be met with burning instead of herbicide, or may at least eliminate the need for foliar spray treatments on seedlings / saplings.

   The determination for herbicide application would be made shortly after cutting treatments have been completed, on a stand by stand basis. Waiting until after cutting would enable a better assessment of herbicide needs, because the conditions which influence the decision on whether or not to apply the herbicide can change considerably from before to after cutting. Factors such as the ecological zone, site potential, species composition, and residual stocking would be considered. Scheduling of cutting treatments would be coordinated with prescribed burn activities to utilize burning as an aid for site preparation and release treatments to the extent practicable.

   The type and method of herbicide application would be the same in both action alternatives.

7) Target basal area range for the residual stand in woodlands treatments for Alternative 3 is increased from 30-40 ft^2/acre (Alternative 2) to 40-60 ft^2/acre. This change is based on observations of woodlands treatments that have been implemented for other projects

since the time that Alternative 2 was proposed. Leaving more trees accounts for mortality that has been observed after treatments due to wind-throw, logging damage, etc.

8) To increase herbaceous species diversity, woodland stand understories would be enhanced by the planting of native herbaceous species.

Table 2.2.3-1 provides a summary of proposed treatments and Table 2.2.3-2 provides a stand-specific list of treatments for Alternative 3.

Table 2.2.3-1. Alternative 3 Treatment Summary

PROPOSED TREATMENTS	ACRES	TREATMENT OBJECTIVES
Regeneration Harvest with Reserves (*Cut and Remove*)	3,172	Replace loblolly pine with native hardwood/pine species mix. Harvest merchantable wood for forest products.
Regeneration Cutting with Reserves (*Cut and Leave*)	1,587	Replace loblolly pine with native hardwood/pine species mix.
Harvest for Woodlands Management (*Cut and Remove*)	413	Harvest loblolly and manage regeneration for open conditions
Cutting for Woodlands Management (*Cut and Leave*)	371	Cut loblolly and manage regeneration for open conditions
Total Cut	5,542	
CONNECTED ACTIONS	**ACRES**	
Site Preparation and/or Release	5,542[1]	Herbicide would be used initially to prepare sites for regeneration and later to release trees from competition.
Reforestation by Planting	2,833	Native species such as shortleaf pine, pitch pine, Table Mountain pine, and American chestnut would be planted on suitable sites depending on availability of seed sources.
New permanent system road construction	0 miles	
Existing system road maintenance or reconstruction	60 miles	For access (corrected from earlier estimate of 59.2 miles)
Temporary road construction /reconstruction/obliteration	24.9 miles	For access

[1]*In Alternative 3, the intent is not to apply herbicide to all 5,542 acres. The intent is to have the option to use herbicide under an adaptive management approach. Effects analyses will assume all 5,542 would receive treatment in order to analyze for the maximum potential effect.*

Table 2.2 3-2. Alternative 3 Stand-Specific Treatments

COMPARTMENT	STAND	ACRES	CUTTING TREATMENT	REFORESTATION METHOD	HERBICIDE OPTION FOR SITE PREP/RELEASE
15	6	43	Cut & Leave	Natural Regeneration	Yes for all stands on the option to apply herbicide for site preparation or release. Refer to the narrative in item #5 of section 2.2.3 for more information.
15	8	37	Cut & Remove	Plant Trees	
15	19	22	Cut & Remove	Plant Trees	
15	35	10	Cut & Remove	Plant Trees	
16	2	25	Cut & Remove	Plant Trees	
16	6	6	Woodland-Cut & Remove	N/A	
16	9	28	Cut & Remove	Plant Trees	
16	12	32	Cut & Remove	Plant Trees	
16	27	44	Cut & Remove	Plant Trees	
16	32	9	Cut & Remove	Plant Trees	
16	33	24	Woodland-Cut & Remove	N/A	
16	04A	20	Cut & Remove	Natural Regeneration	
16	04B	21	Woodland-Cut & Remove	N/A	
16	07A	16	Cut & Remove	Plant Trees	
16	07B	12	Woodland-Cut & Remove	N/A	
17	18	36	Cut & Remove	Plant Trees	
18	4	42	Cut & Leave[1]	Already Reforested[1]	
18	10	13	Cut & Leave[1]	Already Reforested[1]	
18	17	29	Cut & Leave[1]	Already Reforested[1]	
19	18	20	Cut & Leave[1]	Already Reforested[1]	
24	14	24	Cut & Leave[1]	Already Reforested[1]	
24	16	30	Cut & Leave[1]	Already Reforested[1]	
25	2	49	Cut & Remove	Plant Trees	
25	8	15	Cut & Remove	Natural Regeneration	
25	9	23	Cut & Remove	Natural Regeneration	
25	23	22	Cut & Remove	Plant Trees	
25	24	32	Cut & Remove	Plant Trees	
25	25	6	Cut & Remove	Natural Regeneration	
25	31	32	Cut & Remove	Plant Trees	
27	23	44	Cut & Leave[1]	Already Reforested[1]	
28	2	35	Cut & Leave[1]	Already Reforested[1]	
28	5	6	Cut & Leave	Natural Regeneration	
28	10	37	Cut & Leave[1]	Already Reforested[1]	
28	12	9	Cut & Remove	Natural Regeneration	
28	16	5	Cut & Leave[1]	Already Reforested[1]	
28	19	15	Cut & Leave[1]	Already Reforested[1]	

28	24	35	Cut & Remove	Plant Trees	
28	26	8	Cut & Remove	Plant Trees	
28	30	42	Cut & Leave	Plant Trees	
28	31	17	Cut & Leave	Plant Trees	
28	32	12	Cut & Leave[1]	Already Reforested[1]	
28	34	49	Cut & Remove	Plant Trees	
28	35	10	Cut & Leave	Plant Trees	
28	37	16	Cut & Leave	Plant Trees	
28	38	21	Cut & Leave[1]	Already Reforested[1]	
28	42	15	Cut & Leave	Plant Trees	
28	44	3	Cut & Leave	Natural Regeneration	
29	1	16	Cut & Remove	Plant Trees	
29	4	28	Cut & Remove	Plant Trees	
29	7	12	Cut & Remove	Plant Trees	
29	8	13	Cut & Remove	Plant Trees	
29	9	31	Cut & Remove	Plant Trees	
29	12	17	Cut & Remove	Plant Trees	
29	14	11	Cut & Remove	Plant Trees	
29	17	29	Cut & Remove	Plant Trees	
29	19	8	Cut & Remove	Plant Trees	
30	1	34	Cut & Leave[1]	Already Reforested[1]	
30	5	22	Cut & Remove	Plant Trees	
30	6	10	Cut & Leave[1]	Already Reforested[1]	
30	16	6	Cut & Leave[1]	Already Reforested[1]	
30	19	7	Cut & Leave	Natural Regeneration	
30	26	95	Cut & Remove	Plant Trees	
30	27	100	Woodland-Cut & Leave	N/A	
30	34	24	Cut & Leave	Natural Regeneration	
30	41	94	Cut & Remove	Natural Regeneration	
30	42	8	Cut & Remove	Plant Trees	
31	1	13	Cut & Remove	Natural Regeneration	
31	2	173	Cut & Remove	Natural Regeneration	
31	17	11	Cut & Remove	Natural Regeneration	
31	18	21	Cut & Remove	Natural Regeneration	
32	8	71	Cut & Leave	Plant Trees	
32	15	153	Cut & Leave	Natural Regeneration	
32	17	49	Cut & Remove	Plant Trees	
32	19	15	Cut & Remove	Natural Regeneration	
32	26	15	Cut & Leave	Natural Regeneration	

32	29	12	Cut & Remove	Plant Trees	
32	30	32	Cut & Leave	Natural Regeneration	
33	4	32	Cut & Leave	Natural Regeneration	
34	20	52	Cut & Remove	Plant Trees	
36	1	28	Cut & Remove	Plant Trees	
36	12	10	Cut & Leave[1]	Already Reforested[1]	
36	17	6	Cut & Remove	Natural Regeneration	
36	19	22	Cut & Leave	Natural Regeneration	
36	23	36	Cut & Leave[1]	Already Reforested[1]	
36	26	45	Cut & Remove	Plant Trees	
36	32	16	Cut & Leave	Natural Regeneration	
36	34	4	Cut & Remove	Natural Regeneration	
36	35	41	Cut & Remove	Natural Regeneration	
36	36	29	Cut & Remove	Natural Regeneration	
36	37	21	Cut & Remove	Plant Trees	
37	2	56	Cut & Leave[1]	Already Reforested[1]	
37	16	18	Cut & Leave[1]	Already Reforested[1]	
37	22	43	Cut & Leave[1]	Already Reforested[1]	
37	24	40	Cut & Leave[1]	Already Reforested[1]	
37	27	27	Cut & Leave[1]	Already Reforested[1]	
37	34	5	Cut & Leave[1]	Already Reforested[1]	
37	45	25	Cut & Leave[1]	Already Reforested[1]	
37	46	14	Cut & Remove	Natural Regeneration	
37	64	8	Cut & Remove	Natural Regeneration	
38	3	27	Woodland-Cut & Leave	N/A	
38	9	32	Cut & Remove	Plant Trees	
38	11	28	Woodland-Cut & Remove	N/A	
38	40	33	Cut & Remove	Plant Trees	
38	42	3	Woodland-Cut & Remove	N/A	
39	7	16	Cut & Remove	Natural Regeneration	
39	18	12	Cut & Remove	Plant Trees	
39	20	20	Cut & Remove	Plant Trees	
39	34	4	Cut & Remove	Plant Trees	
39	35	5	Woodland-Cut & Remove	N/A	
41	12	245	Woodland-Cut & Leave	N/A	
42	1	87	Cut & Remove	Plant Trees	
42	23	29	Cut & Remove	Plant Trees	
42	24	24	Cut & Remove	Plant Trees	
42	25	21	Cut & Remove	Plant Trees	

42	26	21	Cut & Remove	Plant Trees	
43	2	18	Cut & Remove	Plant Trees	
44	33	2	Cut & Remove	Plant Trees	
45	1	67	Cut & Remove	Plant Trees	
45	6	46	Woodland Cut & Remove	N/A	
45	7	104	Woodland Cut & Remove	N/A	
45	10	41	Woodland Cut & Remove	N/A	
45	27	19	Cut & Remove	Natural Regeneration	
45	28	10	Cut & Leave	Natural Regeneration	
46	26	26	Cut & Remove	Plant Trees	
47	7	52	Cut & Remove	Plant Trees	
48	1	96	Cut & Remove	Plant Trees	
48	2	44	Woodland-Cut & Remove	N/A	
48	3	50	Cut & Remove	Plant Trees	
48	4	41	Cut & Remove	Plant Trees	
48	5	42	Cut & Remove	Plant Trees	
48	6	8	Cut & Remove	Plant Trees	
49	1	29	Cut & Remove	Plant Trees	
49	2	17	Cut & Remove	Plant Trees	
49	9	19	Cut & Remove	Plant Trees	
49	30	21	Woodland-Cut & Remove	N/A	
49	32	24	Cut & Remove	Plant Trees	
49	33	4	Cut & Remove	Plant Trees	
50	2	98	Cut & Remove	Plant Trees	
50	10	14	Cut & Remove	Plant Trees	
51	1	12	Cut & Remove	Plant Trees	
51	3	25	Cut & Remove	Plant Trees	
51	4	43	Cut & Remove	Plant Trees	
52	23	40	Cut & Remove	Plant Trees	
52	24	48	Cut & Remove	Plant Trees	
52	29	5	Cut & Remove	Plant Trees	
53	5	43	Cut & Leave[1]	Already Reforested[1]	
54	6	17	Cut & Remove	Plant Trees	
54	13	43	Cut & Remove	Plant Trees	
54	17	50	Cut & Remove	Plant Trees	
54	27	96	Cut & Remove	Plant Trees	
54	29	17	Cut & Remove	Plant Trees	
54	31	7	Cut & Remove	Plant Trees	
55	7	24	Cut & Leave	Natural Regeneration	

55	8	47	Cut & Leave	Natural Regeneration	
55	13	33	Cut & Leave	Natural Regeneration	
55	14	14	Cut & Leave	Natural Regeneration	
55	17	14	Cut & Leave	Natural Regeneration	
55	18	14	Cut & Leave	Natural Regeneration	
55	19	10	Cut & Leave	Natural Regeneration	
56	3	33	Woodland-Cut & Remove	N/A	
56	12	13	Woodland-Cut & Remove	N/A	
56	15	8	Cut & Remove	Plant Trees	
56	23	17	Cut & Remove	Plant Trees	
56	32	19	Cut & Remove	Plant Trees	
56	37	4	Cut & Remove	Plant Trees	
56	38	7	Woodland-Cut & Remove	N/A	
56	39	18	Cut & Remove	Plant Trees	
56	40	3	Woodland-Cut & Remove	N/A	
56	43	6	Cut & Remove	Plant Trees	
56	44	9	Cut & Remove	Plant Trees	
56	45	3	Cut & Remove	Plant Trees	
56	91	2	Woodland-Cut & Remove	N/A	
57	3	68	Cut & Remove	Plant Trees	
57	7	44	Cut & Remove	Plant Trees	
57	15	23	Cut & Remove	Plant Trees	
57	16	35	Cut & Leave	Natural Regeneration	
58	12	53	Cut & Remove	Plant Trees	
58	14	40	Cut & Remove	Plant Trees	
62	5	51	Cut & Remove	Plant Trees	
65	16	17	Cut & Remove	Plant Trees	
65	21	6	Cut & Leave	Natural Regeneration	
65	22	40	Cut & Leave	Natural Regeneration	
65	23	10	Cut & Leave	Natural Regeneration	
65	24	9	Cut & Leave	Natural Regeneration	
65	25	13	Cut & Leave	Natural Regeneration	
65	26	31	Cut & Leave	Natural Regeneration	
65	27	55	Cut & Leave	Natural Regeneration	

[1]*stands have been harvested and reforested as part of past projects. Cut/leave activity for this project would be loblolly pine that has regenerated and other regenerated species as needed to balance competition*

[2]*tree regeneration is not a primary objective for woodlands treatments*

Connected Actions

The following activities would be conducted in connection with vegetation management activities.

- **Road Reconstruction and Maintenance:** Road maintenance and/or reconstruction would be needed on approximately 60 miles of existing Forest Service system roads. Reconstruction work would consist of but not be limited to graveling road surfaces, replacing culverts – including replacements for aquatic organism passage, ditch cleaning, removing brush and trees along road rights-of-way, installing, repairing or replacing gates and correcting road safety hazards. Road maintenance would consist of spot gravel replacement, blading, cleaning culverts, light brushing and mowing.
- **Temporary Roads:** Log landings that have no access to existing roads would be accessed by a temporary road that connects to the forest transportation system. Temporary roads are generally under 10 percent grade and road widths less than 14 feet. Approximately 24.9 miles of temporary roads are needed for access. Most temporary roads would be in the form of utilizing existing undesignated "woods" roads that already exist in the forest, that are in suitable locations, and for the most part have stabilized cut and fill slopes that would not be disturbed. Upon completion of treatments, temporary roads would be closed, obliterated and adequate erosion and stormwater control measures completed and replanted with vegetation.
- **Skid Trails:** Skid trails would be used to skid logs to log landings. They would be closed after use with adequate stormwater and erosion control measures.
- **Log Landings:** Log landings are locations where logs are piled and then loaded onto trucks. Existing landings sites would be used as practicable to limit soil effects (compaction). They would be closed after use with adequate stormwater and erosion control measures.

2.3 Alternatives Considered but Not Developed

A) Prescribed Burning only
Timber harvest would not be done under this alternative. Therefore, no road work, skid trails or landings would be needed, resulting in fewer impacts on the land. Herbicide treatments also would not be applied, eliminating any potential effects they might have. Loblolly pine plantations would be prescribe-burned on a periodic basis matching that of the historic fire regime.

This alternative was considered but not developed because it would not meet the purpose and need to establish native forest vegetation consisting of mixed hardwood/pine forests and woodlands. Prescribed-burning alone would not kill the mature loblolly pine.

B) Defer Harvest to Recover Economics
Timber harvest would only occur in mature loblolly stands where harvesting would be profitable and waiting longer would result in a lower net present value. Harvest would occur either as regeneration cuts or as commercial thinning. Treatment in remaining

stands would be deferred until the time when harvest would maximize net present value. Conversion to native species would occur at time of final harvest.

This alternative was considered but not developed because it would not meet the purpose and need or Forest Plan objective # 8 to "Maintain and restore natural communities and habitats in amounts, arrangements, and conditions capable of supporting viable populations of existing native and desired non-native plants, aquatic, and wildlife species within the planning area."

Many of the loblolly pine stands have been impacted by southern pine beetle (SPB) to the point that they are not commercially viable. Given the cyclic nature of SPB epidemics, future outbreaks are expected to reduce commercial viability even further. Non-native loblolly pine stands are more susceptible to SPB here on the Andrew Pickens than on other Forest Service Districts that are within its natural range. Loblolly pine is also more susceptible to freeze and ice damage, which is a contributing factor to insect outbreaks on the Andrew Pickens Ranger District.

Thinning loblolly pine would perpetuate a seed source that would inhibit the restoration of native pine and hardwood establishment. The health of native tree species on the District, in particular shortleaf pine, pitch pine, and Table Mountain pine would continue to decline on the District and in the Southern Appalachians. This alternative would not provide for the opportunity for these species to regenerate and to expand.

Another problem with this alternative has to do with the spatial arrangement of the loblolly pine stands. Where two stands are adjacent to one another and both are of seed-producing age, if one stand is regenerated and the other is deferred, then the deferred stand would continue to be a seed source for loblolly pine that could continually regenerated in the harvested stand. This could compromise the reforestation objectives in the harvested stand.

2.4 Mitigation Measures Common to All Action Alternatives

Mitigation measures for all action alternatives are incorporated from the following documents:

- The *Revised Land and Resource Management Plan, Sumter National Forest (2004)*
- *South Carolina's* Best Management Practices *for Forestry* (South Carolina Forestry Commission 1994)
- Soil and Water Conservation Practices Guide, Southern Region, (U.S. Department of Agriculture 2002).

PHYSICAL (Hydrology, Fisheries, and Soils)

1. To mitigate effects related to increased flow response resulting from vegetation removal, only half the treatment acreage in the drainages listed in Table 2.4-2 would be regenerated at any one time and at least three years would elapse before the remaining area would be regenerated.

Table 2.4-2 4th and 3rd Order DBRUs

4th Order DBRU Number	3rd Order DBRU Number
601020102	60102011202
601020103	60102015401
601020115	60102021604
601020116	60102021502
601020209	60102027027
601020216	60102052301
601020217	60102023303
601020523	60102027002
	60102027029

2. Within the primary streamside management zone (SMZ) for perennial and intermittent streams, timber removal would be limited to loblolly trees to mitigate soil and bank disturbance, provide large wood input to streams and to maintain shade on streams. Loblolly pine would be directionally felled away from streams or girdled (manually with herbicide or chainsaws) and left on site in areas where it is not feasible to commercially remove them. The South Carolina Forestry Commission would be consulted for a BMP variance where the overstory basal area along perennial streams would be less than 50 square feet per acre after removing loblolly pine. In riparian corridors outside the SMZ, timber removal would be limited to loblolly pine to maintain diversity of other species for riparian habitat.

3. To favor hardwood tree species because of their riparian benefits, pine trees would not be planted in riparian corridors

4. To minimize repetitive soil and vegetation disturbance, riparian corridors would not be converted to or maintained as woodlands.

5. To minimize potential effects from herbicides to aquatic organisms:

    a. Herbicide use in riparian corridors would be limited to loblolly pine using cut-surface or stem injection methods. Application methods would ensure that no herbicide entered stream waters. No foliar spray would be applied in riparian corridors (minimizes potential for drift into water).

    b. In stands that contain channeled ephemeral streams, foliar spray would use Cide-Kick or equivalent as an adjuvant.

    c. Herbicide would not be applied when off-site movement via surface or subsurface runoff in water or with soil particles is probable due to rain events.

6. To minimize potential for soil runoff into streams:

    a. Erosion control devices such as diversions, temporary rock sediment dams, silt fences, or log constructed basins would be installed during road or skid trail construction/ reconstruction as needed to deter soil runoff into perennial, intermittent or channeled ephemeral streams. Erosion control devices would be maintained in working order until plant growth is established and stable enough to control runoff and erosion.

    b. Road stream crossings and approaches would be seeded and matted immediately after construction. Temporary road and skid trail crossing approaches would be rehabilitated and re-vegetated as soon as possible once they are no longer needed to facilitate timber removal.

    c. Temporary roads would use portable spanning structures for all perennial stream crossings. Intermittent and channeled ephemeral stream crossings for temporary roads or skid trails would utilize methods that would maintain streambank stability and minimize sediment input.

    d. To minimize soil movement, temporary roads would be rehabilitated and closed as soon as possible following project treatments and would be covered with logging slash, mulch material and seeded.

7. To minimize adverse impacts on soil productivity (maintain duff and humus cover), the district silviculturist and district fire management officer would coordinate prescribed burn planning (timing, conditions, etc.), such that high fire severity, if it occurs at all, would occur on 2% or less of the stand area.

8. To minimize mass wasting potential, bench cut skid trails on Brevard soils would be avoided. On slopes greater than 30%, primary skid trails perpendicular to the slope on Brevard soils would not be constructed.

BIOLOGICAL (NNIS, Sensitive or Endangered plants, Rare Plant Communities)

9. To mitigate spread of non-native invasive species (NNIS):

    a. Only native and/or desirable non-native forbs and grasses would be used for erosion control measures when seeding temporary roads, log landings and in road maintenance activities. Forest Botanist and Forest Soil Scientist would be consulted on the planting mix.

    b. All materials (plant materials, mulch, gravel) brought on site would be from weed-free sources when such sources are available and economically comparable to other sources.

    c. Non-native invasive plant species treatments (autumn olive, Chinese privet, and mimosa) would be scheduled prior to loblolly pine removal treatments for the following loblolly and NNIS treatment stands:

        1. C.15, St.19 and C.16, St.4 and 27. (sun-facing coneflower habitat),
        2. C.39, St.7 and St.20 (smooth coneflower habitat) and
        3. C.65, St.23 (smooth coneflower habitat).

10. To prevent unnecessary removal of rare community plant species, tree planting, log deck placement, and road construction would not occur inside rare community inclusions that are located within the following stands:

    a. C.36, St.1 – Post oak savannah habitat – western portion of stand
    b. C.65, St.27 – Smooth coneflower habitat also contains wild quinine, yucca-leaved snakeroot and blackjack oak.

11. Coordinate all ground-disturbing activities (including the placement of log landings, loading areas, skid trails, access roads) and all reforestation and herbicide operations with Sumter National Forest biological staff to avoid sensitive plant species in the following treatment stands:
    a. Compartment 16, stands 4A, 4B, and 27 – sun-facing coneflower;
    b. Compartment 41, stand 12 – ashleaf goldenbanner, piedmont strawberry, whorled horsebalm;
    c. Compartment 50, stand 2 – whorled horsebalm;
    d. Compartment 55, stand 7 – piedmont strawberry;
    e. Compartment 56, stand 91 – whorled horsebalm; and
    f. Compartment 58, stand 12 – whorled horsebalm.

12. In compartment 39, stand 20, the distribution of smooth coneflower shall be identified by Sumter National Forest biological staff prior to project implementation. The following protective measures shall be followed:
    a. Avoid the use of heavy equipment to harvest trees within smooth coneflower areas (in coneflower areas, overstory trees may be felled using hand tools as long as trees are not felled directly on coneflower plants);
    b. Any herbicide operation within a smooth coneflower area shall be supervised by Sumter National Forest biological staff;
    c. Avoid placing log decks, skid trails, temporary roads, or reconstructed roads within smooth coneflower areas, and avoid skidding trees through coneflower areas (trees may be skidded out of coneflower areas as long as damage does not occur to coneflower);
    d. Avoid reforestation operations within smooth coneflower areas.

13. In compartment 41, stand 12; compartment 53, stand 5; and compartment 65, stand 27 the distribution of smooth coneflower shall be identified by Sumter National Forest biological staff prior to implementation. The following protective measures shall be followed:
    a. Avoid the use of heavy equipment to control woody vegetation within smooth coneflower areas (in coneflower areas, overstory trees may be felled using hand tools as long as trees are not felled directly on coneflower plants, and hand tools may be used to control mid- and understory woody vegetation);
    b. Any herbicide operation within a smooth coneflower area shall be supervised by Sumter National Forest biological staff;
    c. Avoid placing log decks, skid trails, temporary roads, or reconstructed roads within smooth coneflower areas, and avoid skidding trees through coneflower areas.

SOCIAL (Recreation, Scenery)

The following mitigation measures apply to specific compartment/stands, roads, and the Chauga Scenic Area identified in Table 2.4-1.

14. As practicable, to maintain naturally appearing landscape character, openings and stand boundaries would be organically shaped. Straight lines and geometric shapes would not be used and unit edges would be shaped and/or feathered. Openings would be oriented to contours and existing vegetation patterns blended with existing landscape characteristics, as appropriate.

15. As practicable, the contrasting edge of roads would be blended so that they remain subordinate to the existing landscape character in size, form, line, color and texture.

16. To minimize bare mineral soil being seen from roads, disturbed road cut and fill slopes would be re-vegetated to the extent possible.

17. To reduce visual impact and duration of the disturbed appearance, slash would be lopped (cut down or cut into pieces) to within an average of two feet of the ground when visible within the immediate foreground viewshed (approximately 300 feet).

18. To minimize bare mineral soil being seen from roads, log landings, temporary roads and main skid trails would be located outside the immediate foreground viewshed where practicable. If these features must be located in the immediate foreground viewshed, bare mineral soil would be re-vegetated or covered with slash as soon as possible following logging operations.

19. To maintain a natural appearance, leave tree marking and unit boundary marking paint would be applied so as to not be visible within 50 feet of the roads listed in Table 2.4-1.

20. As practicable, treatment areas with more than 40 acres visible to the roads listed in table 2.4-1 would be broken up temporally (at least 2 years apart) or spatially (at least 1,000 feet apart) to avoid large contiguous visible areas of vegetation disturbance along roads specified in Table 2.4-1.

21. The Rocky Gap Horse Trail would be cleared of downed trees and slash.

22. Logging operations in stands adjacent to the Rocky Gap Horse Trail would be limited to weekdays to reduce conflicts with recreation users.

23. Coordinate with District recreation staff and post advance notices when the Rocky Gap Horse Trail is to be closed during logging operations.

24. Rocky Gap Horse Trail would not be increased in width or straightened. Character trees/blaze trees (with the exception of loblolly pine) that define the trail corridor would not be cut unless to mitigate safety concerns.

25. Consultation with the forest landscape architect would be needed on unit boundary layout and silviculture prescription development for treatments within 300 feet of the Chauga River.

Table 2.4-1 Scenery Mitigation Measures Common to the Action Alternatives

Compt.	Std.	Alt2_Treat	Alt3_Treat	Mitigation Number	Road / Trail Area
28	30	Cut & Leave	Cut & Leave	14-17, 20	SR-290
28	31	Cut & Leave	Cut & Leave	14-17, 20	SR-290
28	38	Cut & Leave	Cut & Leave	14-17, 20	SR-290
28	42	Cut & Leave	Cut & Leave	14-17, 20	SR-290
30	06	Cut & Leave	Cut & Leave	14-17, 20	SR-196
30	26	Cut & Remove	Cut & Remove	14-19	SR-196

30	34	Cut & Leave	Cut & Leave	14-17, 20	Chauga Scenic Area (CSA)
32	08	Cut & Leave	Cut & Leave	14-17, 21-24	Rocky Gap Trail
32	17	Cut & Remove	Cut & Remove	14-19	SR-196,FS-721,FS-757
32	26	Cut & Leave	Cut & Leave	14-17, 21-24	Rocky Gap Trail
33	04	Cut & Leave	Cut & Leave	14-17	FS-757
36	26	Cut & Remove	Cut & Remove	14-19	SR-290
36	37	Cut & Remove	Cut & Remove	14-19	SR-290
37	24	Cut & Leave	Cut & Leave	14-17, 20	SR-290
37	46	Cut & Remove	Cut & Remove	14-20	CSA
37	64	Cut & Remove	Cut & Remove	14-20	SR-290
38	09	Cut & Remove	Cut & Remove	14-20	SR-290
42	23	Cut & Remove	Cut & Remove	14-20	SR-290
45	01	Cut & Remove	Cut & Remove	14-20	SR-290
45	27	Cut & Leave	Cut & Leave	14-17, 20	SR-290
46	26	Cut & Remove	Cut & Remove	14-19	FS-757
48	05	Cut & Remove	Cut & Remove	14-19	FS-755
48	01	Cut & Remove	Cut & Remove	14-19	FS-757
49	09	Cut & Remove	Cut & Remove	14-19	FS-755
49	32	Cut & Remove	Cut & Remove	14-19	FS-755
49	33	Cut & Remove	Cut & Remove	14-19	FS-755
55	07	Cut & Leave	Cut & Leave	14-17, 20	CSA
55	13	Cut & Leave	Cut & Leave	14-17, 20	CSA
55	14	Cut & Leave	Cut & Leave	14-17, 20	CSA
55	17	Cut & Leave	Cut & Leave	14-17, 20	CSA
55	18	Cut & Leave	Cut & Leave	14-17, 20	CSA
55	19	Cut & Leave	Cut & Leave	14-17, 20	CSA
56	03	Cut & Remove	Woodland Cut & Remove	14-20	CSA,FS-748
56	23	Cut & Remove	Cut & Remove	14-19	FS-748
56	32	Cut & Remove	Cut & Remove	14-19	FS-748
56	38	Cut & Remove	Woodland Cut & Remove	14-19	FS-748
56	39	Cut & Remove	Cut & Remove	14-19	FS-748
56	43	Cut & Remove	Cut & Remove	14-19	FS-748
56	44	Cut & Remove	Cut & Remove	14-19	FS-748
56	91	Cut & Remove	Woodland Cut & Remove	14-19	FS-748
57	03	Cut & Remove	Cut & Remove	14-19	FS-748
57	15	Cut & Remove	Cut & Remove	14-20	US-76
48	06	Cut & Remove	Cut & Remove	14-19	FS-755

2.5 Monitoring of Project Activities

The following monitoring activities are to ensure that project activities are implemented consistent with Forest Plan standards and site-specific mitigation measures.

Forest Monitoring Plan

The Monitoring Plan contained in the Land and Resource Management Plan will be applied to this project. This monitoring plan contains implementation and effectiveness monitoring elements that is multi-disciplinary in nature. Additional project monitoring activities specific to this EIS are described below.

Timber Harvest/Contract Requirements

Timber contract provisions would incorporate all applicable mitigation measures. Contract provisions would be enforced on the ground. Timber sale preparation and administration activities, along with applicable mitigation measures for each stand, would be tracked using cutting unit cards.

Responsibility: District Timber Management Assistant, District Presale Forestry Technician, District Timber Sale Administrator

Vegetation/Reforestation

1) Reforestation – for sites that would be planted, 1 and 3-year seedling survival surveys would be conducted to ensure adequate stocking of regeneration (FSM 2496.11). For sites with prescribed natural regeneration, 1 and 3-year stocking surveys would be conducted to evaluate success of natural regeneration.

2) Periodic forest inventory (stand exam) – Forest inventory plots would continue to be measured according to common stand exam (CSE) protocol to track changes in species composition and forest structure. Key inventory variables include stocking per acre by species, size, and crown class (canopy position), mortality, age, and stand condition. Disturbance activity data would also be recorded.

3) Pre and post-treatment inventory - for all *action alternatives* for forest and woodland treatments, a walk-through inventory with photo points would be conducted prior to treatment, one year after harvest, and five years following harvest to evaluate changes to species composition and forest structure. Disturbance activity would also be recorded.

4) Forest inventory data would be compared to ecological zone potential natural vegetation data to see how well existing vegetation species composition and forest structure match the NRV.

Responsibility: District Silviculturist / Forest Botanist / Wildlife Biologist

Wildlife/PETS/NNIS

Non-native invasive species treatments would be monitored in: compartment 15, stand 19; compartment 16, stands 4 and 27; compartment 39, stands 7 and 20; and in compartment 65 stand 23 to determine if treatments were effective in improving habitat conditions for sun-facing coneflower and smooth coneflower. Monitoring would include recommendations for re-treatment if deemed necessary to improve habitat for these plants.
Herbicide Treatments including NNIS: Effectiveness of herbicide treatments would be monitored in a subset of stands receiving herbicide treatments. A general walk through of non-native invasive species treatments in Compartments 15, 16, 39, and 65 would occur the year following treatment. Retreatment would occur as needed.

Responsibility: Forest Botanist / Wildlife Biologist

Soils

Prior to prescribed burning activities, the district fire management officer, district silviculturist and/or forest soils scientist would monitor fuel loading, fuel moisture and the Keetch-Byram Drought Index (KBDI) in treatment stands so that prescribed burning activities would minimize adverse impacts on soil productivity.

The amount of litter or duff layer remaining after a prescribed burn would be monitored to determine if physical or chemical properties of soils have been altered. High fire severity should not exceed two percent of the treatment stand consistent with effects described in the *Final Environmental Impact Statement for the Revised Land and Resource Management Plan, Sumter National Forest*.

Responsibility: District Fire Management Officer, District Silviculturist, Forest Soil Scientist

2.6 Comparison of Alternatives

This section compares alternatives. Information in the table is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 2.6-1. Project Purpose and Need Indicators and Outputs, Summary Comparison of Alternatives.

	Alternative 1	Alternative 2	Alternative 3
FORESTLAND Regeneration Cut with reserves – Cut & Remove (Acres)	0	3,566	3,172
FORESTLAND Regeneration Cut with reserves – Cut & Leave (Acres)	0	1,774	1,587
WOODLAND Cut & Remove (Acres)	0	75	413
WOODLAND Cut & Leave (Acres)	0	126	371
Herbicide Site Prep and/or Release (Acres)	0	3,421	5,542
Reforestation by Planting	0	3,061	2,833
Connected Actions 1. System Road Construction (miles).	0	6.5	0
2. System Road Reconstruction and Maintenance (miles)	0	60	60
3. Temporary Roads	0	21.7	24.9

Table 2.6-2 Comparison of Acres Proposed for Treatment in Sixth Level Watersheds by Alternative

Name	Alternative 1	Alternative 2	Alternative 3
Flat Shoals River	0	387	387
Oconee Creek	0	42	42
Upper Coneross Creek	0	56	56
Middle Chattooga River	0	735	735
Lower Chattooga River	0	433	433
Upper Chauga River	0	499	499
Middle Chauga River	0	2,080	2,080
Toxaway Creek	0	174	174
Lower Chauga River	0	883	883
Upper Tugaloo River	0	252	252
Total	**0**	**5,542**	**5,542**

Table 2.6-3 Comparison of Sixth Level Watershed Sediment Impacts by Alternative

Name	Acres	Alt. 1 Sediment (tons)	Alt. 2 Sediment (tons)	Alt. 3 Sediment (tons)	Alt. 2 Percent Increase in Sediment (decade)	Alt. 3 Percent Increase in Sediment (decade)	Alt. 1 Mean Sediment Conct. Decade (ppm)	Alt. 2 Mean Sediment Conct. Decade (ppm)	Alt. 3 Mean Sediment Conct. Decade (ppm)
Flat Shoals River	21,604	63,887	64,377	64,449	0.8	0.9	59.1	59.6	59.7
Oconee Creek	9,987	45,347	45,347	45,347	0.0	0.0	90.8	90.8	90.8
Upper Coneross Creek	11,308	61,369	61,477	61,468	0.2	0.2	108.5	108.7	108.7
Middle Chattooga River	28,248	92,926	93,929	93,615	1.1	0.7	65.8	66.5	66.3
Lower Chattooga River	20,231	74,193	75,314	75,082	1.5	1.2	73.3	74.5	74.2
Upper Chauga River	16,514	56,446	57,262	57,120	1.4	1.2	68.4	69.3	69.2
Middle Chauga River	16,109	31,842	34,197	33,880	7.4	6.4	39.5	42.5	42.1
Toxaway Creek	13,963	51,257	51,443	51,513	0.4	0.5	73.4	73.7	73.8
Lower Chauga River	24,190	98,367	99,756	99,493	1.4	1.1	81.3	82.5	82.3
Upper Tugaloo River	43527	191,020	191,312	191,289	0.2	0.1	87.8	87.9	87.9
Total	205,681								

Table 2.6-4 Summary of 3rd and 4th order DBRUs Relative to Sediment

DBRU	Average Sediment (tons per acre per year over the decade)								
	Alternative 1			Alternative 2			Alternative 3		
	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum
4th Order	.04	.22	.52	.05	.24	.52	.05	.24	.52
3rd Order	.03	.20	.58	.03	.23	.59	.03	.23	.59
Sediment Increase (percent over decade)									
	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum
4th Order	na	na	na	0	10.4	66.5	0	8.9	66.5
3rd Order	na	na	na	0	10.7	225	0	9.1	335.5
Sediment Concentration (ppm-parts per million)									
	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum
4th Order	8.2	45.0	103.9	10.5	48.4	103.9	10.5	48.0	104
3rd Order	5.3	40.6	115.4	5.3	46.5	117.5	5.4	45.9	117.3

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Physical Environment

3.1.1 Soils

Affected Environment

The physical character of the project area is greatly influenced by the geology associated with the Blue Ridge physiographic province. Most of the soils within the analysis area formed in residuum that weathered from igneous or metamorphic rock. Two soil types that are found within the analysis area formed in colluviums and alluvium. The diverse parent material along with other factors such as aspect, topography, climate and vegetation has resulted in a wide range of soil types within the project area.

Upland soils that are well drained and have moderate permeability most frequently occur within the analysis area. However, the depth to bed rock may vary greatly depending on landscape position and past events such as landslides. Seeps and springs may occur in soil types that are found on benches, foot slopes, toe slopes, colluvial fans and coves.

Most soils within the analysis area have a moderate to severe risk of erosion due to the textures and slope. Brevard soils are subject to slippage and slumping due to steep slopes and low strength. Slopes range from 5% to 50% with some areas exceeding 50 %. The topography is moderately dissected by drainages and streams.

Soils within the project stands have undergone intensive management in the past and have remained stable and productive. However, the soil types found within the project stands have limitations that should be considered before ground disturbing activities take place. Soil compaction, rutting, displacement and erosion are the key factors that affect soil productivity. The soils found within the project stands range from no erosion to only slightly eroded. The surface textures are loam and fine sandy loam. Surface horizons have a moist soil consistence that is very friable to friable. These characteristics allow for good root penetration and nutrient uptake. The subsurface textures are sandy loam, sandy clay loam, clay loam and clay with a consistence of friable to firm. Common soil series found within project stands include Evard, Hayesville and Walhalla (Herren, Hurt, and Law 1985 Soil Survey of Sumter National Forest Area Oconee County, South Carolina).

Soil series percentages in the proposed treatment stands include Evard (75%), Hayesville (11%), Walhalla (8%), and Edneytown (1%). Brevard, Saluda, and Toccoa soil series are also found in the treatment area but at low percentages, about (5 % combined).

Treatment areas vary widely in conditions related to stocking densities of loblolly pine. Some stands such as 16/04 are nearly pure loblolly, which would require more trafficking of equipment across the area. Soil disturbance in these stands would be more extensive. Stands such as 36/01

had been impacted by Southern pine beetle or past timbers sales and have minimal loblolly that needs to be removed. In these stands the soil disturbance pattern would be inconsistent across the stand which minimizes overall soil impacts. In general, the effects to soils from the proposed treatments would vary depending on the current condition of specific stands.

Direct and Indirect Effects of Alternative 1

Soil disturbance would not occur from proposed activities. Current rates of soil building and erosion would continue. In general, the area has no severe chronic hill slope erosion problems.

Cumulative Effects of Alternative 1

Alternative 1 does not propose any new ground disturbance. Effects to soils generally occur because of ground disturbing activities. Cumulative effects from past and present activities generally result in a localized loss in soil productivity due to compaction, rutting, and/or soil displacement. However, soil erosion may also occur which may contribute to sedimentation. Activities, on national forest system lands, that are reasonably foreseeable would be implemented under the standards for protecting soils listed in the *Revised Land and Resource Management Plan, Sumter National Forest* [USDA Forest Service 2004a, (Forest Plan)]; therefore, cumulative effects from these actions are minimal. Activities on private lands will be site specific to those lands and no cumulative effects would occur to the soil resource from those actions.

Refer to Appendix B for current erosion rates for current land management practices.

Direct and Indirect Effects of Alternative 2

Timber Harvesting (Cut and Remove Treatments)

Timber harvesting involves various types and intensities of ground disturbing activities that can potentially affect the soil resource. Erosion hazard and steepness of slope are the primary soil concerns that could limit management activities. Soil concerns associated with logging and other connected actions center around rutting, soil compaction, displacement/erosion and soil exposure. Soil disturbance and compaction during timber harvest vary depending upon both the type of soil and harvest method (Swank and others 1989). Timber harvesting can directly affect the physical, chemical and biological properties of the soil (Swank and others 1989). Effects from this action may include immediate changes in soil and/or organic matter displacement, water infiltration rates and soil compaction.

Loss of organic matter can result in disruption to nutrient recycling in the soil and reduced nutrient availability for trees and other plants. Nutrient removal varies with the intensity of the activities and degree those organic materials are removed.
Nutrients are removed through harvested wood. The degree in which nutrients are removed greatly depends on the harvesting method and type of material removed. Impacts on soil productivity from nutrient removal is site specific and is complex in nature due to a wide range

of soil-vegetation types and rates of nutrient replacement from the atmosphere and from soil weathering (Swank and others 1989). In general, since most nutrients in trees are held in the leaves, twigs, and branches a loss in soil productivity is usually not a concern unless there is complete utilization of wood fiber and rotations are short. Studies in eastern hardwoods indicate that conventional clearcut harvest with only sawlog removal is usually not a serious threat to soil nutrient depletion (Swank and others 1989). However, a study in the piedmont of South Carolina has also shown that even conventional harvesting had an adverse impact on P, K and Ca status of the ecosystem (Van Lear and others 1983).

Commercial harvest under the action alternatives would remove mostly off-site loblolly pine. Limbs, tops and un-merchantable material would be left on-site to decompose and would contribute to the nutrient cycle. Native pines and hardwoods including but not limited to desirable oaks and hickory would be left as components of stands to be maintained for the long term. These trees would contribute nutrients to the forest floor through leaf-fall / needle cast.

Compaction can limit root growth and development in the soil, decreasing tree growth (Swank and others 1989) and increase risk for blow down or tree stress. Water infiltration rates may be reduced due to compacted soils. Soil rutting and erosion can reduce soil productivity and result in permanent loss of soil.

Where soil compaction is severe and unmitigated, soil productivity would be reduced due to loss of soil structure. Compaction is most likely to occur on those areas where heavy equipment operates repeatedly, especially when soils are wet. Areas subject to compaction include skid trails, temporary roads and log landings. While subject to many variables, it is estimated that about 10% of a given area harvested by conventional logging equipment (rubber tired skidders/forwarder) is impacted by skid trails, temporary roads and log landings.

The potential effects of soil erosion, sediment yield, and compaction have a spatial and temporal context. The amount produced depends upon the topographic, soil and climatic characteristics of the affected area along with the intensity of management practices being implemented. Erosion that results from timber harvest would be greatly modified through time in that disturbance would be temporary and generally a single pulse over a long period of time. Research has repeatedly shown that sediment production during timber harvest may accelerate temporarily to about 0.05 to 0.50 tons per acre per year (Patric 1976 and 1994). Any given area to be disturbed by regeneration harvest would be cut and site prepared within a year's time. After this other than prescribe burning, it is unlikely the area would be disturbed (barring natural disturbance) for at least 10 years.

There are approximately 376 acres of cut and remove proposed in stands that have areas with slopes exceeding forty percent. Directional felling and cable yarding or winching with at least partial suspension would be used on slopes greater than 40%. Effects to soils would to be minimal using these methods of harvest. Stands with these areas are disclosed in the project file. All proposed units have been harvested in the past and they have existing skid trails and landings. The number of existing miles of skid trails has been estimated at about 0.15 miles per acre. Some of these skid trails served as temporary road access for log trucks to the harvest units. These skid trails and landings would be used again as practicable and where resource damage isn't a concern. Skid trails would be closed, water-barred, limed, fertilized and planted if needed to reduce erosion potential after sale activities are completed.

Impacts from timber harvest on soil loss, sediment yield and compaction would return to precutting conditions within two to five years. If any areas suffer severe compaction, however, the effects of the compaction could last much longer. Severe compaction would be reduced by using soil ripping techniques and disking. This aids in revegetation of the areas, improves water infiltration and reduces erosion potential. Impacts to soils would be reduced by following existing Forest Plan standards and implementing *South Carolina's Best Management Practices for Forestry* (BMPs). Refer to Appendix B for erosion rates for proposed activities.

Approximately 40 acres within the project consist of the Brevard soil series. These soil types developed in colluvium material which is susceptible to slippage and slumpage when disturbed. Extra caution should be used when disturbing these soils. This soil type occurs as small inclusions in harvest unit that's identified in the project file. Mitigation measures would include adequate drainage such as out sloping, cross drains, and/or rolling dips when building skid trails and/or temporary roads on these soil types.

Timber Cutting Without Harvest (Cut and Leave)

Activities associated with this type of treatment include cutting trees with hand tools and chainsaws. These activities would have no effect on the soil resource because soils would not be disturbed.

Cut vegetation would decay on soil surface over time and nutrients would be released back into the soil. Soil organic matter would increase from these treatments. Overall, the percent increase is expected to be minimal.

Indirect effects occur with time such as accelerated weathering of the soil, increased erosion and accumulation of soil in depressional areas, nutrient leaching and alteration of organic matter formation.

Woodland Treatments

Stands proposed for woodlands management would be thinned to a low basal area and potentially would undergo up to three different treatments such as mechanical vegetation control, herbicide treatments and burning at a regular interval. These activities would occur on 3.8 percent of the treatment area for Alternative 2.

The proposed treatments associated with woodland creation would involve activities that can affect the soil resource. Impacts from timber harvest operations are covered under the Timber Harvesting section. Disturbance from mechanical vegetation control would be similar to that of logging operations in terms of rutting, soil compaction, displacement/erosion and soil exposure. However, vegetation material from mechanical vegetation control such as mowers and/or gyro-track equipment would not be removed from the site. This vegetation material would decay on the soil surface over time and nutrients would be released back into the soil. Soil organic matter would increase to some degree from these treatments. The overall percent increase is expected to be minimal. Impacts to soils from herbicide application are covered under the Herbicide section.

Manual Vegetation Control

Methods associated with these treatments would have limited effects on the soil resource. There would be no soil disturbance when using hand tools such as chainsaws and/or brush saws. Cut vegetation would decay on soil surface over time and nutrients would be released back in to the soil. Soil organic matter would increase from these treatments. Overall, the percent increase is expected to be minimal.

Herbicides (Cut-Surface and Foliar Spraying)

Herbicide site preparation and release treatments would have minimal effects on the soil resources due, in part, to the application methods. Herbicide would be manually applied as foliar spray from backpack pumps, by stem injection, or from squirt bottles applied directly to cut surfaces. Minimal amounts of herbicide would come in contact with the soil as most are targeted for application on the leaf surface or directed at the stem. These application methods do not require disturbance to the soil litter or duff layer and therefore, erosion is not a concern.

Triclopyr would be applied by direct foliar application, stem injection or cut-surface treatments. Only the individual plant requiring treatment would be targeted. The herbicide is absorbed through foliage or the bark and is readily moved throughout the plant. Triclopyr is not highly mobile in the soil, and is not a leaching problem under normal conditions since it binds to clay and organic matter in the soil. It may leach from sandy soils if rainfall is heavy after application. The herbicide is broken down by soil microorganisms and ultraviolet light, and persists for 30 to 90 days (46 day average) in the soil depending on soil type and weather (Extoxnet Fact Sheet, 1996). The risk characterization for aquatic organisms differs for triclopyr TEA (Garlon 3A or equivalent) and triclopyr BEE (Garlon 4 or equivalent). For triclopyr TEA (triethylamine salt), risks to aquatic species are low over the entire range of application rates that may be used in Forest Service programs (SERA, 2011). Although triclopyr BEE is much more toxic to aquatic species than triclopyr TEA, or triclopyr acid, the projected levels of exposure are much less even for acute scenarios because of the rapid hydrolysis of triclopyr BEE to triclopyr acid, as well as, the lesser runoff of triclopyr BEE because of its lower water solubility and higher affinity for soils (SERA, 2011). Nonetheless, triclopyr BEE is projected to be somewhat more hazardous when used near bodies of water where runoff to open water may occur (SERA, 2011). For triclopyr TEA, at an application rate of one pound per acre acute and chronic risks to aquatic animals, fish or invertebrates, as well as risk to aquatic plants are low (SERA, 2011). The risk of chronic exposure of triclopyr BEE to aquatic species is essentially the same as triclopyr TEA since it rapidly hydrolyzes to triclopyr acid. Specific formulations of triclopyr are registered and labeled for aquatic use and these could be used on selective sites where non-native invasive plants need to be controlled close to water.

The binding of Imazapyr to soil is very complex depending on soil texture, pH, presence of iron oxides, organic carbon, aeration, soil depth, and soil moisture. In general Imazapyr does not bind strongly with soil particles and can be persistent in soils. The most influential factor in the persistence of imazapyr in soil, however, appears to be microbial activity. Imazapyr is chemically stable in soil, and microbial breakdown along with dispersal by mechanisms such as percolation and runoff, will be the primary ways that Imazapyr decreases in soil over time. The

half-life of imazapyr in soils usually ranges between one to seven months (American Cyanamid 1986). There does not appear to be any basis for asserting that imazapyr is likely to adversely affect microorganisms in soil (SERA, 201 pages 4-26).

In stands with channeled ephemeral streams, Cide-Kick or equivalent would be used as an adjuvant with triclopyr ester formulations (Garlon 4 or equivalent). The main ingredient is d-limonene which is a derivative of plant oils, particularly lemon, orange, caraway, dill and bergamot. It is insoluble in water; hence these surfactants add a water soluble compound (nonylphenol ethoxylate) to allow for dispersion in water-based mixtures (Bakke). The U.S. EPA is responsible for the regulation of inerts and adjuvants in pesticide formulations. As implemented, these regulations affect only pesticide labeling and testing requirements (SERA 2011). According to the Code of Federal Regulations 180.910 d-limonene is exempt from the requirement of a tolerance when used in accordance with good agricultural practice. This means that the EPA has examined the possible environmental and health impacts of using d-limonene as a carrier in pesticides and found that no risks exist for this usage. This allows d-limonene to be used in pesticide formulations at any level without having to meet any residue tolerances requirements.

Tree Planting

There would be minimal to no effects on the soil resource from tree planting activities.

Roads

Some soil types within the analysis area are better suited for road building. Proper location of roads would reduce the risk of road failure.

During road construction and reconstruction activities, soil may be displaced and exposed. Soil movement would occur, however, measures designed to stabilize the road surface, such as adding aggregate surfacing by armoring the soil or limiting distance and amount of concentrated flow by installing water diversion devices (dips, reverse grades, out slopes, leadoff ditches, and culverts) would reduce adverse effects. The detachment and distance soil particles move would be reduced by limiting water concentration and movement on disturbed surfaces and/or fill materials.

Temporary roads used for harvest operations contribute to erosion and sediment in the short term (up to 3 years), but the effects to soil and water can be mitigated to a great extent with effective erosion control measures. Closing temporary roads after use allows the soil building process to begin on the road surface. As soils develop vegetative growth enhances. This process allows closed roads to recover to a more natural state over time.

Approximately 40 acres within this project area consist of the Brevard soil series. These soil types developed in colluvium material which is susceptible to slippage and slumpage when disturbed. Extra caution should be used when disturbing these soils. Data analysis shows that there are no temporary or system road segments that cross Brevard soil map units. However, there could be small inclusions of Brevard soils within other soil map units and if these soils are

found to be present proper mitigation would be used to mitigate effects should they occur. Adequate road drainage such as out sloping, cross drains, and/or rolling dips is important when building roads on these soil types. Most of the temporary roads would reuse a path that has been cut into the landscape at a previous time. Therefore, the probability of intersecting Brevard soils that are problematic with temporary road construction is low. There is a more increased risk of new system road construction to intersect small inclusions of Brevard soils. Proper mitigation would alleviate issues with disturbing these soils should this occur.

Cumulative Effects of Alternative 2

Over the last 10 years timber harvesting and periodic prescribed burns have been implemented in portions of the analysis areas. Cumulative impacts on soil conditions relative to compaction, displacement and subsequent erosion from these activities and connected actions are considered minimal for the majority of areas.

Impacts on soils resulting from timber harvests normally recover before a new cycle of harvesting begins, and as a result, cumulative impacts relative to compaction and displacement from successive harvesting operations would be expected to be minimal for the majority of harvested areas. Approximately, 1,000 acres of the analysis area has been harvested within the last 5 years. Of this recently harvested area, cut and leave treatments would be implemented on 938 acres to cut out loblolly pine regeneration. Cut and leave treatments would have minimal cumulative impacts to soils in those stands because no equipment would be used and recovery from the last entry would continue. Cut and remove treatments would occur on 90 acres which have had some type of harvesting activities within the last 5 years. Recovery from past harvesting activities would be interrupted by reentering into these stands. Specific compartments and stands are listed in the project file. Areas that are repeatedly used for logging decks and skid trails in stands that have frequent entries have the potential to suffer more continuous periods of decreased soil productivity and decreased water infiltration. Although rehabilitation of these sites decreases the duration of the recovery period for soils and lessens the potential for cumulative degradation of soil conditions across the area, the re-opening and use of these areas during successive harvest operations generally results in some decreased soil quality on these sites. Estimates of existing skid trail density are about 1.5 miles per 10 acres of harvest unit. These areas are a small fraction of the project area.

Prescribed burning activities have been implemented on approximately 1,480 acres of the analysis area. Cumulative impacts on soil conditions from past prescribed burning is considered minimal for the majority of areas burned, as soil recovery takes less than a year for most burned areas (USDA, 1989b). Severely burned areas require a longer recovery time as soil productivity is decreased and erosion potential is increased. Generally, prescribed burning when done under the proper conditions to promote nutrient cycling and increase growth of vegetative cover (USDA, 1989a; Clinton and others 1996).

In these areas, there is potential to reduce soil productivity over time by removing surface organic matter if there are not enough fuels (grasses) above the organic layer to carry fire. When surface organic matter is removed, water infiltration rates decrease, which increases overland flow and erosion potential. Due to more sunlight reaching the forest floor and burning these sites

would also become more xeric than at the present. Exposing the soil surface to more sunlight increases organic matter decomposition rates. Loss of surface organic matter also decreases moisture retention in soils. Grasses and forbs are expected to establish in the newly thinned and burned areas. However, it is unknown if the resulting flush of grasses would balance these effects.

Fuel loading after treatment in cut-and-leave and cut-and-remove stands are expected to be quite variable based on past southern pine beetle activity. In some cases, most of the overstory pine was killed and the woody material has decomposed and does not pose much of a risk during prescribed burning activities. In contrast, some stands would have heavy fuel loadings after the pine is cut – especially in the cut and leave treatment stands. Fuel loadings are expected to be similar to those depicted as activity fuels SB1 – SB3 in *Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model*. The potential for fire severity increases as fuel loading increases. With mitigation and monitoring, the potential for adverse impacts such as high soil heating or deep ground char is reduced. Monitoring would look at the amount of litter or duff layer remaining after a burn to determine if physical or chemical properties of soils have been altered. Prior to prescribed burning activities, the district fire management officer, district silviculturist and/or forest soils scientist would monitor fuel loading, fuel moisture and the Keetch-Byram Drought Index (KBDI) in treatment stands so that prescribed burning activities would minimize adverse impacts on soil productivity. High fire severity should not exceed two percent of the treatment stand consistent with effects described in the *Final Environmental Impact Statement for the Revised Land and Resource Management Plan, Sumter National Forest*. To reduce the potential adverse impacts on soil productivity, the district silviculturist and district fire management officer would coordinate the timing of the prescribed burn to minimize the potential for high fire severity in treatment stands. Scheduling stand treatments immediately after prescribed burning is completed would allow sufficient time for down woody material to decompose before the next scheduled prescribed burn. Implementation of this mitigation measure would reduce the potential for severe impacts to soil litter and duff layers and physical and chemical soil properties.

Burning in areas where there has been previous soil disturbance, such as skidding of logs, increases the probability of soil erosion after burning (Swift et al. 1993). Burning after harvesting is completed can be of high intensity and severity because of the increased amount of woody fuels present. There are approximately 750 acres that would be harvested under this decision that occur in burn blocks with a regular burn interval. Cumulative impacts to soils would be minimal by following mitigation measures. Refer to the project file for specific compartments and stands.

Approximately 730 acres of cut and leave stands occur within prescribe burning units. There is a potential to impact soils within these stands depending on the amount of activity fuel generated from the cut and leave treatments and conditions when these areas are burned. These stands are listed in the project file and mitigation measures would be followed to prevent soil resource damage. Effects to the organic layers and soil organisms depend greatly on heat penetration into the soil. Heat penetration depends upon duration of heating and soil moisture (Swift et al. 1993). Care must be taken to avoid burning areas too hot, affecting soil properties, nutrients, and organisms that may lead to loss in soil productivity. If burns consume the entire forest floor severe erosion and nutrient loss may result. These negative consequences can generally be

prevented if burning is done when the lower layers of the forest floor and root mat are damp (Van Lear 2004).

New permanent system road construction would reduce soil productivity within the road prism and erosion would increase from the roads and ditches. Effects from establishing a new road system would reduce over time but would not return to present erosion rates unless the road was obliterated in the future. These roads would become part of the regular maintenance schedule for roads and effects within the foreseeable future are the same as the effects that occur from the current maintenance of roads.

Soil productivity would be decreased in the locations of temporary roads. These areas would become disturbed and compacted over the time they are used. Obliteration and rehabilitation of these roads after use would quicken the recovery of these roads. Over time the area where the road is located would grow vegetation and become stable. Analysis shows that no roads are proposed to be located on Brevard soils. However, small inclusions of these soils may exist on the landscape if these areas are encountered proper mitigation would be needed to stabilize these soils. No long term effects are expected as long as mitigation measures are used in problematic areas.

Other activities on national forest system lands within the proposed treatment areas include a variety of maintenance measures. For roads and rights-of-way, activities are performed to ensure the safety of the public and to prevent degradation of infrastructure and the environment. Road maintenance operations such as blading the road surface and pulling the ditches can lead to increases in soil erosion and increases in sediment production. However, these operations may be combined with structural improvements and improvements to drainage structures which reduce soil erosion and sediment production from the road surfaces over the long term.

Implementation of Alternative 2 considered together with past and reasonably foreseeable future activities is not expected to have a cumulative effect on the soil resource. Project design and/or mitigation that would be used during project implementation are the primary factors leading to this determination.

Direct and Indirect Effects of Alternative 3

Timber Harvesting (Cut and Remove Treatments)

There would be approximately 395 acres less of this type of treatment under this alternative when compared to alternative 2. Soil disturbance from timber harvesting would be reduced but would not be measurably different than those effects already disclosed for alternative 2.

Timber Cutting Without Harvest (Cut and Leave)

There would be 157 acres more of this treatment type under this alternative than alternative 2. The effects described for alternative 2 are not measurably different from this alternative since there is very little soil disturbance associated with cut and leave treatments.

Woodland Treatments

Stands proposed for woodlands management would be thinned to a low basal area and potentially would undergo up to three different treatments: mechanical vegetation control, herbicide treatments and burning at a regular interval. These activities would occur on 14.6 percent of the project area.

Impacts from activities associated with converting areas from non-woodland to woodlands are the same for this alterative as alternative 2. However, the extent of effects would be greater because there are 581 more acres of woodlands being proposed under this alternative. This is a 10.8 percent increase in area in woodland habitat over alternative 2.

Manual Vegetation Control

These types of treatments would be the same under alternative 3 as they are in alternative 2. Therefore, the effects of these treatment types are the same under this alternative.

Herbicides (Direct Injection and Foliar Spraying)

The same types of herbicides and treatments would be used under this alternative as in alternative 2. Effects to soils from herbicide and associated treatments are covered under alternative 2.

Tree Planting

Effects to soils from tree planting are the same under this alternative as in alternative 2. There would be 228 acres less of tree planting under this alternative.

Roads

Effects from road reconstruction and maintenance are covered under alternative 2 and would be the same under this alternative. System road reconstruction and maintenance is expected to be the same under this alternative as in alterative 2.

There would be no system road construction. Temporary roads would be used for access or in some stands; timber would be cut but not removed.

Effects of temporary roads are covered under alternative 2. There would be an increase of 3.2 miles of temporary road construction under this alternative. There would be an increase in erosion levels from these temporary roads.

Cumulative Effects of Alternative 3

In general the cumulative effects of alternative 3 are the same as cumulative effects of alternative 2, the exceptions are written below. Appendix B contains information on past, present and future erosion levels from both NFS and private lands within drainages in the project area.

Approximately, 1,000 acres of the analysis area has been harvested within the last five years. Of this harvested area, cut and leave treatments would be implemented on 953 acres to cut out loblolly pine regeneration. Cut and leave treatments would have minimal cumulative impacts to soils in those stands because no equipment would be used and recovery from the last entry would continue. Cut and remove treatments would occur on 75 acres which have had some type of harvesting activities within the last five years. Recovery from past harvesting activities would be interrupted by a reentering into these stands. Refer to the project file for specific compartments and stands.

There would be no cumulative effect to soils from system road construction since no system roads are proposed with this alternative.

Implementation of Alternative 3 considered together with past and reasonably foreseeable future activities is not expected to have a cumulative effect on the soil resource. Project design and/or mitigation that would be used during project implementation are the primary factors leading to this determination.

3.1.2 Water, Riparian Areas, Wetlands, Floodplains, Prime Farmlands

Affected Environment

Rainfall is well distributed throughout the year with 50-year annual precipitation averages from 66 inches at the Long Creek, SC site in the southern portion of the Chattooga River watershed to 85 inches at the Highlands, NC rain gage near the headwaters (NOAA, 1999). The USGS stream gaging station number 02177000 for the Chattooga River near Clayton, GA has a drainage area of 207 square miles and an average water yield of 42 inches during 72 years of record (USGS, 2012). Snow is a minor component, which seldom accumulates for significant periods of time.

The primary geological materials include graywacke, mica schist, amphibolite, aluminous schist, granite, mica gneiss, gneiss and granite gneiss. The geological materials are highly weathered with a prominence of saprolitic materials in the C soil horizon. Saprolite has poor competence, structure and limited nutrients and is highly erosive when exposed.

The dominant native forest types in upland watershed areas such as the Chattooga River watershed are Virginia and shortleaf pine (*Pinus virginiana and P. echinata*) and chestnut and scarlet oak (*Quercus prinus* and *Q. coccinea*) species, while eastern hemlock (*Tsuga canadensis*), yellow poplar (*Liriodendron tulipfera*) and white pine (*P. strobus*) often dominate moist areas associated with coves and stream sides. Forest openings (gaps) can become dense understories or shrubby thickets of rhododendron (*Rhododendron sp*.) and mountain laurel (*Kalmia latifolia*) (Van Lear et al., 1995). Lack of fire and other disturbance in the streamside areas may be influencing the amount of rhododendron and mountain laurel. Most of the eastern hemlocks are infected with wooly adelgid (*Adelges tsugae*) and tree mortality has resulted in loss of shade and other benefits that eastern hemlock provides.

Loblolly pine (Pinus taeda) is not a native species. It was planted in the past to provide future wood fiber. It was planted mostly on flat ridges but has spread onto lower slopes and near streams. This species not only dominates in the overstory but the needle-cast and shade from the trees restricts the development of a native species understory.

Southern pine beetle has affected localized concentrations of both native and non-native pine stands. Some accessible areas have been salvaged, and some were cut and left to help reduce spread to adjacent areas.

Sediment is typically one of the main effects addressed in the analysis of environmental impacts as to the both the direct effect of sediment to stream channel morphology as well as habitat effects to aquatic organisms. Estimates of sediment loading and concentration are reliable indicators of the level of effects to stream water quality.

Sediment can come from a variety of sources such as roads, farmland, pasture, forest and urban areas. Other ground disturbing activities such as gold mining, horse or foot trails, ATV/OHV trails, recreational uses, and home development can also contribute to sediment or other water quality problems not estimated in this analysis. Table 3.1.2-1 depicts estimated sediment sources based on current land use patterns. By far, the major land use is forest.

Table 3.1.2-1 –Estimated Percentage of Total Existing Sediment Sources by Land Use/Land Cover within the Project Area[1]

Land Use/Land Cover	USFS	Other	Total
Forest	8.0	35.6	43.6
Grass/herbaceous/pasture	1.9	13.1	15.0
Agriculture - Cropland	0.0	2.1	2.1
Urban	0.0	0.6	0.6
Barren	0.0	0.8	0.8
Prescribed Fire (primarily forest lands)	7.8	0.0	7.8
Roads	17.6	11.8	29.4
Utility Lines	0.2	0.1	0.3
Wildlife Management Areas	0.4	0.0	0.4
Totals	35.9	64.1	100.0

The sediment values calculated for this analysis would be spread out in space and time and it should be recognized that some sediment is assimilated within the river system into floodplains or substrates and some delivered downstream. Increases in sediment would not be easy to detect at the smaller scales (i.e., larger hydrologic units such as 5th and 6th level HUCs or watershed and subwatershed scales). As will be also be discussed in upcoming sections, increases can probably be detected and more easily highlighted and discussed in small headwater, perennial streams at the drainage basin response unit (DBRU) scale.

[1] Based on 305 3rd order DBRUs covering 28,800 acres of lands managed by the USFS and 12,400 acres of private and state-owned lands. The total sediment contribution from roads and utility lines were apportioned accordingly (60% of road acreage and 70% of utility lines were considered occurring on national forest system lands).

Much of the discussion of water effects in this analysis will be on sediment, but the potential for localized water yield increases are also addressed. Water yield may be increased when concentrated areas cut or remove forest vegetation. This effect is noticed when at least 25% of an area is cleared of vegetation. Water yield increases return to near normal levels with revegetation over a period of about 5-10 years (Swank, et. al., 1988). The primary effect is for the first 2-3 years and a good share of this increase is in the summer months when normally transpiration depletes the supply of water in the soil and taps into the water table. For areas with vegetation loss, streams can have higher base flow during this period and maintain a higher water table. For many aquatic species, increasing base flow is beneficial. The risk of impact from flow increases appears to be in connection with tropical and/or intense thunderstorms during periods when trees would have normally depleted soil and groundwater stores of water. Higher than normal peak flows could develop under these above normal moisture conditions due to reduction in evapotranspiration. During periods of seasonal dormancy of vegetation, the likelihood of major differences between vegetated and recently cut areas diminishes as rainfall events replenish soil moisture and groundwater. The risk of impacts from flow increases appear to be temporary / short term, possibly seasonal, and related both to the extent of vegetation removal or mortality and to some degree the type of vegetation removed. Since pine trees use substantially more water in evapotranspiration processes than hardwoods and grasses, pine removal or mortality has the greatest potential for concern. The effects of flow increases are of greater concern if the stream channel is already unstable. If streams are currently stable with well-vegetated banks and not actively degrading or aggrading, it is unlikely that they would become unstable during temporary / short term increases in flow.

The type and significance of effects differs depending on the scale being considered. Therefore, the affected environment and effects analysis are considered at the following hydrologic and spatial scales (from smaller to larger scale):

1) 5th Level Watersheds
2) 6th Level Subwatersheds
3) 4th Order DBRUs – range from about 100 acres to 2,000 acres
4) 3rd Order DBRUs – typically headwater perennial streams, range from tens to hundreds of acres in size
5) Streams and Riparian Areas – conditions were evaluated at a variety of scales from landscape level, stream orders, stream classification, types, to occasionally stream section or site level evaluations.

5th Level Watersheds

Fifth level hydrologic units typically range from about 40,000 acres to 250,000 acres in size. The proposed activities are located primarily within two fifth level hydrologic units, Chauga and Chattooga River watersheds. Assessment of impacts at this scale seldom shows more than minute changes. Estimates of sediment and water quality changes would be highest in the Chauga watershed for this scale as it contains most of the activities, is a relatively small watershed at this scale than the other fifth level watersheds. The Chattooga River, Little River-Lake Keowee, Hartwell Lake-Tugaloo River and Coneross watersheds contain fewer activities for their size and are therefore less likely to show impacts. For these reasons, the Chauga was the watershed selected to represent the maximum effects that the proposed activity would have for

this scale. Subwatershed and smaller drainages within all the watersheds are analyzed in other sections.

Additional Background

Many of the Chattooga and Chauga River streams are listed as Outstanding Resource Waters (ORW) by South Carolina as being tributary to the Chattooga Wild and Scenic River, eligible Wild and Scenic River or state designated outstanding waters (SC DHEC, 2006). Other water classifications include natural trout waters (TN); trout put, grow and take (TPGT) and freshwaters (FW). The streams in the Chattooga and Chauga watersheds are identified as ORW, TN or TPGT and typically contain trout. The other watersheds may also contain drainage areas with trout waters with suitable habitats and temperatures that would be protected accordingly. *South Carolina's Best Management Practices for Forestry* (BMPs) include an additional 40 feet to total 80 feet of width of protection along perennial and intermittent trout streams within the primary streamside management zone (SMZ). Regardless of the presence or absence of trout, all the perennial and intermittent streams would be protected as if they contain or support trout as this best agrees with SC DNR approach to protect headwaters of trout streams that SC BMPs tries to implement. The intent of the SMZs in this instance is primarily to maintain water quality by maintaining ground cover and bank stability and limiting ground disturbance, erosion and sediment and direct exposure to sunlight.

The Chauga River Scenic Area (Management Prescription 4.F.) has been identified in the *Revised Land and Resource Management Plan, Sumter National Forest* (Forest Plan) as eligible for potential inclusion in the National Wild and Scenic Rivers System (USFS-2004b). Therefore, current management goals are to protect the Outstandingly Remarkable Values of the corridor (1/4 mile on each side of the river) in the event that legislation is passed by Congress to designate it into the Wild and Scenic River System. The Chauga River is also a municipal watershed for the community of Westminster, South Carolina, and after treatment, used for community drinking water and other domestic uses. The intake pipe is located below the National Forest.

Much of the Chauga River follows the Brevard Geologic Fault (a shear lineament) and provides many unique habitat conditions and containing a high diversity of plant species. Management concerns about non-point pollution sources are associated with roads, timber harvest, rural development and other private land uses associated with agriculture and pastures. Some of these concerns are from past actions and activities that have left legacy sediment and chronic sediment sources in streams. The sensitive Oconee stream crayfish, *Cambarus chaugaensis*, is found within the Chauga watershed as are a variety of rare plants within the calcareous soil area associated with the Brevard fault zone. Slopes range from moderate to steep with maximum slopes above 50%. The Chauga River watershed contains about 1,100 miles of streams, with about 40% perennial or intermittent and 60% ephemeral, as estimated from information reported by Hansen, 2001.

Hansen (2001) presents findings on the Chattooga River watershed (fifth level HUC) relative to the number and mileage of streams by stream order that one might expect in the Blue Ridge Mountains and the importance to include them in planning activities and implementing BMPs.

The Chattooga River watershed has been studied more intensively over the last few decades. It has a significant history of logging and in some instances agricultural uses. Historic practices including moving logs to concentration points where splash dams were built to contain logs. During higher water or storm periods, the slash dams were breached in order to float the logs downstream to the mill sites. Barriers within the channel were dynamited to facilitate and continue log movement downstream to access points or log mills. Temporary and permanent roads were not always well located, maintained or closed and have resulted in substantial long term erosion and sediment sources. Farming, ranching and development realigned streams, allowed unrestricted access for cattle and built structures adjacent to streams.

A substantial amount of information was collected and compiled on the Chattooga River Watershed from the Chattooga River Ecosystem Demonstration and the Chattooga River Large Scale Watershed Projects in the 1990s. In both projects, work was done to address some of the sediment and fecal coliform issues that have impacted sections of the Chattooga River and problem tributaries such as Stekoa Creek. Watershed concerns such as road maintenance, forest health, streambank instability, cattle in riparian areas, historic vegetation cover, wildlife and fish habitat were considered and addressed locally within project and funding constraints. Some of this work was done in collaboration with landowners, community, county, state and federal interests as well as local individuals or resource dependent companies interested in improving watershed conditions. An environmental assessment *Managing Recreational Uses on the Upper Chattooga River* contains detailed information on water quality in the upper portion of the Chattooga River along with the cumulative impacts of past, present and proposed projects. The analysis completed for that document (which is included as a reference) indicates that the upper Chattooga is known for having good water quality.

The fifth level watersheds containing the proposed activities have relatively low sediment yields per unit area based primarily on land use as analyzed in the *Final Environmental Impact Statement for the Revised Land and Resource Management Plan, Sumter National Forest* (USDA-FS, 2004a). The amount of area within the South Carolina Blue Ridge Mountains is limited, so from that aspect, the proposal is contained within some of the highest quality waters within the State of South Carolina. The Francis Marion and Sumter National forests have done preliminary evaluations of all sixth level watersheds following protocols found in the *Watershed Condition Classification Technical Guide*, FS-978, July 2011 (Technical Guide). Many support cold or cool water fisheries and contribute to substantial water based recreational uses. The sixth level subwatershed scale is a more meaningful planning analysis scale since impacts of activities are more noticeable in comparison to the size of fifth level HUCs.

6th Level Subwatersheds

6th level subwatersheds range in size from 10,000 to 40,000 acres and typically include sixth order and smaller order tributary streams. In instances where the name of the stream is not modified with terms like middle or lower, they are pure hydrologic units (all streams have their origin within the subwatershed). Sixth level HUCs with names that include middle or lower are composite subwatersheds and they typically have sources of flow from outside their boundaries that contribute to the main flow channel. These composite areas typically include a large order stream that runs through the subwatershed, and contributing areas are portions of the hydrologic

system that had insufficient size and development such as stream ordering to be identified as a pure subwatershed on their own. The term upper, may or may not indicate a pure hydrologic unit or what might be considered a self-contained, headwater area. The analysis has proposed treatments within ten sixth level watersheds listed as follows: Flat Shoals River; Oconee Creek; Upper Coneross Creek; Middle Chattooga River; Lower Chattooga River; Upper Chauga River; Middle Chauga River; Toxaway Creek; Lower Chauga River; and Upper Tugaloo River. Table 2.6-2 contains information on the potential acres impacted by each alternative. Land use information based on the 6th level HUC scale is shown in Table 3.1.2-2.

Table 3.1.2-2 Summary of Land Use/Land Cover in the Ten Sixth Level Watersheds in the Project Area (percent)

Current Land Use/Land Cover	Forest Service	Private
Forest	31.4	49.4
Agriculture - Cropland	<1	<1
Grass/herbaceous/pasture	<1	13.7
Urban	<1	<1
Water	<1	1.5
Barren	<1	<1
Roads	2.1	
Utilities	<1	
Wildlife Management Areas	<1	

The data indicates that the subwatersheds are dominated by forest. Currently, these subwatersheds are listed in fair condition (functioning at risk) in the Forest's Watershed Condition Assessment that was completed in 2011[2]. Indicators in poor condition include aquatic physical habitat, road density and maintenance, soil productivity/erosion and fire condition class. Most of the proposed activities are located along upper slopes with low to moderate slopes adjacent to existing road systems that are stable.

4th and 3rd Order Drainage Basin Response Units (DBRUs)

The drainage basin response units (DBRUs) are third and fourth order perennial drainages that are much smaller than the seventh and sixth order primary streams contained in fifth and sixth level HUCs. As an example, within the Chattooga River watershed, there were 169 fourth order streams and 762 third order streams (Hansen, 2001). The DBRUs are small drainages that repeatedly combine and collectively make up the rivers at the subwatershed and watershed scales. For the Chattooga River watershed with a contributing area of 281 square miles, the 3rd and 4th order streams (DBRUs) make up about 80% of the perennial stream network, so they are the small, dispersed streams or building blocks that make up the river systems. The Chauga River watershed is about 110 square miles, so proportionately, is likely to have about 40% of the number of 3rd and 4th order streams identified within the Chattooga River watershed. There are 81 4th order DBRUs and 305 3rd order DBRUs in the project area. Ground disturbing project activities that may be connected to erosion and sediment sources occur in only 64 of the 4th order DBRUs and 217 of the 3rd order DBRUs. The DBRUs were selected for analysis because they

[2] Following protocols in the Technical Guide, the watershed condition assessment considered a number of indicators to determine watershed health and conditions including fire regime condition class, soil productivity, water quality, NNIS, roads and riparian areas.

better reflect the effects of proposed activities on the uppermost headwater, perennial stream channels and associated habitats. In addition, DBRUs were addressed relative to activity concentration that could cause temporary water yield increase.

Third order DBRUs contain streams that are typically small to very small perennial streams with steeper gradients that maintain limited but varied habitats for indigenous aquatic macroinvertebrates and other species such as salamanders and crayfish. Trout or other fish species may be present. Although some of these headwater streams have relatively steep gradients, they can provide a degree of thermal and other refuge from competition for those species that are present. Streams at this scale are seldom individually named and are often not identified as blue line streams (i.e., perennial or intermittent) on the USGS topographic maps at the 1:24,000 scale. Heavy vegetation cover typically obscures the ability to remotely classify streams from aerial photo interpretation commonly used in making the topographic maps.

Fourth order DBRUs have streams that contain two or more streams from 3rd order DBRUs, typically have larger channels, moderate gradients and maintain more flow and more complex habitats that are more likely to support trout and an increased variety of other aquatic species. Streams from both 3rd order and 4th order DBRUs have a confined channel and the ability to move, process and sort channel materials such as cobbles, gravels, sands and finer materials. Even at the third and fourth order scales, averaging 135 and 425 acres in size, respectively, these areas (defined by their drainage network) range from tens to a few thousand acres in size and have several to many miles of streams included within their drainage boundaries.

The sediment analysis that was completed helps to determine the differences between the alternatives and also identify where activities are concentrated. If there are significant effects, they are likely to show up at this scale. Effects at the DBRU scale are more pronounced because of the steeper gradients associated with hill slopes and headwaters. Also, there is not much slope distance until water enters a channel.

The effects related to forest management tend to be temporary so they can be managed by staggering treatments over time. Sediment increases are normally associated with ground disturbing activities and discrete, severe storms of limited duration. Severe localized storm cell intensities may affect, but seldom cover entire watersheds at one time. On the other hand, severe storms, even quite small ones, can cover the entire area of a small drainage at one time and even extend this coverage for a period of time.

Flow and sediment increases are minor at larger watershed and subwatershed scales. There are substantial differences in terrain (hill slopes, headwaters and valleys), time and space that spread response and effects. Unless the storm is very large and widespread, there will be portions at the watershed scale that are not involved or contributing at the same extent or for the same duration. At larger watershed scales, gradients are gentler, local floodplains and channel networks slow down or retain water and pollutants.

Streams and Riparian Areas

Streams

The intricate system of small ephemeral drainages (order 1) comprises over half of the channel network, and eventually combine into intermittent and perennial streams before they reach the size of the rivers. The drainage density based on the 1:24,000 scale USGS Topographic maps is 10.3 miles per square mile (Hansen 2001) for the Chattooga River, but this density could be higher for the Chauga or other watersheds where the USFS ownership is located to a greater extent in the headwaters. The topography of the watersheds listed in Table 2.6-2 is moderately to highly dissected by drainages and streams.

The following information characterizes streams in the project area.

- Analysis of limited stream morphological data indicates that many of the larger low gradient streams are entrenched into valley sediments and classify as Rosgen F types. These stream characteristics include limited flood-prone widths and relatively high width to depth ratios. They tend to have less than optimal aquatic habitats due to typical domination by sand size particles, with presence of larger materials and occasionally bedrock. Legacy sources of sand exist within these systems.

- Some low gradient stream sections are not entrenched or constrained from their floodplain, and as a result are more stable and may classify as Rosgen C types. The morphology of larger streams has typically developed into riffle pool habitats but some areas with high sediment loads or hard bedrock have limited pool capacity.

- Channels that run from headwaters through steeper terrain are entrenched with limited or constrained floodplains or valley development with Rosgen A or B stream types. High gradient sections may have falls, cascades, and occasional step pool habitats controlled by rock outcrops, boulders or debris that effect the gradients (Rosgen, 1996). Rosgen A and B stream types have low to moderate width to depth ratios and limited sinuosity. Both stream types tend to be stable and are high energy systems that tend to be sediment limited. Vegetation on streambanks and adjacent slopes is important for stream channel stability.

- Rosgen G stream types are occasionally present as entrenched gully channels are found in erodible terrain or where past land management has confined or straightened streams or diverted excessive road surface drainage onto the land or into the channel. Failed agricultural terraces sometimes resulted in downstream gullies. As gullies degrade, groundwater is eventually captured resulting in draining the adjacent terrain and limiting or eliminating the stream’s access to a floodplain. Terrace overflows may occur only in extreme events. These channels contain all their energy internally during flood events and are typically unstable, degrading vertically until stable substrate is reached, then laterally as the channel tries to stabilize. In this process, many tons of sediment can be moved and relocated downstream. Loss of flooding due to degradation also reduces hydroperiod of riparian areas and adds stress to these ecosystems. Locally, hill slope failures have

infrequently buried stream sections and gully entrenchment and headcuts can form in the fill materials. The buried channels sometimes have spring-flow from the upstream failure sources and indicators such as holes in the alluvial deposits also reveal flow and instability within this buried layer. Sand materials are commonly found in channel substrates, and sand is typically the dominate particle size.

- Rosgen G streams that have reached vertical grade typically widen into F streams and/or may adjust to Rosgen B or C streams. The ability of the streambank and steep lower slopes to re-vegetate to dense mountain laurel, rhododendron and other species may also add to the ability of these channels to hold form and stabilize.

The history of many of the channels includes effects from past logging which included skid roads along or through small to moderate size streams and tributary areas. Past stream crossings with debris and fill are sometimes noted, and infrequent sections of underground flowing water within small perennial channels may sometimes interrupt surface flow. This either impacted streams directly or indirectly by confining their form and altering their shape. The past logging roads and skid trails were not designed or maintained to provide adequate crossing structures, drainage, erosion and sediment control. Some of the access roads caused long term erosion and entrenchment of the road into the landscape and became direct conduits of flow, sediment and other pollutants to streams. Many of these roads have been closed, stabilized and/or decommissioned. Some of the valley channels were moved or riparian areas drained by ditches for farming. Legacy sediment and erosion is still present within most of these stream systems.

Various methods have been used to map stream location and determine stream type (ephemeral, intermittent, or perennial). Streamflow accumulation models were compiled in GIS using the LiDAR hill-shade coverage (based on digital elevation model) and reviewed adjacent to proposed treatment activities to help determine stream position, stream order and estimate where riparian and stream protection measures would be needed within planned unit boundaries. The LiDAR hill-shade coverage also helps to visually estimate how much of the channel is entrenched, with abrupt changes in channel depth evident. It also was used to locate sections that were probably channelized or in some instances may have natural geological controls such as shear lineaments notable within the Chauga River watershed. LiDAR can be used to estimate entrenched sections of stream and in one instance revealed an abrupt change in gradient and character section that was later confirmed to be falls/cascades with bedrock dominated step-pool form.

Riparian Areas

The vast majority of treatment acreage (over 95%) occurs outside of riparian areas.

In most instances, riparian areas are relatively narrow in extent along upper piedmont and mountain streams and some are past deposits of sediment in valleys or landscape depressions where gradients abruptly changed from much steeper hill slopes to much lower channel gradients. Some are a result of historic or anthropogenic related earthflows, landslides, fill-slope or other failures that have left alluvial and fluvial remnants bordering streams. Generally speaking, riparian areas have scattered pockets of loblolly pine proposed for removal.

Eastern hemlock (Tsuga canadensis), yellow poplar (*Liriodendron tulipifera*), red maple (*Acer rubra*) and white pine (*P. strobus*) often dominate moist areas as coves and stream sides with locally dense shrub thickets or understories of rhododendron (*Rhododendron sp.*) and mountain laurel (*Kalmia latifolia*) (Van Lear et al., 1995). Riparian areas are mostly dominated by mixtures of hardwoods and native evergreens.

In narrow confined channels with limited or no depositional valley feature, riparian corridor buffer widths were designed to extend beyond the actual riparian areas to act as filter strips or vegetated buffers to provide cover, slope stability, shade for streams, and a source for woody debris and organic materials for primary production of aquatic organisms. The following criteria were used to define the riparian corridor boundaries where Forest Plan standards (including BMPs) apply. Riparian corridor standards are found on pages 3-43 and 3-44.

- Riparian corridor includes the relatively flat or low gradient alluvial and fluvial deposited soils along streams that may be flooded and periodically saturated.

- Riparian corridor includes bottomland hardwoods.

- Hydric soils that are likely to be wetlands are included in the riparian corridor.

- Springs, seeps and other persistently wet or flowing areas fed by groundwater are included in the riparian corridor.

- Corridor widths for each side of perennial streams would be 100 feet, 125 feet and 150 feet corresponding to the following slope breaks 0-30%, 31-45%, and 46% plus, respectively.

- Corridor widths for each side of intermittent streams would be 50 feet, 75 feet, and 100 feet corresponding to the following slope breaks 0-30%, 31-45%, and 46% plus, respectively.

- Channeled ephemeral streams zones are not part of the riparian corridor, but include 25 feet wide from the channel and have separate standards that would apply as defined in the Forest Plan page 2-5 [including forest-wide standards (FW)] FW-6 to FW-9, FW-11, FW-13 through FW-16.

Unless field verified to refine its delineation, the riparian corridor as described in the Forest Plan includes order 2 as intermittent streams and order 3 and larger as perennial streams, based on the 1:24,000 scale interpretations that were used in the Forest Plan. Riparian corridor also includes alluvial/fluvial deposits including floodplains and terraces along stream margins, wetlands, springs, seeps and lakes. Some adjustments to the use of stream orders, stream types and stream location were made by applying the LiDAR-derived based stream coverage or from further site-specific evaluations. However, much of the current stream coverage and ordering was hand digitized and based on the USGS Topographic Map contours. LiDAR derived contours and hill-shade analysis offer substantial improvements to channel geo-referencing and detail (James et. al., 2007). By default in the forest plan direction, the 1:24,000 scale second order and larger

streams within the riparian corridor have designated protection widths unless determined in the field to be ephemeral. Order 1 streams are generally ephemeral with no riparian corridor, but in some circumstances, they may be field verified as intermittent or perennial, such as those with mountain spring sources. Any scoured ephemeral streams would be identified and managed to meet both Forest Plan standards in FW-6 to FW-16 (USDA-FS, 2004b) that apply within 25 feet either size of the channel and BMP direction. Order 1 streams (for planning purposes) are not included within the riparian corridor and do not have designated streamside protection widths unless evaluated in field surveys or during implementation to be either intermittent or perennial flow or supported by springs or seeps. The 25 foot zone, where channeled ephemeral standards apply, is not to be considered a designated SMZ or riparian corridor.

Forest Plan direction for riparian corridor management is documented in management prescription 11- Riparian Corridors and Forest Standards.

Streamside Management Zones

To meet Riparian Corridor management objectives, streamside management zones (SMZs) are defined in BMPs as an on-the-ground spatial operational designation used during timber harvest to define special mitigation practices for operations occurring near streams for protection of water quality. They vary in width from 40 to 240 feet (depending on slope) along perennial and intermittent streams. The SMZ is broken out into primary and secondary zones, with primary being next to the stream and the more restrictive of the two zones in terms of the kinds of activities that can occur. Within the primary SMZ along perennial streams, BMPs prescribe retention of at least 50 square feet of basal area per acre of dominant trees for stream shade, bank stability and protection of water quality. Consultation with the SC Forestry Commission would be undertaken to address situations where removal of loblolly pine would result in residual overstory vegetation of less than 50 square feet with the SMZ..

Floodplains and Wetlands

Wetlands are not known to be present within the upper landscape and headwater tributary areas being proposed for treatment. Approximately 13 acres of Toccoa soil series were mapped within the proposed activities and these are relatively flat and potentially subject to flooding from streams or excess rainfall that can accumulate from adjacent slopes on flat areas, leading to short periods of saturation. Approximately eight acres of treatments are contained within two harvest units under either of the two action alternatives with the remaining acreage spread over another 18 units. These areas are part of the riparian corridor, which allows management activities if needed to maintain or restore riparian habitats, but is considered unsuitable for timber production. Few loblolly pine trees were observed in these areas and proposed treatments would allow directional felling and removal or girdling trees in order to remain consistent with Forest Plan direction. Any heavy equipment and skidding activity would minimize ground and stream disturbance using site-specific mitigation measures and Forest Plan standards. Given the limited number of loblolly pine found within the riparian areas, Forest Plan standards and site-specific design criteria the potential for measureable impacts to these areas are unlikely.

Flood-prone areas may exist to a limited degree along stream channel margins, but these areas are typically outside of treatment areas and are very confined in extent. Loblolly pine cut-and-remove or cut-and-leave treatment activities would not or have very limited affect to floodplains or wetlands. Roads used for timber and other management activities would typically avoid these areas. Mitigation measures within the Forest Plan standards and BMPs would be implemented to limit effects to these areas. Further analysis of impacts from proposed activities to floodplains and wetlands is not needed due to the limited extent of flood-prone areas, adherence to Forest Plan standards and site-specific mitigation measures that provide added protection to these areas.

Prime Farmlands

Only the Toccoa soil series that occurs in the project area could possibly be considered as prime farmland if not subject to flooding. The Toccoa Soils occupy about 13 acres of the project area, with about ten acres of the 13 acres within four treatment areas. Fine sandy loam soils are encountered in riparian and bottomland areas where alluvial sediments are present within the riparian corridor prescription. Due to the adjacent steep topography and limited access to most of these soils for forest management when forestry BMPs and riparian corridor direction are applied, they are typically not available or suitable for use as prime farmlands. These areas may be included in prescribed burns, but frequently do not carry fire well and only partially burn due to more persistent, higher moisture conditions. Effects are unlikely under any alternative given the low number of acres in the project area in the Toccoa soil series and the likelihood that these areas would have limited if any activity. In addition, the riparian corridor would be protected by Forest Plan standards. There would be no loss in prime farm lands by implementing any of the alternatives. Impacts to prime farmlands will not be considered further in the analysis.

Direct and Indirect Effects of Alternative 1

Effects at All Hydrologic Scales

No ground disturbing activities associated with the proposal would occur under alternative 1. For this analysis, alternative 1 represents the current level of management activities based on land use estimates and associated erosion, sediment and water quality effects. Ongoing management activities such as prescribed burning, wildlife opening maintenance, road maintenance, existing timber management and treatment of non-native invasive species would continue on the national forest. The reduced level of activity in this alternative would cause fewer impacts to soils, water quality and aquatic habitats than would activities under the action alternatives. Not replacing the dense, to in some instances sparse, loblolly pine stands with a suite of native species would result in decreased forest health and ecosystem diversity. In the long term, this could impact water quality. Southern pine beetle activity aggravated by drought conditions would likely occur with time similar to outbreaks that occurred in 2002 and 2003, resulting in some increase in localized fuel loading and safety issues as the pine trees die and fall. Loblolly pine tends to dominate the forest canopy in areas where it was planted and the needle layer on the forest floor along with low light conditions suppresses understory grass and forb production. Pine tends to use more water than hardwoods or grass species, so the result may be less erosion and less water to maintain the base flow of streams and aquatic habitats. Peak flows during summer months would also be less as pine trees utilize substantial amounts of water for evapotranspiration processes

from soils and water table. Pine needles provide less food for aquatic organisms as compared to hardwood and other leaves. This alternative would tend to maintain these past and present effects.

Loblolly would maintain its presence in stands for the long term. Periodic insect outbreaks would kill trees and create canopy gaps where loblolly pine would begin to regenerate again. These areas would remain in a degraded state for the long term. Periodic disturbances such as drought and wildland fires may favor slow expansion or increased dominance of loblolly pine over native species. Additional decline in flows may be expected if loblolly pine expands in extent or density, especially in areas that are currently adjacent to loblolly stands and are covered by hardwoods, grass and forbs.

By comparison, areas without loblolly pine have increased variety of native hardwoods and evergreens. There may be an increase in grasses and forbs which tend to develop a greater root density. This improved plant diversity stabilizes and adds organic matter to the soil benefitting filtration and retention of pollutants and improvements in water absorption. Increased litter layer and organic soils helps to moderate peak streamflow and maintain base flows. Hardwoods, grasses and forbs use less water in evapotranspiration than dense pine stands, typically resulting in higher base flows in streams (Swank et. al., 1988).

5th Level Watersheds (Chauga River)[3]

Most of the proposed activities would occur in this watershed. It is comprised of four sixth level watersheds: Upper, Middle and Lower Chauga River and Toxaway Creek. Current estimated average erosion levels are 0.34 tons per acre per year over the 70,776 acre watershed. Current mean sediment concentration levels are 67.2 ppm, based on estimates of erosion, sediment and water yield from existing land uses, activities and rainfall/runoff over a decade.

6th Level Subwatersheds

The 6th level subwatersheds are displayed individually in Table 2.6-3 with estimated sediment concentration levels ranging from a low of 39.5 ppm for Middle Chauga River, to a high of 108.5 ppm for Upper Coneross Creek. These are based on current land uses and activities, coefficients of erosion and sediment delivery to streams.

4th and 3rd Order DBRUs

The current erosion levels for the 4th order DBRUs ranges from 0.04 tons to 0.52 tons per acre per year over the decade and sediment concentrations range from a low of 8.2 ppm to a high of 104.0 ppm (see Table 2.6-4). This establishes the current level or baseline conditions for the determination of changes relative to the action alternatives.

[3] The Chattooga River, Little River-Lake Keowee, Hartwell Lake-Tugaloo River and Coneross watersheds contain fewer activities for their size and are less likely to show impacts at the 5th level watershed scale, so analysis will be primarily confined to the fifth level watershed with the most activities, sixth level subwatersheds and the 4th and 3rd order DBRUs.

The current erosion levels for the 3rd order DBRUs ranges from 0.03 tons to 0.58 tons per acre per year over the decade and sediment concentrations range from a low of 5.3 ppm to a high of 115.4 ppm (see Table 2.6-4). This establishes the current level or baseline conditions for the determination of changes relative to the action alternatives.

Streams and Riparian Areas

The effects of existing system roads would remain and periodic work to reconstruct, maintain and/or decommission them would be needed to avoid undue environmental effects. Efforts to reduce existing erosion and sediment sources may be undertaken during normal road maintenance or other ongoing practices. However, this alternative would result in less funding and attention to existing open and closed road needs within the National Forest, potentially adding to existing erosion and sediment sources and road maintenance backlog.

It should also be noted that SC Water Standards for streams within the Outstanding Resource Waters, Trout Waters and Freshwater Classifications have standards that address pertinent water quality issues. The design of the standards is to address the more permanent changes such as those associated with land development (Gina Kirkland, SC DHEC Water Quality Standard Coordinator). Agricultural and forestry practices are also subject to these standards, but with avoidance, proper design, implementation and maintenance of BMPs are typically sufficient to meet stormwater, turbidity and temperature standards. Temporary increases in stormwater and non-point source pollutants associated with agricultural, forestry and similar activities are controlled with BMPs. It appears that the turbidity standard considers changes in the existing levels of turbidity during non-storm periods. Turbidity increases due to temporary or short term activities that are actively stabilized are not considered unless they produce a change in the beneficial uses or impact resources of the stream.

The turbidity standard is based on reflectance of light bouncing off small particles such as clay and silt or organic particles, while suspended sediment concentrations is a weight by volume. Clay, silt and organic particles weigh very little so are minor portions for suspended sediment concentration. It is the sand and small gravel particles that may or may not reflect much light in order to be measured as turbidity, but they are much heavier that clay, silt and organic particles, so their particle sizes dominate suspended sediment values if present. Larger particles such as the larger gravels, cobbles and boulders are less likely to be suspended under most circumstances and are measured as components of bed load as they tend to move, roll or skip along the bottom substrate. The movement of suspended and bed load particles is generally most active during bankfull flood events and this movement along with the velocity and force of water, helps to define the channel morphology.

Many of the headwater mountain streams have limited opportunity to transport sediment due to sediment availability in forested terrain. Most forests have excellent cover and organic layers, and are excellent filters of sediment and other pollutants from activities as long as they avoid direct connectivity to streams. Mountain streams have ample energy in most instances to move fine sediment, so either there are dense roots, protected niches, margins, substrates or slack pools that hold fine materials together or the fine particles are already scoured and moved downstream, leaving more stable materials or bedrock. In ephemeral channels, the soil type, cover, rooting,

flow amount and velocity are all factors that have led to maintaining soil surface and limit the intensity of erosion that is necessary to create a defined stream channel. Disturbing and exposing soil can provide an increase in the amount of concentrated flow, erosion and supply of sediment that channels or streams can move. However, not all exposed soil provides a source of sediment. Proper design, implementation, maintenance and mitigation help to limit the extent and time of soil exposure and duration and volume of concentrated flows that can erode and deliver sediments.

Cumulative Effects of Alternative 1

Effects at All Hydrologic Scales

Appendix B displays sediment sources from past and present activities across the project area from both national forest system lands and private lands. Sediment impacts were accounted for from such activities as timber harvesting, prescribed fire, roads and utility line rights-of-ways, agriculture and farming, home sites and urban areas.

Natural erosion, sedimentation buildup and water quality levels would continue as influenced by ongoing activities and past land uses and legacy sediment. Roads throughout the project area would contribute to sedimentation during regular use as well as maintenance activities and during storm events. Opportunities to utilize timber sale activities and improvements to stabilize and improve road, watershed, wildlife and other resources conditions with KV and stewardship funding would be foregone under this alternative. Soil disturbance within the analysis area would be associated with other ongoing projects such as prescribed burning, silvicultural, wildlife and recreation activities. On private and other lands, these and many additional land use activities continue locally as some areas are used for pasture, cropland, gardens, rural and urban development, etc.

5th Level Watersheds

Existing levels of suspended sediment for the Chauga River watershed were 67.2 ppm based on sediment delivered to DBRU size streams from all current and proposed activities and expected flow over the next decade. When adjusted for the watershed scale difference, this amount would be significantly reduced from the sediment delivery ratio of 38% for DBRU size streams to less than 10% for this watershed. This is based on sediment delivery changes based on watershed size (Roehl, 1962).

6th Level Subwatersheds

Existing levels of sediment are displayed in Table 2.6-3 for sixth level watersheds. At the sixth level hydrologic scale, the Middle Chauga subwatershed has the lowest concentration of current land use activity of the sixth level subwatersheds in the analysis area. The current levels of use translate into an estimated 31,842 tons of sediment over the decade with an average suspended sediment concentration of 39.5 ppm. This is the amount of sediment delivered to streams and has not been adjusted for reduced sediment delivery ratios for larger drainage units. In addition, the sediment analysis does not estimate other types of sediment sources, such as gullies and streambanks.

The other sixth level subwatersheds have average suspended sediment concentrations ranging from 59.1 ppm for Flat Shoals River to 109 ppm for Coneross Creek, indicating that there is substantially more land use activities and more sediment loading per unit area within these other subwatersheds than present within the Middle Chauga River.

These levels are relatively low in comparison to many other streams across the State of South Carolina and on the national forests. For example, the South Pacolet River in the Upper Piedmont near Campobello, SC is a slightly smaller subwatershed dominated by forest and pastureland. From 2006 to 2009, it produced about 9,500 tons per year as compared to the estimate of 3,200 tons per year for the Middle Chauga River. The Chauga River during storm events has a substantial sediment load to the extent that the bottom cannot be seen even in relatively shallow flow. Of all the sixth level subwatersheds being evaluated in this proposal, the Middle Chauga currently has the lowest estimated concentration of suspended sediment. The estimates associated with erosion from un-grazed forest land were dominant, consistent with forest as the overwhelming land cover.

The trend in higher average sediment load or suspended sediment concentration for larger hydrologic units seems to hold for the sixth level subwatersheds. As hydrologic units increase in size, there is likely to be a wider array of activities, population, pollution sources and potential for streambank erosion. One must also considered that legacy sediment from past activities stored within stream network channels and banks is a large contributor within much of South Carolina. Many of the stream types are not fully stable, are located in highly erodible materials and continue to be sources of sediment as they adjust.

4th and 3rd Order DBRUs

Existing levels of sediment are displayed in Table 2.6-4 and detailed information on 3rd and 4th order DBRUs can be found in Appendix B and in the process record. Existing sediment levels are associated with current land uses consisting of grassland/pasture/herbaceous, forest, roads, prescribed fire, cropland, wildlife management, barren areas, urban and utility use (Table 3.1.2-1).

- About 2/3 of the acreage in the 305 3rd order DBRUs analyzed for effects of potential cutting and water yield increases occur on national forest system lands. However, sediment from national forest system lands only accounts for about 1/3 of the current

estimated sediment load for these areas. This alternative serves as a comparison to the action alternatives as described in later sections of this document. The average size of these small perennial drainages is 135 acres, and primary sources of estimated sediment comes from forest, roads, grass/herb and prescribed fire land management activities. Overall, cropland, barren areas and urban areas do not account for a large percentage of the land use in the project area, but they can add considerably to the estimated sediment loading and water quality issues on some specific DBRUs. The 305 3rd order DBRUs produce an estimated 91,000 tons of sediment over a decade, for an average of about 300 tons/decade per DBRU or about 0.2 tons/acre/year and a mean concentration of about 40 parts per million (ppm) suspended sediment.

- There are 217 3rd order DBRUs (with an average size of 154 acres) that have ground-disturbing activities planned under the action alternatives. Table 2.6-4 displays the range of concentration of suspended sediment. The estimated average suspended sediment concentration based on existing, ongoing and planned activities was 40.6 ppm with sediment concentrations ranging from a low of 5.3 ppm to a high of 115.4 ppm. The very lowest concentrations were located within the National Forest, and highest concentrations had substantial sediment inputs from private lands and connected ground disturbing activities. It was estimated that 36% of the sediment sources or 14.3 ppm come from the National Forest. The total current sediment load for the 217 3rd order drainages with ground disturbance was estimated at 72,600 tons over the decade for this alternative.

