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Lower Cowpasture Restoration and Management Project

James River & Warm Springs Ranger Districts
George Washington & Jefferson National Forests
Alleghany, Bath, and Rockbridge Counties, Virginia

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Introduction

In early 2013, we started working on a unique project called the Lower Cowpasture Restoration and Management Project. This undertaking involves a large, landscape-scale analysis that is designed to:

1) consider resource management in a more integrated manner and over a longer timeframe (ten years);
2) utilize scientific and technological advances to address resource issues at a larger scale (around 117,000 acres); and
3) build upon the collaborative relationships that developed among a diverse set of publics during the recent revision process of the Land and Resource Management Plan (Forest Plan) for the George Washington National Forest (GWNF).

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

Chapter 1-Purpose and Need for Action: Includes information on the history of the project proposal, the purpose 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.