- There are 64 4th order DBRUs that have ground-disturbing activities being proposed under the action alternatives. Table 2.6-4 displays the range of concentration of suspended sediment. The estimated average suspended sediment concentration based on existing, ongoing and planned activities and land uses in alternative 1 was 45.0 ppm with sediment concentrations ranging from a low of 8.2 ppm to a high of 103.9 ppm. The total current estimated sediment load as delivered to DBRU size streams for the current land uses was estimated at 63,686 tons over the decade for the 64 drainages (28,449 acres) with activities in one or both of the action alternatives. As mentioned, the activities within these vary substantially. Most have sediment impacts associated with roads, forest, and pasture/grassland/herbaceous management. About half had impacts identified for prescribed fire. Only about ten had notable effects from cropland or barren areas. Utilities, urban and wildlife management areas were even less common. Added detail on the specific amount of land use practices and their effects are provided in Appendix B.

Streams and Riparian Areas

Past and present projects have been very limited adjacent to project proposal streams and riparian areas. Past timber sales have left buffer strips in place along streams and prescribed burning utilizes low fire severity in riparian areas. Forest Plan goals and objectives have placed emphasis on protection and maintenance of ecosystem functions. All areas are extensively forested which enhances opportunities to maintain properly functioning riparian ecosystems. Thus, streams and riparian corridors are relatively stable in the project area. The emphasis then becomes maintaining current conditions while restoring upland native forests.

Field reviews indicate that most of the riparian corridors and perennial and intermittent streams are occupied by native hardwoods and pines. Establishment of the loblolly pine plantations took place mainly on ridges and flatter slopes that may include some ephemeral drainages. As a result, most riparian areas and streams have had little past insect and disease outbreaks. Streams and riparian areas are generally well vegetated and include continuous canopy coverage and shading along perennial, intermittent an ephemeral streams both in the overstory and understory. Streams are mostly stable and riparian areas are able to provide woody material to streams and to provide habitat conditions typical of mountain riparian areas.

Direct and Indirect Effects of Alternative 2

Effects at All Hydrologic Scales

In areas where loblolly pine would be removed, logging methods would include conventional or mechanized ground-based (generally less than 40% slopes) or cable-based (generally over 40% slopes). The intent is to remove or kill loblolly pine and convert this area to native pine and hardwood forest types. Most of the activity would be on uplands as this is where the loblolly plantations were originally established. There are limited areas within the riparian corridor or streamside management areas that have loblolly pine. Most healthy native pine (shortleaf pine, pitch pine and Table Mountain pine) and hardwood species (oaks, hickories) would be left as part of the residual stand where they occur. Site preparation and planting would be utilized for reforestation in selected stands (see Table 2.2.2-1 – Chapter 2).

The cut and leave treatment areas would use manual chainsaw felling. Cutting and leaving pine produces little ground disturbance, erosion or sediment. Other connected activities include tree planting, prescribed burning and herbicide application. These activities typically have minimal to low levels of ground disturbance.

Conversion from loblolly pine to mixed-pine/hardwoods or woodlands can affect evapotranspiration rates that can increase soil moisture and water yield flows for the long term. These added flows in many ways are more natural to this area as native hardwood and hardwood-pine mixtures are likely the historic vegetation types. Recovery of residual vegetation such as shrubs, native pines and hardwood trees would respond to improved ground cover, soils, stream stability and aquatic habitats which would help reduce drainage and sediment effects. Woodland areas have lower forest densities and may maintain increased potential for grass, forbs and other species in the understory based on prescribed burning.

<u>5th Level Watersheds</u>

The Chauga River fifth level watershed is 70,800 acres in size and has the highest intensity of proposed activities with 3,636 acres of treatment or 5.1% of the watershed. The Chauga River had the greatest potential for impact and it was assessed in more detail with results from the proposed actions indicating an increase of 4,745 tons of sediment and a 1.34 ppm increase (67.2 ppm to 68.6 ppm) in suspended sediment concentration over the decade based on sediment delivered to DBRU size streams within the watershed. This amount of increase is small and not significant.

6th Level Subwatersheds

Table 2.6-2 displays the proposed acres of treatment in each of the 6th level watersheds in the analysis area under each of the alternatives. The Middle Chauga River at 16,100 acres was selected to represent the highest level of proposed activity and associated effects at that sixth level HUC scale (subwatershed). The Middle Chauga River subwatershed proposes 13% for cut treatment with slightly more than one-half of the treatment acreage receiving a cut and remove treatment. The other subwatersheds have a much lower intensity of activity proposed. Sediment calculations estimated 2,355 tons of sediment from activities would increase sediment concentrations three ppm.

The sediment delivery ratio [(SDR) equal to 0.38] presented in the figures was for DBRU size hydrologic units. This is the percentage of erosion expected to be delivered to streams at the DBRU scale. This sediment delivery ratio is often used with hydrologic units to avoid confusion and add comparability. Typically as drainage size increases the SDR decreases. The Upper and Middle Chauga River comprise about 50 square miles, and that size hydrologic unit would have a SDR of about 0.08, as some of the sediments are deposited along the floodplain (Roehl, 1962).

The effects of estimated sediment delivered to streams within the sixth level subwatershed from proposed activities change water quality very little as evidenced in the small increases from less than one to three ppm (Table 2.6-3) in estimated sediment concentrations. These changes would not be noticed and would be difficult to measure the difference.

4th and 3rd Order DBRUs

The extent and intensity of proposed treatments such as tree cutting and constructing temporary roads and skid trails have the potential to reduce evapotranspiration, increase water yield, impact stream morphology and stability and alter sediment regimes temporarily for several years (Swank et. al, 1998).

Increased water yield is estimated to begin when 25% of the drainage is regenerated (cut and removed or cut and leave treatment) or 50% of the drainage when a combination of cut and remove and cut and leave or woodland treatments are prescribed. These water yield effects are most noticeable for the first few years after treatment but less obvious effects can last up to 10-15 years before water yield changes are not noticeable (Swank, et. al., 1988). This is not a concern in lower density loblolly pine stands that contain mixtures of hardwoods and native pines that would remain after removal treatments.

Third and fourth order perennial DBRU streams are the ones that would most likely show temporary to short-term, potential changes to water quality or channel morphology as a result of treatments. There is a higher risk of sediment and potential channel changes occurring for a short time period after activities are completed. The estimates made do not mean that these would occur and do not include the beneficial effects of implementing Forest Plan standards including BMPs and site-specific mitigation measures. Mitigation measures including BMPs can be quite effective in limiting the amount of sediment entering streams, and likely limit the time that treatment areas would be highly sensitive to severe storms. The coefficients to estimate erosion

and sediment are based on average conditions of sediment delivered to drainages this size (Hansen et. al., 1994).

Erosion coefficients were developed that model effects associated with site-disturbing activities (Hansen and Holden, 2012, Hansen et. al, 1994). In addition, the erosion and sediment calculations were made over a decade to account for implementing all the proposed activities, differences in scheduling of activities and recovery responses. The primary utility from the estimates is to be able to compare alternatives and be able to discuss effects and if needed, responses to those effects such as site-specific mitigation measures.

4th Order DBRUs

Appendix B contains information on 4th order DBRUs that were evaluated for potential water yield increases that could cause changes to stream channels to occur as a result of the concentration of treatment units. In addition, they were analyzed for increased sediment concentrations as a result of project activities.

Table 3.1.2-3 displays the eight 4th order DBRUs where treatment units would be staggered over at least three years and no more than half of the area in the drainage would be cut at any one time. This mitigation measure would allow some time for vegetation to recover and evapotranspiration rates to return toward normal before reentry. This would reduce water yield increases and reduce the potential for adverse effects to stream channels. Treatment activities in the remaining drainages would proceed without any additional mitigation measures. For all remaining 4th order DBRUs, as discussed earlier in this section, adherence to Forest Plan standards including BMPs would minimize adverse effects to stream channels.

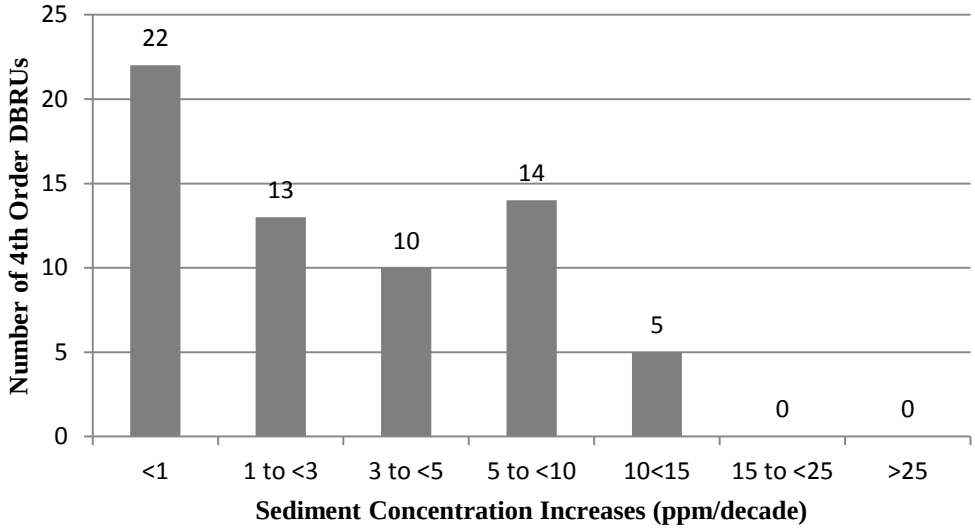
Table 3.1.2-3 Fourth Order DBRUs Proposed for Mitigation

DBRU Number	Sixth Level Drainage Where Occurs
601020102	Middle Chauga River
601020103	Middle Chauga River
601020115	Middle Chauga River
601020116	Middle Chauga River
601020209	Middle Chauga River
601020216	Middle Chauga River
601020217	Middle Chauga River
601020523	Upper Tugaloo River

Four of the 4th order DBRUs listed in Table 3.1.2-3 also have some of the highest mean sediment concentration increases. Staggering treatment entries in these drainages would also help to reduce sediment concentrations.

Average suspended sediment concentrations over the decade analyzed range from 0 ppm to 14 ppm with an average increase of 3.5 ppm. Figure 3.1.2-1 displays the range of sediment concentration increases by DBRU as a result of implementing the alternative. Drainages with ground disturbing activities proposed would have sediment increases, while those with no sediment increases are associated with cut, leave, girdling or herbicide treatments and have no mechanical or ground disturbing treatments that result in soil disturbance.

Figure 3.1.2-1 Alternative 2 Sediment Concentration Increase by Category in 4th Order DBRUs



Since 90% of the sediment typically occurs during storm events that occur only 10% of the time, and the activity effects are typically linked to just a few years, there may be times when the sediment concentrations are ten or more times the mean values that are presented for the decade. During non-storm periods, the stream suspended sediment concentrations would typically be substantially less than estimated. The effects are most noticeable within the activity area or at the smaller drainage scales. In larger watersheds, sediment loading remains high during intense storm events, but properly functioning floodplains allow substantial sediment settling to occur. Many of the streams and rivers are entrenched and do not have properly functioning floodplains to detain or retain as much sediment. However, there is still a substantial amount of dilution and locations within stream channels and margins of streams where sediment can be detained for substantial periods. The finest particles of clay and silt are mostly flushed through the system as they are less able to settle out. Suspended sediment concentrations estimated at the DBRU scale are more pronounced because the activities being analyzed are locally more concentrated in their proximity to headwater streams. Headwater streams also often have sufficient gradient and energy to easily move sediment if dislodged. Adherence to Forest Plan standards including BMPs would help to reduce impacts in all units with sediment increases.

3rd Order DBRUs

Appendix B contains information on 3rd order DBRUs that were evaluated for potential changes to stream channels to occur as a result of the concentration of treatment units. In addition, they were analyzed for increased sediment concentrations as a result of project activities.

Fifty of the 305 3rd order DBRUs were determined to have proposed units that would cover more than 25% of the drainage area possibly triggering the need for additional mitigation. Upon further review, 36 did not need additional mitigation because: loblolly pine was sparse enough

that residual vegetation would offset any potential water increases; and, in some instances, past loblolly removal activities had already reduced pine density and only minor additional manual follow-up treatments were needed. The small size of some DBRUs makes their impact on water yield or stream channel changes likely to be very small. Adverse effects would be reduced by following Forest Plan standards and BMPs. The remaining 14 DBRUs of concern were evaluated individually and information is presented below.

Table 3.1.2-4 displays nine of the fourteen 3rd order DBRUs of concern where treatment units cover more than 25 percent of the vegetation within the DBRU. To mitigate the potential for water yield change, only about half the treatment acreage in the drainages listed in Table 2.4-2 would be regenerated at any one time and at least three years would elapse before the remaining area would be regenerated. Six of the nine DBRUs would have vegetation treatments that range from 17 to 23 percent of the drainage per entry. The mitigation measure would allow some time for vegetation to recover and evapotranspiration rates to return toward normal before reentry in three or more years. This would reduce the potential risk for excessive water yield increases and adverse effects to stream channels. The potential for water yield increases would still occur in three very small DBRUs where it was not practicable to divide up harvest units into two entries.

Table 3.1.2-4 Third Order DBRUs Proposed for Mitigation

DBRU Number	Sixth Level Drainage Where Occurs
60102011202	Upper Chauga River
60102015401	Upper Chauga River
60102021604	Middle Chauga River
60102021502	Middle Chauga River
60102027027	Middle Chauga River
60102052301	Upper Tugaloo River
60102023303	Lower Chauga River
60102027002	Lower Chauga River
60102027029	Middle Chauga River

The remaining five 3rd order DBRUs could not be logically treated when dividing into additional units, so these were evaluated in the field by the hydrologist to determine stream stability. All streams had relatively stable channels and it is unlikely that they would exhibit noticeable changes as a result of cutting these units. Streambanks and upper channels were well protected with vegetation such as mountain laurel and rhododendron. Adjacent slopes also contained a mixture of mature native tree species, while loblolly pine trees were seldom present within the riparian corridor. The stream channels showed areas of local grade control with bedrock and/or tree roots and streambanks were generally stable. Almost all channels had localized bank erosion with substantial portions or dominance of substrate by sand particles, which is not atypical for mountain streams with presence of highly erodible or saprolite materials and the legacy of sediment issues. Signs of severe active degradation or aggradation typical of unstable stream systems were not present. The data suggests that these streams should be able to withstand temporary flow increases. No additional mitigation measures are necessary beyond Forest Plan standards and BMPs.

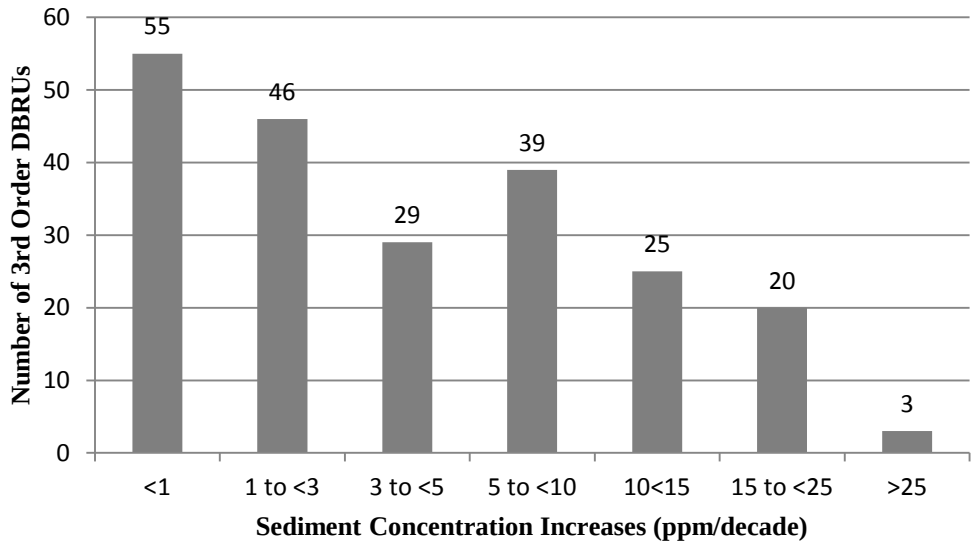
The increase in sediment within the 217 3rd order DBRUs with ground disturbing activities is estimated to be 7,800 tons over the decade. About 2/3 of the 33,400 acres within these DBRUs is national forest. Alternative 2 (Table 2.6-4) would have an average 10.7% increase in sediment delivered to these DBRU streams and 5.9 ppm increase in suspended sediment concentrations over the decade as compared to existing conditions in Alternative 1 (no action or current condition). On average, the mean increases in suspended sediment for 3rd order DBRUs over the decade would be minor and would generally not be noticed in streams.

Seven 3rd order DBRUs listed in Table 3.1.2-4 had sediment concentration increases above nine ppm. Applying the mitigation measure that would stagger cutting in these drainages would also reduce the potential increases in sediment as well. In addition, Forest Plan standards including BMPs would be very effective at reducing erosion, sediment delivery to streams and water yield increase effect, as this allows recovery time for one treatment before another treatment begins.

In alternative 2, 87 3rd order DBRUs had mean suspended sediment concentrations greater than or equal to five ppm or more above Alternative 1. Alternative 2 had somewhat more sediment than alternative 3 due in part to the proposed construction of system roads. Alternative 2 had six DBRUs with increases in sediment concentration for the decade greater than or equal to five ppm above alternative 3 and six DBRUs with the increases that were more than five ppm lower than those in alternative 3.

Figure 3.1.2-2 displays increased sediment concentrations in the 3rd order drainages.

Figure 3.1.2-2 Alternative 2 Sediment Concentration Increase by Category in 3rd Order DBRUs



Streams and Riparian Areas

Streams

Ground disturbance can increase erosion and sediment yields in areas where heavy equipment is used to cut, skid and transport trees or logs. Areas with extensive loblolly pine removal and a high density of roads and skid trails that occur in small perennial drainages with a dense stream network are of particular concern. Efforts to effectively drain skid roads into the forest filter, rather than connecting activities into the stream channel system are required under Forest Plan and BMP direction.

Maintenance on road surfaces may dislodge and expose fine materials and add sediment to localized drainages. Spot treatments, such as blading and shaping road surfaces expose fine aggregate material and soils that can erode and produce sediments that would be susceptible to forces of rainfall and runoff during storm events. Use of rock aggregate can protect the road surface and prevent wheel track rutting and the associated channelization of water on the road surface. Road maintenance also directs water off the road surface into vegetated areas and reduces sediment and other pollutants from entering streams directly.

Some increases in flow associated with roads and other impermeable surfaces would be reduced when these areas are properly drained with frequent flow diversions into forest buffers. In addition, flow increases would be reduced when temporary and closed system roads are re-vegetated and other erosion control practices are implemented. If culverts are left on upland areas, dips or other water diversions would be installed in the road surface to divert flow in case the unmaintained culverts become blocked. Ripping, disking, and re-vegetating compacted and exposed road surfaces would increase water infiltration rates and rapidly restore vegetative cover. Closing temporary roads following treatment would prevent continued use, protect newly established vegetation and eventually would allow shrubs and trees to become established.

Following cutting treatments, severe thunderstorms or tropical storms during the summer season can produce higher stormflows because groundwater levels and streamflow would be higher during the growing season for several years. Woodland treatments that are maintained with grass and forb understories and conversion from pine dominated plantations over extensive areas could result in stream channel changes. Increased soil organic matter that develops under hardwoods and native grasses does have the potential to improve water detention and retention capacity within the soils which may help to moderate this effect. There may be little difference in flow response during dormant periods. Overall, grassed lands produce 10-15% more water flow than hardwoods except in years when the grass density is increased in response to fertilization (Swank et. al,, 1988).

Stable streams could in many instances withstand short term or temporary water yield increases, but the biggest problem with added water yields would be in instances where streams and banks are already unstable. Increased water yields connected with higher flows such as a severe storm event are of special concern if the channel is unstable. Extended increases in bankfull flow volumes or frequency would eventually produce adjustments that may or may not produce changes in channel stability. Added scour along entrenched, exposed or unstable streambanks

can produce moderate to severe effects, however most channels in the activity areas are relatively stable. There are local circumstances where past agricultural activity has terraced slopes and altered stream location that have become unstable gully channels.

These potential adverse effects can be mitigated when treatment can be feasibly divided into two or more entries, such as cutting one side of a stream in one year, and the other side in 3-5 years. Where this can be done, it reduces the intensity of sediment and water yield increases by spreading the impacts over a longer period of time. However, under some circumstances dividing a harvest unit into two or more entries may not be practicable. For instance, reopening and disturbing a closed road with multiple entries could result in long term watershed effects. It makes more sense to reduce sediment load by just entering the area once as long as the stream is stable.

Field review was done for a number of stands where it was thought that dense stands of loblolly pine existed in the riparian areas. Upon examination, most of these stands were mixtures of native pines and hardwoods with only scattered loblolly pine. In these cases, the loblolly pine could be cut and removed or cut and left while minimizing damage to other overstory and understory trees. In places where dense loblolly pine patches occurs near streambanks and there are stream stability issues, some or all of the loblolly pine may be girdled or herbicide-killed instead of felled/removed. However, in field reviews, there were no instances of dense loblolly pine in riparian areas, but rather extremely infrequent loblolly pine within the riparian corridor.

Impacts from sediment would also be reduced by minimizing activity in the riparian corridor and maintaining its function as a vegetative buffer and filter zone. Minimal activity in the riparian area would also help to provide shade for streams and provide a long term supply of woody debris and organic material inputs for habitat. In addition to system and temporary road stream crossings, an estimated 15 intermittent stream crossings for skid trails would be needed to access portions of compartment/stand numbers 16/02, 25/24, 28/24, 29/01, 29/12, 31/02, 34/20, 38/40, 39/18, 48/01, 51/01, 51/04, 54/06, 54/13 and 58/14. The number and type of skid trail crossings would be designated during timber contract administration, based on site and stream conditions. The type of crossing would depend on site conditions such as streambank and bottom stability, slope of terrain leading to and out of crossing area, entrenchment and width of channel. Stabilization measures would be undertaken as soon as activity is completed. Utilizing temporary bridges where practicable would be another way to reduce channel and bank disturbance and maintain bank stability. It also avoids placing and removing fill material in riparian areas during culvert installations which can make its way into streams as sediment.

The effects of added flows would also be minimized by riparian buffers; leaving native trees and other vegetation along stream channels and streambanks during harvest operations. Bottomland areas with native pine and hardwood mixtures would have a water use rate similar to loblolly pine forest. Generally, the removal of sparsely distributed loblolly pine in riparian buffers would meet restoration needs and continue to protect riparian area resources by leaving native vegetation on the site. Sediments and road pollutants would also be filtered out within the forested riparian corridor before it reaches streams.
A variance may be needed infrequently to cut-and-remove or to cut-and-leave or otherwise kill loblolly pine that occurs within the primary SMZ of perennial streams if less than 50 BA/acre of

dominate residual live tree cover cannot be maintained following treatment. Joint meetings with US Forest Service personnel and South Carolina Forestry Commission indicate that most of the streams within this project proposal are ephemeral or intermittent. The South Carolina Forestry Commission has the option of issuing a variance from BMPs when it is determined that an alternative approach would effectively protect water quality in situations where it is not possible to meet the current BMP. A site specific review with the SC Forestry Commission BMP forester would be conducted and a variance would be issued if needed on a case-by-case basis (letter from SC Forestry Commission dated June 8, 2012).

Forest Plan standards FW-1 and FW-2 direct that BMPs, including Streamside Management Zones (SMZs), would be adhered to for forest management activities (USDA-FS, 2004b). When properly implemented, BMPs have been effective at protecting water quality and associated resources (Adams and Hook, 1993, Adams, 1994, 1996, Jones, 2000).

Riparian Areas

Eliminating loblolly pine in riparian areas as a seed source in the short term would help to meet the desired conditions in the Forest Plan for streams and riparian areas in the long term. Elimination of this nonnative species would allow growth of native hardwoods and evergreens, particularly hardwoods normally found in riparian areas and moist coves. Restoration of this habitat would lead to long term bank stability, provide a source of future down woody material to streams and serve to buffer streams activities in upland areas. In addition, low intensity management for many of these areas also suggests that some of these riparian areas may contribute to old growth in the future.

Vegetation within riparian corridors would be removed where needed to provide equipment access across the riparian corridors to the treatment areas that cannot reasonably be accessed from upland areas. There are some existing intact stream crossings in the project area that could be utilized. Stream crossings are avoided when possible, but when needed, crossings would be located, designed and implemented to reduce the impacts on streamflow and aquatic habitats and meet current Forest Plan standards including BMPs would be used. There would temporarily be an increase in turbidity and sedimentation in the waterway during the installation and removal of culverts. In some instances, portable bridges would be used and in small intermittent or ephemeral streams, fords would be allowed. Logs may be used without soil fill to provide for some stream crossing of ephemeral and intermittent channels when minimal impacts are likely and stability of the site can be maintained. Forest Plan riparian standards 11.-8, 11.-21, 11.-22, and 11.-23 including BMPs would be used to mitigate impacts from stream crossings within the riparian corridor. These standards ensure that:

- Stream crossings do not affect the passage of aquatic organisms.
- Temporary roads would be stabilized after their use, and culverts at stream crossings would be removed unless properly sized to remain in place.
- When necessary, minor adjustments in road locations may be made so culverts are installed in locations that minimize the need for fill material and minimize channel impacts.

- Streambanks and channels are restored to a pre-project or natural size and shape and fill material is removed from the floodplain and stabilized.

Vegetation adjacent to streams provides a source of organic matter input which is important for aquatic organisms. Vegetation also protects streams from solar heating and streambank failure. Cooler water temperatures maintain dissolved oxygen levels needed to maintain aquatic life and habitats.
The amount of actual riparian corridor or SMZ area that would be affected by proposal, based on selected field review areas with loblolly pine are minimal. Field review by specialists did not find any areas where loblolly pine treatments were going to have a substantial effect on riparian resources or streamside ground cover, disturbance, shading or bank stability. Localized effect from cutting, removal or other treatment of a few dispersed loblolly pine trees may be expected.

Approximately 220 acres of riparian corridor are within project areas as estimated by GIS analysis. This acreage is primarily small inclusions within stands. No riparian inclusions to be treated are over 10 acres. Most stands had riparian inclusions that were less than one acre in size. Many of these areas are dominated by hardwoods where cutting and removing, felling and leaving or girdling loblolly pine would be minimal within streamside areas.

The riparian prescription in the Forest Plan maximizes protection of the rivers, streams, creeks, channels, springs, floodplains and wetlands bordering management activities to ensure water quality and aquatic and riparian habitat are maintained or improved throughout the forest. The BMPs are designed primarily for water quality protection during management activities. When used together, Forest Plan standards and BMPs protect and enhance riparian conditions. Activities within the riparian corridor, streamside management zones and scoured ephemeral channel buffers would be limited in extent and level of ground disturbance.

Herbicide Applications

The herbicide risk assessment is located in the project file. Herbicide treatments include a limited potential for water quality (surface and ground water) contamination from low volume foliar spray from backpack sprayers and squirt bottle applications. Stem injection or cut-surface methods are more precise applications and have very low potential for drift or non-target application.

Application rates for foliar treatment for imazapyr and triclopyr ester were estimated at 0.16 and 0.63 pounds/acre, respectively, while the cut surface treatment rates were 0.022 and 0.18 pounds per acre of imazapyr and triclopyr amine, respectively. These application rates are much lower than broadcast methods which further reduce the potential for detectable contamination in comparison to broadcast methods common to some other land use applications. In just a one inch rainfall event on one acre, there would about 220,000 pounds of water available to dilute any herbicide rinsed off, and normally in forest conditions the rainfall would be absorbed into, retained, detained or otherwise filtered through the soil as there is very little direct runoff. Under this scenario, without any consideration for plant uptake, breakdown in the water or absorption and filtering in the soil, the amount of dilution alone for the foliar treatment would result in a concentration of less than 3 ppm for the triclopyr ester and less than 1 ppm for the imazapyr. The

dilutions are greater and maximum concentrations lower for the cut surface treatments. In actuality, most of the herbicide is absorbed into the treated plant so substantially less than the applied rates would be available for discussion for being washed off, mixing with rainfall, being retained on litter, mixing with soil water, adhering to soil particles, being absorbed by roots and breaking down by sun, biological or other processes. Over just a one year period, the amount of rainfall on that acre would exceed 10 million pounds, so the potential for residual concentrations, not taking into account the breakdown rates, absorption or other factors, continues to decrease with time and storm events as the potential for dilution continues.

Imazapyr binds loosely to clay particles and organic matter and can be highly available in the environment. Imazapyr is unlikely to move from treated areas into streams, especially considering buffer zones between treated areas and streams and the low rate of treatment. Despite its potential mobility, imazapyr has not been reported to be a problem in water runoff. The half-life of imazapyr in water is about two days. Triclopyr would not be a leaching problem under normal conditions since it binds to clay and organic matter in soil. Again, buffer zones between treated areas and streams and the low application rates with the spot treatments make it even less likely that triclopyr would enter streams. Sunlight rapidly breaks down triclopyr in water. The half-life in water is four days.

Herbicide applications would follow label requirements and Forest Plan standards and mitigation measures (see herbicide Risk Assessment in the analysis file). These criteria require mix water to be brought to the application site and vehicles are required to park a minimum distance from bodies of water and streams. Mitigation measures would also limit use on windy days and before or during rain storms. Applications would focus on target plants, but still may offer minimal potential for herbicide drift or wash-off. Careful attention to weather including temperature, wind speed and humidity measurements, and adhering to Forest Plan standards would limit effects.

The dispersed nature of herbicide application directed at individual plants or groups of plants in combination with the low volume application rates present a low risk of pollution to surface or ground water. The application of herbicide to treat individual plants would not create any discernible ground disturbance or erosion. Additional effects of herbicides are contained in *Vegetation Management in the Appalachian Mountains Environmental Impact Statement* (VMEIS).

Spill plans and contingencies would be included to reduce impacts on the environment from potential spills. Herbicide treatment leaves the forest litter, duff and humus layers intact. Water yield increase would be minimal since mainly woody stems or needle surfaces would be targeted. Grass and shrubs would be left to occupy the site.

Only loblolly pine would be targeted with herbicides in riparian areas. The potential for herbicide to enter streams is low by following Forest Plan standards and site-specific mitigation that restricts applications to only the cut-surface or stem injection methods in riparian areas (no foliar spray). The riparian corridor would absorb the limited movement without noticeable effect on land or aquatic vegetation. Based on the low stream concentrations measured in previous studies, along with dilution and flow of stream, soil absorption and biological breakdown rates,

herbicide contamination of water quality should be difficult to detect and temporary in nature (Brown and Binkley, 1994).

Effects of Mitigation Measures

Measures that reduce impacts to water quality and ensure channel stability in the project area are identified in Forest Plan standards, BMPs, Region 8 Soil and Water Conservation Practices Guidance, National Best Management Practices and in normal contract language for timber sales, road construction/maintenance and other ground disturbing activities.

After commercial harvest is completed, skid roads and trails, landings and temporary roads would be closed and re-vegetated to reduce erosion, sediment and water quality effects. These areas would use dips, diversions or water-bars, disked, fertilized and seeded with an appropriate grass mixture and mulched, when needed. Mitigation measures would include minimizing exposed bare soil and concentrated water flow that lead to erosion and sediment delivery to streams. Diverting and draining water off of roads, skid trails and landings in small amounts into forest or vegetated areas reduces water flows that contribute to soil erosion and avoids connectivity in order to prevent sediment delivery to streams. Temporary bridges or culverts that reduce the extent and impact of filling adjacent to streams would be employed as feasible to help limit effects. New system roads would be constructed and maintained accordingly. Temporary roads and skid trails would be closed after use and stabilized, including removal of culverts as necessary.

Mitigation measures would be used in riparian areas to reduce impacts from project activities and to meet resource objectives as defined in the management prescription in the Forest Plan. In infrequent instances, loblolly pine may have been planted in or found a way to spread into the riparian corridor or the streamside management zones. If needed, a variance from BMP requirements for residual basal areas along perennial streams would be obtained from the SC Forestry Commission after on-site review. Loblolly pine would be girdled or killed with herbicide and left standing if it is not possible to commercially remove them without causing undo disturbance. This would limit adverse impacts to stream shade, bank stability and water quality in the SMZ.

Mitigation is planned for the identified small 3rd and 4th order perennial drainages (Drainage Basin Response Units – DBRUs) where activities would be concentrated and there is potential risk of higher water yield having effects on stream channels. Mitigation would not be needed in instances when stream channels are stable. Staggering units temporally and geographically would spread out streamflow increases over a longer time period. This would reduce the potential for flow increases that could affect channels. Field reviews indicate that most of the loblolly plantations were located on broad flat ridges and streamside vegetation consists mostly of native hardwoods and pines. In some rare cases, this native riparian vegetation is 400 to 600 feet wide on either side of the streams. This vegetation would remain largely unaltered by the proposed activities, and would contribute toward bank stability. Given the current stable nature of stream channels observed during field observations in 2011-2012, and provided that Forest Plan standards, BMPs, and mitigation measures specific to this project would be followed, temporary to short-term effects have been noted, but long term adverse effects are unlikely.

Cumulative Effects of Alternative 2

Past, present and foreseeable activities on federal and private lands have been evaluated at the fifth level watershed for the Chauga and sixth level subwatersheds where activities are proposed. In addition, cumulative effects analysis was completed at the 3rd and 4th order DBRU. Detailed information is contained in Appendix B relative to all sediment sources. Information is displayed as tons of sediment , percent increase in sediment over the decade over Alternative 1 (no action or existing conditions) and mean sediment concentration (ppm) for the decade. Erosion and sediment contributions from private lands are displayed separately.

5th Level Watersheds

The Chauga fifth level watersheds had the highest amount of area proposed for treatments. The other fifth level watersheds had minimal acres impacted and did not show measureable changes at the fifth level HUC. Therefore, all impacted drainages were also analyzed for cumulative effects at the sixth level HUC and at the 3rd and 4th order DBRU scale to determine measurable impacts. For the Chauga watershed, past, present and future projects would contribute an estimated 242,658 tons of sediment over the decade and a sediment concentration of 68.6 ppm under alternative 2. It is calculated, that over the decade, that there would be less than two percent increase in sediment load and the increase in mean sediment concentration would be 1.34 parts per million (ppm). These temporary increases are not measurable at this scale, and would not be noticed. The Chauga River and many tributaries are going to be turbid or have a high enough sediment load during storm events that makes seeing the stream bottom difficult, except in shallow water. Non-storm periods would have some turbidity and sediment, but the channel bottom would be evident in most places. Low flow periods would in most instances maintain the clarity and low turbidity water quality common to mountain streams.

Sixth Level Subwatersheds

The highest increase among the sixth level watersheds would be the Middle Chauga River with an estimated 7.4 percent increase in sediment loading over the decade and three ppm increase in suspended sediment over the same time period. Past, present and future projects would increase sediment levels from 39.5 ppm to 42.5 ppm (Table 2.6-3). This is a short term increase that would have minor effects to the stream. The other 6th level watersheds would be impacted even less and in some cases project effects are not measureable at this scale.

4th and 3rd Order DBRUs

Table 2.6-4 displays a summary of cumulative increased sediment concentrations over a decade based on activities proposed with Alternative 2 for 3rd and 4th order DBRUs. Appendix B contains information on individual watersheds and includes past, present and future impacts on tons of sediment over the decade, sediment increases and sediment concentrations.

- The estimated average suspended sediment concentration based on existing, ongoing and planned activities for the 3rd order DBRUs was 46.5 ppm with sediment concentrations ranging from a low of 5.3 ppm to a high of 117.5 ppm. The total current sediment load for the 217 3rd order drainages was estimated at 80,353 tons over the decade for this alternative plus all other past, present and future actions.

  The estimated average suspended sediment concentration based on existing, ongoing and planned activities for the 4th order DBRUs was 48.4 ppm with sediment concentrations ranging from a low of 10.5 ppm to a high of 103.9 ppm. The total current sediment load for ground disturbance was estimated at 68,065 tons over the decade for this alternative for the 64 fourth order drainages. The increase in sediment from activities planned is 4,379 tons over the decade, or an average increase per DBRU in suspended sediment concentration of 3.5 ppm. The range and levels of increase are presented in Figure 3.1.2-1.

Sediment increases would be evident in these smaller drainages as treatment units are harvested. However, drainages have substantial native forest vegetation along stream channels that would be left intact and only non-native loblolly pine would be harvest where possible or killed by girdling or felling and leaving on site. In addition, Forest Plan standards including BMPS would help to limit adverse effects and hasten recovery from disturbance. Many of the drainages reviewed in the field indicated that streams were stable native vegetation was substantially wider along stream corridors than riparian buffers or SMZs.

Streams and Riparian Areas

Past and present projects when combined with this proposal would continue to protect streams and riparian areas. Forest Plan standards including BMPs place particular emphasis on protection and management of these areas. In addition, site-specific mitigation measures have been developed to protect streams and riparian areas. Adverse cumulative effects to streams and riparian areas beyond existing conditions are unlikely.

Direct and Indirect Effects of Alternative 3

The effects associated with alternative 3 are the same as alternative 2 with the exception that:

- Temporary roads would be used for access to some harvest units in lieu of construction of system roads.

- More acres are proposed for woodland treatments in order to increase vegetative diversity and to protect/enhance habitat conditions for smooth coneflower (federally listed species) populations.

- More emphasis would be placed on managing desirable existing native vegetation appropriate to site conditions, e.g., on wetter sites, mesic species such as yellow poplar would be favored if present.

- Approximately 2,121 more acres would be considered for herbicide use as needed for site preparation and for release of desirable crop trees.

5th Level Watersheds

The Chauga River fifth level watershed is 70,776 acres in size and has the highest intensity of proposed activities with 3,636 acres of treatment or 5.1% of the watershed. The Chauga River had the greatest potential for impact and it was assessed in more detail with results indicating an increase of 4,093 tons of sediment and a 1.16 ppm increase (67.2 ppm to 68.4 ppm) in suspended sediment concentration based on sediment delivered to DBRU size streams within the watershed. This amount of increase is small and not significant.

6th Level Subwatershed

The effects of estimated sediment delivered to streams within the sixth level subwatershed (Table 2.6-3) from proposed activities change water quality very little as evidenced in the small increases (from less than one to three ppm) in estimated sediment concentrations. When compared to alternative 2, sediment changes in alternative 3 are only slightly different (small increase in some drainages and slight decreases in others); essentially resulting in no measureable changes to effects between the two action alternatives. These changes would not be noticed and would be difficult to measure the difference. In actuality, sediment concentrations would be even less within the main stream channel as sediment would be retained in the margins and on the floodplain as evidenced in sediment delivery ratios that decrease with watershed size (Roehl, 1962).

4th and 3rd Order DBRUs

4th Order DBRUs

Appendix B contains information on 4th order DBRUs that were evaluated for potential changes to stream channels to occur as a result of the concentration of treatment units. In addition, they were analyzed for increased sediment concentrations as a result of project activities as compared to the current level of land use estimated erosion and sediment effects provided in Alternative 1.

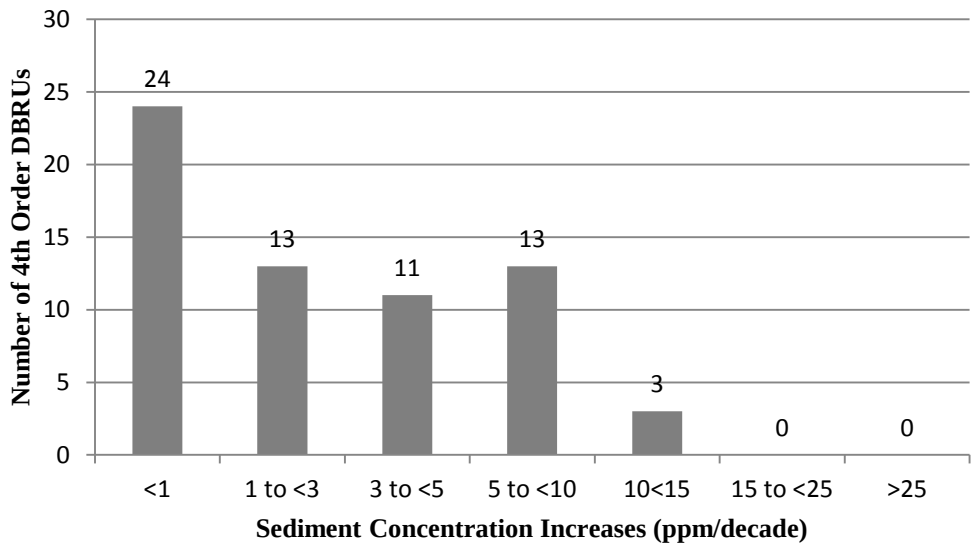
Table 3.1.2-3 displays the eight 4th order DBRUs where treatment units would be staggered over at least three years and no more than half of the area in the drainage would be cut at any one time. This mitigation measure would allow some time for vegetation to recover and evapotranspiration rates to return toward normal before reentry. This would reduce the extreme

in water yield increases and reduce the potential for adverse effects to stream channels. Treatment activities in the remaining drainages would proceed without any additional mitigation measures except as further addressed for specific 3rd order channels. Instead, as discussed earlier in this section, adherence to Forest Plan standards including BMPs would reduce adverse effects to stream channels.

Four of the 4th order DBRUs listed in Table 3.1.2-3 also have some of the highest mean sediment concentration increases. Staggering treatment entries in these drainages would also help to reduce sediment concentrations as well.

Figure 3.1.2-3 displays the range of sediment concentration increases as a result of implementing the alternative.

Figure 3.1.2-3 Alternative 3 Sediment Concentration Increase by Category in 4th Order DBRUs



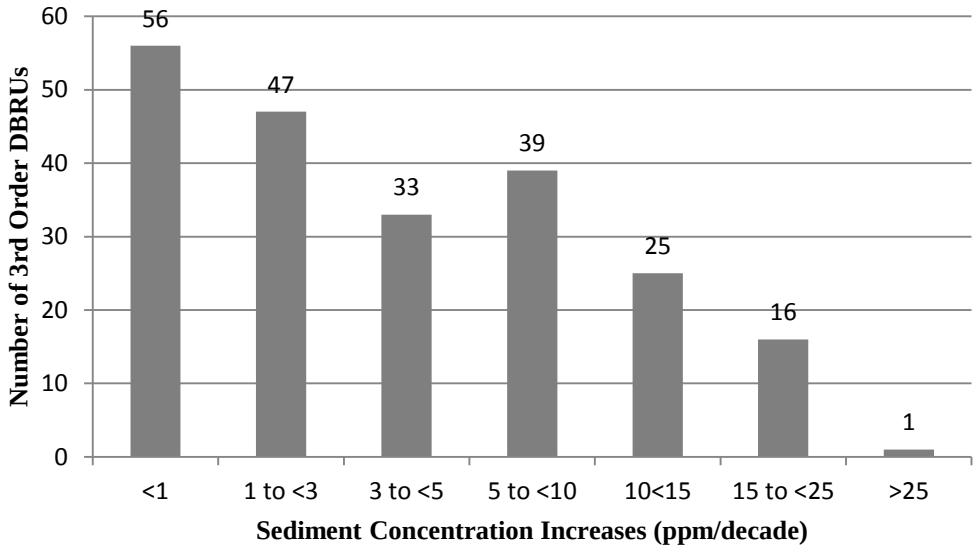
Sediment concentrations increases range from 0 ppm to 11 ppm with an average increase of 3.0 ppm. Under alternative 3, two more 4th order DBRUs with sediment increases of less than 10 ppm as compared to alternative 2 were calculated. There is a reduction in sediment increases at the high end (10<15 ppm) on two 4th order DBRUs as compared to alternative 2.

3rd Order DBRUs

Appendix B contains information on 3rd order DBRUs that were evaluated for potential changes to stream channels to occur as a result of the concentration of treatment units. In addition, they were analyzed for increased sediment concentrations as a result of project activities. Alternative 3 had less sediment overall as compared to alternative 2, but it had more sediment associated with temporary roads than alternative 2. As temporary roads are closed and re-vegetated, their effects would diminish rapidly as compared to alternative 1 where new system roads would continue to chronic sources of sediment to streams in the long term.

Of the 3rd order DBRUs analyzed for activities relative to the proposed actions, 206 had estimates indicating higher levels of road sediment in Alternative 3 as compared to Alternative 1. In alternative 3, 81 DBRUs had mean suspended sediment concentrations greater than or equal five ppm or more above Alternative 1. Alternative 3 had six more DBRUs than alternative 2 where increases in sediment concentration for the decade were less than five ppm. Sediment levels in Alternatives 3 and 2 were the same in 146 DBRUs, suggesting that the activities are the same in these action alternatives relative to ground disturbance.

Figure 3.1.2-4 Alternative 3 Sediment Concentration Increase by Category in 3rd Order DBRUs



Streams and Riparian Areas

The effects described in alternative 2 apply here as well.

Herbicide Applications

This alternative has the potential to apply more herbicide than alternative 2. However, this alternative would rely on site-specific conditions to determine how much of the area would actually need to be treated. Site conditions would be evaluated relative to desirable species that need to be favored and released from competition or to prepare the site for planting.

The herbicide risk assessment is located in the project files and discloses the application rates of active ingredient and the method of application. There would be no broadcast application of herbicide and all applications would target the specific vegetation necessary to prepare the site for planting or to release desirable crop trees. In all applications, residual loblolly pine would be targeted for removal. Measures to protect water and buffer areas from direct applications are included with treatment plans. Spill and other contingency plans are developed and included prior to treatments. Work is conducted under direction from a certified USFS applicator.
The effects described in alternative 2 apply here as well.

Effects of Mitigation

The effects of mitigation described in alternative 2 apply here as well.

Cumulative Effects of Alternative 3

Past, present and foreseeable activities on federal and private lands have been evaluated at the fifth level watershed for the Chauga and sixth level subwatersheds where activities are proposed. In addition, cumulative effects analysis was done at the 3rd and 4th order DBRU. Detailed information is contained in Appendix B. Information is displayed as tons of sediment , percent increase in sediment over the decade over Alternative 1 (no action or existing conditions) and mean sediment concentration (ppm) for the decade. Erosion and sediment contributions from private lands are displayed separately

5th Level Watershed

The Chauga fifth level watersheds had the highest amount of area proposed for treatments. The other fifth level watersheds had minimal acres impacted and did not show measureable changes in sediment concentrations. Therefore, the Chauga was the only drainage analyzed at the fifth level hydrologic scale. For the Chauga watershed, past, present and future projects would contribute an estimated 242,006 tons of sediment over the decade and a sediment concentration of 67.2 ppm under alternative 2. It is calculated, that over the decade, that sediment from project activity would be less than two percent in alternative 3 and increases in mean sediment concentration would be 1.2 parts per million (ppm). These temporary increases are not measurable at this scale, and would not be noticed. The Chauga River and many tributaries are going to be turbid or have a high enough sediment load during storm events that makes seeing the stream bottom difficult, except in shallow water. Non-storm periods would have some turbidity and sediment, but the channel bottom would be evident in most places. Low flow periods would in most instances maintain the clarity and low turbidity water quality common to mountain streams.

Sixth Level Subwatersheds

The highest increase among the 6th level watersheds in Alternative 3 would be the Middle Chauga River based on acres with activities with an estimated six percent increase in sediment loading over the decade and 2.6 ppm increase in suspended sediment, both slightly less than Alternative 2. Past, present and future projects would increase sediment levels from 39.5 ppm to 42.1 ppm (Table 2.6-3). This is a short term increase that would have minor effects to the stream. The other 6th level watersheds would be impacted even less and in some cases project effects are not measureable at this scale.

4th and 3rd Order DBRUs

Table 2.6-4 displays a summary of cumulative increased sediment concentrations over a decade based on activities proposed with Alternative 3 for 3rd and 4th order DBRUs. Appendix B

contains information on individual watersheds and includes past, present and future impacts on tons of sediment over the decade, sediment increases and sediment concentrations.

- The estimated average suspended sediment concentration based on existing, ongoing and planned activities for the 3rd order DBRUs was 45.9 ppm with sediment concentrations ranging from a low of 5.4 ppm to a high of 117.3 ppm. The total current sediment load for the 217 3rd order drainages with ground disturbance was estimated at 79,232 tons over the decade for this alternative plus all other past, present and future actions. This is an increase of estimated sediment of 6,637 tons over the decade over Alternative 1 and 1,122 tons less than Alternative 2.

- The estimated average suspended sediment concentration based on existing, ongoing and planned activities for the 4th order DBRUs was 48.0 ppm with sediment concentrations ranging from a low of 10.5 ppm to a high of 104.0 ppm. The total current sediment load for ground disturbance was estimated at 67,526 tons over the decade for this alternative plus all other past, present and future actions. This is an increase of 3,840 tons over Alternative 1 and 539 tons less than Alternative 2.

Sediment increases would be evident in some of these smaller drainages as treatment units are harvested. However, drainages have substantial native forest vegetation along stream channels that would be left intact and only non-native loblolly pine would be harvested where possible or killed by girdling or felling and leaving on site are options that can be used to reduce ground disturbances. In addition, Forest Plan standards including BMPS would help to limit adverse effects and hasten recovery from disturbance. Many of the drainages reviewed in the field indicated that streams were stable native vegetation was substantially wider along stream corridors than riparian buffers or SMZs.

Streams and Riparian Areas

The cumulative effects described in alternative 2 apply here as well.

3.1.3 Air

Affected Environment

The alternative treatments are proposed to occur within Oconee County, South Carolina. The county has been classified by the Environmental Protection Agency (EPA) as attaining the National Ambient Air Quality Standards (NAAQS) for ground-level ozone. The county is unclassified for fine particulate matter (PM2.5) because no ambient PM2.5 monitoring is currently being conducted. This analysis will focus on the potential cumulative impact of the alternatives on fine particulate emissions and the potential to adversely impact air quality. Information is also provided for carbon dioxide and methane emissions because these greenhouse gases are known to contribute climate change.
The criteria pollutants of most concern on the Sumter National Forest are particulate matter and ozone. Levels of these two pollutants are measured at air monitoring sites near all three districts

of the National Forest. The two main activities that cause air pollution within the Sumter National Forest are vehicular traffic and prescribed fires. Both of these activities emit pollutants that can increase ozone and fine particulate matter concentrations. Fine particulate matter is the leading cause of regional haze (also known as visibility impairment), while ozone can harm sensitive vegetation within the forest. Additionally, at elevated concentrations these two pollutants can impair the health of both employees of and visitors to the National Forest. All air quality monitors near the Sumter National Forest show that ozone and fine particulate matter concentrations meet air quality standards, and no negative impacts to either visitors to the Forest or to vegetation within the Forest are expected.

Direct and Indirect Effects of Alternative 1

No adverse impacts on air quality under Alternative 1 would be anticipated.

Cumulative Effects of Alternative 1

Existing prescribed burning activities would continue on national forest system lands around and within the project area. The annual monitoring report for the Forest will continue to monitor air quality on the District. The entire Sumter NF is classified as being in attainment for all six criteria pollutants (USEPA, 2002; USDA, 2001c).

Direct and Indirect Effects of the Action Alternatives

Cut and remove and cut and leave regeneration and woodland treatments would be conducted with the sustained use of heavy machinery which generates emissions in a localized area. Minor and temporary increases in carbon monoxide (CO), nitrogen oxides (NO_x) and hydrocarbons would occur as a result of proposed on-site operations.

In addition to tailpipe emissions from heavy equipment, increased vehicle traffic along paved, unpaved (dirt), and gravel roads, as well as the temporary disturbance of ground surface during vegetation management activities, could potentially cause increases in fugitive dust. These impacts would be temporary and limited to periods of high vehicle traffic and activity.

Construction of new roads in alternative 2 would add minor additional long term sources of tailpipe emissions form vehicle use on these roads. However, most of these new roads would be closed to public traffic so addition pollution would be minimal. Minor and temporary increases in carbon monoxide (CO), nitrogen oxides (NO_x) and hydrocarbons would also occur as a result of proposed road reconstruction and maintenance operations; however, these operations would occur over a comparatively short time period and would not likely result in substantial effects to air quality.

Effects on air quality from proposed activities and connected actions would be temporary; no long-term effects would result.
Cut and remove treatment units would typically be whole-tree-skidded to landings. Where logging slash would initially be concentrated. Slash at the landing would be scattered back out

into the unit along skid trails and broken up into small pieces, arranging fuels in a way that would not burn at a high intensity where prescribed burning occurred. In addition, rapid decomposition rates along with the limited number of acres that are within prescribed burn units would result in minimal short term impacts to air quality.

Cut and leave treatments would result in accumulations of woody material on the ground. Residual down woody material in the woodland units would be subsequently treated during woodland maintenance work. This would reduce the amount of material available for burning. Cut and leave material fuel loadings would vary from SB1 to SB3 (*Standard Fire Behavior Fuel Models: Comprehensive Set for Use with Rothermel's Surface Fire Spread Mode 2005*) on cut and leave units. These categories define activity fuels relative to the tons per acre of fine fuels, size of material and fuel depth. Prescribed burning immediately after treatments are completed would temporarily increase fire intensity. However, scheduling treatments immediately after burning and burning with higher fuel moistures would help to reduce fuel intensity

The action alternatives would result in nearly the same effects to air quality. Periodic prescribed fires have the potential to create temporary minor impacts to localized air quality. The changes are dependent on weather conditions, timing, characteristics of the area (fuel loadings and time period since last burning) and the size of the area being burned. In general, impacts are most frequent in the local area of the burn where large quantities of smoke can be produced over a short period of time (USDA, 1989a). Prescribed burning would only take place when conditions are favorable for smoke dispersal.

Additional detailed discussion and analysis of the potential impacts from prescribed fire on air quality are discussed in the *Guide to Prescribed Fire in the Southern Forests* (USDA, 1989a) and the *Vegetation Management of the Coastal Plain/Piedmont EIS* (USDA, 1989b). Detailed analyses from these documents are incorporated by reference.

Cumulative Effects of Alternatives 2 and 3

The Sumter National Forest Monitoring and Evaluation Annual Report for Fiscal Year 2011 (2011 Monitoring Report) summarizes information related to air quality on the Enoree RD. The SC Forestry Commission uses a permitting process to regulate prescribed burning on National Forest and private lands to ensure compliance with the Clean Air Act and the NAAQS.

Alternatives 2 and 3 have the potential to increase annual PM2.5 emissions released in Oconee County above the amount currently (Alternative 1) being released by prescribed fires from the USDA Forest Service on the Andrew Pickens Ranger District. This is because cut & remove and cut & leave treatments would create additional slash that would be available for burning. Utilizing the results from the Consume 3.0 model (Ottmar and Prichard, 2008), Alternative 2 may increase annual fine particulates, carbon dioxide, and methane emissions by 38%; while Alternative 3 is estimated to increase annual emissions by 17% above Alternative 1 (Table 3.1.3-1). Utilizing the 2008 National Emissions Inventory results for Oconee County, this represents a seven percent increase in annual county-wide PM2.5 emissions for Alternative 2 and a three percent increase in PM2.5 annual county-wide emissions for Alternative 3. Therefore, it is unlikely Alternative 2 or Alternative 3 would significantly impact air quality on an annual basis

within Oconee County. The small increase in carbon dioxide emissions released from the project is unlikely to contribute to global climate change because over time the new growth in vegetation within the treatment areas will utilize carbon dioxide from the atmosphere in an amount that equals or exceeds the amount released from any of the three alternatives.

Table 3.1.3-1. Estimates of Fine Particulate ($PM_{2.5}$), Carbon Dioxide (CO_2), and Methane (CH_4) Emissions from Each of the Three Alternatives on the Andrew Pickens Ranger District.

			Total Emissions (tons)*		
	Burn Area	**Acres**	**$PM_{2.5}$**	**CO_2**	**CH_4**
Alternative 1	landscape	2,500	224	44,724	134
	cut and leave	0	0	0	0
	Total	2,500	224	44,724	134
Alternative 2	landscape	1,963	176	35,117	105
	cut and leave	537	133	26,382	80
	Total	2,500	309	61,499	186
	% Increase		38%	38%	38%
Alternative 3	landscape	2,131	191	38,123	114
	cut and leave	369	71	14,133	43
	Total	2,500	262	52,256	157
	% Increase		17%	17%	17%

***** Estimates are based upon Consume 3.0 (Ottmar and Prichard, 2008) results for 20 percent fuel moisture for 1,000-hour fuels.

A mosaic of privately owned and federal land is located within the project area. Prescribed burning has occurred in this area and will continue into the foreseeable on NFS lands. Future burning would occur on areas that have been periodically burned in the past so there would be no net increase in total burn areas as the result of this project. Cumulative impacts from this project and other ongoing activities would not substantially impact air quality. No exceedence of air quality standards is expected.

Air quality would continue to be monitored on the Forest following current protocols and reporting would be done on a yearly basis. This would provide information on impacts and trends in air quality from management activities and the need for adjustments in the burning program on the District and Forest. The annual monitoring report for the Forest will continue to monitor air quality on the District.

3.1.4 Climate Change and Carbon Storage

Affected Environment

On January 16, 2009 the Chief of the Forest Service directed the National Forests to consider Climate Change during project planning. National Forests were directed to consider two types of climate change effects.

- The effect of climate change on a proposed project
- The effect of a proposed project on climate change

The affected environment for climate change is two-fold. First, climate change may affect the natural resources on the Andrew Pickens Ranger District. In this case the affected environment of climate change is limited to the national forest land within the Andrew Pickens. Secondly, the proposed management activities on the Andrew Pickens Ranger District would have some potential to affect greenhouse gas (GHG) emissions, release stored carbon and to affect carbon sequestration and storage on national forest lands in Oconee County. In this case the affected environment is global. Also forest evapotranspiration impacts atmospheric water vapor, cloud cover and precipitation. In this case the affected environment is regional.

Existing Impacts to the Environment

Climate Change Effects on Forests

US Global Changes Research Program published a 2009 report on climate changes in the United States for different regions. Predictions for the Southeastern United States include: air temperature increases; sea level rise; changes in the timing, location, and quantity of precipitation; and increased frequency of extreme weather events such as hurricanes, heat waves, droughts and floods.

- This climate change variability may manifest in long-term and seasonal patterns in temperature that influence ecosystem health and function. These impacts result from both long-term warming and from shorter term fluctuations in seasonal temperature that may interrupt or alter temperature-dependent ecosystem processes. For instance, late spring freezes may kill blossoms on trees disrupting their seed production and affecting food for wildlife. Another example is that the first fall frost may occur later, lengthening the growing season and affecting dormancy of trees or certain wildlife species.
- Climate change variability can affect the patterns of droughts and floods, which in-turn may alter hydrologic characteristics of watersheds with long-term implications for renewable resources, aquatic and terrestrial ecosystems and human health. Another aspect of climate change variability is an increase in the intensity of storm events and an increase in the amount of time between rainfall events. Climate change predictions for the Southeastern United States include decreased water availability due to increased temperature and longer periods of time between rainfall events (US Global Change Research Program 2009). Even if rain fall increases, water availability may still decrease due to increased air temperature. These changes would affect water flows on rivers on the

Andrew Pickens RD. The increased intensity of hurricanes would create extremes in water flows in the headwaters of the rivers.

In general, species are expected to move northward in latitude and upward in elevation, but some species will expand in range while others contract as habitat suitability changes (Malmsheimer et al 2008). Animals as well as plants will be either be forced to adapt to new climate conditions or shift their ranges to more favorable conditions. As a result of climate shifts, some species may go extinct or become extirpated in portions of their current range as access to suitable habitat becomes more limited.

- Forest fragmentation and the anticipated rate of climate change will limit the ability of some plant and animal species to migrate.
- Narrow habitat requirements, such as species located exclusively at high elevations, or a limited ability to disperse their propagules across long distances will reduce their migration to suitable habitats.

Climate change will likely pose a severe risk to the viability of certain tree species, particularly forest tree species with limited ranges and restricted ability to migrate. As ranges of these at risk trees become smaller, these patches of trees may become genetically isolated or more susceptible to insect and disease outbreaks.

Warmer summers predicted for the East will affect available soil moisture and affect net productivity (Morris and Walls 2009). Insect populations are controlled by cold winter temperatures and warmer winters could lead to more insect outbreaks. Warmer, longer summers can also lead to increased number of insect generations per year. Also, the timing of insect outbreaks and predator migration may become misaligned. The insects may begin reproducing before the birds arrive, leading to increased outbreaks. Another possible effect is the changes in rainfall patterns could affect hemlocks already weakened by hemlock wooly adelgid. A combination of increasing air temperatures, more extremes in rainfall events and extensive mortality of hemlock sets the stage for increased wildland fires.

Potter, Hargrove, and Koch (2009) note similar climate change impacts (increasing air temperatures and the changes in rainfall patterns) on Southern Appalachian forests. The authors report that climate change will probably threaten the viability of certain forest trees, which will be forced to adapt to new conditions or to move to more favorable environments, which may require human assistance. Several tree species of central and southern Appalachian forests are at risk since they occur in limited high elevation ranges and/or threatened by nonnative insects and diseases. The Carolina Hemlock is one of these at-risk tree species that may not adapt to new climate conditions, which would ultimately result in population extirpation of the Carolina Hemlock. Table Mountain pine and striped maple are less likely to experience range-wide extinction, but could have the southern and central Appalachian populations eliminated, which includes the Andrew Pickens Ranger District. These tree species would eventually be replaced by other species, which would adjust to the new conditions.

Management Activity Effects to Climate Change and Carbon Storage

Forests play a role in stabilizing the earth's climate and management can enhance that role. National Forests can reduce Greenhouse Gas (GHG) emissions and atmospheric GHG's while providing environmental and social benefits, including clean water, wildlife habitat, recreation, forest products and other uses (Malmsheimer, et al 2008). When thinking about offsetting fossil fuel emissions, the "sequestration rate" or the change in carbon stocks over time is critical. If the amount of carbon is increasing, it is offsetting emissions; if the amount is decreasing, it is contributing to emissions.

When considered in total, forests in the United States currently take up more carbon via photosynthesis and store it in living trees and soil than they release through decay and respiration. It is important to note that this is a net amount: some individual forests may act as sinks, while others act as "sources" (releasing more greenhouse gases than they provide) (USDA Forest Service 2010). U.S. forests and forest products currently offset 12-19% of U.S. fossil fuel emissions, largely owing to recovery from past deforestation and extensive harvesting (Ryan et al 2010). Southern forests cover the greatest area in the conterminous U.S. and form a strong carbon sink because of their young age structure (resulting from past human disturbance) and very active forest management in this region (McKinley et al 2011). About 13 million hectares of southern forests are in pine plantations and include some of the more intensively managed forests in the world.

How long will U.S. forests remain a carbon sink? Since 1940, forest regrowth in the U.S. has recovered about a third of the carbon lost to the atmosphere through the deforestation and harvesting that occurred from 1700-1935 (Ryan et al 2010). Today's recovery from the forest clearing and wood-based economy of the 1800s and early 1900s will likely sustain carbon storage rates at the current rate for decades, but not indefinitely. Even under the best scenarios, the amount of carbon storage potential is finite. Strategies that combine increased use of forest products to offset fossil fuel use (such as use of biomass energy and substitution), in conjunction with increasing carbon storage on forested landscapes, are likely to produce the most sustainable forest carbon benefits.

Forest Products - Forest can reduce GHG emissions by substituting wood for fossil-fuel intensive products and storing carbon:

- Lumber, wood panels and other forest products used in construction emit less GHG's and use less fossil fuel than steel, concrete, brick or vinyl. While wood product substitution does not permanently eliminate carbon from the atmosphere it does sequester carbon for the life of the product.
- Timber harvest residues can be used for electrical power generation or feedstock for biofuels. Forest biomass can offset fossil-fuels, such as coal, natural gas, and gasoline. Recycling helps to both reduce CO2 from decomposition of the product and reduces CO2 emissions from fossil fuel because it is more energy efficient to recycle compared to new production.

Silvicultural Treatments that affect carbon storage – The challenges for management are significant, largely owing to the rapid rate of change, coupled with the inherent uncertainty of what the future will bring to ecosystems. Managers have three broad choices: (1) do nothing, (2) respond to a disturbance after the fact, or (3) try to prepare the ecosystem for disturbance by increasing its resistance to disturbance (minimize the impact) or enhance its responsive capability via increased resilience. Under the third category, for example, managers might enhance diversity of all sorts, from genetic to structural, so that the ecosystem can find its own route into the future. Another, functional, approach would be to reduce the leaf area via thinning to reduce transpiration and increase the resistance to drought stress. The two approaches can also be combined, for example, by thinning strategically to enhance wildlife habitat and also to reduce the intensity or spread rate of fire (USDA Forest Service 2011b).

Managers of national forest lands are currently facing the challenge of developing management strategies that meet broad ecological and social considerations in spite of a high degree of uncertainty in future climatic conditions. Forest managers use state-of-the art knowledge about climate change and potential impacts to facilitate development of silvicultural objectives and prescriptions that are flexible and enhance ecosystem resistance and resilience. No single strategy is likely to fit all future challenges, so a variety of techniques are needed to achieve silvicultural objectives. Traditional forest management techniques will be viable under a changed climate but these strategies may need to be used more frequently or in different combinations that in the past. Recommended silvicultural treatments generally incorporate consideration of Mitigation and Adaptive strategies (Malmsheimer et al 2008):

Mitigation-Forests and forest products are used to sequester carbon, provide renewable energy through biomass, and avoid carbon losses through forest management activities, such as a combination of prescribed burning, thinning and reforestation. Traditional silvicultural treatments that focus on providing multiple-use benefits of wood, water, wildlife and aesthetics can enhance carbon sequestration and reduce GHG emissions. Choices regarding <u>even-aged</u> and uneven-aged regimes along with rotation length, species composition, <u>slash disposal</u>, site preparation, thinning, and prescribed burning can be modified to increase carbon storage and reduce GHG emissions (Malmsheimer et al 2008).

Uneven-aged and Even-aged management silvicultural systems generally consider more than just carbon storage, but consider economics, site, and tree characteristics. Matching the appropriate silviculture strategy to the species and site can increase forest productivity and carbon uptake to meet multiple goals and objectives (Malmsheimer et al 2008). Bragg and Guldin (2010) compared the carbon storage of even-aged and uneven-aged loblolly pine stands over a 100-year period in Arkansas. The authors looked at 3 management scenarios: a short-rotation loblolly pine plantation (4 cycles); a seed tree based (natural origin) even-aged/shortleaf pine stand (2 rotations) and an even-aged loblolly/shortleaf pine stand (20 cutting-cycle harvests under the selection method). The authors reported that the two even-aged systems produced large quantities of above ground live biomass (nearly 190 tons/hectare) compared to the uneven-aged system with 61.1 to 78.5 tons/hectare. By the end of the 100-year simulation, the two even-aged systems had sequestered approximately 120 tons/hectare of carbon in live tree and product pools or about 50 percent more than the uneven-aged stand. Over the 100-year period, annual carbon (C) storage averaged 0.38, 1.11, and 1.16 tons/hectare for the uneven-aged, seed tree, and

plantation, respectively. The pattern of C uptake varied considerably; the uneven-aged management scenario provided a steadier stream of C uptake. These models did not consider the effects of natural disturbances, such as insect and disease outbreaks or major storm events.

Bragg and Gulden (2010) note that when the fate of the materials produced is considered, C sequestration in southern pine stands has considerable potential to offset some atmospheric CO2 increases. The sustained accumulation of in their study suggests that active management of southern pinelands may increase atmospheric CO2 sequestration over no-treatment options.

Since trees are long-lived they can accrue carbon over a long period of time; the amount of C stored varies greatly but live and dead trees can store about 60% of the carbon in a forested ecosystem (McKinley et al 2011). In general younger trees have higher rates of carbon storage, but lower levels of stored carbon. Older stands have lower rates of uptake, but generally store more carbon, but they can reach a steady state since mortality and respiration rates are higher. Longer rotations in even-aged management systems can increase carbon storage because less time is taken up in reforestation and rebuilding the canopy. Longer rotations in even-aged systems generally incorporate thinning to maintain forest health (Malmsheimer et al 2008). However, changes in disturbance patterns and the severity under a changing climate may change this situation.

Species Composition can affect carbon storage in a forested ecosystem. Forests of all types and ages have the capacity to sequester and store carbon and affect GHG emissions. Initially, fast-growing, shade-intolerant species, such as loblolly pine and shortleaf pine have higher rates of carbon sequestration than broad-leaf species, such as maples and various oaks, but over time, the broadleaf species tend to higher accumulations of carbon stocks (Malmsheimer et al 2008). Malmsheimer et al (2008) noted that in eastern forests aspen-birch has 309 tons/hectare of C while loblolly-shortleaf carries 163 tons/hectare of C. In general, there is more potential for carbon storage in complex stand structures with mixed species composition and several age classes than single species stands. The rates of carbon sequestration vary greatly with age and species, but a complex system with different species and ages can take advantage of the different niches across a landscape.

Matching species to the right site affects the rate of carbon sequestration. A tree planted off-site will not grow as rapidly and will not sequester C as rapidly as a tree planted on the correct site.

Slash Disposal, Site Preparation, and Regeneration techniques can affect the amount of carbon stored in the soil. Given the potential for carbon storage in forest soils, management should reduce the amount of time that the soil is exposed to sunlight, which in turn reduces the potential for increase soil temperatures. In the context of carbon storage, management techniques that limit the amount of time that bare soil is exposed limit the loss of soil carbon. Tops, needles, and branches that are residues from harvesting can affect the carbon balance. Leaving this material on-site to decay is C neutral, but can increase wildfire risk. Incorporating this material into the soil can increase or prolong C storage in the soil. This material may be used for bio-energy, but removal of logging may not be cost efficient or appropriate for sites with low productivity. Prompt tree regeneration minimizes the amount of time that bare soil is exposed to sunlight and potential erosion and reduces the amount of time that the canopy is open.

Thinning is used to control stocking levels and stand density and improve the growth of preferred trees. From a carbon storage standpoint, light frequent thinning is preferable to heavy, infrequent thinning (Malmsheimer et al 2008). However, this scenario does not consider trade-offs, such as economics, site or tree characteristics.

Prescribed Burning can reduce the number and intensity of wildland fires, which are a source of greenhouse emissions (North and Hurteau 2011). Wildland fires can release carbon dioxide into the atmosphere and the decay of killed trees can release more carbon. Most climate change models predict an increase in wildfire activity. Treatments to reduce the intensity of wildland fires, such as prescribed burning or harvesting biomass to reduce fuel loading, can reduce GHG emissions and mitigate losses of stored carbon.

Adaptation- The impact of climate change on most terrestrial ecosystems are expected to occur at rates that will exceed the capacity of many plant and animals species and communities to adapt or migrate (USDA Forest Service 2008). Adaptation strategies help forested ecosystem adjust to climate change variability include increasing resistance, increasing resiliency and assisting transitions.
Adaptation strategies to help forested ecosystem adapt to climate change variability include increasing forest resistance to disturbance, increasing forest resiliency from disturbance, and assisting forest movement to new habitats:

Resistance is "The capacity of the ecosystem to absorb disturbances and remain largely unchanged" (Thomas et al 2009). Disturbances can kill all or some of the trees in an area and alter the balance between production and decomposition. Resistance strategies are appropriate for short-term protection of high-value resources on a site-specific basis (USDA Forest Service 2011c). Management actions should consider protecting resources, such as water quality, endangered species, wildland urban interface and special forest stands. Recommended treatments include thinning overstocked stands to improve tree vigor, use of prescribed burning to reduce fuel loading, removal of invasive species, and restoration of native species.

Resilience is "The capacity of an ecosystem to return to the pre-condition state following a perturbation, including maintaining its essential characteristics taxonomic composition, structures, ecosystem functions, and process rates" (Thomas et al 2009). Resilience strategies are longer term and broader in scale, designed to help ecosystems attain a healthy condition, often within the historic pattern of stressors (USDA Forest Service 2011c). Most natural disturbances are generally limited in scale, but can range from a single tree to events affecting a portion of the landscape, such as extensive flooding or Category 5 hurricanes. Due to the different types and timing of disturbances, a forested landscape generally has a mosaic of stands with a variety of age classes and tree species. Management would focus at retaining desired species. Possible treatments include promoting a variety of species, age classes, and genetics when completing silvicultural treatments.

Transitions are the longest term approach, responding to changes in environmental conditions; often taking a trajectory beyond the historical conditions (USDA Forest Service 2011c). Various techniques can facilitate the transition of ecosystems from current to new conditions. Some of these techniques include: introducing better-adapted species or genotypes, linking habitats

through corridors, expanding genetic diversity, encouraging diverse species mixture to increase ecosystem resistance, and reforestation with more climate adapted species after natural disturbances. Under new climatic conditions, previously common habitat may become reduced to a network of locations where topography provides microhabitat buffering, and populations can persist. Identifying and enhancing refugia for these remnant populations may become a priority for land managers.

Some of these techniques are controversial because management actions would be based on projections on which outcomes are uncertain. For instance, how elevated CO2 levels will influence plant growth is not precisely known and the different models reflect considerable variation in ranges and growth response.

Climate Change Effects on the Andrew Pickens Ranger District

The Template for Assessing Climate Change Impacts and Management Options (TACCIMO) was used to assess differences among three general circulation models at three different emission scenarios for Oconee County, SC (USFS 2011). Estimates for Oconee County include a decrease in precipitation from 2.5 to nearly 8 millimeters and increases in temperature from 0.5 to 1.5 degree centigrade by 2050. Along with soils, aspect, inclination and elevation, climate determines what will grow where and how well. Changes in temperature and precipitation regimes therefore have the potential to dramatically affect forest growth in Oconee County, SC and the Andrew Pickens Ranger District.

Oconee County is in the middle of the historical shortleaf pine (*Pinus echinata*) range and northwest of the historical range of the loblolly pine (*Pinus taeda*) range. Based on predictions of the different circulation models loblolly and shortleaf pine will persist in Oconee County on suitable sites (USDA Forest Service 2011). One exception is the extreme Hadley A1 2100 projection, based on this projection loblolly pine would be eliminated from Oconee County by 2100.

Based on an assessment of the site conditions and projected models, shortleaf should adapt to the short-term as well as the long-term climate changes in Oconee County. Due to the genetic variability of shortleaf pine, choosing the correct seed source and assessing the current suitability of the site are more critical issues than assessing what percent of the shortleaf habitat in the county will be unsuitable in the future.

On-going restoration efforts of native tree species in the project area include:

- Table Mountain pine (*Pinus pungens*) is an Appalachian endemic that occurs where pitch pine (*Pinus rigida*) and Virginia pine (*Pinus virginia*) grow, but it is less frequent (Burns and Honkala 1990). It occupies rocky and shaly mountainous area and is frequently found on the precipitous gorges that dissect the Blue Ridge Mountains. Table Mountain pine is the most fire-adapted pine species on the District, and it has declined primarily due to wildfire control measures. Table Mountain pine is not regenerating well on the Andrew Pickens RD and most of the present stands range from 60 to 100 years old. Based on

climate change scenarios, Table Mountain pine may be eliminated from the southern portion of its range, which includes the Andrew Pickens RD.

- American chestnut was once the dominant tree species in the Appalachian Mountains. It was killed by the introduced chestnut blight. Research has created a strain of American chestnut that has increased blight resistant and efforts are under way to plant American chestnut hybrid seedlings on suitable test sites.
- Pitch pine (*Pinus rigida*) is another fire-adapted native pine species that occurs over a wide geographical area from Maine down to western South Carolina. Because it grows mostly on poorer soils, its distribution is spotty (Burns and Honkala 1990). The amount of pitch pine on the Andrew Pickens RD has declined due to recent wildfire control efforts. Climate change models predict that pitch pine will persist in Oconee County.
- Oaks and hickories are also fire-adapted. Fire of sufficient intensity provides more open conditions favorable to these intolerant species to give them a competitive advantage over shade tolerant species such as red maple. Periodic droughts and warmer weather would favor oaks and hickories over shade tolerant species that prefer more mesic site conditions. Oaks and hickories are expected to persist in Oconee County.

Other tree species comprising of significance to species composition in the project area:

- Eastern white pine (*Pinus strobus*) is a commercially important, fast growing conifer in the eastern United States. It was due to these characteristics that white pine was widely planted on the Andrew Pickens RD in the 1980s.
- Virginia pine (*Pinus virginiana)* occurs across Piedmont and lower elevations of the Appalachians. It is a pioneer species that occurs on disturbed sites, such as burned areas and tolerates low soil moisture. The Andrew Pickens RD is located on the southern portion of its range and most climate change models predict that it will persist on the Andrew Pickens RD.
- Red maple is a generalist that occurs across a wide range of habitat and it is the most common tree species in the eastern United States. Red maple is top-killed by prescribed burning, but it sprouts back readily.
- Yellow poplar also has a wide distribution across the eastern United States. Under the climate change scenario models, yellow poplar will persist in the Appalachian Mountains. Yellow poplar is not fire tolerant and has expanded its range due to wildfire control efforts.

Management on Andrew Pickens Under a Changing Climate

Bragg and Gulden (2010) note that when the fate of the materials produced, C sequestration in southern pine stands has considerable potential to offset some atmospheric CO_2 increases. Their study suggests that active management of southern pinelands may increase atmospheric CO_2 sequestration over no-treatment options.

Forest Inventory Analysis used plot data to estimate carbon stocks across the United States of America. Based on Forest Inventory Analysis (2010), there is 39 million metric tons of carbon stored on 548 thousand acres of national forest land in SC. This represents an average of 72 metric tons of stored carbon per acre for the Francis Marion and Sumter National Forest. For

other public land, it is an average of 76.9 metric tons per acre and 62.9 metric tons per acre on private forested lands (Source: Forest Inventory Data Online (FIDO) at http://www.fia.fs.fed.us). However, these carbon stock estimates only tell us the amount of carbon stored in a forest at a particular time. They do not tell us whether that is an increase or decrease from past conditions.

Most harvested pine trees from Oconee County are sold for either sawtimber or pulpwood. Larger pine trees may be made into lumber or plywood used for construction, while smaller pine trees are used as pulp in paper manufacturing facilities. Currently there are limited markets for bioenergy or biomass in Oconee County, SC and nearby counties.

Environmental Consequences

Indicators developed to assess climate change impacts on national resources of the Andrew Pickens are the potential shifts in the range of loblolly pine and shortleaf pine.

Impacts of management activities on climate change: production of wood products & carbon storage and changes in species diversity.

Direct and Indirect Effects of Alternative 1

This alternative would not implement any silvicultural treatments to remove loblolly pine and reintroduce shortleaf pine. Based on the modeling, loblolly pine would persist in the short-term and long-term in Oconee County, except under the most extreme climate change predictions.

No wood products would be produced. In the short-term, the loblolly pine would continue to grow and store carbon. As these loblolly pine stands age, the rate of carbon sequestration would decline, but overall carbon storage would increase until mortality and respiration exceed growth.

Shortleaf pine and other tree species targeted for restoration would not increase in abundance in the project area for several decades. White pine, red maple and yellow poplar tree species would persist and likely increase.

Direct and Indirect Effects of the Action Alternatives

Shortleaf pine and other native fire-adapted species would increase within its historic range. Based on site assessments and modeling, shortleaf pine would not only persist in Oconee county in the short-term, but also in the long-term even under the most extreme climate change scenarios. Restoration of Table Mountain and pitch pines would occur. Under some climate change scenarios, Table Mountain pine would eventually be eliminated on the Andrew Pickens RD. However, it is difficult to determine how fast climate changes may occur and restoration of Table Mountain pine may provide refugia on the Andrew Pickens RD. Planting of American chestnut hybrids may re-introduce a species that was eliminated across most of its native range. Based on research predictions, an increase in species diversity can increase a forest's resiliency to disturbances, resistance to insect and disease outbreaks and facilitate migration of species as climates change.

Wood products would be produced that could store carbon in either paper or lumber products. In the short-term, the stored carbon on national forest land would be reduced, but the carbon would be stored in wood products. Techniques to reduce exposure of the soil would reduce the loss of soil carbon. Young shortleaf pine would act as a carbon sink; storing carbon in the above ground biomass. In the long-term, management scenarios predict that more carbon is stored when the carbon stored by wood products is considered.

Cumulative Effects of All Alternatives

The Climate Change Resource Center for the Forest Service summarizes management strategies for carbon storage:

> The most defensible options for managing forests for their carbon storage are keeping forests as forests, reforesting areas where forests historically occurred, using forest biomass to offset fossil-fuel use (burning forest biomass generally means that fossil fuel will not be burned), and promoting long-lived forest products such as wood-framed buildings. Forests (particularly older forests) generally store carbon better than forest products, so harvesting old-growth forests for their forest products is not an effective carbon conservation strategy. However, harvest and regeneration of young to middle-aged forests for long-lived forest products can help with carbon storage. In forests with an ecological history of surface and mixed-severity fires, managing for maximum carbon storage will lead to an increase in stand density and the probability of more severe fires. In contrast, managing to reduce fuels and crown fire probability will reduce the carbon stored in the forest and likely be a carbon source unless the thinnings are used for biomass fuel (USDA Forest Service 2011b).

Management activities, such as prescribed burning and thinning, could be used to offset some predicted climate change effects. Management activates could minimize drought effects by reducing stand densities, avoiding or reducing the effects of wildland fire events, managing for the predicted increase for insect and disease outbreaks, and enhance resistance and resiliency by planting suitable tree species (USFS 2011).

Past activities on the district have included commercial thinning and overstory removal of some existing loblolly pine stands. Thinning was done to improve growth and vigor on some existing stands and overstory removal were done in stands to replace existing loblolly pine with native species including planted shortleaf pine. Timber harvest of loblolly pine stands on private lands is conducted mainly for economic reasons and to minimize loss of merchantable products. Prescribed burning is done on a periodic basis to reduce fuel loadings and to increase habitat diversity for plants and wildlife on the district. All these activities promote healthy stands and increase diversity of habitat and create conditions that increase resistance and resiliency of forest areas to adapt to climate change variability. Prescribed burning and timber harvesting would continue on a periodic basis in the future continuing to increase resistance of stands to climate changes.

Other management activities on national forest land in Oconee County have limited effects on carbon storage, carbon sequestration, or climate change. Man-powered recreation activities, such as hiking, camping, swimming, fishing, hunting, or canoeing generally have limited to no impacts on carbon storage, carbon sequestration or the release of greenhouse gases. Vehicle emissions from activities, such as road maintenance, release CO2, but have no direct effect on carbon storage or sequestration.

3.2 Biological Environment

3.2.1 Vegetation, Ecological Communities and Non-Native Invasive Species

Affected Environment

The project area lies within the Blue Ridge Foothills Management Area (Management Area 3) and Chattooga River Management Area (Management Area 2) of the Forest Plan (see map in Appendix B). Most of the project area (83%) is within Management Area 3. None of the project area lies within the Chattooga Wild and Scenic River Corridor.

Blue Ridge Foothills Management Area (Management Area 3, 83% of project area)

The 59,975-acre management area is located in the mountains and upper piedmont of South Carolina within Oconee County. The dominant forest cover types in upland areas are Virginia and shortleaf pine (*Pinus virginiana and P. echinata*) and chestnut and scarlet oak species, (*Quercus prinus* and *Q. coccinea*) while eastern hemlock (*Tsuga canadensis*), yellow poplar (*Liriodendron tulipfera*) and white pine (*P. strobus*) often dominate moist areas as coves and stream sides with dense understories of rhododendron (*Rhododendron sp*.) and mountain laurel (*Kalmia latifolia*) (Van Lear et al., 1995).

Rainfall is well distributed throughout the year, averaging somewhat less than found within the Chattooga Watershed. About ½ of the rainfall is returned to streamflow as water yield. The primary rock types include graywacke, mica schist, amphibolite, aluminous schist, granite, mica gneiss, gneiss, and granite gneiss. The rocks are highly weathered. The primary soil types are Evard and Brevard Series with Toccoa Series in the floodplains. Most of the perennial and intermittent streams are entrenched to moderately entrenched, with low to high width to depth ratios.

Chattooga River Management Area (Management Area 2, 17% of project area)

This 180,000-acre watershed includes the 122,192-acre management area comprised of public lands in National Forest management located within the Blue Ridge Mountains and upper piedmont of Georgia, South Carolina, and North Carolina. The Chattahoochee-Oconee National Forests in Georgia, Nantahala National Forest in North Carolina and the Sumter National Forest in South Carolina share management of the watershed, with the Sumter National Forest in charge of administering the river uses associated with the Chattooga Wild and Scenic River Corridor.

The dominant forest types in upland areas are Virginia and shortleaf pine (*Pinus virginiana and P. echinata*) and chestnut and scarlet oak *(Quercus prinus and Q. coccinea*) species, while eastern hemlock (*Tsuga canadensis*), yellow poplar (*Liriodendron tulipfera*) and white pine (*P. strobus*) often dominate moist areas as coves and stream sides with dense understories of rhododendron (*Rhododendron sp.*) and mountain laurel (*Kalmia latifolia)* (Van Lear et al., 1995).

Rainfall is well distributed throughout the year. The 50-year annual precipitation averages from 167 cm at the Long Creek, South Carolina, site in the lower portion of the watershed to 216 cm at the Highlands, North Carolina, rain gauge near the headwaters (NOAA, 1999). About ½ of the rainfall is returned to streamflow as water yield. Elevation ranges from about 300 m to 1,500 m.

Most natural forests in the project area are adapted to frequent disturbance, primarily frequent, low-intensity fire. In these systems, many of the tree and other plant species need site disturbance at some point in their life cycle in order to perpetuate. These forests have significant wildlife and human community values, but are less abundant than they were historically. Some tree and plant species, namely shortleaf pine, pitch pine, and Table Mountain pine, are below historic levels and continue to decline in abundance. (NatureServe 2002; Martin et.al. 1993).

Tree species that would dominate most of the forest communities in the project area under natural conditions include shortleaf pine, pitch pine, Table Mountain pine, and various species of oaks and hickories. This group of species will be referred to in the vegetation section of this EIS as primary species. In a natural forest setting with natural disturbance patterns (or management activities that mimic natural disturbance), primary species would typically comprise the majority of the species composition. Other native secondary species, such as red maple, sourwood, blackgum, Virginia pine, yellow poplar, dogwood, and redbud (among others) would comprise the remainder of the species composition. Primary and secondary species would differ somewhat in different forest communities (i.e. – xeric pine vs. mixed mesophytic, aka cove forests).

Vegetation information is described in four different components: species composition, forest structure, age distribution and dynamic processes (function). Species composition defines the species mix that occurs on a given site and in what proportion. Composition can be simple (100% all one species), or more complex. Forest or woodland species can be categorized in terms of the plant type, such as tree, shrub, and non-woody (forbs, grasses, etc.). Because this project focuses primarily on changing the composition of the tree component of forest vegetation, this component will receive the most focus of the analysis.

Forest structure deals with the size and spatial arrangement of plant species. Plant height, diameter, and crown spread are aspects of the size component. Spatial arrangement is further defined into vertical and horizontal. The vertical arrangement deals with the number of forest canopy layers and position of the trees growing in that canopy. The vertical structure may be simple (single story), or more complex. Horizontal arrangement deals with the density of the forest (how closely trees are growing together), and whether they are spaced in an even arrangement (like a plantation) or spaced more randomly.

Forest structure also describes the type, quantity, and arrangement of dead vegetation (snags, down logs, leaf litter). Age information for trees growing in the stand help describe the structure. Age is usually described as even-aged (most trees in the stand are from the same generation) or uneven-aged. Diversity of age classes (age distribution) usually is an indicator of high structural diversity. However, even-aged stands can also have structural diversity if the species composition is mixed. Different species grow at different rates, which can produce trees of various sizes and multiple canopy layers. The older a mixed-species even-aged stand, the better chance for high structural diversity.

Dynamic processes shape the way that species composition and forest structure change or stay the same over time. There are the inherent dynamics of tree growth, competition, and senescence that occur on any given site, and there are disturbance agents that sometimes occur in a given area that affect composition and structure. Succession is the process by which the vegetation in a stand grows from its initial establishment, also called stand initiation (seedlings) through various stages of development (seral stage, also known as successional stage) to maturity. Species composition may or may not change from one stage to the next. Forest structure does change.

On the Andrew Pickens Ranger District, the primary disturbance agents are fire, insects and disease, human use (such as timber management, grazing or settlement), and wind (most significantly from tornados). Disturbance agents are not qualified in the EIS as good or bad, except in the context of whether or not they help or hinder the achievement of desired forest conditions defined in the Forest Plan and the project purpose and need. Disturbance agents usually push a stand's development back from a later seral stage to an earlier one, or even back to stand initiation.

The District vegetation inventory contains information on existing vegetation and potential natural vegetation (PNV) components. Existing vegetation inventories describe what is currently growing on a given site. PNV inventories describe the site capability in terms of what kinds of native plant communities (species composition) and structure conditions could exist without the presence non-native species and with disturbance patterns in place similar to those that occurred historically. PNV descriptions are based on environmental and physical factors such as temperature, moisture, sun exposure, soil type, elevation, topographic aspect, and disturbance patterns. These factors are the constraints for what can grow on the site. PNV usually describes a range of possible conditions rather than one constant condition or one preset succession path. This range of possible conditions for potential natural vegetation is known as the natural range of variability (NRV).

Existing vegetation may or may not match the potential vegetation for a site. In fact, it often does not. For example, specific to this project, loblolly pine is not native to any part of the District, so it does not show up in the PNV inventory. Yet loblolly pine comprises almost 100% of the existing vegetation species composition in most of the project stands due to its introduction by past forest management practices (planting loblolly pine).

Vegetation Mapping

Vegetation in the project area has been mapped by compartment, stand and ecological zone.[4] All three map layers are area-based. Stands are delineations of areas with similar existing vegetation characteristics. Ecological zones are delineations of the potential natural vegetation for that map unit area. Ecological zones can be larger or smaller in scale than stands, but usually, they are much larger because the process used to delineate them is at a coarser scale.

The project area encompasses 187 stands on approximately 5,500 acres, spread across 40 compartments and 11 ecological zones. Five of these eleven ecological zones occur on less than 10 acres of the project area. Because they encompass such a small area and may be due in part to mapping errors, they are not considered further in this analysis.

Species Composition - Existing Vegetation

Species composition describes species diversity. Forest cover type is the predominant existing forest tree species in a stand that occupies the majority of the forest overstory. There may be one, a few, or many tree species that occur in a given forest cover type. For example, with the chestnut oak cover type, in addition to chestnut oak as the dominant species; there can be as many as 16 other tree species that commonly occur in this forest cover type.

There is a stark difference between existing and potential species diversity in the project stands. There are only two forest cover types currently represented in the project area, and neither of them is native:

1) loblolly pine
2) loblolly pine w/ hardwood.

There are 26 forest cover types within the NRV for the project stands that could be represented in the project area if non-native loblolly pine was converted to native species. These cover types are listed in Table 3.2.1-2.

Based on inventory conducted in 2008, it is estimated that over 95% of existing species composition is comprised of non-native loblolly pine. Intensive site preparation preceded the planting of the loblolly pine seedlings. Also, the trees were planted at densities as high as 680 trees per acre. Such heavy stocking inhibited other vegetation from getting established during stand initiation. As the loblolly pine matured, it occupied the overstory in a mostly single canopy layer, shading out everything below. For these reasons, the species diversity of trees along with understory shrubs and plants is low compared to the NRV for these stands.

[4] Stands are area-based map units that are delineated usually on aerial photographs. Stands represent similar vegetation characteristics, such as species or structure. The forest stand is usually considered the smallest unit of management. Compartments are aggregations of stands usually bounded by permanent features such as streams, roads and ridges.

Forest cover types are grouped into forest communities based on similar growing site characteristics and other flora/fauna found together on those sites. An example of a forest community is "Dry and Dry-Mesic Pine and Pine-Oak". The Forest Plan identifies seven forest communities that exist on the District, six of which could potentially occur in the project area. Currently, only one forest community is represented in the project stands: *loblolly pine.*

Species Composition – Potential Vegetation and Ecological Zones

Ecological zone modeling is a tool for predicting the PNV and NRV. An ecological zone model, developed by Steve Simon in conjunction with the Forest Service, The Nature Conservancy (TNC), and the Fire Learning Network (FLN), has been developed which combines numerous environmental variables with the sampling of natural forested vegetation, from over 5,800 field reference sites located throughout Virginia, North Carolina, and South Carolina, including 730 field reference plots within the Southern Blue Ridge Escarpment (Simon, 2011). Given the broader scale at which eco-zones are mapped, unmapped stand-level variation does occur within each of the mapped ecological zones. Smaller scale (<100 acre) rare plant communities, were not included in the mapping, as the digital data used to model ecological systems was too coarse in resolution.

A complete description of the modeling process including the results of an accuracy assessment is available upon request. The overall accuracy across the Southern Blue Ridge study area, based on re-intersection of 730 field reference plots with modeled map units, was 76%, and 95% for the most fire-adapted vegetation (Simon, 2011).

Twenty ecological zones were identified and mapped on over 5 million acres in the Southern Appalachians Mountains, then linked to ecological systems as identified by Natureserve. NatureServe is a non-profit conservation organization who collects and maintains biological inventory data nationwide and internationally.

Table 3.2.1-1 lists the primary ecological zones found in the project area (>10 acres) with a crosswalk to Natureserve ecological systems, which are equivalent to LANDFIRE Biophysical Setting (BpS) models (Natureserve, 2011). A description of each zone follows, describing the potential forest communities that would exist naturally in those zones.

Table 3.2.1-1 Ecological Zones

Ecological Zone Code	Ecological Zone	Natureserve Ecological System	Proportion of Project Area
16	Shortleaf pine-Oak	Southern Appalachian Low-Elevation Pine Forest	77%
13	Dry-Mesic Oak	Southern Appalachian Oak Forest	14%
10	Dry Oak Evergreen Heath	Allegheny-Cumberland Dry Oak Forest and Woodland	8%
4	Rich Cove/Acidic Cove	Southern and Central Appalachian Cove Forest	1%

Shortleaf Pine-Oak Ecological Zone

The majority of the project area (77%) falls within this zone, which in the absence of loblolly pine consists of shortleaf pine- and Virginia pine-dominated forests in the lower elevation Southern Appalachians. Examples can occur on a variety of topographic and landscape positions,

including ridge tops, upper and mid-slopes, as well as low elevation mountain valleys. Pitch pine (and Table Mountain pine) may sometimes be present and hardwoods are sometimes abundant, especially dry-site oaks such as southern red oak, post oak, blackjack oak, chestnut oak, scarlet oak, but also pignut and other hickories, red maple, and other hardwoods.

Frequent, low-intensity fires, coupled with severe fires, can influence the occurrence of pines, particularly shortleaf pine, pitch pine, or Table Mountain pine, rather than hardwood forests or even Virginia pine, under natural conditions (Natureserve, 2011).

The shrub layer is typically well-developed, and includes ericaceous (acid-loving) deciduous "heath" species, including hillside blueberry and dwarf deerberry and black and dwarf huckleberry (*Gaylussacia baccata, dumosa*). The herbaceous layer can be sparse, including goat's rue (*Tephrosia* sp.), narrowleaf silkgrass (*Pityopsis graminifolia*), and rosinweed (*Silphium compositum*), but sometimes may have a more grassy component, dominated by little bluestem (*Schizachyrium scoparium*) with oatgrass (*Danthonia sp*.), and with other forb species, particularly when exposed to frequent prescribed fire, or mowing. This ecological zone may also include Southern Appalachian Montane Pine Forests and Woodlands, particularly at moderate to upper elevations (1500-4500 feet), which are more likely to be dominated by Table Mountain pine and pitch pine (Natureserve, 2011).

Dry-Mesic Oak Ecological Zone

This zone occurs over a smaller percentage of the area (14%), on broad lower to mid elevation ridges and smooth to concave slopes, drainage headlands, and narrow, dry coves (Simon, 2011). In the absence of loblolly pine, tree species typically consists of oak-dominated forests, including chestnut oak, white oak, black oak, red oak, scarlet oak, and hickory, though black gum, red maple, white pine, yellow poplar, and black locust may also occur as seral stages within this system or zone. Historically, American chestnut was a dominant or co-dominant (Natureserve, 2011) and American chestnut sprouts can still be found in these areas.

Understory and shrub layers are usually well-developed, and include a dense evergreen shrub layer, dominated by mountain laurel and great rhododendron. In some areas, the shrub layer may be deciduous and sparse, with native blueberry and huckleberries as constant species. Herbs, forbs, and ferns are usually spare to moderate in density, and can include Galax, Indian cucumber-root, New York fern, and hay-scented fern. Fire may have been important for favoring oak dominance over more mesophytic trees species, and for producing a more open canopy and less dense shrub layer (Natureserve, 2011).

Dry Oak Evergreen Heath

This zone comprises 8% of the project area, and includes xeric to dry mixed oak forests on predominantly nutrient-poor or acidic substrates, and are dominated by evergreen and deciduous ericaceous shrubs and oaks, rather than pines, and includes chestnut oak, scarlet oak, mountain laurel, black huckleberry and hillside blueberry, red maple, and sourwood. American chestnut sprouts may be common and was likely abundant historically. Small inclusions of shortleaf pine and/or Virginia pine may occur, particularly following fire. In the absence of fire, white pine may become established and be common. Evergreen heaths, such as mountain laurel and

Rhododendron (maximum, minus), are common, but may range from dense to open, depending on the influence of fire.

Rich and Acidic Cove Forests

Comprising 1% of the project area, these forests consist of mesophytic hardwood or hemlock-hardwood forests of sheltered topographic positions, or on north-facing concave and lower slopes, and narrow coves. This system includes a mosaic of acidic or "rich" (basic) coves based on high soil fertility and high species richness. Characteristic overstory species include yellow buckeye, sugar maple, white ash, basswood, American beech, Fraser's magnolia, cucumber magnolia, yellow poplar, and silverbell (Natureserve 2011). White pine can often be found on disturbed sites. Rich coves generally lack dense stands of evergreen ericaceous shrubs and the diversity and density of herbaceous species is higher than that which would occur in acidic coves, and may include black and blue cohosh, American ginseng, bloodroot, northern maidenhair fern, mountain sweet cicely, and wood nettle.

Existing vs. Potential Species Diversity

By overlaying existing forest cover types and communities with ecological zones, a comparison can be made between existing and potential diversity of forest cover types and forest communities for the project. Table 3.2.1-2 shows this comparison.

Table 3.2.1-2 Ecological Zones, Forest Cover Types and Forest Communities

Ecological Zone	Ecological Zone Code	Proportion of Project Area	Existing Forest Communities	Potential Forest Communities within Natural Range of Variability	Existing Cover Types	Potential Cover Types within the Natural Range of Variability for Each Ecological Zone[1]
Acidic Cove Rich Cove	4, 5	1%	Loblolly Pine	Mixed Mesophytic Northern hardwood	Loblolly pine Loblolly pine w/ hardwood	1. Cove hardwood/white pine/hemlock 2. Bottomland hardwood/yellow pine 3. Yellow poplar/white oak/northern red oak 4. White pine 5. White pine/hemlock 6. Hemlock/hardwood
Dry Oak Evergreen Heath	10	8%	Loblolly Pine	Dry-xeric oak forest	Loblolly pine Loblolly pine w/ hardwood	1. Chestnut oak 2. Scarlet oak 3. Chestnut oak/scarlet oak **4. AMERICAN CHESTNUT**
Dry Mesic Oak	13	14%	Loblolly Pine	Dry, Dry-Mesic Oak/Oak-Pine	Loblolly pine Loblolly pine w/ hardwood	1. White oak/northern red oak/hickory 2. White oak 3. Upland hardwoods/white pine 4. Southern red oak/yellow pine 5. Chestnut oak/scarlet oak/yellow pine 6. White oak/black oak/yellow pine 7. Northern red oak/hickory/yellow pine 8. Bear oak/southern scrub oak/yellow pine **9. AMERICAN CHESTNUT**
Shortleaf pine-Oak	16	77%	Loblolly Pine	Dry, Dry-mesic pine/Pine-Oak Xeric Pine/Pine-Oak	Loblolly pine Loblolly pine w/ hardwood	1. Shortleaf pine/oak 2. Pitch pine/oak 3. Virginia pine/oak 4. Shortleaf pine 5. Virginia pine 6. Pitch pine 7. Table Mountain pine 8. Table Mountain pine w/hardwood

[1] *Each cover type may contain just dominant species in a pure stand or could have up to 30% of the stand mixed with a suite of species not explicitly listed in the cover type name.*

Shortleaf pine and pitch pine are declining throughout the southern Appalachian Mountains and on this District. (NatureServe 2002; Martin et.al. 1993). The current distribution of shortleaf and pitch pine cover types is approximately 50% of its estimated historic distribution, and the trend is downward.

Table Mountain pine has also declined, to the point where forest cover types associated with this species are now considered rare communities. This is due to natural senescence and succession with replacement by shade tolerant hardwoods, from southern pine beetle disturbance, and most importantly, due to lack of fire (Turrill and Buckner 1995). According to existing vegetation inventories, there are less than 100 acres of Table Mountain pine forest cover types District-wide. It is uncertain just how abundant Table Mountain pine was before fire exclusion, but some estimates are as high as 20% of the landscape in the shortleaf pine-oak ecological zone (US Forest Service EIS, 2004b). This proportion would equate to 800 acres of the project area currently occupied by loblolly pine and 12,000 acres District-wide.

Table Mountain pine is a seed source for wildlife and deer browse has been observed. Many other tree species can fill those food requirements in the absence of Table Mountain pine. Table Mountain pine's more unique ecological importance lies in its ability to grow on poorer sites where most other tree species cannot. This can make Table Mountain pine important to prevent soil erosion. Also, Table Mountain pine is the sole habitat source for the mountain pine coneworm (Williams, 2002). Potential genetic benefits from either Table Mountain pine or from the coneworm are unknown at this time.

Wildlife, particularly squirrels, eat the seeds. Because it grows where few other trees will, Table Mountain pine is an important soil protector, minimizing erosion and runoff from the rugged landscapes where it thrives.

The proportion of oak forest cover types is also well below estimated historic distribution. The current distribution of oak cover types is approximately 67%, or 2/3rds of its historic distribution. The trend is harder to determine than that of the native pines, but given that existing disturbance frequency and intensity is lower than it was historically, it is likely that oak forest cover types are on a downward trend. Gypsy moth impact is still a "what if" scenario; it has not been observed on the District and is not expected to arrive by natural spread for the next 20 years. Introduction by human vectors is always a possibility.

Disturbance is necessary to sustain both the native yellow pine (shortleaf pine, pitch pine, and Table Mountain pine), and oak forest communities. The decline of these cover types is most likely due to frequency and/or intensity of disturbance being too low to create/sustain the right growing conditions (mainly sunlight) and reduce competition from other tree species that are more shade-tolerant and less fire resilient. In the project area, decline is also due to the native pine species being replaced by non-native loblolly pine.

Regarding species composition, of particular note is American chestnut as a potential tree species and cover type (Table 3.2.1-2). There are sites in the project area where this species occurred historically prior to the accidental introduction of chestnut blight in the early 1900s. Stump sprouts are still present. American chestnut provided many benefits both ecologically and

socially before its demise. American chestnut provided hard mast for a variety of wildlife and for human consumption (economically important as a cash crop). The wood is straight-grained, lighter, and more easily worked than oak. It is also rot resistant. (American Chestnut Foundation, 2009).

Based on ecological zone modeling, an estimated 1,250 acres of the project treatment stands is suitable habitat for American chestnut. However, the ecological zone modeling is at a coarse scale and it is more difficult to model suitable habitat for a species like American chestnut that has almost been completely extirpated from its native range. American chestnut historically had a very wide ecological amplitude (it grew well on a wide variety of sites). A substantial amount of additional treatment stand acreage may be suitable habitat for American chestnut.

At the time of this EIS, viable blight-resistant strains of American chestnut are not yet available for production-level planting. The latest progeny tests revealed only 17% resistance to blight (Makowski, 2012).

Forest Structure

As a forest stand ages passes through various stages of development from stand initiation to maturity, it provides different structural conditions that function as different kinds of habitat. The Forest Plan objectives for the management prescriptions included in this project area are to maintain a mix of stand development stages (successional stages). The current proportions of these successional stages (District-wide) are displayed in Table 3.2.1-3.

Table 3.2.1-3 Community Types on the Andrew Pickens Ranger District by Seral Stage[5]

Seral Stage of Succession				
Forest Community Type	**Early (i.e., seedling) 0-10 years old (percent)**	**Sapling/pole 10-40 years old (percent)**	**Mid (mature) 40-80 years old (percent)**	**Late (old) 80+ years old (percent)**
Conifer-Northern Hardwood Forest, Mixed Mesophytic Forest,	.06	27	16	56
Dry-Mesic Oak Forest	0.3	7.0	16	77
Pine and Pine-Oak Forest, Xeric Pine	4.2	15	28	53
Dry and Xeric Oak Forest	0	13	31	56
Dry and Dry-Mesic Oak-Pine Forest	1.2	1.2	29	69

Forest Plan desired condition allocations for seral stages are given in Table 3.2.1-4.

Table 3.2.1-4 Desired Percentage of Forested Acreage by Seral Stage

Early Seral	Mid- and Late-Seral	Late-Seral Alone
4-10 %	>50 %	>20 %

[5] Old-growth acres are included in “late”.

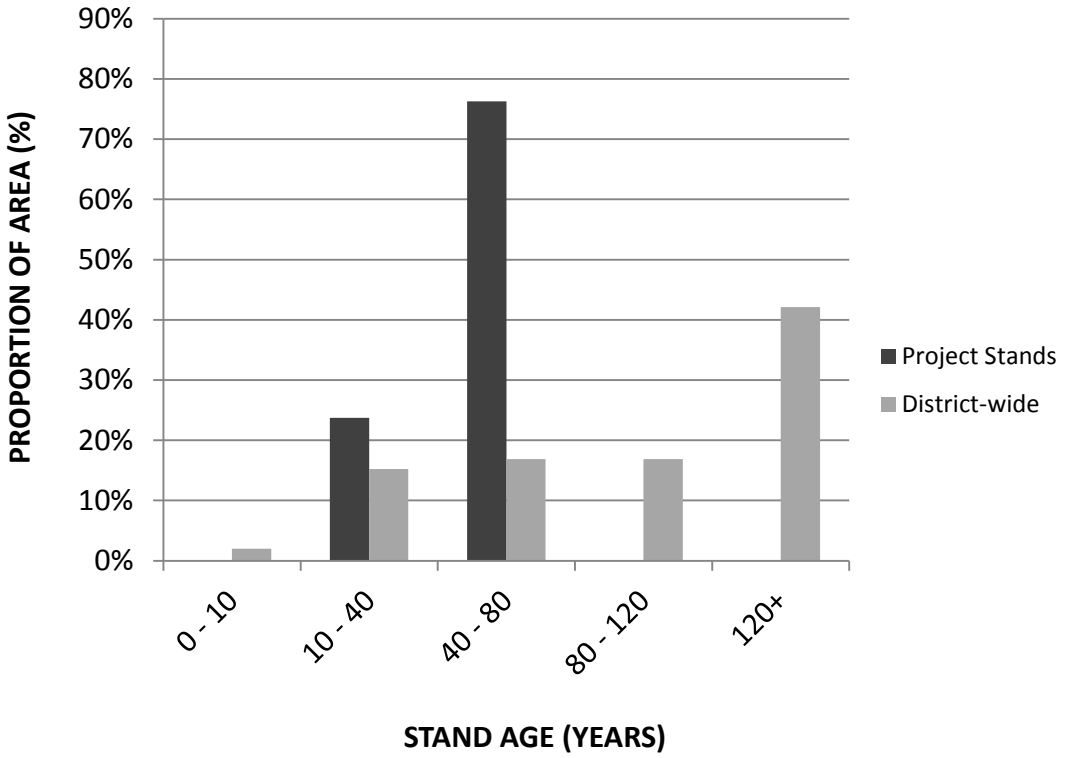
Indicators of conditions related to seral forest habitats are classified into the following three categories:

1) early seral forest,
2) mid- and late-seral forest combined,
3) late-seral forest alone.

These three indicators are selected because they are most relevant to describing important habitat conditions. Early-seral forests are a key condition required by many species, and their level indicates near-future presence of sapling/pole stages as well. Because most species associated with late-seral conditions will also be found to some extent in mid-seral forests, the combined level of these stages provides an indication of the total base of habitat available for these species. However, because late- seral forest conditions will often provide better quality habitat for these species, a focus on levels of this stage alone is also meaningful. (US Forest Service EIS, 2004b) Forest Plan proportions of seral stages are based on what would be expected in the NRV, with disturbance processes in place. For the District as a whole, the proportion of forest area in mid and late-seral stages is at or above desired levels, although old growth (Late-Seral Alone) is below desired levels (see old growth section). Most relevant to this project is that the proportion of forest area in early seral stages is below or barely at desired levels across all forest community types in the project stands. The treatments proposed in this project would create more early seral stage conditions. Averaged across all forest community types for the District as a whole, the Forest Plan has a goal of 4 to 10% of the forested acreage to be in early seral condition. Currently it is approximately 2%.

Specific to the project area, age class diversity is much lower than for the District as a whole or what would be in the NRV (see Figure 3.2.1-1). The project stands were established as loblolly pine plantations between the late 1950s and the late 1980s. Except where there have been disturbances, these stands are even-aged and between 20 and 60 years old. Their seral stage is sapling/pole or mid-seral (mature). It is likely that prior to the establishment of the loblolly plantations, the diversity of seral stages for the total area covered by the project stands more closely resembled the District-wide distribution.

Figure 3.2.1-1 Stand Age Comparison Between Project Stands and All Stands for the District



Horizontal and vertical structural diversity in the project stands are low compared to surrounding stands and with the NRV. During loblolly plantation establishment, site preparation for planting was intense, and loblolly pine seedlings were planted tightly on an even-spacing. This produced uniform horizontal structure. The dense loblolly overstory that has ensued is a single canopy layer, which results in low vertical structural diversity. Some of the stands have been thinned in the past, which has allowed more light to the forest floor. However, the forest canopy in these thinned pine stands has closed up or is closing up since the time of thinning, inhibiting the continued development of additional canopy layers.

Standing dead trees (snags) and down logs are other elements of forest structure. In the project area, most of the woody material that was on-site at the time of loblolly planting was removed or burned on-site. These loblolly stands are still not old enough to start producing snags or down logs from age-related mortality (senescence), although these elements do exist in some portions of stands that have been impacted by southern pine beetle. Snags and down logs are below the NRV in the project stands.

Woodlands

Woodlands are a forest-related vegetation structure condition defined by a more open forest structure with a greater proportion of species composition contained in shrubs and non-woody plants than typically found in a forest setting. The amount of woodlands on the District is below the NRV, and Table Mountain pine woodlands are considered to be a rare community. Currently,

none of the stands in the project area have a woodlands structure, although such a condition would be within the NRV for many project stands. The Forest Plan objective for woodlands is to increase their relative abundance on the District.

Old Growth

The old growth stage of stand development usually has the greatest amount of species and structural diversity that the site is capable of producing. It is distinguished by old, large trees and related structural attributes. Old growth is not necessarily virgin or primeval. It can develop over time following human disturbances, just as it does following natural disturbances. (US Forest Service EIS, 2004b)

None of the project stands are candidate stands for old growth because of the amount of loblolly pine found in them and because of their relatively young age.

In June of 1997 the Southern Region of the Forest Service completed a report entitled *Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region*, hereafter called the "old growth report" (Forest Service 1997). The old growth report contains direction for providing conditions for old growth to develop, in conjunction with Forest plan revision (old growth report, p.8-22), including direction for conducting a preliminary inventory for old growth, to be used as a tool in Forest planning, definitions for several old growth community types, and direction for providing for a network of small, medium, and large-sized patches of old growth on the National Forests based on social, biological, ecological, and spiritual issues and concerns. The Sumter National Forest is committed to implementing the old growth report as described in the Forest Plan. (US Forest Service EIS, 2004b)

Based on the preliminary inventories, very little old growth exists on the District. The Forest Plan sets goals and objectives for increasing the amount of old growth to 20% of the area covered by each forest community type, and identifies stands that are most likely the best "candidates" for growing into an old growth stage more quickly than other stands. In other words, those stands are the best ones to choose to designate as future old growth. (US Forest Service EIS, 2004b)

Shrub and Herbaceous Layers

The majority of the soils on the District are acidic, and support ericaceous shrubs such as hillside blueberry and dwarf deerberry (*Vaccineum pallidum, stamineum,* scattered to dense mountain laurel (*Kalmia latifolia*), and Appalachian cane (*Arundinaria appalachiana),* particularly on mesic sites. Hardwood sprouts are usually abundant but only in stands that have more open canopy structure and a history of prescribed burning or mowing (such as roadsides). There is needle grass (*Piptochaetium avenaceum*), oatgrass (*Danthonia* sp.), bluestems (*Andropogon* sp.), or gamma grass (*Tripsacum dactyloides*). Forbs include Southern Appalachian and small-headed sunflowers (*Helianthus atrorubens, microcephalus*), blazing stars (*Liatris squarrosa, virgata*), and woodland coreopsis (*Coreopsis major*).

Along the Brevard or Chauga belt, which supports mafic geology and soils higher in magnesium and calcium, the understory is more diverse than on other soil types. Along roadsides or areas exposed to prescribed burning, there is yucca-leaved snakeroot *(Eryngium yuccifolium),* wild

quinine *(Parthenium integrifolium)*, Blue Ridge bindweed *(Calystegia catesbiana)*, and silky aster (*Aster concolor*) in the uplands, and yellow ladies' slipper (*Cypripedium calceolus*), acute-leaved hepatica (*Hepatic acutiloba*), whorled horsebalm (*Collinsonia verticillata*), faded trillium (*Trillium discolor*), and piedmont strawberry (*Waldsteinia lobata*) on lower slopes and in rich hardwood coves.

The presence and relative abundance of the shrub and herbaceous vegetation is usually inversely related to how dense the overstory canopy is on a given site. Due to the overstory canopy, most of these vegetation components are currently confined to stand edges, recently thinned stands, or areas where recent mortality has occurred in the loblolly pine overstory from southern pine beetle.

Disturbance

Forest Pathogens and Non-Native Invasive Species

Principal native insect pests on the Sumter National Forest include the Southern pine beetle and a variety of defoliators. Primary native disease problems include oak decline, annosum root disease, and a variety of other decay organisms affecting living trees. (US Forest Service EIS, 2004b)

Chestnut blight has reduced the American chestnut from the dominant hardwood tree species in the mountains to a minor understory component of today's forests. Other significant non-native pests on the District include hemlock woolly adelgid, butternut canker, and dogwood anthracnose. Gypsy moth has not yet been observed on the District. With the likely continued implementation of the Slow the Spread Project for mitigating gypsy moth spread, this pest would likely not reach District for at least the next 20 years (Slow the Spread Assessment, 2009).

Southern Pine Beetle

Southern pine beetle (SPB) (*Dendroctonus frontalis*), infestations have occurred cyclically throughout recorded history in the South. SPB outbreaks move from low levels of infestation to high levels over several years. The cycles may be localized or regional and depend upon weather and other stress factors as well as the interrelationship between the populations of SPB and its predators.

Tree mortality from Southern pine beetle (SPB) in the project area has occurred in most project stands since the time of loblolly establishment. The area impacted in each affected stand has typically been ½ to five acres in size, more often at the smaller end of that range. This disturbance creates a gap in the canopy and frees up growing space for regeneration. However, the amount of area disturbed compared with the overall area of the loblolly pine stands is small, less than five percent. These areas frequently result in regeneration of more loblolly pine along with proliferation of shade tolerant species that were already present before the disturbance, leading to an abundance of those shade tolerant species. Risk of attack from southern pine beetle is most directly related to the density of pine stands. Risk also increases with stand age. This risk is naturally less as the hardwood component increases, since hardwood species are not

susceptible to SPB. Managers can control density, age and species composition through vegetation manipulation activities.

Littleleaf disease

Littleleaf disease is the most serious disease of shortleaf pine in the Southeast regionally, but not on the District. It is caused by a complex of factors including a non-native fungus, *Phytophthora cinnamomi*, low soil nitrogen, eroded soils, a plow pan (from farming), and poor internal soil drainage (Campbell and Copeland 1954). Often, native microscopic roundworms called nematodes and native species of the fungal genus *Pythium* are associated with the disease. (USDA Southern Forest Assessment, 2009)

Shortleaf pine is the most seriously damaged host of littleleaf disease, with loblolly pine damaged to a lesser extent. Hardwoods are not affected. Littleleaf disease occurs almost exclusively in the piedmont (not on the Andrew Pickens Ranger District).

Hemlock woolly adelgid

The current amount and distribution of mature eastern hemlock forests is threatened by the recent emergence of the hemlock woolly adelgid in the Southern Appalachians.
Approximately 60 acres of the project area lies within Mixed Mesophytic and Northern Hardwood forest community types suitable for hemlock. These sites are currently occupied by loblolly pine.

Other Non-Native Invasive Species

Surveys for invasive plant species were conducted in the loblolly removal project area, and were documented from eight roadsides and two wildlife openings within or adjacent to the project area. Non-native invasive plants found included autumn olive (*Elaeagnus umbellata*), sericea lespedeza (*Lespedeza cuneata*), Chinese privet (*Ligustrum sinense*), mimosa (*Albizia julibrissin*), Chinese silvergrass (*Miscanthus sinense*), Japanese stiltgrass (*Microstegium vimineum*), tall fescue (*Schedonorus arundinaceus*), and Johnson grass (*Sorghum halepense*).

Evidence of wild hog (*Sus scrofa*) is common on the district, and has been noted in stands adjacent to the Chauga Creek Scenic Area (Gaddy, 2009).

Fire and Fuels

Other than land clearing for urban development, no disturbance is more common on the District than fire. Fire has historically played an important role in shaping the species composition and structure of the forests on the District. Historically, relatively frequent fires (both human and naturally caused) have maintained and restored many forested communities, especially Xeric Pine and Pine-Oak Forest; Dry and Xeric Oak Forests; and Dry and Dry to Mesic Pine-Oak Forests (US Forest Service EIS, 2004b)

Since the early 1900s, fire suppression has greatly diminished fire’s impact on the landscape.

The District is dominated by fire-adapted and fire-dependent forest communities. Most of the forest is characterized by an understory fire regime with historic fire return intervals between 2 and 15 years (shortleaf pine forests), but up to 35 years (oak/hickory forests). These fires are generally are non-lethal to mature overstory trees. Stand replacement fires, although uncommon, may occur within these regimes, especially in stands where the last occurrence of fire is much longer than its historical periodicity. The chances for this type of fire are also greater due to warmer than normal temperatures and lower than normal precipitation in recent years.

Fire in Xeric Pine and Pine-Oak forests

An overstory of southern yellow pine (Virginia, shortleaf, pitch, and Table Mountain) typically dominates south- and west-facing slopes, but in the absence of fires at rather frequent intervals, hardwoods will succeed pines. Table Mountain pine is well adapted to fire because of its serotinous cones, although the degree of serotiny is variable. This adaptation allows Table Mountain pine to cast seeds when seeds of other pine species would be destroyed. Shortleaf and pitch pines can sprout from the root collar after top-kill by fire. The thick bark of these pine species also makes them well adapted to fire.

Fire in Oak and Oak-Pine forests

The oak-hickory forest type occurs primarily on average to dry upland sites, but it also can be found on moist upland sites, depending upon past disturbance history (Barrett 1994, Braun 1950). The oak-hickory type historically had an understory fire regime (Brose and others 2001, Van Lear and Waldrop 1989, Wade and others 2000).
Presently, infrequent low-intensity surface fires during the spring and fall characterize the fire regime of oak-hickory forests. Fire exclusion has created a fuel complex that is sometimes difficult to ignite. On drier mountainous sites, fire exclusion allows ericaceous shrubs such as mountain laurel and rhododendron to move from riparian areas into upland forests (Elliott and others 1999). These shrubs are shade tolerant and evergreen, shading the forest floor throughout the year. Although the forest floor rarely dries enough to support surface fire, the ericaceous shrub layer is flammable. When it burns, it typically supports intense crown fires.

Fire in Northern Hardwoods and Mixed Mesophytic Forests

Northern hardwoods and mixed mesophytic forest communities occur only on north-facing slopes and deep coves on the District. These forest communities have long fire-return intervals (Lorimer 1977), and are not as resilient or adapted to fire as other forest communities on the District.

Prescribed Burning and Fuels

Currently, approximately half the stands for the project lie within existing prescribed burn areas, and new prescribed burn areas are being proposed in other project that would include additional stands from this project. Most project stands are in Condition Class 2; those with recent disturbances such as harvest are in Condition Class 1. Prescribed burns within the project stands that haven’t had the loblolly pine overstory removed do little to alter the current forest species

composition or structure. The dense overstory canopy precludes development of understory vegetation in any significant amount. The primary fuel to carry fire is the needle cast from the loblolly pines in the overstory. When fire burns through the stand, it is a low intensity surface fire, rarely causing mortality in the overstory. Overstory tree mortality occasionally occurs by torching, but only a few loblolly pine trees are affected.

Fuel litter and duff loading is heavy from loblolly pine needle cast. In the absence of a significant understory or down woody debris, surface fuels are light.

Wind/Weather

Since 1973, there have been six recorded tornados that have passed through a portion of the District. Of these, three were F0 class, two were F2, and one was F3 (NOAA). According to the Fujita damage scale, only small or shallow-rooted trees are uprooted by F0 tornados. F2 and F3 tornados usually uproot large trees. Forest damage reports from these tornados could not be located. In 2011, approximately 2000 acres of National Forest were extensively damaged in northeast Georgia, whose ecosystem is similar to the Andrew Pickens. The damage caused by tornados typically is intermittent and very infrequent across the landscape, but intensity can be profound, with possible complete devastation of mature stands of timber. In such cases, the result is a new stand (stand initiation). Seed from loblolly pine could be disbursed great distances by tornados, potentially expanding its occupied land area on the District. Tornado events are very infrequent on the District and associated effects related to this project would be unpredictable. Therefore effects from tornados will not be considered in further detail.

Hurricanes are not a major disturbance agent for the Andrew Pickens. The District incurs large amounts of rain during tropical storms and hurricanes that approach the southeastern seaboard, but damage to the forests is usually in the form of isolated wind-throw events.

Animals

The principal influence from animals on vegetation in the project area is deer browsing in regenerated stands. Given the acreage that would be treated, the current estimated deer population, and the amount of available browse, effects from deer on vegetation at the stand or landscape level would be minor under any alternative, so no further effects analysis is needed. Effects from the vegetation treatments on wildlife are disclosed in the wildlife reports for this EIS.

Non-native wild hogs can be a detriment to stand initiation, but the extent of their damage is usually localized to small areas within a stand.

Rare Communities or other Plant Species of Concern

Rare communities are assemblages of plants and animals that occupy a small portion of the landscape, but contribute significantly to plant and animal diversity. They are addressed in the Forest Plan and the Southern Appalachian Assessment (1996), and have been cross-walked to Natureserve's ecological community classification system. On the District, notable rare communities include Appalachian bogs and seepage wetlands, rich coves, Southern Appalachian

cliffs, bluffs, and rocky summits, waterfall spray cliffs, forested canebrakes, Table Mountain pine woodlands, and mafic glades and barrens

Inventory for rare plants, rare plant communities, and invasive plants for the project shows only small rare community remnants. These remnants include eleven savanna/mafic glade remnants (potential habitat for the rare smooth coneflower (*Echinacea laevigata)* and sun-facing coneflower *(Rudbeckia heliopsidis)* and one Table Mountain pine (*Pinus pungens*) stand. Rich cove forests harboring faded trillium and piedmont strawberry were found adjacent to one stand in the Chauga Creek Scenic Area and one stand in the Cedar Creek Botanical/ Zoological Area. Riparian forests notable in species composition were observed in Jumping Branch and Long Branch Creeks adjacent to 4 stands (Gaddy, 2009).

For the rare communities that are fire-adapted, of the eleven savanna / mafic glade remnants occurring within stands or along roadsides in the project area, four are in prescribed burn areas. The Table Mountain pine stand remnant is currently not in a prescribed burn area.

Direct and Indirect Effects of Alternative 1

Effects on Species Composition

The Forest Plan objective for converting loblolly pine to native species would not be met under Alternative 1. Species composition would remain outside the NRV for the project stands. Loblolly pine could also expand into adjacent stands that are currently comprised of native tree species. Alternative 1 would forego the opportunity to reverse a declining trend on the District for native shortleaf pine, pitch pine, and Table Mountain pine. Alternative 1 would forego the opportunity to increase the abundance of oaks and hickories, which are below the NRV for the District. Alternative 1 would also forego any potential opportunity to re-introduce American chestnut on 1,250 acres or more of its native range.

Without management or large-scale disturbance, loblolly pine would remain and continue to mature. As loblolly stands continue to mature, they would become more susceptible to insect and disease disturbance, because the competition for growing space would increase while the availability of that growing space would decrease. This condition reduces tree vigor and its ability to withstand attacks from pathogens. Periodically about every 10 years, it is likely that more loblolly overstory mortality would be caused by SPB, creating additional canopy gaps (small-scale disturbances). These disturbances could be an opportunity for native species to regenerate and get re-established in the stand. However, the area of each disturbed site would usually be small enough for a nearby loblolly pine seed source to regenerate loblolly pine in the gaps. Loblolly pine is a prolific seed producer and competitor, and it would probably continue to regenerate into these gaps as it has already been doing in existing gaps created from prior SPB-related mortality. Shade-tolerant secondary species such as red maple would also increase in size and abundance, becoming more abundant than the NRV. This dynamic has also been observed in existing gaps. Another dynamic that has been observed in the existing gaps is that Virginia pine and light-seeded hardwoods, such as yellow poplar, red maple, and sourwood regenerate into these openings from seed provided by mature trees in adjacent stands. These species are native to the District and ecologically significant, but they are secondary species for all but one ecological

zone in the project area (Coves – 60 acres of the project). If primary species (oaks, hickories, shortleaf pine, Table Mountain pine, and pitch pine), regenerate in the gaps, they get out-competed by loblolly pine in the absence of frequent fire. These stand dynamics would be expected to continue under Alternative 1.

If SPB or another disturbance such as fire caused mortality in loblolly pine on larger areas, primary species, which are shade intolerant and most of which are heavy-seeded, could get established and develop. However, frequent, low-intensity fire or some other type of disturbance would be needed to reduce competition from newly-regenerated loblolly and secondary native species. Species composition would likely revert to loblolly pine and secondary native species. Shade tolerant secondary species would eventually replace the loblolly pine in the overstory over the course of several decades and would begin to self-perpetuate since they are tolerant of shade.

In areas where disturbance does not take place, loblolly pine trees would continue to mature for the next 50-80 years before senescence would begin to cause mortality. As the mature loblolly trees die and begin to free up growing space, shade tolerant secondary species, if present, would eventually grow into the overstory. If those species are not already present, light-seeded species from edges of adjacent stands would likely regenerate along with loblolly pine. Primary species might also regenerate, but available growing space from loblolly senescence alone would not be expected to open up enough light for these species to compete well and mature. Secondary species would eventually replace the loblolly pine over time and dominate the overstory. However, loblolly pine would continue to regenerate in some amounts, making the conversion of the stands to native species a very slow process that would take well over a century.

Loblolly pine seed would continue to be available from existing loblolly pine trees for distances of up to ¼ mile. Over time, as disturbance and/or senescence occurred in the surrounding native stands, growing space would become available for loblolly pine to expand its reach. Loblolly pine would likely regenerate some portion of that growing space, expanding its occupied area and further decreasing the proportion of native forest communities.

Effects on Forest Structure

Probable disturbances from SPB would increase the vertical and possibly horizontal forest structure diversity. The scale and extent of these disturbance would likely increase as the loblolly pine matures and becomes more susceptible to SPB attack.

The age class distribution for the project stands would remain narrow, shifting to older age classes. This could eventually lead to older forest conditions, but old growth of non-native species is not a desired condition in the Forest Plan or from an ecological standpoint. Disturbances could introduce enough new cohorts to change the stands from one to two-aged or possibly uneven-aged stands. Mortality from SPB and senescence would create more dead standing and down woody debris, an important structural component for many wildlife species.

Woodlands

Alternative 1 would forego the opportunity to establish between 200 and 800 acres of new woodlands (Alternative 2 or Alternative 3) in the project area. No managed woodlands currently exist in the project stands

Herbaceous and Shrub Species

In the majority of the project stands, the abundance and diversity of herbaceous species is low and shrub species is moderate to low. This condition would persist until the loblolly pine matures and begins to senesce in 50 to 80 years, or until disturbance created openings in the canopy free up growing space and allow light to get to the lower canopy levels of the stand. Stands that are currently managed under a prescribed burn program have had some increase in the shrub and herbaceous layers and that would continue with burning. However, these prescribed fires are not designed to cause mortality in the overstory. When they do cause overstory mortality, it is usually on a small scale of a few trees. Sustained increases in the shrub and herbaceous layers would not occur with prescribed burning alone due to the persistence of shade from the loblolly pine overstory and the lack of surface fuels to sustain more active fire behavior.

Other Disturbance-Related Effects

Forest Pathogens

As described previously, the effect of Alternative 1 on SBP impacts would be an increase in tree mortality due to reduced tree vigor, typically at small scales within a stand.

Invasive Plants

In general, invasive plant species are more likely to spread and be introduced in areas of high sunlight and high soil disturbance. Alternative 1 proposes no treatments that would result in either of these conditions. Eventual disturbance that would be caused to the stands from SPB would most likely be reclaimed quickly by native vegetation.

Where disturbance occurred along heavily travelled roadsides, however, invasive plants could expand. Also, many invasive plant species are also shade tolerant, however, and would continue to occupy an increasing amount of land.

Fire and Fuels

The effect on fire as a disturbance agent would be at one of two extremes. At one extreme, the continued lack of substantial understory vegetation due to the dense loblolly overstory and shade from the overstory would limit fire behavior within the stand to low intensity ground fires that have inconsequential effects to the stand species composition or structure. The lack of understory vegetation in the loblolly pine stands would inhibit fire from reaching the canopy within the stand. At the other extreme, the persistence of a dense overstory that continues to mature and senesce would create more conducive conditions for a crown fire that could result from torching in ladder fuels from adjacent multi-storied (multi-canopied) native stands. Many of the surrounding stands are multi-storied, though, and in dry conditions, a stand-replacing crown fire

could occur. Both extremes are outside the desired conditions for the Forest Plan and outside the NRV for fire behavior in the ecological zones for the project area.

Effects on Rare Communities

Under Alternative 1, there would be negative effects to rare communities over time.

Rare community remnants that are currently present in the project stands would persist to some extent. Physical aspects of rare communities (i.e. – rock barrens, waterfall spray cliffs) would persist regardless of forest species composition or structure. However, species associated with rare communities, such as Table Mountain pine and pitch pine, would persist for the lifespan of the existing cohorts. Disturbance is necessary; most especially fire, for these species to regenerate, except in limited numbers on the most xeric sites. Prescribed burning alone as it is currently managed would not provide the intensity of disturbance needed for Table Mountain pine or pitch pine to regenerate because its intensity is not severe enough to cause enough mortality in the loblolly-dominated overstory to free up a sufficient amount of growing space.

SPB disturbance could provide the necessary growing space for regeneration initially, but Table Mountain pine and pitch pine seedlings would likely be outcompeted by loblolly pine regenerated from seed that is already present in the duff layer on the ground. Table Mountain pine has serotinous cones, requiring heat for them to open. This is facilitated most easily by fire, but in the absence of fire, sustained solar radiation near 95 degrees F can open the cones (US Forest Service EIS, 2004b). This puts Table Mountain pine at a competitive disadvantage with loblolly pine for regenerating on a recently disturbed site in the absence of fire. Small diameter Table Mountain pine can sprout from the stump or other injured location, which would be effective for regenerating after harvest or fire, but ineffective in SPB disturbance regimes. Small diameter pitch pine can also sprout from the stump and its cones are usually not serotinous, at least not in the Southern Appalachians (US Forest Service EIS, 2004b), placing it on more similar competitive ground with loblolly pine for regenerating. However, pitch pine seedlings grow more slowly than loblolly pine, so it would usually be overtaken.

Wildland fire is the one potential disturbance under Alternative 1 that could perpetuate Table Mountain pine and pitch pine. Both species have reproductive strategies that make them better adapted to fire than loblolly pine. Given the prevalence of Wildland Urban Interface (WUI) on the District, suppression of wildland fire is usually a necessity, limiting the area of extent impacted by wildland fire.

Direct and Indirect Effects of Alternative 2 and Alternative 3

Optimality Analysis (common to both action alternatives)

This project was developed to be consistent with the management direction in the *Revised Land and Resource Management Plan Sumter National Forest* (Forest Plan), which was completed under the National Forest Management Act (NFMA) planning regulations.

The Purpose and Need for the Proposed Action identifies the desired conditions found in the Forest Plan and the existing conditions found in the forest (Forest Plan, page 2-7). The Desired Condition is to replace existing non-native loblolly pine with mixed native pines and hardwoods (Forest Plan, pages 2-7, 2-17, 3-27, 3-28, Appendix H-page 5)

In order to remove loblolly pine, an even-aged silviculture system would be more efficient than an uneven-aged system. An uneven-aged system, whether single-tree selection or group selection, would perpetuate loblolly pine regeneration at least to some extent as long as this type of system was employed.

Uneven-aged systems are typically more costly to implement due to more frequent entries and lower volumes per acre on each entry than even-aged systems. Timber sale preparation, administration, and logging costs are usually higher for uneven-aged systems due to higher complexity than even-aged systems. The over-riding factor for using even-aged management for this project is that an uneven-aged would not meet the purpose and need to remove the loblolly pine.

The four regeneration methods for even-aged silviculture systems that could be applied to the forest types in the project area are: shelterwood, shelterwood with reserves, seed tree, clearcutting, or clearcutting with reserves. Shelterwood and seed tree methods would be ineffective because in most stands, there is not a sufficient number of native species in the overstory to qualify as a shelterwood or seed tree method. Clearcutting or clearcutting with reserves (the reserves being native species), would be the optimal regeneration method to employ for removing loblolly as a species from the stand. .

Direct and Indirect Effects of Alternative 2

Effects on Species Composition

Under Alternative 2, the Forest Plan objective for converting loblolly pine to native species would be met. The desired condition for species composition to move closer to the NRV would be achieved.

Cutting Treatments

Following regeneration cut-and-remove and cut-and-leave treatments, over 5,500 acres of would be restored to native vegetation. The cutting of secondary species would give an immediate competitive advantage to primary species. Species composition would be more closely matched with the NRV than existing conditions and several forest communities would be restored (Table 3.2.1-2).

Reforestation and Follow-up Herbicide Treatments

Following regeneration harvest treatments in all stands, the removal of any remaining or newly regenerated loblolly pine by herbicide or cutting would ensure that this species does not gain a competitive advantage during native stand initiation.

Herbicide site preparation and release treatments mimic, to some extent, the effect of natural disturbances, primarily fire. Human influence precludes fire from shaping the species composition of the stand to the extent they would naturally.

Retention of all native species in riparian areas and not applying site preparation or release treatments in those areas would provide a different mix of species than in other parts of the regenerated stand. The proportion of secondary species would likely be higher in these areas over time.

Natural Regeneration in Forest and Woodland Treatment Stands

The retention of healthy dominant and co-dominant primary species of seed-producing age would provide an immediate seed source for regeneration of these species in areas where they exist in sufficient numbers. Advance regeneration of these species would be free to grow in the absence of the loblolly pine overstory. Viable seed in the ground would have full or near full sun to germinate.

Although naturally-regenerated stands with an objective for woodlands management would receive herbicide site preparation and follow-up release treatments, the rest of the naturally-regenerated stands would not. There is advance regeneration of primary species in the understory in those stands. This advance regeneration would likely release following removal of the loblolly overstory. Stand species composition would move closer to the NRV. For stands that are within prescribed burn blocks, frequent fire would increase competitive advantage for primary species, thus increasing the likelihood of keeping species composition close to or within the NRV. In stands that are not within prescribed burn areas, the absence of fire and no herbicide site preparation or release treatments could put primary species at a competitive disadvantage to secondary species over the long term. By that time in the stand's development, primary species should already be well-established. Species composition would likely remain close to or within the NRV, although the proportion of secondary species would be higher than in stands where they were targeted with herbicide during site preparation and release treatments.

Over the long term, the species composition would follow a track of succession close to or within the NRV. Primary species would comprise a majority of the species composition. Secondary species, because most of them are more shade-tolerant than primary species, could eventually get re-established if an available seed source were present from surrounding stands. Ongoing prescribed burning would continue to favor primary species.

Planting

Under Alternative 2, planting native species would lead to an increase in their abundance. Planting American chestnut would re-introduce it to portions of its former range.

The main difference between planted and naturally regenerated stands is that planted stands would provide more certain regeneration and a greater competitive advantage for the primary species, because some primary species would be planted and favored during herbicide site preparation and release treatments.

Herbicide site preparation targeting secondary species followed by planting of shortleaf, Table Mountain, and/or pitch pine would give these pine species a competitive advantage over naturally regenerated species. Even though native pine would be planted, species diversity would still be moved closer to the NRV. It is unlikely that the long term species composition would be pure pine in most stands, and in some stands pure pine would be within the NRV. Any dominant or co-dominant trees of primary hardwood species that were present pre-harvest would have been left in the residual stand and the area they occupy would not be planted. Planting would not occur in riparian areas, leaving both primary and secondary native species to perpetuate there. Planting contractors are typically given some allowance on the spacing in order to find the best planting spots. Growing space not occupied by the planted pines would be filled in with other primary and secondary native species.

Targeting secondary species in follow-up release treatment would help balance competition with primary species. Over the long term, the species composition of planted stands would follow a track of succession close to or within the NRV. Species composition would likely be a mix of native pines and hardwoods. Primary species would comprise the majority of species composition, with pine species more abundant than hardwoods. Secondary species, most of which are light-seeded and more shade tolerant than primary species, would be a smaller minority than in naturally regenerated stands. Since these are mostly shade tolerant species, they would eventually increase in numbers in the understory if an available seed source were present from surrounding stands.

Effects on Forest Structure

In most stands, cutting treatments would reset the forest structure to stand initiation. In stands where a sufficient number of primary species were present prior to cutting treatments and retained, a two-aged stand would result following cutting treatments. The stand would develop as an even-aged (one or two-aged) stand over time.

Early seral stage conditions for the District would increase by approximately six percent, moving all forest community types closer to the Forest Plan objective for proportion of land in early seral stages.

Herbaceous and Shrub Species

Full or nearly full sunlight conditions to the forest floor would be created by the cutting treatments. Following treatment, for at least 5 to 10 years, there would be an increase in early successional herbaceous species, such as dog-fennel (*Eupatorium capillifolium*) and fireweed (*Erechtites hieracifolius*), and would increase the sprouting of woody vegetation. There would also initially be a higher abundance of light-seeded perennial grasses and forbs, as woody competition is reduced.

Stands that are treated with herbicide for site preparation and release treatments would have conditions more favorable for herbaceous and shrub species. Imazapyr and Triclopyr are selective on woody species as is the proposed application method. Minimal to no soil movement is anticipated and the amount of drift is also expected to be minimal. Therefore, effects on non-targeted species would be minimal.

In all stands where herbicide site preparation and/or release treatments are applied, initially the abundance of the native herbaceous component would increase and the shrub cover would decrease. Longer term (approximately ten years after cutting treatments), the shrub cover would increase and the herbaceous cover decrease.

Stands managed as woodlands, with a low target basal area and frequent prescribed burning would have a higher cover of native herbaceous species than stands managed as forest.

Woodlands

Cutting treatments in stands proposed for woodlands management would be a first step towards creating woodlands conditions. Reducing the tree component to the target basal area per acre (30 – 40 square feet/acre) would set the tree component of woodlands structure in place, provided that native trees are available to retain. Follow-up herbicide treatments along with mechanical and manual treatments would provide control of regenerating trees to favor shrub and herbaceous components. Continued disturbance from fire would perpetuate the woodlands structural conditions.

Other Disturbance-Related Effects

Forest Pathogens

Cutting treatments under Alternative 2 would virtually eliminate the risk for SPB impacts. The newly established stands would be at minimal risk to pathogens until later stages of stand development. Residual older native pine trees would have a minor risk of being attacked by SPB. The increase in available growing space provided to them would increase tree vigor, increasing their resilience to SPB activity.

Invasive Plants

Silvicultural activities that result in soil disturbance and the creation of high light conditions such as harvest can indirectly increase habitat opportunities for the proliferation of non-native invasive plant species (Evans et.al, 2006). In addition, activities which involve heavy machinery and the introduction of plant materials, rock can indirectly lead to the introduction of non-native invasive seeds, spores, and propagules. The cutting treatments under Alternative 2 would involve such activities.

Mitigation measures have been developed to minimize the risk of introduction and spread of NNIS (see mitigation measure #9). Seeding of native and/or desirable non-native forbs and grasses in disturbed areas such as temporary roads, log landings and in other disturbed areas would minimize NNIS from getting established. Ensuring all materials (plants, mulch, gravel) brought in are from weed-free sources when such sources are an economically viable option would reduce the accidental introduction of NNIS. The treatment of specific stands listed in mitigation measure #9 prior to loblolly pine removal would prevent the spread of autumn olive, Chinese privet and mimosa.

Fire and Fuels

For the first three years following harvest, there would be a temporary increase in the fuel loading from activity fuels associated with cutting treatments, especially in cut-and-leave stands where trees are not removed. This increase in fuel loading would increase the fuel hazard in the short term. Eventually these activity fuels would decompose, providing beneficial woody debris for soil structure and wildlife.

Effects on Rare Communities

Alternative 2 would benefit Table Mountain pine forest and Table Mountain pine woodland rare communities in the project area. It would have no effect on other rare communities.

Physical aspects of rare communities (i.e. – rock barrens, waterfall spray cliffs) would persist regardless of forest species composition or structure. Species associated with rare communities located in the project area, such as Table Mountain pine and pitch pine, would be retained under all action alternatives. These species would have an increase in available growing space and an opportunity for regeneration as a result of the cutting and site preparation herbicide treatments. In stands where planting is proposed for Table Mountain pine and pitch pine, these species would have an initial competitive advantage over other naturally regenerated species. Follow-up herbicide release treatments would give these species an additional competitive advantage. For the long term success of these species, however, frequent low to mixed severity fire would be needed.

Direct and Indirect Effects of Alternative 3

Effects on Species Composition

Under Alternative 3, the Forest Plan objective for converting loblolly pine to native species would be met. The desired condition for species composition to move closer to the NRV would be achieved.

Cutting Treatments

Following cut-and-remove or cut-and-leave treatments, over 5,500 acres of growing space would become available for native species to occupy. Alternative 3 would use species preferences for cutting or retention based on the ecological zone and the NRV for each stand to determine which (if any) native species to cut. Varying the species preference for retention based on these ecology mapping and inventory tools for each stand instead of always a pre-set species list for all stands would lead to greater species diversity in the overstory following treatment.

Reforestation and Follow-up Herbicide Treatments

Following cutting treatments in all stands, the removal of any remaining or newly regenerated loblolly pine by herbicide or cutting would ensure that it does not gain a competitive advantage during stand initiation.

Retention of all native species in riparian areas and not applying site preparation or release treatments in those areas would provide a different mix of species than in other parts of the regenerated stand. The proportion of secondary species would likely be higher in these areas over time.

Herbicide site preparation and release treatments mimic, to some extent, the effect of natural disturbances, primarily fire. Human influence precludes fire from shaping the species composition of the stand to the extent they would naturally.

Under Alternative 3, waiting until after cutting to determine whether or not to apply herbicide for site preparation (and later for follow-up release treatments) would enable a better assessment of herbicide needs, because the conditions which influence the decision on whether or not to apply the herbicide can change considerably from before to after cutting.

Herbicide treatments applied adaptively only as needed to balance species competition would result in greater species diversity for the project. Where herbicide application can help move species composition closer to the NRV, it would be applied. Ecological zone mapping information would be used to help determine the NRV for each stand.

In some cases, stands to be planted would not need herbicide site prep for planted trees to get established. Likewise, in some cases naturally regenerated stands may need herbicide site prep for the preferred species to get established.

As an example, if following a cutting treatment, the regenerated stand (from advance regeneration and/or new seedlings) is comprised of 50% red maple, 30% blackgum, and 20% oak, but the NRV for the stand is predicted to be 60% oak, 20% short leaf pine, and 20% other species, then herbicide treatments targeting the red maple and blackgum would reduce their numbers and bring the stand's species composition closer to the NRV. If the species composition of regeneration is already within the NRV and expected to stay in that range over time, then the same effect for species composition would be achieved without the need for herbicide treatments.

In stands where prescribed burning occurs, depending on the timing, vegetation and weather conditions at time of burning, site preparation and/or release treatment objectives may be met with burning instead of herbicide, or may at least eliminate the need for foliar spray treatments on seedlings / saplings.

Natural Regeneration in Forest and Woodland Treatment Stands

The retention of healthy dominant and co-dominant native species of seed-producing age would provide an immediate seed source for regeneration of these species in areas where they exist in sufficient numbers. Advance regeneration of native species would be free to grow in the absence of the loblolly pine overstory. Viable seed in the ground would have full or near full sun to germinate.

For stands that are within prescribed burn blocks, frequent fire would increase competitive advantage for primary species, increasing the likelihood of keeping species composition close to or within the NRV.

Over the long term, the species composition would follow a track of succession close to or within the NRV.

Planting

Under Alternative 3, planting native species would lead to an increase in their abundance. Planting American chestnut would re-introduce it to portions of its former range.

The main difference between planted and naturally regenerated stands is that planted stands would provide more certain regeneration and a greater competitive advantage for the planted species.

Species selection for planting based on the NRV as indicated by the ecological zone for each stand would ensure that planted species are ecologically suited to the site.

As in naturally regenerated stands, those that are within prescribed burn blocks, frequent fire would increase competitive advantage for primary species, increasing the likelihood of keeping species composition close to or within the NRV.

Over the long term, the species composition would follow a track of succession close to or within the NRV.

Effects on Forest Structure

In most stands cutting treatments would reset the forest structure to an early seral stage, the stand initiation stage of development. In stands where a sufficient number of primary species were present prior to cutting treatments and retained, a two-aged stand would result following cutting treatments. The stand would develop as an even-aged (one or two-aged) stand over time.

Early seral stage conditions for the District would increase by approximately 6%, moving all forest community types closer to the Forest Plan objective for proportion of land in early seral stages.

Varying the planting density from one stand to the next based how many overstory trees of native species were not removed, and based on the proportions of naturally regenerating primary and secondary species that occur in the stand, would lead to a horizontally diverse forest structure consistent with the NRV.

Herbaceous and Shrub Species

Full or nearly full sunlight conditions to the forest floor would be created by the cutting treatments. Following treatment, for at least 5 to 10 years, there would be an increase in early successional herbaceous species, such as dog-fennel (*Eupatorium capillifolium*) and fireweed (*Erechtites hieracifolius*), and would increase the sprouting of woody vegetation. There would

also initially be a higher abundance of light-seeded perennial grasses and forbs, as woody competition is reduced.

Stands that are treated with herbicide for site preparation and release treatments would have conditions more favorable for herbaceous and shrub species. Imazapyr and Triclopyr are fairly selective on woody species as is the proposed application method. Minimal to no soil movement is anticipated and the amount of drift is also expected to be minimal. Therefore, effects on non-targeted species would be minimal.

In all stands where herbicide site preparation and/or release treatments are applied, initially the abundance of the native herbaceous component would increase and the shrub cover would decrease. Longer term (approximately ten years after cutting treatments), the shrub cover would increase and the herbaceous cover decrease.

With variable planting densities based on site potential and existing conditions, native shrubs are likely to decline initially following cutting treatments, and then gradually increase to levels more native to the site.

Stands managed as woodlands, with a low target basal area and a frequent prescribed fire regime would have a higher cover of native herbaceous species than stands managed as forest.

Woodlands

Cutting treatments in stands proposed for woodlands management would be a first step towards creating woodlands conditions. Reducing the tree component to the target basal area per acre (40 – 60 sq. ft. per acre) would set the tree component of woodlands structure in place, provided that native trees are available to retain. Follow-up herbicide treatments (if needed) would provide control of regenerating trees to favor shrub and herbaceous components. Continued disturbance from fire would be needed to fully establish and maintain all the components of a woodland environment.

Other Disturbance-Related Effects

Forest Pathogens

Cutting treatments under Alternative 3 would virtually eliminate the risk for SPB impacts. The newly established stands would be at minimal risk to pathogens until later stages of stand development. Residual older native pine trees would have a minor risk of being attacked by SPB. The increase in available growing space provided to them would increase tree vigor, increasing their resilience to SPB activity.

Invasive Plants

Silvicultural activities that result in soil disturbance and the creation of high light conditions such as harvest can indirectly increase habitat opportunities for the proliferation of non-native invasive plant species (Evans et.al, 2006). In addition, activities which involve heavy machinery and the introduction of plant materials, rock can indirectly lead to the introduction of non-native

invasive seeds, spores, and propagules. The cutting treatments under Alternative 2 would involve such activities.

Mitigation measures have been developed to reduce the risk of introduction and spread of NNIS (see mitigation measure #9). Seeding of native and/or desirable non-native forbs and grasses in disturbed areas such as temporary roads, log landings and in other disturbed areas would minimize NNIS from getting established. Ensuring all materials (plants, mulch, gravel) brought in are from weed-free sources when such sources are a viable option would reduce the accidental introduction of NNIS. The treatment of specific stands listed in mitigation measure #9c prior to loblolly pine removal would prevent the spread of autumn olive, Chinese privet and mimosa.

Fire and Fuels

For the first three years following harvest, there would be a temporary increase in the fuel loading from activity fuels associated with cutting treatments, especially in cut-and-leave stands where activity fuels are left on-site. This increase in fuel loading would increase the fuel hazard in the short term. Eventually these activity fuels would decompose, providing beneficial woody debris for soil structure and wildlife.

Effects on Rare Communities

Alternative 3 would benefit Table Mountain pine forest and Table Mountain pine woodland rare communities in the project area. It would have no effect on other rare communities.

Physical aspects of rare communities (i.e. – rock barrens, waterfall spray cliffs) would persist regardless of forest species composition or structure. Species associated with rare communities located in the project area, such as Table Mountain pine and pitch pine, would be retained under all action alternatives. These species would have an increase in available growing space and an opportunity for regeneration as a result of the cutting and site preparation herbicide treatments. In stands where planting is proposed for Table Mountain pine and pitch pine, these species would have an initial competitive advantage over other naturally regenerated species. Follow-up herbicide release treatments would give these species an additional competitive advantage. For the long term success of these species, however, frequent low to mixed severity fire would be needed.

Cumulative Effects All Alternatives

In the past five years, approximately 1,000 acres of loblolly removal treatments have occurred in the form of timber harvest. This has reduced the risk for SPB effects in those stands, but over 4500 acres of loblolly pine stands remain untreated, 3600 acres of which are mature in age, making them more susceptible to SBP than younger stands. An SPB suppression management decision is in place to take action for SPB, but the project is reactive not proactive. It only provides for management of SPB once it is detected.

Where harvest of loblolly pine has occurred, loblolly pine has regenerated. Some of the projects for these harvests had follow-up herbicide treatments to kill the loblolly regeneration, others did not.

Prescribed burning has occurred each year on the District for the past five years. New prescribed burn projects are being proposed in separate project proposals. Some portions of existing burn blocks overlap project stands, and some of the proposed burn blocks would overlap with project stands in the AP Loblolly Removal Restoration project. Where prescribed burns have occurred in this project's stands, there has been only occasional torching of loblolly pine, limited to mortality of a few trees or a few groups of trees in the burned stand. More extensive mortality has not occurred, nor has it been intended to occur. There are other constraints on prescribed burning that do not allow the type of fire behavior needed to replace the loblolly pine overstory. Primarily, the constraints deal with minimizing negative effects on soil productivity and with maintaining control of the prescribed burn. Prescribed burning has not provided new early successional habitat in the treatment stands. It has maintained Smooth coneflower habitat where such habitat already exists.

Private lands

Agriculture and ranching – these activities provide open land habitat but are not specifically managed for plants and wildlife. Generally they lack diversity and distribution of forest age classes and structure

Forestry – Private timberlands are managed primarily for wood production or aesthetics. There are managed loblolly pine plantations on private land, some of which are adjacent to National Forest.

Cumulative Effects of Alternative 1

Under Alternative 1, loblolly pine seed would continue to disperse for considerable distances from the existing loblolly pine. Over time, as disturbance and/or senescence occur in the surrounding native stands, more growing space would become available. Loblolly pine would likely regenerate some portion of that growing space, expanding its occupied area and decreasing the proportion of native forest communities. This would decrease the amount of natural forest habitat. Without some combination of harvest, cutting, burning, or herbicide treatments, loblolly pine would likely expand its occupied territory on the District. Of greatest concern would be the impact to forest communities described in the affected environment section that already occupy much smaller areas than their historic range. Some of these communities continue to decline.

SPB would continue to cause mortality in mature loblolly pine, and affording loblolly pine the opportunity to regenerate in areas where mortality occurs. Unless the scale of disturbance is larger than what has been observed, it is not likely that native species regeneration would out-compete the loblolly pine. In affected stands adjacent to private lands, SPB could cause mortality in pine forests on private lands.

Where loblolly regeneration remains untreated, it would continue to grow and compete with native species for growing space.

Based on ecological zone modeling, at least 1,250 acres of the project treatment stands is suitable habitat for American chestnut. Under Alternative 1, there would be no potential opportunity for planting American chestnut and possibly restoring this species to the project stands and possibly a larger area on the landscape.

Any private landowner trying to restore native forest communities by replacing their loblolly pine would be affected by adjacent loblolly pine stands on National Forests. Private landowners could apply the same type of mitigation measures to reduce the chances for loblolly pine in adjacent National Forest stands of getting established on recently harvested private land.

Cumulative Effects of Alternatives 2 and 3

Under Alternatives 2 and 3, loblolly pine would not be able to expand its occupied area into surrounding native stands, because the loblolly pine would be removed.

SPB hazard would be reduced in all treated stands, including those adjacent to private land.

Loblolly regeneration would be removed, eliminating its competition with native species for growing space.

At the time of this EIS, viable blight-resistant strains of American chestnut are not yet available for production-level planting. If viable blight-resistant seedlings became available, American chestnut could be reintroduced on 1,250 acres or more of its former range. If American chestnut were able to get re-established on even a portion of this planted acreage, this would be a positive restorative ecological effect. Once established, American chestnut could reproduce and expand to other adjacent stands.

Re-introduction and possible natural expansion of American chestnut would create a positive cumulative effect by serving as an example to other forest managers in the Southern Appalachians that restoration of American chestnut is feasible. It could lead other forest managers to attempt re-introducing American chestnut in other areas of the Southern Appalachians, greatly expanding its re-occupation of its former range.

Loblolly pine on adjacent private lands could seed in to recently-cut stands on National Forests. This effect will be mitigated by implementing cutting treatments in potentially affected stands at the same time together, and following up with herbicide or mechanical methods to remove and regenerating loblolly pine.

3.2.2 Proposed, Endangered, Threatened and Sensitive Species

Affected Environment

Several proposed, endangered, threatened and sensitive (PETS) plant and animal species occur throughout the Andrew Pickens Ranger District of the Sumter National Forest. The Andrew Pickens District is located in the Blue Ridge physiographic province where variations in elevation lead to differences in vegetation community types. Pitch pine (*Pinus rigida*) and Table

Mountain pine (*P. pungens*) are found on high ridges, there is a mixture of shortleaf pine (*P. echinata*) and various hardwoods on low elevation ridges and south-facing slopes, mesic oak-hickory forests are found on lower and north-facing slopes and mixed mesophytic and white pine-hemlock forests are located in forested coves.

The treatment stands in the project area are dominated by loblolly pine (*P. taeda*), red maple (*Acer rubrum*), oak species (*Quercus alba, Q. coccinea, Q. falcata, Q. prinus, Q. stellata*), yellow poplar (*Liriodendron tulipifera*) and Virginia pine (*P. virginianus*) with lesser quantities of shortleaf pine, white pine (*P. strobus*), sourwood (*Oxydendrum arboreum*), eastern redbud (*Cercis canadensis*), dogwood (*Cornus florida*), hickory (*Carya* spp.) and sweetgum (*Liquidamber styraciflua*). Mountain laurel (*Kalmia latifolia*) and blueberry (*Vaccinium* spp.) are common in the understory.

For additional information and descriptions of affected environment for PETS species and associated habitats see the Final Environmental Impact Statement for the Revised Land and Resource Management Plan, Sumter National Forest Land and Resource Management Plan (US Forest Service 2004).

Proposed, endangered and threatened species are designated by the US Fish and Wildlife Service (USFWS) and are managed under the authority of the Endangered Species Act (ESA) [Public Law (PL) 93-205, as amended] and the National Forest Management Act (PL 94-588). The ESA requires federal agencies to ensure that no actions that they “authorize, fund, or carry out” are likely to jeopardize the continued existence of any proposed, endangered or threatened species or their habitat.

Sensitive species are managed under the authority of the National Forest Management Act requiring that National Forests manage for "viable populations of all native and desirable non-native species" both across the range of the species and within the planning area. Sensitive species designation occurs on a periodic basis through the recommendation of Forest Biologists who consult with local State Heritage Programs, The Nature Conservancy and local species experts. The Regional Forester administratively designates sensitive species.

The complete list of PETS species for the Sumter National Forest is attached in Appendix A of the *Biological Assessment/Biological Evaluation, Loblolly Pine Removal and Restoration Project* (December 14, 2012). All species on this list were considered for this analysis. Using a step-down process, species and potential habitat in the project area were identified by:

1) Evaluating the location and nature of the proposed project;
2) Considering the species’ range, life history and available habitat information;
3) Reviewing District records of known PETS species surveys and occurrences;
4) Reviewing the USFWS Distribution Records of Endangered, Threatened, Candidate and Species of Concern (2012); and
5) Reviewing the South Carolina Heritage Trust Geographic Database of Rare, Threatened and Endangered Species.

Table 3.2.2-1 lists those species that are known to occur or that have potential habitat within the project area. These species are addressed in the effects section of this analysis.

Table 3.2.2-1. Proposed, endangered, threatened and sensitive (PETS) species that are known to occur or have potential habitat in the Loblolly Pine Removal and Restoration Project, Andrew Pickens Ranger District Sumter National Forest.

Species	Conservation Status	Status in Project Area		Habitat Association
		Known to Occur	Potential Habitat Exists	
Ashleaf Goldenbanner *Thermopsis mollis* var. *fraxinifolia*	Sensitive	+		Pine-oak heaths; open habitats and roadsides
Bald Eagle *Haliaeetus leucoocephalus*	Sensitive		+	Mixed forests adjacent to streams and lakes
Brook Floater *Alasmidonta varicosa*	Sensitive		+	Aquatic habitats
Butternut *Juglans cinerea*	Sensitive		+	Mesic forests
Chauga Crayfish *Cambarus chaugaensis*	Sensitive		+	Aquatic habitats
Diana Fritillary *Speyeria diana*	Sensitive	+		Open habitats and roadsides
Eastern Small-footed Myotis *Myotis leibii*	Sensitive		+	General forested habitats
Edmund's Snaketail *Ophiogomphus edmundo*	Sensitive		+	Aquatic habitats
Fort Mountain Sedge *Carex communis* var. *amplisquama*	Sensitive		+	Mesic forests
Fraser's Loosestrife *Lysimachia fraseri*	Sensitive		+	Open habitats and roadsides
Georgia Aster *Symphiotrichum georgianus*	Sensitive		+	Open habitats and roadsides
Hartwig's Locust *Robinia viscose* var. *hartwegii*	Sensitive		+	Pine-oak heaths; open habitats and roadsides
Jeweled Trillium *Trillium simile*	Sensitive		+	Mesic forests
Mountain Witch Alder *Fothergilla major*	Sensitive		+	Pine-oak heaths; dry ridge tops
Nodding Trillium *Trillium rugelii*	Sensitive		+	Mesic forests
Persistent Trillium *Trillium persistens*	Federally Endangered		+	Mesic forests
Piedmont Strawberry *Waldsteinia lobata*	Sensitive	+		Mesic forests
Radford's Sedge *Carex radfordii*	Sensitive		+	Mesic forests
Rafinesque's Big-eared Bat *Corynorhinus rafinesquii*	Sensitive		+	General forested habitats
Small Whorled Pogonia *Isotria medeoloides*	Federally Threatened		+	Mesic forests

Species	Conservation Status	Status in Project Area		Habitat Association
		Known to Occur	Potential Habitat Exists	
Smooth Coneflower *Echinacea laevigata*	Federally Endangered	+		Open habitats and roadsides
Southern Appalachian Salamander *Plethodon teyahalee*	Sensitive		+	Mesic forests
Southern Oconee Bells *Shortia galacifolia* var. *galacifolia*	Sensitive		+	Mesic forests
Spreading Pogonia *Cleistes bifaria*	Sensitive		+	Pine-oak heaths; dry ridge tops
Sun-facing Coneflower *Rudbeckia heliopsidis*	Sensitive	+		Open habitats and roadsides
Sweet Pinesap *Monotropsis odorata*	Sensitive		+	Pine-oak heaths
Whorled Horsebalm *Collinsonia verticillata*	Sensitive	+		Mesic forests

All other species on the Sumter National Forest PETS list were eliminated from further analysis because they lack habitat in the proposed project area.

Environmental Baseline for the Evaluated Species

See the Biological Assessment (BA) and Biological Evaluation (BE) for the *Revised Land and Resource Management Plan, Sumter National Forest* (hereafter, Forest Plan) (US Forest Service 2004b) and the *Fiscal Year 2011 Monitoring and Evaluation Annual Report* (US Forest Service 2012) for information on the status and environmental baseline for PETS species on the Sumter National Forest.

Ashleaf goldenbanner usually occurs in pine-oak heaths, on dry ridges, or along roadsides. Habitat also includes dry, sandy, or rocky margins of large mountain streams. During 2001, nine populations of *Thermopsis mollis*, commonly known as Appalachian goldenbanner, were confirmed on the Andrew Pickens District. It is possible that these plants are actually ashleaf goldenbanner, *T. mollis* var. *fraxinifolia* (*T. fraxinifolia* in Weakley 2007). The two species are generally separated phenologically, with ashleaf goldenbanner exhibiting peak flowering six to seven weeks after that of Appalachian goldenbanner. Species verification will occur in the future, but for the purposes of this analysis, it is assumed to be *T. mollis* var. *fraxinifolia*. A population of this species occurs within the project area in compartment 41, stand 12, and several stands within the project area provide potential habitat.

Bald eagles nest in tall, usually living trees near open bodies of water. This species almost always forages near estuaries, lakes, ponds, rivers, open marshes and shorelines. Bald eagles will soar over a body of water and swoop to the surface for fish. They also scavenge for dead fish and other carrion along shores and occasionally consume small birds and mammals. Although nationwide recovery efforts led to the removal of bald eagles from the Threatened and Endangered Species List on August 9, 2007, this species is still protected under the Bald and Golden Eagle Protection Act (16 USC 668-668c) and the Migratory Bird Treaty Act (16

USC 703-712). There are no known nests on the Andrew Pickens District; however, the Chattooga and Chauga Rivers and several large water bodies (e.g., Lake Cherokee, Lake Cheohee, and Chattooga Lake) provide suitable foraging habitat for this species. Several proposed treatment stands within the project area provide potential nest and roost sites.

Brook floater is known to occur in the Chattooga River downstream of the Highway 28 Bridge. This freshwater mussel inhabits streams and rivers of varying sizes, especially those that have low to moderate flow velocities and stable substrates. In fast water, they will often occur clustered in protected areas such as behind boulders and near banks. The brook floater is sparse or absent in headwater streams and high-gradient river reaches that are prone to scour. It is frequently found in streams that have low calcium levels, low nutrient levels, and good water quality. The brook floater population in the Chattooga River is considered the most viable populations in the southernmost portion of the species' range. Streambank instability, point and nonpoint sources of siltation and pollution, habitat degradation resulting from deforestation, impoundments, channelization, dredging, the introduction of exotic species and severe drought all threaten the aquatic habitats of freshwater mussels, as well as other aquatic species.

In South Carolina, Chauga crayfish is restricted to the upper Savannah River basin, particularly the Chauga and Chattooga River basins in Oconee County. This species was found at nine sites on the Andrew Pickens District (Eversole et al. 2002). Although it was found in both high- and low-order streams, Chauga crayfish appears to be more abundant at higher order stream sites. This species occurs at sites with a substrate of cobble, large stones, and/or boulders with very little sediment accumulation. Because it seems particularly sensitive to sedimentation, bank stability is probably necessary for the survival of this species.

Butternut is an uncommon species found on sites with rich, moist, well-drained soils. It is also known to occur on drier, rocky slopes, overlying soils of limestone origin. This species is experiencing significant mortality throughout its range as a result of infection by the *Sirococcus clavigignenti-juglandacearum* fungus that causes butternut canker. Butternut is not known to occur within proposed treatment stands; however, habitat may occur.

Diana fritillary. This butterfly occurs in deciduous and pine forests near streams and along roadsides. The caterpillar feeds on violet (*Viola)* species, whereas adults feed on the nectar of a variety of plants such as milkweed (*Asclepias* spp.), buttonbush (*Cephalanthus occidentalis*), coneflower (*Echinacea* spp.), compassplant (*Silphium laciniatum*) and common mint (*Pycnanthemum incanum*). In 2004, one male Diana fritillary was captured in compartment 39, stand 35 after 9-person days of surveying throughout the Andrew Pickens District (Scholtens 2004). In 2011, Dennis Forsythe observed three male Diana fritillaries along Rich Mountain Road, which is adjacent to several proposed treatment stands (compartment 39, stands 20 and 35, and compartment 54, stands 27 and 29). Potential habitat for this species occurs within the project area in several proposed treatment stands.

Eastern small-footed myotis is one of the smallest North American bats. At the southern terminus of its range on the Andrew Pickens District, this species was detected near Lake Cherokee and at the Chattooga River near Highway 28. In winter, eastern small-footed myotis roost in caves, rock shelters and fissures in cliffs. During migration and summer, little is known

about the species' roosting habits, although there are reports of the species using abandoned buildings, bridges and rock shelters. Potential habitat for eastern small-footed myotis occurs within several proposed treatment stands.

Edmund's snaketail is one of the least known dragonfly species in North America and has one of the most restricted ranges. It is known to occur in just a few counties in Georgia, South Carolina, North Carolina and Tennessee. Edmund's snaketail was thought to be extinct in the 1970s and 1980s, but was rediscovered in North Carolina in 1994. This species was documented for the first time in South Carolina in 2008 on the Chattooga River near the Highway 76 Bridge (Hill 2009). Edmund's snaketail larvae inhabit clear, cold rivers and streams with rocks and riffles in the southern Appalachians. Adults occur in the riparian areas of rivers and streams. This species is susceptible to alterations in streamflow, siltation, flood scouring, pollution and loss of adult foraging habitat.

Fort Mountain Sedge has a very restricted range in the mountains of South Carolina, North Carolina and Georgia. It is known to occur in rich mountain coves at Tamassee Knob, East Fork of the Chattooga and White Rock Cove on the Andrew Pickens District. Fort Mountain sedge is not known to occur within any proposed treatment stands, but potential habitat may occur in or adjacent to the project area.

Fraser's loosestrife occurs in permanent openings located along roads, utility rights-of-way, and river corridors. This species has a high light requirement, especially for flowering. It grows at elevations that range from 1,100 to 3,000 feet. Soils at most sites are mapped as Evard (a strongly acid upland soil that is deep, well drained, and has a loamy surface and sub-surface). Approximately 1,700 plants from 35 locations were documented on the Andrew Pickens District in 1999 (Shatley 1999). While Fraser's loosestrife is not known to occur within any of the proposed treatment stands, suitable habitat occurs in some areas.

Georgia aster is a relict species of the savanna/woodland plant community that existed in the southeast prior to widespread fire suppression and extirpation of large native grazing animals. The majority of the remaining populations survive adjacent to roads, along woodland borders, in dry, rocky woods and within utility rights-of-way and other openings where current land management practices mimic natural disturbance regimes. Many existing populations across its range are threatened by woody plant succession resulting from fire suppression, development, highway expansion/improvement and herbicide application. There are no records of this plant in the project area but potential habitat does exist.

Hartwig's locust. This species occurs in forests, outcrop edges on high elevation granitic domes, clearings and on roadsides. One site for Hartwig's locust has been documented on the Andrew Pickens District near Village Creek. There are no known occurrences of this species in the proposed treatment stands; however, potential habitat does exist.

Jeweled trillium grows in very rich soils of slopes and coves over mafic or calcareous rocks, often in or near seepages. There are seven known populations of this species on the Andrew Pickens District. Although no populations of jeweled trillium are known to occur within proposed treatments stands, potential habitat may exist.

Mountain witch alder occurs in mesic-dry to dry habitats of the uplands, rich mountain woods and balds, and rocky ravine streambanks with rapid water flow. Although it can be occasionally found in mature mesic forests, its most characteristic habitats are disturbed areas on dry ridges. This plant is very shade-tolerant, and it occurs in moderate to slight acid soils that are well drained. Four populations are known to occur on the Andrew Pickens District. Potential habitat exists within some of the proposed treatment stands.

Nodding trillium occurs in four populations on the Andrew Pickens District. This species can be found in calcium-rich soils of cove forests. While nodding trillium does not occur within proposed treatment stands, potential habitat does exist.

Persistent trillium was listed as a federally endangered species on April 26, 1978. It is restricted to the Tallulah-Tugaloo River system in Rabun, Habersham and Stephens Counties, Georgia, and Oconee County, South Carolina. Persistent trillium is apparently restricted to gorges and steep ravines. Habitat for this species was described by Duncan et al. (1971) as "deciduous or conifer-deciduous woods of ravines or gorges, under or near *Rhododendron maximum* L. or *R. minus* Michx., rooted in well-decomposed litter and/or loose loam." According to the recovery plan (US Fish and Wildlife Service 1984), persistent trillium has also been found under open or nearly closed canopies dominated by hemlock, hemlock-white pine, hemlock-beech, white pine, chestnut oak-white oak, or black oak-chestnut oak; under open or nearly closed shrub covers of *R. maximum*, *R. minus*, *Leucothoe axillaris*, and all combination of the above, or with no shrubs or deciduous shrubs only; generally with few herbaceous associates but occasionally adjacent to thick mats of *Galax*; on all exposures except due south; and on slopes zero to 60 degrees. Additional different habitat conditions described in the recovery plan include deciduous woods on slopes with an exposure of due south and in shortleaf pine-Virginia pinewoods near a ridge top. Persistent trillium is not known to occur on the Andrew Pickens District; however, it was discovered nearby on Battle Creek in 1970. Potential habitat could occur within some of the proposed treatment stands.

Piedmont strawberry. This evergreen perennial herb occurs in stream terraces and adjacent slopes in beech or oak-hickory forests. Piedmont strawberry is known to occur in 36 separate locations in the southern half of the Andrew Pickens District. Populations of this species occur within the project area in compartment 41, stand 12 and compartment 55, stand 7. Several stands within the project area may provide potential habitat.

Radford's sedge is found in rich, often rocky, calcareous sites on well-drained soils. This rare species is associated with the Brevard geologic fault zone. Radford's sedge has been found at elevations between 1,000 to 2,100 feet, and is known to exist at three locations on the Andrew Pickens Distinct. It is not known to occur within proposed treatment stands, but potential habitat may occur within the project area.

Rafinesque's big-eared bat is one of the least know bats of the southeastern United States. It is colonial (roosts can contain over 100 individuals) and uses a wide variety of roost sites: caves, old mine shafts, hollow trees, areas behind loose bark, abandoned buildings and under bridges. It leaves its roost only when it is completely dark, forage for insects and returns to the roost before sunrise. Rafinesque's big-eared bat hibernates in the winter months, but may be active

during warm spells in the southern portions of its range. Several Rafinesque's big-eared bat roosts have been identified on the Andrew Pickens District. While there are no records of this species occurring in the proposed treatment stands, potential habitat does exist.

Small whorled pogonia was listed as federally endangered on October 12, 1982, and was reclassified as federally threatened on November 7, 1994. This rare orchid occurs on the lower slopes of mesic woods, in acidic cove communities and along streams. It is commonly associated with white pine and eastern hemlock (*Tsuga canadensis*). This species is known to occur at three locations on the Andrew Pickens District. Forest Service monitoring in 2008 found that one population exhibited a significant increase in the number of plants over a 26-year period, one population showed a decreasing trend since 1995, and the third population appears to be relatively stable (US Forest Service 2009b). While small whorled pogonia is not known to occur within proposed treatment stands, it does occur adjacent to compartment 28, stand 34. Potential habitat for this species occurs in the project area.

Smooth coneflower was listed as federally endangered on October 8, 1992. This species occurs along roadsides or in dry, open woodlands on calcium-rich soils that overlay mafic or calcareous rocks. All of the District's smooth coneflower populations occur in the Brevard geologic fault zone and are located along road rights-of-way subject to frequent mowing. This plant is a fire-associated (occurring under conditions similar to burned areas) or fire-dependent (requiring some mechanism that can be provided only by fire) species (Emanuel 1996). Ten populations, including one new population of approximately 200 rosettes, were monitored on the Andrew Pickens District in 2008 (US Forest Service 2009a). This species appears to be increasing in number on the District. Smooth coneflower is known to occur in the following proposed treatment stands: compartment 39, stand 20; compartment 41, stand 12; compartment 53, stand 5; and compartment 65, stand 27.

Southern Appalachian salamanders inhabit deciduous forests. They are known to occupy birch-beech-hemlock forests with witch hazel (*Hamamelis virginiana*), mountain laurel, and rhododendron in the understory (Nishikawa 1990). Southern Appalachian salamanders seek shelter under rotting logs and less frequently under rocks and leaf litter. Their activity levels correspond with moisture availability. Although not known to occur within any of the proposed treatment stands, potential habitat may occur in or adjacent to the project area.

Southern Oconee bells. A low growing evergreen plant that forms dense colonies, this species occurs on moist slopes, creek banks and rock outcrops on humid escarpment gorges with high rainfall. Southern Oconee bells are most commonly associated with rhododendron, specifically *Rhododendron maximum* and *R. minus*. While one population occurs in the southern half of the Andrew Pickens District, it is more abundant near Lake Jocassee. This species is not known to occur within the proposed treatment stands, but potential habitat does exist.

Spreading pogonia is an orchid that occurs in savannas, meadows and dry ridge tops under pines (where seasonally moist). While there are no known records of this species on the Andrew Pickens District, potential habitat does exist within some of the proposed treatment stands.

Sun-facing coneflower inhabits streambanks, barrens, pinelands and roadsides. It is known to

occur on the Andrew Pickens District along roadsides near Lake Cherokee. Like smooth coneflower, this disturbance-dependent species is adapted to fire. Sun-facing coneflower occurs within the following proposed treatment stands: compartment 16, stands 4A, 4B and 27.

Sweet pinesap is a cryptic species that occurs in dry to mesic upland woods under oaks and/or pines (especially Virginia pine and shortleaf pine), especially slopes or bluffs with abundant heaths. Eleven populations of sweet pinesap have been documented on the Andrew Pickens District. Although none are known to occur in the proposed treatment stands, potential habitat does exist.

Whorled horsebalm inhabits rich forests, ranging from moist cove forests to dry oak forests over mafic or calcareous rocks. It is known to occur at 68 different locations on Andrew Pickens District, including the following proposed treatment stands: compartment 41, stand 12; compartment 50, stand 2; compartment 56, stand 91; and compartment 58, stand 12.

Effects of Proposed Management Actions on Each Species Evaluated

This effects analysis takes into account not only the knowledge of species distribution from previous field surveys, but also the adequacy of those surveys. The best available science (including species' habitat requirements, reasons for species' decline, limiting factors, project area habitat conditions and the biological effects of the intensity of the proposed action) is also considered in the effects analysis. The effects of a proposed action on a species can be direct, indirect or cumulative.

Direct and Indirect Effects of Alternative 1

Under this alternative, current management plans would continue to guide management of the project area. No regeneration harvests or cutting (cut-and-remove and cut-and-leave), woodland treatments, planting, site preparation for planting, or release treatments would occur. The natural resources and ecological processes within the project area would continue at the existing level of human influence. The characteristic of the forest environment would be affected primarily by natural disturbances such as insects, disease and weather. Custodial management of recreation areas, roads, prescribed burning and other projects already approved under prior decisions would continue under this alternative.

Direct Effects

Direct effects are effects to the species known to occur in the proposed project area. They occur at the same time and place as the project activity.

There would be no direct effects to any of the PETS species under the no action alternative because no activities would take place.

Indirect Effects

Indirect effects are effects to the species' habitat in or near the project area and they could

occur during or after project implementation.

Aquatic habitats. There would be no effects to aquatic habitats under the no action alternative. No ground-disturbing activities or in stream work would take place under this alternative that would affect aquatic habitats. Vegetation within riparian corridors, including off-site loblolly pine trees, would continue to filter runoff, provide for large wood and leaf litter recruitment, and moderate stream temperatures.

Pine-oak heaths, open habitats and roadsides, and dry ridge tops. Under the no action alternative, there would be no activities that would benefit species associated with pine-oak heaths, open habitats and roadsides, and dry ridge tops. Cut-and-leave, cut-and-remove, and woodland treatments would not remove off-site loblolly pine and favor native tree species such as shortleaf pine, pitch pine, Table Mountain pine and xeric oak species. Disturbance-dependent species such as ashleaf goldenbanner, Fraser's loosestrife, Georgia aster, Hartwig's locust, smooth coneflower and sun-facing coneflower would not benefit from treatments that would reduce tree densities or create canopy gaps.

Mesic forests. There would be no effects to mesic forests under alternative 1 because most off-site loblolly pine occurs on dry sites. Mesic habitat would not be significantly influenced by the continued presence of the species.

General forest habitats and mixed forests adjacent to streams and lakes. Off-site loblolly pine would not be removed and native tree species such as shortleaf pine, pitch pine, Table Mountain pine and hardwoods would not be favored under the no action alternative. Loblolly pine would continue to out-compete these native species, resulting in less diverse forest composition.

Direct and Indirect Effects of the Action Alternatives

Direct Effects

Ashleaf goldenbanner is known to occur in compartment 41, stand 12. In alternative 2, this stand would receive a cut-and-leave treatment with no planting. In this treatment, all felling of trees would occur using manual methods (hand tools, chainsaws). Heavy equipment (e.g., feller-buncher, skidder) would not be used and herbicides would not be applied. Aboveground damage to plants is possible but not likely. If a tree were felled on an individual or clump of individual plants, it is possible that damage could occur. Damage to belowground plant parts during the cut-and-leave treatment would not occur (see section 2.4 Mitigation Measure #11).

In alternative 3, compartment 41, stand 12 would receive a cut-and-leave woodland treatment. This treatment includes the potential use of herbicide and/or manual control methods to control competing woody vegetation. Adverse direct effects resulting from the use of herbicide and/or manual control methods to control competing woody vegetation are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or cut-surface / stem injection would make application to non-target species possible but unlikely. In order to avoid direct effects, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

Bald eagles are not known to occur within the project area. Proposed treatment stands are not likely to be used for foraging since bald eagles generally forage over large water bodies, including rivers and lakes. However, some proposed treatment stands (especially those that occur within ½ mile of open water), in both alternatives 2 and 3, may provide roosting or nesting habitat for this species. If a bald eagle were roosting or nesting in a treatment stand, logging operations could disturb them; however, Forest Plan Standard FW-28[6] provides protective measures that would prevent adverse direct effects to this species.

The use of herbicides for site preparation, crop tree release and woody vegetation control in woodland treatments as proposed in alternatives 2 and 3 is not expected to have a direct effect on bald eagles. While the use of some herbicides can have direct effects on wildlife by causing injury or mortality from direct spray, drift, or ingestion of contaminated food or water, those herbicides proposed in this alternative, namely imazapyr and triclopyr, are practically non-toxic to birds and other wildlife species.

The acute oral LD_{50}[7] of imazapyr for mallard ducks (*Anas platyrhynchos*) and northern bobwhite (*Colinus virginianus*) are both greater than 2,150 mg/kg. Imazapyr is rapidly eliminated in the urine and feces of animals, and is not known to accumulate in animal tissues. The acute oral LD_{50} of triclopyr for mallard ducks and northern bobwhite are 1,698 mg/kg and 2,935 mg/kg, respectively. A one-generation reproduction study showed no reproductive effects, symptoms of toxicity, or abnormal behavior when mallards were given up to 500 ppm of triclopyr in their diet for a 20-week period, including 10 weeks prior to egg laying and 10 weeks during egg laying. Newton et al. (1990) predicted that triclopyr would not be present in animal forage in doses large enough to cause either acute or chronic effects to wildlife, and concluded that the tendency for triclopyr to dissipate quickly in the environment would preclude any problems with bioaccumulation in the food chain.

Brook floater, Chauga crayfish and Edmund's snaketail. Field reviews indicate that most of the treatment stands are located on broad, flat ridges and that streamside vegetation consists mostly of native hardwoods and pines. In some cases, streamside buffers are up to 400 to 600 feet wide on either side of the streams. These buffers would remain largely unaltered by proposed activities. However, there are areas of concentrated treatment stands located within single headwater stream sheds and in adjacent stream sheds that drain to larger streams. If regeneration harvests or cutting (cut-and-remove and cut-and-leave) take place in these areas over a short period of time, there could be a substantial increase in streamflow within individual streams and downstream into larger waters. This could result in an increase of streambank erosion in unstable downstream channels, which could cause adverse direct effects to brook floater, Chauga crayfish and Edmund's snaketail. Mitigation is planned to stagger the management of concentrated treatment stands in order to temporally and geographically spread out impacts over a longer period of time. This would reduce the potential for flow increases

[6] See p. 2-9 in the Forest Plan for a complete description of Standard FW-28.

[7] Acute toxicity is commonly measured by the lethal dose (LD) that causes death in 50 percent of treated laboratory animals. LD_{50} indicates the dose of a chemical per unit body weight of an animal and is expressed as milligrams per kilogram (mg/kg). Chemicals are highly toxic when the LD_{50} value is small and practically nontoxic when the value is large.

that could affect stream channels.

Herbicides would be applied in perennial and intermittent riparian corridors to control loblolly pine; within channeled ephemeral stream zones for site preparation and reforestation; and after regeneration harvests and woodland treatments to control unwanted woody vegetation. Herbicides would not be applied within stream channels. Although project mitigation measures, Forest Plan standards/guidelines, and South Carolina Best Management Practices (BMPs) protect aquatic species, adverse direct effects may occur from the use of herbicides.

Imazapyr and triclopyr would be used as a foliar spray using backpack sprayers, stem injection, or cut-surface methods from July through September. Individual trees within riparian corridors would be targeted with the stem injection or cut-surface methods to minimize the risk of herbicides entering stream channels directly or by drift. No direct foliar spraying would be applied in riparian corridors. The greatest risk of herbicides entering water systems and impacting aquatic life would be from treating loblolly pine in close proximity to streams and from spraying herbicides within 25 feet of channeled ephemeral streams. This risk is associated with herbicide drift, accidental spills, unexpected rain events, and soil movement.

On sites where loblolly pine is the major component within 25 feet of channeled ephemeral streams, there would be reduced vegetative cover following harvest. The result would be an increased possibility of soil movement into downstream reaches with heavy rainfall. However, tree slash would remain on site which would slow and deter the movement of disturbed soils. Herbicides would not be applied immediately after harvest, but to tree sprout growth in July through September. At that time, there should be sufficient herbaceous growth to further deter the movement of soils and any soil residual herbicides. In addition, with herbicides being applied during periods of warm to hot temperatures, rapid breakdown should occur and herbicide half-life should be on the shorter end of those reported in the literature (Jay Purnell, US Forest Service silviculturist, personal communication).

Imazapyr has a low toxicity to fish and aquatic invertebrates and is not expected to bioaccumulate in aquatic organisms. The LC_{50}[8] of imazapyr on channel catfish (*Ictalurus punctatus*), bluegill (*Lepomis macrochirus*), rainbow trout (*Oncorhynchus mykiss*), and *Daphnia magna* (an aquatic crustacean) all exceed 100 mg/l. In aquatic systems, sunlight rapidly degrades imazapyr, which has a half-life of two days in surface water. It is slowly degraded by soil microorganisms and can be relatively persistent in soils with a half-life of one to seven months. Imazapyr does not bind strongly to soils and can be highly available in the environment. Heavy rainfall can cause significant movement of the herbicide with soil particles and leaching up to 50 cm deep in soils.

In soils triclopyr amine degrades to the parent compound, triclopyr acid. Triclopyr amine and triclopyr acid are slightly toxic to fish and aquatic invertebrates. The average half-life of

[8] Acute toxicity is sometimes measured by the lethal concentration that causes death in 50 percent of treated laboratory animals (LC_{50}). LC values usually refer to the concentration of a chemical in air, but it can also mean the concentration of a chemical in water. LC_{50} indicates the dose of a chemical per unit body weight of an animal and is expressed as milligrams per liter (mg/l). Chemicals are highly toxic when the LC_{50} value is small and practically nontoxic when the value is large.

triclopyr acid in soil is 30 days. Offsite movement through surface or subsurface runoff is possible, as it is relatively persistent and has only moderate rates of soil particle adsorption. In water, the formulation (triethylamine salt) is soluble and may degrade in several hours with adequate sunlight. The LC_{50} for rainbow trout of the acid and the salt formulation is 117 mg/l and 552 mg/l, respectively; for bluegill, the LC_{50} is 148 mg/l and 891 mg/l, respectively. If applied properly, triclopyr would not be found in concentrations adequate to kill aquatic organisms. However, some water bodies remain at risk of lethal contamination levels, especially those that are shallow and have slow velocity where dissipation is slow and those that are heavily shaded where photo-degradation is reduced.

Cide-Kick or an equivalent adjuvant would be used in herbicide mixes applied in channeled ephemeral stream zones. No adjuvant would be used with cut-surface methods in the riparian corridors. There is little information on the effects of adjuvants to aquatic systems. Some adjuvants have the potential to be mobile and pollute surface or groundwater sources. The use of adjuvants near water may have adverse effects in some aquatic species. Cide-Kick or an equivalent adjuvant is formulated for use around waters. The active ingredient of this adjuvant is d-limonene, a byproduct of the citrus industry. The formulated product is practically nontoxic to freshwater fish and slightly toxic to freshwater invertebrates on an acute basis (Environmental Protection Agency 1994).

Soil and vegetation disturbance from road reconstruction and maintenance, temporary and skid roads, and log landings could result in the addition of sediments to project area streams, which could adversely affect aquatic species. Sedimentation can cause direct mortality to aquatic organisms through burial and suffocation of eggs and larvae and can result in a reduction of fish and macroinvertebrate density and biomass in a stream. Turbidity can cause abrasion, changes in feeding behavior, avoidance and displacement, gill damage (which interferes with respiration) and macroinvertebrate drift. However, Forest Plan standards/guidelines, South Carolina BMPs and project-specific mitigation measures would be followed to minimize effects.

Diana fritillary. If adults were present during any project activity, they would likely relocate to undisturbed areas. Larvae, being less mobile than adults, would be less likely to relocate if disturbed. It is possible that if larvae were present during project activities, including tree removal, roadwork, site preparation and planting, individuals could be harmed.

Very little is known about the toxicity of imazapyr and triclopyr on terrestrial invertebrates. Most research has been done on the effects of these herbicides on aquatic invertebrates. Research suggests that imazapyr and triclopyr are of low toxicity to invertebrates. Adverse direct effects to adult or larvae Diana fritillary are possible but not expected.

Eastern small-footed myotis and Rafinesque's big-eared bat. Because of the highly mobile nature of chiropteran species, any disturbance associated with this project would likely result in the temporary displacement of individuals to undisturbed areas. It is possible that project activities (namely, tree removal) could influence summer or winter roost trees. Roost trees would most likely be large snags that are hollow or have loose bark, mature live trees with exfoliating bark and mature live trees with cavities caused by disease or injury. If an occupied roost tree were felled, it could result in the injury or death of one to several individuals. Given the widely distributed nature of the treatment stands within the project area, and assuming that these bats would be using similar habitats across the Andrew Pickens District, bat mortality as a result of the felling of roost trees would not likely affect the viability of these species.

Herbicide application is not expected to adversely affect eastern small-footed myotis and Rafinesque's big-eared bat. Herbicides would not be applied directly to roost trees and application would occur during the daytime when bats are inactive. Additionally, imazapyr is practically non-toxic to mammals based on an acute oral LD_{50} of >5,000 mg/kg in rats and an acute dermal toxicity of >2,000 mg/kg in rabbits. Triclopyr is considered slightly toxic with an acute oral LD_{50} ranging from 630 to 729 mg/kg in rats.

Piedmont strawberry is known to occur in compartment 41, stand 12. In alternative 2, compartment 41, stand 12 would receive a cut-and-leave treatment with no planting. In this treatment, all felling of trees would occur using manual methods (hand tools, chainsaws). Heavy equipment (e.g., feller-buncher, skidder) would not be used and herbicides would not be applied. Aboveground damage to plants is possible but not likely. If a tree were felled on an individual or clump of individual plants, it is possible that damage could occur. Damage to belowground plant parts during the cut-and-leave treatment would not occur (see section 2.4 Mitigation Measure #11).

In alternative 3, compartment 41, stand 12 would receive a cut-and-leave woodland treatment. This woodland treatment would include the use of herbicide and/or manual control methods to control competing woody vegetation. Adverse direct effects resulting from the use of herbicide and/or manual control methods to control competing woody vegetation are possible but unlikely. Herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species unlikely. In order to avoid direct effects, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

Piedmont strawberry is also known to occur in compartment 55, stand 7. In alternative 2, compartment 55, stand 7 would receive a cut-and-leave treatment with no planting. In the cut-and-leave treatment, timber would be cut manually (e.g., hand tools, chainsaws), heavy equipment would not be used and herbicides would not be applied. Aboveground damage to plants is possible but not likely. If a tree were felled on an individual or clump of individual plants, it is possible that damage could occur. Damage to belowground plant parts during the cut-and-leave treatment would not occur (see section 2.4 Mitigation Measure #11).

In alternative 3, compartment 55, stand 7 would also receive a cut-and-leave treatment with no planting; however, herbicides would potentially be used to control competing woody vegetation. Adverse direct effects resulting from the use of herbicides to control competing

woody vegetation are possible but unlikely. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. In order to avoid direct effects, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).
Smooth coneflower occurs in compartment 39, stand 20; compartment 41, stand 12; compartment 53, stand 5; and compartment 65, stand 27. Table 3.2.2-2 lists the proposed treatments in these compartments for alternatives 2 and 3.

Table 3.2.2-2. Proposed treatments for stands with known occurrences of smooth coneflower (*Echinacea laevigata*) in the Loblolly Pine Removal and Restoration Project, Andrew Pickens Ranger District, Sumter National Forest.

Compartment/Stand	Proposed Treatment	
	Alternative 2	**Alternative 3**
39/20	Cut-and-remove, Planting, Herbicide	Cut-and-remove, Planting, Potential Herbicide
41/12	Cut-and-leave, Natural Regeneration, No Herbicide	Woodland, Cut-and-leave, Natural Regeneration, Potential Herbicide
53/5	Cut-and-leave, Natural Regeneration, No Herbicide	Cut-and-leave, Natural Regeneration, Potential Herbicide
65/27	Cut-and-leave, Natural Regeneration, No Herbicide	Cut-and-leave, Natural Regeneration, Potential Herbicide

In the cut-and-remove treatment with planting (compartment 39, stand 20 in alternatives 2 and 3), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and roads for access. Herbicides would be used in site preparation and release treatments. Stands would be reforested by planting with native tree species. In order to avoid adverse direct effects to smooth coneflower in this stand, mitigation measures would be followed (see section 2.4 Mitigation Measure #12). By following these measures, the activities in alternatives 2 and 3 are not likely to adversely affect this species.

In the cut-and-leave treatment with no planting and no herbicide application (alternative 2, compartment/stand 41/12, 53/5 and 65/27), all felling of trees would occur using manual methods (hand tools, chainsaws). Heavy equipment (e.g., feller-buncher, skidder) would not be used and herbicides would not be applied. Aboveground damage to plants is possible but not likely. If a tree were felled on an individual or clump of individual plants, it is possible that damage could occur. Damage to belowground plant parts during the cut-and-leave treatment would not occur.

In the cut-and-leave woodland treatment with no planting (alternative 3, compartment 41, stand 12), herbicide and/or manual control methods would potentially be used to control competing woody vegetation. Adverse direct effects resulting from the use of herbicide and/or manual control methods to control competing woody vegetation are possible but unlikely. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. In order to avoid direct effects, mitigation measures would be followed (see section 2.4 Mitigation Measure #13).

In the cut-and-leave treatment with potential herbicide application and no planting (alternative 3, compartment/stand 53/5 and 65/27), all felling of trees would occur using manual methods (hand tools, chainsaws). Heavy equipment (e.g., feller-buncher, skidder) would not be used. Aboveground damage to plants resulting from the manual felling of trees is possible but unlikely. If a tree were felled on an individual plant or clump of plants, it is possible that damage could occur. Damage to belowground plant parts during the cut-and-leave treatment would not occur. Adverse direct effects resulting from the use of herbicides are possible but unlikely. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. In order to avoid direct effects from herbicide application, mitigation measures would be followed (see section 2.4 Mitigation Measure #13).

Southern Appalachian salamander is not likely to occur within proposed treatment stands, which are generally on xeric sites. However, this species could occur in hardwood inclusions or in mesic hardwood habitats that are located immediately adjacent to treatment stands. Since southern Appalachian salamander does not migrate to breeding grounds or have large home ranges (Beamer and Lannoo 2005), it is unlikely that project activities in xeric pine-dominated stands would have a direct effect on this species in adjacent mesic hardwood habitats.

Sun-facing coneflower occurs in compartment 16, stands 4A, 4B and 27. Table 3.2.2-3 lists the proposed treatments in these compartments for alternatives 2 and 3.

Table 3.2.2-3. Proposed treatments for stands with known occurrences of sun-facing coneflower (*Rudbeckia heliopsidis*) in the Loblolly Pine Removal and Restoration Project, Andrew Pickens Ranger District, Sumter National Forest.

Compartment/Stand	Proposed Action	
	Alternative 2	**Alternative 3**
16/4A	Cut-and-remove, Natural Regeneration, No Herbicide	Cut-and-remove, Natural Regeneration, Potential Herbicide
16/4B	Cut-and-remove, Natural Regeneration, No Herbicide	Woodland, Cut-and-remove, Natural Regeneration, Potential Herbicide
16/27	Cut-and-leave, Planting, Herbicide	Cut-and-remove, Planting, Potential Herbicide

In the cut-and-remove treatment with no planting and no herbicide (compartment 16, stands 4A and 4B in alternative 2), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and roads for access. Heavy equipment could run over plants, causing above- and belowground damage. The placement of log landings, loading areas and access roads could also have an adverse direct effect on this species. In order to avoid direct effects from harvest operations, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

In the cut-and-leave treatment with herbicide application and planting (compartment 16, stand 27 in alternative 2), timber would be cut manually (e.g., hand tools, chainsaws) and heavy

equipment would not be used. Damage to above-or belowground plant parts from cut-and-leave treatments is highly unlikely. Herbicides would be used in site preparation and planting release treatments, and the site would be reforested by planting with native tree species. In order to avoid direct effects from these activities, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

In the cut-and-remove treatment with potential herbicide and no planting (compartment 16, stand 4A in alternative 3), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and access roads. Heavy equipment could run over plants, causing above- and belowground damage. The placement of log landing, loading areas and access roads could also have an adverse direct effect on this species. Adverse direct effects resulting from the use of herbicides are possible but unlikely. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. In order to avoid direct effects from harvest operations and herbicide applications, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

In the woodland cut-and-remove treatment (compartment 16, stand 4B in alternative 3), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and roads for access. Heavy equipment could run over plants, causing above- and belowground damage. The placement of log landings, loading areas and access roads could also have an adverse direct effect on this species. Herbicide, mechanical and/or manual control methods potentially would be used to control competing woody vegetation. Adverse direct effects resulting from the use of herbicide, mechanical and/or manual control methods to control competing woody vegetation are possible but unlikely. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. Mechanical treatments used to mow or masticate competing woody vegetation could damage aboveground plant parts, but are not likely to damage belowground parts. In order to avoid direct effects, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

In the cut-and-remove treatment with planting and potential herbicide (compartment 16, stand 27 in alternative 3), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and access roads. Stands would be reforested by planting with native tree species. Above- and belowground plant parts could be damaged or destroyed by timber harvesting and planting activities. Herbicides potentially would be used in site preparation and release treatments. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. In order to avoid direct effects from these activities, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

<u>Whorled horsebalm</u>. This species is known to occur in compartment 41, stand 12; compartment 50, stand 2; compartment 56, stand 91; and compartment 58, stand 12. Table 3.2.2-4 lists the

proposed treatments in these compartments for alternatives 2 and 3.

Table 3.2.2-4. Proposed treatments for stands with known occurrences of whorled horsebalm (*Collinsonia verticillata*) in the Loblolly Pine Removal and Restoration Project, Andrew Pickens Ranger District, Sumter National Forest.

Compartment/Stand	Proposed Treatment	
	Alternative 2	**Alternative 3**
41/12	Cut-and-leave, Natural Regeneration, No Herbicide	Woodland, Cut-and leave, Natural Regeneration, Potential Herbicide
50/2	Cut-and-remove, Planting, Herbicide	Cut-and-remove, Planting, Potential Herbicide
56/91	Cut-and-remove, Planting, Herbicide	Woodland, Cut-and-remove, Natural Regeneration, Potential Herbicide
58/12	Cut-and-leave, Natural Regeneration, No Herbicide	Cut-and-remove, Planting, Potential Herbicide

In the cut-and-leave treatment with no planting (compartment 41, stand 12 and compartment 58, stand 12 in alternative 2), timber would be cut manually (e.g., hand tools, chainsaws). Heavy equipment would not be used, there would be no new roads, herbicide would not be used and there would be no planting. Because there would be no ground disturbance or use of herbicides, this treatment is not likely to have adverse direct effects on whorled horsebalm.

In the cut-and-remove treatment with planting (compartment 50, stand 2 and compartment 56, stand 91 in alternative 2, and compartment 50, stand 2 and compartment 58, stand 12 in alternative 3), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and access roads. Herbicides potentially would be used in site preparation and release treatments. Stands would be reforested by planting with native tree species. In order to avoid adverse direct effects to whorled horsebalm in this stand, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

In the woodland cut-and-leave treatment (alternative 3, compartment 41, stand 12), herbicide and/or manual control methods potentially would be used to control competing woody vegetation. Adverse direct effects resulting from the use of herbicide and/or manual control methods to control competing woody vegetation are possible but unlikely. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. In order to avoid direct effects, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

In the woodland cut-and-remove treatment (compartment 56, stand 91 in alternative 3), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and roads for access. Heavy equipment could run over plants, causing above- and belowground damage. The placement of log landings, loading areas, and access roads could also have an adverse direct effect on this species. Herbicide, mechanical and/or manual control methods potentially would be used to control competing woody vegetation. Adverse direct

effects resulting from the use of herbicide, mechanical and/or manual control methods to control competing woody vegetation are possible but unlikely. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. Mechanical treatments used to mow or masticate competing woody vegetation could damage aboveground plant parts, but are not likely to damage belowground parts. In order to avoid direct effects, mitigation measures would be followed (see section 2.4 Mitigation Measure #11).

All other botanical PETS species. Butternut, Fort Mountain sedge, Fraser's loosestrife, Georgia aster, Hartwig's locust, jeweled trillium, nodding trillium, persistent trillium, Radford's sedge, small whorled pogonia, southern Oconee bells, spreading pogonia and sweet pinesap are not known to occur within any proposed treatment stand so there would be no direct effects.

Indirect Effects

Aquatic habitats. Streambank instability, point and nonpoint sources of siltation and pollution, habitat degradation resulting from deforestation, impoundments, channelization, dredging, the introduction of exotic species and severe drought all threaten the aquatic habitats of freshwater mussels and crayfish. Forested riparian buffers help protect aquatic habitats by: (1) absorbing and filtering runoff, (2) storing and filtering groundwater, (3) stabilizing streambanks and maintaining natural channel morphology, (4) providing course woody debris for habitat structure and diversity, (5) providing dissolved organic matter and other nutrients necessary to support the aquatic food web and (6) stabilizing aquatic microclimates (including stream temperature).

All riparian corridors on national forest system lands are managed to retain, restore and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian and upland components within the corridor. The Forest Plan's riparian corridor management prescription [9] is embedded in all adjoining prescriptions. Riparian corridors occur along all defined perennial and intermittent stream channels that show signs of scour and around natural ponds, lakeshores, wetlands, springs and seeps. Portions of the corridor may extend into upland areas, especially within steep-sided stream valleys and headwater streams. The Forest Plan also addresses "Water and Soil Quality" and "Channeled Ephemeral Steam Zone" standards that further protect aquatic and riparian habitats.[10] The riparian corridor management prescription and other Forest standards meet or exceed South Carolina BMPs; however, adverse effects to aquatic habitat could occur with the implementation of alternatives 2 or 3.

Indirect effects to aquatic habitats could occur from project activities through soil and stream disturbance, culvert placement and herbicide use. Stream sediment deposition and turbidly may result from harvest activities and road work and skid trail and temporary road stream crossings. Indirectly, sediments can fill in and destroy habitat niches within a stream impacting refugia and

[9] See pp. 3-39 through 3-44 in the Forest Plan for a complete description of the Riparian Corridor management prescription.
[10] See pp. 2-4 and 2-5 in the Forest Plan for a complete description of "Water and Soil Quality" and "Channeled Ephemeral Stream Zone" Forest Standards.

food sources.

Removal or loss of riparian vegetation could result in a decrease of filtering capabilities, a decrease of large wood and leaf litter recruitment and an increase in stream temperatures. Loss of riparian vegetation could lead to a decreased food base and a decrease in instream habitat complexity. This is not expected to occur on a large scale in riparian corridors with this project; however, there may be areas where the primary component of the riparian vegetation is loblolly pine that would be removed and/or girdled. In these areas, the risk of impacts to aquatic habitat would increase.

Where channeled ephemeral stream zones are completely harvested, there is an increased potential for sediments and herbicides to wash into downstream stream reaches. Channeled ephemeral stream zones that would be reforested with pine trees would have a decrease in beneficial leaf litter, detritus and wood and as an upstream source; these materials would be diminished in downstream stream reaches.

Pine-oak heaths are communities that occur on poor, highly acidic soils of narrow ridges, steep south slopes and the entire tops of some mountains. These communities are characterized by open stands of several different pine and oak species. Pine-oak heath understories are dominated by a dense shrub layer of ericaceous species such as mountain laurel, rhododendron, blueberries and huckleberries (*Gaylussacia* spp). Species that are associated with this community include ashleaf goldenbanner, Hartwig's locust, spreading pogonia, sweet pinesap and mountain witch alder.

Habitat for these species would benefit by the implementation of cut-and-leave, cut-and-remove and woodland treatments in alternatives 2 and 3. By removing all off-site loblolly pine, these treatments would favor native tree species that are associated with pine-oak heaths, such as shortleaf pine, pitch pine and dry-site oak species. Proposed treatments would also increase the amount of sunlight reaching the understory layer, benefiting ashleaf goldenbanner, Hartwig's locust, spreading pogonia, sweet pinesap and mountain witch alder.

Mesic forests generally occur in sheltered locations on north-facing slopes, on the lower slopes of broad ravines, or on broad flats adjacent to streams. Soils in mesic forests are typically deep and rich, are usually high in calcium, and have good soil moisture for most of the growing season. Plant diversity and density are very high in mesic forests. Northern red oak, yellow poplar, beech (*Fagus grandifolia*) and basswood (*Tilia heterophylla*) are common overstory trees. Fort Mountain sedge, jeweled trillium, nodding trillium, persistent trillium, piedmont strawberry, Radford's sedge, small whorled pogonia, southern Oconee bells and whorled horsebalm occur within the herbaceous layer of mesic forests. Butternut is an uncommon tree species that also occurs on mesic sites in the mountains, and southern Appalachian salamander is usually found at high elevations sites.

Most loblolly pine removal and restoration activities would take place on dry sites. There may be mesic habitat occurring within hardwood inclusions or along the edges of treatment stands. Butternut, Fort Mountain Sedge, jeweled trillium, nodding trillium, persistent trillium, Radford's sedge, small whorled pogonia, southern Appalachian salamander and southern Oconee bells are

not known to occur within proposed treatment stands, suggesting that habitat is not available. While piedmont strawberry and whorled horsebalm are known to occur within some proposed treatment stands, these species also occur on drier sites, such as oak-hickory forests. Proposed treatments in alternative 3 are not likely to affect mesic forest sites.

Small whorled pogonia is known to occur in a stand that is immediately adjacent to a proposed cut-and-remove treatment (compartment 28, stand 34). Management of the adjacent stand is not expected to affect short- or long-term habitat conditions for small whorled pogonia.

Open habitats and roadsides. Implementation of alternatives 2 or 3 would have beneficial indirect effects on species that use open habitats and roadsides. Cut-and-leave, cut-and-remove and woodland treatments would improve habitat for disturbance-dependent plant species (ashleaf goldenbanner, Fraser's loosestrife, Georgia aster, Hartwig's locust, smooth coneflower and sun-facing coneflower) by opening up dense canopies and allowing increased sunlight to reach the forest floor.

By reducing tree densities, creating gaps and managing for woodland conditions, the amount of herbaceous plants made available to larval and adult Diana fritillary is expected to increase. *Viola* species used by larvae and various herbaceous species used by adults would not be targeted in herbicide operations.

Dry ridge top habitats are common within treatment stands. Much of the cut-and-leave and cut-and-remove regeneration treatments would occur on these sites. Initial thinning of timber would result in an opening up of the forest stands that would result in short-term habitat benefits for species that occur on dry ridge tops. Restoring shortleaf pine, pitch pine and Table Mountain pine to these sites would result in beneficial long-term habitat improvements for native species that inhabit these areas, like mountain witch alder and spreading pogonia.

General forest habitats. Eastern small-footed myotis and Rafinesque's big-eared bat use a wide variety of forest habitats for roosting, foraging and commuting. Of all the habitat components required by bats, the two most heavily influenced by forest management are roost sites and foraging habitat (Hayes and Loeb 2007). The number of summer and winter roost trees is not expected to decrease significantly with the implementation of alternatives 2 or 3. Most snags would be retained during regeneration harvests and woodland treatments. The Forest Plan includes specific language that provides for the retention of snags during regeneration treatments.[11] Additionally, most live hickories and oaks – trees commonly used as roost sites because of their exfoliating bark – would also be retained.
Although roost abundance may not be significantly altered by implementing alternatives 2 or 3, the environmental conditions around a roost may be affected. Because bats spend so much time roosting, thermal dynamics during roosting play a critical role in bat ecology (Barclay and Kurta 2007). Regeneration harvests or woodlands thinning around existing roost trees may change the thermal characteristics of the roost site, possibly causing it to become unsuitable.

Bats must contend with physical obstruction ("clutter") while in flight (Bringham et al. 1997). Most North American species avoid areas that are extremely cluttered. Foraging habitat may be

[11] See Standard FW-22 on pp. 2-7 and 2-8 in the Forest Plan for a description of snag retention standards.

improved through regeneration harvests and woodland thinning because of the reduction of tree density. Regeneration harvests and woodland thinning would also result in increased edge habitat, which bats frequently use for commuting and foraging.

Any road work in alternatives 2 or 3 (which includes system road construction in alternative 2 and road reconstruction/maintenance, temporary road construction, and skid trail construction in alternatives 2 and 3) would likely increase foraging habitat suitability for eastern small-footed myotis and Rafinesque's big-eared bat. Roads often provide flyways for chiropteran species, presumably because of reduced clutter over roads.

Mixed forests adjacent to streams and lakes. Bald eagles generally nest near coastlines, rivers and large lakes and streams. They often nest in mature trees, snags, cliffs, rock promontories and on human-made structures such as power poles and communications towers. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest. Bald eagles also use a variety of perches for roosting; however, roost trees do not have to be as robust as nest trees. Project activities in alternatives 2 and 3 could remove large loblolly pines that could be potential nest or roost trees. However, only those treatment stands that occur within close proximity (approximately ½ mile) to a large body of water would likely be used by bald eagles. Considering the amount of available habitat District-wide, and the widely distributed nature of treatment stands, any loss of potential nest or roost sites is insignificant and would not have an adverse indirect effect on bald eagles.

Cumulative Effects of the Action Alternatives

Cumulative effects are those resulting from incremental impacts of the proposed action added to other past, present and future actions. Cumulative effects can result from individually minor but collectively significant actions that take place over a period of time.

In the past, projects on the Andrew Pickens District included timber harvesting, timber stand improvement practices, storm-damaged timber salvage, prescribed burning, mechanical and herbicide control of non-desirable species (including non-native invasives), wildlife opening construction and maintenance, trail construction and maintenance, road construction and maintenance (including culvert repair) and erosion control practices. In the future, all activities are expected to continue at about the same levels.

Past, present and reasonably foreseeable projects on national forest land have and would continue to avoid impacts to known PETS species and their habitats. Surveys would be completed in areas with potential habitat and known populations would be protected. Consultation with the USFWS would be completed to ensure threatened and endangered species protection.

On privately owned lands within the National Forest boundary, the primary land uses are timber management, farming, livestock production, hunting and residential uses. These uses are expected to continue in the future.

3.2.3 Wildlife

Affected Environment

Management Indicator Species (MIS)

A wide variety of wildlife species occur throughout the Andrew Pickens Ranger District of the Sumter National Forest. Wildlife habitat in the Loblolly Pine Removal and Restoration Project area consists of loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), oak species (*Quercus alba, Q. coccinea, Q. falcata, Q. prinus, Q. stellata*), yellow poplar (*Liriodendron tulipifera*) and Virginia pine (*P. virginianus*) with lesser quantities of shortleaf pine (*P. echinata*), white pine (*P. strobus*), sourwood (*Oxydendrum arboreum*), eastern redbud (*Cercis canadensis*), dogwood (*Cornus florida*), hickory (*Carya* spp.) and sweetgum (*Liquidamber styraciflua*). Mountain laurel (*Kalmia latifolia*) and blueberry (*Vaccinium* spp.) are common in the understory.

Management Indicator Species (MIS)[12] are representative of the diversity of species and associated habitats. MIS can be used as a tool for identifying specialized habitats and creating habitat objectives, standards and guidelines. The MIS concept is to identify a few species that are representative of many other species and to evaluate management direction by the effects of management on MIS habitats. Both population and habitat data are used to monitor MIS on National Forests. The 2004 *Sumter National Forest Revised Land and Resource Management Plan* (Forest Plan; US Forest Service 2004) lists 13 species as MIS; 12 are avian species and one is a mammal.

Trends in MIS populations are normally assessed relative to trends in their respective habitat. This section focuses on terrestrial MIS. Aquatic species are addressed in the Aquatic Communities section of this EIS. Sumter National Forest MIS are listed in Table 3.2.3-1, along with general comments regarding their habitats. General discussions of these species and their relationship to monitoring can be found in the Forest Plan.

[12] Management Indicator Species (MIS): A species whose presence in a certain location or situation at a given population indicates a particular environmental condition. Their population changes are believed to indicate effects of management activities on a number of other species or water quality.

Table 3.2.3-1. Management Indicator Species for the Sumter National Forest.

Species	General Comments
Hooded Warbler *Wilsonia citrina*	Uses mesic deciduous forest with a shrubby understory; frequents dense thickets; fairly common in upland and bottomland woodlands
Scarlet Tanager *Piranga olivacea*	Uses mature deciduous forest and some mixed conifer-hardwood forests; requires large areas of forest for breeding
Pine Warbler *Dendroica pinus*	Uses middle-aged to mature open pine forest; seldom in hardwoods; overwinters throughout much of its breeding range
Acadian Flycatcher *Empidonax virescens*	Uses mesic sites with a diverse canopy structure; found in heavily wooded deciduous bottomlands, swamps, riparian thickets, and in the wooded ravines of drier uplands
Brown-headed Nuthatch *Sitta pusilla*	Uses open, mid- to late-successional pine (age classes over 20 years); not common in dense stands of pines; will overwinter
Prairie Warbler *Dendroica discolor*	Frequents brushy old fields, open pine stands, and other early successional habitats
Field Sparrow *Spizella pusilla*	Uses woodland, grassland, and savanna habitats; fairly common in old fields, open brushy woodlands, and forest edge habitats
American Woodcock *Scolopax minor*	Often found in shrub- and seedling-dominated regeneration areas in association with riparian areas; requires moist soil conditions for feeding
Pileated Woodpecker *Dryocopus pileatus*	Uses mature and extensive forests, primarily in deciduous forests; occurs in both deep woods and swamps as well as in rather open and upland forests; excavates nesting and roosting cavities
Northern Bobwhite *Colinus virginianus*	Uses fields, grasslands, brushy habitats, and open woodlands; significantly declining over most of its range due to habitat loss and changes in farming practices
Swainson's Warbler *Limnothlypis swainsonii*	Uses canebrakes and other early-successional riparian habitats
Black Bear *Ursus americanus*	Trends in population indices and harvest levels will be used to help evaluate the results of management activities on this high profile species
Eastern Wild Turkey *Meleagris gallopavo*	Most common in extensive bottomland forests where the understory is moderate; also occurs in extensive upland hardwood or mixed forests, less so in pine forests

Based on habitat within the Loblolly Pine Removal and Restoration Project area and the biological requirements of the species, all MIS are considered and analyzed in this EIS.

Vegetation manipulation changes the diversity and abundance of wildlife species in a given area. Planning regulations define diversity as "the distribution and abundance of different plant and animal communities and species within [an] area…" (36 CFR 219.3[g]). In general, forested areas that are in various stages of development and include periodic openings support a wide diversity of species and habitats. Management activities that result in different types of habitats, including prescribed burning, thinning and herbicide use, tend to increase wildlife diversity. Impacts beneficial to wildlife are typically greater with a combination of management activities versus any of the treatments separately. Table 3.2.3-2 lists the habitat associations for the MIS analyzed for this project. Following the table are effects to these MIS by alternative.

Table 3.2.3-2. Habitat associations of Management Indicator Species that occur or have habitat within the Loblolly Pine Removal and Restoration Project, Andrew Pickens Ranger District, Sumter National Forest.

Habitat Association	Species
Mixed Pine-Hardwood Forest	Hooded Warbler, Scarlet Tanager, Pileated Woodpecker, Eastern Wild Turkey, Black Bear
Late Successional Pine	Brown-headed Nuthatch, Pine Warbler
Early Successional/Disturbance-dependent	Prairie Warbler, Field Sparrow, Northern Bobwhite
Riparian Areas	Acadian Flycatcher, American Woodcock, Swainson's Warbler

Insect Pollinators

Approximately 70% of all flowering plants depend on animal vectors such as insects for reproduction (NRC 2007). Insect pollinator abundance and species richness are correlated with herbaceous plant cover (Campbell et al. 2007) and plant species diversity (Ghazoul 2006). The availability of nest sites and nesting material, presence of host plants, level of light intensity, abundance of dead wood and leaf litter, and overall structural complexity have also been suggested to be equally important to pollinators (Nyoka 2010).

Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Early successional habitat is one of the most limited wildlife habitat conditions on the Andrew Pickens District. Hunter et al. (1999) estimate that less than 10% of the forests in the Southern Blue Ridge region are in early successional stages. Populations of most disturbance-dependent bird species continue to decline sharply. The decline of early successional bird species is attributed not only to loss of habitat, but also the degradation of remaining habitat because of improper or inadequate management, fragmentation of habitat patches into smaller, isolated units, and encroachment of non-native vegetation (Johnson and Igl 2001).

Ruffed grouse (*Bonasa umbellus*) and golden-winged warbler (*Vermivora chrysoptera*) have been identified in the purpose and need of this EIS because of their conservation status and dependence on early-successional habitats. Ruffed grouse depend on shrub-dominated and young forest habitats. The high stem densities characteristic of these habitats provide protection from predators throughout the year, but are especially important as drumming and brood-rearing habitat (Dimmick et al. 1998, Stoll et al. 1999).

Golden-winged warbler also use shrub-dominated early successional habitats. They primarily occupy abandoned fields with scattered deciduous saplings or patches of regenerating forests. Wilson et al. (2007) found that elevation was a significant modifier of golden-winged warbler distribution, with the majority of birds occurring at >2,100 feet. Buehler et al. (2005) found that in the Blue Ridge Mountains this species is typically not found at elevations below 1,800 feet.

Effects Analysis

The following effects analysis takes into account not only the knowledge of species distribution from previous field surveys, but also the adequacy of those surveys. The best available science (including species' habitat requirements, reasons for species' decline, limiting factors, project area habitat conditions and the biological effects of the intensity of the proposed action) is also considered in the effects analysis. The effects of a proposed action on a species can be direct, indirect or cumulative.

Direct and Indirect Effects of Alternative 1

Under this alternative, current management plans would continue to guide management in the project area. No regeneration harvests or cutting (cut-and-remove and cut-and-leave), woodland treatments, reforestation and site preparation and release for reforestation would occur. The natural resources and ecological processes within the project area would continue at the existing level of human influence. The characteristic of the forest environment would be affected primarily by natural disturbances such as insects, disease and weather. Custodial management of recreation areas, roads, prescribed burning and other projects already approved under prior decisions would continue under this alternative.

Direct Effects

Direct effects are effects to the species known or assumed to occur in the proposed project area. They occur at the same time and place as the project activity.

MIS, Insect Pollinators and Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

There would be no direct effects to any of the MIS, insect pollinators or other wildlife species associated with early successional habitats (ruffed grouse and golden-winged warbler) under the no action alternative because no activities would take place.

Indirect Effects

Indirect effects include the consequences of management activities that result in the modifications of habitat and ecological conditions that affect food, water, shelter and other life requirements for a species. Indirect effects could occur during or after project implementation.

MIS associated with Mixed Pine-Hardwood Forest (Hooded Warbler, Scarlet Tanager, Pileated Woodpecker, Eastern Wild Turkey, Black Bear)

Under the no action alternative, habitat for species associated with mixed pine-hardwood forests would not increase. Stands, which are currently dominated by loblolly pine, would not be restored to native pines (shortleaf pine, pitch pine and Table Mountain pine) and hardwood tree species (predominantly oaks and hickories). MIS that depend on hard mast, such as wild turkey and black bear, would not benefit from an increased hardwood component. Regeneration and

woodland treatments would not provide edge habitat and forest gaps for foraging wild turkey and black bear. Herbicides would not be used to release desirable oaks and hickories by controlling undesirable vegetation.

MIS associated with Late Successional Pine (Brown-headed Nuthatch, Pine Warbler)

Under alternative 1, there would be no short-term loss of late successional pine habitat resulting from regeneration harvests and woodland treatments. However, loblolly pine would continue to dominate stands, resulting in decreased habitat quality for MIS associated with late successional pine forests. Since natural regeneration of shortleaf pine, pitch pine and Table Mountain pine, as well as the artificial regeneration of native pine species, would not occur, there would be no long-term increase in habitat quality for these MIS.

MIS associated with Early Successional/Disturbance-dependent Habitats (Prairie Warbler, Field Sparrow, Northern Bobwhite)

Since regeneration harvests or cutting (cut-and-remove and cut-and-leave) would not occur under the no action alternative, there would be no increase in short-term early succession habitat that would be used by disturbance-dependent species. Additionally, there would be no permanent early successional habitat created by woodland treatments. Early successional habitat would continue to be one of the most limited habitat conditions on the District.

MIS associated with Riparian Areas (Acadian Flycatcher, American Woodcock, Swainson's Warbler)

Under the no action alternative, off-site loblolly pine that remain within riparian areas would continue to impact soil moisture availability and perpetuate the ecological imbalance of native riparian vegetation composition.

Insect Pollinators

Individual trees that are important to insect pollinators (e.g., sourwood and yellow poplar) would not be cut under alternative 1. However, since there would be no regeneration harvests or cutting (cut-and-remove and cut-and-leave) or woodland treatments, there would be no increase in short- or long-term early successional habitat. Early successional habitat is important for insect pollinators because of increased herbaceous plant diversity and abundance. Herbaceous plants serve as a source of nectar, pollen, host plants and insect prey.

Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Since regeneration harvests or cutting (cut-and-remove and cut-and-leave) would not occur under the no action alternative, there would be no increase in short-term early succession habitat that would be used by ruffed grouse or golden-winged warbler. Additionally, there would be no permanent early successional habitat created by woodland treatments. Early successional habitat would continue to be one of the most limited habitat conditions on the Andrew Pickens District.

Direct and Indirect Effects of Alternative 2

Direct Effects

MIS

Significant direct effects are not expected to occur to MIS with the implementation of the proposed action. Regeneration harvests or cutting (cut-and-remove and cut-and-leave), woodland treatments, reforestation and site preparation/release, and connected actions such as system road construction, reconstruction and maintenance and the establishment of temporary roads and log landings could temporarily disturb and, to some degree, displace all of the MIS. However, after the disturbance is over these species would likely reoccupy the habitat. It is possible that nests and nestlings of avian species could be lost due to these activities. These effects are considered minor since only a small portion of the project area would be affected by project activities. In addition, project activities and connected actions would have to occur at the exact time when species are most vulnerable and also occur over successive years to have substantial impacts. This is unlikely given past management practices. Additionally, avian species would re-nest multiple times throughout the nesting season, so no significant decrease in MIS reproductive success is expected.

Project activities could also potentially disrupt black bear reproduction. Breeding occurs in summer and peaks between June-July, a timeframe which coincides with potential project activities. However, with home ranges of Appalachian black bears estimated at 7-51 km^2 in Tennessee (van Manen 1994) and 27-112 km^2 in Virginia (Hellgren and Vaughan 1989), the likelihood of this project impacting breeding black bears is low.

The use of herbicides for site preparation, crop tree release and woody vegetation control in woodland treatments as proposed in the proposed action is not expected to have a direct effect on MIS. While the use of some herbicides can have direct effects on wildlife by causing injury or mortality from direct spray, drift or ingenstion of contaminated food or water, those herbicides proposed in this alternative, namely imazapyr and triclopyr, are practically non-toxic to wildlife species.

The acute oral LD_{50}[13] of imazapyr for mallard ducks (*Anas platyrhynchos*) and northern bobwhite (*Colinus virginianus*) are both greater than 2,150 mg/kg. Imazapyr is rapidly eliminated in the urine and feces of animals and is not known to accumulate in animal tissues. The acute oral LD_{50} of triclopyr for mallard ducks and northern bobwhite are 1,698 mg/kg and 2,935 mg/kg, respectively. A one-generation reproduction study showed no reproductive effects, symptoms of toxicity or abnormal behavior when mallards were given up to 500 ppm of triclopyr in their diet for a 20-week period, including 10 weeks prior to egg laying and 10 weeks during egg laying. Newton et al. (1990) predicted that triclopyr would not be present in animal forage in doses large enough to cause either acute or chronic effects to wildlife and

[13] Acute toxicity is commonly measured by the lethal dose (LD) that causes death in 50 percent of treated laboratory animals. LD_{50} indicates the dose of a chemical per unit body weight of an animal and is expressed as milligrams per kilogram (mg/kg). Chemicals are highly toxic when the LD_{50} value is small and practically nontoxic when the value is large.

concluded that the tendency for triclopyr to dissipate quickly in the environment would preclude any problems with bioaccumulation in the food chain.

Insect Pollinators

Most adult insect pollinators are capable of flight (e.g., Lepidoptera, Coleoptera, Diptera and many Hymenoptera). If volant adults were present during any project activity, they would likely relocate to undisturbed areas. Adults incapable of flight (e.g., ants) and other life cycle stages (eggs, pupae, larvae) would be less likely or unable to relocate if disturbed. It is possible that if these less mobile or immobile life cycle stages were present during project activities, including tree removal, road work, site preparation and reforestation, individuals could be harmed.

Very little is known about the toxicity of imazapyr and triclopyr on terrestrial invertebrates. Most research has been done on the effects of these herbicides on aquatic invertebrates. Research suggests that imazapyr and triclopyr are of low toxicity to invertebrates. Adverse direct effects to insect pollinators are possible; however, considering that herbicides would be applied by stem injection or directly sprayed to targeted vegetation (not broadcast sprayed), adverse direct effects would be minimized.

Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Under alternative 2, direct effects to ruffed grouse and golden-winged warbler would be the same as those that would occur to the avian MIS.

Indirect Effects

MIS associated with Mixed Pine-Hardwood Forest (Hooded Warbler, Scarlet Tanager, Pileated Woodpecker, Eastern Wild Turkey, Black Bear)

Treatment stands are currently dominated by loblolly pine. Few hardwood trees exist in the overstory of most stands but hardwood sprouts and saplings are common in stand understories. These conditions do not provide suitable habitat for wildlife species associated with mixed pine-hardwood forests. The removal of loblolly pine and the restoration of native pines (shortleaf, pitch and Table Mountain pines) and hardwood tree species (predominantly oaks and hickories) would result in an increase of mixed pine-hardwood forests.

Species that depend on hard mast, such as wild turkey and black bear, would especially benefit from an increased hardwood component. As the principle winter food, acorns are the most important component in the wild turkey’s diet. Oak mast also becomes a staple food for black bear during the fall and winter. Regeneration and woodland treatments would also provide edge habitat and forest gaps for foraging wild turkey and black bear. Edges and open areas provide grasses and forbs that are used for food and cover.

The effects of herbicide on the habitat of these MIS are expected to be beneficial. By controlling undesirable vegetation (e.g., maples and yellow poplar), oaks and hickories would be allowed to

thrive. Herbicide would not be used on herbaceous understory species so this source of food and cover would not be affected.

MIS associated with Late Successional Pine (Brown-headed Nuthatch, Pine Warbler)

These MIS use middle-aged to mature pine forest, although pine warbler can be found in pine woods in a variety of situations. Regeneration harvests and woodland treatments would reduce the quantity of loblolly pine across treatment stands, resulting in short-term loss of late successional pine habitat. However, natural regeneration of shortleaf pine, pitch pine and Table Mountain pine, as well as the artificial regeneration of native pine species, would result in a long-term increase in habitat quality for species that use late successional pine habitats. The effects of herbicide on the habitat of these MIS are also expected to be beneficial for the reasons stated above.

MIS associated with Early Successional/Disturbance-dependent Habitats (Prairie Warbler, Field Sparrow, Northern Bobwhite)

Early successional habitat is one of the most limiting terrestrial habitat types on the Sumter National Forest. Regeneration harvests or cutting (cut-and-remove and cut-and-leave) would provide short-term early succession habitat that could be used by disturbance-dependent species. Early successional conditions are expected to persist in these treatment stands for 5-10 years until natural and artificial regeneration matures. Woodland treatments would provide permanent early successional habitat. By thinning pine-dominated stands to 30-40 ft^2/acre of basal area, applying herbicides to control woody understory species and control-burning on a periodic basis, native grasses and forbs would occupy and thrive in the understory. Open woodlands with grass-dominated understories are ideal for meeting the biological requirements of MIS associated with early successional habitats.

MIS associated with Riparian Areas (Acadian Flycatcher, American Woodcock, Swainson's Warbler)

Most of the proposed treatment stands occur on upland sites; however, there would be some timber cutting and herbicide use in riparian areas. Approximately 220 acres of riparian corridors are within the project area. This acreage consists primarily of small inclusions. No riparian inclusion exceeds 10 acres.

Activities that would take place in riparian corridors include the harvest (cut-and-remove) or felling (cut-and-leave) of loblolly pine. In riparian areas where trees are inaccessible, loblolly pine may be treated with herbicide (cut-surface, no foliar spray) or girdled. There would be no tree planting in the riparian corridor. All Forest Plan standards/guidelines and South Carolina Best Management Practices (BMPs) would be followed.

The removal of loblolly pine within riparian corridors is expected to improve habitat for MIS that use riparian areas by increasing soil moisture availability and improving native riparian vegetation composition.

Insect Pollinators

Regeneration harvests and woodland treatments would result in the loss of individual trees (e.g., sourwood and yellow poplar) that may be used by insect pollinators. However, proposed treatment units represent a small percentage of the total land area of the Andrew Pickens District. Additionally, treatments would be implemented over a period of 10-15 years, reducing the number of acres that are managed across the District annually. Species of individual trees that might be lost in a treatment unit would remain available in adjacent forest stands.

Project activities are expected to increase resource availability for insect pollinators. Regeneration harvests or cutting (cut-and-remove and cut-and-leave) and woodland treatments would result in short- and long-term early successional habitat, respectively. Campbell et al. (2007) found that herbaceous plant cover and pollinator abundance increases with a decrease in basal area. The increased sunlight that reaches the forest floor as a result of regeneration and woodland treatments creates the conditions for abundant growth of herbaceous plants. Increased abundance and diversity of herbaceous plants translates into greater availability of nectar, pollen, host plants and insect prey (which are consumed by the larvae of some insect pollinators) for insect pollinators. Another benefit of open canopies is that insects use sunlight for thermoregulation and preferentially forage in sunlit areas (Haddad and Baum 1999).

Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Under alternative 2, effects to ruffed grouse and golden-winged warbler habitat would be the same as those that would occur to MIS associated with early successional/disturbance-dependent habitats.

Connected Actions

Actions are considered connected if they: (1) automatically trigger other actions that may require NEPA documentation, (2) cannot or will not proceed unless other actions are taken previously, or (3) are interdependent parts of a larger action and depend on the larger action for their justification. The construction of temporary roads, log landings and skid trails, and the implementation of erosion control measures are examples of connected actions.

MIS

Connected actions include the construction of approximately 6.5 miles of system roads, approximately 60 miles of system road reconstruction and maintenance, approximately 21.7 miles of temporary road construction and the establishment of approximately 122 log landings.

Road systems can have an effect on the habitat of terrestrial wildlife species. Effects are usually associated with habitat loss and fragmentation. These effects are influenced by a combination of landscape patterns, patch sizes and habitat types. In landscapes that are predominantly forested (>70%), issues related to habitat loss and fragmentation are reduced to minor or insignificant levels. All watersheds that occur within the proclamation boundary of the Andrew Pickens District exceed 70% in forested habitats. The construction of new system roads, temporary roads and log landings, and the reconstruction and maintenance of existing roads is

not a significant source of habitat loss or fragmentation and is not expected to adversely affect the habitat availability or suitability for terrestrial wildlife species.

Insect Pollinators

The open conditions that roadsides and log landings provide create ideal habitats for insect pollinators that rely on herbaceous plants for nectar, pollen, host plants and insect prey. System road construction, reconstruction and maintenance, and the establishment of log landings are expected to increase habitat availability for insect pollinators.

Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Effects of connected actions on other wildlife species associated with early successional habitats would be the same as the effects on MIS species. The construction of new system roads, temporary roads and log landings, and the reconstruction and maintenance of existing roads is not a significant source of habitat loss or fragmentation and is not expected to adversely affect the habitat availability or suitability for ruffed grouse and golden-winged warbler.

Direct and Indirect Effects of Alternative 3

Alternative 3 is similar to alternative 2 with the following notable exceptions: (1) There would be no new system road construction (this would affect stand access and would result in a change in the number of acres for the different treatments) and the construction of temporary roads would increase from 21.7 miles to 24.9 miles; (2) tree planting would not occur on a 12’x12’ spacing (instead, target stocking would average 300 trees per acre including planted and existing trees); and (3) woodland treatments would increase from 201 acres to 784 acres and would result in a residual basal area of 40-60 ft^2/acre (compared to 30-40 ft^2/acre in alternative 2). See Chapter 2 in this EIS for specific differences between alternatives.

Direct Effects

MIS, Insect Pollinators and Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Direct effects to MIS, insect pollinators and other wildlife species associated with early successional habitats under this alternative would be similar to alternative 2. The number of treatment units on which herbicide might be applied would increase from 3,421 acres to 5,542 acres. However, as discussed under alternative 2, direct effects of herbicide use on MIS and other wildlife species associated with early successional habitats are not expected and direct effects on insect pollinators would be minimized by application methods.

Indirect Effects

MIS

Indirect effects to all MIS under this alternative would be similar to alternative 2. The way in which regeneration harvests or cutting (cut-and-remove and cut-and-leave), woodland treatments, and site preparation and release for reforestation would take place under alternative 3 does not substantially differ from alternative 2. The additional 583 acres of woodland treatments in alternative 3 would benefit species associated with early successional/disturbance-dependent habitats (prairie warbler, field sparrow, northern bobwhite). The reforestation treatment under alternative 3, since it may result in less dense pine stands, would likely result in suitable habitat for species that use mixed pine-hardwood forest (hooded warbler, scarlet tanager, pileated woodpecker, eastern wild turkey, black bear) and late successional pine (brown-headed nuthatch, pine warbler) sooner than under alternative 2.

Alternative 3 proposes a more adaptive management approach to the use of herbicides. The determination would be made shortly after cutting treatments have been completed, on a stand by stand basis. Waiting until after cutting would result in a better assessment of herbicide needs. The intent is to evaluate site conditions and habitat to determine the most desirable tree species to favor for management. For instance, on dry mesic sites oaks would be favored and on mixed mesophytic sites cove hardwoods would be favored.

Insect Pollinators

Indirect effects to insect pollinators under alternative 3 would be similar to the proposed action. Insect pollinators would benefit from the additional 583 acres of woodland treatments in alternative 3.

Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Indirect effects to other wildlife species associated with early successional habitats under this alternative would be similar to alternative 2. The way in which regeneration harvests or cutting (cut-and-remove and cut-and-leave), woodland treatments, and site preparation and release for reforestation would take place under alternative 3 does not substantially differ from alternative 2. The additional 583 acres of woodland treatments in alternative 3 would benefit ruffed grouse and golden-winged warbler.

Alternative 3 proposes a more adaptive management approach to the use of herbicides. The determination would be made shortly after cutting treatments have been completed, on a stand by stand basis. Waiting until after cutting would result in a better assessment of herbicide needs. The intent is to evaluate site conditions and habitat to determine the most desirable tree species to favor for management. For instance, on dry mesic sites oaks would be favored and on mixed mesophytic sites cove hardwoods would be favored.

Connected Actions

MIS, Insect Pollinators and Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Connected actions under this alternative would be similar to alternative 2. There would be a net decrease of approximately 6.5 miles of system road construction under alternative 3, and temporary road construction would increase by approximately 3.2 miles. These changes would not have a significant impact on MIS or insect pollinators. The number of log landing and the amount of road reconstruction/maintenance and skid trials would remain the same.

Cumulative Effects for the Action Alternatives

Cumulative effects are effects to the species and their habitats over time and consider past, present and future actions. Typical ongoing activities on the Andrew Pickens District include timber harvesting, prescribed burning, wildlife habitat improvements and management activities, and road maintenance.

This cumulative effects analysis tiers to *Management Indicator Species Population and Trends* (US Forest Service 2001), which provides context for species and their habitats across the Sumter National Forest.

MIS associated with Mixed Pine-Hardwood Forest (Hooded Warbler, Scarlet Tanager, Pileated Woodpecker, Eastern Wild Turkey, Black Bear)

Hooded warbler and scarlet tanager populations have been declining slightly (0.6% and 1.0% annual declines, respectively) on the Francis Marion and Sumter National Forests (FMS) between 1992-2004 (La Sorte et al. 2007). Hooded warbler primarily use deciduous forests, but also occupy mixed pine-hardwood habitats. Scarlet tanager inhabit large blocks of mature forests, especially where oaks are common. The action alternatives would increase the quality and quantity of these habitat types over the long-term.

Trend estimates indicate that populations of pileated woodpecker are stable across the southeastern United States. Pileated woodpecker use extensive areas of late successional coniferous and deciduous forest. However, young forests that retain scattered, large, dead trees also provide suitable habitat. This species is versatile in utilizing various forest habitats and adapts well to human habitation. Habitat also exists for pileated woodpecker on private property across the mountains, including in rural and suburban settings. Alternatives 2 and 3 would have a beneficial cumulative effect on habitat for this species.

Populations of wild turkey suffered dramatic declines in the early 1900s. Aggressive stocking programs successfully reintroduced this species to most of its eastern range where populations continue to increase. Wild turkey use upland forests of oaks, hickories and pines as well as bottomland forest. Habitat management should center on maintaining mature bottomland hardwood forest, open upland forests and scattered openings dominated by herbaceous cover. Proposed regeneration harvests and woodland treatments would result in an increase in wild

turkey habitat.

Black bear are steadily increasing in the mountains of South Carolina, with an estimated population of 1,500 to 2,000 individuals. Habitat loss continues to threaten black bear. Forest fragmentation and the conversion of forest to agriculture, commerical and urban development, and pine monoculture restricts available habitat or limits additional range expansion (Pelton 2001; Jones 2005). The implementation of either action alternative would increase the quality of black bear habitat.

MIS associated with Late Successional Pine (Brown-headed Nuthatch, Pine Warbler)

Brown-headed nuthatch populations have increased 5.4% annually on the FMS from 1992 to 2004. Pine warbler populations have declined slightly (0.2% annual decline) over the same period of time (La Sorte et al. 2007). The population stability of these MIS is a reflection of the quantity and quality of available habitats on the Sumter NF. The implementation of alternatives 2 or 3, along with other activities on the Sumter National Forest and surrounding private lands, is not expected to adversely affect species that use late successional pine habitats.

MIS associated with Early Successional/Disturbance-dependent Habitats (Prairie Warbler, Field Sparrow, Northern Bobwhite)

All MIS associated with early successional/disturbance-dependent habitats are experiencing population declines across their range and on the Sumter National Forest. From 1992 to 2004, prairie warbler, field sparrow and northern bobwhite populations on the FMS experienced annual declines of 8.1%, 19.1% and 10.0%, respectively (La Sorte et al. 2007). The most commonly accepted reason for decline is loss and fragmentation of habitat. The action alternatives would increase breeding, foraging and wintering habitat for these species.

MIS associated with Riparian Areas (Acadian Flycatcher, American Woodcock, Swainson's Warbler)

Acadian flycatcher generally use relatively undisturbed, mature, deciduous forests in riparian areas. This species has declined 1.2% per year on the FMS from 1992 to 2004 (La Sorte et al. 2007). American woodcock populations within the Appalachian Mountain region (Bird Conservation Region 28) have experienced a 1.6% annual decline from 1966 to 2009 (Sauer et al. 2011). Population trends are unavailable for the FMS because this species is not usually detected during annual bird monitoring. Swainson's warbler breed in dense shrub layers of mixed mesophytic forests of the southern Appalachian Mountains. They are often associated with extensive canebrake habitats. Swainson's warbler have experienced a positive population trend on the FMS, increasing 8.2% per year from 1992 to 2004 (La Sorte et al. 2007). Since project activities would improve riparian habitats, adverse cumulative effects would not occur.

Insect Pollinators

There is evidence that insect pollinator biodiversity has been declining worldwide (NRC 2007; Thomas et al. 2004). Long-term honey bee (*Apis mellifera*) population data suggest that North America's most important managed pollinator is in decline. Population trends for several wild bee species (notably bumble bees, *Bombus* spp.) and some butterflies are also declining. However, a lack of long-term population data, as well as incomplete knowledge of pollinator taxonomy and ecology, make definitive assessment of population status a difficult task.

A number of threats to insect pollinators have been identified, including habitat alteration, parasitism and disease, competition with exotic pollinators (including the honey bee) and pesticide poisoning. Since project activities under alternative 2 or alternative 3 would increase the availability of pollinator habitat, adverse cumulative effects are not expected to occur.

Other Wildlife Species Associated with Early Successional Habitats (Ruffed Grouse, Golden-winged Warbler)

Between 1980 and 2005, ruffed grouse drumming male population densities within the Appalachian Mountain Bird Conservation Region have declined 6% annually (Dessecker et al. 2006). Observations made by Sumter National Forest biological staff suggest that ruffed grouse are present but uncommon on the Andrew Pickens District. The action alternatives would increase drumming, nesting, brood-rearing and foraging habitat for this species.

Breeding Bird Survey data indicate that during 1966-2009, golden-winged warbler populations have been decreasing 8.3% per year in the Appalachian Mountain region (Sauer et al. 2011). Although portions of the Andrew Pickens District occur within the historic breeding range of golden-winged warbler, breeding populations are probably absent from state, private and federal lands in South Carolina; however, the species is known to migrate through the area. Management actions proposed under the action alternative would not result in adverse cumulative effects to the species.

3.2.4 Migratory Birds

Affected Environment

The Forest Service is recognized as a national and international conservation leader and plays a pivotal role in the conservation of migratory bird populations and their habitats. Within the National Forest System, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for other land management activities.
The Andrew Pickens Ranger District (District) occurs within the physiographic region known as the Blue Ridge Province in South Carolina. This area is associated with Bird Conservation Region (BCR) 28 – Appalachian Mountains. The 105 million-acre BCR 28 is a forest-dominated area that provides habitat for approximately 234 breeding, migratory, and wintering bird species, many of which have experienced steep population declines in recent decades.

The following sources, along with an analysis of species' range, life history, and available habitat information, were reviewed to identify priority migratory birds that are likely to occur in the project area: (1) Partners in Flight (PIF) Species of Continental Importance in the Eastern Avifaunal Biome; (2) USFWS Birds of Conservation Concern for BCR 28; (3) South Carolina Breeding Bird Atlas; (4) Region 8 Bird Application Database; and (5) *The Land Manager's Guide to the Birds of the South* (Hamel 1992). The results of this analysis produced the following table (Table 3.2.4-1) of priority migratory birds that are associated with and potentially affected by activities proposed in the Loblolly EIS project.

Table 3.2.4-1. Priority Migratory Birds Associated Loblolly EIS Project, Sumter National Forest, Andrew Pickens Ranger District, South Carolina

Species	Habitat	Habitat Altered Y/N	Habitat Created Y/N
Black-throated blue warbler (*Setophaga caerulescens*)	Mature hardwoods, hemlock/white pine, mixed mesophytic forest	N	Y
Brown Thrasher (*Toxostoma rufum*)	Shrub, successional forests	N	Y
Eastern towhee (*Pipilo erythrophthalmus*)	Shrub, successional forest	N	Y
Golden-winged Warbler (*Vermivora chrysoptera*)	Open woodland, patchy shrubland, forest edge	N	Y
Kentucky warbler (*Geothlypis Formosa*)	Mixed mesophytic, cove hardwoods, upland hardwoods	N	Y
Louisiana waterthrush (*Parkesia motacilla*)	Stream borders in mature hardwoods, hemlock/white pine, mixed mesophytic forests	N	N
Northern parula (*Setophaga Americana*)	Bottomland and upland hardwood forests	N	Y
Prairie warbler (*Setophaga discolor*)	Scrub-shrub, successional forests	N	Y
Red-headed woodpecker (*Melanerpes erythrocephalus*)	Open forests with abundant snags	N	Y
Swainson's warbler (*Limnothlypis swainsonii*)	Dense understory in mature hardwood, forested wetlands, regenerating forests, stream margins	N	Y
White-eyed vireo (*Vireo griseus*)	Shrub, successional forests	N	Y
Wood thrush (*Hylocichla mustelina*)	Mixed mesophytic, upland hardwoods, hemlock/white pine	N	Y
Worm-eating warbler (*Helmitheros vermivorus*)	Mature Mixed mesophytic, cove hardwoods	N	Y
Yellow-throated vireo (*Vireo flavifrons*)	Mixed mesophytic forest	N	N

All other migratory bird species that occur in BCR 28 were excluded from analysis because: 1) they were not identified as birds of continental importance in the PIF North American Landbird Conservation Plan; 2) they were not identified as birds of conservation concern in the USFWS Birds of Conservation Concern BCR 28; 3) the project area occurs outside of their known

breeding, wintering, or migratory range; and/or 4) suitable habitat is not expected within the project area (currently or in the near future).

The District has been monitoring bird populations on the forest since the early 1990's. This monitoring has typically been conducted annually in order to assess avian presence/absence, relative abundance and frequency of occurrence by habitat condition. There are approximately 17 bird monitoring points located ≤ 50 meters from treatment areas and 11 points located within treatment areas. Temporal trends for species listed in Table 1 are reported in Attachment 1. Avian species relative abundance for the 17 bird monitoring points can be found in Attachment 2.

Species almost exclusively found in hardwood stands (i.e., Worm-eating warbler, Yellow-throated vireo and northern parula) and species of coves or stream margins (i.e., black-throated blue warbler, Kentucky warbler and Louisiana waterthrush) would largely be unaffected by this project in the short term due to the fact that most of the project area is unsuitable habitat. However, the proposed treatments would be expected to benefit the aforementioned species in the long term due the restoration of natural forested communities.

Forest Plan Goals/Objectives

In general, the proposed activities in this EIS are expected to provide short and/or long term benefits to species listed in Table 1. Desired and expected results of this project are consistent with the goals, objectives and standards described in the Sumter Forest Plan, as well as the 2008 Migratory Bird MOU between the USFS and USFWS. As described in Purpose and Need section, Goal 8 of the Sumter Forest Plan states: "Maintain and restore natural communities and habitats in amounts, arrangements, and conditions capable of supporting viable populations of existing native and desired non-native plants, aquatic, and wildlife species within the planning area." Goal 9 of the Forest Plan further states: "Provide habitats to sustain the diversity and distribution of resident reptile and amphibian species as well as breeding, wintering, and migration staging and stopover habitat for migratory birds in ways that contributes to their long-term conservation." There are specific mitigation measures which can and would be utilized to benefit migratory birds and other wildlife species in the project area. In addition, the following Forest Plan standards would be incorporated into all project activities:

FW-18 Standing snags, bird peck trees, and living den trees will not be cut or bulldozed during vegetation management treatments unrelated to timber regeneration treatments, unless necessary to provide for public or employee safety.

FW-20 During silvicultural treatments in all forest types, patches of hemlock greater than 0.25 acres are retained.

FW-21 Oak forests on mesic sites are not converted to pine forests.

FW-22 For all timber regeneration treatments, including salvage activities, two or more snags per acre from the larger size classes will be retained. Live den trees will not be cut unless

necessary to provide for public or employee safety. Distribution of retained snags may be clumped.

FW-23 On the Andrew Pickens, potential black bear den trees will be retained during all vegetation management treatments occurring in habitats suitable for bears. Potential den trees are those that are greater than 20" diameter at breast height (DBH) and are hollow with broken tops.

Direct and Indirect Effects of Alternative 1

Under the No Action alternative, current management actions would continue to guide management of the project area. No activities presented in this proposal would be implemented to accomplish the purpose and need.

The natural resources and ecological processes within the project area would continue at the existing level of human influence. The characteristics of the forest environment would be affected primarily by natural disturbances such as insects, disease, and weather events. Custodial management of recreation areas, roads, prescribed burning and other projects already approved under prior decisions will continue under this alternative.

Direct effects are effects to the species known or assumed to occur in the proposed project area. They occur at the same time and place as the project activity. Priority migratory bird species listed in Table 1 would continue to use what little habitat is available for them in the project area under the No Action alternative. Landscape scale habitat creation/restoration would not occur under this alternative. Alternative 1 would not provide any benefits to priority migratory bird species that were identified.

Indirect effects include the consequences of management activities that result in the modifications of habitat and ecological conditions that affect food, water, shelter, and other life requirements for a species. Habitat conditions for priority migratory bird species would not be affected under the No Action alternative. Natural processes and the minimal amount of forest management within the project area would create a minimal amount of preferred habitat. Due to the closed canopy conditions found within most of the unnatural loblolly pine stands identified, little if any habitat would be restored or enhanced. It is conceivable that the no-action alternative would lead to indirect negative avian effects, especially for those species listed in Table 1. It is important to note that the treatment areas are dominated by loblolly pine, a non-native tree species in the mountains. Currently, these treatment areas provide marginal habitat for avifauna.

Cumulative Effects of Alternative 1

Cumulative effects are effects to the species and their habitats over time, and consider past, present, and future actions. There are other projects being planned and implemented on the District that would continue under the No Action alternative. Projects include a minor amount of timber harvesting, prescribed burning for hazard fuel reduction and wildlife habitat improvement, road maintenance, and recreation trail construction/maintenance. Ongoing activities have the potential to benefit various species listed in Table 1, but not on the scale that

the proposed project seeks to accomplish. With the No Action alternative, no additional activities would take place, so there would be no additional cumulative effects within the project area or across the District.

Direct and Indirect Effects of Alternative 2

Alternative 2 could temporarily disturb and to some degree, displace migratory birds that are present at the time of activity. It is possible that individual nests and nestlings of avian species could be lost due to the planned activities during the breeding season. However, this potential effect is expected to be temporal in nature for the following reasons: 1) proposed activities may or may not occur while nests are active; 2) harvesting/mechanical activities are of short duration in any given location should active nests be present; and 3) many avian species raise multiple broods or are known to re-nest if disturbed during the nesting season. Consequently, no measurable decline in reproductive success of migratory birds is expected to result from any of the proposed activities. Even if the proposed activities were to negatively affect reproductive success of certain species within or immediately adjacent to treatment areas, the effect would be moderated by the amount of suitable habitat surrounding the treatment areas, and the capability of most migratory bird species to re-nest after initial nest failure. Impacts to adult birds are not expected, as adults would likely disperse from the area of disturbance and readily re-nest (either in adjacent suitable habitat or within the treatment area after treatments are completed).

In the short term, the regeneration and woodland treatments proposed under alternative 2 are expected to improve habitat for species that are dependent upon early successional habitat, forest edge and/or open woodland forest conditions (e.g., brown thrasher, eastern towhee, golden-winged warbler, prairie warbler, red-headed woodpecker, and white-eyed vireo). The proposed treatments are expected to benefit all other species listed in Table 1 in the long term by restoring natural forest communities and structure. Woodland treatments would permit more sunlight to reach the forest floor, allowing for increased understory plant diversity. Prescribed burning within the woodland treatments would allow these areas to be maintained into the future, thus perpetuating this relatively rare habitat type on the District. Woodland treatments should provide suitable habitat for species such as the golden-winged warbler and red-headed woodpecker, which prefer open woodland conditions.

Within southern pine and hardwood stands, bird density and diversity are typically high in young brushy stands, decrease in dense pole stands (as canopies close and shade out understory), and are highest in older stands with distinct vegetation layers. Changes in stand structure and plant species composition via management can result in decreased numbers of some species, increases in others, and possibly little effect on others (Hunter et al. 2001). Restoring native forest conditions should lead to increased avian habitat within the treatment areas in the long term. Improved nesting and foraging habitat, combined with reduced distances to next similar habitat on the landscape, would translate into higher likelihood of nesting success, higher reproductive rates and better condition of individuals. When combined with timber harvesting and/or prescribed burning, wildlife snag creation would greatly enhance habitat for cavity nesters such as the brown-headed nuthatch, eastern bluebird and woodpecker species. Snags also serve as refugia, perches and foraging sites for numerous other bird and wildlife species.

Herbicide treatments proposed in this alternative are not expected to have a direct negative effect on priority migratory birds. Alternative 2 proposes herbicide site preparation and release treatments on all woodland sites (202 acres) and those regeneration areas that would be planted (approximately 3,061 acres). Natural regeneration areas would not receive herbicide treatments. While the use of some herbicides can cause injury or mortality in some faunal groups due to direct contact, drift, or ingestion of contaminated food or water, the herbicides proposed in this alternative (i.e., triclopyr and imazapyr) are practically non-toxic to birds. Herbicide treatments may produce indirect avian effects by altering vegetative structure, nesting habitat and food resources. However, should indirect effects result; they are expected to be temporal in nature and of minimal intensity. Essentially, the time that the treated site is available to successional-scrub species may be temporarily reduced because more intense vegetation control often removes habitat for >1 year. Various studies have reported that single applications of forestry herbicides at stand initiation have minor and temporary impacts on plant communities and wildlife habitat conditions (Miller and Miller 2004). Some studies have even reported enhanced habitat conditions for both game and nongame wildlife species following single herbicide applications in southern forests. In a study that compared plant, small mammal and avian responses to herbicide and mechanical site preparation, O'Connell 1993 found that avian diversity was actually higher in herbicide-site prepared treatments 2 and 3 years post treatment, but not different 5 years after treatment. In an eight year study of intensively managed loblolly pine stands, Lane et al. 2011 reported that chemical (herbicide) site prep (CSP) reduced bird abundance in year 2, increased bird abundance in year 6, had no effect on abundance after year 7, and did not affect species richness in any year. Increasing intensity through the addition of vegetation control methods (i.e., CSP and 1 year herbaceous weed control) had few cumulative impacts on plant and animal communities beyond the effects of mechanical site preparation or pine spacing (small mammals and birds) or the use of CSP (woody plants). It is noteworthy to mention that the CSP treatments in Lane et al. 2011 were conducted in intensively managed loblolly pine plantations, surrounded by similarly managed habitat. As such, treatments in Alternative 2 would be expected to produce even more favorable avian responses than were observed by Lane et al. 2011.

The acute oral LD50 of imazapyr for mallard ducks (Anas platyrhynchos) and northern bobwhite (Colinus virginianus) are both greater than 2,150 mg/kg. Imazapyr is rapidly eliminated in the urine and feces of animals, and is not known to accumulate in animal tissues. The acute oral LD50 of triclopyr for mallard ducks and northern bobwhite are 1,698 mg/kg and 2,935 mg/kg, respectively. A one-generation reproduction study showed no reproductive effects, symptoms of toxicity, or abnormal behavior when mallards were given up to 500 ppm of triclopyr in their diet for a 20-week period, including 10 weeks prior to egg laying and 10 weeks during egg laying. Newton et al. (1990) predicted that triclopyr would not be present in animal forage in doses large enough to cause either acute or chronic effects to wildlife, and concluded that the tendency for triclopyr to dissipate quickly in the environment would preclude any problems with bioaccumulation in the food chain.

All herbicide would be applied by backpack sprayer or from squirt bottles direct to targeted vegetation. This minimizes impacts to non-target vegetation. This along with mitigation measures that set specific environmental parameters for herbicide application (i.e. not applied on windy days further reduces impacts to non-target vegetation.

When combined with the wide tree spacing proposed, the herbicide application would encourage vegetation structure beneficial to various bird species. Forest-wide direction (FW-22) on the retention of snags should prove to be an important mitigation measure to offset any temporal changes in the plant community and structure from herbicide site preparation and release. Alternative 2 proposes to construct approximately 6.5 miles of system roads and 24.7 miles of temporary roads in order to provide access to twenty treatment areas. This alternative also involves road reconstruction and maintenance on approximately 60 miles of existing roads. Although the 6.5 miles of new system roads would be typical forest system roads, this activity would result in the permanent loss of avian habitat, especially if these roads were to be perpetually maintained. Additionally, these new roads could serve as vectors for increased nest predation and parasitism. Minor direct and indirect effects may occur as a result of new road construction and maintenance activities. However, the avian benefits expected by restoring native forest vegetation on the regeneration areas should negate any and all negative effects resulting from new road construction.

Cumulative Effects of the Alternative 2

In general, the timber harvest and restoration treatments are expected to cumulatively benefit all species listed in Table 3.2.4-1 in the short and/or long term. High tree densities and closed-canopied conditions currently exist in almost all of the treatment areas and in loblolly stands on private lands. These conditions reduce the amount of light reaching the forest floor and limit floral and faunal diversity. Restoring native forest species and natural conditions would ultimately increase avian diversity and utilization of these loblolly pine dominated areas. Avian use of the treatment areas is expected to increase following treatments, especially when areas such as the woodlands are maintained via prescribed burning. In addition to activities planned in alternatives 2, other projects are being implemented and/or planned on the District. Those projects include a minor amount of timber harvesting, prescribed burning for hazard fuel reduction and wildlife habitat improvement, road maintenance and recreation trail construction/maintenance. Ongoing activities have the potential to benefit various species listed in Table 3.2.4-1, but not on the scale that the proposed project seeks to accomplish.

According to USFS Breeding Bird Survey data from 1992-2007, a significant number of priority migratory bird species have experienced range-wide population declines in the Blue Ridge Mountains (La Sorte et al. 2007). Table 3.2.4-2 lists the population trends for priority migratory bird species that were identified for the Loblolly EIS.

Table 3.2.4-2. Population Trends for Priority Migratory Birds Associated with the Loblolly EIS, Sumter National Forest, Andrew Pickens Ranger District, South Carolina

Species	Percent Annual Change in # of Observations	
	Region 8 Southern Blue Ridge 1997-2004[1]	Francis Marion & Sumter National Forests 1992-2004[1]
Black-throated blue warbler	-4.4	-5.9
Brown Thrasher	-8.3	4.0
Eastern towhee	-3.7	-5.2
Golden-winged Warbler	-27.0	NA (last observed 1994)
Kentucky warbler	-12.7	8.4
Louisiana waterthrush	-7.1	8.8
Northern parula	-3.2	-4.1
Prairie warbler	-7.5	-8.1
Red-headed woodpecker	-14.7	-7.1
Swainson's warbler	-4.3	8.2
White-eyed vireo	-9.2	-3.4
Wood thrush	1.3	-9.9
Worm-eating warbler	4.0	7.7
Yellow-throated vireo	-6.4	-4.4

[1] La Sorte et al. (2007)

In general, most declines for species listed in Table 3.2.4-2 are the direct result of poor management practices and lack of suitable habitat. For instance, the decline of early successional species can be attributed to a loss of early-successional habitats range wide. Very little management resulting in long-term early-successional habitat has been implemented on the District or across the Southern Blue Ridge Physiographic Area. There are approximately 300 acres of dove fields, wildlife openings, and linear strips that provide early-successional habitat on the District. During 2005-2009, only 711 acres have been managed as woodlands. While district-wide prescribed burning may contribute to early-successional conditions, more timber management is required to benefit wildlife species that use this habitat type.

Private lands adjacent to the proposed project area are comprised of timberland, home sites, pastures, and farmland. Timber management activities on private lands, including thinning, regeneration cuts, and road building, have occurred over the past 10 years within some of these areas. Open habitats on private lands are generally not managed to specifically benefit wildlife.

Alternative 2 is not expected to have a significant adverse cumulative effect on priority migratory bird populations. Priority migratory bird species would still use habitat within the project area, and treatments should provide enhanced habitat for all species listed in Tables 3.2.4-1 and 3.2.4-2. However, there could be minor cumulative effects as a result of creating 6.5 miles of new forest system roads. As aforementioned, the construction and maintenance of new system roads would result in the permanent loss of avian habitat, especially if these roads were to be perpetually maintained. Additionally, these new roads could serve as vectors for increased avian nest predation and parasitism.

Direct and Indirect Effects of Alternative 3

The direct, indirect, and cumulative effects of Alternative 3 would be the same as those described for Alternative 2. However, Alternative 3 would be less likely to produce direct, indirect and cumulative negative effects. This is especially true due to the fact that this alternative does not propose to construct any new system roads. There are modest differences between Alternative 2 and 3's regeneration acreages (see Chapter 2 of the EIS). These differences in acreage would not result in any measurable differences in effects from those already described in Alternative 2. However, increased woodland treatment acreage in Alternative 3 should provide even more benefits to those species that are dependent upon open woodland habitat (e.g., golden-winged warbler and red-headed woodpecker).

Although all treated acres in Alternative 3 would be eligible for herbicide site preparation and release treatments, it is highly unlikely that all areas would need to be treated. For example, if the existing stand of loblolly pine is fairly dense, harvest is relatively late in the year, and seedlings are available for planting the following season, only a release treatment may be necessary. Likewise, if a site preparation treatment is effective and competing vegetation does not redevelop for a few years, a release treatment would not be necessary. However, effects analysis was based on the assumption that all of these acres could receive both site preparation and release treatments.

As previously mentioned, adherence to the forest standards described in the Sumter Forest Plan would benefit migratory birds and other wildlife species. From an avian standpoint, the retention and creation of snags would likely be the single most important mitigation measure to incorporate into all treatments.

Cumulative Effects of the Alternative 3

Cumulative effects described for alternative 2 apply here as well with the exception of the effects associated with system road construction. Since no system roads would be constructed and maintained, there would be no permanent loss of avian habitat nor would they serve as vectors for increased avian nest predation and parasitism.

3.2.5 Aquatic Communities

Affected Environment

The Andrew Pickens Pine Removal and Restoration project is located across the district on 5,542 acres. This encompasses streams in the Chattooga River, Chauga River, Tugaloo River, Coneross Creek, Whitewater River and Little River watersheds. These six watersheds are components of the upper Savannah River. The majority of the headwater streams and their tributaries are managed as trout streams by the SC Department of Natural Resources (SCDNR). Cool and warm water aquatic communities occur further downstream. The aquatic community serves as a management indicator that is monitored to indicate the effects of management on riparian

resources. These communities include fish, crayfish, aquatic insects and mollusks. Fish surveys are conducted annually by SCDNR and USFS personnel in various streams across the district. English and Pike (2009), Weber and Isely (1995), and English (1990) conducted aquatic insect surveys in the Chattooga River watershed. Mussel surveys were conducted in the main channel of the Chattooga River by Alderman in 2004 and 2008. The most recent crayfish survey occurred in 2002 (Eversole et. al. 2002) in the Chauga and Chattooga River watersheds. Stream habitat surveys have been conducted in several trout streams and a large wood inventory was conducted in the main channel of the Chattooga River in 2008 (Roghair et. al. 2008). Aquatic species that may occur in the project area watershed are listed in the following tables.

Table 3.2.5-1 Fish Species Known to Occur in the Upper Savannah River Watershed
(Rhode, et.al. 2009)

Scientific Name	Common Name	Scientific Name	Common Name
Catostomidae	**Suckers**	**Cyprinidae**	**Carps and Minnows**
Cataostomus commersonii	White sucker	*Notemigonus crysoleucas*	Golden shiner
Hypentelium nigricans	Northern hogsucker	*Notropis leuciodus*	Tennessee shiner
Moxostoma collapsum	Notchlip redhorse	*Notropis lutipinnis*	Yellowfin shiner
Scartomyzon rupiscartes	Striped jumprock	*Notropis scepticus*	Sandbar shiner
Centrarchidae	**Sunfishes**	*Notropis spectrunculus*	Mirror shiner
Ambloplites rupestris	Rock bass	*Rhinichthys obtusus*	Western blacknose dace
Lepomis auritus	Redbreast sunfish	*Rhinichthys cataractae*	Longnose dace
Lepomis cyanellus	Green sunfish	*Semotilus atromaculatus*	Creek chub
Lepomis macrochirus	Bluegill sunfish	**Ictaluridae**	**Bullhead Catfishes**
Lepomis microlophus	Redear sunfish	*Ameiurus brunneus*	Snail bullhead
Micropterus coosae	Redeye bass	*Ameriurus melas*	Black bullhead
Micropterus dolomieu	Smallmouth bass	*Ameiurus natalis*	Yellow bullhead
Micropterus salmoides	Largemouth bass	*Ameiurus nebulosus*	Brown bullhead
Cottidae	**Sculpins**	*Ameiurus platycephalus*	Flat bullhead
Cottus bairdii	Mottled sculpin	*Noturus insignis*	Margined madtom
Cyprinidae	**Carps and Minnows**	*Noturus leptacanthus*	Speckled madtom
Campostoma anomalum	Central stoneroller	**Percidae**	**Perches**
Clinostomus funduloides	Rosyside dace	*Etheostoma inscriptum*	Turquoise darter
Cyprinella galactura	Whitetail shiner	*Perca flavescens*	Yellow perch
Cyprinella nivea	Whitefin shiner	*Percina nigrofasciata*	Blackbanded darter
Hybopsis rubrifrons	Rosyface chub	**Salmonidae**	**Trouts**
Luxilus coccogenis	Warpaint shiner	*Oncorhynchus mykiss*	Rainbow trout
Nocomis leptocephalus	Bluehead chub	*Salmo trutta*	Brown trout
Nocomis micropogon	River chub	*Salvelinus fontinalis*	Brook trout

All of the fish species in the community have been assigned a Global Rank of either G4 (Apparently Secure) or G5 (Secure) by NatureServe (2012). The SC Comprehensive Wildlife Conservation Strategy (Kohlsaat et. al. 2005) includes the South Carolina's Priority Species List. These species warrant conservation concern to maintain diversity in South Carolina waters. The species are ranked in priority as moderate, high and highest. The redeye bass is rated as highest priority. The mottled sculpin and turquoise darter are ranked as high priority. The notchlip redhorse, central stoneroller, whitetail shiner, river chub, snail bullhead, flat bullhead, Tennessee shiner, warpaint shiner, rosyface chub and mirror shiner, and brook trout are rated as moderate priority.

The brook trout is ranked by the SC Natural Heritage Program as S2. Management efforts throughout the watersheds have increased over the last decade to identify existing Southern

brook trout populations, increase the species distribution, and enhance habitat in brook trout streams. Most populations are now isolated in headwater tributaries. Brook trout restoration has been completed in three tributaries on the forest.

The snail bullhead and flat bullhead are listed as Vulnerable by the American Fisheries Society (AFS) (Jelks et. al. 2008). This indicates that the species is in imminent danger of becoming threatened throughout all or a significant portion of its range due to present or threatened destruction, modification, or reduction of its habitat or range. The remaining fish species in the community are ranked as CS (currently stable) by the AFS (Warren et al. 2000).

Table 3.2.5-2 Crayfish Species Known to Occur in the Upper Savannah River Watershed
(Eversole and Jones 2004)

Scientific Name	Common Name	Conservation Status			
		NatureServe	State	AFS	State Priority
Cambarus acuminatus	Acuminate crayfish	G4	S4	+CS	
Cambarus asperimanus	Mitten crayfish	G4		CS	
Cambarus bartonii	Common crayfish	G5		CS	
Cambarus carolinus	Red burrowing crayfish	G4	S2?	CS	Highest
Cambarus chaugaensis	Chauga crayfish	G2	S2S3	T	Highest
Cambarus howardi	Chattahoochee crayfish	G3		CS	
Cambarus latimanus	Variable crayfish	G5	S4?	CS	
Cambarus nodosus	Knotty burrowing crayfish	G4		CS	
Cambarus striatus	Ambiguous crayfish	G5		CS	
Procambarus raneyi	Disjunct crayfish	G4		CS	
Procambarus spiculifer	White tuberculed crayfish	G5		+CS	

The Chauga crayfish is listed as a Forest Sensitive species. The Chauga crayfish is ranked as G2 and the Chattahoochee crayfish is ranked G3 (NatureServe 2010). The G2 ranking indicates that the species is Imperiled, meaning that it is at high risk of extinction or elimination due to very restricted range, very few populations, steep declines or other factors. The G3 ranking indicates that a species is Vulnerable, meaning that it is at moderate risk of extinction or elimination due to a very restricted range, very few populations, recent and widespread declines, or other factors. The red burrowing crayfish and Chauga crayfish are rated as S2? and S2S3 respectively by the SC Natural Heritage Program. AFS status ranks (Taylor et al 2007) include CS (currently stable), V (vulnerable), T (threatened), E (endangered) and E* (endangered, possibly extinct). The T rank for the Chauga crayfish indicates that a species is likely to become endangered throughout all or a significant portion of its range. The SC Comprehensive Wildlife Conservation Strategy ranks the red burrowing crayfish and Chauga crayfish as highest priority.

A mussel survey was conducted by Alderman (2008) in the Chattooga River. Three species of mussels were identified during that survey. In addition to the species reported by Alderman, Roghair et al. (2005) reported finding a relic shell of Eastern elliptio in the Chattooga River.

Table 3.2.5-3 Mussel Species Known to Occur in the Chattooga River Watershed

Scientific Name	Common Name	Conservation Status			
		NatureServe	State	AFS	State Priority
Alasmidonta varicosa	Brook floater	G3	SNR	T	Highest
Elliptio angustata	Carolina lance	G4	S3	SC	Moderate
Elliptio complanata	Eastern elliptio	G5	S5	CS	Moderate
Elliptio producta	Atlantic spike	G3	S3	SC	Moderate

Table 3.2.5-4 Additional Mussel Species Known to Occur in the Upper Savannah River Watershed
(Alderman 2008)

Scientific Name	Common Name	Conservation Status			
		NatureServe	State	AFS	State Priority
Elliptio icterina	Variable spike	G5	S4	CS	Moderate
Pyganodon cataracta	Eastern floater	G5	SNR	CS	
Uniomerus carolinianus	Florida pondhorn	G4	S3	CS	Moderate
Utterbackia imbecillis	Paper pondshell	G5	SNR	CS	

The aquatic community includes one Forest Sensitive mussel species, the brook floater. This species has a global rank of G3. The brook floater is also ranked as Threatened by the AFS (Williams et. al. 1992). The Atlantic spike has a global rank of G3 and is ranked as Special Concern by the AFS. SNR denotes that the species is unranked by the SC Natural Heritage Program. The Carolina lance has a global rank of G4 and is ranked as Special Concern by the AFS. Eastern elliptio has a global rank of G5 and is ranked as Currently Stable by the AFS. The SC Comprehensive Wildlife Conservation Strategy ranks the brook floater as Highest Priority; and the Carolina lance, Atlantic spike and Eastern elliptio as Moderate Priority.

Aldermen (2004) reported that the brook floater, Carolina lance and Atlantic spike were reproducing and have viable populations in the Chattooga River. Of the mussel species found on the Andrew Pickens Ranger District, the brook floater population within the Chattooga River is of global significance. From Georgia through at least Maryland, this is the best extant population within this range (Alderman, 2008).

Aquatic insect surveys were conducted in the Chattooga River from 1986-89 by English (1990), in 2007-08 by English and Pike (2009), and in 1994 by Weber and Isely (1995). Weber and Isely concluded that water quality in the Chattooga River basin was good to excellent using macroinvertebrates as biological indicators of water quality. Analysis of macroinvertebrate data in the English 1990 report indicated the water quality in the Chattooga River watershed was good. The average density over the entire Chattooga River watershed suggested that the river was neither over nor under productive compared to streams in the Great Smoky Mountains National Park. Sites from the 1990 report were resampled in fall 2007 and 2008 (English and Pike 2009) and encompass sample sites from the headwaters downstream to just above Tugaloo Lake, including some tributaries. A comparison of the combined data from the 1990 and 2009 reports for both sampling periods in the entire watershed, indicated that the upper Chattooga river area (upstream of Highway 28) had better water quality than the lower Chattooga River area and the tributaries. Taxa richness and diversity metrics in the 1990 report indicate better water quality throughout the watershed than in the 2009 report. This may be contributed to lower water discharges in 2007 than in 1989. When looking at differences among all watershed areas for both sampling periods, water quality was better in the tributaries during the 1990 report

sampling period when compared to tributary water quality in the 2009 report sampling period; the upper Chattooga River had better water quality than the lower section of the river in the 2009 report sampling period; and most of the watershed had excellent or very good water quality for both sampling periods. Of all the watershed areas sampled for the 2009 report, the upper Chattooga River area had the highest taxa richness, diversity and ept index indicating the best water quality. The biotic index indicated that the lower Chattooga River area had the poorest water quality. The ept index represents the abundance of macroinvertebrates belonging to the orders *Ephemeroptera*, *Plecoptera* and *Trichoptera*. Since these orders of macroinvertebrates are highly sensitive to pollution, they are often used as water quality indicators. Their presence indicates a high quality of water, while their absence suggests water may be polluted.
Two rare aquatic insects have been sampled from the Chattooga River watershed. English (1990) sampled *Beloneuria georgiana* in the Chattooga River and two tributaries. *Ophiogomphus edmundo* was recently reported from the Chattooga River in the vicinity of Highway 76 (Abbott 2010).

Direct and Indirect Effects of Alternative 1

There would be no direct or indirect impacts to the aquatic community under Alternative 1. The aquatic community would remain in the present state or continue any current population trends.

Cumulative Effects of Alternative 1

There would be no cumulative impacts to the aquatic community under Alternative 1.

Direct and Indirect Effects of Alternative 2

Alternative 2 proposes cut and remove timber harvest on 3,566 acres and cut and leave on 1,774 acres across the district. Additional treatments within the same areas include site preparation and release for reforestation on 3,421 acres using herbicide, reforestation on 3,061 acres and woodland treatment on 202 acres using herbicide, prescribed burning and mechanical treatment. Connected actions include, system road construction, reconstruction and maintenance; temporary road construction; skid trails; log landings and loading areas.

Timber Activities

Timber removal within riparian corridors would be limited to loblolly trees that can be harvested with minimal soil disturbance and minimal overstory disturbance. Where it is not practicable to remove loblolly trees, they may be felled with hand tools under the same criteria. Loblolly would be removed within riparian corridors according to SC Best Management Practices for Forestry (BMPs), allowing a residual basal area of 50 square feet on perennial streams and no residual tree cover required on intermittent streams. The South Carolina Forestry Commission would be consulted on a BMP variance in situations where, as a result of treating loblolly pine, the residual basal area in the primary SMZ for perennial streams would be less than 50 square feet. There is no BMPs residual basal area requirement for ephemeral streams. Where the loblolly component of the canopy is large enough to exceed the residual basal area restriction and is not completely

harvested, the remaining trees would be felled, girdled or treated with herbicide. Girdled trees would begin to fall within five to seven years. An undergrowth of natural regenerated hardwoods within the riparian corridor would likely be established at that time unless prescribed burning is used in the area. To increase soil stability, no stumps would be disturbed within the riparian corridor or channeled ephemeral stream zones.

There are concentrated areas of cutting units contained within single headwater stream sheds. There are also concentrated areas of cutting units in adjacent stream sheds that drain to larger streams. Cutting these concentrated loblolly units in a short period of time would substantially increase streamflow within individual streams and downstream into larger waters. This could increase streambank erosion in unstable downstream channels. Excessive streamflow increases would be minimized by staggering the cutting of these units as specified over the implementation period.

Mitigation Measures

- To mitigate effects related to increased flow response resulting from vegetation removal, only half the treatment acreage in the drainages listed in Table 2.4-2 would be regenerated at any one time and at least three years would elapse before the remaining area would be regenerated.

Table 2.4-2 4th and 3rd Order DBRUs

4th Order DBRU Number	3rd Order DBRU Number
601020102	60102011202
601020103	60102015401
601020115	60102021604
601020116	60102021502
601020209	60102027027
601020216	60102052301
601020217	60102023303
601020523	60102027002
	60102027029

- Within the primary SMZ for perennial and intermittent streams, timber removal would be limited to loblolly trees to mitigate soil and bank disturbance, provide large wood input to streams and to maintain shade on streams. Loblolly pine would be directionally felled away from streams or girdled (manually with herbicide or chainsaws) and left on site in areas where it is not feasible to commercially remove them. The South Carolina Forestry Commission would be consulted for a BMP variance where the overstory basal area along perennial streams would be less than 50 square feet per acre after removing loblolly pine. In riparian corridors outside the SMZ, timber removal would be limited to loblolly pine to maintain diversity of other species for riparian habitat.

Forest standards and guidelines from the *Revised Land and Resource Management Plan, Sumter National Forest*, 2004 (Forest Plan) and BMPs would be applied to all activities associated with

this project. As a minimum, channeled ephemeral stream zones would extend 25 feet either side of channeled ephemeral streams. Minimum widths for perennial streams, lakes, ponds and wetlands are associated with slope class. At 0-30% slope, the minimum width is 100 feet; at 31-45%, 125 feet; and at 46+%, 150 feet. For intermittent streams the minimum widths associated with these slope classes are 50 feet, 75 feet and 100 feet respectively. These lands are unsuitable for timber production (FS 11.-24). Channeled ephemeral stream zones and riparian corridors are managed for large woody debris recruitment. Removal of large woody debris is determined on a case-by-case basis and should include interdisciplinary input. Logging slash should not be placed in streams (FW-13; FS 11.-2). For cable logging, at least partial suspension is required when yarding logs over ephemeral streams (FW-7).

Site Preparation and Reforestation

There are no site preparation and reforestation activities proposed within perennial or intermittent riparian corridors as defined by the Forest Plan. To promote the hardwood component in riparian corridors, no pine trees would be planted within these areas. These activities would occur within channeled ephemeral stream zones.

Mitigation Measure

- To favor hardwood tree species because of their riparian benefits, pine trees would not be planted in riparian corridors.

Herbicide Use

Herbicide use in perennial and intermittent riparian corridors would be limited to killing individual loblolly trees. Herbicide use would occur within channeled ephemeral stream zones for site preparation and reforestation. Herbicide application would be used after timber activities to control unwanted woody vegetation on up to 3,421 acres. An additional herbicide treatment would be applied approximately three to five years after reforestation to reduce competition. Imazapyr and triclopyr would be used to control unwanted woody vegetation. These herbicides would be applied as a foliar spray using back pack sprayers and with stem injection or cut-surface methods from July through September. The greatest risk of herbicides entering water systems and impacting aquatic life would be from killing loblolly trees in close proximity to streams and from spraying herbicides within 25 feet of channeled ephemeral streams. This risk is associated with herbicide drift, accidental spills, unexpected rain events and soil movement.

Herbicide may be used in riparian corridors to kill individual loblolly trees. Individual trees would be targeted with the stem injection or cut-surface methods to minimize the risk of herbicides entering stream channels directly or by drift. No direct foliar spraying would be applied in riparian corridors. Foliar spraying of herbicides would occur in channeled ephemeral stream zones. Where loblolly is the major component within 25 feet of channeled ephemeral streams, these areas would be lacking vegetation following harvest. The result would be an increased possibility of soil movement into downstream reaches with heavy rainfall. However, tree slash would remain on site which would slow and deter the movement of disturbed soils. Herbicides would not be applied immediately after harvest, but to tree sprout growth in July through September. At that time, there should be sufficient herbaceous growth to further deter

the movement of soils and any soil residual herbicides. In addition, with herbicides being applied during periods of warm to hot temperatures, rapid breakdown should occur and herbicide half-life should be on the shorter end of those reported in the literature (Jay Purnell, FMSNF Silviculturist, personal communications). No herbicide would be applied within stream channels. Cide-Kick or an equivalent adjuvant would be used in herbicides applied in channeled ephemeral stream zones. No adjuvant would be used with stem injection / cut-surface methods in the riparian corridors.

The imazapyr formulation (Arsenal AC or an equivalent) and a triclopyr amine formulation (Garlon 3A or an equivalent) would be used as a mixture for stem injection / cut-surface methods. The imazapyr formulation (Arsenal AC or an equivalent) and a triclopyr ester formulation (Garlon 4 or an equivalent) would be used as a mixture for the foliar spray application. Herbicide application would follow the Forest Plan (Channeled Ephemeral Stream Zones Standards and Riparian Corridor Standards).

Imazapyr – Sunlight rapidly degrades imazapyr in aquatic systems with a half-life of two days in surface water. It is slowly degraded by soil microorganisms and can be relatively persistent in soils with a half-life of one to seven months. Imazapyr does not bind strongly to soils and can be highly available in the environment. Heavy rainfall can cause significant movement of the herbicide with soil particles and leaching up to 50 cm deep in soils. Despite its potential mobility, imazapyr has not been reported in water runoff and there have been no reports of imazapyr contamination in water. Imazapyr is of low toxicity to fish and aquatic invertebrates. The LC50s for channel catfish, bluegill sunfish, rainbow trout and *Daphnia magna* (crustacean) are all >100 mg/l. An imazapyr formulation, Habitat, is registered for use in aquatic environments (http://invasive.org/gist/products/handbook/17.imazapyr.pdf). The Environmental Protection Agency (EPA) determined that there is no risk to non-vascular aquatic plants, but there are ecological risks of concern with the use of imazapyr for non-target aquatic vascular plants. Toxicity studies indicate that imazapyr is highly toxic and expected to exert detrimental effects to aquatic vascular plants through runoff and drift. Indirect impacts to aquatic animal life can result from the loss of habitat, feeding or cover requirements. Imazapyr is not expected to bioaccumulate in aquatic organisms (http://www.epa.gov/oppsrrd1/reregistration/REDs/imazapyr_red.pdf).

Triclopyr – There are two formulations of triclopyr; a triethamine salt and a butoxyethyl ester. In soils, both degrade to the parent compound, triclopyr acid. The average half-life of triclopyr acid in soil is 30 days. Offsite movement through surface or subsurface runoff is possible, as it is relatively persistent and has only moderate rates of soil particle adsorption. In water, the salt formulation is soluble and may degrade in several hours with adequate sunlight. The ester form is not water soluble and can take significantly longer to degrade in water. It can bind with organic material in the water column and be transported and deposited as sediments. Triclopyr acid and the salt formulation are slightly toxic to fish and aquatic invertebrates. The LC50 for rainbow trout of the acid and the salt formulation is 117 mg/l and 552 mg/l respectively. For bluegill, the LC50 is 148 mg/l and 891 mg/l respectively. The ester formulation is highly toxic to fish and aquatic invertebrates with an LC50 of 0.74 mg/l for rainbow trout and 0.87 mg/l for bluegill sunfish. The ester formulation is readily absorbed through fish tissues and rapidly converted to triclopyr acid. The acid can be accumulated to a toxic level when fish are exposed

to sufficient concentrations or for sufficient durations. There is a significant chance of acute lethal effects to fish exposed to low levels residues for more than six hours and delayed lethal effects have been seen in fish exposed to high concentrations for a short duration. If applied properly, triclopyr would not be found in concentrations adequate to kill aquatic organisms. However, some water bodies remain at risk of lethal contamination levels, especially those that are shallow and have slow velocity where dissipation is slow and those that are heavily shaded where photo-degradation is reduced (http://invasive.org/ gist/products/handbook/20.triclopyr.pdf)

Adjuvants – An adjuvant is any compound (including surfactants) that is added to an herbicide formulation or tank mix to facilitate the mixing, application, or effectiveness of that herbicide. There is little information on the effects of adjuvants to aquatic systems. Some adjuvants have the potential to be mobile and pollute surface or groundwater sources. The use of adjuvants near water may have adverse effects in some aquatic species (http:// http://invasive.org). Cide-Kick or an equivalent adjuvant is formulated for use around waters. The active ingredient of this adjuvant is d-limonene, a byproduct of the citrus industry. The formulated product is practically nontoxic to freshwater fish and slightly toxic to freshwater invertebrates on an acute basis http://www.epa.gov/pesticides/reregistration/REDs/factsheets/3083fact.pdf).

Mitigation Measures

- Herbicide use in riparian corridors would be limited to loblolly pine using cut-surface or stem injection methods. Application methods would ensure that no herbicide entered stream waters. No foliar spraying would be applied in riparian corridors (minimizes potential for drift into water).

- In stands that contain channeled ephemeral stream zones, foliar spray would use Cide-kick or an equivalent as an adjuvant.

- Herbicides would not be applied when offsite movement via surface or subsurface runoff in water or with soil particles is probable due to rain events.

Forest Plan standards and guidelines and BMPs would be applied to all activities associated with this project. For all herbicide applications, the following forest wide standards apply. Application equipment, empty herbicide containers, clothes worn during treatment and skin are not cleaned in open water or wells. Mixing and cleaning water must come from a public water supply and be transported to the site (FW-47). Herbicide mixing, loading, or cleaning areas are not located within 200 feet of private land, open water or wells or other sensitive areas (FW-48). Weather is monitored and the project is suspended if temperature, humidity or wind becomes unfavorable as described (FW-43). Herbicides and application methods are chosen to minimize risk to human and wildlife health and the environment (FW-40). Minimum widths for perennial streams, lakes, ponds and wetlands are associated with slope class. At 0-30% slope, the minimum width is 100 feet; at 31-45%, 125 feet; and at 46+%, 150 feet. For intermittent streams the minimum widths associated with these slope classes are 50 feet, 75 feet and 100 feet respectively. Soil active herbicides are not broadcast within channeled ephemeral stream zones. Stream zones are identified before treatment, so applicators can easily avoid them (FW-15). Pesticide mixing,

loading, or cleaning areas are not located within the channeled ephemeral stream zone (FW-16). As a minimum, channeled ephemeral stream zones would extend 25 feet either side of channeled ephemeral streams. BMPs state to avoid applying pesticides if surface water is present in ephemeral streams.

Woodland Treatment

Woodland treatment is proposed in five stands where loblolly would be cut through timber activities. After the loblolly is cut, the areas would be burned on a periodic basis. In addition, herbicide and manual and mechanical treatment would be applied to non-desirable tree species. The stands are located in the headwaters of Cedar Creek, Hellhole Creek and an unnamed tributary to the Chauga River (Chauga River watershed) and adjacent to Long Creek (Chattooga River watershed). There are no woodland treatment activities proposed within riparian corridors. Riparian corridors would be maintained adjacent to woodland treatment areas to exclude repetitive soil and vegetation disturbance from mechanical treatment. Woodland treatment activities would occur in channeled ephemeral stream zones.

Herbicide Use

Herbicide application would be used within one to two years after post-harvest prescribed burning to control unwanted woody vegetation in the woodland treatment areas. Up to two additional herbicide treatments would be applied to balance vegetative species competition. Imazapyr and triclopyr ester would be used to control unwanted woody vegetation. These herbicides would be applied as a foliar spray using back pack sprayers from July through September. No direct foliar spraying would be applied in riparian corridors. Foliar spraying of herbicides would occur within 25 feet of channeled ephemeral streams. Where loblolly is the major component in channeled ephemeral stream zones, these areas would be lacking vegetation following harvest. The result would be an increased possibility of soil movement into downstream reaches with heavy rainfall. However, tree slash would remain on site which would slow and deter the movement of disturbed soils. Herbicides would not be applied immediately after harvest, but to tree sprout regrowth in July through September. At that time, there should be sufficient herbaceous growth to further deter the movement of soils and any soil residual herbicides. In addition, with herbicides being applied during periods of warm to hot temperatures, rapid breakdown should occur and herbicide half-life should be on the shorter end of those reported in the literature (Jay Purnell, FMSNF Silviculturist, personal communications). No herbicide would be applied within stream channels. Cide-Kick or an equivalent adjuvant would be used in herbicides applied in channeled ephemeral stream zones. No adjuvant would be used with stem injection / cut-surface methods in the riparian corridors.

The imazapyr formulation (Arsenal AC or an equivalent) and a triclopyr ester formulation (Garlon 4 or an equivalent) would be used as a mixture for the foliar spray application. Herbicide application would follow the Forest Plan (Channeled Ephemeral Stream Zones Standards and Riparian Corridor Standards) as stated above under Timber Activities. No herbicide would be applied within riparian corridors with woodland activities, beyond the initial treatment of killing loblolly trees. Herbicide use would occur within channeled ephemeral stream zones for woodland treatment.

Mechanical and Manual Treatment

Hand tools and heavy equipment would be used to maintain the established woodland areas. Mechanical treatments would grind up undesirable understory vegetation. These activities would occur within one to two years after the initial post timber harvest prescribed burn. Off-site movement of disturbed soils may occur during periods of rain after mechanical treatments. No mechanical or manual treatment would occur within perennial and intermittent riparian corridors with woodland activities. These activities would occur within channeled ephemeral stream zones.

Mitigation Measures

- To minimize repetitive soil and vegetation disturbance, riparian corridors would not be converted to or maintained as woodlands.

- Herbicide use in riparian corridors would be limited to loblolly pine using cut-surface or stem injection methods. Application methods would ensure that no herbicide entered stream waters. No foliar spraying would be applied in riparian corridors (minimizes potential for drift into water).

- In stands that contain channeled ephemeral stream zones, foliar spray would use Cide-kick or an equivalent as an adjuvant.

- Herbicides would not be applied when off-site movement via surface or subsurface runoff in water or with soil particles is probable due to rain events.

Road Construction and Reconstruction and Log Landings

There are 6.5 miles of new system road construction and 60 miles of system road reconstruction and maintenance proposed under this alternative. In addition, there are 21.7 miles of temporary road construction, most of which follow existing old road prisms. There would also be skid trail construction and reconstruction within each harvest unit. Soil and vegetation disturbance from all road construction and reconstruction, log landing and skid trail construction could result in the addition of sediments to project area streams. These activities should be accomplished so that any sediment loading would be short term. No log landings would be constructed in riparian corridors or channeled ephemeral stream zones. Log landings would be re-vegetated at the time each harvest area is closed to reduce soil erosion and off-site soil movement.

New system road construction and system road reconstruction and maintenance would produce a sediment source through soil disturbance and grading and ditching. These activities would be accomplished in a manner that would prevent sediment runoff into area waters. In accordance with BMPs, drainage structures would be used to reduce concentrated water flow from roads and skid trails and disperse it into forested areas. Also in accordance with BMPs, road ditch lines would not be routed toward stream crossings, but instead into vegetative buffers. Erosion control devices such as diversions and temporary rock sediment dams would be installed prior to road

construction, reconstruction and maintenance activities where needed to deter soil runoff from streams. Erosion control devices would be maintained in working order throughout project activities and until plant growth is established and stable enough to control runoff and erosion. Road reconstruction would not include road widening which would increase sediment input, decrease available instream habitat and decrease riparian vegetation. New road construction would be located outside riparian corridors and channeled ephemeral stream zones except at crossings. New road stream crossings would be seeded and matted immediately after construction. New system road construction would occur across two tributaries to the Chauga River, one tributary to Long Creek and one tributary to Rocky Fork.

Habitat loss may occur upstream of new culverts or culvert replacements where aquatic organism passage may be impeded. Any new culverts and culvert replacements would allow for aquatic organism passage where deemed appropriate by the aquatic biologist.

Portable spanning structures would be used for all perennial stream crossings. Fords or temporary culverts would be used to cross intermittent on temporary roads and skid trails. Fords would create a source of sediment to area streams and district watersheds and may impede aquatic organism passage. Temporary culverts are usually undersized culverts which are removed at a later date, disturbing the stream channel more than once and impeding aquatic passage. In accordance to BMPs, disturbed soils would be stabilized around crossings soon after construction and portable bridges should be considered instead of culverts. BMPs state to avoid using soil as fill material except when installing culverts and avoid altering the flow of the stream. Rock fill would most likely alter streamflow. BMPs also state that woody material may be used as fill to protect streambanks and instream habitat when crossing small intermittent and ephemeral streams as long as soil is not introduced into the stream with the woody fill; streamflow is not blocked or diverted; and woody material that restricts flow of water is removed.

Skid trail intermittent stream crossings would occur in two tributaries to Cheohee Creek, two unnamed tributaries to Chauga River, six tributaries to Swafford Creek, two tributaries to Jerry Creek, one tributary to Yellow Branch, one tributary to Bone Camp Creek, two tributaries to Shoulder Bone Branch, two tributaries to Baker Branch, three tributaries to Persimmon Branch, four tributaries to Ramsey Creek and two tributaries to Little Toxaway Creek. Temporary road crossings would occur in, one tributary to Chauga River, two tributaries to Swafford Creek, one tributary to Long Creek, two tributaries to Ramsey Creek and one crossing of Persimmon Branch. These streams are SCDNR managed trout streams.

If skid trails are constructed across ephemeral streams, it is probable that sediments could reach intermittent and perennial streams during periods of rain. The placement of water bars during skid trail construction and the maintenance of those water bars during operations would divert water flow away from these crossings and minimize sediment input. Water bars would be reconstructed and the skid roads re-vegetated at the time each harvest area is closed. Where needed, rock or log constructed basins would be installed below ephemeral and channeled ephemeral stream crossings to capture disturbed soils and prevent downstream sedimentation. Temporary roads would be rehabilitated and blocked with a berm or boulders immediately following the loblolly removal to prevent illegal use. Temporary roads may be used for up to five

years after harvest activities to achieve site preparation and reforestation activities. These roads would not be used as wildlife strips or accessed for any activity.

All stream crossing approaches would be aligned with the stream channel at as near a right angle as possible (Forest Plan standard 11-22, Riparian Corridors) through the riparian corridor and channeled ephemeral zones and located where the amount of fill would be minimized. Stream crossing approaches would not be located on steep slopes. Temporary and skid road crossing approaches would be rehabilitated and vegetated immediately after timber removal from the unit.

Mitigation Measures

- Erosion control devices such as diversions, temporary rock sediment dams, silt fences, or log constructed basins would be installed during road or skid trail construction/ reconstruction as needed to deter soil runoff into perennial, intermittent or channeled ephemeral streams. Erosion control devices would be maintained in working order until plant growth is established and stable enough to control runoff and erosion.

- Road stream crossings and approaches would be seeded and matted immediately after construction. Temporary road and skid trail crossing approaches would be rehabilitated and re-vegetated as soon as possible once they are no longer needed to facilitate timber removal.

- Temporary roads would use portable spanning structures for all perennial stream crossings. Intermittent and channeled ephemeral stream crossings for temporary roads or skid trails would utilize methods that would maintain streambank stability and minimize sediment input.

- To minimize soil movement, temporary roads would be rehabilitated and closed as soon as possible following project treatments and would be covered with logging slash, mulch material and seeded.

Forest Plan Standards and Guidelines would be applied to road activities associated with this project. As a minimum, channeled ephemeral stream zones will extend 25 feet either side of channeled ephemeral streams. Within that zone, skidders will only be allowed at designated crossings (FW-6) and those crossings will be located in a manner that minimizes stream channel and bank disturbance (FW-8). Stabilize disturbed soils at channel crossings (FW-11). Trees and native vegetation on the streambank should not be removed except at designated crossings (FW-14). New stream crossings would be evaluated and where necessary constructed to allow for aquatic organism passage (FS 11.-8). Where risks of resource damage are high, each road segment will be constructed and stabilized before starting another segment. High risk areas include landslide prone areas and high risk streams include those containing sensitive aquatic species, trout, mussels, Wild and Scenic Rivers, Outstanding Resource Waters and those state listed with sediment, turbidity or aquatic habitat problems (FS-11.-21). To minimize the length of streamside disturbance, ensure that road approaches are aligned with the stream channel at as near a right angle as possible. Locate stream crossings to minimize fill material and stream channel impacts (FS-11.-22). In addition, SC Best Management Practices pertaining to road construction and stream crossings would be implemented.

Specific Impacts

Direct and indirect impacts may occur from project activities through soil and stream disturbance, culvert placement, herbicide use, and riparian disturbance and loss. Stream sediment deposition and turbidity may result from road work, harvest activity, and skid and temporary road stream crossings. Sedimentation can cause direct mortality to macroinvertebrate and fish life stages through burial and suffocation of eggs and larvae. Indirectly, sediments can fill in and destroy habitat niches within a stream impacting refugia and food sources. Sediment deposition can result in a reduction of fish and macroinvertebrate density and biomass in a stream. Turbidity can cause abrasion, changes in feeding behavior, avoidance and displacement, gill damage which interferes with respiration and macroinvertebrate drift. Available data on the effects of suspended sediments on biota can be found in USEPA 2003. Initial vegetation removal, ground disturbing activities, and temporary and skid trail stream crossings would provide the greatest risk for these impacts. Revegetation of disturbed soils and installation of erosion control methods would be implemented to minimize these impacts. However, temporary and skid trail crossings on intermittent streams are likely to increase the sediment levels and have impacts on stream habitat and the aquatic community in the immediate area and potentially downstream in perennial stream reaches. Risk of sediment impacts on aquatic species in project activity streams depend on the duration and intensity of temporary and skid trail use and future streamflow. Culvert placement and removal would cause direct mortality to aquatic life in the immediate area and would also increase sediment and turbidity impacts. Instream flow increases from harvesting adjacent units in the same stream sheds may increase sediment and turbidity in downstream reaches that have unstable streambanks. A mitigation measure has been developed that requires staggering units to reduce adverse impacts.

Culvert placement on temporary roads would impede aquatic organism passage for the duration that the structure is in the stream. This would be critical during trout spawning seasons.

The greatest risk of herbicides entering water systems and impacting aquatic life would be from killing loblolly trees in close proximity to streams and from spraying herbicides in channeled ephemeral stream zones. Forest Plan standards and guidelines, BMPs and mitigation measures associated with herbicide use would minimize the risk.

Removal or loss of riparian vegetation could result in a decrease of filtering capabilities, a decrease of large wood and leaf litter recruitment and an increase in stream temperatures. Loss of riparian vegetation impacts would include a decreased food base and a decrease in instream habitat complexity. This is not expected to occur on a large scale in riparian corridors with this project, however there may be areas where the primary component of the riparian vegetation is loblolly pine that would be removed or girdled. In these areas, the risk of impacts to aquatic life and habitat would increase. The risk would be of a longer duration if prescribed burning occurs within the riparian corridor. Where channeled ephemeral stream zones are completely harvested, there is an increased potential for sediments and herbicides to wash into downstream stream reaches. Channeled ephemeral stream zones that would be reforested with pine trees would have a decrease in beneficial leaf litter, detritus and wood and as an upstream source; these materials would be diminished in downstream stream reaches.

Determination of Effect

There are no federally listed aquatic species in the project area. Three forest sensitive species occur in district watersheds: brook floater, Chauga crayfish, and Edmunds snaketail. Direct impacts may occur to the aquatic community from soil and stream disturbance, culvert placement, and herbicide use. Indirect impacts may occur to the aquatic community from soil and stream disturbance, culvert placement and riparian vegetation disturbance or loss. Impacts on stream habitat and the aquatic community are more likely to occur in the immediate area of project activities and for some distance downstream depending on the intensity and duration of project activities.

Cumulative Effects of Alternative 2

Under the *Final Environmental Impact Statement (FEIS) for the Revised Land and Resource Management Plan, Sumter National Forest*, a Watershed Condition Rank was assigned to 5th level watersheds across the forest. The Chattooga River watershed (Tugaloo Reservoir to headwaters) and the Coneross Creek watershed received a rank of Below Average in comparison to other watersheds on the forest, which denotes that the potential to adversely affect aquatic resources is high on a scale of low, moderate and high. Forest objectives in high ranked watersheds include maintaining and improving aquatic health through the implementation of the Riparian Corridor Prescription, conducting watershed assessments at the project level, pre-project monitoring efforts to determine actual biota health, and maintaining and restoring watershed health and aquatic systems on a project level. The Little River Composite, Tugaloo River Composite and Chauga River watersheds received a rank of Average in comparison to other watersheds on the forest, which denotes that the potential to adversely affect aquatic resources is moderate on a scale of low, moderate and high. Forest objectives in moderate ranked watersheds include maintaining and improving aquatic health through the implementation of the Riparian Corridor Prescription, conducting watershed assessments at the project level and pre-project monitoring efforts to determine actual biota health. Sediment was determined to be a risk factor for aquatic species viability in all of these watersheds. The Whitewater River Composite received a rank of Excellent in comparison to other watersheds on the forest, which denotes that the probability is low for adverse effects to aquatic resources. Excellent watershed objectives are to maintain or improve aquatic health through the implementation of the Riparian Corridor Prescription.

The Forest Plan also addresses watersheds and aquatic habitats. This section of the FEIS recognizes that while direct and indirect adverse effects to aquatic communities are minimized by the Riparian Corridor Prescription and the Forest-wide standards, these effects are not eliminated from the entire watershed. The FEIS analysis of aquatic viability is based on present Forest Plan standards. The Aquatic Viability Outcome for the aquatic Region 8 sensitive species is that they are potentially at risk from sediment in the Chattooga River watershed and the Chauga River watershed; however, the Forest Service may influence conditions in the watershed to keep the species well distributed. Therefore, the likelihood of maintaining viability is moderate. The Aquatic Viability Outcome for the aquatic Region 8 sensitive species is that they are potentially at risk from sediment in the Little River Composite, Tugaloo River Composite and Coneross Creek watersheds; however the Forest Service opportunity to measurably affect the

watershed is limited. Therefore, species viability in the watersheds may be at risk. Forest objectives listed above associated with the Watershed Condition Rank were designed to eliminate this risk. The Aquatic Viability Outcome for the aquatic Region 8 sensitive species is that they are at low risk in the Whitewater River Composite watershed.

There are municipalities, agriculture and private ownership activities within the forest proclamation boundary. Future USFS activities within the district watersheds include the proposed Southern Appalachian Farmstead and a recent decision on boating on the Chattooga River. Other past and present projects that have occurred or may be occurring include prescribed burning, wildlife opening maintenance, road maintenance and reconstruction, non-native invasive species treatment and various recreational activities. Each of these projects has been or would be analyzed for impacts to aquatic resources and design criteria will be implemented to minimize impacts where needed. The Riparian Corridor Prescription addressing perennial and intermittent streams and the Forest-wide Standards specific to ephemeral channels would be implemented for most of these projects. A Forest Plan amendment has been proposed to decrease the width of riparian corridors for the Southern Appalachian Farmstead. For the Loblolly Removal and Restoration project, construction and reconstruction of firelines under existing decisions may have an additional impact to project area streams.

Prescribed burning is accomplished through categorical exclusions on the Andrew Pickens Ranger District. Forest Plan standards that apply to prescribed burning include prohibiting construction of firelines with heavy mechanized equipment in riparian corridors and using hand tools for fireline construction and water diversions to deter sediments from streams (FW 11.-19 and 11.-20). For channeled ephemeral stream zones, firelines are not constructed along the length of stream channels (FW-9). SC BMPs require burning at a time when the moisture level of the forest floor prevents the entire humus layer from being burned; locating firebreaks on the contour as much as possible; constructing water bars in firebreak lines at frequent intervals on grades over five per cent and over 200 feet long; and using hands tools when it is necessary to tie firebreak lines into stream channels. BMPs also state to avoid burning when conditions will cause a fire to burn too hot and expose mineral soil; avoid allowing high intensity fire to enter filter strips or primary streamside management zones; avoid burning where the average litter duff is less than one half inch; and avoid constructing water bars that divert surface water directly into streams. The Forest Plan and BMPs do not address the rehabilitation of firelines. Firelines are seeded and mulched following fire activity. Firelines within riparian corridors and channeled ephemeral stream zones should be monitored for vegetation growth and erosion problems for the period it takes for plant growth to be established and stable. Firelines that connect stream or other water bodies are blocked to prevent illegal use. Without established vegetation and blockage, firelines may become a source of sediment and turbidity to streams. Where prescribed burning is adjacent to harvested riparian corridors that lose canopy cover from harvesting activities, burning could hinder the growth of hardwood regeneration and riparian revegetation. Prescribed burning increases the potential for nutrients to be carried to the stream channel. Long term nutrient input has the potential of enriching stream waters and altering aquatic community composition and decreasing species diversity.

Cumulative soil erosion and sediment effects have been analyzed for sixth level watersheds and for the smaller 4th and 3rd order drainage basin response units (DBRUs). The information is summarized in section 2.5 of the EIS and more detailed information is found in Appendix A.

Determination of Effect

There are no federally listed aquatic species in the project area. Three forest sensitive species occur in district watersheds: brook floater, Chauga crayfish, and Edmunds snaketail. Cumulative impacts may occur to the aquatic community in project areas of concentrated activities from soil and stream disturbance, culvert placement, herbicide use, and riparian disturbance; particularly where streams are crossed with temporary roads and skid roads or where loblolly pine is the major component of riparian vegetation. Impacts on stream habitat and the aquatic community are more likely to occur in the immediate area of project activities and for some distance downstream depending on the intensity and duration of project activities.

Direct and Indirect Effects of Alternative 3

Alternative 3 proposes cut and remove timber harvest on 3,172 acres and cut and leave on 1,587 acres across the district. Additional treatments within the same areas include site preparation and release for reforestation on 5,542 acres using herbicide, reforestation on 2,833 acres and woodland treatment on 783 acres using herbicide, prescribed burning and mechanical treatment. Woodland treatment is proposed in three additional unnamed tributaries to the Chauga River. Connected actions include temporary road construction, system road construction and reconstruction, skid trails, log landings and loading areas. There are no miles of new system road construction and 60 miles of system road reconstruction and maintenance proposed under this alternative. In addition, there are 24.9 miles of temporary road construction. There would also be skid trail construction and reconstruction within each harvest unit.

Intermittent stream crossings of skid trails are the same 27 crossings discussed under Alternative 2. The new system road construction under Alternative 2 becomes temporary road construction under Alternative 3. Therefore, additional temporary road stream crossings under Alternative 3 include two tributaries to the Chauga River, one tributary to Long Creek and one tributary to Rocky Fork. Under Alternative 3, a temporary road stream crossing would also occur in a tributary to Jumping Branch.

Aquatic impacts associated with Alternative 3 would increase in those streams where temporary road stream crossings occur. There would be an increase of reforestation activities in channeled ephemeral stream zones and a resulting increase of foliar herbicide use for those areas potentially increasing the impact risk (herbicide drift, accidental spills, unexpected rain events and soil movement) to aquatic species.

Determination of Effect

There are no federally listed aquatic species in the project area. Three Forest Sensitive species occur in district watersheds: brook floater, Chauga crayfish, and Edmunds snaketail. Direct impacts may occur to the aquatic community from soil and stream disturbance, culvert placement, and herbicide use. Indirect impacts may occur to the aquatic community from soil and stream disturbance, culvert placement, and riparian vegetation disturbance. Impacts on stream habitat and the aquatic community are more likely to occur in the immediate area of project activities and for some distance downstream depending on the intensity and duration of project activities.

Cumulative Effects of the Alternative 3

Cumulative effects remain the same as under Alternative 2.

Determination of Effect

There are no federally listed aquatic species in the project area. Three Forest Sensitive species occur in district watersheds: brook floater, Chauga crayfish, and Edmunds snaketail. Cumulative impacts may occur to the aquatic community in project areas of concentrated activities from soil and stream disturbance, culvert placement, herbicide use, and riparian disturbance; particularly where streams are crossed with temporary roads and skid roads or where loblolly pine is the major component of riparian vegetation.

3.3 Social Environment

3.3.1 Cultural Resources

Affected Environment

A cultural resources inventory was completed for the Area of Potential Effects (APE) to historic properties in the *Andrew Pickens Loblolly Pine Removal and Restoration Project* analysis area. The APE includes all cut and remove areas and roads where ground disturbance could impact archeological resources. The purpose of the inventory was to identify and document cultural resources and evaluate their eligibility for listing in the National Register of Historic Places (NRHP) using the criteria established under 36 CFR 60 and 38 CFR 800.

A total of 116 archeological sites were identified through archival research and during intensive level cultural resource surveys (Bates 1994, 2004, 2006; Jordan 2010; Southerlin et. al. 2009). The survey consisted of a review of archived cultural resources information for the APE, intensive archeological field surveys, and archeological site evaluations to determine individual site NRHP eligibility. The inventory identified one site that is eligible and seven archeological sites that are possibly eligible for the NRHP, but unevaluated. The remaining 108 sites were determined not eligible for the NRHP.

Direct, Indirect and Cumulative Effects of Alternative 1

There would be no effect on known historic properties. There would be no cumulative effects to known historic properties or unevaluated sites as a result of the no-action alternative.

Direct and Indirect Effects of Alternative 2

The action alternative would avoid effects to known historic properties and unevaluated archeological sites. Cut and leave would use hand tools and chainsaws which would have little ground disturbance and not affect archeological resources. Cultural resource surveys have identified historic properties in the APE. The eight eligible or unevaluated sites would be marked and protected during any ground disturbing work in their vicinity.

An evaluation of proposed activities under the action alternative would minimize the potential effects to undiscovered sites. In accordance with the signed memorandum of understanding (MOU) with the South Carolina State Historic Preservation Office (SHPO), if any additional cultural resource sites are encountered during any project related activity, they will be treated as an unanticipated discovery. The District Archeologist would be notified and activities suspended at that location until the location is evaluated using unanticipated discovery protocols in accordance with 36 CFR 60 and 43 CFR 10.

The SHPO and Eastern Band of Cherokee Indians Tribal Historic Preservation Office (THPO) have reviewed the archeological survey reports and documentation of previous cultural resource surveys. They have been consulted on this project including the determination of National Register eligibility of all sites in the APE. Letters concurring with Forest Service eligibility determinations were received.

Cumulative Effects of the Action Alternatives

Avoidance of known historic properties and unevaluated archeological sites would result in no cumulative adverse effects to cultural resources. In addition, the Sumter National Forest has completed a cultural resources overview of the Sumter National Forest (Benson 2006). The overview establishes a context for heritage resources on the Andrew Pickens Ranger District and provides a basis for evaluating cumulative effects to cultural resources.

Direct and Indirect Effects of Alternative 3

Alternative 3 is similar to alternative two except there would be no new system road construction, some stands would be changed from cut and remove to cut and leave treatments and there would be slightly more temporary roads used. Direct effects to cultural resources would be similar to those for alternative 2. This alternative would avoid effects to known historic properties and unevaluated archeological sites. Cut and leave treatments would use hand tools and chainsaws which would have little ground disturbance and not affect archeological resources. Cultural resource surveys have identified historic properties in the APE. The eligible

or unevaluated sites will be marked and protected during any ground disturbing work in their vicinity.

3.3.2 Scenery and Recreation

Affected Environment

Scenery Resources
The Andrew Pickens Ranger District (District) can be seen from many vantage points, from roads, trails, rivers, recreation areas and vistas. The more scenic landscapes are generally associated with or occur adjacent to bodies of water (rivers and streams and include the numerous waterfalls), rock formations and outcrops and hardwoods that produce spectacular fall foliage. Many areas of the District are viewed from the immediate foreground, meaning it is nearest to the viewer. Views beyond the immediate foreground are influenced by terrain as well as vegetation type and density. The District is mountainous and covered with an almost-continuous canopy of deciduous and coniferous vegetation creating a natural-appearing landscape character. The viewshed is managed in components of foreground, middle and background scenes.

The scenic resource management direction is determined by the *Landscape Aesthetics, A Handbook for Scenery Management (USDA, 1995).* From that handbook, Scenic Integrity Objectives (SIO's) were established for all lands in the Sumter National Forest (Sumter NF) in the *Revised Land and Resource Management Plan, Sumter National Forest* (Forest Plan). SIO's include: "low", where management activities may dominate the landscape; "moderate", where management practices are visually subordinate in the landscape; and "high", where management activities are not evident to the casual observer and "very high" where ecological changes only are allowed.

Scenic Integrity Objective (SIO):
The SIO refers to degree of acceptable alteration of the characteristic landscape. The five levels are Very High, High, Moderate, Low, and Very Low. The process is described in Agriculture Handbook 701, *Landscape Aesthetics: A Handbook for Scenery Management* (FSM 2380 – Landscape Management).

The following table depicts the SIO for the project area.

Table 3.3.2-1 Scenic Integrity Objectives for Project Area

Scenic Integrity Objectives	Acreage
Very High (VH)	135
High (H)	153
Moderate (M)	1,663
Low (L)	3,499
Total*	**5,450**

**The Geographic Information System (GIS) Scenic Integrity Objectives data layer used for this analysis contains minor boundary line errors between national forest system lands and private*

lands. There were no discrepancies in physical land lines on the ground, only in the electronic mapping system in the computer database. The minor acreage differences do not affect the effects analysis

Vegetation management has the potential to significantly alter the landscape and impact the scenic resource. Vegetation management practices can cause long-term effects on scenery by altering landscapes through species conversion by reduction or increase in species diversity, forest structure, and alteration of opening size, location, and frequency. The potential effects may be positive or negative, depending on their consistency with the desired condition of the landscape.

Recreation Resources

Visitors come to the District to participate in a wide variety of recreation opportunities and experiences in outdoor settings. The recreation opportunity spectrum (ROS) classifies the types of recreation experiences available and can specify desired recreation experience in certain areas. The classes range from Primitive, where areas are essentially unmodified natural environments of fairly large size to Urban, where areas are the most modified urban environments.

Recreation Opportunity Spectrum (ROS): A method for classifying types of recreation experiences available on National Forest lands. Classes include Primitive (P), Semi-Primitive, Non-motorized (SPNM), Semi-Primitive, Motorized (SPM), Roaded Natural (RN), Rural (R) and Urban (U).

The entire project area is within either the Roaded Natural or Rural ROS classes, with the predominance of the area in Roaded Natural. Roaded Natural areas are characterized by predominately natural – appearing environments with moderate evidence of the sights and sounds of man. Such evidences usually harmonize with the natural environment. Interaction between users may be low to moderate, but evidence of other users is prevalent. In the more Rural settings the areas are more modified to enhance recreation activities and to maintain vegetative cover and soil but harmonize with the natural environment and there will be facilities designed for larger numbers of people.

Table 3.3.2-2 Recreation Opportunity Spectrum for Project Area

Sumter Revised Land and Resource Management Plan Prescription	Acreage	Recreation Opportunity Spectrum
Scenic Area	109	Roaded Natural and Rural
Mix of Successional Forest Habitats	1,116	Roaded Natural and Rural
Dispersed Recreation with Vegetation Management	4,225	Roaded Natural and Rural
Total*	**5,440**	

**The Geographic Information System (GIS) Recreation Opportunity Spectrum data layer used for this analysis contains minor boundary line errors between national forest system lands and private lands. There were no discrepancies in physical land lines on the ground, only in the electronic mapping system in the computer database. The minor acreage differences do not affect the effects analysis*

Direct and Indirect Effects of Alternative 1

Scenery Resources
Substantial direct impacts on the visual character are not anticipated under Alternative 1. Without the proposed vegetation management, the stands in the long term would become more dense overtime and would be more susceptible to senescence, insects, disease, and wildland fire, all of which could impact the scenic quality in the area. The dense stands would also decrease views into the forest. Species composition would remain primarily non-native and species diversity would remain low. In this alternative, there is little to no change in the landscape character themes of natural appearing. All areas would meet SIO designations.

Recreation Resources
Substantial impacts on the recreation opportunity spectrum are not anticipated under Alternative 1. Recreation demand on National Forest will remain stable or increase for a variety of activities including dispersed recreation and developed recreation. Recreation activities that predominate in these areas include dispersed recreation activities such as hiking, equestrian use, hunting and fishing. This alternative does not affect the current distribution of the Recreation Opportunity Spectrum or the emphasis placed on recreational use, either dispersed or developed recreation activities.

Cumulative Effects of Alternative 1

Scenery
Cumulative impacts on visual resources may also occur in the event of a southern pine beetle outbreak on either private or Federal lands in the long term. In this case, small salvage logging clearcuts in infected areas may occur and temporarily change the visual landscape. Other ongoing activities include prescribed burning, road maintenance, wildlife opening maintenance. These activities primarily impact foreground by exposing soils and killing patches of understory vegetation. Over the last decade, past timber harvest has focused on removing loblolly pine in favor of native species. Vegetation in many of these areas has recovered and is less noticeable by the casual observer. Private land activities are primarily associated with farming, ranching and timber harvest in small tracts. Recent and ongoing timber harvesting has the most visual impacts associated with private lands since usually most of the pine timber is removed. These activities occur sporadically across the district and are not widespread. The overall visual effect on national forest system (NFS) lands related to activities on private lands would be minimal. Any cumulative impacts to scenic quality would be temporary and local.

Recreation
Cumulative effects on recreation opportunities, settings and experiences would be minimal for Alternative 1. Impacts of private land activities would not affect overall recreation opportunity in the project area.

Direct and Indirect Effects of Alternative 2

Scenery

The scenic resource is affected by management activities altering the appearance of what is seen in the landscape. This alternative includes management activities of regeneration cuts (with harvest) and regeneration cuts (without harvest), site preparation and follow-up release treatments with herbicide, reforestation by planting or natural regeneration, prescribed burning, permanent road construction, temporary road construction and existing road reconstruction and maintenance. Management activities that have the greatest potential of affecting scenery are the vegetation management activities such as regeneration cuts and associated road construction. Site preparation and release treatments with herbicides and reforestation can affect scenic quality to a lesser extent and for shorter timeframes. All acres in the project area have a Scenic Integrity Objective to meet the appropriate desired condition set in the Forest Plan.

In areas that have a ***very high and high SIO***, predominately the Chauga Scenic Area and occasionally areas seen along US Highway 76, there would be short term and long term impacts to the scenic quality. The Sumter National Forest assigned SIOs to all lands in the Forest. Each SIO provides guidance for how each acre is to be managed to achieve the desired SIO over time. It is important to note that the SIO does not necessarily represent current scenery conditions, but the desired conditions as defined in the Forest Plan to be achieved and maintained over time. Restoration of native hardwood/pine stands from the current loblolly pine stands would improve and enhance the scenic quality and meet the Forest Plan Objective of very high in the long term. However, in the short term there would be negative impacts. These impacts include removing the forest canopy creating large openings causing contrasts in form, line, color, and texture. These openings would vary in their magnitude on the effects on scenery depending on size, shape, location and nearness to other openings as well as the timing of the openings. Depending on topography and what lies behind the foreground scene, visual effects from certain vantage points may be improved and positive panoramic views of background scenes may be created in the short term.

Treatment units were evaluated against the established SIO and ROS, including along certain roads and for the Chauga Scenic Area. Many of the adverse impacts to scenery and to recreation would be avoided or reduced by adherence to Forest Plan standards and mitigation measures described in section 2.4 of the EIS relative to scenery and recreation management. However, impacts to the observer would vary, and some observers may consider the scenic quality of the site to be degraded until the stand has the desired species in an older condition. Openings that repeat the size and general character of surrounding natural openings and the landscape character would impact scenery the least. Also staggered timing and concentration of stands would reduce the initial impacts. After the initial regeneration, additional treatments to ensure the desired conditions would be prescribed. Planted seedlings would eventually lessen the visual impacts to some extent by hastening revegetation of the treated stands. Also stands that have a more mixed age conditions after treatment would lessen visual impacts. Follow-up herbicide release applications may cause browning and shriveling of treated vegetation. These herbicide effects would be short term.

In areas that have ***moderate to low SIO***, restoration of native hardwood/pine stands from the current loblolly pine stands would improve the scenic quality over time. However, there would be impacts to scenery in the short term. Creation of woodland conditions would have a positive impact on scenery in the long term with some short term impacts. Short term impacts include removing the forest canopy creating large openings causing contrasts in form, line, color and texture. These openings would vary in their magnitude on the effects on scenery depending on size, shape, location and nearness to other openings as well as the timing of the openings. These impacts would be greatest in stands closest to major travel routes and recreation areas and trails. However, impacts to the observer would vary, and some observers may consider the scenic quality of the site to be degraded until the stand has the desired species in an older condition.
In all areas, road construction, reconstruction and maintenance affect scenery. Road construction introduces unnatural visual elements into the landscape and causes form, line, color and texture contrasts. Road construction may have either temporary or long term effects on the scenery. These linear clearings would both increase visibility into forested lands which can create some positive elements and also can create visually disrupted areas. The effects of the temporary road construction are initially similar to permanent road construction but would be closed and re-vegetated after temporary use. The effects would eventually be less than permanent road construction with the rehabilitation and growth of vegetation in the temporary road corridors.

Road reconstruction and maintenance operations would not likely have the same effects on the scenery as construction due to the transient nature of these operations, as the roads visual effects are already present. Road reconstruction and maintenance activities can improve access into the forest, so visitors can enjoy it for activities, such as picnicking, hiking, fishing or hunting. These linear clearings would both increase visibility into forested lands and alter the visual character of the area. The negative effects would go unnoticed by the majority of the public.

All areas would meet the Scenic Integrity Objectives by adhering to Forest Plan standards and site-specific mitigation measures.

Recreation

The recreation resource is affected by management activities that would alter the recreation experiences of forest visitors. Management activities that have the greatest potential of affecting recreation are the vegetation management activities such as regeneration cuts and associated road construction. Site preparation with herbicides, planting, and follow-up release treatments can affect scenic quality to a lesser extent and for shorter timeframes. All acres in the project area would be subject to Forest Plan goals, objectives, and standards for Recreation Opportunity Spectrum set in the Forest Plan.
Impacts to recreation users vary, as they seek out their recreation experiences. Hikers, backpackers and trail users may seek more continuously forested areas with occasional vistas and natural and openings, such as woodlands, rocky outcrops, rivers and lakes. These recreation visitors may avoid recently cut areas where regeneration methods have been employed because of the dense shrubs, vines and young trees that sprout after a harvest cut. Hiking is often slow-going and difficult in these areas. Hunters and wildlife viewers may depend on more early succession vegetation for successful experiences. In general, these regeneration areas would

likely be reduced in use for scenic viewing but would see increased use for hunting and wildlife viewing opportunities.

Road construction, reconstruction and maintenance may change the recreation value of an area for some visitors. It may also increase the recreation value for those national forest visitors seeking easier access to interior forest areas (hunters, hikers, etc.). Noise production during the construction, reconstruction, maintenance (and temporary closure) of the roads may disrupt recreation visitors. However, these operations would be transient and would not result in a significant impact on the level of recreation use of the area.

Temporary impacts on recreation would occur as a result of timber harvest operations. Disturbance to recreation visitors may occur due to increased truck and logging equipment traffic or by operations at the site that are either visible or audible from a designated recreation area. This impact would be minimal due to the fact that most harvesting operations are not done on the weekend when the majority of recreation visitors would be visiting the District. However, following harvest operations, increased visibility, access, understory plant development and wildlife viewing opportunities would benefit both developed and dispersed recreation users of the forest.

All acres in this alternative would meet the roaded natural and rural ROS class by adhering to Forest Plan standards and site-specific mitigation measures.

Direct and Indirect Effects of Alternative 3

The effects of alternative 3 are similar to alternative 2 with some differences in road construction, temporary road construction and some difference in types of vegetative treatments (with additional woodland acres.) Herbicide use in Alternative 3 is used in a more adaptive way, assessing the needs of the stand post-harvest which may result in some areas with more mixed-age and greater species diversity conditions.

Scenery

Differences in proposed activities for Alternative 3 would not change the effects in terms of geographic scale as the total acres treated would be about the same. Although vegetation treatments are slightly different the general effects are the same as Alternative 2, with one notable exception. In Alternative 2, species such as sourwood and red maple (and others) would usually not be retained. These species are generally considered undesirable for timber management, but are beneficial for scenery because of their fall foliage color. Under Alternative 2, these species would not be intentionally retained. However, there would likely still be individual trees of these species that would comprise a portion of the composition of the stand as the stand develops,. Alternative 3, with its more ecologically-based and adaptive approach to species diversity, would intentionally retain some trees of these species on sites where they would naturally occur, but only to the extent that they would not be a competition problem to primary species (oaks, hickories, shortleaf pine, pitch pine, and Table mountain pine). The portion retained would be based on the natural range of variation and current abundance for these species in each stand.

Long term impacts to scenery from permanent road construction would be avoided under Alternative 3 by the use of temporary roads. Temporary roads would be closed and would be re-vegetated where necessary to reduce soil erosion. These actions would reduce scenery impacts by hastening the recovery of vegetation on road surfaces.

All acres in this alternative would meet the roaded natural and rural ROS class by adhering to Forest Plan standards and site-specific mitigation measures.

Recreation

The additional acres in woodlands condition resulting from Alternative 3 may have additional positive effects on scenic viewing and hunting.

Alternative 3 would have no new system road construction. This would be beneficial to certain types of recreational users and detrimental to others. Some visitors prefer fewer roads for their specific recreation activity however; some people who use the road system for scenic viewing may prefer more roads. Temporary road reconstruction is greater in this alternative and would still have the direct effects of noise, dust and that may degrade the recreation experiences for some users. These impacts would be short term.

All acres in this alternative would meet the roaded natural and rural ROS class by adhering to Forest Plan standards and site-specific mitigation measures.

Cumulative Effects of the Action Alternatives

Scenery

The Forest Service is proposing issuing a permit for a Southern Appalachian Farmstead along the Chattooga River. However, scenery impacts from that project have been evaluated and there would be no cumulative adverse impacts to scenery. All harvest units in this proposal are located outside of the Chattooga Wild and Scenic River Corridor. Other past and present projects that have occurred or may be occurring include prescribed burning, wildlife opening maintenance, road maintenance and reconstruction and non-native invasive species treatments. Past and ongoing timber sales have removed / are removing loblolly pine. As projects are developed, they are individually evaluated for potential effects to the scenic resource. If needed, mitigation measures are developed to address concerns and impacts.

For all areas, regardless of SIO, prescribed burning would maintain open conditions in the understory. Temporary impacts on the visual character of the landscape would occur during and immediately following prescribed burning operations and include blackened soil, dead vegetation, scorched trees and fire lines. The long term visual effects of burning are increased views into the forest and a greater diversity of the preferred species of flora and fauna. The positive long term visual effects of prescribed burning would outweigh the short term negative effects.

It is anticipated that no long-term adverse cumulative impacts would affect scenic resources from past, present and future projects either on public or private lands. However, temporary and localized effects may occur as individual projects are implemented on the ground. In general, the scenic resources on national forest system lands, combined with the potential for activities on private lands, would not exceed the SIO designated for these areas in the long term.

The Scenic Integrity Objectives would be met by adhering to Forest Plan standards and site-specific mitigation measures.

Recreation
Cumulative impacts on the recreation opportunities in the long term may occur in the future within the area. As projects are developed, they are individually evaluated for potential effects to the recreation resource. If needed, mitigation measures are developed to address concerns and impacts. It is anticipated that no long-term cumulative impacts would affect recreation opportunities, but temporary and localized effects may occur as individual projects are implemented on the ground. In general, the recreation opportunities on national forest system lands, combined with the potential for activities on private lands, would not exceed the recreation opportunity spectrum designation for these areas in the long term.

3.3.3 Economics

Affected Environment

The Forest Service program "Quick Silver" was used to conduct the economic analysis. Calculations are based on recent appraisals of fair market value for wood products, expected harvest volume, and recent contract prices for service work (site preparation, planting, road maintenance, etc.). Reports containing the complete content of the analysis are in the project file.

The analysis focuses on the benefit to cost ratio (BCR) for each alternative. A BCR is an economic indicator that summarizes the overall efficiency of a proposed project. A BCR is the ratio of the present value (PV) of benefits of a project expressed in monetary terms, relative to the PV of the project's costs, also expressed in monetary terms. All benefits and costs are discounted to a common base year for analysis (in this case, expressed in 2013 dollars). The analysis allows for changes in values over a ten-year period due to inflation and the interest rate for borrowing money. The discount rate used for the analysis was 4% and the inflation rate was 2.5%. The net present value is evaluated over the service life of the proposed project (in this case, a ten year period). A summary of the analysis is provided here and the complete analysis is contained in the project file.

Costs used in the economic analysis include timber hauling, road construction/reconstruction, road maintenance, herbicide site preparation, planting, and follow-up herbicide release treatments. The determination for whether or not to apply herbicide site preparation and release treatments under Alternative 3 would not be made until after cutting treatments were implemented. For this analysis half of the total acreage of cutting treatments is assumed to

receive these treatments for Alternative 3. The single revenue source for the analysis is the sale of forest products to timber purchasers.

The action alternatives also produce other public benefits such as, but not limited to:

1) wildlife habitat created or maintained (kinds of habitat that are currently below desired levels)

2) increased forest resiliency to disturbance such as fire and southern pine beetle

3) re-establishment and increase of native species (including American chestnut) that have social, ecological, and economic significance

These benefits are not factored into the economic analysis calculations.

Direct and Indirect Effects of Alternative 1

No costs or revenues would be generated under this alternative.

The risk for loss of timber to disturbance, primarily southern pine beetle, would increase as the loblolly pine stands continue to age. Timber loss would also occur from mortality via senescence. Wood products not harvested and lost growth would be revenue foregone under this alternative. There would be minor impacts on local timber buyers in the form of foregone procurement opportunities. Timber supply from Oconee County would be dependent on private timberland and/or other non-National Forest lands.

Direct and Indirect Effects of Alternatives 2 and 3

Benefits and costs for the alternatives 2 and 3 are displayed in table 3.3-1. Detailed information for each transaction and cash flow are contained in the project file.

Table 3.3-1 Economic Comparison of the Alternatives

	Alt. 1	Alt. 2	Alt. 3
Present Value of Costs	0	$10,745,327	$9,958,332
Present Value of Benefits	0	$10,131,060	$9,969,445
Present Net Value	0	-$614,268	$11,113
B/C Ratio	0	0.94	1.00

Alternative 2 has a negative economic return. Alternative 3 has a slightly positive economic return. Alternative 3 has a higher return than Alternative 2 primarily because of lower road costs. Timber revenue would offset the majority of project implementation costs for Alternative 2 (94% of costs) and would contribute a net positive return $11,113 for Alternative 3.

Overall, the economic return for both alternatives is low primarily due to timber haul costs. Currently, the nearest full-service dimension lumber forest products mill is located in Newberry, South Carolina, over 100 miles from the project area. The increased availability of forest products from either action alternative over a several year period increases the potential for small local mills to increase their capacity or for new mills to open in the local area. This would reduce haul costs and increase the benefit to cost ratio for the project.

Another significant cost factor is site preparation and release treatments for reforestation. Mountain terrain often precludes the use of broadcast (machine) methods of herbicide application. Hand-based application methods (foliar spray, stem-injection) are more costly to implement than broadcast methods. However, vegetative response after harvest can vary considerably, and there is not always a need for herbicide site preparation to facilitate reforestation. By making the determination for herbicide needs after harvest (based on the response of natural regeneration), Alternative 3 would likely have less cost for these treatments than Alternative 2.

The use of stewardship contracts for project implementation could increase the benefit to cost ratio under either action alternative. Stewardship contracts allow for the exchange of goods for services instead of monetary payments for goods. For example, a contractor could do road work,

site preparation and/or planting in exchange for timber. Under a stewardship contract, the amount of capital needed to purchase timber would be reduced. If less capital is needed, then the contractor's borrowing costs and risk would be lower. This situation would allow contractors to bid more on timber (or bid less on service work), resulting in a higher benefit to cost ratio for the project.

Cumulative Effects

Past, Present, and Future Projects

Past projects include similar timber management treatments for the conversion of loblolly pine to native forests. The timber sales from these projects have had a greater benefit to cost ratio than current conditions, because a full-service dimension mill was operating in nearby Westminster, South Carolina.

In the past five years, approximately 1000 acres of loblolly removal treatments have occurred in the form of timber harvest. This has reduced the risk for SPB effects in those stands, but over 4500 acres of loblolly pine stands remain untreated, 3600 acres of which are mature in age, making them more susceptible to SBP than younger stands. An SPB suppression management decision is in place to take action for SPB, but the project is reactive not proactive. It only provides for management of SPB once it is detected.

Other projects on the District involve various service contracts, such as road maintenance, recreation facility work, and seeding for wildlife habitat improvement.

There are currently no other projects on the District that provide a source of revenue to the Forest, other than ongoing recreation activities and the sale of special forest products.

Cumulative Effects of Alternative 1

Under Alternative 1, SPB would continue to cause mortality in mature loblolly pine, and affording loblolly pine the opportunity to regenerate in areas where mortality occurs. Further mortality of mature loblolly pine would be an economic loss, and would make it less feasible in affected stands to replace loblolly pine with native species by way of commercial timber removal. It would be likely in some of the affected stands that the Forest Service would have to pay for service contract work to cut the loblolly pine. This condition already exists in some of the cut-and-leave stands for the AP Loblolly Removal Restoration project.

Where SPB activity occurred in stands that are adjacent to privately-owned pine forests, SPB would likely spread to private land, causing a negative effect on privately-owned forests.

Cumulative Effects of Alternative 2 and 3

None of the past, present, or future projects would have any cumulative economic effect with the actions proposed in Alternatives 2 or 3.

3.3.4 Human Health and Safety

Affected Environment

The Forest Service Handbook (FSH), Forest Service Manual (FSM), and the *Revised Land and Resource Management Plan, Sumter National Forest* (Forest Plan) all provide guidance and establish required measures to protect human health and safety during forest management activities. The Sumter National Forest also has a spill response program in place to contain and remove contaminants, such as herbicides.

Direct, Indirect and Cumulative Effects of Alternative 1

This alternative would have no effect on human health and safety beyond current management actions in the area. Under Alternative 1, no road improvements would occur, since none of the proposed vegetation management activities would occur.

Past, present and current activities in the area that have the potential to impact human health and safety include prescribed burning, road maintenance and herbicide applications for non-native invasive plants. All of these activities will comply with Forest Plan direction to protect public health and safety and also include project-specific design criteria. Adverse cumulative effects are not expected to human health and safety.

Direct and Indirect Effects of the Action Alternatives

Commercial timber harvesting activities, temporary and permanent road construction and reconstruction, maintenance of system roads and wildlife areas would require the use of heavy equipment (such as dozers, skidders, log loaders, bush-hogs, tractors and trucks). The use of heavy equipment and the movement of trees and logs present the highest potential for safety risks during harvest activities. Cut and leave treatments would require manual felling of trees by chainsaws. There is risk of injury to contract workers, Forest Service personnel and recreationists. These effects described here tiers to the *Final Environmental Impact Statement, Vegetation Management in the Appalachian Mountains* (VEG EIS) which analyzes manual, mechanical, herbicide and prescribed burning effects from vegetation management activities.

In accordance with Forest Service Health and Safety Code Handbook (FSH 6709.11), vegetation management activities require all Forest Service workers to wear safety equipment, including hard hats, eye and ear protection, chaps, and fire retardant clothes. Monitoring of compliance with the Forest safety code would be accomplished through on-site inspections and reviews of accident reports. For all mechanical treatments, equipment operators must demonstrate proficiency with the equipment and be licensed to operate it. In addition, a helper must direct the operator where safety is compromised by terrain or limited sight distances.

The private timber sale contractor conducting the harvest would be responsible for adhering to safety specifications during the entire harvest process.
These requirements include the:

- Installation of temporary traffic control devices on roads and trails open to public travel to warn users of hazardous or potentially hazardous conditions;
- Removal of logging slash from all trails open to the public;
- Development of a specific traffic control plan; and
- Installation of road closure devices, such as but not limited to barricades to control entry to the activity site (USDA, 2000a).

An herbicide risk assessment was conducted for this EIS on November 16, 2012. The risk assessment is filed in the project record.

Any risks to workers or the public would be minor and temporary. Strict adherence to safety measures would minimize or eliminate adverse human health and safety effects.

The herbicides proposed for use contain the active ingredients imazapyr and triclopyr. Limonene is the adjuvant to be used and a water soluble dye would be mixed in. The herbicides would be applied by direct foliar spray from backpack sprayer equipment, by stem injection, or by spray bottle using the cut-surface methods. Amounts to be used and the herbicide risk assessment can be found in the project file

Herbicide applications have the potential to adversely affect public and worker health and safety. Contractors applying herbicides have the potential to be inadvertently directly exposed to the herbicide as a result of drift or accidental contact during spraying. They can be indirectly exposed by contact with the herbicide residue on plant surfaces. However, due to the use of appropriate control and safety procedures, use of herbicides would not be expected to harm people in the area.

Herbicides would be applied by direct foliar spray from backpack sprayer equipment. No direct public exposures are expected to occur since the potential for drift is negligible from this equipment and since no public forest users are expected to be on-site during vegetation management activities.

Public exposure to herbicides would be minimized by the clear placement of notice signs at application sites, especially in areas of anticipated visitor use. Monitoring and inspections during and after the project would be used to ensure that proper procedures were followed.

Workers are at greater risk of direct adverse effects from herbicide use than the public. Workers, including personnel directly involved in the herbicide applications, have the potential to be harmed as a result of an accidental spill of the herbicide during mixing, loading and spraying. Only herbicides and additives registered by the United States Environmental Protection Agency (USEPA) and approved by the USFS are proposed for use, and only a certified pesticide applicator would train the crew and supervise the application.

Applicators are required to follow regulations established by the Occupational Safety and Health Administration (OSHA). OSHA regulations require that workers personal protective equipment and it must be cleaned. They are required to wear a hard hat with plastic liner, waterproofed boots and gloves and other safety clothing. First aid equipment, including eyewash bottles and wash water separate from drinking water, are required to be on-site during application. Use of protective clothing can substantially reduce worker exposure to herbicides and reduces adverse effects.

Accidental spills of herbicides or additives may pose a risk to human health and safety. Containers of herbicide would be secured in a part of the vehicle away from people, food, and water to prevent tipping and contamination. Trucks containing herbicide or tank mixed herbicide would not be allowed to park within 200 feet of a stream or pond. Equipment would be required to be inspected daily for leaks and proper function. A spill plan will be prepared prior to implementation. In the event of an accidental spill, the spill plan (FSM 2109.12) would be implemented to contain and clean up the spill and notify the appropriate agencies and individuals. Herbicides would be applied with strict conformance with herbicide label information and instructions.

Road maintenance would improve safety conditions for Forest personnel and users during project activities. While this would have a beneficial effect on human health and safety, this effect would not be significant.

Cumulative Effects of the Action Alternatives

Past, present, and future actions in and adjacent to the project area would be required to comply with established standards, guidelines and design criteria in the Forest Plan as well. The implementation of other management actions over several years designed to achieve desired conditions in and around the project area, would not increase the potential for cumulative, adverse safety impacts. With strict adherence to required safety measures, no significant, cumulative impacts on human health and safety would occur, regardless of the type and amount of activity conducted.

The USFS also conducts prescribed fire within and adjacent to the project area as part of its normal maintenance and general management of the Sumter National Forest. Threats to human health and safety during a prescribed fire are smoke inhalation and injury from the fire itself in the event that a controlled burn escapes the area. Various safety measures are in place to protect workers and the public from adverse effects during prescribed fires. A prescribed fire plan is required for each managed burn, which includes a smoke mitigation plan in the event that planned conditions change. Roads and highways are closed if the smoke impairs visibility enough to threaten public safety (USDA, 2000b). The public is notified through signs and closed roads, if necessary, and nearby residents adjacent to the Forest are notified prior to a prescribed burn. In addition, standards and guidelines and mitigation measures provided in the Forest Plan are adhered to during prescribed fires, which minimize or eliminate public human health and safety concerns resulting from smoke exposure and fire injuries. All burns are conducted by trained staff, supervised by an experienced burn boss, and monitored through review of burn plans, on-site inspections, and post-burn evaluations.

Herbicide use in the area is currently restricted to treating non-native invasive species that pose threats to management objectives on national forest system lands and use on private lands. Adherence to Forest Plan standards and design criteria in this EIS would avoid adverse cumulative impacts from application of herbicides to human health and safety.

3.3.5 Environmental Justice and the Protection of Children

Affected Environment

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, requires Federal agencies to identify and address any disproportionate adverse human health or environmental effects of its projects on minority or low-income populations. Each Federal agency must conduct its programs, policies, and activities that substantially affect human health or the environment in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons or populations from participation in, denying persons or populations the benefits of, or subjecting persons or populations to discrimination under, such programs, policies, and activities because of their race, color, national origin, or income level.

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, directs Federal agencies to "identify and assess environmental health risks and safety risks that may disproportionately affect children." This Executive Order requires Federal agencies to "ensure that [their] policies, programs, activities, and standards address disproportionate risks to children."

Demographic information was compiled using the Economic Profile System-Human Dimensions Toolkit (EPS-HDT) to produce socioeconomic reports for the county subdivisions area including Seneca, Walhalla, Westminister, Salem, Mountain Rest and Oakway, Oconee County, South Carolina. EPS-HDT uses published statistics from federal data sources, including Bureau of Economic Analysis and Bureau of the Census, U.S. Department of Commerce; and Bureau of Labor Statistics, U.S. Department of Labor. The reports are contained in the project record.

An examination of environmental justice sets the stage for whether the action alternatives or the No Action alternative would pose disproportionate environmental, health or safety risks to children, minorities or low-income people or families.

Table 3.3.5-1 Racial Makeup in Oconee County Subdivision as Compared to South Carolina

Demographics	County Subdivision	South Carolina
White Alone	89.1%	67.3%
Black or African American alone	8.2%	28.1%
American Indian alone	0.2%	0.3%
Asian alone	0.5%	1.2%
Native Hawaiian & Other Pacific Is. alone	0.0%	0.0%
Some other race alone	0.9%	1.6%
Two or more races	1.2%	1.5%

Table 3.3.5-2 Poverty Levels in Oconee County Subdivision as Compared to South Carolina

Poverty Levels	County Subdivision	South Carolina
People	16.3%	16.4%
Families	11.5%	12.3%

The project is located on the Andrew Pickens Ranger District which is located within Oconee County, South Carolina. Tables 3.3.5-1 and 3.3.5-2 lists the racial makeup and poverty levels, respectively of the population in the sub-county area as compared to the State of South Carolina.

Direct and Indirect Effects of Alternative 1

None of the proposed vegetation management activities would occur under alternative 1. There would be no activities occurring under this alternative that would adversely impact residents, minorities, children, people or families at or below the poverty level or forest users. Therefore, environmental justice analysis is not required.

Direct and Indirect Effects of the Action Alternatives

Tables 3.3.5-1and 3.3.5-2 indicates that there are substantially fewer minorities in the sub-county area as compared to the state as a whole. In addition, people and families living at or below the poverty level are about the same as the State.

Noise generated during vegetation management activities may disturb adjacent residents or Forest users, although these impacts would be localized and temporary. There would be additional traffic on state, county and local roads. These management activities would not disproportionately affect minorities or residents at or below the poverty level. All members of the public would be restricted from work areas to maintain safety. There are no planned vegetation management activities close to schools. Therefore, children would not be affected. No disproportional impacts would occur to minorities, children or to people or families at or below the poverty level with adherence to Forest Plan standards. Therefore, environmental justice analysis is not required.

Cumulative Effects of All the Alternatives

Past, present and reasonably foreseeable projects in the area on federal and private lands would not have cumulative disproportionate impacts on minorities, children or people living at or below the poverty level.

3.3.6 Civil Rights

Affected Environment

The Forest Service participates in special programs to enhance opportunities for equal participation of women, minorities and the handicapped (FSM 1761 and 1762).

Direct and Indirect Effects of the Alternatives

Review of human health and safety and environmental justice information presented, indicates that individual civil rights and the rights of minority groups would not be affected directly or indirectly by the alternatives considered. Women, Native Americans and minority groups would not be impacted by any of the alternatives any differently than any other groups.

There are no barriers for the potential participation as contractors or subcontractors by small business, minority-owned business, small disadvantaged business, and women-owned business concerns in contracts, grants, and cooperative agreements generated by the action alternatives.

Cumulative Effects of the Alternatives

There have been no identified or documented instances of management actions adversely affecting civil rights from past, present or future activities on either federal or private lands. There are no barriers to equal access by minorities and handicapped people in the project area or as a result of past, present or future activities management actions. There are no past or present evidence of discriminatory practices in the locale or with any of the alternatives developed.

3.4 Other Elements

3.4.1 Rivers Eligible for Inclusion in the National Wild and Scenic River System

Affected Environment

The Chauga River and Cedar Creek have been determined to be eligible for inclusion in the National Wild and Scenic River system during revision of the Forest Plan. This requires that the preliminary (inventoried) classification is to be maintained, absent a suitability determination. The recommended classification is to be maintained throughout the duration of the forest plan.

Under all alternatives, management emphasis for the eligible rivers and their corridors (about ¼ miles on either side) is focused on protection and enhancement of the values for which they were established, without limiting other uses that do not substantially interfere with public use and enjoyment of those values.

Forest Goals and Objectives that guide the management direction of the river include Goal 29, which states "Eligible rivers will be managed to protect free-flow, protect and to the extent possible enhance outstandingly remarkable values, and maintain the identified wild, scenic, or recreational classification. Section 16 (a) of the Wild and Scenic Rivers Act defines "free-flowing" as "existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway." There would be no modifications of the waterways of either Cedar Creek or the Chauga River under any of the alternatives. The free-flowing conditions would remain unchanged therefore, no further analysis is needed.

The following table provides information on Cedar Creek and Chauga River relative to eligible segment length, outstandingly remarkable values (ORVs) and preliminary classification.

Table 3.5.1-1. Cedar Creek and Chauga River

River	Segment	Miles	ORVs	Preliminary Classification
Cedar Creek	all	4.2	Botanical/Ecological	Scenic
Chauga	I	7.9	Scenic Recreation Geologic Botanical/Ecological	Scenic
	II	4.1	Scenic Recreation Geologic Botanical/Ecological	Wild
	III	4.0	Scenic Recreation Geologic Botanical/Ecological	Scenic

The outstandingly remarkable values for the rivers include botanical/ecological for Cedar Creek and scenic, recreation, geologic and botanical/ecological for the Chauga River.

Cedar Creek

General
Cedar Creek is not considered by South Carolina as navigable waters. The average size of the stream is ten feet wide and the stream is not floatable for canoes or boats.

There are no major developments along the river. Most of the land in the corridor is national forest system lands. Presbyterian Lake, now a recreation area, is located within the one mile of

the river. No power lines or pipelines parallel or cross the river.

Botanical and Ecological ORV
Cedar Creek is home for at least 21 populations and 11 species of rare plants. Most species are considered rare within the state, as the Brevard fault provides unique habitat for both subtropical flora and for Southern Appalachian endemics. Only three species are regionally rare. Cedar Creek has unusually rich sedge diversity, including rich coves, white pine-hemlock-hardwood forest and mesic oak-hickory and waterfall spray zones. The area around Blue Hole is especially rich. Some old growth occurs on the upper part of the creek. Few exotics occur and also little fragmentation occurs along the creek corridor. Compartment 41, St.12 borders the Cedar Creek Botanical/Zoological Area and Eligible Wild and Scenic River Corridor. Loblolly pine was removed from a portion of this stand in 2010 as part of the Cedar Creek decision, and the stand was prescribed burned in 2012. The majority of the area is included within the Cedar Creek Burn Block, which is burned a 2-3 year rotation. Ecological systems within the Cedar Creek eligible river corridor are mapped as dry mesic oak, dry oak heath, and acidic and rich cove. Prescribed burning within rich cove communities within the eligible river corridor would be of low intensity only, based on forest plan standard 9.F.-9, “In proximity to rich cove communities, limit the direct application of fire on north-and east-facing slopes”.

Chauga River

General
The Chauga River is considered a navigable stream by SC with an average width of 30 feet. Water flows year round, but is not always floatable for canoes/kayaks. Flat bottom boats are not used. Water flows can fluctuate rapidly. Pastures and apple orchards on private lands near the upper reaches of the stream and Village and East Village Creeks contribute sediment and turbidity during storm events.

Upstream from the boundary of Segment I, there are several roads within corridor: Verner Mill Road (CH33) is the northernmost crossing. There are various roads accessing private homes and farmlands/orchards between the confluence of Village and East Village Creeks and Land Bridge (SC 196).

Scenic ORV
The scenery along the river is characterized by steep forested slopes, often greater than 50%. The steepness of the slopes confines the majority of views to the areas within the immediate foreground of the river. There are few chances to see any distance, occasionally at locations of valleys. The gorge area is particularly rugged with steep rock walls. These are large boulders and rock outcrops present throughout the length of river. The forest cover is mature mixed hardwoods and evergreens with common understories of mountain laurel and rhododendron. Large trees are seen throughout the area. There are a number of small tributaries which feed into the Chauga River and add interest with such features as waterfalls. The water is clear and has a good flow rate. There are two large waterfalls and several small waterfalls on the river itself. There are very few manmade features which detract from the natural scenery. The majority of the river has outstandingly remarkable scenic values.

Recreation ORV
There is great potential for photography opportunities, wildlife and nature viewing, all of which are dependent on good scenery. The surroundings are extremely scenic, especially nearest the water.

There are also good opportunities for angling along some points of the Chauga. Trout can be caught here, as well as largemouth bass, redeye bass, bluegill and catfish. The Chauga is stocked throughout the year with trout. There are good opportunities for hunting in this area with mostly closed canopy habitats with some maintained wildlife openings in the area.

Grapevine, Cassidy Bridge, and Riley Moore Falls Campgrounds are close to Chauga River and have opportunities for camping, angling, swimming and relaxing. There are opportunities for day hiking but are somewhat limited with only one maintained trail in the Chauga Scenic Area, the .75 mile Riley Moore Falls hiking trail. There are limited opportunities for backpacking, and horseback riding. There are no mountain biking trails in this area. There is potential for dispersed camping.

Currently there is some use of canoes and kayaks on the Chauga. Use is limited by water levels (floatability) and by skill level required. The Chauga is generally considered to be a whitewater alternative to the Chattooga River. The river received a Class 1 rating in the whitewater boating category by the SC Rivers Assessment. Many publications divide the Chauga River into sections. Most sections begin at Blackwell Bridge and run to Cassidy Bridge, next from Cassidy Bridge to Cobb Bridge, and the third to just above the confluence with Lake Tugaloo. All descriptions vary between publications, but the section from Blackwell Bridge to Cassidy Bridge contains mostly Class II and III drops and ledges; a 15 foot waterfall and 100 foot chute, and Class IV rapid at Chauga Narrows. The river drops close to 70 feet in the next river mile. The first 5.5 miles drops 159 feet total, or 29 feet per mile. The section from Cassidy Bridge to Cobbs Bridge is known as Chauga Gorge. This section is considered very difficult and is only recommended for very experience paddlers. In this section, the river drops 415 feet or 42 feet per mile. This 9.6 mile section contains Class II – IV rapids. The Chauga River has been highlighted in various regional and nation publications. Regional publications include various canoeing and kayaking books which provide information on paddling opportunities in South Carolina in the surrounding region. Visitors come for water sports from outside SC, mostly within the Southeast region. There is some overflow of visitors from the Chattooga River.

The river is managed in the Forest Plan under the Scenic Area Prescription (4F) which assigns a roaded natural recreational opportunity spectrum (ROS). This Management Prescription calls prescribes predominately natural appearing environments with moderate evidence of the sights and signs of man.

Geologic ORV
This river occurs within the Brevard fault zone, generally accepted as the boundary between the Blue Ridge Mountains and the Southern Appalachian Piedmont. The Brevard fault zone has a complex geological history, significant in that it is newer geologically than much of the surrounding areas due to faulting and thrusting. The Brevard fault is 1 to 2 kilometers wide, extending from Alabama almost to the NC/VA border. The sedimentary rocks originating during

the late Precambrian or early Paleozoic underwent extreme geologic forces that produced the gneisses, schistose and phyllitic rocks that make the lithology of the Chauga River gorge the most diverse and distinct within the zone. The river corridor falls steeply in elevation from 426.7m to 243.8m between Blackwell Creek and the boundary of the Andrew Pickens Ranger District. The river bends and changes from a southwestern to an eastern direction into a complex section of cataracts. Curiously, the floodplains were once well above the river, as indicated by the polished stones from soil samples in the area. The sequence of rocks (stratigraphy) exposed here is not found anywhere else in the Blue Ridge, hence the name Chauga River Formation. A unique rock type is found here called Knox dolomite (named from Knox County Tennessee) which was transported from the ridge and valley province. There are rocks exposures which normally occur 6-7 kilometers below ground in most other areas.

Botanical and Ecological ORV
This river corridor is home for at least 23 populations and 15 species of rare plants. Of the 15 species, five are considered regionally rare. A regionally rare moss called gorge moss (C2; *Plagiomnium carolinianum*) occurs here. The Chauga River provides habitat for a mixture of sub-tropical flora and Southern Appalachian endemics. Plant communities are diverse and include rich coves, white pine-hemlock-hardwood forest, mesic oak-hickory, and waterfall spray zone. The corridor contains older forests, which is patchily distributed among 11-30 year old and 30-60 year old age classes, creating some fragmentation.

Direct and Indirect Effects of Alternative 1

Cedar Creek

Botanical and Ecological ORV
Under Alternative 1, no treatment activities would occur. The Cedar Creek area consists of generally older forests and closed canopy conditions, so loblolly pine, a shade-intolerant species, is unlikely to seed into these areas, with the possible exception of firelines or in the event of other natural disturbances. Loblolly pine where it is presently growing would continue to impede native species from occupying that space and it would be decades before native species would be able to fully replace the loblolly pine in those areas, especially if more disturbance occurs providing opportunities for loblolly pine regeneration.

Chauga River

Scenic ORV
Scenery impacts from the no-action alternative within the Chauga river corridor would be minimal. The desired condition of the Chauga Scenic Area (and the eligible Chauga River corridor) is a landscape that is natural appearing with an intact, mostly continuous forest canopy containing a variety of species native to the area.

Loblolly pine stands would continue to age, mature and eventually senesce. Mortality from senescence is usually a single tree or small groups of trees at a time. Overall, the effects of scattered dead trees would have a minimal effect on scenery within the larger boundary of the river. Mature stands of loblolly pine would be more susceptible to insect and disease activity,

most notably southern pine beetle (SPB). This disturbance agent could cause mortality of larger groups or even whole stands of trees.

In addition to the vegetation of the river corridor itself, the many rapids, whitewater, shoals, boulders, cliffs and stretches of slower water on the river itself would remain unchanged.

As long as larger scale disturbances do not occur in the maturing loblolly pine stands, Alternative 1 would meet the classification objectives of wild, scenic and recreation ORVs and meet the Scenic Integrity Objectives (SIOs)

Recreation ORV
Alternative 1 would have no effect on opportunities for photography opportunities, wildlife and nature viewing, all of which are dependent on good scenery. The surroundings are high in scenic value, especially the river environs.

Alternatives 1 would maintain recreation opportunities, meet the classification objectives of wild, scenic and recreation, and meet the ROS objectives.

There would be no effect on recreational opportunities for angling along the Chauga.

There would be no effect on camping, both developed and dispersed, swimming, sightseeing, photography and wildlife viewing, relaxing as well as day hiking, backpacking, horseback riding and mountain biking.

Alternative 1 maintains the roaded natural recreational opportunity spectrum (ROS).

Geologic ORV
There would be no impact to the geologic ORV under the alternative.

Botanical and Ecological ORV
Under Alternative 1, no treatment activities would occur. Loblolly pine where it is presently growing would continue to impede native species from occupying that space and it would be decades before native species would be able to fully replace the loblolly pine, especially if more disturbances occur.

Cumulative Effects of Alternative 1

Cedar Creek

Botanical and Ecological ORV
Since no treatment activities are proposed under Alternative 1 and loblolly pine is not likely to expand in area, there would be no cumulative effects on botanical/zoological ORV's. Under Alternative 1, loblolly pine is expected to persist where it already occurs and could expand with disturbances in adjacent stands. The majority of Cedar Creek is forested. Past, present and future actions on federal lands are moving towards restoration of native ecological systems. This would benefit the botanical and ecological ORV. Private land management would not impact the

botanical and ecological ORV.

Chauga River

Scenic and Recreation ORVs
There are no past, present and reasonably foreseeable projects on federal and private lands that have potential to affect ORV's for the Chauga River. Two projects Southern Appalachian Farmstead and Managing Recreation Uses in the Upper Segment of the Chattooga Wild and Scenic River Corridor are not in the immediate area and are not anticipated to affect recreation or scenic ORV's of the Chauga River.

Geologic ORV
There would be no impact to the geologic ORV under the alternative.

Botanical and Ecological ORV
Since no treatment activities are proposed under Alternative 1 and loblolly pine is not likely to expand in area, there would be no cumulative effects on botanical/ecological ORV's. Under Alternative 1, loblolly pine is expected to persist where it already occurs and could expand with disturbances in adjacent stands. The majority of the Chauga River is forested. Past, present and future actions on federal lands are moving towards restoration of native ecological systems. This would benefit the botanical and ecological ORV. Private land management would not impact the botanical and ecological ORV.

Direct and Indirect Effects of Alternative 2

Cedar Creek

Botanical and Ecological ORV
The stand occurring adjacent to the eligible river corridor is proposed for cut and remove, with natural regeneration and herbicide site preparation or release treatments. Since no activities are being proposed within the eligible river corridor, there are likely to be no direct or indirect effects of the proposed action on botanical/ecological ORV's. Treatments would favor restoration of native vegetation benefitting the botanical and ecological ORV in the long term.

Direct and Indirect Effects of Alternative 3

Cedar Creek

Botanical and Ecological ORV
In Alternative 3, the stand occurring adjacent to the eligible river corridor is proposed for managing as a woodland. Cutting and herbicide treatments (directed foliar spray or cut-surface / stem injection methods) would be used to move the stand towards the desired condition. These treatments would have a positive effect on the botanical/ecological ORV by replacing non-native loblolly pine with natural species and moving the treated area closer to a natural structure.

Direct and Indirect Effects of Alternative 2 and 3

Chauga River

Scenic ORV
Scenery impacts from this alternative within the Chauga river corridor would be minimal. The desired condition of the Chauga Scenic Area (and the eligible Chauga River corridor) is a landscape that is natural appearing with an intact, mostly continuous forest canopy containing a variety of species native to the area.

Proposed treatments would replace loblolly pine with native pine and hardwood species. There would be short term visual effects in some areas however views of the treatments from the Chauga River itself would be negligible. Most openings would be not seen in the foreground views from the river. Long term effects would be positive since replacing non-native species with native ones creates more natural conditions. Site-specific mitigation measures in section 2.4 have been developed to minimize impacts to scenery from units with 300 feet of the river.

In addition to the vegetation of the river corridor itself, the many rapids, whitewater, shoals, boulders, cliffs and stretches of slower water on the river itself would remain unchanged.

Alternatives 2 and 3 would maintain scenery, meet the classifications of wild, scenic and recreation plus meet the SIOs and therefore forest plan standards. These activities would protect the Scenery ORV.

Recreation ORV
Alternatives 2 and 3 would maintain recreation opportunities, meet the classification objectives of wild, scenic and recreation, and meet the ROS objectives. Site-specific mitigation measures in section 2.4 have been developed to minimize impacts to recreation from units with 300 feet of the river.

Alternatives 2 and 3 would have minimal effect on opportunities for photography opportunities, wildlife and nature viewing, all of which are dependent on good scenery. There would be minimal effect on camping, both developed and dispersed, swimming, sightseeing, photography and wildlife viewing, relaxing as well as day hiking, backpacking, horseback riding and mountain biking. Occasionally off trail visitors may encounter recently cut areas and foot travel would be more limited due to the fallen trees, but this effect would be negligible spatially and temporally. Dispersed camping opportunities in recently cut areas would be limited due to logging slash. However, these effects would be minimal as the majority of campers prefer closer proximity to the water than where the proposed treatment areas are located.

There would be no effect on recreational opportunities for angling along the Chauga.
There would be long term positive effects on hunting due to an increase in early successional habitat, which is currently deficit across the District.

Geologic ORV
There would be no impact to the geologic ORV under the alternative.

Botanical and Ecological ORV
Where treatments occur, alternatives 2 and 3 would have a positive effect on the botanical and ecological ORV. Non-native loblolly pine would be replaced by native species that would be allowed to regenerate under natural conditions.

Cumulative Effects of Alternative 2 and Alternative 3

Cedar Creek

The majority of the Cedar Creek drainage and eligible corridor is forested and is in national forest system lands (NFS). Impacts from private land use would not cumulatively impact the botanical and ecological ORV in any measurable way. Past, present and future management actions on NFS lands have an objective of restoring native vegetation and replacing off-site loblolly pine. There would be no adverse cumulative effects from Alternative 2 or 3 on the botanical and ecological ORV.

Chauga River

The majority of the Chauga River drainage and eligible corridor is forested and is in NFS lands. Impacts from private land use would not cumulatively impact ORVs in any measurable way. Past, present and future management actions on NFS lands have an objective of restoring native vegetation and replacing off-site loblolly pine. This would benefit the botanical and ecological ORV. Site-specific mitigation measures in section 2.4 would reduce impacts to scenery and recreation from units adjacent to and within the corridor. In addition, mitigation measures that are aimed at reducing impacts in the 4.F. - Scenic Areas management prescription would also cumulatively benefit the recreation and scenery ORV. There would be no adverse cumulative effects from Alternative 2 or 3 on the ORVs for the Chauga River.

3.4.2 Chattooga Wild and Scenic River

3.4.2.1 Outstandingly Remarkable Values

Affected Environment

Congress designated the 57-mile Chattooga River as part of the National Wild and Scenic Rivers System in 1974 to preserve the river’s free-flowing condition, protect its water quality and protect and enhance, whenever possible, the river’s Outstandingly Remarkable Values (ORVs) —biology, geology, recreation, scenery and history. The river’s many natural attributes, access and recreation infrastructure provide a variety of recreation opportunities including hiking and backpacking, fishing, swimming and wading, whitewater and scenic boating, hunting, photography and nature study.

The following is a description of the ORVs; additional information is available in the 1971 and 1996 reports and in a report located in the project file.

A. History ORV

Archaeological artifacts indicate human use of the corridor may trace back 12,000 years. More than 15 prehistoric and 15 historic sites have been surveyed, although other known sites have not been systematically examined. The Chattooga Town site has regional significance and contributes to the outstanding historic (heritage) rating for the Chattooga River; it is eligible for the National Register of Historic Places (NRHP). Few other sites apparently qualify.

B. Geology ORV

Geologic and geomorphological values of the Chattooga WSR include monolithic treeless domes of exposed resistant granite in the upper segment of the river and geomorphic processes that produced the narrow rocky gorges characteristic of the entire corridor. Other noteworthy geologic features include a substantial "river capture" that sends the Chattooga to the Atlantic (most other rivers in the Southern Blue Ridge drain into the Gulf of Mexico).

C. Biology ORV

The Biology ORV is comprised of three components: botany, wildlife and fisheries. Periodic studies and surveys have been done over the years to better understand the diversity of species and habitats that have been found in the Chattooga WSR Corridor since Congress designated the river.

1. Fisheries

The Chattooga Wild and Scenic River includes both cold water and warm-water fisheries. The cold water fisheries and trout habitat are located above Highway 28 in the upper segment of the Chattooga River; the warm-water fisheries are located in the lower segment. Trout stocking occurs periodically throughout the year and has been done since before Congress designated the river as wild and scenic.

2. Wildlife

The Chattooga River watershed has a geology and climate which is unique in the Southern Appalachians; therefore it provides suitable habitats for several wildlife species which are listed as state rare or altogether globally rare. Some of the most important and unique habitat components for rare wildlife species within the watershed include: exposed rock outcrops; deep, narrow gorges and associated vertical rock walls; steep, exposed, rocky forested slopes; and sheltered riparian corridors. These unique geologic features and habitats provide a full spectrum of important and unique wildlife habitats. In addition, they are mostly associated with the upper portion of the watershed; for this reason, approximately 70% of all rare species known or with

potential to occur in the Chattooga River Watershed are restricted to the upper portion of the watershed above the Highway 28 Bridge.

Other species mentioned in the 1996 ORV Report or the habitats they represent are considered critical to the wildlife component of the Biology ORV. The habitat represented includes: large contiguous forest interior; hard mast forest; pine/pine–oak forest; mid–late successional riparian forests; and mid–late successional mesic forests.

3. Botany

The botany component of the Biology ORV is composed of the Southern Appalachian endemics, spray cliff communities and old growth forests. These were considered rare when botanical values were designated.

The Southern Appalachian endemics include liverworts, rock gnome lichen, Blue Ridge bindweed, Fraser's loosestrife, Manhart's sedge, Biltmore's sedge, pink shell azaleas, mountain camellia, Oconee bells and divided leaf ragwort. Only Blue Ridge bindweed, Manhart's sedge, Oconee bells (a sensitive species) and Mountain camellia are located within the project area. Proposed, endangered, threatened and sensitive plant species (including Oconee bells) have been surveyed in the project area and are evaluated in section 3.2.2 of this EIS. Please refer to that section for effects information.

Southern Appalachian Blue Ridge spray cliffs are vertical to gently sloping rock faces that are constantly wet from the spray of waterfalls (NatureServe 2011, Schafale and Weakley 1990). Given these characteristics, they are inherently rare. The global rank is G2. These communities are found within southwestern North Carolina, northwestern South Carolina, northeastern Georgia and west of the escarpment in eastern Tennessee (NatureServe 2011). It is best developed within the Blue Ridge Escarpment region across North Carolina, South Carolina and Georgia. This community is dominated by mosses, liverworts and algae with vascular herbs having substantially less cover. Most associated species require a constantly moist substrate and high relative humidity. Sheltered site characteristics result only in rare freezes. Rare bryophytes, disjunct from tropical or subtropical regions, are able to persist within this community given the relatively constant temperature and high humidity. Deeply sheltered grottoes are often associated with spray cliff communities. These dark environs provide suitable habitat for other unusual or rare plants. There are no spray cliff communities located within or immediately adjacent to the proposed project area. Further analysis of spray cliff plant communities is not needed since there would be no impact from any of the alternatives.

No old growth inventory was documented at the time of wild and scenic designation. The most comprehensive old growth assessment was completed across the Chattooga River watershed in 1995 (Carlson 1995). Old growth was defined as principally plant communities dominated by trees more than 150 years of age and with little to no signs of human disturbance. A total of 110 stands, consisting of 4,578 acres, were identified as existing old growth across all three national forests in the Chattooga River watershed. While old growth conditions were identified across all forest types, the vast

majority, around two-thirds, were in sub-mesic oak, which often was dominated by chestnut oak (*Quercus prinus*). There are no old growth communities located within or immediately adjacent to the proposed project area. Further analysis of old growth plant communities is not needed since there would be no impact from any of the alternatives.

D. Scenery ORV

Scenery in the Chattooga WSR Corridor has remained largely unchanged since the time of designation and features several outstanding views that are regionally exemplary and carefully described in the 1971 study report. In most sections of the river, the deeply entrenched forested gorge between two high ridges is characteristic, along with constantly changing scenes due to meandering bends and frequent rapids, cataracts and falls in the river itself. Seasonal vegetation changes affect the color, texture and character of the scenery, with winter exposing occasional bedrock cliffs.

E. Recreation ORV

The Chattooga WSR offers a variety of activities along the river's 57-mile course. It offers slow-water opportunities for swimming and fishing (from cold water to warm water habitats) as well as fast water for boating, canoeing and kayaking. Opportunities for hiking, camping, backpacking, wildlife and scenery viewing, horseback riding and hunting all take place in a spectacular setting. Opportunities for solitude, challenge, risk and adventure are found throughout the Chattooga WSR and attract many visitors to the area.

Specific components of the Recreation ORV include:

1. Fishing

Outstanding fishing opportunities for warm- and cold-water species are described in the 1971 and 1996 reports and accounted for the majority of recreation use on the river at the time of designation. Cold and cool water species were noted in the upper river, with warm water species in the lower river. The 1971 study team in particular noted that "trout fishing is excellent in the upper areas [but] marginal in the lower most reaches" and there might be "special interest from a wild river fishery" from Highway 28 north to Bullpen Road Bridge (comprising most of the upper segment of the river).

Numerous perennial streams that flow in the lower and middle sixth level Chattooga watersheds provide trout fishing opportunities. They are accessed by trails or the stream itself that are very near the WSR Corridor or by roads that are higher in the drainage. All of these roads are outside the WSR Corridor.

2. Hiking

Hiking is mentioned in the 1971 report, but only four miles of designated trail (in the upper segment of the river from Burrells Ford to Ellicott Rock) were available at that time, with unofficial trails offering a more rugged hiking opportunity into other areas. In subsequent years, the U.S. Forest Service built more trails.

Hiking trails in the lower and middle sixth level watersheds of the Chattooga that are near proposed activities include Opossum Creek and Camp Branch Creek Trails (compartment 49, stands 9 and 32 and compartment 48 stand 5) and the Rocky Gap Horse Trail. Effects to Rocky Gap Horse Trail have been analyzed in section 3.3.2.

3. Horseback riding, hunting and motorized use

Horseback riding, hunting and motorized use on several river-adjacent roads were also common and provided recreation, with most of it occurring in the lower segment of the river. All roads except for major highway crossings were removed or converted to trails in the 1970s after designation, making the river appear more remote and less developed. As a trade-off, the river became less accessible to day users, particularly those interested in picnicking or camping near their vehicles.

The Rocky Gap Horse Trail is located outside the WSR Corridor and is analyzed in 3.3.2. Trails and roads outside the WSR Corridor provide hunting access to areas higher in the two drainages.

4. Boating

Boating has occurred on the upper and lower segments of the river, but higher boating use has occurred downstream, even prior to the boating prohibition on the upper river segment in 1976. The original WSR study team travelled the entire river in small rafts, noting in reference to the upper segment of the Chattooga that “some method of floating is the best way to see this rugged portion of the river.” Commercial use has burgeoned on the lower river segment since designation and the access and diversity of whitewater and flat-water trips are also regionally exemplary.

These activities are specific to the WSR Corridor and would not be impacted by proposed activities. No further analysis will be done.

5. Experience

National Forest System lands are often categorized into one of six different “Recreation Opportunity Spectrum” (ROS) classes that range from “primitive” to “urban” (USFS, 1982). This system helps land managers and the public understand how a range of setting attributes (ecological, social and managerial) affect the quality of recreation experiences. It offers a framework for inventorying recreation settings and attributes, and considering how changes to that setting may change the outputs of recreation experiences.

The ROS class outside the WSR corridor in the lower and middle sixth level watershed specifically are displayed in Tables 3.2.1-1 and 3.2.1-2.

Table 3.2.1-1 – Setting Indicators and Description for ROS Class Rural

Rural ROS Class	
Setting Indicators	**Description**
Visual Quality	Not to exceed Modification in the Foreground and Maximum Modification in middle ground.
Access	All forms of access and travel modes may occur, although access to and through the area is primarily by passenger vehicle. Road and trail surfaces are often hardened.
Remoteness	Remoteness is of little importance and moderate to high concentrations of people and sights and sounds of human activity are acceptable when not continuous. Setting is located within 1/2 mile of heavily traveled roads and state highways or areas that receive heavy aircraft travel.
Visitor Management	On-site regimentation and controls are obvious. Control facilities such as parking areas, medians and barriers harmonize with natural/exotic landscaping. Information and interpretive facilities may be complex and dominant on developed sites.
On-site Recreation Development	All Development Scales (I-V) are appropriate and maintained at intended standards necessary to accommodate the types and levels of use anticipated for the site and area. Facilities typically include visitor centers, major campgrounds and other facilities for concentrated use.
Social Encounters	User may meet many (more than 20) other parties per day on trails, in dispersed areas, on roads, and in developed facilities. Developed sites often are at full capacity, but do not exceed 80% of the design capacity over the operating season
Visitor impacts	Visitor-caused impacts are noticeable, but not degrading to basic resource elements nor do they exceed established Visual Quality Objectives. Site hardening may be dominant, but is in harmony with natural/exotic landscape.

Table 3.2.1-2 – Setting Indicators and Description for ROS Class Roaded Natural

Roaded Natural ROS Class	
Indicators	**Description**
Visual Quality	Not to exceed the Modification Visual Quality Objective and typically is Partial retention. Existing Visual Conditions ranging from Preservation through Retention are fully compatible and encouraged.
Access	All forms of access and travel modes may occur. Access to and through the area is typically by passenger vehicle, although motorized use may be restricted to provide for resource protection, user safety, or to provide a diversity of recreation opportunity.
Remoteness	Remoteness is of little importance, but low to moderate concentrations of human sights and sounds are preferred. Setting is located within ½ mile (greater or less depending on terrain and vegetation but no less than ¼ mile) of moderate to heavily-traveled waterways and/or roads which are maintained to Levels 3, 4, and 5 and open for use by the public or those areas that receive heavy small aircraft travel.
Visitor Management	On-site regimentation and controls are obvious. Control facilities such as parking areas, barriers and signs harmonize with the natural environment. Visitor information facilities are not elaborate or complex.
On-site Recreation Development	Facilities and structures generally do not exceed Development Scale III and are maintained to accommodate the types and levels of use anticipated for the site and area. Typical facilities include outdoor interpretive displays and rustic campgrounds and picnic areas.
Social Encounters	User meets less than 20 other parties per day on trails and in dispersed areas, during at least 80% of the primary use season. User may meet numerous other parties on roads and developed recreation sites. Developed sites often are at full capacity but do not exceed 80% of the design capacity over the season of operation.
Visitor impacts	Visitor-caused impacts are noticeable, but not degrading to basic resource elements nor do they exceed established Visual Quality Objectives. Site hardening may be dominant, but is in harmony with natural-appearing landscape and appropriate for the site and setting.

The management actions in each alternative would be analyzed to determine whether management actions would affect ROS Class Rural/Roaded Natural.

Direct and Indirect Effects of Alternative 1

A. History ORV

All historic and pre-historic sites would continue to be protected.

The alternative would continue to protect the History ORV in the Chattooga WSR Corridor and watershed.

B. Geology ORV

There are no impacts to the Geology ORV since land uses are not expected to change, no consumptive uses are proposed and further infrastructure development is unlikely given the extensive federal ownership in the drainage and river corridor.
The alternative would continue to protect the Geology ORV in the Chattooga WSR Corridor and watershed.

C. Biology ORV

1. Fisheries

Effects of the Alternative 1 on aquatic communities are described in section 3.2.5.

The alternative would continue to protect the fisheries component of the Biology ORV in the Chattooga WSR Corridor and watershed.

2. Wildlife

Effects of the Alternative 1 are described in sections: 3.2.2 Proposed, Endangered, Threatened and Sensitive Species; 3.2.3 Management Indicator Species; and 3.2.4 Migratory Birds.

The alternative would continue to protect the wildlife component of the Biology ORV in the Chattooga WSR Corridor and watershed.

3. Botany

Under the no action alternative, current management plans would continue to guide management of the project area. The natural resources and ecological processes within the project area would continue at the existing level of human influence. The characteristic of the forest environment would be affected primarily by natural disturbances such as insects, disease, and weather. Custodial management of recreation areas, roads, prescribed burning, and other projects already approved under prior decisions would continue under this alternative.

Effects of Alternative 1 are described in section 3.2.2 Proposed, Endangered, Threatened and Sensitive Species (PETS) (including for the plant Oconee bells). There would be no effects to Blue Ridge bindweed, Manhart’s sedge and Mountain camellia from this alternative.

The alternative would continue to protect the botany component of the Biology ORV in the Chattooga WSR Corridor and watershed.

D. Scenery ORV

There would be no impact to the scenery along the Chattooga WSR corridor. The "Wild" sections would continue to be inaccessible by road, have a natural-appearing character and dramatic natural beauty. "Scenic" sections including road crossings, bridges and developed recreation sites would not be impacted by the Alternative 1. The scenery along the Chattooga River would continue to be exceptional and would remain present in the corridor.

The alternative would continue to protect the Scenery ORV in the Chattooga WSR Corridor.

E. Recreation ORV

Specific components of the Recreation ORV include:

1. Fishing

Outstanding fishing opportunities for warm- and cold-water species would not be impacted within and outside the corridor under this alternative. Fishing opportunities in adjacent streams and tributaries would continue along with stocking.

2. Hiking

This alternative would have no impact on hiking trails.

3. Horseback riding, hunting and motorized use

Horseback riding on Rocky Gap Horse Trail and the effects have been analyzed in section 3.3.2. Hunting use would not be impacted. Lack of treatment activities would decrease certain types of hunting that rely on early successional habitat (i.e., white-tailed deer hunting).

4. Boating

There would be no impact from the alternative since this activity is confined to the WSR Corridor.

5. Experience

Recreation experiences in the WSR Corridor would not be impacted. Recreation opportunities in the roaded natural and rural settings would not be impacted by this alternative.

The alternative would continue to protect the Recreation ORV in the Chattooga WSR Corridor.

Cumulative Effects of Alternative 1

Past, present and future projects in the area consist of timber harvest on private lands, farming and ranching and home sites including road maintenance. Activities on national forest system lands have included past timber sales, prescribe burning, road, trail and utility line maintenance.

A. History ORV

All past, present and future activities would avoid impacts to historic and pre-historic sites. No activities are expected to impact the Chattooga WSR Corridor. No cumulative adverse impacts are expected to historic and pre-historic sites.

The alternative would continue to protect the History ORV in the Chattooga WSR Corridor and watershed.

B. Geology ORV

Past, present and future activities would have no impacts to the Geology ORV.
The alternative would continue to protect the Geology ORV in the Chattooga WSR Corridor and watershed.

C. Biology ORV

1. Fisheries

Past, present and future projects are not located within the Chattooga WSR corridor. Streams that feed into the corridor have been evaluated for direct, indirect and cumulative effects in the aquatic communities section of the EIS.

The alternative when added to other past, present and future actions and ongoing activities would continue to protect the fisheries component of the Biology ORV in the Chattooga WSR Corridor and watershed.

2. Wildlife

Past, present and future projects are not located within the Chattooga WSR corridor. No additional impacts to species are expected than what has already been disclosed in sections 3.2.2 Proposed, Endangered, Threatened and Sensitive Species; and, 3.2.3 Management Indicator Species.

The alternative when added to other past, present and future actions and ongoing activities would continue to protect the wildlife component of the Biology ORV in the Chattooga WSR Corridor and watershed.

3. Botany

Past, present and future projects are not located within the Chattooga WSR corridor. No additional impacts to species are expected than what has already been disclosed in sections 3.2.2 Proposed, Endangered, Threatened and Sensitive Species (PETS) (including Oconee bells). There would be no cumulative effects to Blue Ridge bindweed, Manhart's sedge, Oconee bells (see PETS section 3.2.2) and Mountain camellia from this alternative.

The alternative when added to other past, present and future actions and ongoing activities would continue to protect the botany component of the Biology ORV in the Chattooga WSR Corridor and watershed.

D. Scenery ORV

Past, present and future projects are not located within the Chattooga WSR corridor and would not impact the scenery ORV. The "Wild" sections would continue to be inaccessible by road, have a natural-appearing character and dramatic natural beauty. "Scenic" sections including road crossings, bridges and developed recreation sites would not be impacted by past, present and future projects. The scenery along the Chattooga River would continue to be exceptional and would remain present in the corridor.

The alternative when added to other past, present and future actions and ongoing activities would continue to protect the Scenery ORV in the Chattooga WSR Corridor and watershed.

E. Recreation ORV

Past, present and future projects are not located within the Chattooga WSR corridor.

Specific components of the Recreation ORV include:

1. Fishing

Outstanding fishing opportunities for warm- and cold-water species would not be impacted by past, present and future projects. Fishing opportunities in adjacent streams and tributaries would continue and stocking would also not be impacted. Current aquatic communities and habitat have been assessed in section 3.2.5.

2. Hiking

Past, present and future projects are not located within the Chattooga WSR corridor. Trails and access points would not be impacted by past, present and future projects.

3. Horseback riding, hunting and motorized use

Past, present and future projects are not located within the Chattooga WSR corridor. Horseback riding on Rocky Gap Horse Trail would not be impacted. Some types of hunting opportunities would be maintained by road maintenance and prescribed burning. These types of disturbances would result in minimal improved conditions for deer hunters and other early successional hunting opportunities.

4. Boating

Past, present and future projects are not located within the Chattooga WSR corridor and would have no impact on this activity.

5. Experience

Recreation experiences in the WSR Corridor would not be impacted by past, present and future projects. Some types of hunting opportunities/experiences would be slightly improved by prescribed burning and road maintenance.

The action alternatives would continue to protect the recreation ORV in the Chattooga WSR Corridor.

Direct and Indirect Effects of the Action Alternatives

A. History ORV

All treatments would avoid impacts to historic and pre-historic sites. Section 3.3.1 of this EIS discloses that there would be no impacts from the action alternatives to known historic properties and unevaluated archeological sites. Cultural resource surveys have identified historic properties. An evaluation of proposed activities under the action alternatives would minimize the potential effects to undiscovered sites. In accordance with the signed Memorandum of Understanding (MOU) with the South Carolina State Historic Preservation Office (SHPO), if any additional cultural resource sites are encountered during any project related activity, they would be treated as an unanticipated discovery. The District Archeologist would be notified and activities suspended at that location until the site is evaluated using unanticipated discovery protocols in accordance with 36 CFR 60 and 43 CFR 10. The SHPO and Eastern Band of Cherokee Indians Tribal Historic Preservation Office (THPO) have reviewed the archeological survey reports and documentation of previous cultural resource surveys. They have been consulted on this project including the determination of National Register eligibility of all sites in the project area. Letters concurring with Forest Service eligibility determinations were received.

The action alternatives would continue to protect the History ORV in the Chattooga WSR Corridor and watershed.

B. Geology ORV

Impacts to the Geology ORV would not be expected from any of the action alternatives since land uses are not expected to change, no consumptive uses are proposed and further infrastructure development is unlikely given the extensive federal ownership in the drainage and river corridor.

All proposed activities are outside the Wild and Scenic River Corridor. The activities proposed would have no impacts to the Geology ORV under the action alternatives.

The action alternatives would continue to protect the Geology ORV in the Chattooga WSR Corridor and watershed.

C. Biology ORV

The EIS provides analysis of impacts to proposed, threatened, endangered and sensitive (PETS) species of plants and animals section 3.2.2 and the Biological Assessment/Biological Evaluation (BA/BE); management indicator species (MIS) section 3.2.3; migratory birds (MB) section 3.2.4; and aquatic communities section 3.2.5. The project file contains additional background information on the Biology ORV that was used to assess impacts to various terrestrial and aquatic wildlife and plants.

1. Fisheries

No proposed treatments are located within the Chattooga WSR corridor. Streams that feed into the corridor have been evaluated for direct, indirect and cumulative effects in the aquatic communities section of the EIS. Some of the more prominent tributaries in the lower and middle sections of the Chattooga River are periodically stocked with trout. Access to these areas is provided by roads and trails and would not be impacted by treatment activities.

The action alternatives would continue to protect the fisheries component of the Biology ORV in the Chattooga WSR Corridor and watershed.

2. Wildlife

No proposed treatments are located within the Chattooga WSR corridor. No additional impacts to species are expected than what has already been disclosed in the PETS, BA/BE, MIS and MB sections of the EIS.

The action alternatives would continue to protect the wildlife component of the Biology ORV in the Chattooga WSR Corridor and watershed.

3. Botany

No additional impacts to species are expected than what has already been disclosed in section 3.2.2 PETS (including Oconee bells) of the EIS.

Direct Effects

Blue Ridge Bindweed is known to occur within proposed treatment stands. It is abundant in stands along Rifle Range Road and Cedar Creek Road. In cut-and-remove treatments (including woodlands), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas, and roads for access. Heavy equipment could run over plants, causing above- and belowground damage. The placement of log landings, loading areas, and access roads could also have an adverse direct effect on this species.

In cut-and-leave treatments (including woodlands), timber would be cut manually (e.g., hand tools, chainsaws) and heavy equipment would not be used. Damage to above-or below-ground plant parts from cut-and-leave treatments is highly unlikely.

Herbicide, mechanical and/or manual control methods potentially would be used to control competing woody vegetation for site preparation, planting release treatments, and woodland treatments. Adverse direct effects resulting from the use of herbicide, mechanical and/or manual control methods to control competing woody vegetation are possible but unlikely. If used, herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species possible but unlikely. Mechanical treatments used to mow or masticate competing woody vegetation could damage aboveground plant parts, but are not likely to damage belowground parts.

Manhart's Sedge and Mountain Camellia are not known to occur within any proposed treatment stand so there would be no direct effects.

Indirect Effects

Blue Ridge Bindweed is a sun-loving species that occurs in early successional habitats such as meadows, roadside edges, rock outcrops, and openings in oak-hickory forests. Implementation of the action alternatives would have beneficial indirect effects on this species. Cut-and-leave, cut-and-remove, and woodland treatments would improve habitat for Blue Ridge Bindweed by opening up dense canopies and allowing increased sunlight to reach the forest floor.

Manhart's Sedge occurs on mesic sites in cove forests and montane oak-hickory forests, especially over mafic rocks (such as amphibolite) and calcareous rocks (such as granite), but occurs on more acidic substrates as well. Most loblolly pine removal and restoration activities would take place on dry sites. There may be mesic habitat

occurring within hardwood inclusions or along the edges of treatment stands, but project activities are not likely to affect these habitats.

Mountain Camellia inhabits mesic forests, especially acidic bluffs, often in openings in rhododendron thickets. Most loblolly pine removal and restoration activities would take place on dry sites. There may be mesic habitat occurring within hardwood inclusions or along the edges of treatment stands, but project activities are not likely to affect these habitats

The action alternatives would continue to protect the botanical component of the Biology ORV in the Chattooga WSR Corridor and watershed.

D. Scenery ORV

No proposed treatments are located within the Chattooga WSR corridor. The "Wild" sections would continue to be inaccessible by road, have a natural-appearing character and dramatic natural beauty. "Scenic" sections including road crossings, bridges and developed recreation sites would not be impacted by proposed treatments. The scenery along the Chattooga River would continue to be exceptional and would remain present in the corridor.

The action alternatives would continue to protect the Scenery ORV in the Chattooga WSR Corridor.

E. Recreation ORV

No proposed treatments are located within the Chattooga WSR corridor.

Specific components of the Recreation ORV include:

1. Fishing

Outstanding fishing opportunities for warm- and cold-water species would not be impacted by project activities. Fishing would not be impacted in the corridor from the action alternatives. Fishing opportunities in adjacent streams and tributaries would continue and stocking would also not be impacted.

2. Hiking

Although most hiking takes place within the WSR Corridor, some trails provide hiking opportunities higher in the drainage. Also, natural access points along major tributary streams provide opportunities further up the drainages, particularly for anglers. These trails and access points would not be impacted by the action alternatives. No additional mitigation measures are needed for Opossum Creek and Camp Branch Creek Trails since units would not be impact the trails.

3. **Horseback riding, hunting and motorized use**

   Horseback riding occurs on Rocky Gap Horse Trail and the effects have been analyzed in section 3.3.2. Specific mitigation measures have been developed to reduce adverse impact to recreation users in this area during treatment activities. Hunting use would be impacted in areas where active logging is taking place which may force some hunters to go to a different area. These impacts would be short-term and minor. Increased maintenance on access roads would improve driving conditions for motorize use and for hunter access in the long term. In addition, treatment activities would develop habitat conditions improve some types of hunting opportunities (i.e., white-tailed deer hunting). All these activities and effects are outside the WSR Corridor.

4. **Boating**

   There would be no impact from the action alternatives since this activity is confined to the WSR Corridor.

5. **Experience**

   Recreation experiences in the WSR Corridor would not be impacted. Activities higher in the two sixth level drainages could result in minor short term impacts during the time that project activities are taking place. Some of these impacts would be offset by improve motorized access as a result of road maintenance during logging activities and improvements in some types of hunting experiences for species that prefer early successional habitat.

The action alternatives would continue to protect the Recreation ORV in the Chattooga WSR Corridor.

Cumulative Effects of the Action Alternatives

Other management activities that have taken place on National Forest land within the Chattooga River watershed include prescribed burning, timber sales, pre-commercial thinning and release of timber, southern pine beetle control, recreation trail reconstruction and maintenance, seeding of roads, skid trails, firelines, and log decks, and road maintenance (grading, brushing, and mowing). Most of these activities are expected to continue in the near future at approximately the same levels.

Private lands within or adjacent the proposed project areas are made up of timberland, home sites, pastures, and farmland. Timber management activities on private lands, including thinning, regeneration cuts, and road building, have occurred over the past 10 years within some of these areas. There are no adverse cumulative effects that are expected with the implementation of alternatives 2 or 3.

A. History ORV

All past, present and future activities would avoid impacts to historic and pre-historic sites. No activities are expected to impact the Chattooga WSR Corridor. No cumulative adverse impacts are expected to identified sites.

The action alternatives would continue to protect the History ORV in the Chattooga WSR Corridor and watershed.

B. Geology ORV

Past, present and future activities would have no impacts to the Geology ORV under the action alternatives.

The action alternatives would continue to protect the Geology ORV in the Chattooga WSR Corridor and watershed.

C. Biology ORV

1. Fisheries

Past, present and future projects are not located within the Chattooga WSR corridor. Streams that feed into the corridor have been evaluated for direct, indirect and cumulative effects in the aquatic communities section of the EIS.

The action alternatives when added to other past, present and future actions and ongoing activities would continue to protect the fisheries component of the Biology ORV in the Chattooga WSR Corridor and watershed.

2. Wildlife

Past, present and future projects are not located within the Chattooga WSR corridor. No additional impacts to species are expected than what has already been disclosed in the PETS, BA/BE, MIS and MB sections of the EIS.

The action alternatives when added to other past, present and future actions and ongoing activities would continue to protect the wildlife component of the Biology ORV in the Chattooga WSR Corridor and watershed.

3. Botany

Past, present and future projects are not located within the Chattooga WSR corridor. No additional impacts to species including Oconee bells are expected than what has already been disclosed in the PETS section of the EIS. There would be no cumulative effects to Blue Ridge bindweed, Manhart’s sedge and Mountain camellia from this alternative.

The action alternatives when added to other past, present and future actions and ongoing activities would continue to protect the botany component of the Biology ORV in the Chattooga WSR Corridor and watershed.

D. Scenery ORV

Past, present and future projects are not located within the Chattooga WSR corridor and would not impact the scenery ORV. The "Wild" sections would continue to be inaccessible by road, have a natural-appearing character and dramatic natural beauty. "Scenic" sections including road crossings, bridges and developed recreation sites would not be impacted by past, present and future projects. The scenery along the Chattooga River would continue to be exceptional and would remain present in the corridor.

The action alternatives when added to other past, present and future actions and ongoing activities would continue to protect the Scenery ORV in the Chattooga WSR Corridor and watershed.

E. Recreation ORV

Past, present and future projects are not located within the Chattooga WSR corridor.

Specific components of the Recreation ORV include:

1. Fishing

Outstanding fishing opportunities for warm- and cold-water species would not be impacted by past, present and future projects. Fishing opportunities would not be impacted. Fishing opportunities in adjacent streams and tributaries would continue and stocking would also not be impacted.

2. Hiking

Past, present and future projects are not located within the Chattooga WSR corridor. Trails and access points would not be impacted by past, present and future projects.

3. Horseback riding, hunting and motorized use

Past, present and future projects are not located within the Chattooga WSR corridor. Horseback riding on Rocky Gap Horse Trail would not be impacted. Specific mitigation measures have been developed to reduce adverse impact to recreation users in this area during treatment activities and no other activities in the area are planned that might contribute to additional adverse impacts. Some types of hunting opportunities would be improved by a combination of timber harvesting, road maintenance and prescribed burning. These types of disturbances would improve conditions for deer hunters and other early successional hunting opportunities. All these effects would occur outside the WSR Corridor.

4. **Boating**

   Past, present and future projects are not located within the Chattooga WSR corridor and would have no impact on this activity.

5. **Experience**

   Recreation experiences in the WSR Corridor would not be impacted by past, present and future projects. Some types of hunting opportunities/experiences would be improved by cumulative impacts from timber harvesting, prescribed burning and road maintenance.

The action alternatives would continue to protect the recreation ORV in the Chattooga WSR Corridor.

3.4.2.2 Water Quality

The Wild and Scenic Rivers Act (WSRA) requires that the managing agency preserve the water quality of designated rivers. This section analyzes the effects of all alternatives on the river's water quality.

Affected Environment

Sediment is one of the pollutants of concern in the Chattooga River. A variety of measures have been used to address erosion and sediment such as closing roads on Ranger Districts as well as specific efforts to identify pollutant sources such as the Chattooga River Ecosystem Demonstration Project from 1993 to 1995. In 1999, the Chattooga watershed was selected to participate in the Large Scale Watershed Restoration Program by the U.S. Forest Service national office. The goal was to restore watershed conditions on both public and private lands. This followed other earlier efforts to reduce sediment in the river. Numerous projects have been implemented over the years to reduce sediment input to the watershed. The success of this effort is seen in the 2010 303(d) listings for the Chattooga River which indicates that the river is not impaired by sediment. The proposed project is located outside the WSR Corridor in an area noted for high water quality. None of the 303d/305b listed streams are connected to the proposed area.

The 1976 *Federal Register* outlines some of the administrative responsibilities of the state and local governments. On page 11853, the *Federal Register* states:

> Each State has a Water Quality agency charged with setting water quality standards and pollution prevention programs. Even though the Chattooga is an interstate river, the State Water Quality classification varies between states. These standards are, however, adequate to protect the aesthetics of the area and health of the users.

The states of Georgia, North Carolina and South Carolina all have responsibility for monitoring water quality in the Chattooga River. Under the Clean Water Act, each state is required to publish a 305(b) monitoring report that summarizes water quality conditions. If a stream does not have high enough water quality to meet its designated beneficial uses, it is listed as not supporting or impaired based on the presence of certain pollutants. Streams that are not supporting their designated beneficial uses are added to the state's 303(d) list of impaired streams.

In addition to its federally designated wild and scenic river status, the Chattooga River and its tributaries have various classifications developed by each state water quality agency. The predominant beneficial use for the Chattooga and its tributaries is fishing, with waters designated as primary trout waters above Big Bend Falls. Below Big Bend Falls, there is a cool to warm temperature transition that results in changes to the trout community.

Direct and Indirect Effects of Alternative 1

Baseline soil erosion rates and sediment concentrations are displayed in Table 2.5-3 and analysis is contained in section 3.1.2.

The alternative would continue to protect the water quality of the Chattooga River.

Cumulative Effects of Alternative 1

Both the middle and lower Chattooga sixth level watersheds comprise about 27 percent of the total Chattooga fifth level watershed. Land use indicates that both sixth level watersheds are predominantly forested. Past, present and future activities indicate that most current erosion is primarily attributed to past timber harvest activities, prescribed burning, roads, utility rights-of-way and maintenance of roads and wildlife management areas. Private land impacts also include farming, grazing and home sites.

Sediment and some minor fecal coliform loading within the Chattooga River would continue from roads, recreation, urban areas, pastures, gardens, homes, golf courses, timber harvest, small farms and other activities. Most of the concerns associated with fecal coliform loading in the Chattooga River are associated with the streams mainly in Georgia that have extensive urban development such as Clayton, GA in the Stekoa Creek watershed.

Impacts from past sediment sources are expected to continue from existing roads, past logging and other practices that placed skid roads along stream margins and have altered stream channels.

Direct and Indirect Effects of the Action Alternatives

Estimates of sediment increases in the lower and middle sixth level watersheds that contribute flows to the Chattooga River indicate minute changes as a result of project activities. This information is displayed in Table 2.5-3 and detailed analysis can be found in section 3.1.2. Use

of site-specific mitigation measures listed in section 2.2.3 along with Forest Plan standards that including adherence to BMPs would limit adverse impacts to the Chattooga River.
Both action alternatives would continue to protect the water quality of the Chattooga River.

Cumulative Effects of the Action Alternatives

The sediment concentration for the middle Chattooga sixth level watershed is estimated at 1.1 percent increase for alternative 2 and 0.7 percent increase for alternative 3 above Alternative 1 (current condition). The sediment concentration for the lower Chattooga sixth level watershed is estimated at 1.5 percent increase for alternative 2 and 1.2 percent increase for alternative 3 above Alternative 1. This project would not have measureable effects to water quality at the larger watershed scale along the Chattooga River based on sediment and turbidity estimates.
The additional treatments proposed would not measurably create additional water impacts. In addition, the treatments proposed under the action alternatives are short term. Woody shrubs and vegetation would be treated for site preparation to release desirable crop trees. The effects of cumulative herbicide use would not be measureable on the Chattooga River.

3.4.2.3 Free-flowing Condition

The Wild and Scenic Rivers Act (WSRA) requires that the managing agency preserve the free flowing condition of designated rivers. This section analyzes the effects of all alternatives on the river's free flowing condition.

Section 16 (a) of the WSRA defines "free-flowing" as "existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway." As required by the WSRA, at the time of designation, the Chattooga River was flowing in its natural condition without impoundment from Cashiers Lake south to Tugaloo Lake.

Affected Environment

There are currently no impacts to the natural flows of the Chattooga River for its entire length.

Direct, Indirect and Cumulative Effects of All Alternatives

Section 7 of the Wild and Scenic Rivers Act is applied if a project requires construction within the bed or banks of the designated river. Examples of water resource projects include dams, fish habitat structures or boat ramps. No water resources projects are proposed in any alternative; therefore, none would affect the free-flowing condition of the Chattooga Wild and Scenic River.

All alternatives and past, present and foreseeable projects are not water resources projects; therefore, the free-flowing conditions of the Chattooga WSR and the entire Chattooga WSR would be preserved.

3.5 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species, the destruction or removal of cultural resources or the removal of mined ore. Irreversible commitments of resources are permanent losses of non-renewable resources. Irretrievable commitments are those that are lost for a period of time, such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road. Irretrievable commitments of resources are temporary losses of renewable resources. With implementation of this project, there are no irreversible commitments of forest resources. The irretrievable commitment of resources for the action alternatives includes the temporary loss of productive timber lands from creation of log landings. Productivity is expected to return upon completion of project activities and log landings are re-vegetated.

3.6 Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Under the Multiple-Use Sustained Yield Act and the National Forest Management Action, all renewable resources are to be managed in such a way that they are available for future generations. The harvesting of timber can be considered a short-term use of a renewable resource. As a renewable resource, trees can be reestablished and grown again if long-term soil productivity is maintained through application of mitigation protection measures described in chapter 2.

Short-term use (1 to 7 years during treatment operations) for the AP Loblolly Pine Removal and Restoration Project would remove forest products and generate revenue for the Federal government. The State and local economy would see benefits in the form of business and employment taxes. Treatment activities and resulting forest products would directly support jobs in the forest products and management industry. Existing roads would be used to access the treatment units during the timeframe for treatments. When treatments have been completed road use would return to the status quo on most roads. Road reconstruction and maintenance activities would improve road conditions both for the contractors and the public driving these roads. Benefits would exist for some time after logging activities are completed. There would be a short-term loss of soil productivity on areas dedicated to log landings. Dust and air pollutants would be created in the project area, but would disperse quickly and not impact long-term air quality.

In the long term (7 to 15 years), replacing off-site non-native loblolly pine stands with native trees would increase biodiversity and improve forest health. The forest would be more resistant to insects and disease due to the reduced competition for water and nutrients and replacement of

trees that are considered off-site and are susceptible to ice and insect damage. Treatments to improve forest health are summarized in Table 2.2.2-1 and 2.2.3-2. Native trees would be established on approximately 5, 542 acres. Additional discussion on forest health can be found in section 3.2.1 of chapter 3. American chestnut would be planted on appropriate sites in the project area if seedlings are available.

Regeneration harvest and woodlands would also benefit wildlife and understory plants, particularly the federally endangered smooth coneflower. Establishment and maintenance of woodland habitat would provide additional habitat diversity for a variety of disturbance-dependent, early successional game and nongame wildlife species in all stages of their lifecycles. Effects on proposed, endangered, threatened and sensitive species, management indicator species, migratory birds and aquatic communities are discussed in chapter 3.

3.7 Unavoidable Adverse Effects

Implementation of any of the alternatives, including no action, could cause adverse environmental effects that cannot be fully mitigated or avoided. These are discussed by resource area throughout chapter 3. Unavoidable adverse impacts often result from managing the land for one resource at the expense or condition of other resources. Some adverse effects are short-term and necessary to achieve long-term beneficial effects. The application of Forest Plan standards including South Carolina's Best Management Practices for Forestry (BMPs), along with site-specific mitigation measures are intended to limit the extent, severity and duration of potential impacts.

The "No Action" alternative would have an adverse effect on forest health and diversity of habitat for a variety of wildlife and plant species in the long term. Loblolly pine would continue to persist and possibly expand its dominance on over 5500 acres of the District. The Table mountain pine rare community would continue to decline, as would shortleaf pine and some oak and hickory species. Periodic outbreaks of Southern pine beetle would be expected, leading to habitat conditions not conducive to promoting or maintaining diverse native forest habitats in the long term.

Treatments proposed in the action alternatives would result in minimal damage to residual trees from equipment operation and harvest activities. Alternative 2 has slightly more potential for damage to residual trees since slightly more acres would be commercially harvested than alternative 3. Damage would be minimized through sale administration and proper harvest methods. Adherence to Forest Plan standards would reduce overall impacts.

There would be short term increases in water yield, sediment concentrations and disturbance in riparian areas. There would be temporary disturbance to wildlife and to recreation as activities and traffic would increase. Hikers, backpackers, horseback riders, anglers and hunters could be temporarily displaced while activities are going on. Site- specific mitigation measures found in chapter 2 would reduce impacts. Short term impacts to scenery would result. Adherence to Forest Plan standards, including BMPs and site-specific mitigation measures would reduce and limit the duration of effects to water yield, sediment concentrations and disturbance in riparian areas.

Mitigation measures and treatment unit design address impacts to scenery, recreation and to the outstandingly remarkable values that make the Chauga River and Cedar Creek, both eligible for inclusion in the National Wild and Scenic River system. Chapter 3 of the environmental impact statement and associated project file provide more detailed information on unavoidable adverse impacts.

Threatened and endangered species were analyzed for this project. The action alternatives are not likely to adversely affect persistent trillium, small whorled pogonia and smooth coneflower. A detailed discussion of the adverse effects are found in the threatened and endangered wildlife species section of chapter 3 and in the Biological Assessment /Biological Evaluation (BA/BE). The action alternatives include mitigation measures to minimize disturbance to individual plants. Mitigation measures are listed in chapter 2.

Project impacts on sensitive wildlife and plant species were also analyzed. The action alternatives may impact individuals, but are not likely to result in a trend towards listing or loss of viability for the following species: ashleaf goldenbanner; piedmont strawberry; sun-facing coneflower; whorled horsebalm; brook floater; Chauga crayfish; Edmund's Snaketail and Diana fritillary. There are no impacts expected to bald eagles, butternut, Fort Mountain sedge, jeweled trillium, nodding trillium, Radford's sedge, Southern Appalachian salamander and Southern Oconee bells. Discussion of effects to these species can be found in the sensitive species section in chapter 3 and in the BA/BE.

Soil disturbance would be evident from logging activities. The action alternatives would have long- and short-term direct negative effects on forest soils. Effects to soils include: compaction, rutting and displacement, disturbed litter layer and soil organic matter. Discussion of the adverse effects to soils can be found in the soils section of chapter 3. By implementing the mitigation measures in chapter 2 and Forest Plan standards, including BMPs, impacts to soils would be minimal.

The action alternatives would increase sunlight and soil disturbance to the forest floor which has the potential to spread or increase already existing populations of non-native invasive species (NNIS) in the project area. Mechanical equipment can inadvertently bring in seeds of invasive plants as can material and seed used for soil stabilization. Mitigation measures listed in chapter 2 would minimize NNIS from spreading or getting established. Existing populations of autumn olive, Chinese privet and mimosa would be treated under an existing decision prior to other vegetation treatments. This would reduce their chance of spreading to other areas once project treatments are completed. Timber sale contract provisions also require the cleaning of equipment to prevent the spread or introduction of NNIS from other areas. These actions would ensure that the purpose and need for the project can be achieved by controlling the spread of existing populations of NNIS and introduction of new NNIS into the project area. Additional discussion on NNIS can be found in the invasive plants section of chapter 3.

Treatment activities and burning would impact air quality through equipment emissions, dust and smoke; however project impacts are expected to still meet State and Federal air quality standards. Additional discussion on air quality impacts can be found in the air quality section of chapter 3.

3.8 Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft and final environmental impact statements concurrently with and integrated with… other environmental review laws and executive orders." The proposed action and alternative must comply with environmental laws, as well as direction provided to agencies through executive orders." The Forest Service has consulted with the United States Fish and Wildlife Service, the State Historic Preservation Office and the South Carolina Forestry Commission. In addition to the above named agencies, the Forest Service has sent copies of this EIS to South Carolina Department of Health and Environmental Control and South Carolina Department of Natural Resources.

Principal Environmental Laws

The following laws contain requirements for protection of the environment that apply to the proposed action and the alternatives:

Endangered Species Act

See section 3.2.2 for effects to proposed, endangered, threatened species in chapter 3 and the BA/BE in Appendix C.

Clean Water Act

See section 3.1.2 for effects to water, riparian areas, wetlands, floodplains and prime farmlands in chapter 3.

There is uncertainty [40 CFR 1502.25 (b)] whether a permit, license or other authorization for this proposal will be required for stormwater discharge from logging roads under the Clean Water Act due to pending review of NEDC v. Brown by the Supreme Court. This EIS has been sent to the South Carolina Department of Health and Environmental Control, the agency responsible for issuing National Pollution Discharge Elimination System (NPDES) permits. A permit would be obtained if required. Whether or not a permit is required, the project has been developed to include all required road design measures to reduce impacts of roads on water quality (refer to sections 3.1.2 Water, Riparian Areas, Wetlands, Floodplains, Prime Farmlands and Mitigation Measures Common to All Alternatives).

Clean Air Act

See the air section 3.1.3 in chapter 3.

National Historic Preservation Act

See the cultural resources section 3.3.1 in chapter 3. The South Carolina State Historic Preservation Office (SHPO) and Eastern Band of Cherokee Indians Tribal Historic Preservation Office (THPO) have reviewed the archeological survey reports and

documentation of previous cultural resource surveys for the project area. They have been consulted on this project including the determination of National Register eligibility of all sites in the area of potential effects. Letters concurring with Forest Service eligibility determinations were received.

National Forest Management Act

The National Forest Management Act requires projects to be consistent with the Forest Plan and to make the following findings [16 U.S.C. 1604 (g)(3)(E)]:

1. Soil, slope, or other watershed conditions will not be irreversibly damaged;

See soils and hydrology sections, chapter 3.

2. There is assurance that such lands can be adequately restocked within five years after harvest;

Reforestation would occur within five years of final harvest. Any stand that receives any harvest activity would not be maintained as a permanent opening and would be fully stocked, or can be adequately restocked with natural regeneration within five years of final harvest. Live green trees would be retained on units to provide a source of seed and additional trees would be planted to ensure the area is fully stocked. All areas proposed for final harvest have been review by a certified silviculturist and a soil scientist to ensure adequate soils for planting and growth of conifer seedlings.

3. Protection is provided for streams, streambanks, shorelines, lakes, wetlands and other bodies of water from detrimental changes in water temperatures, blockages of water courses and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat;

Effects to water, riparian areas, streams, streambanks, wetlands and floodplains are disclosed in chapter 3. Forest Plan standards including BMPs and site-specific mitigation measures are included to provide protection to streams and reduce effects of sediment. Riparian buffers would provide shading to streams and temporary stream crossings would ensure there are no blockages of the steam course.

4. The harvesting system to be used is not selected primarily because it will give the greatest dollar return or the greatest unit output of timber.

The harvesting system selected is commonly used in the southeast and meets environmental requirements. Timber sale contract provisions that incorporate Forest Plan standards along with site-specific mitigation measures would reduce adverse environmental effects.

A Responsible Official may authorize project and activity decisions on National Forest administered lands using clearcutting, seed tree cutting, shelterwood cutting and other cuts designed to regenerate an even-aged stand of timber as a cutting method only where:

1. For clearcutting, it is determined to be the optimum method and for other such cuts it is determined to be appropriate, to meet the objectives and requirements of the relevant land management plan.

All harvest units have been reviewed by a certified silviculturist. See section 3.2.1 for a determination that regeneration harvest with reserves is the optimum method to regenerate native stands in the project area.

2. The interdisciplinary review as determined by the Secretary has been completed and the potential environmental, biological, esthetic, engineering and economic impacts on each advertised sale area have been assessed, as well as the consistency of the sale with the multiple use of the general area.

The *AP Loblolly Pine Removal and Restoration Project Environmental Impact Statement* documents the interdisciplinary review, as well as the consistency with the *Revised Land and Resource Management Plan, Sumter National Forest* (2004) (Forest plan); see chapter 3 of this EIS.

3. Cut blocks, patches, or strips are shaped and blended to the extent practicable with the natural terrain.

Treatment units follow stand boundaries and other natural terrain features. Site-specific design criteria are in place to ensure impacts to scenery are reduced; see chapter 2 of this EIS.

4. There are established according to geographic areas, forest types, or other suitable classifications the maximum size limits for areas to be cut in one harvest operation, including provision to exceed the established limits after appropriate public notice and review by the responsible Forest Service officer one level above the Forest Service officer who normally would approve the harvest proposal; provided, that such limits shall not apply to the size of areas harvested as a result of natural catastrophic conditions such as fire, insect and disease attack, or windstorm.

See Forest Plan, forestwide direction, page 2-17, FW-54, 2nd paragraph.

5. Such cuts are carried out in a manner consistent with the protection of soil, watershed, fish, wildlife, recreation and esthetic resources and the regeneration of the timber resource.
See mitigation measures in chapter 2. All proposed activities are in compliance with direction in the Forest Plan and with the applicable environmental regulation, see various sections in chapter 3.

6. Even-aged stands of trees scheduled for regeneration harvest generally have reached culmination of mean annual increment of growth, unless the purpose of the timber cutting is excepted in the land management plan.

See the Purpose and Need in chapter 1 of the EIS. A goal of the Forest Plan was to restore natural communities in amounts, arrangements and conditions capable of supporting viable populations of existing native and desired non-native plants, aquatic and wildlife species on sites occupied by loblolly pine over the 10 year period. Forest health concerns in the early part of the 21st century lead to the development of forest goal #16 – "Maintain or restore native species whose role in forest ecosystems is threatened by insects and disease." The desired condition for the Andrew Pickens Ranger District was to have more native species composition. Leaving loblolly pine would provide and unwanted seed source and would work against restoration activities.

Executive Orders

The following executive orders provide direction to federal agencies.

- Invasive Species, Executive Order 13112 of February 3, 1999

  See section 3.2.1 in chapter 3 and mitigation measures in chapter 2 of the EIS.

- Migratory Birds, Executive Order 12962 of January 10, 2001

  See migratory bird section 3.2.4 in chapter 3 of the EIS.

- Environmental Justice, Executive order 12898 of February 11, 1994

  This order requires an assessment of whether implementation of this decision would disproportionately affect minority or low-income populations. See section 3.3.5 in chapter 3 of the EIS.

Special Area Designations

There are no inventoried roadless areas, wilderness or wilderness study areas. Impacts to the Chattooga Wild and Scenic River are analyzed in section 3.4.2. The Chauga River and Cedar Creek are both eligible for inclusion in the National Wild and Scenic River System. The outstandingly remarkable values that make them eligible for inclusion have been evaluated in section 3.4.1 of the EIS.

Federal, Regional, State and local land use plans, policies and controls

Implementation of BMPs and project specific mitigation measures would result in the proposed activities being in compliance with South Carolina Best Management Practices for Forestry and the State Historic Preservation Office.

Energy and natural or depletable resource requirements and conservation potential

Consumption of fossil fuels would occur with the action alternatives during treatment activities, timber hauling as well as road maintenance actions. There are no unusual energy requirements associated with the action alternatives nor is it the type of proposal that provides an opportunity to conserve energy at a large scale. Wood is a renewable resource. With the proper application of Forest Plan standards and guidelines and mitigation measures described in chapter 2 for soils, water, wildlife, forest vegetation and other resources, the project would conserve resources.

Urban quality, historic and cultural resources and the built environment

Historic and cultural resources would be protected as described in chapter 3, cultural resources. There would be no changes to urban quality or the built environment with this project.

CHAPTER 4. CONSULTATION AND COORDINATION

Preparers and Contributors

The Forest Service consulted the following individuals during the development of this environmental assessment:

ID TEAM MEMBERS:

Jim Bates

Position: Sumter Zone Archeologist
Education: MA, Anthropology, University of Tennessee 1982
Experience: 37 years professional experience, Archeology
EIS Contribution: Cultural Resources, resource identification, effects analysis, cultural resources section

Larue Bryant

Position: Forest Engineer (Supervisory Civil Engineer)
Education: BS, Civil Engineering, Clemson University (1991)
Experience: 21 years professional experience
EIS Contribution: Transportation infrastructure – planning and analysis

Robbin Cooper

Position: Landscape Architect
Education: BLA, Bachelor of Landscape Architecture, Louisiana State University, (1989)
Experience: 23 years professional experience
EIS Contribution: scenery analysis and portions/review of recreation section

Mark Danaher

Position: Forest Biologist
Education: BSFR University of Georgia 1998
Experience: Certified Wildlife Biologist with The Wildlife Society, 14 years experience as a forester and wildlife biologist
EIS Contribution: Migratory Birds

Bill Hansen

Position: Forest Hydrologist
Education: BS, Forestry and MS Forestry (Hydrology), University of Missouri, School of Forestry, Fisheries and Wildlife, Columbia, Missouri.
Experience: 42 years professional experience
EIS Contribution: sections on water related subjects including riparian, floodplains and wetlands, hydrology, estimates of stream types, erosion, sediment and water quality effects by hydrologic scale, associated standards/BMPs/mitigation, IDT member.

Geoff Holden

Position: Forest GIS Coordinator
Education: BS, Forestry, Northern Arizona University (1999); Masters in Geographic Information Systems, University of Minnesota (2003)
Experience: 10 years professional experience
EIS Contribution: maps; geospatial analysis for soil/water cumulative effects

Bill Jackson

Position: Air Resource Management (ARM) Specialist
Education: Bachelor of Arts – Biology, Bachelor of Science -- Forestry
Experience: 5 years as Plant Pathologist, 20+ years as an ARM Specialist
EIS Contribution: Potential impact of proposed actions on air quality

Jason Jennings

Position: Forest Soil Scientist
Education: BS, Forest Resource Management, College of Agriculture, Forestry and Life Sciences, Clemson University (2003), Master of Forest Resources (MFR), College of Agriculture, Forestry, and Life Sciences, Clemson University (2005)
Experience: 7 years professional experience
EIS Contribution: Soil Resource Section

Jim Knibbs

Position: Forest Environmental Coordinator
Education: BS, Resource Management, College of Environmental Science and Forestry, Syracuse University (1975)
Experience: 35 years professional experience
EIS Contribution: portions of the social analysis and Other Elements section, document review/IDT coordination

Robin Mackie

Position: Forest Botanist/Ecologist
Education: MS Forest Resources, University of Georgia; BS Biology Berry College
Experience: 22 years - experience with the Forest Service
EIS Contribution: Ecological communities and non-native invasive plant species, TES review

Jeff Magniez

Position: Zone Wildlife Biologist
Education: BS, Wildlife Management, Humboldt State University (1996)
Experience: 16 years professional experience
EIS Contribution: MIS and PETS Sections, Biological Assessment/Evaluation

Jay Purnell

Position: Forest Silviculturist
Education: BS, Forest Management, Auburn University, 1977
Experience: 35 years professional experience
EIS Contribution: Herbicide risk assessment, document review

Jeanne Riley

Position: Forest Fisheries Biologist
Education: MS, Fisheries Science, University of Tennessee, Knoxville, TN 1986
Experience: 28 years professional experience
EIS Contribution: Aquatic Analysis

Victor Wyant

Position: Andrew Pickens Ranger District Silviculturist and Timber Management Assistant
Education: BS, Forest Ecosystem Management, Purdue University, 1996
Experience: 12 years professional experience
EIS Contribution: Alternative development, field reconnaissance, Vegetation and Economics sections, document review and IDT Coordination

Distribution of the Environmental Impact Statement ___

This draft environmental impact statement (DEIS) will be distributed to the following government agencies as well as those organizations and individuals who submitted comments during the scoping period or requested a copy:

Emily Cooper
Chris Holcomb
Michael Hood – Clemson University
Bessie Matheson
Tom McEwen
Tom Swayngham – South Carolina Department of Natural Resources
Shirley Reeves
June Chastain
Theodore Snyder
Jay Herrington – United States Fish and Wildlife Service
Lem Chastain
Buzz Williams – Chattooga Conservancy
Donald Sanders
Butch Clay
Jean Public
Bettina George
Paul and Keiffer Green
Heinz J. Mueller – Environmental Protection Agency (EPA), Atlanta, GA
Dick Artley

Other State Agencies

The DEIS will also be sent or made available to:

South Carolina Forestry Commission, Columbia, SC

South Carolina Department of Health and Environmental Control, Columbia, SC

Federal Agencies

The following federal agencies will either receive a hard copy, CD and/or a one page Executive Summary of the project, including a contact name and number and a web site address where the full document is posted:

Director, Planning and Review, Advisory Council on Historic Preservation

Deputy Director, APHIS PPD/EAD

National Environmental Coordinator, NRCS

Acquisitions and Serials Branch

NOAA Fisheries Services SE Region, St. Petersburg, FL

U.S. Army Corps of Engineers, Atlanta, GA

EPA Office of Federal Activities

Director, Office of Environmental Policy and Compliance

U.S. Coast Guard, Department of Homeland Security

Regional Director, Federal Aviation Administration, Southern Region

Division Administrator, Federal Highway Administration, Columbia, SC

Director, NEPA Policy and Compliance, DOE

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Glossary

COMMONLY USED ACRONYMS

BMP – Best Management Practice
BA – Biological Assessment
BE – Biological Evaluation
DBH – Diameter at Breast Height
EIS – Environmental Impact Statement
EA – Environmental Analysis
EPA – Environmental Protection Agency
GIS – Geographic Information System
HUC – Hydrologic Unit Code
IDT – Interdisciplinary Team
KBDI – Keetch-Byram Drought Index
LRMP – Land and Resource Management Plan
LWD – Large Woody Debris
MA – Management Area
MIS – Management Indicator Species
NEPA – National Environmental Policy Act
NFMA – National Forest Management Act
NRV – Natural Range of Variability
NNIS – Non-native invasive species
PETS – Proposed, Endangered, Threatened, or Sensitive Species
PNV – Potential Natural Vegetation, also Present Net Value
ROD – Record of Decision
ROS – Recreation Opportunity Spectrum
SIO – Scenic Integrity Objective
SPB – Southern Pine Beetle
SMZ – Streamside Management Zone
WUI – Wildland Urban Interface

DEFINITIONS

Accessibility – the relative ease or difficulty of getting from or to someplace, especially the ability of a site, facility or opportunity to be used by persons of varying physical and mental abilities.

Activity fuel – see slash

Advance regeneration (reproduction) - Seedlings or saplings that develop, or are present, in the understory.

Affected environment - The current environment that may be affected by implementation of an alternative. Also, a chapter heading in environmental documents.

Age class (cohort) - An interval, usually 10 to 20 years, into which the age ranges of vegetation are divided for classification or use.

Age distribution – the proportion of ages for trees in a given stand

Air pollutant - Any substance in air that could, if in high enough concentrations could harm humans.

Air quality - The composition of air with respect to quantities of pollution therein; used most frequently in connection with "standards" of maximum acceptable pollutant concentrations.

Alternative - In an environmental document, one of several possible options for responding to the purpose and need for action.

Analysis area - Area used in a resource area for affected environment condition description and environmental consequences discussions. May or may not be the same area of consideration as the "project area".

Analysis file - See "project file".

Aquatic ecosystem - A natural system based on a body of water (such as a stream, lake, or estuary) with its aquatic living organisms and abiotic components.

Artificial regeneration - Renewal of a forest stand by direct seeding or by planting tree seedlings.

Bald - An early successional opening generally above 4,000 feet, characterized by grassy or heath vegetation.

Basal area - The area of the cross-section of a tree inclusive of bark at breast height (4.5 feet or 1.37 meters above the ground) most commonly expressed as square feet per acre or square meters per hectare. Used to measure the density of a stand of trees. For shrubs and herbs it is used to determine phytomass. Grasses, forbs, and shrubs usually measured at or less than 1 inch

above soil level. Trees—the cross-section area of a tree stem in square feet commonly measured at breast height (4.5' above ground) and inclusive of bark, usually computed by using diameter at breast height (DBH), or tallied through the use of basal area factor angle gauge.

Best Management Practices (BMPs) - A practice or combination of practices that are the most effective and practical (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals.

Biodiversity - The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Biological Assessment (BA) - A Forest Service process that provides an analysis of the potential effects on species classified as threatened or endangered by the U.S. Fish & Wildlife Service. Used to provide a process and standard by which to ensure that listed species receive full consideration in the decision making process.

Biological Evaluation (BE) - A Forest Service process that provides an analysis of the potential effects on species of animals, fish and plants classified as “Sensitive” by the Regional Forester. Used to provide a process and standard by which to ensure that sensitive species receive full consideration in the decision making process.

BMP - see Best Management Practices

Browse - Young twigs, leaves and tender shoots of plants, shrubs or trees that animals eat.

Canopy layer – the vertical structural layer in a forest, such as understory, mid-story, or overstory

Channeled ephemeral streams - Ephemeral streams that have a defined channel of flow where surface water converges with enough energy to remove soil, organic matter, and leaf litter. Ones that exhibit an ordinary high watermark and show signs of annual scour or sediment transport are considered navigable waters of the United States (USACE, Part 330- Nationwide Permit program, 2000).

Channelization – Artificial change of a stream channel profile.

Clearcutting - The harvesting in one cut of all trees on an area for the purpose of creating a new, even-aged stand. The area harvested may be a patch, stand, or strip large enough to be mapped or recorded as a separate age class in planning for sustained yield under area regulation. A method of regenerating an even-aged stand. Regeneration is from natural seeding, direct seeding, planted seedlings, and/or advance reproduction. Harvesting may be done in groups or patches (group or patch clearcutting), or in strips (strip clearcutting). In the clearcutting system, the management unit or stand in which regeneration, growth, and yield are regulated consists of the individual clearcut stand.

Clearcutting with reserves - A two-aged regeneration method in which varying numbers of reserve trees are not harvested to attain goals other than regeneration.

Climax - The culminating stage in plant succession for a given environment with the vegetation having reached a highly stable condition.

Cohort – a group of trees developing after a single disturbance, commonly consisting of trees of similar age, although it can include a considerable range of tree ages of seeding or sprout origin and threes that predate the disturbance.

Colluvial fan – fan-shaped deposits resulting from transportation of deposition by mass movement (direct gravitational action) and local, unconcentrated runoff on side slopes or at the base of slopes

Commercial thinning – Any type of thinning producing merchantable material at least equal to the value of the direct cost of harvesting.

Compartment - In silviculture discussions, refers to a collection of forest stands grouped into a subwatershed, usually several thousand acres, but not as large as watersheds.

Cove forests – forests located in protected landscape positions, often in concave landforms near stream headwaters. Coves are some of the most productive sites in the southern mountains due to high site moisture and soil fertility. These forests have high species diversity of both plants and animals. May be divided into rich or acid cove forest.

Cover type (Forest Type, Forest Cover Type) - A forest or stand type defined by its vegetation (particularly its composition and local environmental factors). Classification is based on the percent of an area occupied by tree species.

Crown - The upper portion of a tree or other woody vegetation that supports branches and foliage.

Crown class - A class of tree based on crown position relative to the crowns of adjacent trees.

- *Dominant* - Trees with crowns extending above the general level of the main canopy of even-aged groups of trees. They receive full light from above, and partly from the sides.
- *Co-dominant* - Trees with crowns forming the general level of the main canopy in even-aged groups of trees. They receive full light from above, and comparatively little from the sides.
- *Intermediate* - Trees with crowns extending into the lower portion of the main canopy of even-aged groups of trees, but shorter in height than the co-dominants. They receive little direct light from above, and none from the sides.
- *Overtopped (suppressed)* - Trees of varying levels of vigor that have their crowns completely covered by the crowns of one or more neighboring trees.

Crown fire - fire that burns in the crowns of trees and shrubs, usually ignited by a surface fire. Crown fires are common in western coniferous forests and chaparral-type shrub lands.

Cultural resource - The remains of sites, structures, or objects used by humans in the past - historical or archaeological.

Cumulative effects - The effects on the environment that results from the incremental impact of the action when added to other actions. Cumulative effects can also result from individually minor but collective, individual actions over a period.

Cut and leave – a tree felling (cutting) treatment where trees are felled and left on-site

Cut and remove – a tree felling (cutting) treatment where trees are felled and removed (harvested)

Cut-surface method – a manual treatment method for applying herbicide using a hatchet, machete, or similar device to make frill or cut at a downward angle at proper spacing, following label recommendations. Cuts penetrate through the bark into living cambium tissue (the wood next to the bark) and produce a cupping effect to hold herbicide. Herbicide is sprayed in a measured quantity into the cuts using a squirt bottle and not allowed to overflow.

DBH - see Diameter at Breast Height.

Den trees - Trees having rainproof, weather- tight cavities used by wildlife.

Density (tree, stand, or stem) - The quantity of trees that occupy a unit of land; commonly expressed as basal area and/or number of trees per acre by size and spacing.

Direct effects - Environmental consequences as a result of a proposed action, which are caused by the action and occur at the same time and place

Directional felling – felling trees so that they fall in a pre-determined direction, used primarily for the purpose of minimizing damage to a site

Dispersed recreation – Recreation opportunities or use occurring in the general forest area. Does not take place in developed sites. Examples are camping and picnicking.

Disturbance (ecology) – Any relative discrete event in time that disrupts the ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.

Disturbance-recovery regime – A natural pattern of periodic disturbance followed by a period of recovery. Examples include fire or flooding.

Diversity - The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Drainage area/basin - The total area above a given point on a stream that contributes to the flow at that point. Term is often used interchangeably with watershed.

Duff - partially decomposed organic matter lying beneath the litter layer and above the mineral soil. Includes the fermentation and humus layers of the forest floor (02 soil horizon)

Early succession (early seral) – the biotic community that develops immediately following the removal or mortality of most or all of forest canopy, resulting in a predominance of woody species regeneration. As used in this EIS and Sumter Forest Plan, a stand age of 0 to 10 years is used to define this condition. See successional stage.

Early successional (early seral) habitat – a vegetative condition typically characterized by low density to no tree canopy cover and an abundance of herbaceous and/or woody ground cover. This
condition may include early-successional forest, maintained openings, pastures, balds, and open woodlands.

Early successional (early seral) species - plant or animal species characteristic of early forest successional stages.

Ecological zone - units of land that can support a specific plant community or plant community group based upon environmental factors such as temperature, moisture, fertility, and solar radiation that control vegetation distribution. They may or may not represent existing vegetation, but instead, the vegetation that could occur on a site (potential vegetation) with historical disturbance regimes. Ecological Zones are equivalent to Biophysical Settings (BpS) which represent the vegetation that may have been dominant on the landscape prior to Euro-American settlement and are based on both the current biophysical environment and an approximation of the historical disturbance regime.

Ecosystem - a spatially explicit, relatively homogeneous unit of the earth that includes all interacting organisms and components of the abiotic environment within its boundaries

Edge habitat - the more or less well-defined boundary between two or more elements of the environment, e.g., a field adjacent to a woodland or the boundary of different silvicultural treatments

Effects - Environmental consequences because of a proposed action. Included are direct effects, which are caused by the action and occur at the same time and place, and indirect effects, which are caused by the action and are later in time, or further removed in distance, but which are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern or land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.

EIS - see Environmental Impact Statement.

Endangered species - Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plants or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.

Environmental Analysis (EA) - An analysis of alternative actions and their predictable short and long-term environmental effects, which include physical, biological, economic, social, and environmental design factors and their interactions.

Environmental consequence - The result or effect of an action upon the environment.

Environmental impact - Used interchangeably with environmental consequence or effect.

Environmental Impact Statement (EIS) - A statement of the environmental effects of a proposed action and alternatives to it. A formal document that must follow the requirements of NEPA, the Council on Environmental Quality (CEQ) guidelines, and directives of the agency responsible for the project proposal. A Draft EIS is released to public and agencies for comment, and then a Final EIS is issued after consideration of those comments. A Record of Decision (ROD) is the decision document that informs the public of what action is to be taken.

Environmental Protection Agency (EPA) - an agency of the US Government.

Ephemeral streams - Streams having flows that occur for short periods of time in direct response to storm precipitation or snowmelt runoff. Their bottoms are always above the water table and do not contain fish or aquatic insects that have larvae with multiple-year life cycles. Ephemeral streams may have a defined channel, but may be manifested as a natural swale or depression with vegetation and organic material covering the bottom. They also may serve as a conduit for much of the sediment that enters the stream system. Large woody debris associated with ephemeral streams may also contribute significantly to the stability of a stream system. Ephemeral streams that exhibit an ordinary high watermark, show signs of annual scour or sediment transport, are considered navigable waters of the United States.

Ericaceous – “acid-loving” plants, those that would grow well in low pH soils.

Erosion - Detachment or movement of soil or rock fragments by water, wind, ice or gravity. Accelerated erosion is much more rapid than normal, natural or geologic erosion, primarily because of the influence of activities of man, animals or natural catastrophes.

Even-aged management - a type of silvicultural prescription that manages the stand by regenerating the entire stand and all trees would be of the same age/size class as the stand develops.

Even-aged silvicultural system - A planned sequence of treatments designed to maintain and regenerate a stand with one age class.

Even-aged stand - A stand of trees containing a single age class in which the range of tree ages is usually less than 20 percent of rotation.
Felling – The cutting down of trees.

Fine particulate matter – inhalable particles 2.5 micrometers in diameter and smaller, such as those found in smoke and haze

Fire condition class – Based on coarse scale national data, classes measure general wildfire risk:

- *Class One* – Fire regimes are usually within historical ranges. Vegetation composition and structure are intact. The risk of losing key ecosystem components from the occurrence of fire is relatively low.
- *Class Two* – Fire regimes on these lands have been moderately altered from their historical range by increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified.
- *Class Three* – Fire regimes on these lands have been significantly altered from their historical return interval. The risk of losing key ecosystem components from fire is high. Fire frequencies have departed from historical ranges by multiple return intervals. Vegetation composition, structure and diversity have been significantly altered.

Fire intensity – a general term relating to the heat energy released in a fire; specifically, the rate of heat energy released per unit time per unit length of fire front. Numerically, it is the product of the heat of combustion, quantity of fuel consumed per unit area in the fire front, and the rate of spread of a fire, in Btu per second per foot of fire front, or in kilowatts per meter.

Fireline - Generally, any cleared or treated strip used to control a fire's spread; more specifically, that portion of a control line from which flammable materials have been removed by scraping or digging to mineral soil.

Fire regime – A generalized description of the role a fire plays in the ecosystem. It is characterized by fire frequency, predictability, seasonality, intensity, duration, scale (patch size), and regularity or variability. Five combinations of fire frequency exist.
Groups One and Two include fire return intervals in the 0-35 range. Group One includes Ponderosa Pine, other long needle pine species, and dry site Douglas fir. Group Two includes the drier grassland types - tall grass prairie, and some Pacific chaparral ecosystems.
Groups Three and Four include fire return intervals in the 35-100+ year range. Three includes interior dry site shrub communities including sagebrush and chaparral ecosystems. Group Four includes Lodgepole and Jack Pine.
Group Five is the long interval (infrequent), stand replacement fire regime and includes temperate rain forest, boreal forest, and high elevation conifer species.

Fire return interval – the period of time (usually in years) between two fire episodes in a given area.

Fire severity – the product of fire intensity and fire residence time, it is the degree to which soil organic matter is lost due to fire, both above and below ground, classified as low (light), moderate, or severe (high)

Fisheries habitat - The aquatic environment needed to support fish.
Flow response – change in streamflow due to some change in environmental condition, such as vegetation removal.

Foliar spray – a method of applying herbicide by spraying the foliage of target plants.

Forage - All browse and non-woody plants that are available to livestock or game animals used for grazing or harvested for feeding.

Foreground - The area between the viewer and the middle ground in a landscape.

Forest - an ecosystem characterized by a more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish, and wildlife

Forest cover type – see cover type

Forest type – see cover type

Forest community – a grouping of forest cover types based on similar growing site characteristics and other flora/fauna found together on those sites.

Forest fragmentation – see fragmentation

Forest health – The perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance.

Forest plan – see Land and Resource Management Plan

Forest structure – 1. In ecology, the physical and temporal distribution of plants in a stand. 2. In silviculture, the horizontal and vertical distribution of forest stand components including the height, diameter, canopy layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris

Fragmentation - the process by which a landscape is broken into small islands of forest within a mosaic of other forms of land use or ownership —*note* e.g., islands of a particular age class (e.g., old growth) that remain within areas of younger-aged forest —*note* fragmentation is a concern because of the effect of noncontiguous forest cover on connectivity and the movement and dispersal of animals in the landscape

Frill girdle – see cut-surface

Fuel loads - amounts of vegetative material (both alive and dead) on the forest floor or still standing that would be burned for a prescribed fire or by a wildfire.

Gap – 1. the space occurring in forest stands due to individual or group tree mortality or blowdown, usually small in scale from less than 1 acre to a few acres in size 2. A forest management term specific to the Sumter National Forest Plan that refers to openings in forest stands smaller than 2 acres in size that are intentionally created by felling and/or removing trees

to release mast producing species, particularly hard mast (oak, hickory, walnuts, etc.) and soft mast bearing trees (cherry, black gum, persimmon, etc.). (synonym - canopy gap)

Geographic Information System (GIS) - Information processing computer technology to input, store, manipulate, analyze, and display earth-referenced spatial resource data in a map base format. GIS has two main components, the first being a data base, and the second being a display of data, both numerically, and spatially in map format.

Growing space – 1. The physical area available to and utilized by a tree 2. that portion of the resources of the site (light, water, nutrients, etc.) available to and utilized by a tree —note growing space is not usually directly measurable but often represented from crown projection or leaf area or as an area allocation obtained using various mathematical techniques

Group selection – An uneven-aged regeneration method in which trees are removed periodically in small groups. Uneven age classes for trees are established in small groups. The width of groups is about twice the height of the mature trees, with small opening providing microenvironments suitable for tolerant regeneration, and the larger openings providing conditions suitable for more intolerant regeneration.

Habitat - The place where a plant or animal naturally or normally lives or grows.

Habitat Diversity - The distribution and abundance of different plant and animal communities and species within a specific area.

Habitat type - The aggregate of all areas that support or can support the same primary vegetation at climax.

Hack and squirt – see cut-surface

Hard mast – the fruit of trees considered as food for livestock and certain kinds of wildlife — hard mast is the fruits or nuts of trees such as oak, beech, walnut, chinquapin, and hickories

Harvest – the removal of merchantable volume from trees in an area

Harvesting method - A procedure by which a stand is logged. Emphasis is on meeting logging requirements rather than silvicultural objectives.

Herbicide – A pesticide used for killing or controlling the growth of undesirable plants.

HUC – see Hydrologic Unit Code

Humus layer – the organic layer of the soil formed by the decay of organic matter
Hydrologic Unit Code (HUC) – A standardized watershed coding system adopted for Agency use. The hierarchical system codes watersheds from larger to smaller drainage areas.

IDT – see Interdisciplinary Team

Imazapyr – an herbicide used in Forest Service vegetation management programs, primarily in the Southern United States, to control a variety of grasses, broadleaf weeds, vines, brush, and tree species.

Impacts - See "effects"

Indirect effects - Environmental consequences that are caused by the proposed action and are later in time or further removed in distance.

Interdisciplinary Team (IDT) - a group of individuals representing areas of knowledge and determining the environmental effects of a proposed action. The basic working group for the NEPA process.

Intermittent stream - A stream which flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas.

Intolerant (shade intolerant) – A plant requiring sunlight and exposure for establishment and growth.

Irretrievable effects - Applies to losses of production, harvest or commitment of renewable natural resources.

Irreversible effects - Applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Issue - A point, matter, or question of public discussion or interest to be addressed or decided through the planning process. In the EA/EIS process, may result in the development of a new alternative.

Keetch-Byram drought index (KBDI) – a continuous reference scale for estimating the dryness of the soil and duff layers. The index increases for each day without rain (the amount of increase depends on the daily high temperature) and decreases when it rains. The scale ranges from 0 (no moisture deficit) to 800.

Land and Resource Management Plan (LRMP) - A plan developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended, that guides all natural resource management activities and establishes management standards and guidelines for the National Forest Systems lands of a given National Forest.

Landing – A cleared area in the forest to which logs are yarded or skidded for loading onto trucks for transport.

Landtype - Natural portions of the landscape resulting from geomorphic and climatic processes with definable characteristics that have predictable soil, hydrologic, engineering, productivity, and other behavior patterns.

Large Woody Debris (LWD) - Logs or pieces of woody material large enough to become lodged or imbedded in a stream.

Late-successional (late seral) - the stage of forest development at which overstory trees have attained most of expected height growth and have reached ecological maturity. Small gaps become more common as some trees die allowing full sunlight to reach the mid- and understories. This stage contains the largest trees within a forest and provides the highest capability for large snags, large live cavities, and den tree production. The presence of large, downed, woody material is highest during this period. Old-growth forests occur during the late periods of this seral stage at ages that vary by forest type and in response to a variety of environmental conditions. As used in the Final Environmental Impact Statement and Forest Plan, a stand age of greater than 80 years is generally used to defin this condition. See successional stage.

Late seral – see late successional

Litter - vegetative debris found on the forest floor.

Logging - The felling, skidding, on-site processing, and loading of trees or logs onto trucks.

Logging debris – the unutilized and generally unmarketable accumulation of woody material, such as limbs, tops, and stumps, that remains after timber removal.

LWD - see Large Woody Debris

Management Area (MA) - An area of land with similar management goals and a common management prescription or theme.

Management direction - A statement of multiple-use and other goals and objectives, the associated management prescriptions, and standards and guidelines for attaining them.

Management Indicator Species (MIS) - A plant or animal species adapted to a particular kind of environment. Its presence is sufficient indication that specific habitat conditions are also present.

Management prescription - Management practices and intensity selected and scheduled for application on a specific area to attain multiple-use and other goals and objectives.

Manual treatment – methods of treatment that use hand tools, such as hand saws, chain saws, backpack sprayers, etc.
Mass wasting – the fall or slide of a hill slope which results in the rapid or slow en masse movement of soil, organic debris, and rock down a slope

Mast – the fruit of trees considered as food for livestock and certain kinds of wildlife —note Hard mast is the fruits or nuts of trees such as oak, beech, walnut, chinquapin, and hickories; soft mast includes the fruits and berries from plants such as dogwood, viburnum, elderberry, huckleberry, hawthorn, grape, raspberry, and blackberry

Mast tree - Generally hardwood trees of the heavy seeded variety including oaks, hickories, walnut, beech—25 years and older capable of producing frequent seed crops to feed a variety of wildlife species.

Mechanical treatment – methods of treatment that use machinery, such as feller-bunchers, skidders, tractors, etc.

Merchantable volume – that portion of a tree or stand volume that can be economically turned into products such as lumber, pulp, plywood, etc.

Mesic – Sites or habitats characterized by intermediate moisture conditions, i.e., neither decidedly wet or dry.

Mid-successional (mid-seral) - the stage of forest development during which distinct overstory, midstory, and understory canopies are developed. As used in this EIS and Forest Plan, a stand of 11 to 40 years is generally used to define this condition. See successional stage.

Mineral soil - Weathered rock materials without any vegetative cover.

MIS - see Management Indicator Species

Mitigation - Actions to avoid, minimize, reduce, eliminate, or rectify the impact of a management practice.

Mixed mesophytic – forests that occur on lower north-and east-facing slopes and mesic coves, typically having high tree and other plant species diversity (synonym – mesic hardwood, similar to cove forest)

Monitoring - The periodic evaluation on a sample basis of Forest Plan management practices to determine how well objectives have been met and how closely management standards have been applied.

National Environmental Policy Act (NEPA) - An Act to declare a National policy which will encourage productive and enjoyable harmony between man and his environment, to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man, to enrich the understanding of the ecological systems and natural resources important to the Nation and to establish a Council on Environmental Quality.

National Forest Management Act (NFMA) - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning act requiring the preparation of Regional Guides and Forest Plans and the preparation of regulations to guide that development.

National Register of Historic Places (NRHP) - A listing (maintained by the U.S. National Park Service) of areas that have been designated as being of historical significance. The Register includes places of local and state significance as well as those of value to the Nation.

Natural regeneration - An age class created from natural seeding, sprouting, suckering, or layering.

Natural channel – a watercourse created by the erosive forces of water moving over land. Drainage ditches are not considered natural channels.

Natural Range of Variability (NRV) – in the context of this project, the range of vegetation conditions (i.e. species composition, structure, etc.) that a forest or woodland can produce and sustain over time assuming that natural processes (including disturbance) are able to function. (synonyms – range of natural variability, range of natural variation, natural range of variation)

NEPA - see National Environmental Policy Act

NFMA - see National Forest Management Act

No Action Alternative - In environmental documents, one option for responding to the purpose and need for action. This alternative (usually Alternative 1 in most NEPA documents) is used as the "baseline" to compare the effects of other "action" alternatives. The No-Action Alternative is usually defined as the present or current situation, but including ongoing activities.

Non-native species – An introduced species evolved elsewhere that has been transported and purposefully or accidentally disseminated by humans

Non-Native Invasive Species (NNIS) – a species that is non-native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health

NRHP – see National Register of Historic Places

Objective - A concise, time-specific statement of measurable planned results that respond to pre-established goals. It forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals.

Old growth forests – An ecosystem distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics including tree size, accumulation of large dead woody material, number of canopy layers, species composition, and ecosystem function. Old growth is not necessarily virgin or primeval. It can develop over time following human disturbances, just as it does following natural disturbances. Old growth encompasses older forests dominated by early seral species, and forests in later successional stages dominated by shade tolerant species.

Operable volume – that portion of a forest stand's tree volume that is merchantable and is practicable to harvest.

Organically shaped – shaped with a natural look and a flowing and curving appearance. (synonym - curvilinear shape)

Overstory - That portion of trees in a two- or multi-layered forest stand that provides the upper crown cover.

Particulate matter – inhalable coarse particles that are larger than 2.5 micrometers and smaller than 10 micrometers in diameter

Perennial stream – a stream where flow persists almost throughout the year in a well-defined channel. Any watercourse that generally flows most of the year in a well-defined channel and is below the water table. Droughts and other precipitation patterns may influence the actual duration of flow. It contains fish or aquatic insects that have larvae with multi-year life cycles. Water-dependent vegetation is typically associated with perennial streams.

Phenologic – pertaining to phenology, the study of the time of appearance of characteristic periodic phenomena in the life cycle of organisms in nature, e.g., migration in birds and flowering and leaf-fall in plants, particularly as these phenomena are influenced by environmental factors —note phenology especially involves the effects of temperature or day length

Plantation - A harvested or burned area that has regenerated with natural and/or planted seedlings. Trees are usually the same age and size class.

Potential Natural Vegetation (PNV) – vegetation that would develop if all successional sequences were completed under present site conditions

Pre-commercial thinning - The selective felling, deadening, or removal of tree in a young stand not for immediate financial return, but primarily to accelerate diameter increment on the remaining stems. To maintain a specific stocking or stand density range, or to improve the vigor and quality of the remaining trees.

Prescribed fire – Any fire ignited by management actions to meet specific objectives including disposal of fuels, and controlling unwanted vegetation. The fires are conducted in accordance with prescribed fire plans, and are also designed to stimulate grasses, forbs, shrubs, or trees for range, wildlife, recreation, or timber management purposes.

Present Net Value (PNV) - The difference between the discounted value (benefits) of all outputs to which monetary values or established market prices are assigned and the total discounted costs of managing the planning area.
Primary species – tree species that are the most abundant for a given ecological zone

Primary trout stream - Streams that contain naturally-reproducing populations of brook, rainbow, and/or brown trout.

Project - A work schedule prescribed for a project area to accomplish management prescriptions. An organized effort to achieve an objective identified by location, activities, outputs, effects, time period, and responsibilities for execution.

Project area - area of land that a proposed action affects, or planned activities would occur

Project file - For a NEPA document (EA, EIS), the reports, correspondence, and meeting notes that were part of the planning and evaluation process leading up the selection of an alternative within the range of alternatives presented. Also called "planning record"

Proposed action - In terms of NEPA, the project, activity, or decision that a Federal agency proposes to implement or undertake. This may or may not be the selected alternative in a final decision for an EA or EIS.

Pure stand - A stand composed of essentially a single tree species, conventionally at least 85 percent based on numbers, basal areas, or volumes.

Ranger District - Administrative subdivisions of a National Forest, supervised by a District Ranger who reports to the Forest Supervisor.

Rare community – an association of plant and animal species which occurs only on a very small portion of the overall ecosystem.

Record of Decision (ROD) - A document separate from, but associated with an environmental impact statement that publicly and officially discloses the responsible official's decision on the alternative assessed in the environmental impact statement chosen to implement.

Recreation - Leisure time activity including swimming, picnicking, camping, boating, hiking, hunting, and fishing.

Recreation Opportunity Spectrum (ROS) - Land classification system which categorizes land into six classes, each being defined by its setting and by the probable recreation experiences and activities it affords. The six management areas are: *Urban, rural, roaded natural, semi-primitive motorized, semi-primitive non-motorized, and primitive*.

- _ *Primitive*- Those recreation activities that occur in areas characterized by an essentially unmodified natural environment of fairly large size.

- _ *Roaded Natural*- A classification of the recreation opportunity spectrum that characterizes a predominately natural environment with evidence of moderate resource alteration and utilization. Evidence of the sights and sounds of humans is moderate, but in harmony with the natural environment. Opportunities exist for both social interaction and moderate isolation from signs and sounds of humans.

- _ *Rural* - A recreation opportunity spectrum classification for areas characterized by a substantially modified natural environment. Sights and sounds of humans are evident. Renewable resource modification and utilization practices enhance specific recreation activities or provide soil and vegetative cover protection.

- _ *Semi-primitive Motorized*- A classification of the recreation opportunity spectrum characterized by a predominantly unmodified natural environment in a location that provides good to moderate isolation from sights and sounds of humans except for facilities/travel routes sufficient to support motorized recreational travel opportunities which present at least moderate challenge, risk, and a high degree of skill testing.

- _ *Semi-primitive Non-motorized* - A classification of the recreation opportunity spectrum characterized by a predominantly unmodified natural environment of a size and location that provides a good to moderate opportunity for isolation from sights and sounds of humans. The area is large enough to permit overnight foot travel within the area, and presents opportunity for interaction with the natural environment with moderate challenge, risk, and use of a high degree of outdoor skills.

Reforestation – The re-establishment of forest cover by seeding, planting, or natural means.

Regeneration - 1. The act of renewing a stand by establishing young trees naturally or artificially. 2. The young trees themselves.

Release and weeding – A silvicultural treatment designed to free desirable trees from competition with overstory trees, less desirable trees, or grasses and other forms of vegetative growth. It includes release of natural and artificial regeneration.

Reserve trees - Trees, pole-sized or larger, retained after the regeneration period under the clearcutting, seed-tree, shelterwood, or coppice methods.

Resilient – capable of recovering from the damaging effects of disturbance quickly

Resistant – capable of being unaffected or minimally affected by a disturbance agent

Responsible official - The Forest Service employee who has been delegated the authority to carry out a specific planning action.

Revegetation - the reestablishment and development of vegetation
Riparian – Land areas directly influenced by water. They usually have visible vegetative or physical characteristics showing this water influence. Streamside, lake borders, and marshes are typical riparian areas.

Riparian area - Geographically delineated areas, with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystem, floodplains and

wetlands. Riparian areas may be associated with lakes, reservoirs, estuaries, potholes, springs, bogs, wet meadows, and ephemeral, intermittent, or perennial streams.

Riparian corridor - An administrative zone applied to both sides of a stream or alongside a pond, lake, wetland, seep or spring. It is a fixed width by stream type that may fall within or beyond the true riparian area.

River classifications -

(1) *Wild* -- Rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.

(2) *Scenic* -- Rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

Road maintenance – the set of upkeep activities such as grading, brushing, and ditch cleanout to keep an existing road at its designated level of service

Road prism – an area of ground containing the roadway, along with any cut and fill slopes, if present.

Road reconstruction – activity that results in a road improvement (improved level of service) or road realignment of an existing classified (system) road. Work includes, but is not limited to, improving alignment, providing additional turnouts, and improving sight distance that improve the standard to which the road was originally constructed. Also undertaken to increase the capacity of the road or to provide greater traffic safety.

Runoff - The total stream discharge of water from a watershed including surface and subsurface flow, but not groundwater. Usually expressed in acre-feet.

Sapling - A usually young tree that is larger than a seedling, but smaller than a pole. Size varies by region.

Scenic integrity objective - A desired level of excellence based on physical and sociological characteristics of an area. Refers to the degree of acceptable alterations of the characteristic landscape. Objectives include Very High, High, Moderate, and Low.

Scoping (public scoping) - Meetings, conferences, seminars, workshops, tours, written comments, responses to survey questionnaires, and similar activities designed and held to obtain comments from the public about Forest Service planning.
Scoping Process - The public land management activities used to determine the range of actions, alternatives, and impacts to be considered in an Environmental Impact Statement.

Scoured channel - A definable channel of flow where surface water converges with enough energy to remove soil, organic matter, and leaf litter.

Secondary species – tree species that may be common, but that comprise the minority of the proportion of tree species composition for a given ecological zone

Secondary trout streams - Streams that do not contain naturally-reproducing trout populations, but will sustain trout throughout the year. Populations must be maintained by stocking.

Sediment - Any material transported, suspended, or deposited by water.

Sediment Delivery - Eroded soil that reaches a stream course.

Sedimentation - process of material being transported, suspended, or deposited by water.

Seed tree - the cutting of all trees except for a small number of widely dispersed trees retained for seed production and to produce a new age class in fully exposed microenvironment —*note* seed trees are usually removed after regeneration is established

Senescence – the life phase of an organism or a part of the organism that precedes natural death, usually involving a decreased ability to repair damage and degradation

Sensitive Species - Those species identified by the Regional Forester for which population viability is a concern. A Biological Evaluation (BE) document assesses project impacts on Sensitive species.

Serotinous – pertaining to fruit or cones that remain on a tree without opening for one or more years —note in some species (e.g., table mountain pine) cones open and seeds are shed when heat is provided by fires or hot and dry conditions

Shade intolerant – see intolerant

Shade tolerant – see tolerant

Shelterwood - A regeneration method of regenerating an even-aged stand in which a new age class develops beneath the partially shaped microenvironment provided by the residual trees. The sequence of treatments can include three distinct types of cuttings: (1) an optional preparatory harvest to enhance conditions for seed production; (2) an establishment harvest to prepare the Seed bed, and to create a new age class; and 3) a removal harvest to release established regeneration from competition with the overstory.

Shelterwood with reserves - A two-aged regeneration method in which some or all of the shelter trees are retained, well beyond the normal period of retention, to attain goals other than regeneration.

Silviculture system - A management process whereby forests are tended, harvested, and replaced, which results in a forest of distinctive form. Silvicultural systems are classified according to:

1) the harvest method that removes the mature crop and provides for regeneration and

2) the type of forest produced by (1).

Silviculture - the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

Silvics – The study of the life history and general characteristics of forest trees and stands, with particular reference to environmental factors, as a basis for the practice of silviculture.

Silviculture Prescription - a planned series of treatments designed to change current stand structure to one that meets management goals —note the prescription normally considers ecological, economic, and societal constraints

Single-tree selection - A regeneration method of creating new age classes in uneven-aged stands in which individual trees of all size classes are removed uniformly throughout the stand to achieve desired stand structural characteristics.
site - An area in which a plant or stand grows, considered in terms of its environment, particularly as this determines the type and quality of the vegetation the area can carry.

Site preparation - The preparation of the ground surface prior to reforestation. Various treatments are applied as needed to control vegetation that will interfere with the establishment of the new crop of trees or to expose the mineral soil sufficiently for the establishment of the species to be reproduced.

Site potential – the capability of an area to grow vegetation, based on factors such as soil type, climate, and topography.

Site productivity – an expression of an area's natural fertility or capacity to grow vegetation, especially trees (synonym - site quality)

Site quality – see site productivity

Skid trails - A travel way through the woods formed by loggers dragging (skidding) logs from the stump to a log landing without dropping a blade and without purposefully changing the geometric configuration of the ground over which they travel.

Slash - The residue left on the ground after felling, silvicultural operations, or as a result of storm, fire, girdling, or poisoning, all vegetative debris resulting from the purchaser's operations. Slash associated with construction of roads is subject to treatment according to construction specifications, all other is subject to the terms of timber sale contract provision.

Slash disposal – the processing and/or removal of slash to change its characteristics (i.e. – piece size) or spatial arrangement

Snag - A dead or partially dead (more than 50 percent) hardwood or pine tree which is used by many bird species for perching, feeding, or nesting.

Soft mast – the fruit of trees considered as food for livestock and certain kinds of wildlife —soft mast includes the fruits and berries from plants such as dogwood, viburnum, elderberry, huckleberry, hawthorn, grape, raspberry, and blackberry

Soil productivity - The inherent capacity of a soil to support the growth of specified plants, plant communities, or a sequence of plant communities. Soil productivity may be expressed in terms of volume or weight/unit area/year, percent plant cover, or other measures of biomass accumulation.

Southern pine beetle - One of the many species of pine bark beetles that are present in the forest at all times. When environmental and forest conditions become favorable, the beetle populations can increase and cause substantial timber losses over extensive areas in a relatively short period of time.

Species composition – the proportion of each tree species in a stand expressed as a percentage of the total number, basal area, or volume of all tree species in the stand.

Stand - a contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit for management.

Standard - A principle specifying conditions or levels to be achieved.

Stand dynamics – changes in species composition and forest structure of a stand over time, including stand behavior during and after disturbance

Stand initiation – the growth and development of new vegetation following disturbance

Stand replacement fire – fire that kills or top-kills aboveground parts of the dominant vegetation, changing aboveground structure substantially. Over 75% of the aboveground, dominant vegetation is either consumed or dies as a result of the fire. Often creates stand initiation conditions.

Stem injection – a manual treatment method for applying herbicide using a hatchet or lance-type tree injector calibrated to deliver the proper amount of herbicide with each blow to penetrate through the bark into the living cambium tissue at properly spaced intervals.

Stocking - The degree of occupancy of land by growing stock trees, measured by basal area or number of trees per unit area and spacing compared with a minimum standard - which varies by tree size and species or species group - to the occupancy that is required to fully utilize the growth potential of the land.

Stream - A watercourse having a distinct natural bed and banks; a permanent source which provides water at least periodically; and at least periodic or seasonal flows at times when other recognized streams in the same area are flowing.

Stream order – a numeric classification for streams, 1=ephemeral, 2=intermittent, 3 and above=perennial

Streamside Management Zones (SMZ) - Land areas adjacent to natural streams, lakes, ponds, and seeps. These zones are typically designed to reduce, minimize or prevent non-point source pollution from entering a stream system (e.g.: sediment from a road or timber harvesting activity). Specific SMZ buffer widths are defined in the South Carolina Best Management Practice handbook.

Succession – the gradual supplanting of one community of plants by another —note 1. The sequence of communities is called a sere, seral stage, or successional stage

Successional stage (seral stage) - A stage or recognizable condition of a plant community that occurs during its development from bare ground to climax: grass, forb, shrub seedling, pole-sapling, immature, mature, old growth.

Suitable site – a site whose characteristics such as soil, climate, and topography would be favorable for development of the species in question

Surface fire – fire that burns in litter and other live and dead fuels at or near the surface of the ground, mostly by flaming combustion

System road – an existing road managed by the Forest Service that is designated for motorized use having specific management objectives for operational maintenance levels and the protection of resources

Temporary road – an existing or newly constructed road for temporary use to implement project activities that is removed once project work is complete.

Thinning - A cutting made to reduce stand density of trees primarily to improve growth, enhance forest health, or to recover potential mortality.

Threatened Species - A formal designation of the U.S. Fish & Wildlife Service. Those plant or animal species likely to become endangered species throughout all or a significant portion of their range within the near future.

Tiering - Refers to the coverage of general matters in broader Environmental Impact Statements (such as National program or policy statements) with subsequent narrower statements or environmental analyses (such as Regional or Basin-wide program statements or ultimately site-specific statements) incorporating, by reference, the general discussions and concentrating solely on the issues specific to the statement subsequently prepared.

Timber - Wood retaining many of the recognizable characteristics of a tree: round, bark covered, and tapering, but without the limbs and leaves. In wood-industry usage, it may be "standing timber"- that portion of living trees with characteristics of value to the wood-using industry, or cut trees not yet processed beyond removing limbs and tops.

Timber production - The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use. For purposes of forest planning, timber production does not include the production of fuelwood or harvests from unsuitable lands.

Tolerant (shade tolerant) - A tree that is able to grow satisfactorily in the shade of, and in competition with, other trees.

Topography - The configuration of a land surface including its relief, elevation, and the position of its natural and human-made features.

Top-kill – Kills aboveground tissues of plant without killing underground parts from which the plant can produce new stems and leaves

Torching – the burning of the foliage of a single or group of trees from the bottom to the top

Treatment – any activity prescribed for implementing project objectives.

Triclopyr – an herbicide used in Forest Service vegetation management programs primarily for conifer and/or hardwood release, noxious weed control, site preparation, and rights-of-way management. Two forms of triclopyr are used commercially as herbicides: the triethylamine salt (TEA) and the butoxyethyl ester (BEE).

Two-aged – one form of even-aged stand condition, with two distinct age classes of trees separated in age by at least one generation

Understory - Trees and other woody species growing under a relatively continuous cover of branches and foliage formed collectively by the upper portion of adjacent trees and other woody growth.

Understory fire regime – fire regime in which fires are generally not lethal to the dominant vegetation and do not substantially change the structure of the dominant vegetation.
Uneven-aged – a stand with trees of three or more distinct age classes, either intimately mixed or in small groups

Universal soil loss equation - An equation used to estimate soil erosion rates and for the design of water erosion control systems. A = RKLSPC wherein A = average annual soil loss in tons per acre per year; R = rainfall factor; K = soil erodibility factor, L = length of slope; S = percent of slope; P = conservation practice factor; and C = cropping and management factor.

Viewshed - The total landscape seen, or potentially seen from all or a logical part of a travel route, use area, or water body.

Watershed - The total area above a given point on a stream that contributes water to the flow at that point.

Water yield - The amount of runoff of water from an area. Usually described as inches or acre-feet of runoff per acre per year.

Water bars - feature designed to funnel surface water off the road surface. Usually this is a linear ridge of native material that bisects the road at a slight angle, with a shallow ditch on the far side that captures water and funnels it to the downhill side of the road.

Wild and scenic river - A river or section of river designated as such by congressional action under the Wild and Scenic Rivers Act of Oct. 2, 1968, as supplemented and amended, or those sections of a river designated as wild, scenic, or recreational by an act of the legislature of the state or states through which it flows.

Wilderness - All national forest lands included in the National Wilderness Preservation System. An area where the earth and its community of life are untrammeled and only visited by humans.

Wildfire – see wildland fire

Wildland fire - Any non-structural fire on wildlands other than one intentionally set for management purposes. Confined to a predetermined area. Not to be confused with “fire use” which includes prescribed fire. (synonym – wildfire)

Wildland Urban Interface (WUI)– The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

Wildlife - All non-domesticated mammals, birds, reptiles, and amphibians living in a natural environment, including game species and non-game species. Animals, or their progeny (i.e., feral animals - including horses, burros, and hogs), that once were domesticated, but escaped captivity, are not considered wildlife.

Wildlife habitat diversity – see habitat diversity

Woodlands - An open stand of trees with crowns not usually touching (generally forming a 25 to 60 percent cover), characterized by an understory of perennial native grasses and forbs rather than trees. Woodlands commonly contain a mosaic of successional stage habitats, from early to late successional.

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Appendices

Appendix A – Maps

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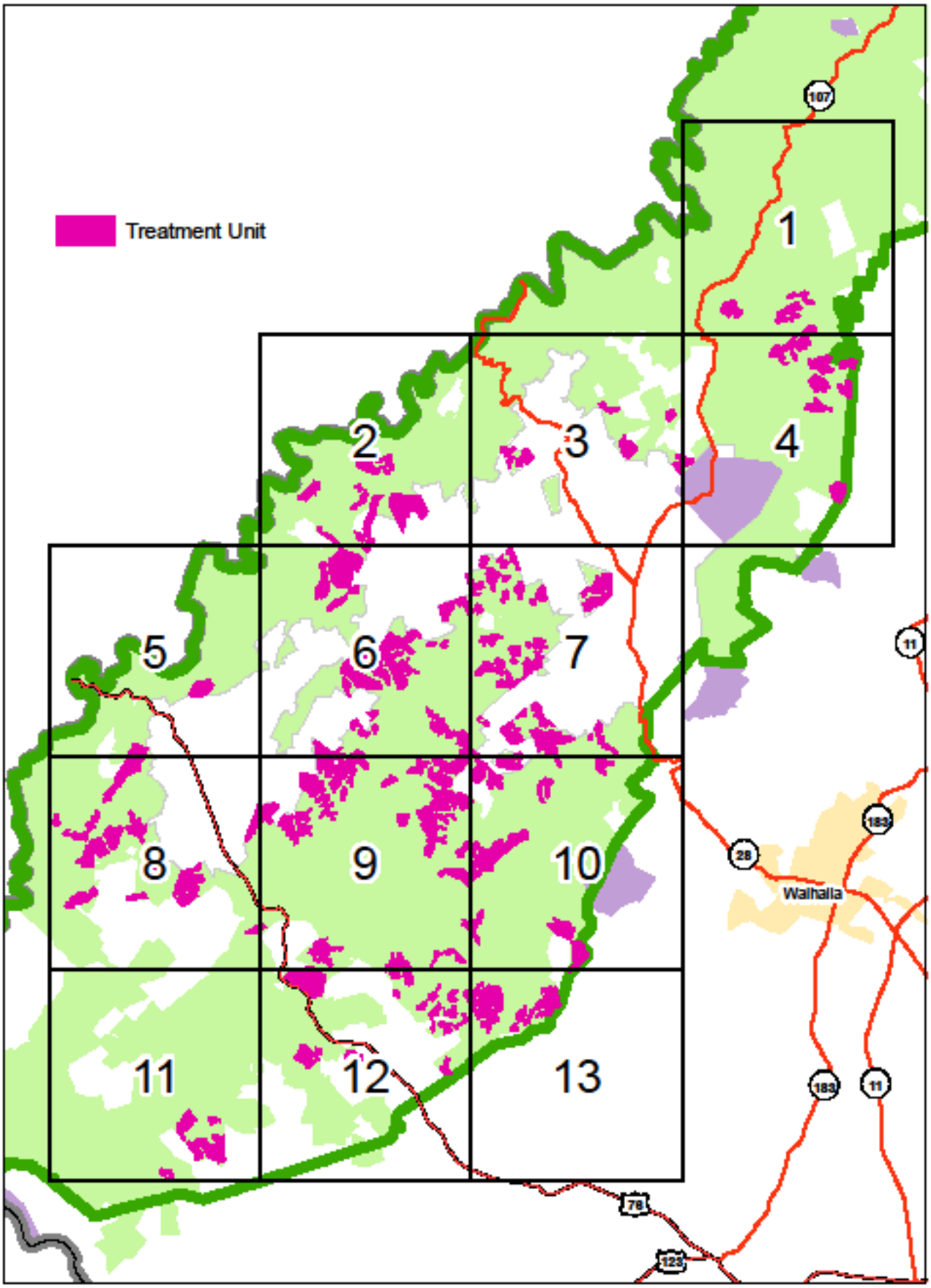
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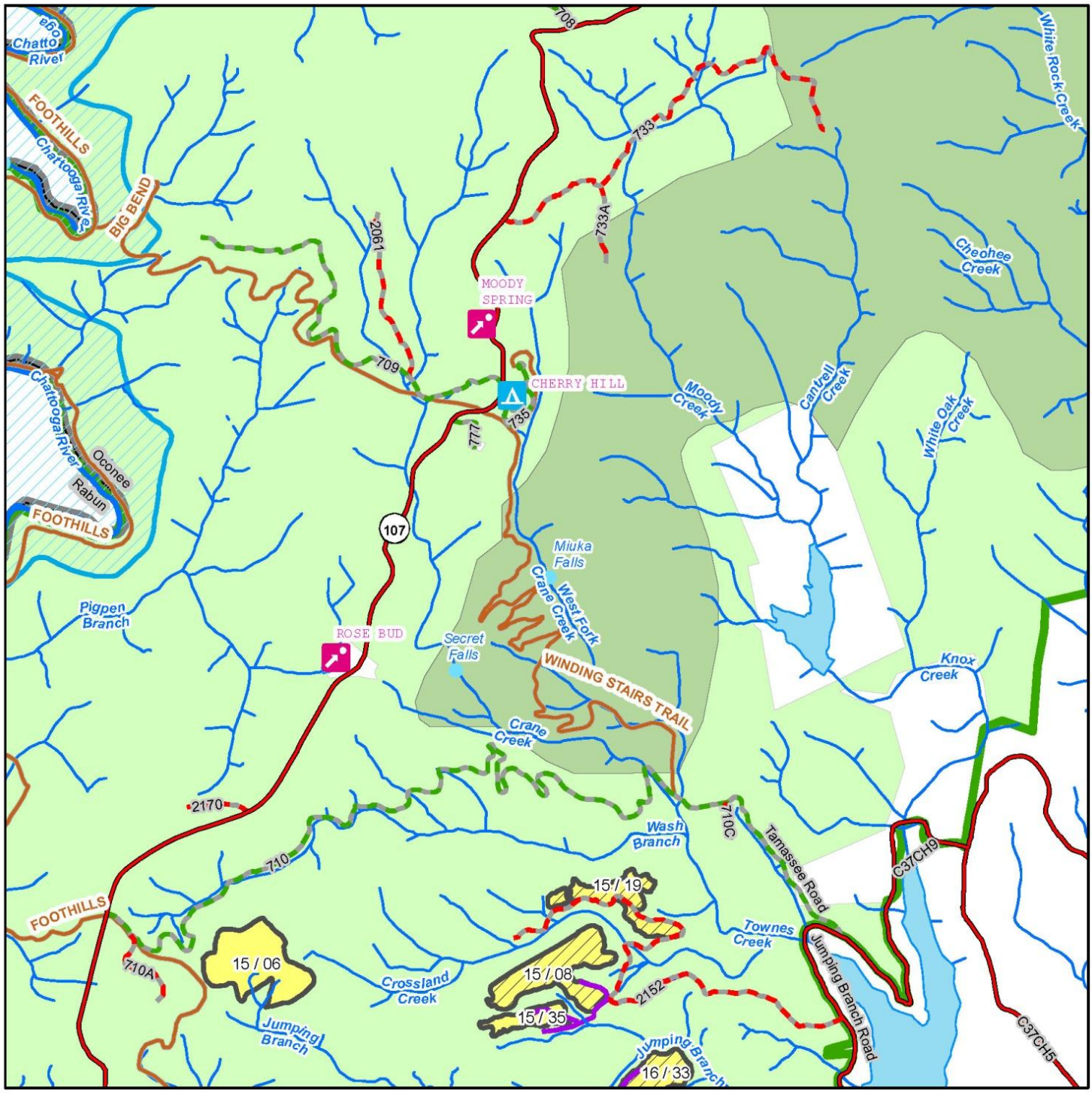
Loblolly Pine Removal Restoration

Alternative 2



New Road Construction
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Woodland Cut & Leave
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Open USFS Road
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Other Public Road
Trail

Wild & Scenic River Corridor
Forest Service
Other Ownership
State Land
Forest Boundary
Scenic Area

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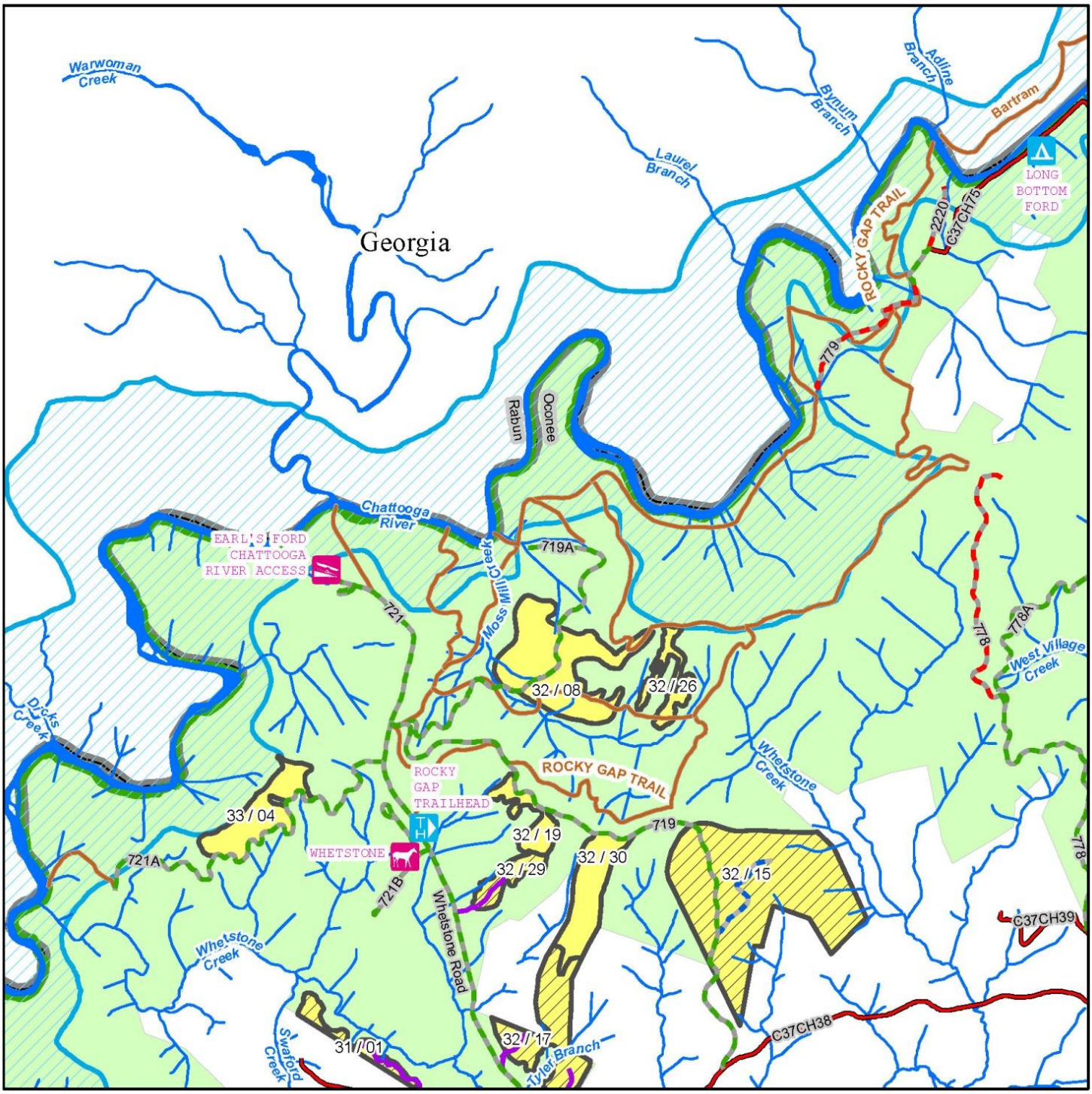

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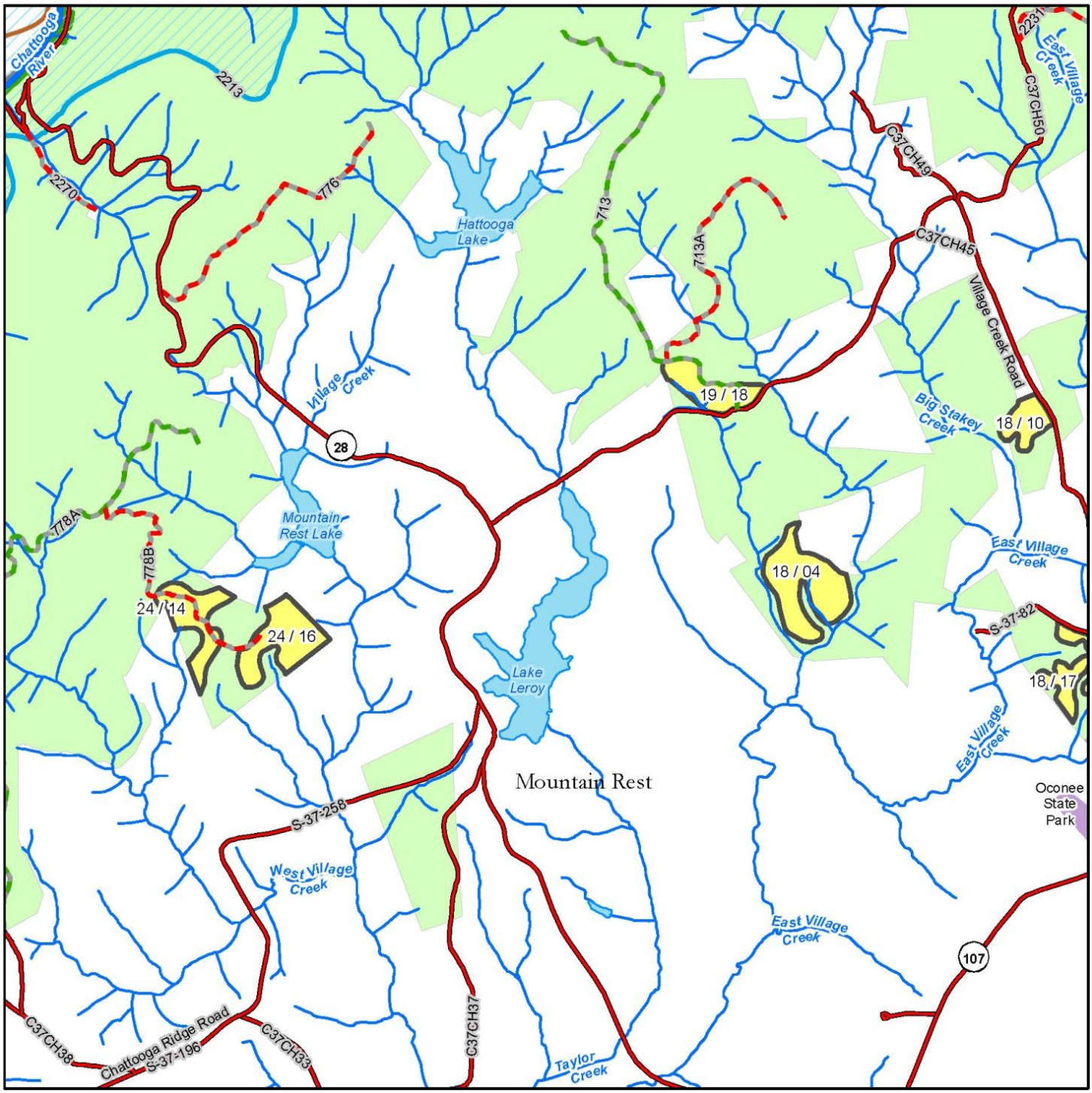

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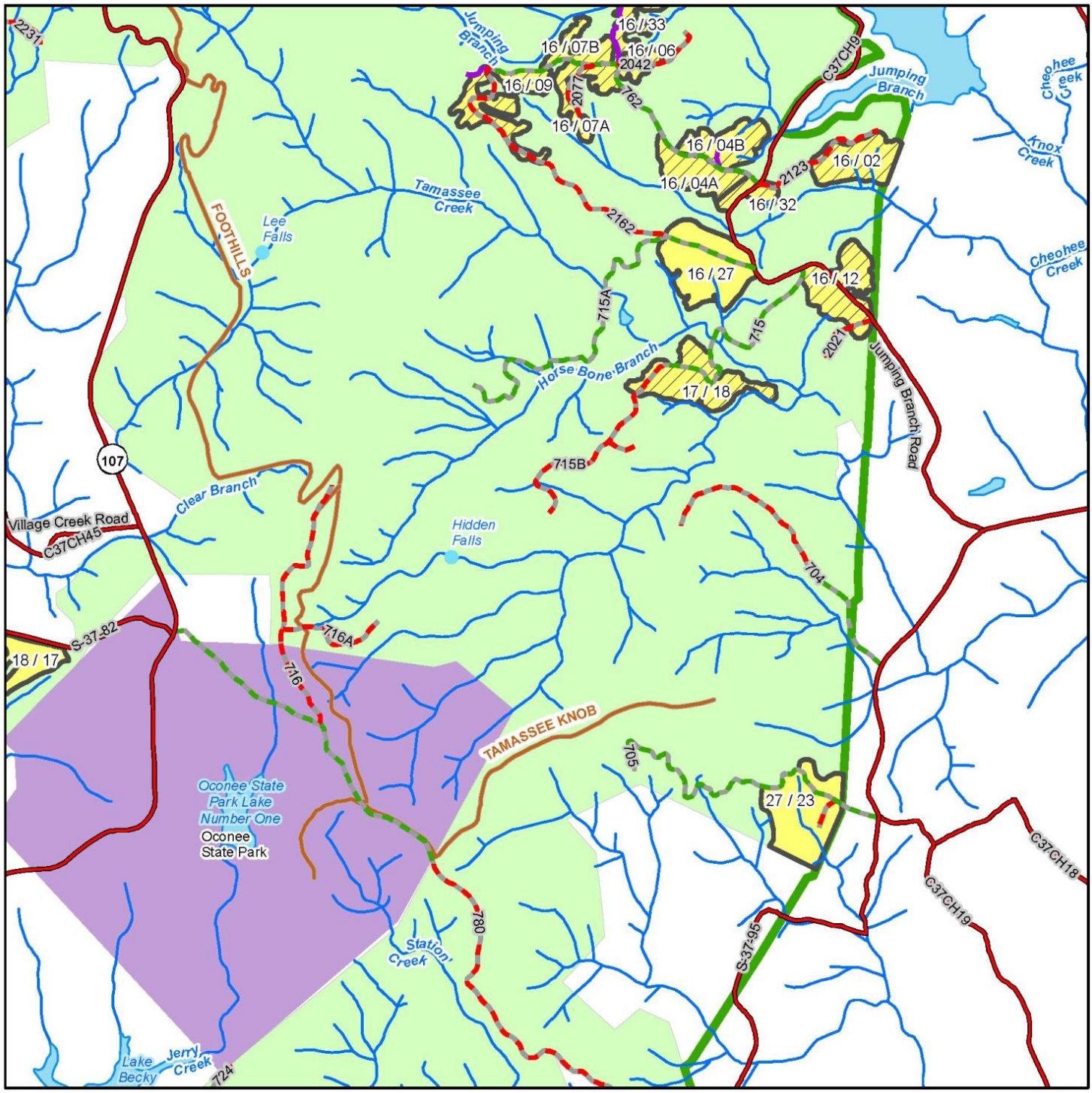

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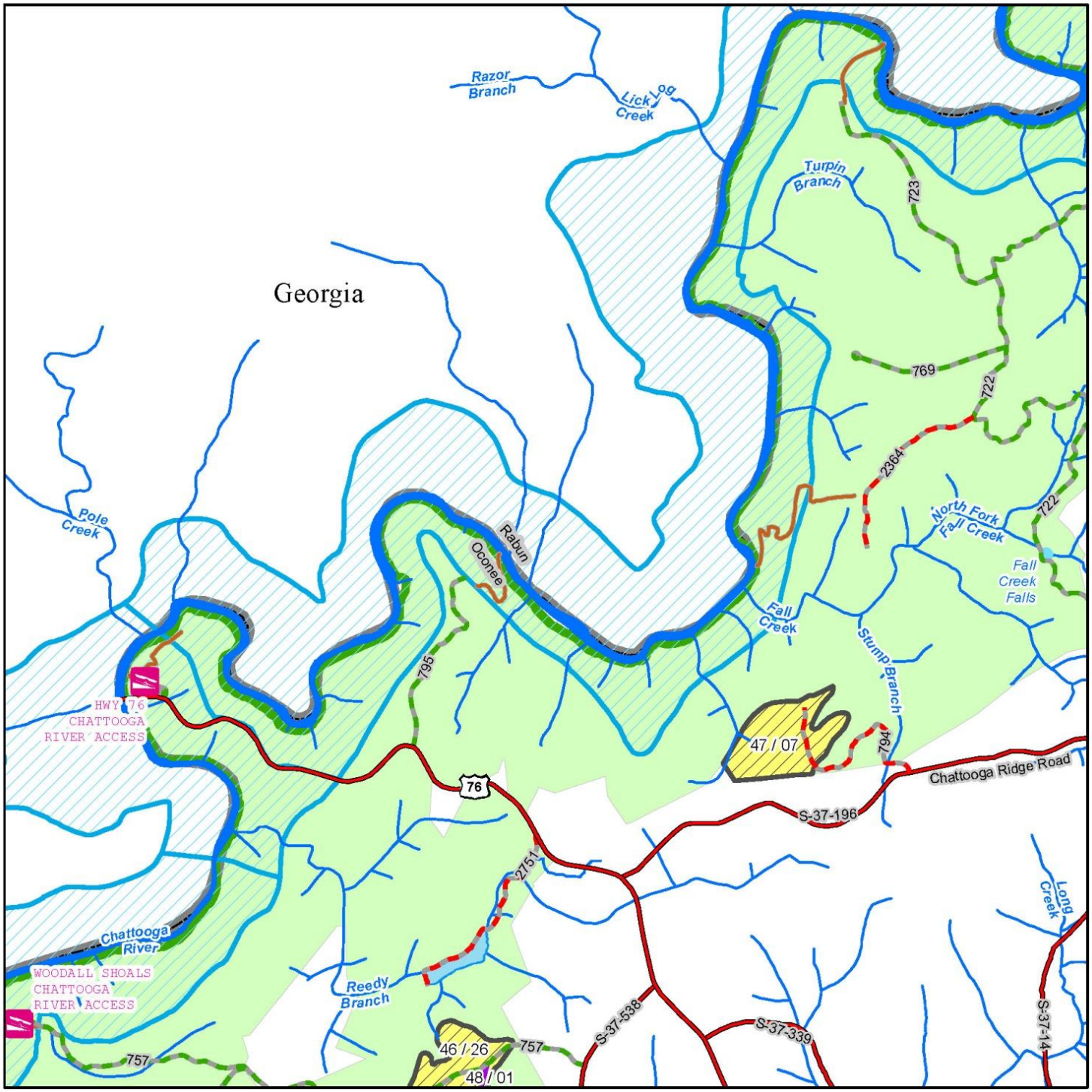

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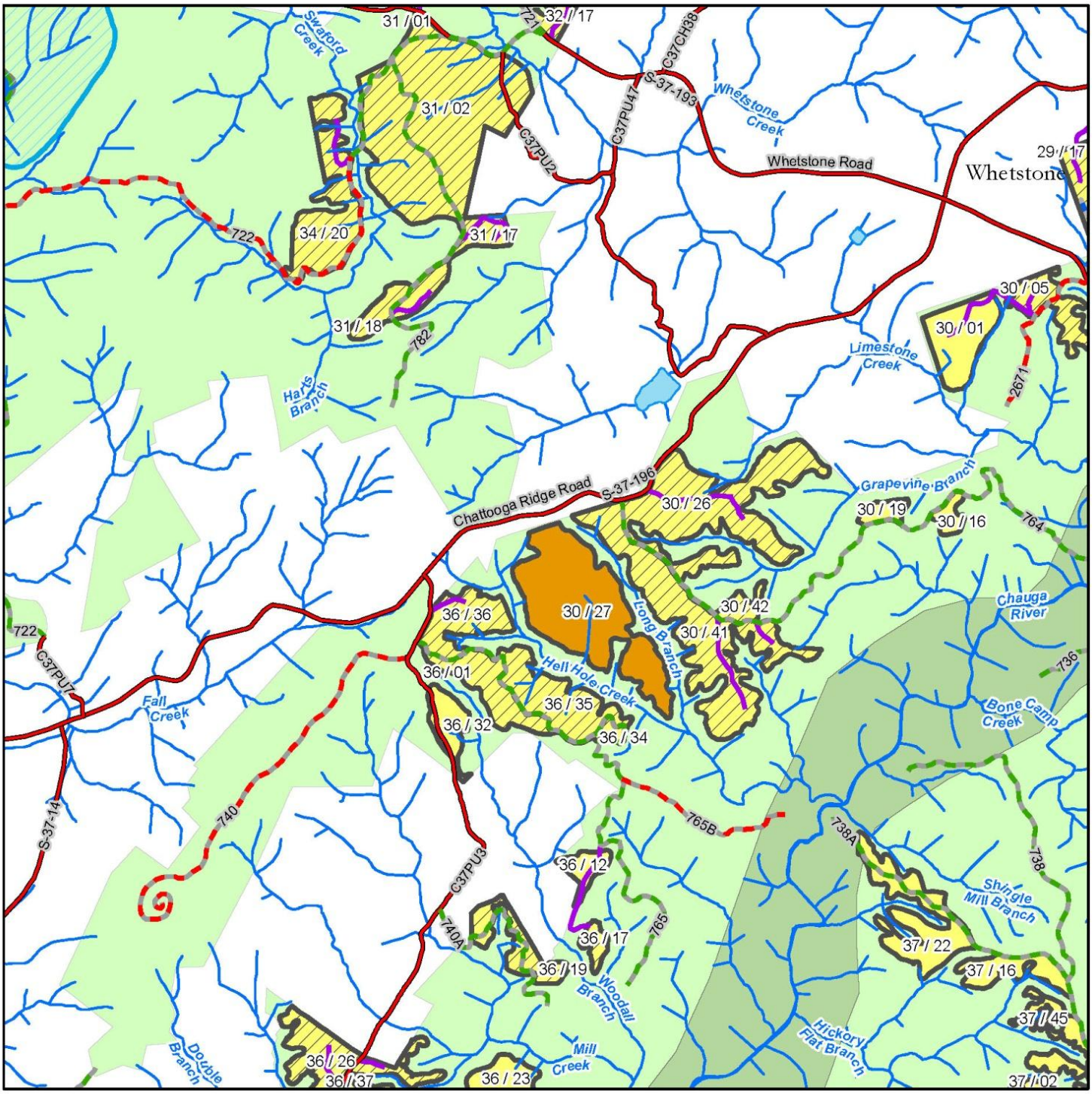

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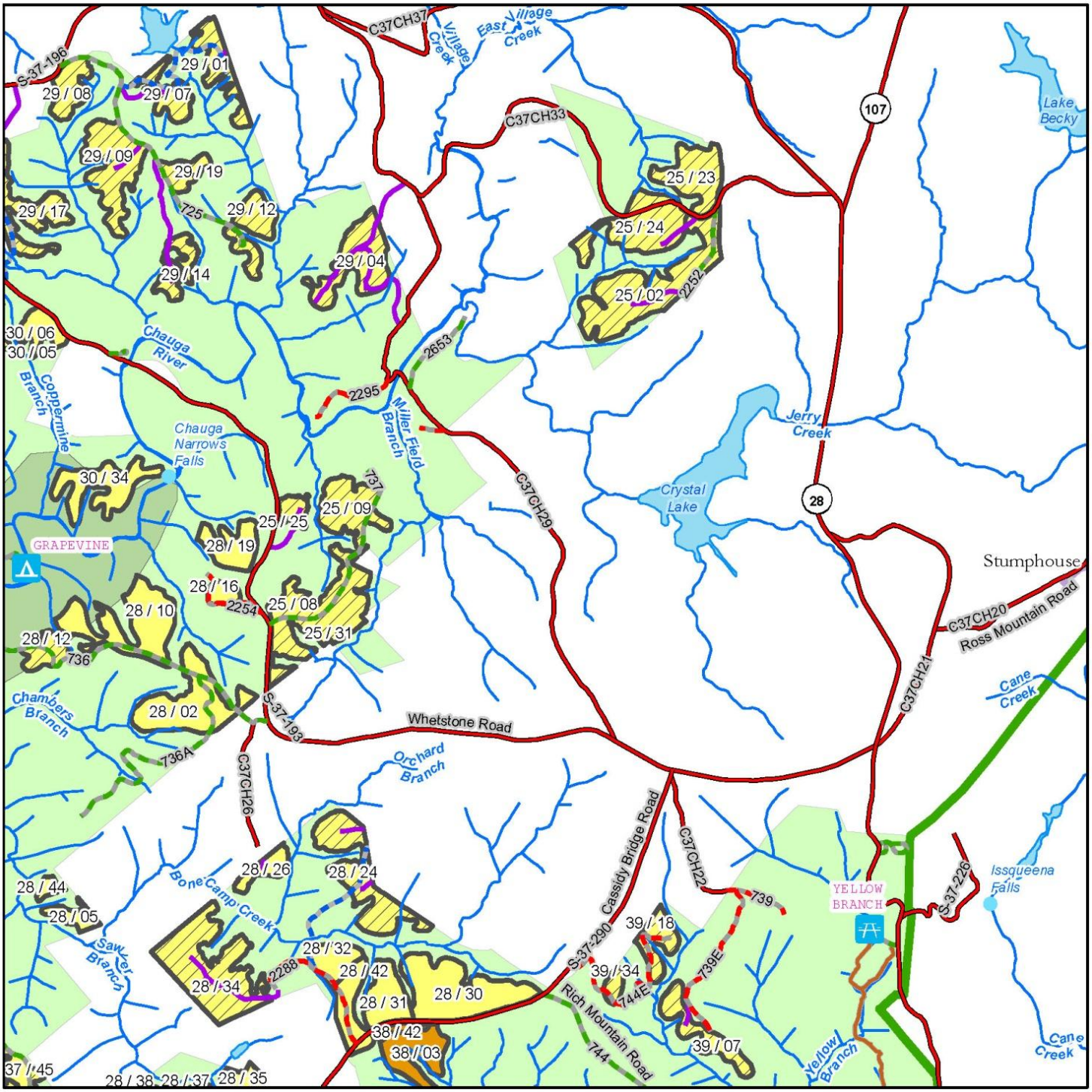

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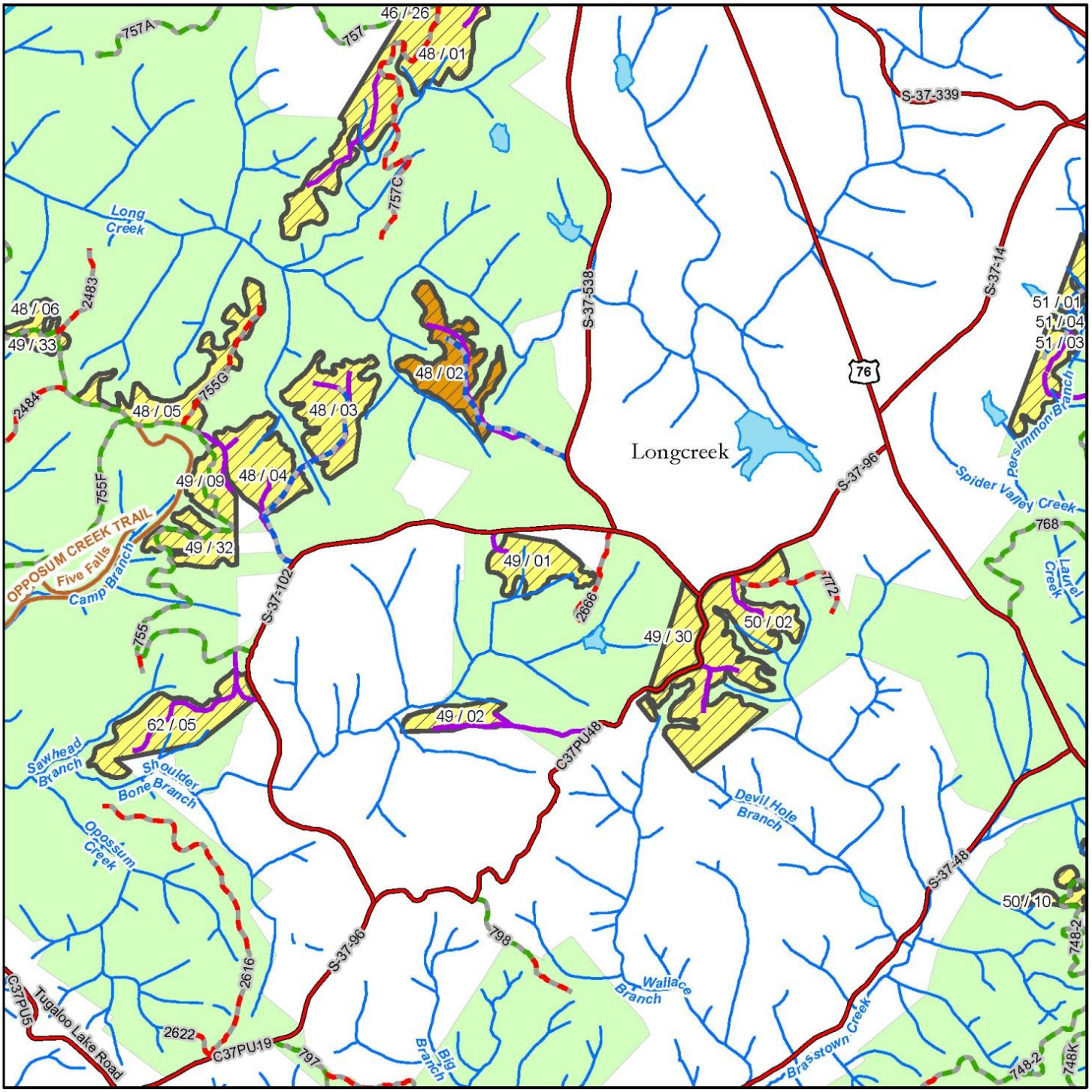

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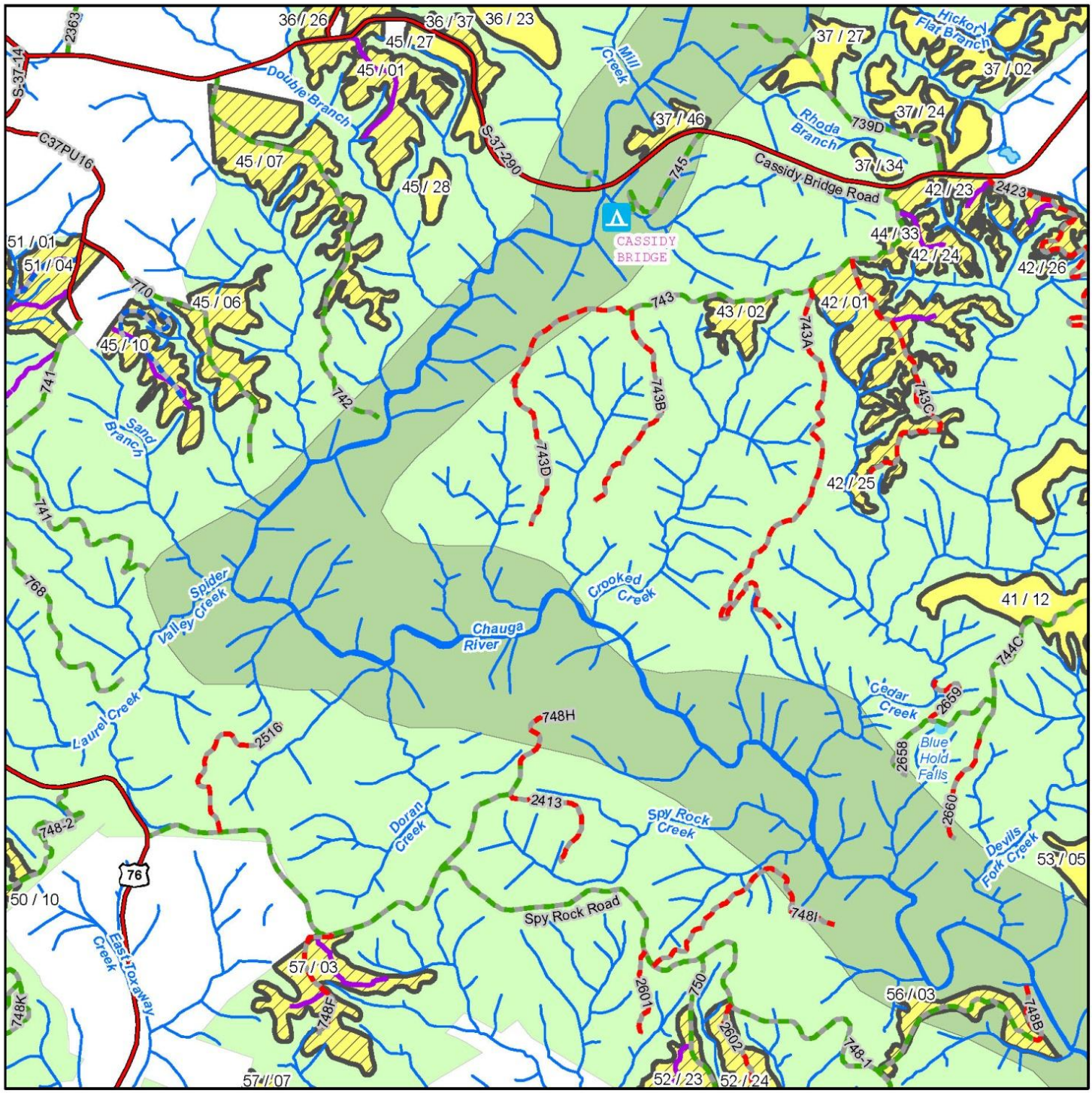
Loblolly Pine Removal Restoration

Alternative 2



New Road Construction
Temporary Road

Treatment
Cut & Leave
Cut & Remove
Woodland Cut & Leave
Woodland Cut & Remove

Open USFS Road
Closed USFS Road
Other Public Road
Trail

Wild & Scenic River Corridor
Forest Service
Other Ownership
State Land
Forest Boundary
Scenic Area

Miles 0 0.25 0.5

N

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Map created: 9/20/2012

Loblolly Pine Removal Restoration

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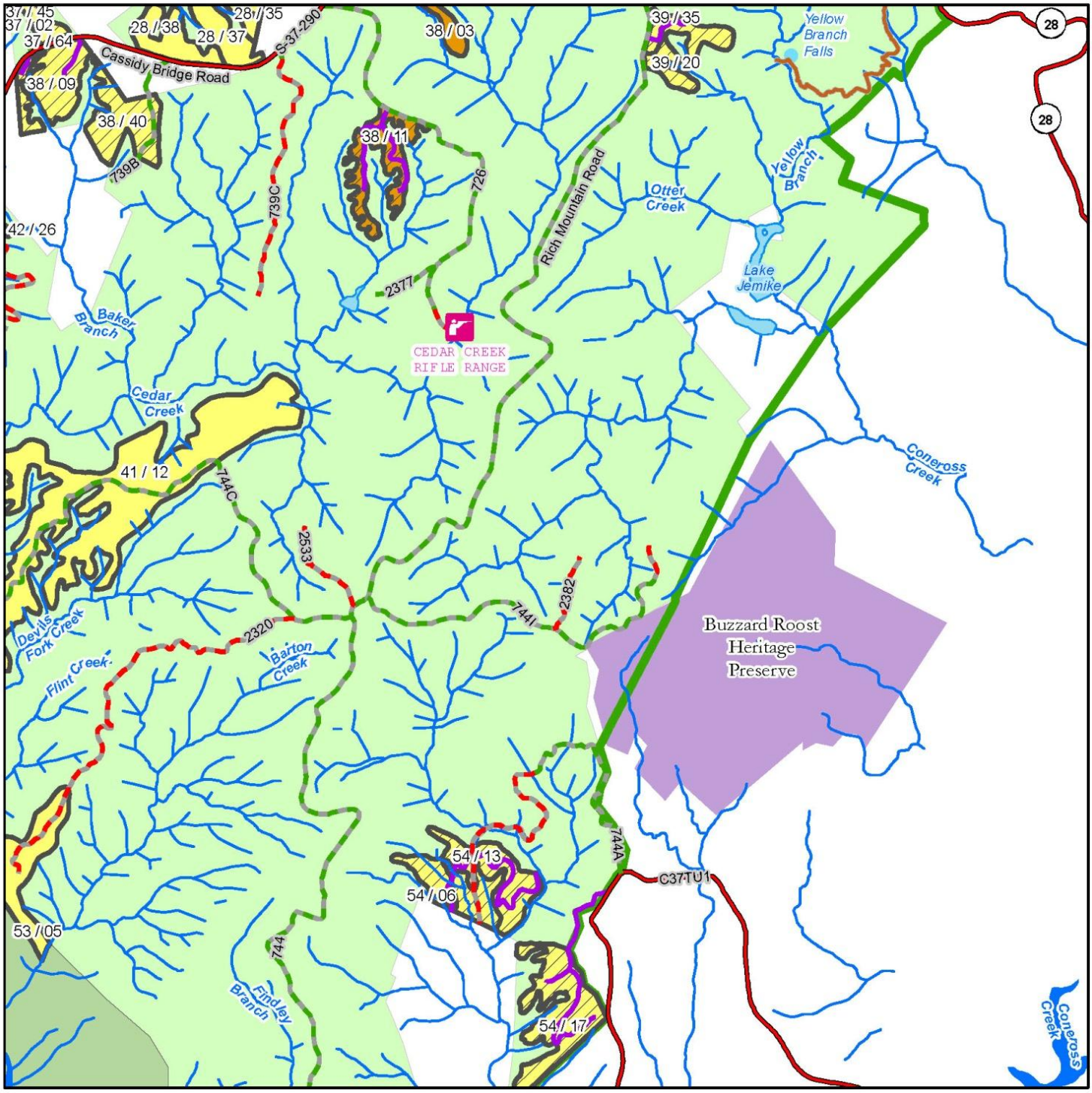

New Road Construction
Temporary Road

Treatment
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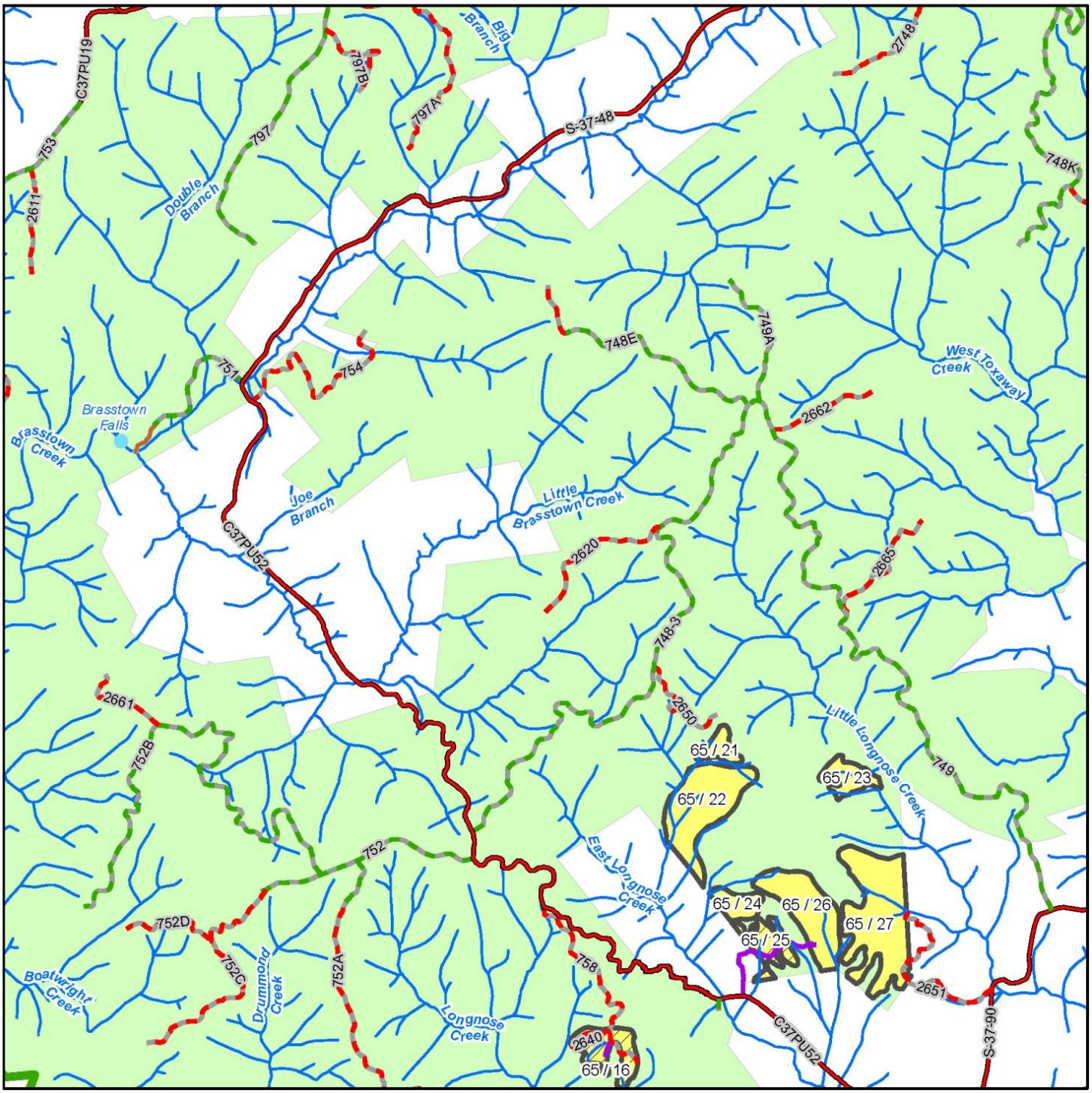

New Road Construction
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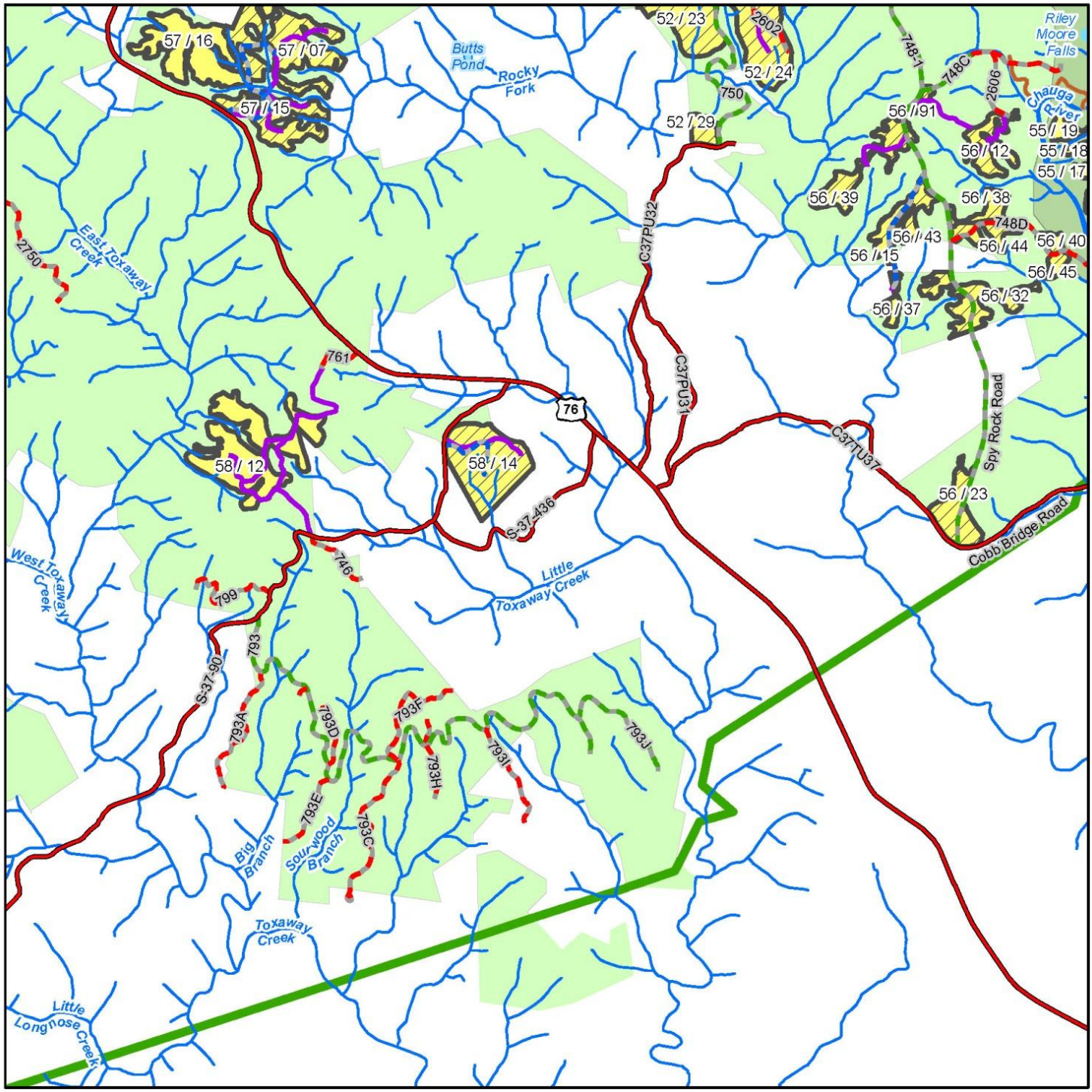

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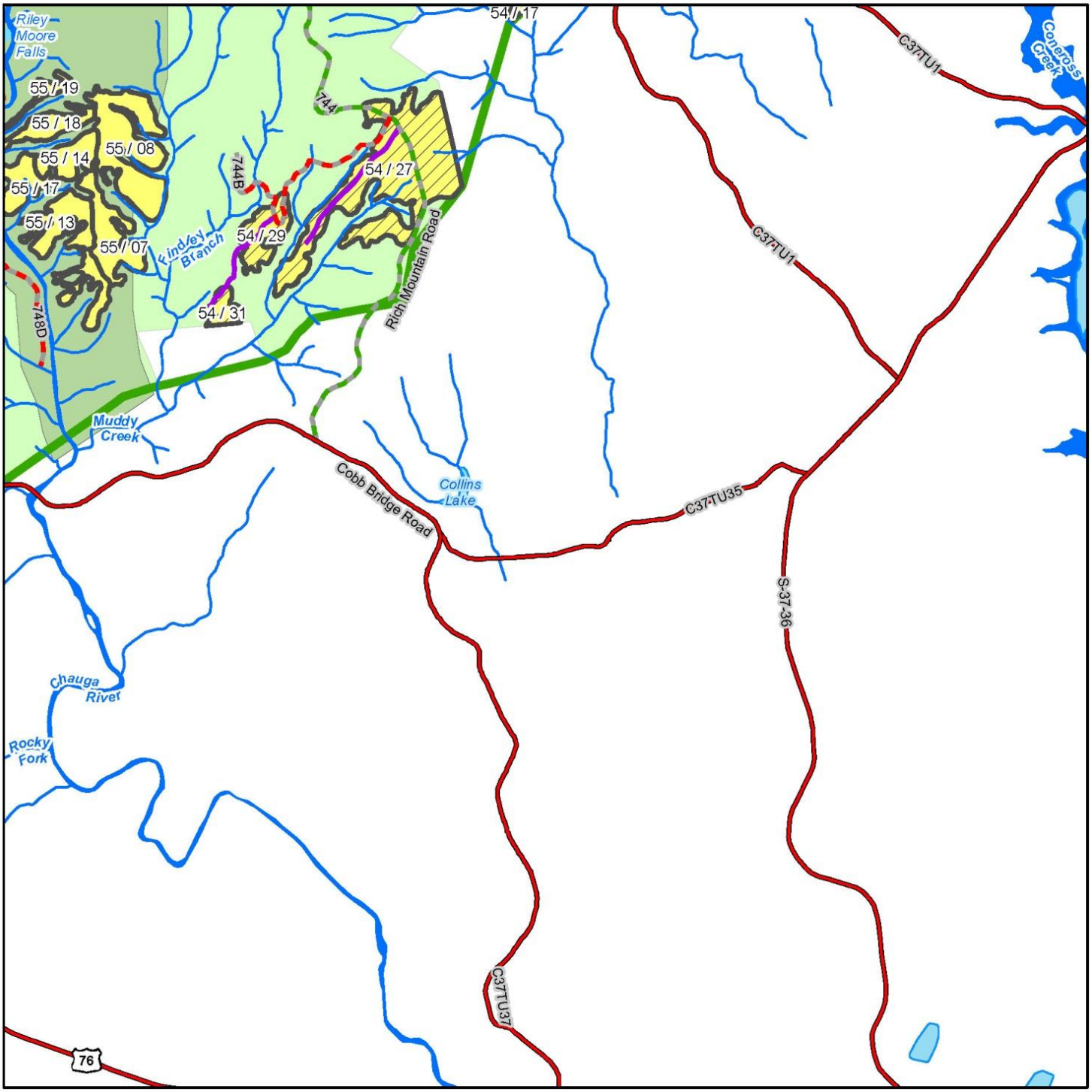

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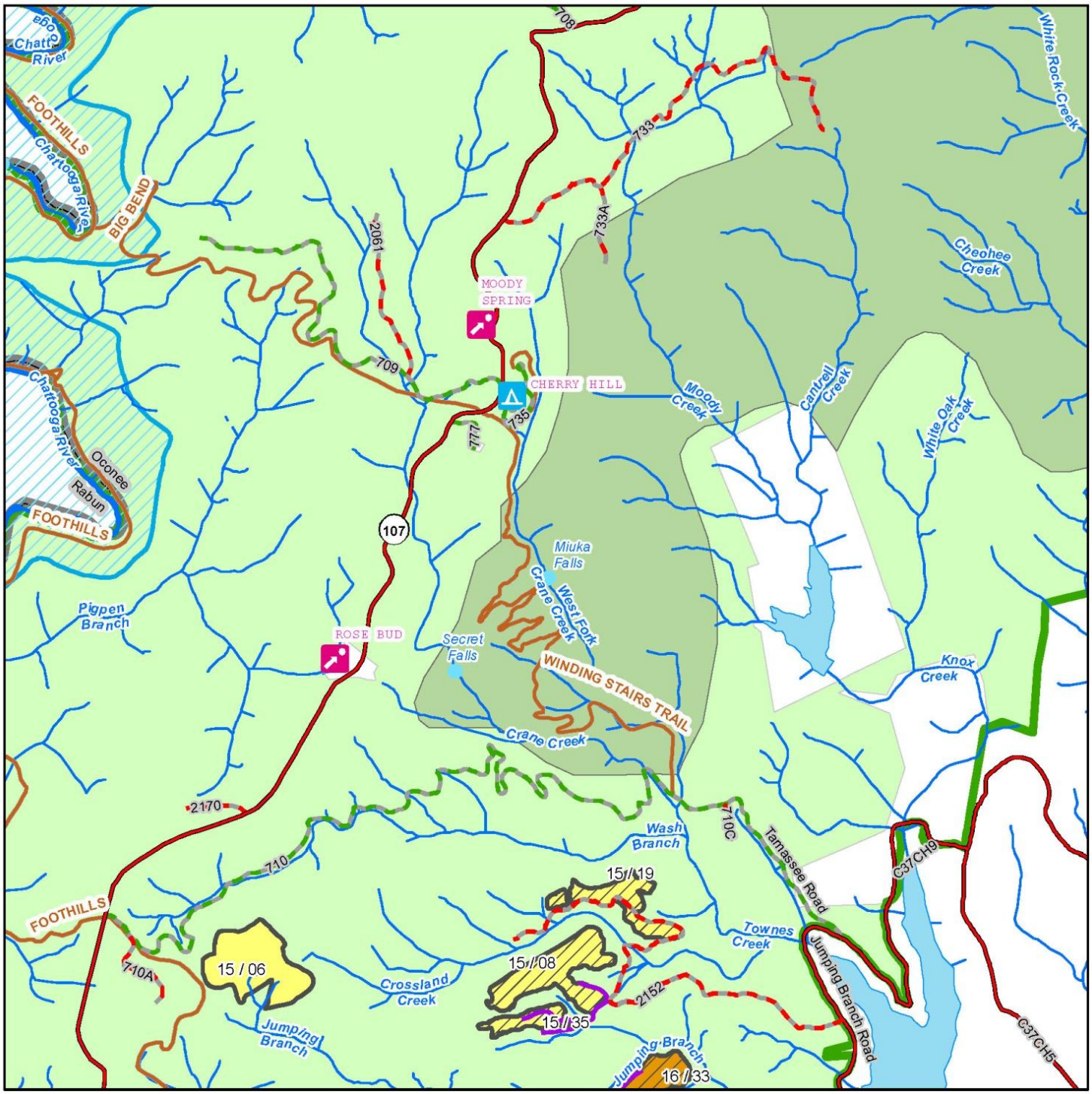

Temporary Road

Treatment

- Cut & Leave
- Cut & Remove
- Woodland Cut & Leave
- Woodland Cut & Remove

- Open USFS Road
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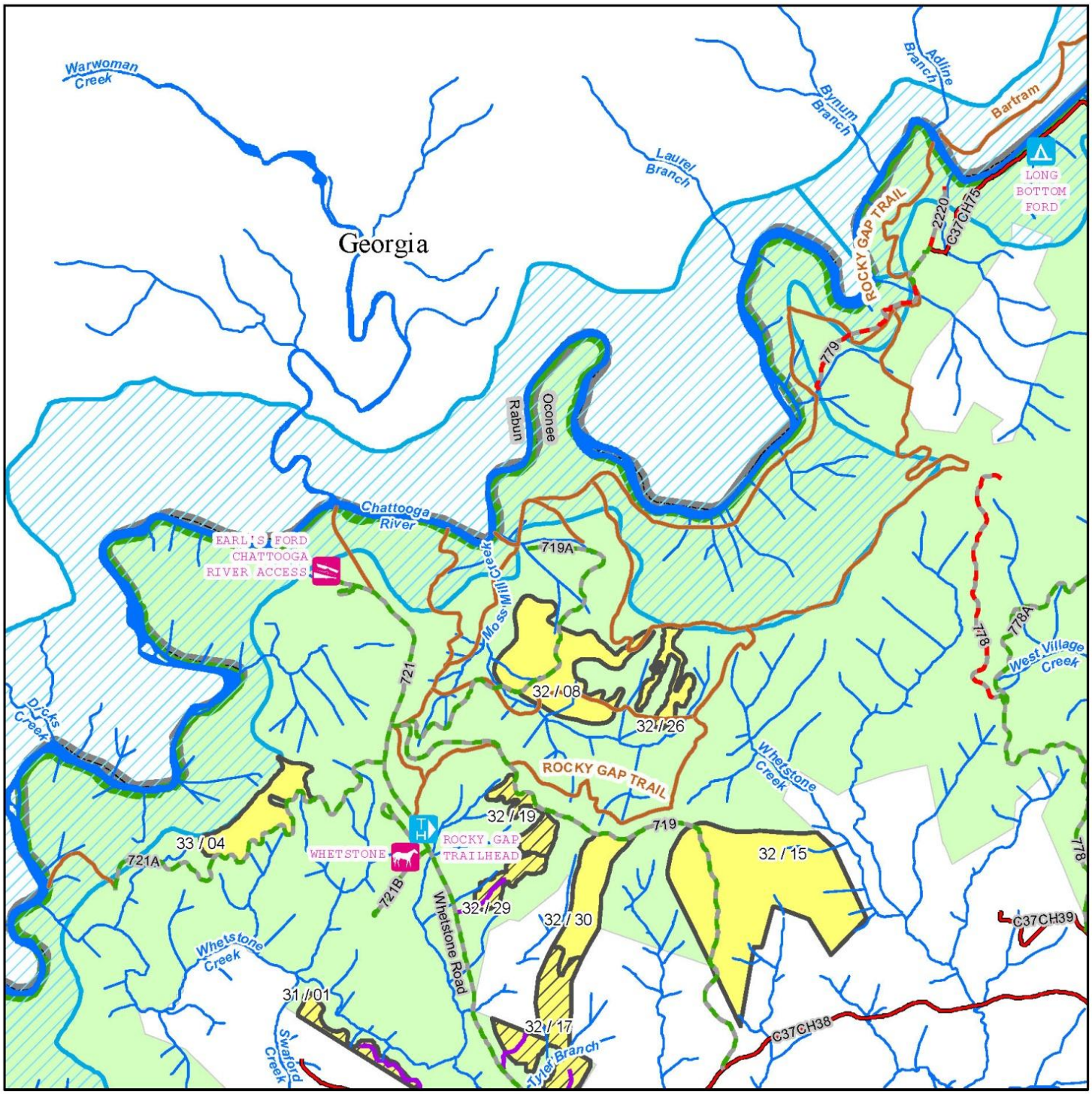

Temporary Road

Treatment

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- Cut & Remove
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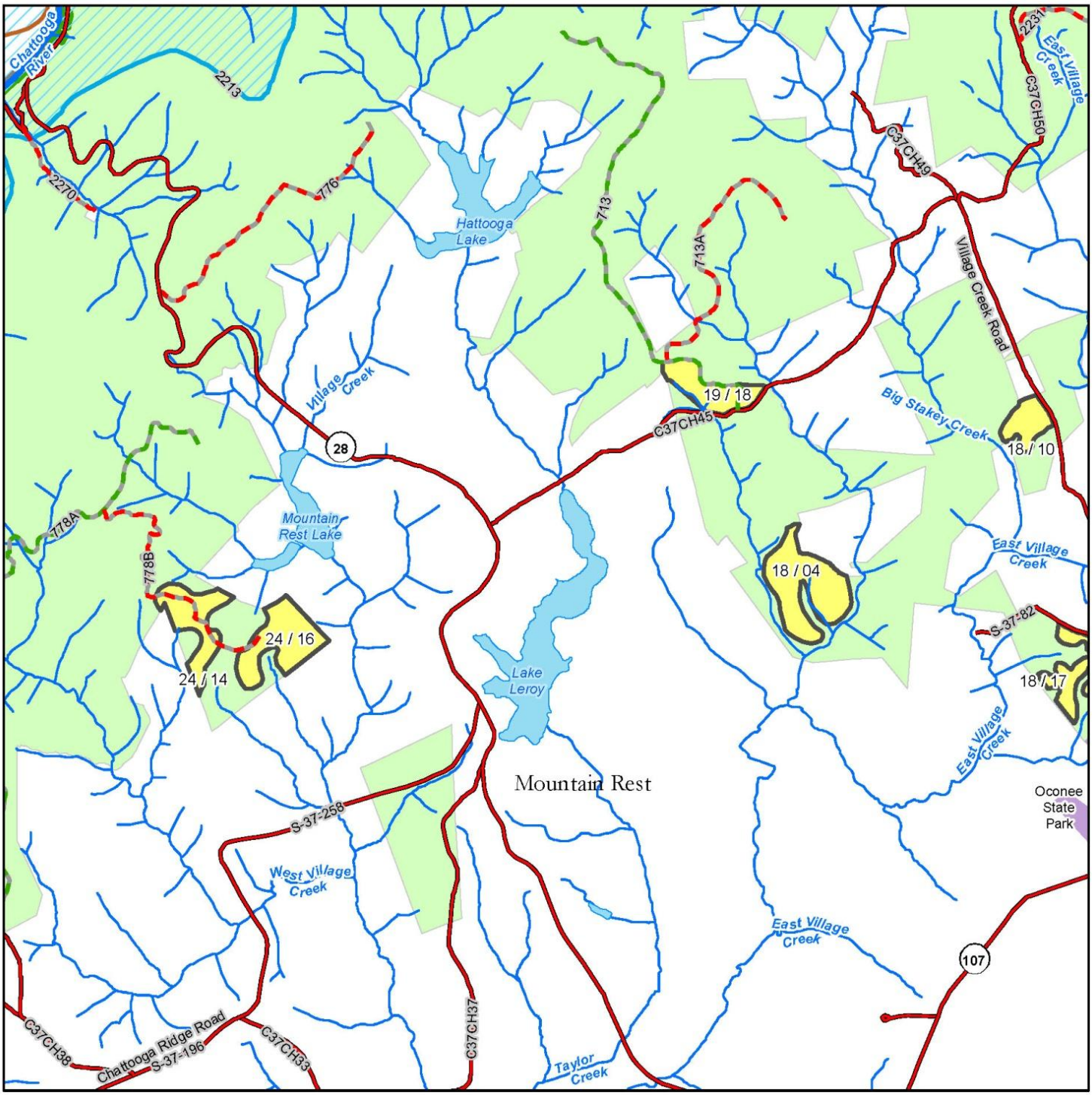

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Treatment

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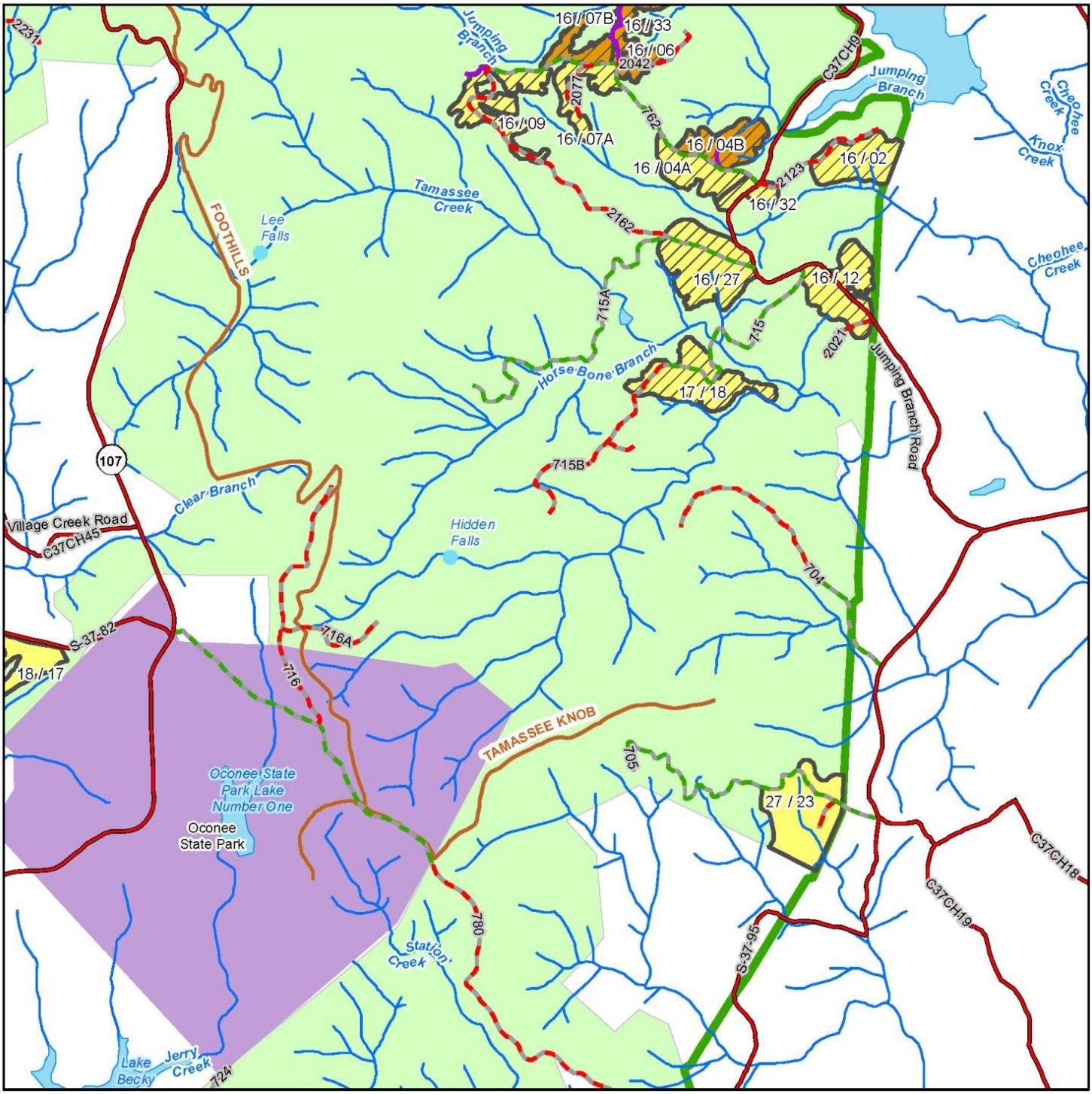

Page 4 of 13

Temporary Road

Treatment

- Cut & Leave
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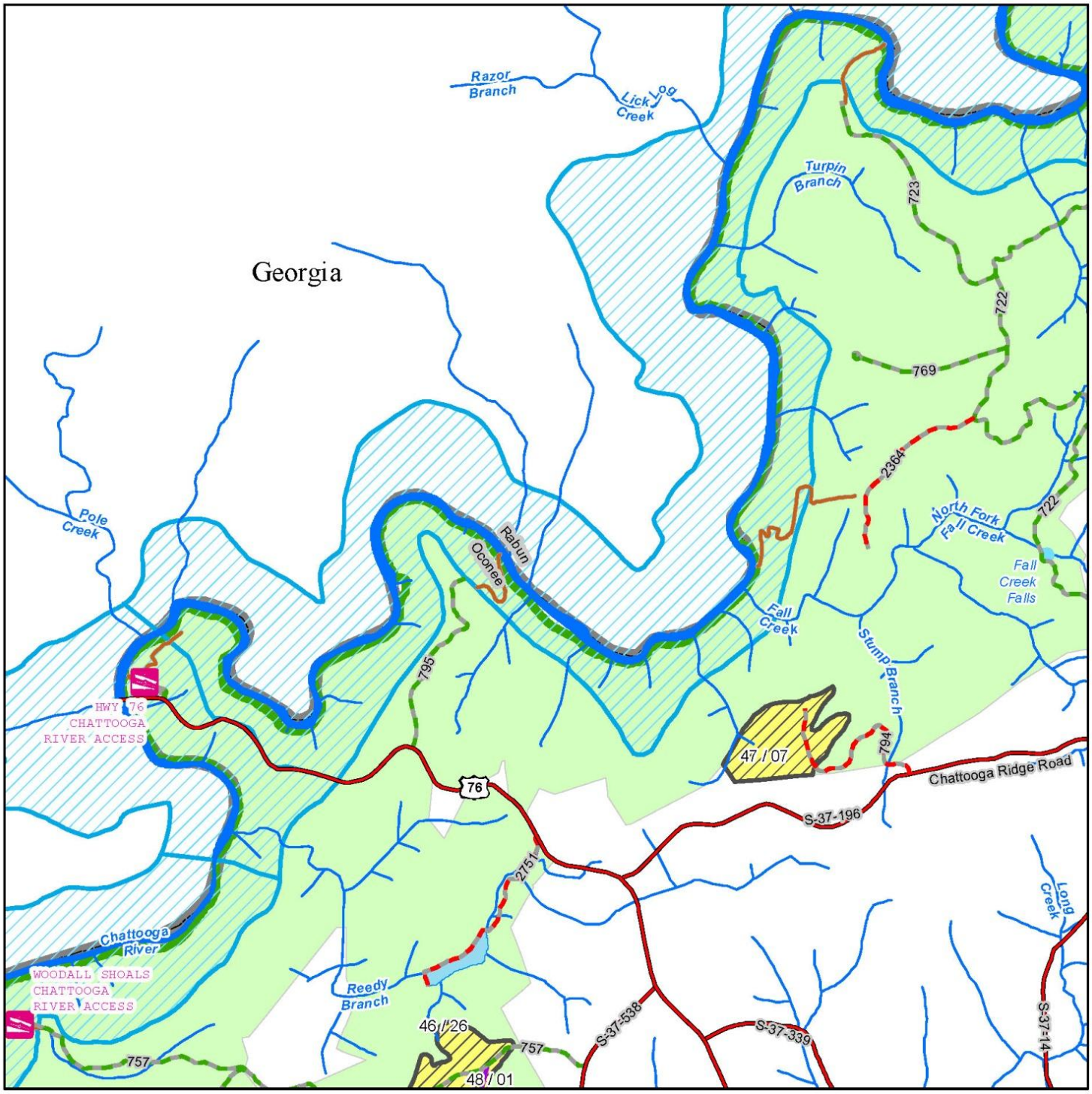

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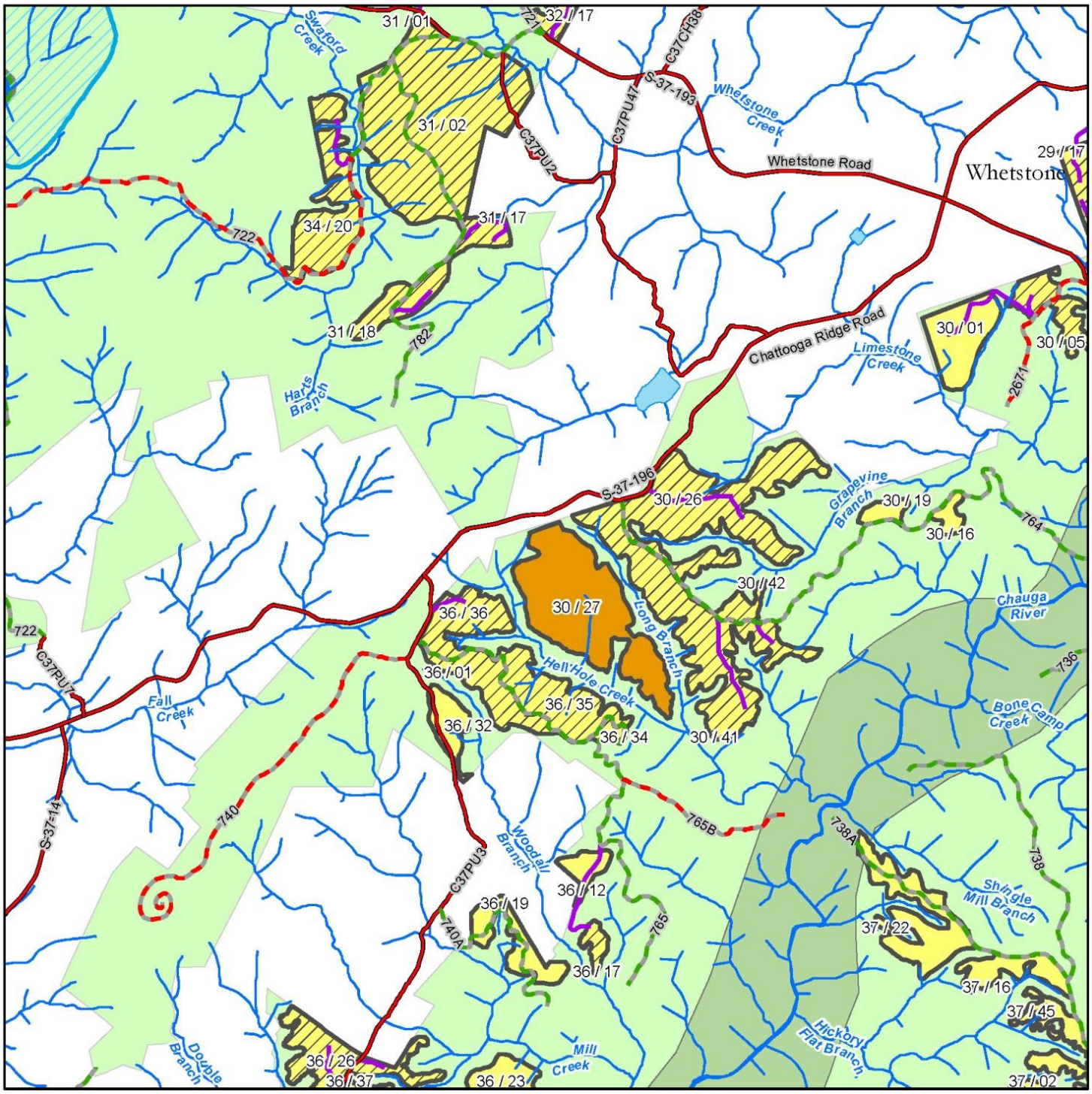

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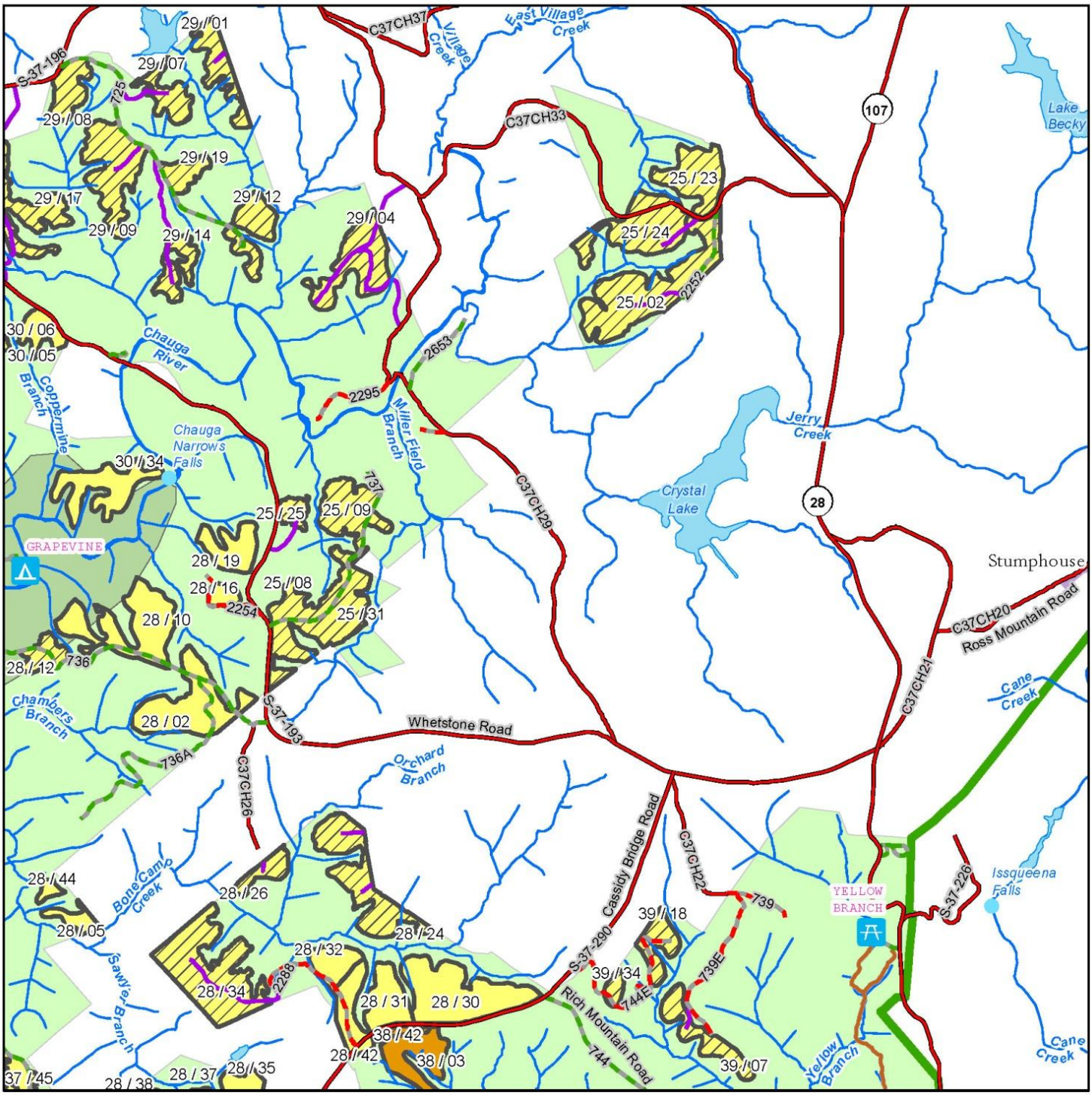

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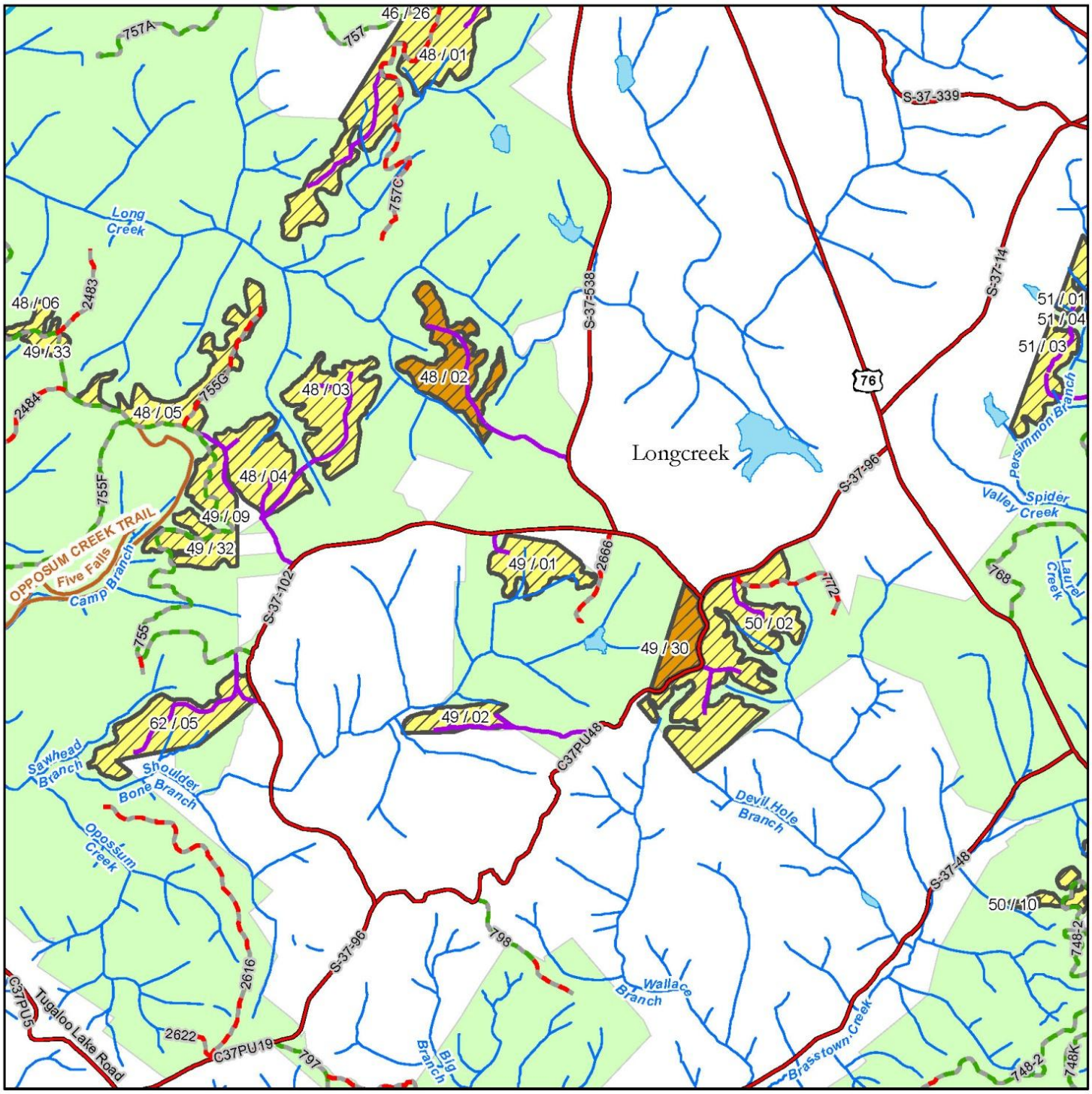

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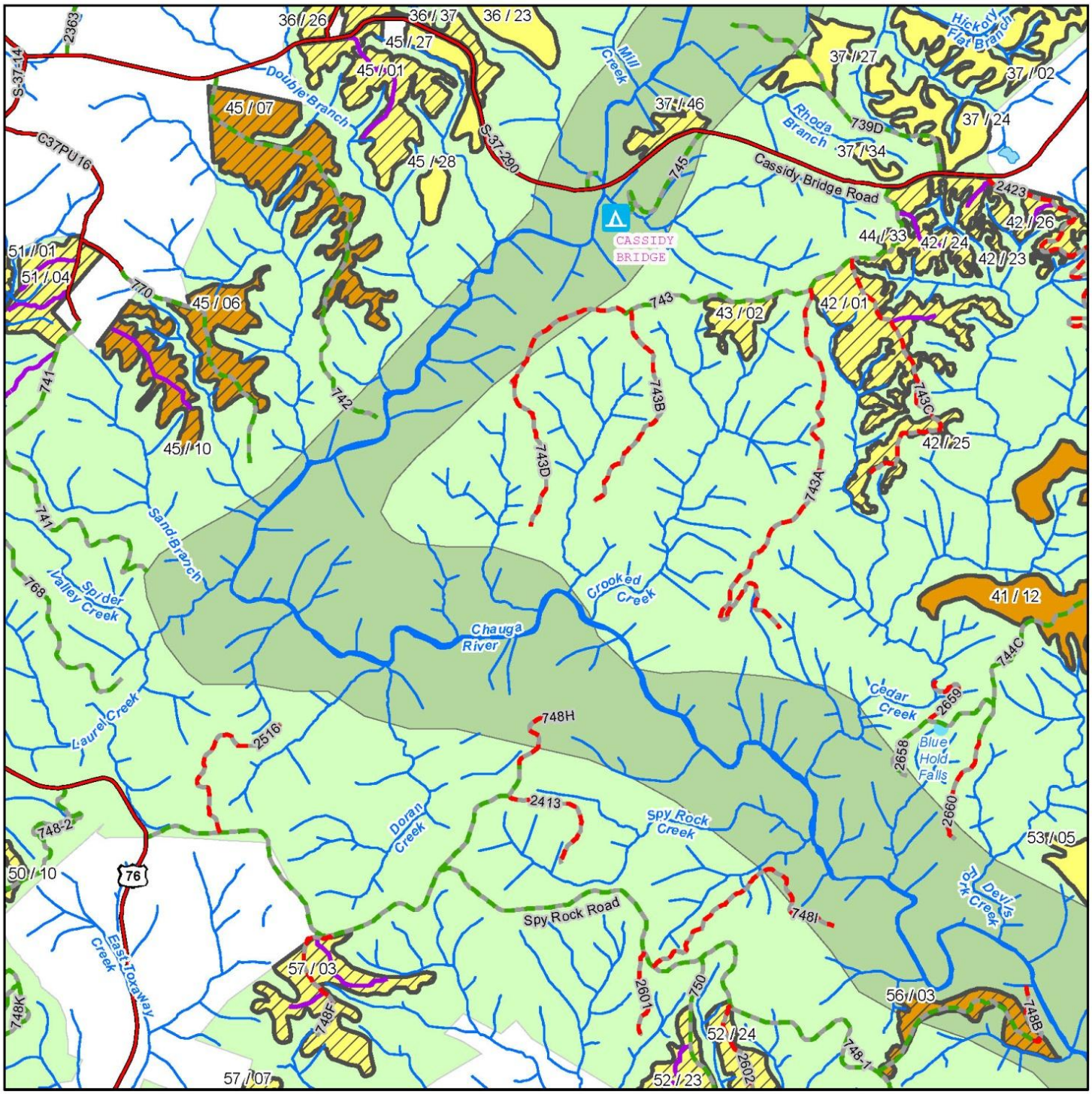

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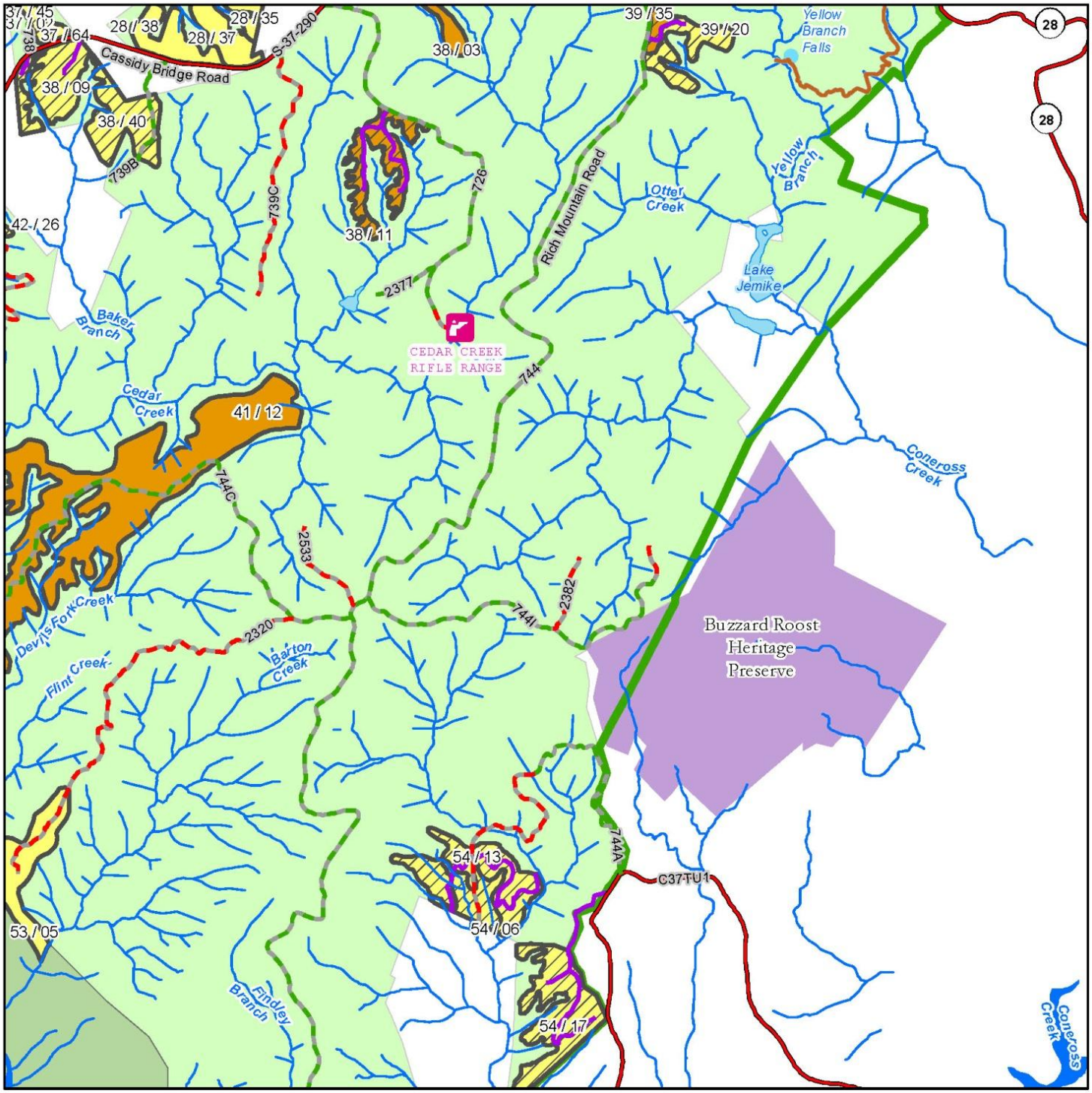

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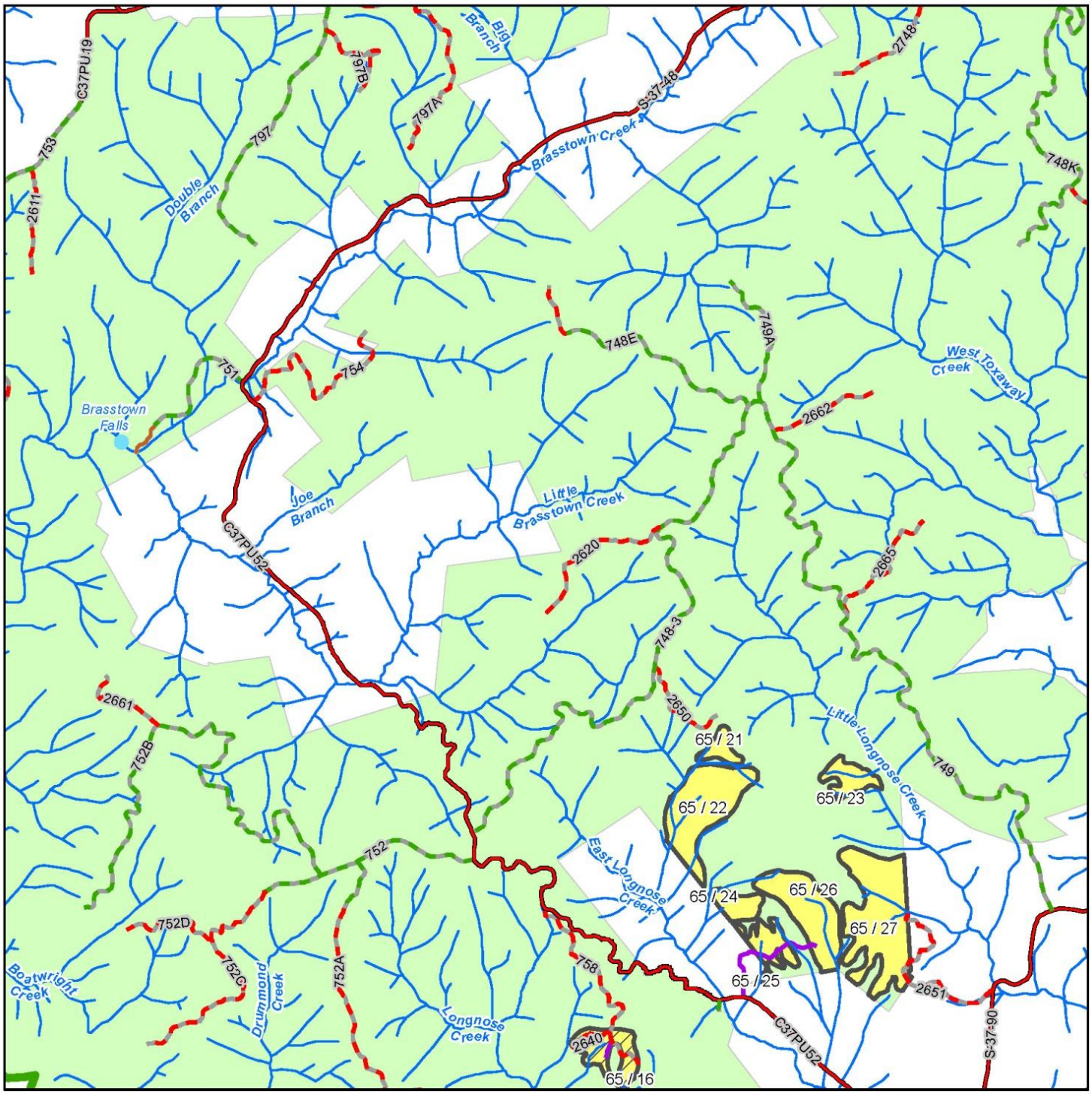

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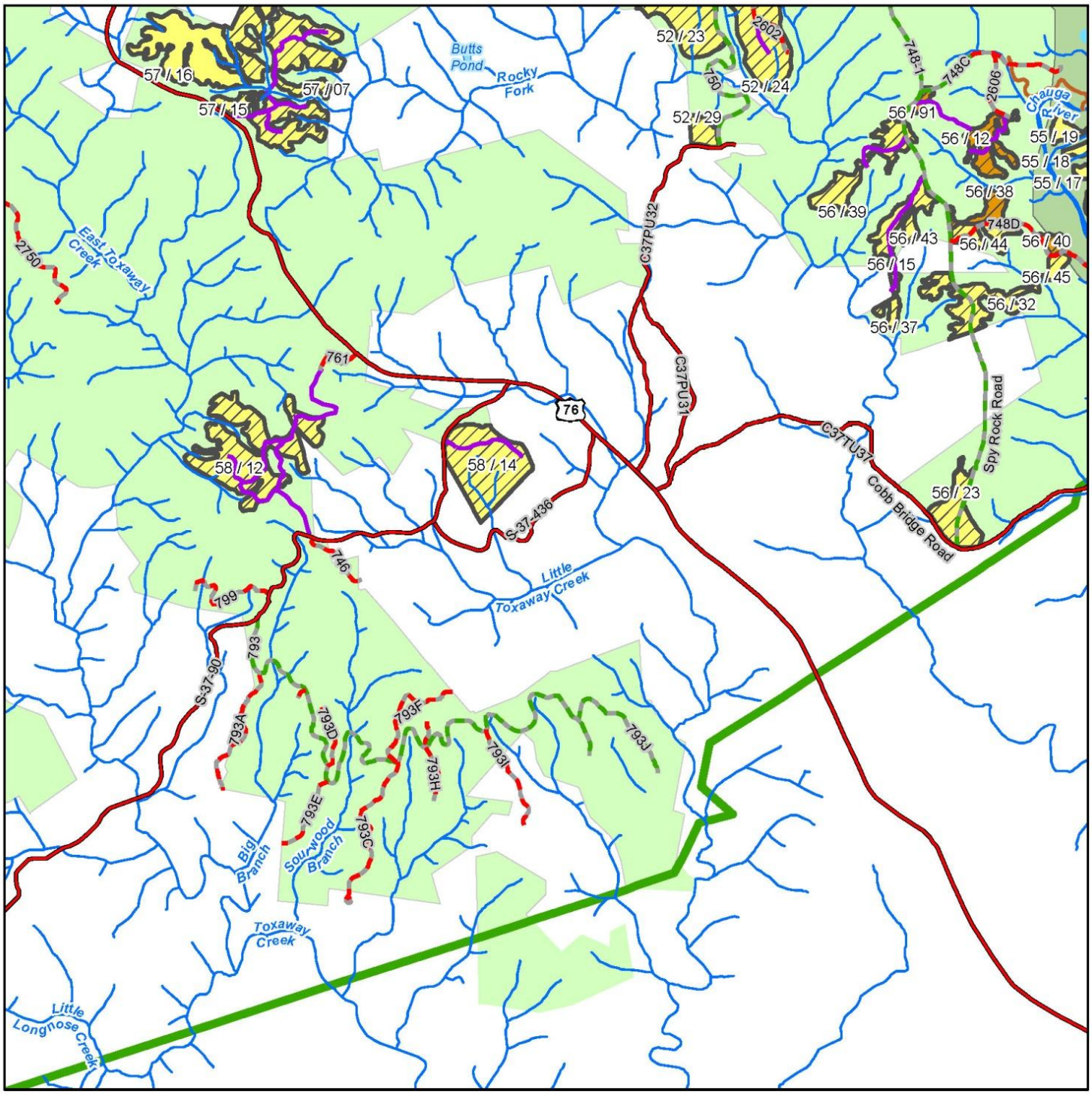

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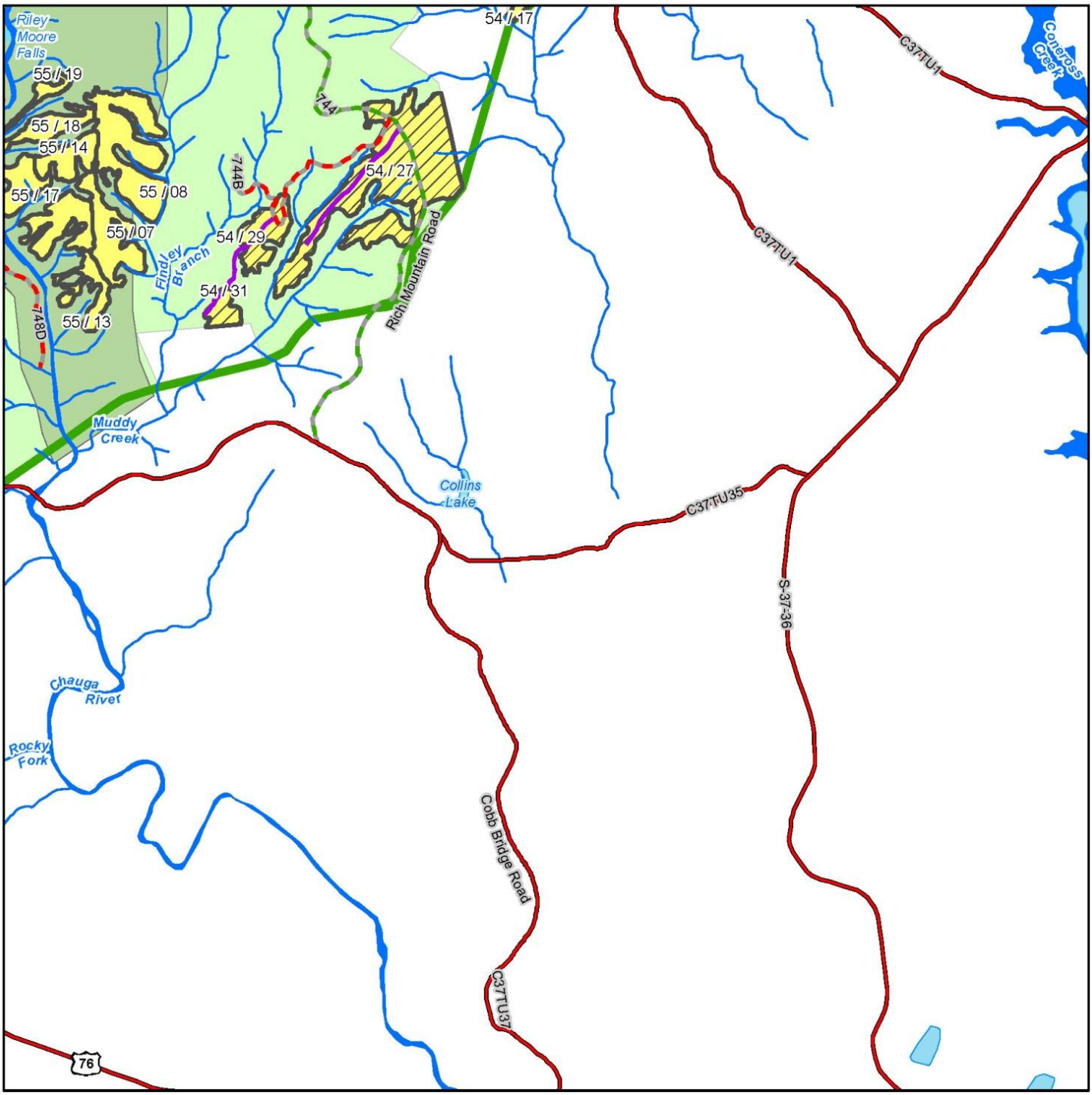

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Appendix B – Hydrology Analysis Summary

Appendix B - Hydrologic Analysis – AP Loblolly Removal and Restoration Project

Summary of Analysis Methods

This project utilizes the drainage density and stream ordering developed from the 1:24,000 USGS topographic maps and expands substantially the "USGS blue line streams" that are typical on topographic maps. Stream channel locations and gradients, stream densities and slope information have been refined based on 2010 Light Detection and Ranging (LiDAR) analysis relative to conditions within proposed units. LiDAR derived analysis included bare-earth relief and delineation of stream channels. Stream coverage locations, ordering and density of streams where corrected where appropriate to help determine the extent of default stream and riparian buffers.

Erosion rates (tons of sediment), suspended concentrations (parts per million) and percent increase in sediment concentrations from base levels over the decade were generated for the Chauga fifth level watershed, ten sixth level subwatersheds and at the 4th and 3rd order drainage basin response units (DBRUs) in the project area. Several hydrologic scales were evaluated to present a picture of what to expect within the streams affected.

The source data for both the land-use and land-cover components is the Multi-Resolution Land Characteristics (MRLC) data set. The MRLC data set is a product of the MRLC Consortium which consists of the Ecological Monitoring and Assessment Program of the US Environmental Protection Agency (USEPA), US Forest Service Remote Sensing Application Center, Gap Analysis Program of the US Geological Survey (USGS) Biological Resources Division, Coastal Change Analysis Program of the National Oceanic and Atmospheric Administration (NOAA), and the National Water-Quality Assessment (NAWQA) Program and EROS Data Center (EDC) of the USGS.

Erosion coefficients from the 1985 plan process records and Natural Resource conservation Service (NRCS) Resource Inventory (1987) were employed to help estimate potential effects for forestry and other land uses (Hansen et. al., 1994). A few adjustments were made in coefficients because the Sumter National Forest has longer rotations and less ground disturbance than private forest operations such as those measured by the NRCS Resource Inventory. Road density from GIS data coverage was also used to estimate existing conditions based on road type, surfacing, widths, jurisdictional ownership, etc. The information is developed to compare alternatives and to provide a relative estimate of changes in sediment load in tons, percent change from existing levels and the average suspended sediment concentration in parts per million in streams based on activities analyzed for the ten year window. These estimates also helped quantify and compare management intensity and recognize increased need for additional monitoring and mitigation.

Soil loss coefficients were calculated using the Revised Universal Soil Loss Equation (Wischmeier and Smith, 1978, Dissmeyer and Foster, 1984) for use in forest conditions and past Drainage Basin Response Unit analysis by physiographic area provided in Appendix C of this document (McLaughlin et al 1981, Goddard 1982, Hansen, et. al. 1994). Soil loss is the amount of soil movement. Only a portion of the erosion is delivered as sediment load to streams and this amount varies by drainage size, slope and other circumstances. The amount of sediment delivery was estimated for each of the activities based on the percentage of erosion (which is 38 percent for the mountains) delivered as sediment to DBRU size drainages (Roehl, 1982). The length of time for site recovery was adjusted from normal timber sale activities that were more intensive

and typically had a greater duration (Dissmeyer and Stump 1978). The recovery time was reduced one year because the treatment areas are stabilized quickly. The surface erosion based sediment values do not include channel, gully, landslide and other forms of erosion and sediment.

The combination of hydrologic scales used and estimated sediment delivered to DBRU size streams gives a tool by which the relative effects can be compared by alternative, land use and stream size. The DBRU analysis provides an estimate of effects to individual perennial streams that are scattered across the district. Additional field visits and/or mitigation measures were added to address circumstances where activities were concentrated.
Appendix B, Exhibits 1-3 are taken from three separate excel spreadsheets that were used to display current erosion for NFS land and private land uses. Mean erosion rates by DBRU, percent increase in sediment in comparison to alternative 1 and mean sediment concentration in suspended sediment (parts per million) over the analysis period were also analyzed.

<u>Exhibit 1</u>

- Sixth level watersheds
- The Chauga fifth level watershed has also been summarized.

<u>Exhibit 2</u>

- 4th Order Drainage Basin Response Units

<u>Exhibit 3</u>

- 3rd order Drainage Basin Response Units

Appendix B - Exhibit 1 - 6th Level HUC

6th Level HUC	NAME	Acres	Sediment Alt 1 Sediment	Alt 2 Sediment	Alt 3 Sediment
30601010301	Flat Shoals River	21,604	63,887	64,377	64,499
30601010303	Oconee Creek	9,987	45,347	45,347	45,347
30601010501	Upper Coneross Creek	11,308	61,369	61,477	61,468
30601020209	Middle Chattooga River	28,248	92,926	93,929	93,615
30601020210	Lower Chattooga River	20,231	74,193	75,314	75,082
30601020301	Upper Chauga River	16,514	56,446	57,262	57,120
30601020302	Middle Chauga River	16,109	31,842	34,197	33,880
30601020303	Toxaway Creek	13,963	51,257	51,443	51,513
30601020304	Lower Chauga River	24,190	98,367	99,756	99,493
30601020403	Upper Tugaloo River	43,527	191,020	191,312	191,289
	total	205,681	766,654	774,414	773,306

Chauga 5th Level 3060102

	Upper Chauga River	16,514	56,446	57,262	57,120
	Middle Chauga River	16,109	31,842	34,197	33,880
	Toxaway Creek	13,963	51,257	51,443	51,513
	Lower Chauga River	24,190	98,367	99,756	99,493
		70,776	237,913	242,658	242,006
			tons/decade	tons/decade	tons/decade

Appendix B - Exhibit 1 - 6th Level HUC

6th Level HUC	NAME	Acres	Erosion Alt 2 Treat	Alt 3 Treat	Alt 2 Temp Road	Alt 3 Temp Road	Alt. 2 New Road Construction
30601010301	Flat Shoals River	21,604	1,242	1,482	49	130	
30601010303	Oconee Creek	9,987	-	-			
30601010501	Upper Coneross Creek	11,308	262	239	21	21	
30601020209	Middle Chattooga River	28,248	2,337	1,664	141	151	162
30601020210	Lower Chattooga River	20,231	1,962	1,962	377	377	612
30601020301	Upper Chauga River	16,514	1,515	1,515	235	257	398
30601020302	Middle Chauga River	16,109	4,913	4,818	470	545	814
30601020303	Toxaway Creek	13,963	279	528	40	145	170
30601020304	Lower Chauga River	24,190	2,577	2,494	469	469	608
30601020403	Upper Tugaloo River	43,527	681	622	87	87	
	total	205,681	15,769	15,323	1,888	2,182	2,764

Chauga 5th Level 3060102

	Upper Chauga River	16,514	1,515	1,515	235	257	398
	Middle Chauga River	16,109	4,913	4,818	470	545	814
	Toxaway Creek	13,963	279	528	40	145	170
	Lower Chauga River	24,190	2,577	2,494	469	469	608
		70,776	9,285	9,355	1,213	1,416	1,990
			tons/decade	tons/decade	tons/decade	tons/decade	tons/decade

Appendix B - Exhibit 1 - 6th Level HUC

			Erosion					
			FS Ownership					
6th Level HUC	NAME	Acres	Cropland	Forest	Grass/Herb	Urban	Water	Barren
30601010301	Flat Shoals River	21,604		8,060	597	1	-	
30601010303	Oconee Creek	9,987	-	1,254	15	1		
30601010501	Upper Coneross Creek	11,308		1,097	126	39	-	
30601020209	Middle Chattooga River	28,248		6,938	1,044	80	-	
30601020210	Lower Chattooga River	20,231	-	2,589	2,147	28	-	
30601020301	Upper Chauga River	16,514		3,467	621	3		
30601020302	Middle Chauga River	16,109	-	8,741	1,301	0		
30601020303	Toxaway Creek	13,963		2,948	415	7		
30601020304	Lower Chauga River	24,190		4,418	665	55	-	
30601020403	Upper Tugaloo River	43,527		5,743	893	28		11
	total	205,681	-	45,256	7,824	242	-	11
Chauga 5th Level 3060102								
	Upper Chauga River	16,514		3,467	621	3		
	Middle Chauga River	16,109	-	8,741	1,301	0		
	Toxaway Creek	13,963		2,948	415	7		
	Lower Chauga River	24,190		4,418	665	55	-	
		70,776	-	19,575	3,002	66	-	-
			tons/decade	tons/decade	tons/decade	tons/decade	tons/decade	tons/decade

Appendix B - Exhibit 1 - 6th Level HUC

			Erosion						
			Non-FS Ownership						
6th Level HUC	NAME	Acres	Barren	Cropland	Forest	Grass/Herb	Herb. Wetland	Urban	Water
30601010301	Flat Shoals River	21,604	2,502		65,594	22,438	-	2,225	-
30601010303	Oconee Creek	9,987	2,581		58,961	17,378		1,578	-
30601010501	Upper Coneross Creek	11,308	7,531		55,057	30,018		14,804	-
30601020209	Middle Chattooga River	28,248	400	3,048	156,384	16,801		327	-
30601020210	Lower Chattooga River	20,231		1,284	133,370	18,671		527	-
30601020301	Upper Chauga River	16,514	1,530	1,613	90,797	16,854		336	-
30601020302	Middle Chauga River	16,109	512	1,854	19,723	9,375		154	-
30601020303	Toxaway Creek	13,963	2,870		69,555	20,356		2,343	-
30601020304	Lower Chauga River	24,190	4,892		122,715	40,991		4,773	-
30601020403	Upper Tugaloo River	43,527	25,632	19	244,339	60,135		33,411	-
	total	205,681	48,450	7,818	1,016,496	253,016	-	60,479	-
Chauga 5th Level 3060102									
	Upper Chauga River	16,514	1,530	1,613	90,797	16,854		336	-
	Middle Chauga River	16,109	512	1,854	19,723	9,375		154	-
	Toxaway Creek	13,963	2,870		69,555	20,356		2,343	-
	Lower Chauga River	24,190	4,892		122,715	40,991		4,773	-
		70,776	9,803	3,467	302,790	87,576	-	7,606	-
			tons/decade	tons/decade	tons/decade	tons/decade	tons/decade	tons/decade	

Appendix B - Exhibit 1 - 6th Level HUC

6th Level HUC	NAME	Acres	Erosion Past Activity	Rx Fire	Road	Utility	Wildlife Mgmt Area	Other Road
30601010301	Flat Shoals River	21,604	-	2,010	29,723		797	34,175
30601010303	Oconee Creek	9,987	55		8,622		192	28,694
30601010501	Upper Coneross Creek	11,308		1,134	11,793		102	39,798
30601020209	Middle Chattooga River	28,248		2,346	29,631		507	27,036
30601020210	Lower Chattooga River	20,231		1,663	12,786	761	140	21,279
30601020301	Upper Chauga River	16,514	113	533	32,452		224	
30601020302	Middle Chauga River	16,109	39	15,049	26,698		349	
30601020303	Toxaway Creek	13,963		1,976	14,689	3,886		15,842
30601020304	Lower Chauga River	24,190		5,088	23,992		117	51,155
30601020403	Upper Tugaloo River	43,527		3,619	27,060	3,855	140	97,801
	total	**205,681**	**207**	**33,418**	**217,445**	**8,502**	**2,569**	**315,780**

Chauga 5th Level 3060102

	Upper Chauga River	16,514	113	533	32,452		224	
	Middle Chauga River	16,109	39	15,049	26,698		349	
	Toxaway Creek	13,963		1,976	14,689	3,886		15,842
	Lower Chauga River	24,190		5,088	23,992		117	51,155
		70,776	152	22,646	97,831	3,886	690	66,997
			tons/decade	tons/decade	tons/decade	tons/decade	tons/decade	tons/decade

past Activity= past timber harvest activity
RX Fire = Forest Service
Road = mostly FS and public roads
Utility = rights-of-way
Wildlife Mgmt Area = wildlife areas mostly on FS
Other Road = mostly private roads on private lands within watersheds.

Appendix B - Exhibit 2 - 4th Order DBRUs

DBRU	Acres	Alt 1 Sediment tons/decade	Alt 2 Sediment tons/decade	Alt 3 Sediment tons/decade	Alt 2 Treatment Erosion t/d	Alt 3 Treatment Erosion t/d	Alt 2 Temp Road Erosion t/d	Alt 3 Temp Road Erosion t/d	New Road Construction Erosion t/d
601010300	**467**	876	1043	1066	440	501			
601010310	**2185**	3193	3210	3210	43	43			
601010311	**378**	156	213	222	150	150	0	25	
601010312	**774**	806	953	987	338	372	49	105	
601010313	**1228**	893	900	900	18	18			
601010314	**470**	266	271	271	14	14			
601010315	**843**	1173	1183	1183	28	28			
601010601	**461**	1186	1186	1186	1	0			
601010602	**259**	759	819	811	151	128	7	7	
601020102	**245**	572	575	574	10	7			
601020105	**185**	413	418	416	14	9			
601020111	**211**	447	600	512	151	151	20	20	229
601020112	**346**	593	814	762	363	363	53	81	163
601020113	**921**	2217	2450	2450	536	536	76	76	
601020114	**165**	305	309	309	10	10			
601020115	**76**	110	153	153	81	81	33	33	
601020116	**543**	1141	1340	1338	505	500	17	17	
601020136	**331**	872	935	930	134	121	33	33	
601020137	**761**	1875	1945	1911	173	84	12	12	
601020139	**1625**	4922	5184	5110	414	446	37	48	239
601020141	**217**	688	754	754	172	172			
601020145	**207**	795	795	795	0	0			
601020201	**349**	730	874	874	324	324	55	55	
601020202	**639**	464	499	499	64	64	27	27	
601020212	**615**	1218	1223	1223	13	13	1	1	
601020213	**229**	364	420	420	91	91	56	56	
601020214	**291**	302	311	311	22	22			
601020215	**327**	1009	1129	1127	296	293	18	18	
601020216	**364**	627	835	835	493	493	55	55	
601020217	**250**	195	325	325	340	340	2	2	
601020219	**138**	130	151	151	57	57			
601020220	**73**	83	94	94	30	30			
601020223	**257**	464	473	473	24	24			
601020224	**983**	2984	3317	3246	587	587	41	104	251
601020225	**262**	429	523	471	77	77	32	32	138
601020226	**172**	753	763	763	26	26			
601020230	**117**	208	225	220	43	30			
601020231	**267**	419	444	444	51	51	14	14	
601020232	**285**	545	618	618	155	155	37	37	
601020233	**653**	1140	1433	1330	427	427	73	73	270
601020237	**223**	683	684	684	0	0			
601020238	**420**	967	1107	1107	336	336	30	30	
601020404	**615**	1733	1888	1888	374	374	36	36	
601020431	**548**	1439	1456	1456	47	47			
601020432	**510**	2028	2070	2070	94	94	15	15	
601020502	**193**	782	790	796	19	19	2	20	3
601020503	**414**	1517	1625	1615	146	195	17	63	120
601020506	**226**	566	566	574	0	10	0	9	
601020518	**572**	1677	1695	1677	26	0	21	0	
601020523	**123**	188	207	188	33	0	18	0	
601020524	**216**	701	724	724	58	58	4	4	
601020525	**144**	652	660	660	20	20			
601027715	**439**	490	490	491	0	3			
601027718	**339**	643	684	701	87	133	19	19	
601027719	**291**	232	327	232	248	0			0
601027721	**250**	664	700	700	58	58	36	36	
601027722	**131**	64	69	69	11	11	1	1	
601027723	**292**	425	448	448	61	61			
601027725	**180**	277	300	300	46	46	14	14	
601027730	**965**	3467	3598	3598	285	285	61	61	

Appendix B - Exhibit 2 - 4th Order DBRUs

DBRU	Acres	Alt 1 Sediment tons/decade	Alt 2 Sediment tons/decade	Alt 3 Sediment tons/decade	Alt 2 Treatment Erosion t/d	Alt 3 Treatment Erosion t/d	Alt 2 Temp Road Erosion t/d	Alt 3 Temp Road Erosion t/d	New Road Construction Erosion t/d
601027737	**1017**	3310	3352	3352	111	111	0	0	
601027738	**287**	929	989	989	146	146	11	11	
601027748	**260**	1352	1352	1354	0	0	0	5	
601027749	**621**	2574	2576	2576	7	7			
Averages (n=64)	444.5	995.1	1063.5	1055.1	141.9	138.3	16.1	19.6	22.1
Totals	28,894	64,681	69,128	68,581	9,221	8,989	1,046	1,274	1,436

Appendix B - Exhibit 2 - 4th O

		FS Ownership Erosion tons/decade (t/d)					Non-FS Ownership Erosion tons/decade						
DBRU	Acres	Cropland	Forest	Grass/Herb	Urban	Water	Barren	Cropland	Forest	Grass/Herb	Herb. Wetland	Urban	Water
601010300	467		229						1243	28			
601010310	2185		1442	348	1				28	3		7	
601010311	378		260	0									
601010312	774		485	34		0			330	10	0		0
601010313	1228		808	19					125	120			
601010314	470		323	6									
601010315	843		442	0					1963	24			
601010601	461		222	49	53				612	498		50	
601010602	259		116	20					375	348			
601020102	245		124	9					530	66			
601020105	185		116	32					79				
601020111	211		83	11					694	165			
601020112	346		175	29					453	349			
601020113	921		361	11			133		3215	584			
601020114	165		113										
601020115	76		52	6									
601020116	543		328	39					339	183			
601020136	331		135	12			378		1059	202			
601020137	761		259	39					1550	1871			0
601020139	1625	0	470	42				518	6520	2368		35	
601020141	217		60	3					1140	119			
601020145	207		10						1264	569			
601020201	349		158	1			21		1043	110			
601020202	639		424				135		251	19			
601020212	615		386	241					6	5			
601020213	229		152	46									
601020214	291		185	8					113	88			
601020215	327	0	109	14				111	1373	206			
601020216	364		240	14					69				
601020217	250		171										
601020219	138		94										
601020220	73		50										
601020223	257		168	41									
601020224	983		369	57				765	2154	1795		125	
601020225	262		175	7					2	68			
601020226	172		27	4				209	454	713			
601020230	117		79	9		0							
601020231	267		146	63					363	20			
601020232	285		132	75					610	134			
601020233	653		289	124					1884	188			
601020237	223		52	3					1170	251			
601020238	420		175	32					1126	400			
601020404	615		150	27					3430	413			
601020431	548		262	117	2				1170	102			
601020432	510		35	40					4292	139			
601020502	193		68	39	7				446	244		298	
601020503	414		61	3					1816	1212		53	
601020506	226		119	12					392				
601020518	572		156	49			3		2367	860			
601020523	123		57	4					279	110			
601020524	216		33	23					1451	161			
601020525	144		14	37					681	378			
601027715	439		299	16									
601027718	339		183	82	14				336	196			
601027719	291		176						316	65			
601027721	250		91						978	163			
601027722	131		89						43				
601027723	292		157	8					424	165			
601027725	180		84						597	5			
601027730	965	0	152	652	28	0		125	4768	1029		27	

Appendix B - Exhibit 2 - 4th O

		FS Ownership Erosion tons/decade (t/d)					Non-FS Ownership Erosion tons/decade						
DBRU	**Acres**	Cropland	Forest	Grass/Herb	Urban	Water	Barren	Cropland	Forest	Grass/Herb	Herb. Wetland	Urban	Water
601027737	**1017**		359	126		0			2525	1669		74	
601027738	**287**		60	23					1011	798			
601027748	**260**							338	1140	1216			
601027749	**621**		89	20					2729	1776			0
Averages (n=64)	444.5	0	201.4	42.6	1.6	0.0	10.5	32.3	989.5	346.9	0.0	10.4	0.0
Totals	28,894	-	13,088	2,770	106	-	680	2,098	64,319	22,549	-	678	-

Appendix B - Exhibit 2 - 4th O

DBRU	Acres	Other Activities Erosion tons/decade					Alt 1 Sediment mean t/a/y for decade	Alt 2 Sediment mean t/a/y for decade	Alt 3 Sediment mean t/a/y for decade
		Past Activity	Rx Fire	Road	Utility	Wildlife Mgmt Area			
601010300	**467**	0	5	782		19	0.2	0.2	0.2
601010310	**2185**	0	1451	5101		22	0.1	0.1	0.1
601010311	**378**			100		50	0.0	0.1	0.1
601010312	**774**	0	455	754		55	0.1	0.1	0.1
601010313	**1228**			877		401	0.1	0.1	0.1
601010314	**470**			344		27	0.1	0.1	0.1
601010315	**843**	0		614		44	0.1	0.1	0.1
601010601	**461**		345	1287		3	0.3	0.3	0.3
601010602	**259**	0	114	1000		24	0.3	0.3	0.3
601020102	**245**	0	318	456			0.2	0.2	0.2
601020105	**185**	0	293	566			0.2	0.2	0.2
601020111	**211**			224			0.2	0.3	0.2
601020112	**346**			555			0.2	0.2	0.2
601020113	**921**	0	40	1491			0.2	0.3	0.3
601020114	**165**	0	325	364			0.2	0.2	0.2
601020115	**76**		156	75			0.1	0.2	0.2
601020116	**543**	0	909	1206			0.2	0.2	0.2
601020136	**331**	7	61	440			0.3	0.3	0.3
601020137	**761**	32		1182			0.2	0.3	0.3
601020139	**1625**	0	178	2821			0.3	0.3	0.3
601020141	**217**	0	60	429			0.3	0.3	0.3
601020145	**207**			248			0.4	0.4	0.4
601020201	**349**			588			0.2	0.3	0.3
601020202	**639**			393			0.1	0.1	0.1
601020212	**615**	0	1253	1313			0.2	0.2	0.2
601020213	**229**		491	269			0.2	0.2	0.2
601020214	**291**	0	2	399			0.1	0.1	0.1
601020215	**327**	0	38	804			0.3	0.3	0.3
601020216	**364**	0	662	634		32	0.2	0.2	0.2
601020217	**250**		65	256		22	0.1	0.1	0.1
601020219	**138**			247			0.1	0.1	0.1
601020220	**73**			168			0.1	0.1	0.1
601020223	**257**	0	43	970			0.2	0.2	0.2
601020224	**983**		589	1999			0.3	0.3	0.3
601020225	**262**		536	343			0.2	0.2	0.2
601020226	**172**			575			0.4	0.4	0.4
601020230	**117**		249	212			0.2	0.2	0.2
601020231	**267**		25	470		17	0.2	0.2	0.2
601020232	**285**		44	439			0.2	0.2	0.2
601020233	**653**			515			0.2	0.2	0.2
601020237	**223**			322			0.3	0.3	0.3
601020238	**420**		166	646			0.2	0.3	0.3
601020404	**615**	0	1	538			0.3	0.3	0.3
601020431	**548**			2132			0.3	0.3	0.3
601020432	**510**	0	14	816			0.4	0.4	0.4
601020502	**193**			955			0.4	0.4	0.4
601020503	**414**			848			0.4	0.4	0.4
601020506	**226**			723	244		0.3	0.3	0.3
601020518	**572**		15	965			0.3	0.3	0.3
601020523	**123**			44			0.2	0.2	0.2
601020524	**216**		4	172			0.3	0.3	0.3
601020525	**144**			606			0.5	0.5	0.5
601027715	**439**	0	20	955			0.1	0.1	0.1
601027718	**339**	0	174	709			0.2	0.2	0.2
601027719	**291**			55			0.1	0.1	0.1
601027721	**250**			516			0.3	0.3	0.3
601027722	**131**			37			0.0	0.1	0.1
601027723	**292**	0	0	364			0.1	0.2	0.2
601027725	**180**			44			0.2	0.2	0.2
601027730	**965**	0	333	2009			0.4	0.4	0.4

Appendix B - Exhibit 2 - 4th O

DBRU	Acres	Other Activities Erosion tons/decade					Alt 1 Sediment mean t/a/y for decade	Alt 2 Sediment mean t/a/y for decade	Alt 3 Sediment mean t/a/y for decade
		Past Activity	Rx Fire	Road	Utility	Wildlife Mgmt Area			
601027737	**1017**			3957			0.3	0.3	0.3
601027738	**287**			553			0.3	0.3	0.3
601027748	**260**			864			0.5	0.5	0.5
601027749	**621**			2160			0.4	0.4	0.4
Averages (n=64)	444.5	0.6	147.5	820.4	3.8	11.2	0.2	0.2	0.2
Totals	28,894	40	9,585	53,325	248	728	14.6	15.7	15.6

Appendix B - Exhibit 2 - 4th O

DBRU	Acres	Alt 2 Percent Increase in Sediment for decade	Alt 3 Percent Increase in Sediment for decade	Alt 1 mean concentration ppm over decade	Alt 2 mean concentration ppm over decade	Alt 3 mean concentration ppm over decade	SS ppm Alt 2 - Alt1	SS ppm Alt 3-Alt1
601010300	**467**	19.1	21.7	37.5	44.7	45.7	7.2	8.2
601010310	**2185**	0.5	0.5	29.2	29.4	29.4	0.2	0.2
601010311	**378**	36.7	42.8	8.2	11.3	11.8	3.0	3.5
601010312	**774**	18.2	22.5	20.8	24.6	25.5	3.8	4.7
601010313	**1228**	0.8	0.8	14.5	14.7	14.7	0.1	0.1
601010314	**470**	1.9	1.9	11.3	11.5	11.5	0.2	0.2
601010315	**843**	0.9	0.9	27.8	28.1	28.1	0.2	0.2
601010601	**461**	0.0	0.0	51.4	51.4	51.4	0.0	0.0
601010602	**259**	7.9	6.8	58.6	63.2	62.6	4.6	4.0
601020102	**245**	0.6	0.4	46.7	47.0	46.9	0.3	0.2
601020105	**185**	1.3	0.9	44.5	45.1	44.9	0.6	0.4
601020111	**211**	34.0	14.5	42.4	56.9	48.6	14.4	6.2
601020112	**346**	37.1	28.4	34.3	47.0	44.1	12.7	9.8
601020113	**921**	10.5	10.5	48.1	53.2	53.2	5.0	5.0
601020114	**165**	1.2	1.2	37.0	37.4	37.4	0.4	0.4
601020115	**76**	39.5	39.5	29.0	40.5	40.5	11.5	11.5
601020116	**543**	17.4	17.2	42.1	49.4	49.3	7.3	7.2
601020136	**331**	7.3	6.7	52.6	56.5	56.2	3.8	3.5
601020137	**761**	3.7	1.9	49.3	51.1	50.2	1.8	1.0
601020139	**1625**	5.3	3.8	60.6	63.8	62.9	3.2	2.3
601020141	**217**	9.5	9.5	63.4	69.4	69.4	6.0	6.0
601020145	**207**	0.0	0.0	76.8	76.8	76.8	0.0	0.0
601020201	**349**	19.7	19.7	41.8	50.0	50.0	8.2	8.2
601020202	**639**	7.4	7.4	14.5	15.6	15.6	1.1	1.1
601020212	**615**	0.4	0.4	39.6	39.8	39.8	0.2	0.2
601020213	**229**	15.4	15.4	31.8	36.7	36.7	4.9	4.9
601020214	**291**	2.8	2.8	20.8	21.3	21.3	0.6	0.6
601020215	**327**	11.8	11.7	61.7	69.0	68.9	7.3	7.2
601020216	**364**	33.2	33.2	34.4	45.9	45.9	11.4	11.4
601020217	**250**	66.5	66.5	15.6	26.0	26.0	10.4	10.4
601020219	**138**	16.8	16.8	18.8	22.0	22.0	3.2	3.2
601020220	**73**	13.9	13.9	22.6	25.7	25.7	3.1	3.1
601020223	**257**	1.9	1.9	36.1	36.8	36.8	0.7	0.7
601020224	**983**	11.2	8.8	60.7	67.5	66.0	6.8	5.3
601020225	**262**	21.8	9.7	32.8	40.0	36.0	7.2	3.2
601020226	**172**	1.3	1.3	87.4	88.5	88.5	1.1	1.1
601020230	**117**	7.9	5.4	35.6	38.4	37.6	2.8	1.9
601020231	**267**	5.9	5.9	31.4	33.2	33.2	1.9	1.9
601020232	**285**	13.4	13.4	38.2	43.3	43.3	5.1	5.1
601020233	**653**	25.7	16.7	34.9	43.9	40.8	9.0	5.8
601020237	**223**	0.0	0.0	61.2	61.2	61.2	0.0	0.0
601020238	**420**	14.4	14.4	46.1	52.7	52.7	6.6	6.6
601020404	**615**	9.0	9.0	56.3	61.4	61.4	5.1	5.1
601020431	**548**	1.2	1.2	52.5	53.2	53.2	0.6	0.6
601020432	**510**	2.1	2.1	79.5	81.2	81.2	1.6	1.6
601020502	**193**	1.1	1.9	81.1	82.0	82.6	0.9	1.5
601020503	**414**	7.1	6.5	73.2	78.4	78.0	5.2	4.7
601020506	**226**	0.0	1.3	50.1	50.1	50.8	0.0	0.7
601020518	**572**	1.1	0.0	58.6	59.2	58.6	0.6	0.0
601020523	**123**	10.3	0.0	30.6	33.7	30.6	3.1	0.0
601020524	**216**	3.3	3.3	64.9	67.1	67.1	2.2	2.2
601020525	**144**	1.2	1.2	90.8	91.9	91.9	1.1	1.1
601027715	**439**	0.0	0.2	22.3	22.3	22.4	0.0	0.1
601027718	**339**	6.3	9.0	38.0	40.4	41.4	2.4	3.4
601027719	**291**	40.7	0.0	16.0	22.5	16.0	6.5	0.0
601027721	**250**	5.4	5.4	53.2	56.0	56.0	2.9	2.9
601027722	**131**	7.5	7.5	9.8	10.5	10.5	0.7	0.7
601027723	**292**	5.5	5.5	29.1	30.7	30.7	1.6	1.6
601027725	**180**	8.2	8.2	30.8	33.3	33.3	2.5	2.5
601027730	**965**	3.8	3.8	71.8	74.6	74.6	2.7	2.7

Appendix B - Exhibit 2 - 4th O

DBRU	Acres	Alt 2 Percent Increase in Sediment for decade	Alt 3 Percent Increase in Sediment for decade	Alt 1 mean concentration ppm over decade	Alt 2 mean concentration ppm over decade	Alt 3 mean concentration ppm over decade	SS ppm Alt 2 - Alt1	SS ppm Alt 3-Alt1
601027737	**1017**	1.3	1.3	65.1	65.9	65.9	0.8	0.8
601027738	**287**	6.4	6.4	64.8	68.9	68.9	4.2	4.2
601027748	**260**	0.0	0.2	103.9	103.9	104.1	0.0	0.2
601027749	**621**	0.1	0.1	82.8	82.9	82.9	0.1	0.1
Averages (n=64)	444.5	10.4	8.9	45.0	48.4	48.0	3.5	3.0
Totals	28,894	676.7	580.6	2,922.6	3,149.0	3,118.8	226.4	196.2

Appendix B - Exhibit 3 - 3rd Order DBRUs

DBRU	Acres	Alt 1 Sediment tons/decade	Alt 2 Sediment tons/decade	Alt 3 Sediment tons/decade	Alt 2 Treatment Erosion t/d	Alt 3 Treatment Erosion t/d	Alt 2 Temp Road Erosion t/d	Alt 3 Temp Road Erosion t/d	New Road Construction Erosion t/d
60102023303	**88**	103	249	166	135	135	31	31	218
60102050301	**67**	228	336	290	146	146	17	17	120
60102775801	**40**	29	82	82	109	109	30	30	
60102011605	**24**	75	104	104	76	76			
60102025701	**70**	113	190	152	82	81	21	21	99
60102025702	**49**	23	76	47	45	45	18	18	77
60102775704	**235**	337	591	504	359	359	82	82	229
60102021602	**42**	71	114	114	94	94	19	19	
60102011502	**43**	74	117	117	81	81	33	33	
60102021303	**29**	31	60	60	38	38	36	36	
60102021603	**44**	109	151	151	106	106	4	4	
60102011604	**40**	125	163	163	89	89	12	12	
60102027029	**130**	357	480	410	136	136	5	5	183
60102011101	**118**	340	450	375	89	89	5	5	198
60102021604	**70**	127	192	192	152	152	20	20	
60102015401	**168**	322	465	465	346	346	31	31	
60102775406	**195**	746	912	746	275	0			162
60102014101	**35**	103	132	132	78	78			
60102011202	**170**	228	367	349	271	271	21	48	74
60102011102	**39**	40	71	59	34	34	15	15	31
60102773703	**52**	100	140	140	106	106	0	0	
60101031203	**46**	78	114	113	82	79	13	13	
60102023202	**61**	35	82	82	99	99	24	24	
60102025102	**90**	106	172	162	125	125	23	23	25
60102021701	**178**	154	284	284	340	340	2	2	
60102040402	**194**	328	470	470	337	337	36	36	
60102022501	**130**	202	296	244	76	76	32	32	138
60102020104	**109**	93	172	172	152	152	55	55	
60102025705	**68**	161	210	210	129	129	0	0	
60102775705	**205**	315	462	377	126	126	39	39	221
60102021502	**167**	581	700	699	296	292	18	18	
60102025100	**371**	965	1230	1165	393	393	132	132	170
60102013702	**29**	101	122	101	55	0			
60102017019	**113**	264	343	343	122	122	85	85	
60102775500	**277**	320	511	511	482	482	19	19	
60102020103	**94**	109	173	173	167	167			
60102022403	**25**	34	49	49	40	40			
60102775408	**112**	262	329	329	163	163	15	15	
60102023800	**214**	205	331	331	302	302	30	30	
60102775802	**90**	121	170	170	101	101	28	28	
60102011305	**306**	496	662	662	404	404	33	33	
60102023302	**91**	63	112	112	116	116	13	13	
60102027037	**91**	156	204	192	95	70	26	26	6
60102011203	**106**	347	404	370	41	41	18	19	89
60102043203	**73**	257	295	295	94	94	7	7	
60102017020	**61**	78	110	110	57	57	26	26	
60102771900	**176**	181	272	181	238	0			0
60101065101	**82**	29	71	71	96	96	14	14	
60102773004	**98**	287	336	336	128	128	2	2	
60102011601	**137**	266	334	334	175	175	2	2	
60102011201	**26**	7	20	20	31	31	3	3	
60102775712	**353**	597	766	766	398	398	49	49	
60102027027	**140**	299	365	365	163	163	12	12	
60102015000	**56**	38	64	64	68	68			
60102052302	**42**	61	80	61	33	0	18	0	
60102023002	**32**	93	108	103	38	26			
60101031100	**112**	61	111	121	133	133	0	25	
60102775703	**89**	45	84	84	103	103			
60102017018	**109**	224	269	269	102	102	17	17	
60102022001	**28**	35	46	46	30	30			
60102023300	**190**	506	582	562	118	118	30	30	52
60102772501	**57**	51	73	73	46	46	14	14	
60102021904	**56**	76	97	97	57	57			
60101031204	**74**	151	180	180	68	67	7	7	
60102025406	**24**	44	53	53	24	24			
60102022402	**661**	2184	2429	2357	352	352	41	104	251
60101030008	**467**	876	1043	1066	440	501			
60102772101	**91**	82	115	115	51	51	34	34	
60102023000	**6**	6	8	7	5	4			
60102023101	**72**	132	157	157	51	51	14	14	
60102011302	**62**	87	108	108	27	27	28	28	
60102777110	**169**	389	442	442	139	139			
60102772300	**65**	31	51	51	53	53			
60102021605	**21**	40	47	47	17	17			
60102025700	**393**	922	1041	1040	272	272	38	38	3
60101031201	**108**	29	61	101	86	135	0	55	
60102021600	**109**	124	156	156	73	73	12	12	
60102052401	**48**	155	168	168	33	33	4	4	

Appendix B - Exhibit 3 - 3rd Order DBRUs

DBRU	Acres	Alt 1 Sediment tons/decade	Alt 2 Sediment tons/decade	Alt 3 Sediment tons/decade	Alt 2 Treatment Erosion t/d	Alt 3 Treatment Erosion t/d	Alt 2 Temp Road Erosion t/d	Alt 3 Temp Road Erosion t/d	New Road Construction Erosion t/d
60102022401	168	568	617	617	128	128			
60102775803	376	674	780	763	213	213	20	20	46
60102775407	255	810	881	810	185	0			
60102011200	43	12	23	23	20	20	11	11	
60101060201	144	594	633	630	96	87	6	6	
60102013900	613	1293	1455	1392	206	224	33	38	185
60101060200	68	56	74	69	46	32	1	1	
60102016001	165	430	472	472	112	112			
60102025104	103	255	281	281	68	68	0	0	
60102027038	139	234	269	269	91	91			
60102021304	50	54	67	67	28	28	4	4	
60102013906	218	881	935	924	87	106	0	7	54
60102013601	56	75	88	88	17	17	18	18	
60102014100	148	393	429	429	95	95			
60102021601	78	156	175	175	50	50			
60102013603	146	416	450	450	92	92			
60102027028	66	138	154	154	41	41			
60102011301	58	48	61	61	34	34	1	1	
60102011600	270	401	462	460	158	152	3	3	
60102055202	59	20	33	33	33	33			
60102025704	127	168	195	195	71	71	1	1	
60102023301	65	143	157	157	37	37	0	0	
60102022400	113	150	174	174	64	64			
60102773801	287	929	989	989	146	146	11	11	
60102043102	49	68	78	78	27	27			
60102775400	790	3692	3854	3854	380	380	46	46	
60102011100	54	68	79	79	28	28			
60102011304	142	399	427	427	72	72	2	2	
60102017021	105	163	183	180	42	42	2	2	9
60102023201	141	255	281	281	56	56	13	13	
60102021302	86	187	203	203	25	25	16	16	
60102013600	87	139	154	149	25	11	14	14	
60102027034	95	155	171	166	42	29			
60102775702	94	66	82	82	42	42			
60102021206	15	20	23	23	7	7			
60102773002	136	542	564	564	23	23	34	34	
60102013902	310	954	1002	1000	121	116	3	3	
60102013706	241	579	615	615	84	84	12	12	
60102022601	51	195	203	203	20	20			
60102040403	96	335	349	349	37	37			
60102771802	212	386	415	430	57	98	19	19	
60102773003	176	526	549	549	62	62			
60102022300	37	149	154	154	12	12			
60102773000	299	1012	1049	1049	72	72	25	25	
60102775701	78	76	85	85	23	23			
60102771903	34	30	34	30	10	0			
60102052400	85	219	229	229	25	25	0	0	
60102775700	1092	3337	3460	3416	151	151	57	57	116
60101035200	730	2554	2634	2634	212	213			
60102015001	19	5	7	7	5	5			
60102050200	82	474	483	482	19	19	2	2	3
60102021403	38	50	54	54	10	10			
60102017026	116	110	122	122	32	32			
60102010500	52	70	75	74	14	9			
60102027036	85	206	215	213	13	9	10	10	
60102023304	84	200	208	208	22	22			
60101031202	311	154	184	179	55	43	23	23	
60102771801	108	221	231	233	27	31			
60102775601	281	683	709	709	67	67			
60102021402	50	162	166	166	12	12			
60102777105	124	101	112	112	28	28			
60101031200	235	394	414	414	48	48	5	6	
60102013701	19	12	13	12	4	0			
60101060202	47	109	112	112	10	10			
60102052502	95	342	350	350	20	20			
60102015800	63	127	132	130	13	9			
60102020200	201	200	215	215	27	27	13	13	
60102771800	19	37	38	38	4	4			
60102022304	28	135	137	137	6	6			
60102043103	102	241	249	249	20	20			
60102011603	37	144	147	147	7	7			
60102775405	69	332	337	332	13	0			
60102020201	276	222	241	241	37	37	13	13	
60102022404	16	47	48	48	3	3			
60102025407	18	20	21	21	3	3			
60102027040	120	309	317	317	21	21			
60102055200	255	443	460	460	39	39	5	5	
60102010203	59	174	178	177	10	7			

Appendix B - Exhibit 3 - 3rd Order DBRUs

DBRU	Acres	Alt 1 Sediment tons/decade	Alt 2 Sediment tons/decade	Alt 3 Sediment tons/decade	Alt 2 Treatment Erosion t/d	Alt 3 Treatment Erosion t/d	Alt 2 Temp Road Erosion t/d	Alt 3 Temp Road Erosion t/d	New Road Construction Erosion t/d
60102023802	**206**	763	776	776	34	34			
60101031400	**86**	98	103	103	14	14			
60101031101	**113**	54	61	61	18	18			
60102772200	**83**	30	35	35	11	11	1	1	
60102055203	**53**	38	41	41	8	8			
60101031500	**197**	154	164	164	28	28			
60102025703	**67**	62	65	64	4	3	4	4	
60102051800	**433**	1440	1458	1440	26	0	21	0	
60101031301	**85**	23	26	26	9	9			
60102013700	**286**	839	851	839	30	0			
60102772399	**84**	330	333	333	9	9			
60102011403	**100**	214	218	218	10	10			
60102025408	**18**	20	20	20	2	2			
60102772100	**107**	507	510	510	7	7	2	2	
60102015500	**99**	268	271	271	8	8			
60102775800	**297**	200	208	208	21	21			
60102022602	**89**	513	515	515	6	6			
60102017017	**55**	206	207	207	4	4			
60102027000	**1477**	1174	1209	1200	92	66	2	2	
60101031000	**570**	779	793	793	36	36			
60102020100	**72**	237	239	239	4	4			
60102011300	**197**	391	396	396	0	0	12	12	
60102011501	**14**	15	15	15	1	1			
60102055700	**565**	2558	2569	2569	24	24	7	7	
60102022303	**92**	147	149	149	5	5			
60102017000	**1319**	2778	2799	2797	51	47	3	3	
60102777104	**174**	177	180	180	7	7			
60101065100	**198**	171	174	174	8	8			
60102017014	**114**	257	259	259	4	4			
60102774900	**276**	1281	1283	1283	7	7			
60102021200	**242**	532	534	534	4	4	1	1	
60102773006	**72**	316	316	316	1	1	0	0	
60101031300	**520**	359	362	362	9	9			
60102022302	**72**	26	27	27	1	1			
60102773705	**238**	1085	1086	1086	4	4			
60102023701	**33**	128	128	128	0	0			
60101031004	**540**	805	808	808	7	7			
60102021207	**98**	152	153	153	1	1			
60102021503	**64**	281	282	282	1	1			
60102772500	**23**	6	6	6	0	0			
60102021202	**88**	143	143	143	1	1			
60102025400	**511**	480	481	481	3	3			
60101060102	**124**	152	152	152	1	0			
60102022500	**61**	72	72	72	0	0			
60102773700	**276**	438	438	438	1	1			
60102021205	**21**	75	75	75	0	0			
60102021300	**50**	60	60	60	0	0			
60102025103	**205**	421	421	421	0	0			
60101035202	**39**	75	75	106	0	81			
60102014500	**31**	74	74	74	0	0			
60102011500	**19**	20	20	20	0	0			
60102774803	**103**	520	520	522	0	0	0	5	
60102011402	**22**	45	45	45	0	0			
60102771500	**220**	175	175	176	0	3			
60102050602	**149**	361	361	368	0	10	0	9	
60102050302	**55**	123	123	127	0	8			
60102055600	**544**	1202	1202	1234	0	84	0	1	
60102055603	**76**	27	27	49	0	35	0	23	
60102050303	**85**	323	323	355	0	41	0	46	
60101035203	**31**	42	42	66	0	62			
60102055602	**41**	11	11	48	0	71	0	26	
Total	33,441	72,595	80,353	79,232	15,769	15,323	1,888	2,143	2,761
mean	154								

Appendix B - Exhibit 3 - 3rd Order D

		FS Ownership Erosion tons/decade (t/d)					Non-FS Ownership Erosion tons/decade							Other Activities Erosion tons/deca				
DBRU	Acres	Cropland	Forest	Grass/Herb	Urban	Water	Barren	Cropland	Forest	Grass/Herb	Herb. Wetland	Urban	Water	Past Activity	Rx Fire	Road	Utility	Wildlife Mgmt Area
60102023303	88		52	28					48	21						122		
60102050301	67		21	2					157	163						256		
60102775801	40		24						52									
60102011605	24		14	11											42	131		
60102025701	70		36	8					155	4					1	94		
60102025702	49		34	1					2						1	24		
60102775704	235		125	223					39	47					179	272		
60102021602	42		28	2					2						85	70		
60102011502	43		29	6											85	75		
60102021303	29		20												63			
60102021603	44		28	13										0	94	153		
60102011604	40		25	6					11	1					63	222		
60102027029	130		68	22					118	113					220	397		
60102011101	118		31	0					643	70						149		
60102021604	70		48	0											128	157		
60102015401	168		81	18					430	28						290		
60102775406	195		41				267		1125	175						357		
60102014101	35		18	2					72	6					22	152		
60102011202	170		98	25					225	8						243		
60102011102	39		26	5												75		
60102773703	52		35	0		0										227		
60101031203	46		30	0											100	52		25
60102023202	61		41						26							25		
60102025102	90		56						82	3						137		
60102021701	178		121												62	200		22
60102040402	194		98	26					425	25					1	288		
60102022501	130		84	7					2	68					260	112		
60102020104	109		74													171		
60102025705	68		42	16					8	8					14	335		
60102775705	205	0	87	301					65	113					251	12		
60102021502	167	0	61	14				111	554	128				0		660		
60102025100	371		153	15			407		887	479					109	490		
60102013702	29		13	0					84	11				18		140		
60102017019	113		52	5					208	140						291		
60102775500	277		188						13							642		
60102020103	94		64	1												223		
60102022403	25		16	13											54	7		
60102775408	112		36	10					551	25						68		
60102023800	214		142	24					51						165	156		
60102775802	90		55	48						0						216		
60102011305	306		155	9					790	0				0	8	344		
60102023302	91		57						88	3						18		
60102027037	91		60	14											187	149		
60102011203	106		29	4					228	341						312		
60102043203	73		18	16					398	22					4	217		
60102017020	61		39	18												148		
60102771900	176		96						316	65								
60101065101	82		56	13											6	1		
60102773004	98		45	59	28			2	43	105		27			30	417		
60102011601	137		84	9					59	64				0	254	231		
60102011201	26		18															
60102775712	353		182	152					390	134					269	443		
60102027027	140		83	55					42	1						605		
60102015000	56		39	0					1							61		
60102052302	42		20						124	16								
60102023002	32		21	3											66	155		
60101031100	112		76													75		10
60102775703	89		61													57		
60102017018	109		73	6					6						230	275		
60102022001	28		19													72		
60102023300	190		41	0					1138	151								
60102772501	57		33						101									
60102021904	56		38													161		
60101031204	74		50												143	205		
60102025406	24		16												42	52		6
60102022402	661		219	22				765	1314	1674		125			144	1485		
60101030008	467		229						1243	28					5	782		19
60102772101	91		62						18							137		
60102023000	6		4			0									12			
60102023101	72		38	11					122	2					1	162		12
60102011302	62		30						191	0						7		
60102777110	169		72						526	98						328		
60102772300	65		45													37		
60102021605	21		14												41	49		1
60102025700	393		137	5			0		1614	263					0	397		9
60101031201	108		76															
60102021600	109		75												233	5		12
60102052401	48		8	0					339	17					2	42		

Appendix B - Exhibit 3 - 3rd Order D

		FS Ownership Erosion tons/decade (t/d)					Non-FS Ownership Erosion tons/decade							Other Activities Erosion tons/deca				
DBRU	Acres	Cropland	Forest	Grass/Herb	Urban	Water	Barren	Cropland	Forest	Grass/Herb	Herb. Wetland	Urban	Water	Past Activity	Rx Fire	Road	Utility	Wildlife Mgmt Area
60102022401	168		46	16					839	120					114	361		
60102775803	376		222	79					239	65					0	1168		
60102775407	255		73						1122	295						643		
60102011200	43		30															
60101060201	144		45	1					327	337					33	811		9
60102013900	613		263	12				89	2132	128				0	164	614		
60101060200	68		47	0											81	5		15
60102016001	165		58	16				54	735	22						247		
60102025104	103		35	1					371	128						138		
60102027038	139		70	9					339	13					1	184		
60102021304	50		35												108			
60102013906	218		43						993	452		35			2	795		
60102013601	56		38						5						11	143		
60102014100	148		42						794	70					35	94		
60102021601	78		46						67						78	199		20
60102013603	146		45	10					594	160					1	285		
60102027028	66		42	20											141	161		
60102011301	58		39													87		
60102011600	270		185	11										0	549	309		
60102055202	59		41													11		
60102025704	127		81	32											30	283		17
60102023301	65		22						337	2						14		
60102022400	113		78	4											243	70		
60102773801	287		60	23					1011	798						553		
60102043102	49		31	1					32	3						112		
60102775400	790		179	45	28			2622	2012	2474					152	2203		
60102011100	54		26	6					50	96								
60102011304	142		37	2					866	15						130		
60102017021	105		53	6					248	12				0		110		
60102023201	141		81	75					45	11					44	414		
60102021302	86		54	34											183	221		
60102013600	87		43						257					7	50	9		
60102027034	95		64	7											200	137		
60102775702	94		64													90		19
60102021206	15		10	7											32	5		
60102773002	136		5	25					1120	97					13	167		
60102013902	310	0	71	19				429	950	924				0	0	117		
60102013706	241		72	10					359	835			0			247		
60102022601	51		5	3					258	154						94		
60102040403	96		6						875									
60102771802	212		131	73					41	1					145	625		
60102773003	176		53	426	0	0		123	0	75					238	469		
60102022300	37		21	15											17	339		
60102773000	299	0	49	106					1503	474					34	496		
60102775701	78		54													146		
60102771903	34		23													55		
60102052400	85		20						488	68								
60102775700	1092		345	387				554	2027	2579		152			449	2289		0
60101035200	730		185	2			222		2302	1875		53		0		2007		72
60102015001	19		13															
60102050200	82		17	6	0				286	161		251				526		
60102021403	38		21	0					51	21						38		
60102017026	116		75	22											0	158		34
60102010500	52		35	7											84	59		
60102027036	85		57	1											183	298		4
60102023304	84		41	96					20	10						360		
60101031202	311		212	32											60	101		
60102771801	108		39	7					292	189					5	50		
60102775601	281		107						1026	164						501		
60102021402	50		24	2					60	61				0		278		
60102777105	124		85						0							170		11
60101031200	235		117	1		0			330	10	0		0		153	396		30
60102013701	19		13											2		16		
60101060202	47		24	19					49	11						183		
60102052502	95		12	33					518	154						183		
60102015800	63		42	9											135	147		
60102020200	201		121				135		251	19								
60102771800	19		12	2	14				3	6					24	35		
60102022304	28		16	9											16	313		
60102043103	102		59	36					52	2						486		
60102011603	37		7						163	79					0	129		
60102775405	69		2					59	589	48						177		
60102020201	276		190													393		
60102022404	16		11	2											35	77		
60102025407	18		13												39	1		
60102027040	120		54	19	7				321	31						380		
60102055200	255		105	7					833	169						48		5
60102010203	59		16	0					329	19					2	92		

Appendix B - Exhibit 3 - 3rd Order D

		FS Ownership Erosion tons/decade (t/d)					Non-FS Ownership Erosion tons/decade							Other Activities Erosion tons/deca				
DBRU	Acres	Cropland	Forest	Grass/Herb	Urban	Water	Barren	Cropland	Forest	Grass/Herb	Herb. Wetland	Urban	Water	Past Activity	Rx Fire	Road	Utility	Wildlife Mgmt Area
60102023802	206		33	8					1075	400					0	490		
60101031400	86		57													173		27
60101031101	113		77													25		41
60102772200	83		58						2							18		
60102055203	53		34	0												42		24
60101031500	197		133											0		232		40
60102025703	67		44	11											4	102		
60102051800	433		88	22			3		2007	850						819		
60101031301	85		60															0
60102013700	286		87	5					731	726				12		648		
60102772399	84		14	8					424	165					0	257		
60102011403	100		68												187	308		
60102025408	18		13												39			
60102772100	107		6						785	163						380		
60102015500	99		51	11					139	64					59	381		
60102775800	297		184			0			302	41								
60102022602	89		1	0				209	195	559						386		
60102017017	55		33	22											117	369		
60102027000	1477		1005	50		0			65	7					1182	676		104
60101031000	570		375	99	1				26	0		7			366	1176		
60102020100	72		8				21		574	22								
60102011300	197		72						926	10						21		
60102011501	14		10												30			
60102055700	565		56	0					2942	1409		587				1341	395	
60102022303	92		60	17										0	10	300		
60102017000	1319		678	63					2392	709				0	1533	1916		20
60102777104	174		114	35					1							307		10
60101065100	198		114			0	111		224	1			0		0			
60102017014	114		74	16					13	0					230	344		
60102774900	276		14	19					1469	822			0			1046		
60102021200	242		145	138											503	614		
60102773006	72		0	2					628	62						138		
60101031300	520		337	4					4							197		401
60102022302	72		50													19		
60102773705	238		13						765	1204		38				836		
60102023701	33		4						254	2						75		
60101031004	540		342	180											37	1561		
60102021207	98		64	17					6	5					202	107		
60102021503	64		2	0					537	57					0	144		
60102772500	23		16															
60102021202	88		57	27											177	115		
60102025400	511		356	4											877	26		
60101060102	124		85												245	65		3
60102022500	61		43												131	14		
60102773700	276		158	27		0			240	106						622		
60102021205	21		12	9											32	143		
60102021300	50		35	1											107	14		
60102025103	205		80						854	29						145		
60101035202	39		26													171		
60102014500	31		10						120	33						32		
60102011500	19		13												40			
60102774803	103								360	571						437		
60102011402	22		15											0	46	56		
60102771500	220		152													309		
60102050602	149		88	12					108							562	180	
60102050302	55		19	0					97	160						48		
60102055600	544		245	40					1119	552		93			192	920		
60102055603	76		51	19					1									
60102050303	85		20	1					343	167		53				266		
60101035203	31		21													86		4
60102055602	41		29															
Total	33,441	-	15,724	3,913	79	-	1,166	5,017	63,366	26,950	-	1,420	-	39	13,911	57,856	575	1,023
mean	154																	

Appendix B - Exhibit 3 - 3rd Order D

DBRU	Acres	Sediment mean t/a/y for decade	Sediment mean t/a/y for decade	Sediment mean t/a/y for decade	Alt 2 Percent Increase in Sediment for decade	Percent Increase in Sediment for decade	mean concentration ppm over decade	mean concentration ppm over decade	mean concentration ppm over decade	SS ppm Alt 2 - Alt1	SS ppm Alt 3 - Alt1
60102023303	**88**	0.12	0.24	0.07	141.86	61.23	23.45	56.72	37.81	33.3	14.4
60102050301	**67**	0.34	0.15	0.09	47.19	27.16	67.77	99.75	86.18	32.0	18.4
60102775801	**40**	0.07	0.28	0.10	182.11	182.11	14.62	41.24	41.24	26.6	26.6
60102011605	**24**	0.32	0.14	0.10	38.39	38.39	63.57	87.97	87.97	24.4	24.4
60102025701	**70**	0.16	0.17	0.08	67.92	34.26	32.22	54.10	43.26	21.9	11.0
60102025702	**49**	0.05	0.33	0.06	225.02	100.73	9.61	31.24	19.29	21.6	9.7
60102775704	**235**	0.14	0.18	0.09	75.52	49.69	28.59	50.18	42.79	21.6	14.2
60102021602	**42**	0.17	0.16	0.10	60.33	60.33	33.55	53.79	53.79	20.2	20.2
60102011502	**43**	0.17	0.16	0.10	57.99	57.99	34.68	54.79	54.79	20.1	20.1
60102021303	**29**	0.11	0.19	0.10	89.31	89.31	21.66	41.01	41.01	19.3	19.3
60102021603	**44**	0.25	0.14	0.10	38.24	38.24	49.98	69.09	69.09	19.1	19.1
60102011604	**40**	0.31	0.13	0.10	30.76	30.76	62.09	81.19	81.19	19.1	19.1
60102027029	**130**	0.27	0.13	0.09	34.47	14.98	54.74	73.61	62.94	18.9	8.2
60102011101	**118**	0.29	0.13	0.08	32.62	10.45	57.73	76.56	63.76	18.8	6.0
60102021604	**70**	0.18	0.15	0.10	51.81	51.81	36.21	54.97	54.97	18.8	18.8
60102015401	**168**	0.19	0.14	0.10	44.52	44.52	38.32	55.38	55.38	17.1	17.1
60102775406	**195**	0.38	0.12	0.08	22.26	0.00	76.45	93.47	76.45	17.0	0.0
60102014101	**35**	0.29	0.13	0.10	28.78	28.78	58.92	75.87	75.87	17.0	17.0
60102011202	**170**	0.13	0.16	0.10	61.23	53.23	26.72	43.08	40.94	16.4	14.2
60102011102	**39**	0.10	0.18	0.08	76.23	46.61	20.72	36.51	30.37	15.8	9.7
60102773703	**52**	0.19	0.14	0.10	40.50	40.50	38.37	53.91	53.91	15.5	15.5
60101031203	**46**	0.17	0.15	0.10	45.76	44.70	33.78	49.23	48.87	15.5	15.1
60102023202	**61**	0.06	0.23	0.10	133.18	133.18	11.40	26.57	26.57	15.2	15.2
60102025102	**90**	0.12	0.16	0.09	62.52	53.38	23.36	37.96	35.82	14.6	12.5
60102021701	**178**	0.09	0.18	0.10	84.54	84.54	17.24	31.82	31.82	14.6	14.6
60102040402	**194**	0.17	0.14	0.10	43.13	43.13	33.80	48.37	48.37	14.6	14.6
60102022501	**130**	0.16	0.15	0.08	46.31	20.44	31.26	45.73	37.64	14.5	6.4
60102020104	**109**	0.09	0.18	0.10	84.35	84.35	17.12	31.57	31.57	14.4	14.4
60102025705	**68**	0.24	0.13	0.10	30.47	30.47	47.14	61.51	61.51	14.4	14.4
60102775705	**205**	0.15	0.15	0.08	46.60	19.88	30.73	45.06	36.85	14.3	6.1
60102021502	**167**	0.35	0.12	0.10	20.54	20.32	69.67	83.98	83.83	14.3	14.2
60102025100	**371**	0.26	0.13	0.09	27.39	20.69	52.02	66.27	62.79	14.2	10.8
60102013702	**29**	0.34	0.12	0.08	20.61	0.00	68.74	82.92	68.74	14.2	0.0
60102017019	**113**	0.23	0.13	0.10	29.78	29.78	46.67	60.57	60.57	13.9	13.9
60102775500	**277**	0.12	0.16	0.10	59.56	59.56	23.07	36.82	36.82	13.7	13.7
60102020103	**94**	0.12	0.16	0.10	58.16	58.16	23.34	36.91	36.91	13.6	13.6
60102022403	**25**	0.14	0.15	0.10	45.24	45.24	27.10	39.36	39.36	12.3	12.3
60102775408	**112**	0.23	0.13	0.10	25.78	25.78	46.98	59.09	59.09	12.1	12.1
60102023800	**214**	0.10	0.16	0.10	61.73	61.73	19.11	30.90	30.90	11.8	11.8
60102775802	**90**	0.13	0.14	0.10	40.80	40.80	26.91	37.88	37.88	11.0	11.0
60102011305	**306**	0.16	0.13	0.10	33.39	33.39	32.46	43.30	43.30	10.8	10.8
60102023302	**91**	0.07	0.18	0.10	77.34	77.34	13.93	24.71	24.71	10.8	10.8
60102027037	**91**	0.17	0.13	0.09	31.12	23.40	34.32	45.00	42.35	10.7	8.0
60102011203	**106**	0.33	0.12	0.09	16.26	6.61	65.51	76.17	69.84	10.7	4.3
60102043203	**73**	0.35	0.12	0.10	15.07	15.07	70.66	81.31	81.31	10.7	10.7
60102017020	**61**	0.13	0.14	0.10	40.51	40.51	25.62	36.00	36.00	10.4	10.4
60102771900	**176**	0.10	0.15	0.07	50.08	0.00	20.55	30.84	20.55	10.3	0.0
60101065101	**82**	0.04	0.24	0.10	144.07	144.07	7.07	17.25	17.25	10.2	10.2
60102773004	**98**	0.29	0.12	0.10	17.07	17.07	58.48	68.46	68.46	10.0	10.0
60102011601	**137**	0.19	0.13	0.10	25.30	25.30	38.77	48.58	48.58	9.8	9.8
60102011201	**26**	0.03	0.28	0.10	182.02	182.02	5.32	15.00	15.00	9.7	9.7
60102775712	**353**	0.17	0.13	0.10	28.43	28.43	33.84	43.46	43.46	9.6	9.6
60102027027	**140**	0.21	0.12	0.10	22.37	22.37	42.64	52.17	52.17	9.5	9.5
60102015000	**56**	0.07	0.17	0.10	67.95	67.95	13.55	22.76	22.76	9.2	9.2
60102052302	**42**	0.14	0.13	0.08	31.96	0.00	28.73	37.91	28.73	9.2	0.0
60102023002	**32**	0.29	0.12	0.10	15.50	10.71	58.99	68.14	65.31	9.1	6.3
60101031100	**112**	0.05	0.18	0.11	82.63	98.19	10.87	19.86	21.55	9.0	10.7
60102775703	**89**	0.05	0.19	0.10	87.19	87.19	10.05	18.81	18.81	8.8	8.8
60102017018	**109**	0.21	0.12	0.10	20.18	20.18	41.25	49.58	49.58	8.3	8.3
60102022001	**28**	0.12	0.13	0.10	33.21	33.21	24.73	32.94	32.94	8.2	8.2
60102023300	**190**	0.27	0.11	0.10	14.98	11.08	53.35	61.35	59.26	8.0	5.9
60102772501	**57**	0.09	0.14	0.10	44.38	44.38	17.95	25.92	25.92	8.0	8.0
60102021904	**56**	0.14	0.13	0.10	28.81	28.81	27.22	35.07	35.07	7.8	7.8
60101031204	**74**	0.21	0.12	0.10	18.84	18.79	41.11	48.85	48.83	7.7	7.7
60102025406	**24**	0.18	0.12	0.10	20.75	20.75	36.22	43.74	43.74	7.5	7.5
60102022402	**661**	0.33	0.11	0.10	11.19	7.94	66.13	73.53	71.38	7.4	5.2
60101030008	**467**	0.19	0.12	0.10	19.06	21.72	37.53	44.68	45.68	7.2	8.2
60102772101	**91**	0.09	0.14	0.10	39.22	39.22	17.99	25.05	25.05	7.1	7.1
60102023000	**6**	0.11	0.13	0.09	32.17	22.22	21.55	28.48	26.34	6.9	4.8
60102023101	**72**	0.18	0.12	0.10	18.78	18.78	36.53	43.39	43.39	6.9	6.9
60102011302	**62**	0.14	0.12	0.10	24.08	24.08	28.01	34.76	34.76	6.7	6.7
60102777110	**169**	0.23	0.11	0.10	13.61	13.61	46.02	52.28	52.28	6.3	6.3
60102772300	**65**	0.05	0.16	0.10	64.38	64.38	9.55	15.70	15.70	6.1	6.1
60102021605	**21**	0.19	0.12	0.10	16.24	16.24	37.49	43.58	43.58	6.1	6.1
60102025700	**393**	0.23	0.11	0.10	12.90	12.76	46.98	53.04	52.97	6.1	6.0
60101031201	**108**	0.03	0.21	0.16	113.12	250.92	5.32	11.34	18.67	6.0	13.3
60102021600	**109**	0.11	0.13	0.10	26.06	26.06	22.78	28.72	28.72	5.9	5.9
60102052401	**48**	0.32	0.11	0.10	8.94	8.94	64.72	70.51	70.51	5.8	5.8

Appendix B - Exhibit 3 - 3rd Order D

DBRU	Acres	Sediment mean t/a/y for decade	Sediment mean t/a/y for decade	Sediment mean t/a/y for decade	Alt 2 Percent Increase in Sediment for decade	Percent Increase in Sediment for decade	mean concentration ppm over decade	mean concentration ppm over decade	mean concentration ppm over decade	SS ppm Alt 2 - Alt1	SS ppm Alt 3 - Alt1
60102022401	**168**	0.34	0.11	0.10	8.53	8.53	67.51	73.26	73.26	5.8	5.8
60102775803	**376**	0.18	0.12	0.10	15.74	13.18	35.87	41.52	40.60	5.6	4.7
60102775407	**255**	0.32	0.11	0.09	8.68	0.00	63.59	69.12	63.59	5.5	0.0
60102011200	**43**	0.03	0.20	0.10	103.01	103.01	5.32	10.80	10.80	5.5	5.5
60101060201	**144**	0.41	0.11	0.10	6.51	5.94	82.54	87.91	87.44	5.4	4.9
60102013900	**613**	0.21	0.11	0.10	12.48	7.68	42.16	47.42	45.40	5.3	3.2
60101060200	**68**	0.08	0.13	0.09	31.39	21.87	16.48	21.66	20.09	5.2	3.6
60102016001	**165**	0.26	0.11	0.10	9.87	9.87	52.12	57.26	57.26	5.1	5.1
60102025104	**103**	0.25	0.11	0.10	10.13	10.13	49.81	54.86	54.86	5.0	5.0
60102027038	**139**	0.17	0.11	0.10	14.80	14.77	33.62	38.60	38.59	5.0	5.0
60102021304	**50**	0.11	0.12	0.10	22.88	22.88	21.66	26.62	26.62	5.0	5.0
60102013906	**218**	0.40	0.11	0.10	6.08	4.87	80.78	85.69	84.71	4.9	3.9
60102013601	**56**	0.13	0.12	0.10	18.20	18.20	26.82	31.71	31.71	4.9	4.9
60102014100	**148**	0.27	0.11	0.10	9.13	9.13	53.30	58.17	58.17	4.9	4.9
60102021601	**78**	0.20	0.11	0.10	12.17	12.17	39.81	44.66	44.66	4.8	4.8
60102013603	**146**	0.29	0.11	0.10	8.38	8.38	57.01	61.79	61.79	4.8	4.8
60102027028	**66**	0.21	0.11	0.10	11.30	11.30	42.17	46.94	46.94	4.8	4.8
60102011301	**58**	0.08	0.13	0.10	27.63	27.63	16.69	21.30	21.30	4.6	4.6
60102011600	**270**	0.15	0.12	0.10	15.27	14.74	29.74	34.28	34.13	4.5	4.4
60102055202	**59**	0.03	0.16	0.10	63.99	63.99	6.73	11.04	11.04	4.3	4.3
60102025704	**127**	0.13	0.12	0.10	16.17	16.17	26.48	30.76	30.76	4.3	4.3
60102023301	**65**	0.22	0.11	0.10	9.78	9.78	43.63	47.90	47.90	4.3	4.3
60102022400	**113**	0.13	0.12	0.10	16.08	16.08	26.53	30.80	30.80	4.3	4.3
60102773801	**287**	0.32	0.11	0.10	6.43	6.43	64.78	68.95	68.95	4.2	4.2
60102043102	**49**	0.14	0.12	0.10	15.06	15.06	27.50	31.65	31.65	4.1	4.1
60102775400	**790**	0.47	0.10	0.10	4.39	4.39	93.47	97.58	97.58	4.1	4.1
60102011100	**54**	0.12	0.12	0.10	15.88	15.88	24.88	28.84	28.84	4.0	4.0
60102011304	**142**	0.28	0.11	0.10	6.99	6.99	56.14	60.07	60.07	3.9	3.9
60102017021	**105**	0.16	0.11	0.10	12.21	10.20	31.03	34.82	34.20	3.8	3.2
60102023201	**141**	0.18	0.11	0.10	10.30	10.30	36.19	39.92	39.92	3.7	3.7
60102021302	**86**	0.22	0.11	0.10	8.26	8.26	43.31	46.89	46.89	3.6	3.6
60102013600	**87**	0.16	0.11	0.10	10.68	7.07	31.89	35.30	34.15	3.4	2.3
60102027034	**95**	0.16	0.11	0.10	10.39	7.17	32.73	36.13	35.08	3.4	2.3
60102775702	**94**	0.07	0.12	0.10	24.11	24.11	13.96	17.33	17.33	3.4	3.4
60102021206	**15**	0.14	0.11	0.10	12.32	12.32	27.02	30.35	30.35	3.3	3.3
60102773002	**136**	0.40	0.10	0.10	4.01	4.01	79.59	82.78	82.78	3.2	3.2
60102013902	**310**	0.31	0.10	0.10	4.96	4.77	61.64	64.70	64.58	3.1	2.9
60102013706	**241**	0.24	0.11	0.10	6.26	6.26	48.14	51.15	51.15	3.0	3.0
60102022601	**51**	0.38	0.10	0.10	3.89	3.89	76.48	79.45	79.45	3.0	3.0
60102040403	**96**	0.35	0.10	0.10	4.26	4.26	69.84	72.82	72.82	3.0	3.0
60102771802	**212**	0.18	0.11	0.10	7.44	11.48	36.48	39.20	40.67	2.7	4.2
60102773003	**176**	0.30	0.10	0.10	4.45	4.45	59.60	62.25	62.25	2.7	2.7
60102022300	**37**	0.40	0.10	0.10	3.12	3.12	80.65	83.16	83.16	2.5	2.5
60102773000	**299**	0.34	0.10	0.10	3.65	3.65	67.61	70.08	70.08	2.5	2.5
60102775701	**78**	0.10	0.11	0.10	11.76	11.76	19.35	21.63	21.63	2.3	2.3
60102771903	**34**	0.09	0.11	0.09	12.83	0.00	17.70	19.97	17.70	2.3	0.0
60102052400	**85**	0.26	0.10	0.10	4.40	4.40	51.46	53.73	53.73	2.3	2.3
60102775700	**1092**	0.31	0.10	0.10	3.68	2.36	61.13	63.38	62.57	2.3	1.4
60101035200	**730**	0.35	0.10	0.10	3.15	3.17	69.98	72.18	72.20	2.2	2.2
60102015001	**19**	0.03	0.14	0.10	40.35	40.35	5.32	7.47	7.47	2.1	2.1
60102050200	**82**	0.58	0.10	0.10	1.84	1.62	115.39	117.51	117.26	2.1	1.9
60102021403	**38**	0.13	0.11	0.10	7.88	7.88	26.56	28.66	28.66	2.1	2.1
60102017026	**116**	0.09	0.11	0.10	10.95	10.95	18.93	21.00	21.00	2.1	2.1
60102010500	**52**	0.14	0.11	0.10	7.39	5.10	27.14	29.15	28.53	2.0	1.4
60102027036	**85**	0.24	0.10	0.10	4.15	3.42	48.30	50.31	49.95	2.0	1.7
60102023304	**84**	0.24	0.10	0.10	4.14	4.14	47.45	49.42	49.42	2.0	2.0
60101031202	**311**	0.05	0.12	0.10	19.37	16.33	9.91	11.83	11.53	1.9	1.6
60102771801	**108**	0.20	0.10	0.10	4.63	5.40	40.95	42.85	43.17	1.9	2.2
60102775601	**281**	0.24	0.10	0.10	3.74	3.74	48.68	50.50	50.50	1.8	1.8
60102021402	**50**	0.32	0.10	0.10	2.75	2.75	64.60	66.37	66.37	1.8	1.8
60102777105	**124**	0.08	0.11	0.10	10.70	10.70	16.25	17.98	17.98	1.7	1.7
60101031200	**235**	0.17	0.11	0.10	5.08	5.17	33.45	35.14	35.17	1.7	1.7
60102013701	**19**	0.06	0.11	0.09	13.50	0.00	12.49	14.17	12.49	1.7	0.0
60101060202	**47**	0.23	0.10	0.10	3.50	3.50	46.29	47.91	47.91	1.6	1.6
60102052502	**95**	0.36	0.10	0.10	2.23	2.23	72.17	73.77	73.77	1.6	1.6
60102015800	**63**	0.20	0.10	0.10	3.93	2.72	40.12	41.69	41.21	1.6	1.1
60102020200	**201**	0.10	0.11	0.10	7.69	7.69	19.82	21.34	21.34	1.5	1.5
60102771800	**19**	0.19	0.10	0.10	3.95	3.95	37.87	39.37	39.37	1.5	1.5
60102022304	**28**	0.48	0.10	0.10	1.56	1.56	95.40	96.89	96.89	1.5	1.5
60102043103	**102**	0.24	0.10	0.10	3.12	3.12	47.33	48.81	48.81	1.5	1.5
60102011603	**37**	0.39	0.10	0.10	1.82	1.82	78.50	79.93	79.93	1.4	1.4
60102775405	**69**	0.48	0.10	0.10	1.47	0.00	96.65	98.07	96.65	1.4	0.0
60102020201	**276**	0.08	0.11	0.10	8.61	8.61	16.05	17.43	17.43	1.4	1.4
60102022404	**16**	0.29	0.10	0.10	2.37	2.37	58.17	59.55	59.55	1.4	1.4
60102025407	**18**	0.11	0.11	0.10	6.07	6.07	22.05	23.39	23.39	1.3	1.3
60102027040	**120**	0.26	0.10	0.10	2.60	2.60	51.47	52.81	52.81	1.3	1.3
60102055200	**255**	0.17	0.10	0.10	3.77	3.77	34.75	36.07	36.07	1.3	1.3
60102010203	**59**	0.30	0.10	0.10	2.11	1.46	59.46	60.71	60.33	1.3	0.9

Appendix B - Exhibit 3 - 3rd Order D

DBRU	Acres	Sediment mean t/a/y for decade	Sediment mean t/a/y for decade	Sediment mean t/a/y for decade	Alt 2 Percent Increase in Sediment for decade	Percent Increase in Sediment for decade	mean concentration ppm over decade	mean concentration ppm over decade	mean concentration ppm over decade	SS ppm Alt 2 - Alt1	SS ppm Alt 3 - Alt1
60102023802	**206**	0.37	0.10	0.10	1.68	1.68	74.13	75.38	75.38	1.2	1.2
60101031400	**86**	0.11	0.11	0.10	5.28	5.28	22.78	23.98	23.98	1.2	1.2
60101031101	**113**	0.05	0.11	0.10	12.52	12.52	9.56	10.76	10.76	1.2	1.2
60102772200	**83**	0.04	0.12	0.10	16.02	16.02	7.16	8.31	8.31	1.1	1.1
60102055203	**53**	0.07	0.11	0.10	7.75	7.75	14.36	15.48	15.48	1.1	1.1
60101031500	**197**	0.08	0.11	0.10	6.80	6.80	15.65	16.71	16.71	1.1	1.1
60102025703	**67**	0.09	0.10	0.10	4.96	4.17	18.45	19.37	19.22	0.9	0.8
60102051800	**433**	0.33	0.10	0.10	1.23	0.00	66.51	67.33	66.51	0.8	0.0
60101031301	**85**	0.03	0.12	0.10	15.18	15.18	5.34	6.16	6.16	0.8	0.8
60102013700	**286**	0.29	0.10	0.10	1.37	0.00	58.76	59.56	58.76	0.8	0.0
60102772399	**84**	0.39	0.10	0.10	1.00	1.00	78.95	79.74	79.74	0.8	0.8
60102011403	**100**	0.21	0.10	0.10	1.72	1.72	42.67	43.40	43.40	0.7	0.7
60102025408	**18**	0.11	0.10	0.10	3.09	3.09	21.66	22.33	22.33	0.7	0.7
60102772100	**107**	0.47	0.10	0.10	0.69	0.69	94.34	94.99	94.99	0.7	0.7
60102015500	**99**	0.27	0.10	0.10	1.18	1.18	53.94	54.58	54.58	0.6	0.6
60102775800	**297**	0.07	0.10	0.10	4.01	4.01	13.46	14.00	14.00	0.5	0.5
60102022602	**89**	0.58	0.10	0.10	0.43	0.43	115.35	115.84	115.84	0.5	0.5
60102017017	**55**	0.38	0.10	0.10	0.66	0.66	75.13	75.63	75.63	0.5	0.5
60102027000	**1477**	0.08	0.10	0.10	3.03	2.21	15.89	16.38	16.25	0.5	0.4
60101031000	**570**	0.14	0.10	0.10	1.76	1.76	27.33	27.81	27.81	0.5	0.5
60102020100	**72**	0.33	0.10	0.10	0.71	0.71	66.16	66.63	66.63	0.5	0.5
60102011300	**197**	0.20	0.10	0.10	1.15	1.15	39.74	40.19	40.19	0.5	0.5
60102011501	**14**	0.11	0.10	0.10	2.00	2.00	21.66	22.09	22.09	0.4	0.4
60102055700	**565**	0.45	0.10	0.10	0.46	0.46	90.49	90.91	90.91	0.4	0.4
60102022303	**92**	0.16	0.10	0.10	1.26	1.26	31.88	32.28	32.28	0.4	0.4
60102017000	**1319**	0.21	0.10	0.10	0.75	0.69	42.11	42.43	42.40	0.3	0.3
60102777104	**174**	0.10	0.10	0.10	1.54	1.54	20.37	20.69	20.69	0.3	0.3
60101065100	**198**	0.09	0.10	0.10	1.78	1.78	17.30	17.61	17.61	0.3	0.3
60102017014	**114**	0.23	0.10	0.10	0.65	0.65	45.27	45.56	45.56	0.3	0.3
60102774900	**276**	0.46	0.10	0.10	0.20	0.20	92.81	93.00	93.00	0.2	0.2
60102021200	**242**	0.22	0.10	0.10	0.40	0.40	44.06	44.24	44.24	0.2	0.2
60102773006	**72**	0.44	0.10	0.10	0.15	0.15	88.10	88.23	88.23	0.1	0.1
60101031300	**520**	0.07	0.10	0.10	0.95	0.95	13.79	13.92	13.92	0.1	0.1
60102022302	**72**	0.04	0.10	0.10	1.69	1.69	7.28	7.40	7.40	0.1	0.1
60102773705	**238**	0.46	0.10	0.10	0.13	0.13	91.16	91.27	91.27	0.1	0.1
60102023701	**33**	0.39	0.10	0.10	0.14	0.14	78.04	78.15	78.15	0.1	0.1
60101031004	**540**	0.15	0.10	0.10	0.35	0.35	29.81	29.91	29.91	0.1	0.1
60102021207	**98**	0.16	0.10	0.10	0.33	0.33	31.17	31.27	31.27	0.1	0.1
60102021503	**64**	0.44	0.10	0.10	0.08	0.08	87.43	87.50	87.50	0.1	0.1
60102772500	**23**	0.03	0.10	0.10	1.07	1.07	5.32	5.38	5.38	0.1	0.1
60102021202	**88**	0.16	0.10	0.10	0.17	0.17	32.50	32.55	32.55	0.1	0.1
60102025400	**511**	0.09	0.10	0.10	0.24	0.24	18.79	18.84	18.84	0.0	0.0
60101060102	**124**	0.12	0.10	0.10	0.16	0.11	24.46	24.50	24.49	0.0	0.0
60102022500	**61**	0.12	0.10	0.10	0.12	0.12	23.45	23.48	23.48	0.0	0.0
60102773700	**276**	0.16	0.10	0.10	0.08	0.08	31.76	31.79	31.79	0.0	0.0
60102021205	**21**	0.36	0.10	0.10	0.03	0.03	72.57	72.59	72.59	0.0	0.0
60102021300	**50**	0.12	0.10	0.10	0.08	0.08	23.93	23.95	23.95	0.0	0.0
60102025103	**205**	0.21	0.10	0.10	0.03	0.03	41.12	41.13	41.13	0.0	0.0
60101035202	**39**	0.19	0.10	0.14	0.02	40.88	38.14	38.15	53.73	0.0	15.6
60102014500	**31**	0.24	0.10	0.10	0.01	0.01	48.23	48.23	48.23	0.0	0.0
60102011500	**19**	0.11	0.10	0.10	0.02	0.02	21.66	21.67	21.67	0.0	0.0
60102774803	**103**	0.50	0.10	0.10	0.00	0.40	100.61	100.61	101.01	0.0	0.4
60102011402	**22**	0.20	0.10	0.10	0.00	0.00	40.60	40.60	40.60	0.0	0.0
60102771500	**220**	0.08	0.10	0.10	0.00	0.68	15.94	15.94	16.05	0.0	0.1
60102050602	**149**	0.24	0.10	0.10	0.00	2.07	48.38	48.38	49.38	0.0	1.0
60102050302	**55**	0.22	0.10	0.10	0.00	2.56	44.54	44.54	45.68	0.0	1.1
60102055600	**544**	0.22	0.10	0.10	0.00	2.68	44.14	44.14	45.33	0.0	1.2
60102055603	**76**	0.04	0.10	0.18	0.00	82.39	7.00	7.00	12.77	0.0	5.8
60102050303	**85**	0.38	0.10	0.11	0.00	10.18	75.53	75.53	83.21	0.0	7.7
60101035203	**31**	0.14	0.10	0.16	0.00	55.84	27.43	27.43	42.75	0.0	15.3
60102055602	**41**	0.03	0.10	0.44	0.00	335.51	5.32	5.32	23.17	0.0	17.8
Total	33,441									1,281	1,148
mean	154	0.20	0.12	0.10	22.74	22.82	40.60	46.50	45.89	5.9	5.3

Appendix C – Biological Assessment/Biological Evaluation

BIOLOGICAL ASSESSMENT / BIOLOGICAL EVALUATION

Loblolly Pine Removal and Restoration Project

US Forest Service
Sumter National Forest
Andrew Pickens Ranger District
Oconee County, South Carolina

December 2012

I. Introduction

The purpose of this Biological Assessment/Biological Evaluation (BA/BE) is to determine whether the proposed action is likely to affect any proposed, endangered, threatened or sensitive (PETS) species.

Proposed, endangered and threatened species are designated by the US Fish and Wildlife Service (USFWS) and are managed under the authority of the Endangered Species Act (ESA) (Public Law [PL] 93-205, as amended) and the National Forest Management Act (PL 94-588). The ESA requires federal agencies to ensure that no actions that they "authorize, fund, or carry out" are likely to jeopardize the continued existence of any proposed, endangered, or threatened species or their habitat.

Sensitive species are managed under the authority of the National Forest Management Act requiring that National Forests manage for "viable populations of all native and desirable non-native species" both across the range of the species and within the planning area. Sensitive species designation occurs on a periodic basis through the recommendation of Forest Biologists who consult with local State Heritage Programs, The Nature Conservancy, and local species experts. The Regional Forester administratively designates sensitive species.

The objectives of this BA/BE are:

- To ensure that Forest Service actions do not contribute to the loss of viability of any PETS species;
- To comply with the requirements of the ESA; and
- To provide a process and standard to ensure PETS species receive full consideration in the decision-making process.

II. Consultation History

Consultation between the Forest Service and USFWS on proposals which may affect listed species or their habitat is required under the ESA, the implementing regulations for the ESA (40 CFR 402), and Forest Service Manual (FSM) 2670.

Informal consultation on this proposal was initiated with USFWS's Charleston Field Office on February 24, 2010. USFWS responded to public scoping in a letter dated April 5, 2010.

A BA/BE was completed for this project on January 19, 2012. The USFWS concurred with the determination of effect in the BA/BE on February 7, 2012 (FWS Log No. 2012-I-0131). Since then, alternative 3 of the proposal was revised to better meet Forest Service management objectives. Additionally, new information about PETS species and their habitats reveals impacts that were not previously considered in the January 2012 BA/BE.

This BA/BE tiers to the Final BA and BE for the *Land and Resource Management Plan Sumter National Forest* (hereafter, Forest Plan) (US Forest Service 2004b). The USFWS was consulted informally on the Forest Plan Final BA and concurred with a determination of "not likely to adversely affect."

III. Proposed Management Action

The Forest Service is proposing to restore native vegetation on sites that were converted to loblolly pine (*Pinus taeda*) 20 to 50 years ago. Loblolly pine is not native to the Blue Ridge Mountains. The Forest Service developed three alternatives: Alternative 1, the No Action Alternative; Alternative 2, the Proposed Action; and Alternative 3, which addresses issues identified during the public scoping process. This BA/BE analyzes the effects of Alternative 3 on PETS species and their habitats. Restoration activities under Alternative 3 would include the following treatments:

<u>Regeneration harvest, with reserves (cut-and-remove – 3,172 acres)</u>. Timber harvest would occur in stands where operable volumes now exist. In addition to cutting loblolly pine, harvest would also include Virginia pine (*P. virginiana*), white pine (*P. strobus*) and hardwoods in some stands. The objectives would be to favor retention of species that are best adapted to a given site and to move stand species composition to more of a mix of native pines and hardwoods. Felling trees of any given species may occur as needed to facilitate safe operations. This treatment would include establishing log landings, loading areas and skid trails, and would include road access in the form of temporary roads or reconstructed roads.

<u>Regeneration harvest, with reserves (cut-and-leave – 1,587 acres)</u>. One or more of the following conditions exist in some stands that preclude efficient removal of felled trees: (1) The quantity of cut merchantable volume in some stands would be too low to be commercially viable, and/or (2) some stands are inaccessible. In these stands, trees would be felled but not removed.

<u>Site preparation and release for reforestation (5,542 acres)</u>. One to three years following cutting treatments, site preparation and release treatments for reforestation include stem injection and foliar spray using the herbicides imazapyr and triclopyr that would be used in identified regeneration units to balance species composition of the regeneration.

Site preparation and release treatments would not be applied in all cases. If an existing stand of loblolly pine is fairly dense, harvest is relatively late in the year, and seedlings are available for planting the following season, only release would be necessary. Likewise, if a site preparation treatment is very effective and competing vegetation does not redevelop for a few years, a

release treatment would not be necessary. If species composition and stocking of the regeneration is within the range of natural variability (the ecological potential), neither site preparation nor release would be necessary. However, effects analysis will be based on all of these acres receiving both site preparation and release treatments.

Vegetation would be treated to control competition with planted or naturally growing preferred species, which would usually be native shortleaf pine (*P. echinata*), pitch pine (*P. rigida*), Table Mountain pine (*P. pungens*), oak (*Quercus* spp.), American chestnut (*Castanea dentata*), hickory (*Carya* spp.), soft mast species and flowering trees. Determination of the exact species to target for herbicide application would be made after cutting treatments. The determination would be based on the site's ecological potential and the stocking for each species.

Stem injections would be applied with hatchets and squirt bottles, or similar application devices, using a mixture of 64 oz water, 64 oz Garlon 3A or equivalent (triclopyr amine) and 6 oz Arsenal AC or equivalent (imazapyr). Stem injection would be applied to target vegetation too large to treat with a foliar spray. This application would be made between the first of July and the end of September because target species are actively growing.

Directed foliar spray would be applied using backpack sprayers. The application would be a low volume direct spray applied to targeted vegetation by speckling the leaf surface. This application would be made between the first of July and the end of September. Per gallon of mix water, the herbicide mixture for this application is: 0.5 oz Arsenal AC or equivalent (imazapyr), 2 oz of Garlon 4 or equivalent (triclopyr ester), ½ oz surfactant, and spray pattern indicator.

<u>Reforestation by planting (2,833 acres)</u>. Reforestation by planting would occur on 2,833 acres. Species selection for planting and planting density would be based on the silviculture objective of maintaining a well-stocked mixed hardwood/pine stand of native species ecologically suited to the site over time. Native shortleaf pine seedlings would be the major species planted. However, where appropriate to the site, other species would also be planted, including but not limited to native pitch pine, Table Mountain pine and American chestnut if seed and/or seedlings are available.

Tree planting would not occur where there is existing adequate stocking of natural regeneration of the preferred species. The target stocking would vary based on ecological site potential. Plantings would take advantage of growing space created during timber harvest and from site preparation since desirable overstory trees would be left as reserves in most units. This would result in a one- or two-aged structure, depending on how many overstory trees (preferred species) were not harvested.

<u>Woodland treatments (783 acres)</u>. Woodland areas would be established across the project area to increase habitat diversity and increase viability of a variety of plant and animal species in the long term. Both cut-and-remove and cut-and-leave treatment methods would be used to establish the woodland areas. In addition to cutting loblolly pine, harvest would also include Virginia pine, white pine and hardwoods in some stands. The treatment would include thinning oaks, hickories and shortleaf pine to a basal area of 40-60 ft^2/acre. To the extent possible, all healthy oak, hickory, shortleaf pine, pitch pine and Table Mountain pine would be left where basal area is currently less than 40-60 ft^2/acre.

After initial treatments are completed, the areas would be burned on a periodic basis (estimated within 1-5 years of initial treatment). Prescribed burning is covered under a separate NEPA decision. To increase herbaceous species diversity, woodland stand understories would be enhanced by the planting of native herbaceous species.

Herbicide, manual, or mechanical methods would be applied within one to two years after the initial post-harvest prescribed burn, and up to two more times after the initial treatment if needed to reduce undesirable species.

Manual or mechanical methods including but not limited to hand tools (chainsaws, brush saws), and/or heavy equipment (tractor with mower, gyro-track) would be used to control sprouts and seedlings of non-desirable tree species to maintain the woodland condition. Mechanical treatments would grind up or masticate undesirable understory vegetation.

Herbicide mixtures, application methods and time of application would be the same as described for site preparation and release treatment in other forest stands.

Woodland stand understories would be enhanced by the planting of native herbaceous species.

The following activities would be conducted in connection with vegetation management activities in alternative 3:

- Road reconstruction and maintenance: System road reconstruction and maintenance would be needed on approximately 60 miles of roads for alternative 3. Reconstruction work would consist of, but not be limited to, graveling road surfaces, replacing culverts (including special culverts for aquatic organism passage), ditch cleaning, removing brush and trees along road rights-of-way, installing, repairing or replacing gates and correcting road safety hazards. Road maintenance would consist of spot gravel replacement, blading, cleaning culverts, light brushing and mowing.
- Temporary roads: Log landings that have no access to existing roads would be accessed by a temporary road that connects to the forest transportation system. Temporary roads are generally under 10 percent grade and have road widths of less than 14 feet. Approximately 24.9 miles of temporary roads are needed in alternative 3. Most of these would be reopening of former temporary roads that are in suitable locations, but for the most part have stabilized cut and fill slopes that would not be disturbed. Temporary roads would be closed and adequate erosion and stormwater control measures completed and replanted with vegetation.
- Skid Trails: Skid trails would be used to skid logs to log landings. They would be closed after use with adequate stormwater and erosion control measures.
- Log landings: Log landings are locations where logs are piled and then loaded onto trucks. Former landings sites would be used whenever appropriate to limit effects on soil compaction. They would be closed after use with adequate storm water and erosion control measures.

IV. Species Considered and Evaluated

The complete list of PETS species for the Sumter National Forest is attached in Appendix A. All species on this list were considered for this BA/BE. Using a step-down process, species and potential habitat in the project area were identified by:

6) Evaluating the location and nature of the proposed project;
7) Considering the species' range, life history and available habitat information;
8) Reviewing District records of known PETS species surveys and occurrences;
9) Reviewing the USFWS Distribution Records of Endangered, Threatened, Candidate and Species of Concern (2012); and
10) Reviewing the South Carolina Heritage Trust Geographic Database of Rare, Threatened and Endangered Species.

Table 1 lists those species that are known to occur or that have potential habitat within the project area. These species will be addressed in the effects section of this BA/BE.

Table 1. Proposed, endangered, threatened and sensitive (PETS) species that are known to occur or have potential habitat in the Loblolly Pine Removal and Restoration Project, Andrew Pickens Ranger District, Sumter National Forest.

Species	Conservation Status	Status in Project Area		Habitat Association
		Known to Occur	Potential Habitat Exists	
Ashleaf Goldenbanner *Thermopsis mollis* var. *fraxinifolia*	Sensitive	+		Pine-oak heaths; open habitats and roadsides
Bald Eagle *Haliaeetus leucoocephalus*	Sensitive		+	Mixed forests adjacent to streams and lakes
Brook Floater *Alasmidonta varicosa*	Sensitive		+	Aquatic habitats
Butternut *Juglans cinerea*	Sensitive		+	Mesic forests
Chauga Crayfish *Cambarus chaugaensis*	Sensitive		+	Aquatic habitats
Diana Fritillary *Speyeria diana*	Sensitive	+		Open habitats and roadsides
Eastern Small-footed Myotis *Myotis leibii*	Sensitive		+	General forested habitats
Edmund's Snaketail *Ophiogomphus edmundo*	Sensitive		+	Aquatic habitats
Fort Mountain Sedge *Carex communis* var. *amplisquama*	Sensitive		+	Mesic forests
Fraser's Loosestrife *Lysimachia fraseri*	Sensitive		+	Open habitats and roadsides
Georgia Aster *Symphiotrichum georgianus*	Sensitive		+	Open habitats and roadsides
Hartwig's Locust *Robinia viscose* var. *hartwegii*	Sensitive		+	Pine-oak heaths; open habitats and roadsides
Jeweled Trillium *Trillium simile*	Sensitive		+	Mesic forests

Table 1. Proposed, endangered, threatened and sensitive (PETS) species that are known to occur or have potential habitat in the Loblolly Pine Removal and Restoration Project, Andrew Pickens Ranger District, Sumter National Forest.

Species	Conservation Status	Status in Project Area		Habitat Association
		Known to Occur	Potential Habitat Exists	
Mountain Witch Alder *Fothergilla major*	Sensitive		+	Pine-oak heaths; dry ridge tops
Nodding Trillium *Trillium rugelii*	Sensitive		+	Mesic forests
Persistent Trillium *Trillium persistens*	Federally Endangered		+	Mesic forests
Piedmont Strawberry *Waldsteinia lobata*	Sensitive	+		Mesic forests
Radford's Sedge *Carex radfordii*	Sensitive		+	Mesic forests
Rafinesque's Big-eared Bat *Corynorhinus rafinesquii*	Sensitive		+	General forested habitats
Small Whorled Pogonia *Isotria medeoloides*	Federally Threatened		+	Mesic forests
Smooth Coneflower *Echinacea laevigata*	Federally Endangered	+		Open habitats and roadsides
Southern Appalachian Salamander *Plethodon teyahalee*	Sensitive		+	Mesic forests
Southern Oconee Bells *Shortia galacifolia* var. *galacifolia*	Sensitive		+	Mesic forests
Spreading Pogonia *Cleistes bifaria*	Sensitive		+	Pine-oak heaths; dry ridge tops
Sun-facing Coneflower *Rudbeckia heliopsidis*	Sensitive	+		Open habitats and roadsides
Sweet Pinesap *Monotropsis odorata*	Sensitive		+	Pine-oak heaths
Whorled Horsebalm *Collinsonia verticillata*	Sensitive	+		Mesic forests

All other species on the Sumter National Forest PETS list are eliminated from further analysis because they lack habitat in the project area.

V. Evaluated Species Survey Information

The procedure used to decide when to inventory for PETS species is consistent with FSM 2672.43. Forest Service personnel and contractors surveyed project stands for PETS botanical species in 2008, 2009, 2010 and 2011. Additionally, District-wide botanical surveys and monitoring have been conducted for smooth coneflower (Emanuel 1996; Earth Design 2000, 2004; US Forest Service 2007, 2009a), small whorled pogonia (US Forest Service 2009b), and Fraser's loosestrife (Shatley 1999). Surveys have also been conducted for Rafinesque's big-eared bat and eastern small-footed myotis (Bunch et al. 1998; Menzel et al. 2003; Loeb 2004), Diana fritillary (Scholtens 2004; Dennis Forsythe, personnal communication), freshwater mussels (Adkins 1995; Alderman 2004), crayfish (Eversole et al. 2002) and herpetofauna (Bruce et al. 1995; Metts and Gibbons 2003) on the Andrew Pickens District.

VI. Environmental Baseline for the Species Evaluated in this BA/BE

The Andrew Pickens Ranger District is located in the Blue Ridge physiographic province where variations in elevation lead to differences in vegetation community types. Pitch pine and Table Mountain pine are found on high ridges, there is a mixture of shortleaf pine and various hardwoods on low elevation ridges and south-facing slopes, mesic oak-hickory forests are found on lower and north-facing slopes, and mixed mesophytic and white pine-hemlock forests are located in forested coves.

The treatment stands in the project area are dominated by loblolly pine, with minor quantities of red maple (*Acer rubrum*), oak species (*Quercus alba, Q. coccinea, Q. falcata, Q. prinus, Q. stellata*), yellow poplar (*Liriodendron tulipifera*), Virginia pine , shortleaf pine, white pine, sourwood (*Oxydendrum arboreum*), eastern redbud (*Cercis canadensis*), dogwood (*Cornus florida*), hickory species, and sweetgum (*Liquidamber styraciflua*). Mountain laurel (*Kalmia latifolia*), rhododendron (*Rhododendron* spp.) and blueberry (*Vaccinium* spp.) are common in the understory.

See the Forest Plan Final BA and BE and the *Fiscal Year 2011 Monitoring and Evaluation Annual Report* (US Forest Service 2012) for information on the status and environmental baseline for PETS species on the Sumter National Forest.

Ashleaf goldenbanner usually occurs in pine-oak heaths, on dry ridges, or along roadsides. Habitat also includes dry, sandy, or rocky margins of large mountain streams. During 2001, nine populations of *Thermopsis mollis*, commonly known as Appalachian goldenbanner, were confirmed on the Andrew Pickens District. It is possible that these plants are actually ashleaf goldenbanner, *T. mollis* var. *fraxinifolia* (*T. fraxinifolia* in Weakley 2007). The two species are generally separated phenologically, with ashleaf goldenbanner exhibiting peak flowering six to seven weeks after that of Appalachian goldenbanner. Species verification will occur in the future, but for the purposes of this analysis, it is assumed to be *T. mollis* var. *fraxinifolia*. A population of this species occurs within the project area in compartment 41, stand 12, and several stands within the project area provide potential habitat.

Bald eagles nest in tall, usually living trees near open bodies of water. This species almost always forages near estuaries, lakes, ponds, rivers, open marshes and shorelines. Bald eagles will soar over a body of water and swoop to the surface for fish. They also scavenge for dead fish and other carrion along shores and occasionally consume small birds and mammals. Although nationwide recovery efforts led to the removal of bald eagles from the Threatened and Endangered Species List on August 9, 2007, this species is still protected under the Bald and Golden Eagle Protection Act (16 USC 668-668c) and the Migratory Bird Treaty Act (16 USC 703-712). There are no known nests on the Andrew Pickens District; however, the Chattooga and Chauga Rivers and several large water bodies (e.g., Lake Cherokee, Lake Cheohee and Chattooga Lake) provide suitable foraging habitat for this species. Several proposed treatment stands within the project area provide potential nest and roost sites.

Brook floater is known to occur in the Chattooga River downstream of the Highway 28 bridge. This freshwater mussel inhabits streams and rivers of varying sizes, especially those that have

low to moderate flow velocities and stable substrates. In fast water, they will often occur clustered in protected areas such as behind boulders and near banks. The brook floater is sparse or absent in headwater streams and high-gradient river reaches that are prone to scour. It is frequently found in streams that have low calcium levels, low nutrient levels and good water quality. The brook floater population in the Chattooga River is considered the most viable populations in the southernmost portion of the species' range. Stream bank instability, point and nonpoint sources of siltation and pollution, habitat degradation resulting from deforestation, impoundments, channelization, dredging, the introduction of exotic species and severe drought all threaten the aquatic habitats of freshwater mussels, as well as other aquatic species.

In South Carolina, Chauga crayfish is restricted to the upper Savannah River basin, particularly the Chauga and Chattooga River basins in Oconee County. This species was found at nine sites on the Andrew Pickens District (Eversole et al. 2002). Although it was found in both high- and low-order streams, Chauga crayfish appears to be more abundant at higher order stream sites. This species occurs at sites with a substrate of cobble, large stones and/or boulders with very little sediment accumulation. Because it seems particularly sensitive to sedimentation, bank stability is probably necessary for the survival of this species.

Butternut is an uncommon species found on sites with rich, moist, well-drained soils. It is also known to occur on drier, rocky slopes, overlying soils of limestone origin. This species is experiencing significant mortality throughout its range as a result of infection by the *Sirococcus clavigignenti-juglandacearum* fungus that causes butternut canker. Butternut is not known to occur within proposed treatment stands; however, habitat may occur.

Diana fritillary. This butterfly occurs in deciduous and pine forests near streams and along roadsides. The caterpillar feeds on violet (*Viola)* species, whereas adults feed on the nectar of a variety of plants such as milkweed (*Asclepias* spp.), buttonbush (*Cephalanthus occidentalis*), coneflower (*Echinacea* spp.), compassplant (*Silphium laciniatum*) and common mint (*Pycnanthemum incanum*). In 2004, one male Diana fritillary was captured in compartment 39, stand 35 after 9-person days of surveying throughout the Andrew Pickens District (Scholtens 2004). In 2011, Dennis Forsythe observed three male Diana fritillaries along Rich Mountain Road, which is adjacent to several proposed treatment stands (compartment 39, stands 20 and 35, and compartment 54, stands 27 and 29). Potential habitat for this species occurs within the project area in several proposed treatment stands.

Eastern small-footed myotis is one of the smallest North American bats. At the southern terminus of its range on the Andrew Pickens District, this species was detected near Lake Cherokee and at the Chattooga River near Highway 28. In winter, eastern small-footed myotis roost in caves, rock shelters and fissures in cliffs. During migration and summer, little is known about the species' roosting habits, although there are reports of the species using abandoned buildings, bridges and rock shelters. Potential habitat for eastern small-footed myotis occurs within several proposed treatment stands.

Edmund's snaketail is one of the least known dragonfly species in North America and has one of the most restricted ranges. It is known to occur in just a few counties in Georgia, South Carolina, North Carolina and Tennessee. Edmund's snaketail was thought to be extinct in the

1970s and 1980s, but was rediscovered in North Carolina in 1994. This species was documented for the first time in south Carolina in 2008 on the Chattooga River near the highway 76 bridge (Hill 2009) Edmund's snaketail larvae inhabit clear, col rivers and streams with rocks and riffles in the southern Appalachians. Adults occur in the riparian areas of rivers and streams. This species is susceptible to alterations in stream flow, siltation, flood scouring, pollution and loss of adult foraging habitat.

Fort Mountain sedge has a very restricted range in the mountains of South Carolina, North Carolina and Georgia. It is known to occur in rich mountain coves at Tamassee Knob, East Fork of the Chattooga and White Rock Cove on the Andrew Pickens District. Fort Mountain sedge is not known to occur within any proposed treatment stands, but potential habitat may occur in or adjacent to the project area.

Fraser's loosestrife occurs in permanent openings located along roads, utility rights-of-way and river corridors. This species has a high light requirement, especially for flowering. It grows at elevations that range from 1,100 to 3,000 feet. Soils at most sites are mapped as Evard (a strongly acid upland soil that is deep, well drained, and has a loamy surface and sub-surface). Approximately 1,700 plants from 35 locations were documented on the Andrew Pickens District in 1999 (Shatley 1999). While Fraser's loosestrife is not known to occur within any of the proposed treatment stands, suitable habitat occurs in some areas.

Georgia aster is a relict species of the savanna/woodland plant community that existed in the southeast prior to widespread fire suppression and extirpation of large native grazing animals. The majority of the remaining populations survive adjacent to roads, along woodland borders, in dry, rocky woods and within utility rights-of-way and other openings where current land management practices mimic natural disturbance regimes. Many existing populations across its range are threatened by woody plant succession resulting from fire suppression, development, highway expansion/improvement and herbicide application. There are no records of this plant in the project area but potential habitat does exist.

Hartwig's locust. This species occurs in forests, outcrop edges on high elevation granitic domes, clearings and on roadsides. One site for Hartwig's locust has been documented on the Andrew Pickens District near Village Creek. There are no known occurrences of this species in the proposed treatment stands; however, potential habitat does exist.

Jeweled trillium grows in very rich soils of slopes and coves over mafic or calcareous rocks, often in or near seepages. There are seven known populations of this species on the Andrew Pickens District. Although no populations of jeweled trillium are known to occur within proposed treatments stands, potential habitat may exist.

Mountain witch alder occurs in mesic-dry to dry habitats of the uplands, rich mountain woods and balds, and rocky ravine stream banks with rapid water flow. Although it can be occasionally found in mature mesic forests, its most characteristic habitats are disturbed areas on dry ridges. Four populations are known to occur on the Andrew Pickens District. Potential habitat exists within many of the proposed treatment stands.

Nodding trillium occurs in four populations on the Andrew Pickens District. This species can be found in calcium-rich soils of cove forests. While nodding trillium does not occur within proposed treatment stands, potential habitat does exist.

Persistent trillium was listed as a federally endangered species on April 26, 1978. It is restricted to the Tallulah-Tugaloo River system in Rabun, Habersham and Stephens Counties, Georgia, and Oconee County, South Carolina. Persistent trillium is apparently restricted to gorges and steep ravines. Habitat for this species was described by Duncan et al. (1971) as "deciduous or conifer-deciduous woods of ravines or gorges, under or near *Rhododendron maximum* L. or *R. minus* Michx., rooted in well-decomposed litter and/or loose loam." According to the recovery plan (US Fish and Wildlife Service 1984), persistent trillium has also been found under open or nearly closed canopies dominated by hemlock, hemlock-white pine, hemlock-beech, white pine, chestnut oak-white oak, or black oak-chestnut oak; under open or nearly closed shrub covers of *R. maximum*, *R. minus*, *Leucothoe axillaris*, and all combination of the above, or with no shrubs or deciduous shrubs only; generally with few herbaceous associates but occasionally adjacent to thick mats of *Galax*; on all exposures except due south; and on slopes zero to 60 degrees. Additional different habitat conditions described in the recovery plan include deciduous woods on slopes with an exposure of due south and in shortleaf pine-Virginia pinewoods near a ridge top. Persistent trillium is not known to occur on the Andrew Pickens District; however, it was discovered nearby on Battle Creek in 1970. Potential habitat could occur within some of the proposed treatment stands.

Piedmont strawberry. This evergreen perennial herb occurs in stream terraces and adjacent slopes in beech or oak-hickory forests. Piedmont strawberry is known to occur in 36 separate locations in the southern half of the Andrew Pickens District. Populations of this species occur within the project area in compartment 41, stand 12 and compartment 55, stand 7. Several stands within the project area may provide potential habitat.

Radford's sedge is found in rich, often rocky, calcareous sites on well-drained soils. This rare species is associated with the Brevard geologic fault zone. Radford's sedge has been found at elevations between 1,000 to 2,100 feet, and is known to exist at three locations on the Andrew Pickens Distinct. It is not known to occur within proposed treatment stands, but potential habitat may occur within the project area.

Rafinesque's big-eared bat is one of the least know bats of the southeastern United States. It is colonial (roosts can contain over 100 individuals) and uses a wide variety of roost sites: caves, old mine shafts, hollow trees, areas behind loose bark, abandoned buildings and under bridges. It leaves its roost only when it is completely dark, forage for insects and returns to the roost before sunrise. Rafinesque's big-eared bat hibernates in the winter months, but may be active during warm spells in the southern portions of its range. Several Rafinesque's big-eared bat roosts have been identified on the Andrew Pickens District. While there are no records of this species occurring in the proposed treatment stands, potential habitat does exist.

Small whorled pogonia was listed as federally endangered on October 12, 1982, and was reclassified as federally threatened on November 7, 1994. This rare orchid occurs on the lower slopes of mesic woods, in acidic cove communities and along streams. It is commonly

associated with white pine and eastern hemlock (*Tsuga canadensis*). This species is known to occur at three locations on the Andrew Pickens District. Forest Service monitoring in 2008 found that one population exhibited a significant increase in the number of plants over a 26-year period, one population showed a decreasing trend since 1995, and the third population appears to be relatively stable (US Forest Service 2009b). While small whorled pogonia is not known to occur within proposed treatment stands, it does occur adjacent to compartment 28, stand 34. Potential habitat for this species occurs in the project area.

Smooth coneflower was listed as federally endangered on October 8, 1992. This species occurs along roadsides or in dry, open woodlands on calcium-rich soils that overlay mafic or calcareous rocks. All of the District's smooth coneflower populations occur in the Brevard geologic fault zone and are located along road rights-of-way subject to frequent mowing. This plant is a fire-associated (occurring under conditions similar to burned areas) or fire-dependent (requiring some mechanism that can be provided only by fire) species (Emanuel 1996). Ten populations, including one new population of approximately 200 rosettes, were monitored on the Andrew Pickens District in 2008 (US Forest Service 2009a). This species appears to be increasing in number on the District. Smooth coneflower is known to occur in the following proposed treatment stands: compartment 39, stand 20; compartment 41, stand 12; compartment 53, stand 5; and compartment 65, stand 27.

Southern Appalachian salamanders inhabit deciduous forests. They are known to occupy birch-beech-hemlock forests with witch hazel (*Hamamelis virginiana*), mountain laurel, and rhododendron in the understory (Nishikawa 1990). Southern Appalachian salamanders seek shelter under rotting logs and less frequently under rocks and leaf litter. Their activity levels correspond with moisture availability. Although not known to occur within any of the proposed treatment stands, potential habitat may occur in or adjacent to the project area.

Southern Oconee bells. A low growing evergreen plant that forms dense colonies, this species occurs on moist slopes, creek banks and rock outcrops on humid escarpment gorges with high rainfall. Southern Oconee bells are most commonly associated with rhododendron, specifically *Rhododendron maximum* and *R. minus*. While one population occurs in the southern half of the Andrew Pickens District, it is more abundant near Lake Jocassee. This species is not known to occur within the proposed treatment stands, but potential habitat does exist.

Spreading pogonia is an orchid that occurs in savannas, meadows, and dry ridge tops under pines (where seasonally moist). While there are no known records of this species on the Andrew Pickens District, potential habitat does exist within some of the proposed treatment stands.

Sun-facing coneflower inhabits stream banks, barrens, pinelands and roadsides. It is known to occur on the Andrew Pickens District along roadsides near Lake Cherokee. Like smooth coneflower, this disturbance-dependent species is adapted to fire. Sun-facing coneflower occurs within the following proposed treatment stands: compartment 16, stands 4A, 4B, and 27.

Sweet pinesap is a cryptic species that occurs in dry to mesic upland woods under oaks and/or pines (especially Virginia pine and shortleaf pine), especially slopes or bluffs with abundant

heaths. Eleven populations of sweet pinesap have been documented on the Andrew Pickens District. Although none are known to occur in the proposed treatment stands, potential habitat does exist.

Whorled horsebalm inhabits rich forests, ranging from moist cove forests to dry oak forests over mafic or calcareous rocks. It is known to occur at 68 different locations on Andrew Pickens District, including the following proposed treatment stands: compartment 41, stand 12; compartment 50, stand 2; compartment 56, stand 91; and compartment 58, stand 12.

VII. Effects of Proposed Management Action on Each Species Evaluated

This effects analysis takes into account not only the knowledge of species distribution from previous field surveys, but also the adequacy of those surveys. The best available science (including species' habitat requirements, reasons for species' decline, limiting factors, project area habitat conditions and the biological effects of the intensity of the proposed action) is also considered in the effects analysis. The effects of a proposed action on a species can be direct, indirect, or cumulative.

Direct Effects

Direct effects are effects to the species known to occur in the proposed project area. They occur at the same time and place as the project activity.

Ashleaf goldenbanner is known to occur in compartment 41, stand 12. In alternative 3, compartment 41, stand 12 would receive a cut-and-leave woodland treatment. This treatment includes the use of chemical and/or manual control methods to control competing woody vegetation. Adverse direct effects resulting from the use of chemical and/or manual control methods to control competing woody vegetation are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. In order to avoid direct effects, mitigation measures would be followed (see Mitigation Measure #1).

Bald eagles are not known to occur within the project area. Proposed treatment stands are not likely to be used for foraging since bald eagles generally forage over large water bodies, including rivers and lakes. However, some proposed treatment stands (especially those that occur within ½ mile of open water) may provide roosting or nesting habitat for this species. If a bald eagle were roosting or nesting in a treatment stand, logging operations could disturb them; however, Forest Plan Standard FW-28[14] provides protective measures that would prevent adverse direct effects to this species.
The use of herbicides for site preparation, crop tree release and woody vegetation control in woodland treatments as proposed in alternative 3 is not expected to have a direct effect on bald

[14] Forest Plan Standard FW-28 (p. 2-9) states, in part: Protection zones are delineated and maintained around all bald eagle nests and communal roost sites, until they are determined to be no longer suitable through coordination with the U.S. Fish and Wildlife Service. The protection zone extends a minimum of 1,500 feet from the nest or roost. Activities that modify the forest canopy within this zone are prohibited. All management activities not associated with bald eagle management and monitoring are prohibited within this zone during the periods of use.

eagles. While the use of some herbicides can have direct effects on wildlife by causing injury or mortality from direct spray, drift, or ingestion of contaminated food or water, those herbicides proposed in this alternative, namely imazapyr and triclopyr, are practically non-toxic to birds and other wildlife species.

The acute oral LD_{50}[15] of imazapyr for mallard ducks (*Anas platyrhynchos*) and northern bobwhite (*Colinus virginianus*) are both greater than 2,150 mg/kg. Imazapyr is rapidly eliminated in the urine and feces of animals, and is not known to accumulate in animal tissues. The acute oral LD_{50} of triclopyr for mallard ducks and northern bobwhite are 1,698 mg/kg and 2,935 mg/kg, respectively. A one-generation reproduction study showed no reproductive effects, symptoms of toxicity, or abnormal behavior when mallards were given up to 500 ppm of triclopyr in their diet for a 20-week period, including ten weeks prior to egg laying and ten weeks during egg laying. Newton et al. (1990) predicted that triclopyr would not be present in animal forage in doses large enough to cause either acute or chronic effects to wildlife, and concluded that the tendency for triclopyr to dissipate quickly in the environment would preclude any problems with bioaccumulation in the food chain.

Brook floater, Chauga crayfish and Edmund's snaketail. Field reviews indicate that most of the treatment stands are located on broad, flat ridges and that streamside vegetation consists mostly of native hardwoods and pines. In some cases, streamside buffers are up to 400 to 600 feet wide on either side of the streams. These buffers would remain largely unaltered by proposed activities. However, there are areas of concentrated treatment stands located within single headwater streamsheds and in adjacent streamsheds that drain to larger streams. If regeneration harvests (cut-and-leave and cut-and-remove) take place in these areas over a short period of time, there could be a substantial increase in streamflow within individual streams and downstream into larger waters. This could result in an increase of stream bank erosion in unstable downstream channels, which could cause adverse direct effects to brook floater, Chauga crayfish and Edmund's snaketail. Mitigation is planned to stagger the management of concentrated treatment stands in order to temporally and geographically spread out impacts over a longer period of time. This would reduce the potential for flow increases that could affect stream channels.

Herbicides would be applied in perennial and intermittent riparian corridors to control loblolly pine; within channeled ephemeral stream zones for site preparation and reforestation; and after regeneration harvests and woodland treatments to control unwanted woody vegetation. Herbicides would not be applied within stream channels. Although project mitigation measures, Forest Plan standards/guidelines, and South Carolina Best Management Practices (BMPs) protect aquatic species, adverse direct effects may occur from the use of herbicides.

Imazapyr and triclopyr would be used as a foliar spray using backpack sprayers and with the hack and squirt method (stem injection) from July through September. Individual trees within riparian corridors would be targeted with the hack and squirt method to minimize the risk of

[15] Acute toxicity is commonly measured by the lethal dose (LD) that causes death in 50 percent of treated laboratory animals. LD_{50} indicates the dose of a chemical per unit body weight of an animal and is expressed as milligrams per kilogram (mg/kg). Chemicals are highly toxic when the LD_{50} value is small and practically nontoxic when the value is large.

herbicides entering stream channels directly or by drift. No direct foliar spraying would be applied in riparian corridors. The greatest risk of herbicides entering water systems and impacting aquatic life would be from treating loblolly pine in close proximity to streams and from spraying herbicides within 25 feet of channeled ephemeral streams. This risk is associated with herbicide drift, accidental spills, unexpected rain events and soil movement. On sites where loblolly pine is the major component within 25 feet of channeled ephemeral streams, there would be reduced vegetative cover following harvest. The result would be an increased possibility of soil movement into downstream reaches with heavy rainfall. However, tree slash would remain on site which would slow and deter the movement of disturbed soils. Herbicides would not be applied immediately after harvest, but to tree sprout growth in July through September. At that time, there should be sufficient herbaceous growth to further deter the movement of soils and any soil residual herbicides. In addition, with herbicides being applied during periods of warm to hot temperatures, rapid breakdown should occur and herbicide half-life should be on the shorter end of those reported in the literature (Jay Purnell, US Forest Service silviculturist, personal communication).

Imazapyr has a low toxicity to fish and aquatic invertebrates and is not expected to bioaccumulate in aquatic organisms. The LC_{50}[16] of imazapyr on channel catfish (*Ictalurus punctatus*), bluegill (*Lepomis macrochirus*), rainbow trout (*Oncorhynchus mykiss*) and *Daphnia magna* (an aquatic crustacean) all exceed 100 mg/l. In aquatic systems, sunlight rapidly degrades imazapyr, which has a half life of two days in surface water. It is slowly degraded by soil microorganisms and can be relatively persistent in soils with a half-life of one to seven months. Imazapyr does not bind strongly to soils and can be highly available in the environment. Heavy rainfall can cause significant movement of the herbicide with soil particles and leaching up to 50 cm deep in soils.

In soils triclopyr amine degrades to the parent compound, triclopyr acid. Triclopyr amine and triclopyr acid are slightly toxic to fish and aquatic invertebrates. The average half-life of triclopyr acid in soil is 30 days. Offsite movement through surface or subsurface runoff is possible, as it is relatively persistent and has only moderate rates of soil particle adsorption. In water, the formulation (triethylamine salt) is soluble and may degrade in several hours with adequate sunlight. The LC_{50} for rainbow trout of the acid and the salt formulation is 117 mg/l and 552 mg/l, respectively; for bluegill, the LC_{50} is 148 mg/l and 891 mg/l, respectively. If applied properly, triclopyr would not be found in concentrations adequate to kill aquatic organisms. However, some water bodies remain at risk of lethal contamination levels, especially those that are shallow and have slow velocity where dissipation is slow and those that are heavily shaded where photo-degradation is reduced.

Cide-Kick or an equivalent adjuvant would be used in herbicide mixes applied in channeled ephemeral stream zones. No adjuvant would be used with hack and squirt methods in the riparian corridors.There is little information on the effects of adjuvants to aquatic systems. Some

[16] Acute toxicity is sometimes measured by the lethal concentration that causes death in 50 percent of treated laboratory animals (LC_{50}). LC values usually refer to the concentration of a chemical in air, but it can also mean the concentration of a chemical in water. LC_{50} indicates the dose of a chemical per unit body weight of an animal and is expressed as milligrams per liter (mg/l). Chemicals are highly toxic when the LC_{50} value is small and practically nontoxic when the value is large.

adjuvants have the potential to be mobile and pollute surface or groundwater sources. The use of adjuvants near water may have adverse effects in some aquatic species. Cide-Kick or an equivalent adjuvant is formulated for use around waters. The active ingredient of this adjuvant is d-limonene, a byproduct of the citrus industry. The formulated product is practically nontoxic to freshwater fish and slightly toxic to freshwater invertebrates on an acute basis (Environmental Protection Agency 1994).

Soil and vegetation disturbance from road reconstruction and maintenance, temporary and skid roads, and log landings could result in the addition of sediments to project area streams, which could adversely affect aquatic species. Sedimentation can cause direct mortality to aquatic organisms through burial and suffocation of eggs and larvae and can result in a reduction of fish and macroinvertebrate density and biomass in a stream. Turbidity can cause abrasion, changes in feeding behavior, avoidance and displacement, gill damage (which interferes with respiration) and macroinvertebrate drift. However, Forest Plan standards/guidelines, South Carolina BMPs and project-specific mitigation measures would be followed to minimize effects.

Diana fritillary. If adults were present during any project activity, they would likely relocate to undisturbed areas. Larvae, being less mobile than adults, would be less likely to relocate if disturbed. It is possible that if larvae were present during project activities, including tree removal, roadwork, site preparation and reforestation, individuals could be harmed.

Very little is known about the toxicity of imazapyr and triclopyr on terrestrial invertebrates. Most research has been done on the effects of these chemicals on aquatic invertebrates. Research suggests that imazapyr and triclopyr are of low toxicity to invertebrates. Adverse direct effects to adult or larvae Diana fritillary are possible but not expected.

Eastern small-footed myotis and Rafinesque's big-eared bat. Because of the highly mobile nature of chiropteran species, any disturbance associated with this project would likely result in the temporary displacement of individuals to undisturbed areas. It is possible that project activities (namely, tree removal) could influence summer or winter roost trees. Roost trees would most likely be large snags that are hollow or have loose bark, mature live trees with exfoliating bark and mature live trees with cavities caused by disease or injury. If an occupied roost tree were felled, it could result in the injury or death of one to several individuals. Given the widely distributed nature of the treatments stands within the project area, and assuming that bats would be using similar habitats across the Andrew Pickens District, bat mortality as a result of the felling of roost trees would not likely affect the viability of these species.

Herbicide application is not expected to adversely affect eastern small-footed myotis and Rafinesque's big-eared bat. Herbicides would not be applied directly to roost trees and application would occur during the daytime when bats are inactive. Additionally, imazapyr is practically non-toxic to mammals based on an acute oral LD_{50} of >5,000 mg/kg in rats and an acute dermal toxicity of >2,000 mg/kg in rabbits. Triclopyr is considered slightly toxic with an acute oral LD_{50} ranging from 630 to 729 mg/kg in rats.

Piedmont strawberry is known to occur in compartment 41, stand 12 and compartment 55, stand 7. In alternative 3, compartment 41, stand 12 would receive a cut-and-leave woodland

treatment. This woodland treatment would include the use of chemical and/or manual control methods to control competing woody vegetation. Adverse direct effects resulting from the use of chemical and/or manual control methods to control competing woody vegetation are possible but unlikely. Herbicides would be applied to target species using directed foliar spray using backpack sprayers, making application to non-target species unlikely. In order to avoid direct effects, mitigation measures would be followed (see Mitigation Measure #1).

In alternative 3, compartment 55, stand 7 would also receive a cut-and-leave treatment with no planting; however, herbicides may be used to control competing woody vegetation. Adverse direct effects resulting from the use of herbicides to control competing woody vegetation are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. In order to avoid direct effects from herbicide application, mitigation measures would be followed (see Mitigation Measure #1).

Smooth coneflower occurs in compartment 39, stand 20; compartment 41, stand 12; compartment 53, stand 5; and compartment 65, stand 27. In alternative 3, compartment 39, stand 20 would receive a cut-and-remove treatment and potential herbicide application and planting; compartment 41, stand 12 would receive a cut-and-leave woodland treatment with potential herbicide application but no planting; and compartment 53, stand 5 and compartment 65, stand 27 would receive cut-and-leave treatments with potential herbicide application but no planting.

In the cut-and-remove treatment with planting (compartment 39, stand 20), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings and loading areas, skid trails and roads for access. Herbicides may be used in site preparation and reforestation release treatments. Stands would be reforested by planting with native tree species. In order to avoid adverse direct effects to smooth coneflower in this stand, mitigation measures would be followed (see Mitigation Measure #2). By following these measures, the activities in alternative 3 are not likely to adversely affect this species.

In the cut-and-leave woodland treatment with no planting (compartment 41, stand 12), chemical and/or manual control methods would be used to control competing woody vegetation. Adverse direct effects resulting from the use of chemical and/or manual control methods to control competing woody vegetation are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. In order to avoid direct effects, mitigation measures would be followed (see Mitigation Measure #3).

In the cut-and-leave treatment with potential herbicide application but no planting (compartment 53, stand 5 and compartment 65, stand 27), all felling of trees would occur using manual methods (hand tools, chainsaws). Mechanical equipment (e.g., feller-buncher, skidder) would not be used. Aboveground damage to plants resulting from the manual felling of trees is possible but unlikely. If a tree were felled on an individual plant or clump of plants, it is possible that damage could occur. Damage to belowground plant parts during the cut-and-leave treatment would not

occur. Adverse direct effects resulting from the use of herbicides are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. In order to avoid direct effects from project activities, mitigation measures would be followed (see Mitigation Measure #3).

Southern Appalachian salamander is not likely to occur within proposed treatment stands, which are generally on xeric sites. However, this species could occur in hardwood inclusions or in mesic hardwood habitats that are located immediately adjacent to treatment stands. Since southern Appalachian salamander does not migrate to breeding grounds or have large home ranges (Beamer and Lannoo 2005), it is unlikely that project activities in xeric pine-dominated stands would have a direct effect on this species in adjacent mesic hardwood habitats.

Sun-facing coneflower occurs in compartment 16, stands 4A, 4B, and 27. In alternative 3, compartment 16, stand 4A would receive a cut-and-remove treatment with no reforestation but with the potential application of herbicide. In this treatment, timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings and loading areas and roads for access. Heavy equipment could run over plants, causing above- and belowground damage. The placement of log landing and loading areas, and access roads could also have an adverse direct effect on this species. Adverse direct effects resulting from the use of herbicides are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. In order to avoid direct effects from harvest operations and herbicide applications, mitigation measures would be followed (see Mitigation Measure #1).

Compartment 16, stand 4B would receive a cut-and-remove woodland treatment. Woodland treatments include the mechanical felling and removal of trees, the placement of log landings and roads, and the use of chemical, mechanical, and/or manual control methods to control competing woody vegetation. Above- and below-ground plant parts could be damaged or destroyed by timber harvesting activities. Plants could be run over with logging equipment, damaged by the skidding of logs, or damaged by the construction of log landings or roads. Adverse direct effects resulting from the use of chemical, mechanical, and/or manual control methods to control competing woody vegetation are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. Mechanical treatments used to mow or masticate competing woody vegetation could damage aboveground plant parts, but are not likely to damage belowground parts. In order to avoid these direct effects, mitigation measures would be followed (see Mitigation Measure #1).

In alternative 3, compartment 16, stand 27 would receive a cut-and-remove treatment with planting and potential herbicide application. In this treatment, timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and access roads. Stands would be reforested by planting with native tree species. Above- and belowground plant parts could be damaged or destroyed by timber harvesting and reforestation activities. Herbicides may be used in site preparation and reforestation release treatments. Herbicide

methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. In order to avoid direct effects from these activities, mitigation measures would be followed (see Mitigation Measure #1).

Whorled horsebalm. This species is known to occur in compartment 41, stand 12; compartment 50, stand 2; compartment 56, stand 91; and compartment 58, stand 12. In alternative 3, compartment 41, stand 12 would receive a cut-and-leave woodland treatment with potential herbicide application and no planting; compartment 50, stand 2 and compartment 58, stand 12 would receive cut-and-remove treatments with potential herbicide application and planting; and compartment 56, stand 91 would receive a cut-and-remove woodland treatment with potential herbicide application and no planting.

In the cut-and-leave woodland treatment (compartment 41, stand 12), chemical and/or manual control methods would be used to control competing woody vegetation. Adverse direct effects resulting from the use of chemical, and/or manual control methods to control competing woody vegetation are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. In order to avoid direct effects, mitigation measures would be followed (see Mitigation Measure #1).

In the cut-and-remove treatment with planting (compartment 50, stand 2 and compartment 58, stand 12), timber would be removed with mechanical (e.g., feller-buncher, skidder) or manual (e.g., hand tools, chainsaws) equipment. Harvest operations would include establishing log landings, loading areas and roads for access. Herbicides may be used in site preparation and reforestation release treatments. Stands would be reforested by planting with native tree species. In order to avoid adverse direct effects to whorled horsebalm in this stand, mitigation measures would be followed (see Mitigation Measure #1).

The cut-and-remove woodland treatment (compartment 56, stand 91), includes the mechanical felling and removal of trees, the placement of log landings and roads, and the use of mechanical, manual, or potentially chemical control methods to control competing woody vegetation. Above- and below-ground plant parts could be damaged or destroyed by timber harvesting activities. Plants could be run over with logging equipment, damaged by the skidding of logs, or damaged by the construction of log landings or roads. Adverse direct effects resulting from the use of chemical, mechanical, and/or manual control methods to control competing woody vegetation are possible but unlikely. Herbicide methods of foliar spray with backpack sprayers or stem injection would make application to non-target species possible but unlikely. Mechanical treatments used to mow or masticate competing woody vegetation could damage aboveground plant parts, but are not likely to damage belowground parts. In order to avoid these direct effects, mitigation measures would be followed (see Mitigation Measure #1).

All other botanical PETS species. Butternut, Fort Mountain sedge, Fraser's loosestrife, Georgia aster, Hartwig's locust, jeweled trillium, mountain witch alder, nodding trillium, persistent trillium, Radford's sedge, small whorled pogonia, southern Oconee bells, spreading pogonia and sweet pinesap are not known to occur within any proposed treatment stand so there would be no direct effects.

Indirect Effects

Indirect effects are effects to the species' habitat in or near the project area and they could occur during or after project implementation.

Aquatic habitats. Stream bank instability, point and nonpoint sources of siltation and pollution, habitat degradation resulting from deforestation, impoundments, channelization, dredging, the introduction of exotic species and severe drought all threaten the aquatic habitats of freshwater mussels and crayfish. Forested riparian buffers help protect aquatic habitats by: (1) absorbing and filtering runoff, (2) storing and filtering groundwater, (3) stabilizing stream banks and maintaining natural channel morphology, (4) providing course woody debris for habitat structure and diversity, (5) providing dissolved organic matter and other nutrients necessary to support the aquatic food web and (6) stabilizing aquatic microclimates (including stream temperature).

All riparian corridors on National Forest land are managed to retain, restore and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian and upland components within the corridor. The Forest Plan's riparian corridor management prescription [17] is embedded in all adjoining prescriptions. Riparian corridors occur along all defined perennial and intermittent stream channels that show signs of scour, and around natural ponds, lakeshores, wetlands, springs and seeps. Portions of the corridor may extend into upland areas, especially within steep-sided stream valleys and headwater streams. The Forest Plan also addresses "Water and Soil Quality" and "Channeled Ephemeral Steam Zone" standards that further protect aquatic and riparian habitats[18]. The riparian corridor management prescription and other Forest standards meet or exceed South Carolina BMPs; however, adverse effects to aquatic habitat could occur with the implementation of alternative 3.

Indirect effects to aquatic habitats could occur from project activities through soil and stream disturbance, culvert placement and herbicide use. Stream sediment deposition and turbidity may result from harvest activities, road work and skid trail and temporary road stream crossings. Indirectly, sediments can fill in and destroy habitat niches within a stream impacting refugia and food sources.

Removal or loss of riparian vegetation could result in a decrease of filtering capabilities, a decrease of large wood and leaf litter recruitment and an increase in stream temperatures. Loss of riparian vegetation could lead to a decreased food base and a decrease in instream habitat complexity. This is not expected to occur on a large scale in riparian corridors with this project; however, there may be areas where the primary component of the riparian vegetation is loblolly pine that would be removed and/or girdled. In these areas, the risk of impacts to aquatic habitat would increase.

Where channeled ephemeral stream zones are completely harvested, there is an increased potential for sediments and herbicides to wash into downstream stream reaches. Channeled

[17] See pp. 3-39 through 3-44 in the Forest Plan for a complete description of the riparian corridor management prescription.
[18] See pp. 2-4 and 2-5 in the Forest Plan for a complete description of "Water and Soil Quality" and "Channeled Ephemeral Stream Zone" Forest Standards.

ephemeral stream zones that would be reforested with pine trees would have a decrease in beneficial leaf litter, detritus and wood and as an upstream source, these materials would be diminshed in downstream stream reaches.

Pine-oak heaths are communities that occur on poor, highly acidic soils of narrow ridges, steep south slopes and the entire tops of some mountains. These communities are characterized by open stands of several different pine and oak species. Pine-oak heath understories are dominated by a dense shrub layer of ericaceous species such as mountain laurel, rhododendron, blueberries and huckleberries (*Gaylussacia* spp.). Species that are associated with this community include ashleaf goldenbanner, Hartwig's locust, mountain witch alder, spreading pogonia and sweet pinesap.

Habitat for these species would benefit by the implementation of cut-and-leave, cut-and-remove and woodland treatments in alternative 3. By removing all off-site loblolly pine, these treatments would favor native tree species that are associated with pine-oak heaths, such as shortleaf pine, pitch pine and dry-site oak species. Proposed treatments would also increase the amount of sunlight reaching the understory layer, benefiting ashleaf goldenbanner, Hartwig's locust, spreading pogonia, sweet pinesap and mountain witch alder.

Mesic forests generally occur in sheltered locations on north-facing slopes, on the lower slopes of broad ravines, or on broad flats adjacent to streams. Soils in mesic forests are typically deep and rich, are usually high in calcium and have good soil moisture for most of the growing season. Plant diversity and density are very high in mesic forests. Northern red oak, yellow poplar, beech (*Fagus grandifolia*) and basswood (*Tilia heterophylla*) are common overstory trees. Fort Mountain sedge, jeweled trillium, nodding trillium, persistent trillium, piedmont strawberry, Radford's sedge, small whorled pogonia, southern Oconee bells and whorled horsebalm occur within the herbaceous layer of mesic forests. Butternut is an uncommon tree species that also occurs on mesic sites in the mountains and southern Appalachian salamander is usually found at high elevations sites.

Most loblolly pine removal and restoration activities would take place on dry sites. There may be mesic habitat occurring within hardwood inclusions or along the edges of treatment stands. Butternut, Fort Mountain Sedge, jeweled trillium, nodding trillium, persistent trillium, Radford's sedge, small whorled pogonia, southern Appalachian salamander and southern Oconee bells are not known to occur within proposed treatment stands, suggesting that habitat is not available. While piedmont strawberry and whorled horsebalm are known to occur within some proposed treatment stands, these species also occur on drier sites, such as oak-hickory forests. Proposed treatments in alternative 3 are not likely to affect mesic forest sites.

Small whorled pogonia is known to occur in a stand that is immediately adjacent to a proposed cut-and-remove treatment (compartment 28, stand 34). Management of the adjacent stand is not expected to affect short- or long-term habitat conditions for small whorled pogonia.

Open habitats and roadsides. Implementation of alternative 3 would have beneficial indirect effects on species that use open habitats and roadsides. Cut-and-leave, cut-and-remove and woodland treatments would improve habitat for disturbance-dependent plant species (ashleaf

goldenbanner, Fraser's loosestrife, Georgia aster, Hartwig's locust, smooth coneflower and sun-facing coneflower) by opening up dense canopies and allowing increased sunlight to reach the forest floor.

By reducing tree densities, creating gaps and managing for woodland conditions, the amount of herbaceous plants made available to larval and adult Diana fritillary is expected to increase. *Viola* species used by larvae and various herbaceous species used by adults would not be targeted in herbicide operations.

Dry ridge top habitats are common within treatment stands. Much of the cut-and-leave and cut-and-remove regeneration harvests and woodland treatments would occur on these sites. Initial thinning of timber would result in an opening up of the forest stands that would result in short-term habitat benefits for species that occur on dry ridge tops. Restoring shortleaf pine, pitch pine and Table Mountain pine to these sites would result in beneficial long-term habitat improvements for native species that inhabit these areas, like mountain witch alder and spreading pogonia.

General forest habitats. Eastern small-footed myotis and Rafinesque's big-eared bat use a wide variety of forest habitats for roosting, foraging and commuting. Of all the habitat components required by bats, the two most heavily influenced by forest management are roost sites and foraging habitat (Hayes and Loeb 2007). The number of summer and winter roost trees is not expected to decrease significantly with the implementation of alternative 3. Most snags would be retained during regeneration harvests and woodland treatments. The Forest Plan includes specific language that provides for the retention of snags during vegetation management and regeneration treatments[19]. Additionally, most live hickories and oaks – trees commonly used as roost sites because of their exfoliating bark – would also be retained.

Although roost abundance may not be significantly altered by implementing alternative 3, the environmental conditions around a roost may be affected. Because bats spend so much time roosting, thermal dynamics during roosting play a critical role in bat ecology (Barclay and Kurta 2007). Regeneration harvests or woodlands thinnings around existing roost trees may change the thermal characteristics of the roost site, possibly causing it to become unsuitable.

Bats must contend with physical obstruction ("clutter") while in flight (Bringham et al. 1997). Most North American species avoid areas that are extremely cluttered. Foraging habitat may be improved through regeneration harvests and woodland thinnings because of the reduction of tree density. Regeneration harvests and woodland thinnings would also result in increased edge habitat, which bats frequently use for commuting and foraging.

Any road work in alternative 3 (which includes system road reconstruction/maintenance, temporary road construction, and skid trail construction) would likely increase foraging habitat suitability for eastern small-footed myotis and Rafinesque's big-eared bat. Roads often provide flyways for chiropteran species, presumably because of reduced clutter over roads.

[19] See Standards FW-18 and FW-22 on pp. 2-7 and 2-8 in the Forest Plan for a description of snag retention standards.

Mixed forests adjacent to streams and lakes. Bald eagles generally nest near coastlines, rivers and large lakes and streams. They often nest in mature trees, snags, cliffs, rock promontories and on human-made structures such as power poles and communications towers. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest. Bald eagles also use a variety of perches for roosting; however, roost trees do not have to be as robust as nest trees. Project activities in alternative 3 could remove large loblolly pines that could be potential nest or roost trees. However, only those treatment stands that occur within close proximity (approximately ½ mile) to a large body of water would likely be used by bald eagles. Considering the amount of available habitat District-wide, and the widely distributed nature of treatment stands, any loss of potential nest or roost sites is insignificant and would not have an adverse indirect effect on bald eagles.

Cumulative Effects

Cumulative effects are those resulting from incremental impacts of the proposed action added to other past, present, and future actions. Cumulative effects can result from individually minor but collectively significant actions that take place over a period of time.

In the past, projects on the Andrew Pickens District included timber harvesting, timber stand improvement practices, prescribed burning, mechanical and chemical control of non-desirable species (including non-native invasives), wildlife opening construction and maintenance, trail construction and maintenance, road construction and maintenance (including culvert repair) and erosion control practices. In the future, all activities are expected to continue at about the same levels.

Past, present and reasonably foreseeable projects on national forest land have and would continue to avoid impacts to known PETS species and their habitats. Surveys would be completed in areas with potential habitat and known populations would be protected. Consultation with the USFWS would be completed to ensure threatened and endangered species protection.

On privately owned lands within the National Forest boundary, the primary land uses are timber management, farming, livestock production, hunting and residential uses. These uses are expected to continue in the future.

VIII. Determination of Effect and Rationale

Threatened and Endangered Species

Persistent trillium, small whorled pogonia – NOT LIKELY TO ADVERSELY AFFECT (Section 7 consultation with USFWS is required)

> Rationale: These species are not known to occur within proposed treatment stands. Potential habitat is not likely to be affected by project activities.

Smooth coneflower – NOT LIKELY TO ADVERSELY AFFECT (Section 7 consultation with USFWS is required)

Rationale: In order to avoid direct effects within stands that receive cut-and-remove treatments with reforestation, woodland treatments with no reforestation and cut-and-leave treatments with no reforestation, Mitigation Measures #2 and 3 would be followed. Habitat for this disturbance-dependent, sun-loving species would improve with the implementation of alternative 3.

Sensitive Species

Ashleaf goldenbanner, piedmont strawberry, sun-facing coneflower, whorled horsebalm – MAY IMPACT INDIVIDUALS BUT NOT LIKELY TO CAUSE A TREND TO FEDERAL LISTING OR A LOSS OF VIABILITY

Rationale: In order to avoid direct effects from project activites, Mitigation Measure #1 would be followed. Habitat for ashleaf goldenbanner and sun-facing coneflower would be improved, and habitat for piedmont strawberry and whorled horsebalm is not likely to be affected by project activities.

Bald eagle – NO IMPACT

Rationale: Project activities would have no adverse effects on foraging bald eagles, and nest/roost sites would be protected by Forest Plan Standard FW-28. There would be no substantial loss of habitat with the implementation of alternative 3.

Brook floater, Chauga crayfish, Edmund's Snaketail – MAY IMPACT INDIVIDUALS BUT NOT LIKELY TO CAUSE A TREND TO FEDERAL LISTING OR A LOSS OF VIABILITY

Rationale: Project activites that result in soil and stream disturbance and the use of herbicides could result in adverse direct and indirect effects on aquatic species. These effects are minimized by following Forest Plan standards/guidelines, South Carolina Best Management Practices and project-specific mitigation measures.

Butternut, Fort Mountain sedge, jeweled trillium, nodding trillium, Radford's sedge, southern Appalachian salamander, southern Oconee bells – NO IMPACT

Rationale: There would be no direct effect to these species because they are not known to occur within proposed treatment stands. Alterations to potential habitat are not likely because these species occur on rich mesic sites, whereas most loblolly pine removal activities would occur on drier sites.

Diana fritillary – MAY IMPACT INDIVIDUALS BUT NOT LIKELY TO CAUSE A TREND TO FEDERAL LISTING OR A LOSS OF VIABILITY

Rationale: If larvae were present during project activities, including tree removal, road

work, site preparation and reforestation, individuals could be harmed. Proposed treatments are expected to improve habitat suitability for Diana fritillary.

Eastern small-footed myotis, Rafinesque's big-eared bat – MAY IMPACT INDIVIDUALS BUT NOT LIKELY TO CAUSE A TREND TO FEDERAL LISTING OR A LOSS OF VIABILITY

Rationale: Injury or death could occur to one or several individuals if an occupied roost tree were felled. Habitat for eastern small-footed myotis and Rafinesque's big-eared bat is expected to benefit from proposed treatments.

Fraser's loosestrife, Georgia aster, Hartwig's locust, mountain witch alder, spreading pogonia, sweet pinesap – BENEFICIAL IMPACTS

Rationale: There would be no direct effect to these species because they are not known to occur within proposed treatment stands. Habitat for Fraser's loosestrife, Georgia aster, Hartwig's locust, mountain witch alder and sweet pinesap would be improved by opening up dense canopies and allowing increased sunlight to reach the forest floor.

IX. Mitigation Measures

The following measures shall be followed during project implementation:

1) Coordinate all ground-disturbing activities (including the placement of log landings, loading areas, skid trails, access roads) and all reforestation and herbicide operations with Sumter National Forest biological staff to avoid sensitive plant species in the following treatment stands:
   a) Compartment 16, stands 4A, 4B, and 27 – sun-facing coneflower;
   b) Compartment 41, stand 12 – ashleaf goldenbanner, piedmont strawberry, whorled horsebalm;
   c) Compartment 50, stand 2 – whorled horsebalm;
   d) Compartment 55, stand 7 – piedmont strawberry;
   e) Compartment 56, stand 91 – whorled horsebalm; and
   f) Compartment 58, stand 12 – whorled horsebalm.

2) In compartment 39, stand 20, the distribution of smooth coneflower shall be identified by Sumter National Forest biological staff prior to project implementation. The following protective measures shall be followed:
   a) Avoid the use of heavy equipment to harvest trees within smooth coneflower areas (in coneflower areas, overstory trees may be felled using hand tools as long as trees are not felled directly on coneflower plants);
   b) Any herbicide operation within a smooth coneflower area shall be supervised by Sumter National Forest biological staff;
   c) Avoid placing log decks, temporary roads, or reconstructed roads within smooth coneflower areas, and avoid skidding trees through coneflower areas (trees may be skidded out of coneflower areas as long as damage does not occur to coneflower);

d) Avoid reforestation operations within smooth coneflower areas.

3) In compartment 41, stand 12; compartment 53, stand 5; and compartment 65, stand 27 the distribution of smooth coneflower shall be identified by Sumter National Forest biological staff prior to implementation. The following protective measures shall be followed:
   a) Avoid the use of heavy equipment to control woody vegetation within smooth coneflower areas (in coneflower areas, overstory trees may be felled using hand tools as long as trees are not felled directly on coneflower plants, and hand tools may be used to control mid- and understory woody vegetation);
   b) Any herbicide operation within a smooth coneflower area shall be supervised by Sumter National Forest biological staff;
   c) Avoid placing log decks, temporary roads, or reconstructed roads within smooth coneflower areas, and avoid skidding trees through coneflower areas.

X. Signature

This Biological Assessment/Biological Evaluation was prepared by:

/s/Jeffrey M. Magniez	12/14/2012
Jeffrey M. Magniez Zone Wildlife Biologist Sumter National Forest	Date

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APPENDIX A

Proposed, Endangered, Threatened and Sensitive (PETS) Species of the Sumter National Forest that are known to occur or have potential habitat within the Loblolly Pine Removal and Restoration Project, Andrew Pickens Ranger District. Obs = PETS species observed during project field surveys or known to occur based on existing records, Hab = Suitable habitat exists within the project area, "+" = meets criterion, "--" = does not meet criterion. P = piedmont (Enoree and Long Cane Ranger Districts), M = mountains (Andrew Pickens Ranger District).

SPECIES	STATUS	HABITAT	Obs	Hab	Range
ASHLEAF GOLDENBANNER *Thermopsis mollis* var. *fraxinifolia*	Sensitive	Pine-oak heaths and roadsides; **Known to occur within project area**	+	+	M
BACHMAN'S SPARROW *Aimophila aestivalis*	Sensitive	Occurs in forest stands with open canopies and grassy understories; **Outside of known range**	--	--	P
BALD EAGLE *Haliaeetus leucoocephalus*	Sensitive	Perennial rivers and lakes, nesting in dominant or co-dominant pines 3 km or less from open water; **Potential habitat occurs within project area**	--	+	P, M
BILTMORE SEDGE *Carex biltmoreana*	Sensitive	Occurs on thin soils on medium to high elevation granitic domes; also on sloping rock outcrops and adjacent woodlands under open to nearly closed canopy of *Quercus* spp., *Fraxinus americana*, *Carya glabr*, and *Juniperus virginiana* var. *virginiana*; **No potential habitat within project area**	--	--	M
BROOK FLOATER *Alasmidonta varicosa*	Sensitive	Small streams with gravel bottoms; known from Chattooga, Turkey and Upper Stevens Creek watersheds on the Long Cane Ranger District; **Potential habitat occurs within project area**	--	+	P, M
BUTTERNUT *Juglans cinerea*	Sensitive	Basic mesic forests along the Brevard Geologic Belt; usually at old homesites; **Potential habitat occurs within project area**	--	+	M
CAROLINA DARTER *Etheostoma collis*	Sensitive	Localized populations occur in lower and middle piedmont streams with slow to moderate current. Known from Saluda and Broad River watersheds; **Outside of known range**	--	--	P
CAROLINA HEELSPLITTER *Lasmigona decorata*	Federally Endangered	Known historically from Catawba, Pee Dee, and Saluda drainages in South Carolina; occurs in Mountain, Beaverdam, Cuffytown, Sleepy, and Turkey Creeks; **Outside of known range**	--	--	P
CAROLINA PLAGIOMNIUM *Plagiomnium carolinianum*	Sensitive	Damp, shaded, vertical rock faces along streams in mountain gorges; known from Long Creek and Opossum Creek; **No potential habitat in project area**	--	--	M

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SPECIES	STATUS	HABITAT	Obs	Hab	Range
CHAUGA CRAYFISH *Cambarus chaugaensis*	Sensitive	Fast-moving, rocky 3rd and 4th order streams in tributaries of the upper Savannah River; known most recently from the Chauga River; noted historically in Ramsey Creek, West Village Creek, Crane Creek, Cedar Creek, and a stream between Long Creek and the Chattooga River (1972 data); **Potential habitat occurs within project area**	--	+	M
DIANA FRITILLARY *Speyeria diana*	Sensitive	Violets are larval host plant; open areas for nectar sources in summer; **Known to occur within project area**	+	+	M
EASTERN SMALL-FOOTED MYOTIS *Myotis leibii*	Sensitive	At southern terminus of range on Andrew Pickens Ranger District; known from Moody Creek near Lake Cherokee; may commonly roost in hemlock trees near streams in summer; **Potential habitat occurs within project area**	--	+	M
EDMUND'S SNAKETAIL *Ophiogomphus edmundo*	Sensitive	Clear, moderately flowing mountain streams and rivers with sand or gravel riffles; **Potential habitat occurs within project area**	--	+	M
FLORIDA GOOSEBERRY *Ribes echinellum*	Federally Threatened	Known from the Stevens Creek drainage, on north facing hardwood slopes in association with basic soils; **Outside of known range**	--	--	P
FORT MOUNTAIN SEDGE *Carex communis* var. *amplisquama*	Sensitive	Found in rich coves, at Tamassee Knob, East Fork of the Chattooga, and White Rock Cove on the Andrew Pickens Ranger District **Potential habitat occurs within project area**	--	+	M
FRASER'S LOOSESTRIFE *Lysimachia fraseri*	Sensitive	Open stands or rights-of-way with grassy understories; **Potential habitat occurs within project area**	--	+	M
GEORGIA ASTER *Symphyotrichum georgianus*	Sensitive; Federal Candidate	Open stands or rights-of-way with grassy understories; piedmont and lower elevations in mountains; **Potential habitat occurs within project area**	--	+	P, M
HARTWIG'S LOCUST *Robinia viscose* var. *hartwegii*	Sensitive	Pine-oak heaths and roadsides in the mountains; one location known near Village Creek on the Andrew Pickens Ranger District; **Potential habitat occurs within project area**	--	+	M
INDIGO BUSH *Amorpha schwerini*	Sensitive	Pine-oak heaths and oak-hickory communities; **Outside of known range**	--	--	P

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SPECIES	STATUS	HABITAT	Obs	Hab	Range
JEWELED TRILLIUM *Trillium simile*	Sensitive	Basic mesic forests of the mountains; **Potential habitat occurs within project area**	--	+	M
LANCELEAF TRILLIUM *Trillium lancifolium*	Sensitive	Basic mesic forests of the piedmont; **Outside of known range**	--	--	P
LIVERWORT SP. *Cheilolejeunea evansii*	Sensitive	Bark of trees in moist escarpment gorges or gorge-like habitats; **No potential habitat in project area**	--	--	M
LIVERWORT SP. *Plagiochila caduciloba*	Sensitive	Found on damp, shaded, vertical rock faces along streams in mountain gorges; southern appalachian endemic; **No potential habitat in project area**	--	--	M
LIVERWORT SP. *Plagiochila sharpii*	Sensitive	Found on damp, shaded, vertical rock faces along streams in mountain gorges; **No potential habitat in project area**	--	--	M
LIVERWORT SP. *Radula sullivantii*	Sensitive	Wet shaded rocks and crevices; **No potential habitat in project area**	--	--	M
MIGRANT LOGGERHEAD SHRIKE *Lanius ludovicia migrans*	Sensitive	Breeds in open areas dominated by grasses interspersed with shrubs, trees, or bare ground; uses agricultural landscapes (pastures); **Outside of known range**	--	--	P
MOUNTAIN WITCH ALDER *Fothergilla major*	Sensitive	Occurs in oak-hickory forests; may occur on monadnocks or north-facing slopes in piedmont; **Potential habitat occurs within project area**	--	+	M
NODDING TRILLIUM *Trillium rugelii*	Sensitive	Rich wooded slopes over mafic or calcareous rocks; **Potential habitat occurs within project area**	--	+	P, M
OGLETHORPE OAK *Quercus oglethorpensis*	Sensitive	Upland wetland depressions and streamside forests in the Carolina Slate belt; **Outside of known range**	--	--	P
PERSISTENT TRILLIUM *Trillium persistens*	Federally Endangered	Known from one site in South Carolina; occurs in mixed mesic forest in the Tugaloo River Composite watershed; **Potential habitat occurs within project area**	--	+	M
PIEDMONT STRAWBERRY *Waldsteinia lobata*	Sensitive	Occurs in mixed mesic hardwood forests in the lower elevations of the mountains; **Known to occur within project area**	+	+	M
RADFORD'S SEDGE *Carex radfordii*	Sensitive	Occurs in basic mesic and mixed mesic hardwood forests; **Potential habitat occurs within project area**	--	+	M

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SPECIES	STATUS	HABITAT	Obs	Hab	Range
RAFINESQUE'S BIG-EARED BAT *Corynorhinus rafinesquii*	Sensitive	Restricted to the mountains, sandhills, and coastal plain Physiographic regions; may be found in hollow trees or behind loose bark near streams, caves, mines, or human-made structures; **Potential habitat occurs within project area**	--	+	M
RAYED PINK FATMUCKET *Lampsilis splendida*	Sensitive	Primarily a costal plain species; one occurrence in Middle Saluda River Composite watershed **Outside of known range**	--	--	P
RELICT TRILLIUM *Trillium reliquum*	Federally Endangered	Basic mesic forests in Savannah and Chattahoochee drainages; known from the lower piedmont/fall line sandhills region; **Outside of known range**	--	--	P
ROBUST REDHORSE *Moxostoma robustrum*	Sensitive	Occurs in the Lower Savannah River composite watershed and introduced to the Broad River **Outside of known range**	--	--	P
SHOAL'S SPIDER LILY *Hymenocallis coronaria*	Sensitive	Rocky river shoals; sandhills and piedmont **Outside of known range**	--	--	P
SMALL WHORLED POGONIA *Isotria medeoloides*	Federally Threatened	Occurs in mixed mesic forests at moderate elevations (>1,000 feet); **Potential habitat occurs within project area**	--	+	M
SMOOTH CONEFLOWER *Echinacea laevigata*	Federally Endangered	Occurs along the Brevard Geologic Belt in association with grassy understories and open canopies; **Known to occur in project area**	+	+	M
SOUTHERN APPALACHIAN SALAMANDER *Plethodon teyahalee*	Sensitive	Mature mesic hardwood forests; **Potential habitat occurs within project area**	--	+	M
SOUTHERN OCONEE BELLS *Shortia galacifolia* var. *galacifolia*	Sensitive	Large colonies in mixed mesic forests near Lake Jocassee; **Potential habitat occurs within project area**	--	+	M
SPREADING POGONIA *Cleistes bifaria*	Sensitive	Dry ridgetops under pines; **Potential habitat occurs within project area**	--	+	M
SUN-FACING CONEFLOWER *Rudbeckia heliopsidis*	Sensitive	Open forests with herbaceous understories; known from roadsides in the vicinity of Lake Cherokee; **Known to occur within project area**	+	+	M
SWEET PINESAP *Monotropsis odorata*	Sensitive	Shortleaf pine-oak heaths in the southern Appalachians and piedmont; **Potential habitat occurs within project area**	--	+	P, M

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SPECIES	STATUS	HABITAT	Obs	Hab	Range
WEBSTER'S SALAMANDER *Plethodon websteri*	Sensitive	Mesic hardwood slopes with rocky outcrops; Greenwood, Edgefield, and McCormick Counties **Outside of known range**	--	--	P
WHORLED HORSEBALM *Collinsonia verticillata*	Sensitive	Found in basic mesic forests along the Brevard Geologic Belt in South Carolina; **Potential habitat occurs within project area**	--	+	M
WOOD STORK *Mycteria americana*	Federally Endangered	Known to forage in freshwater wetlands on both Enoree and Long Cane Ranger Districts; **Outside of known range**	--	--	P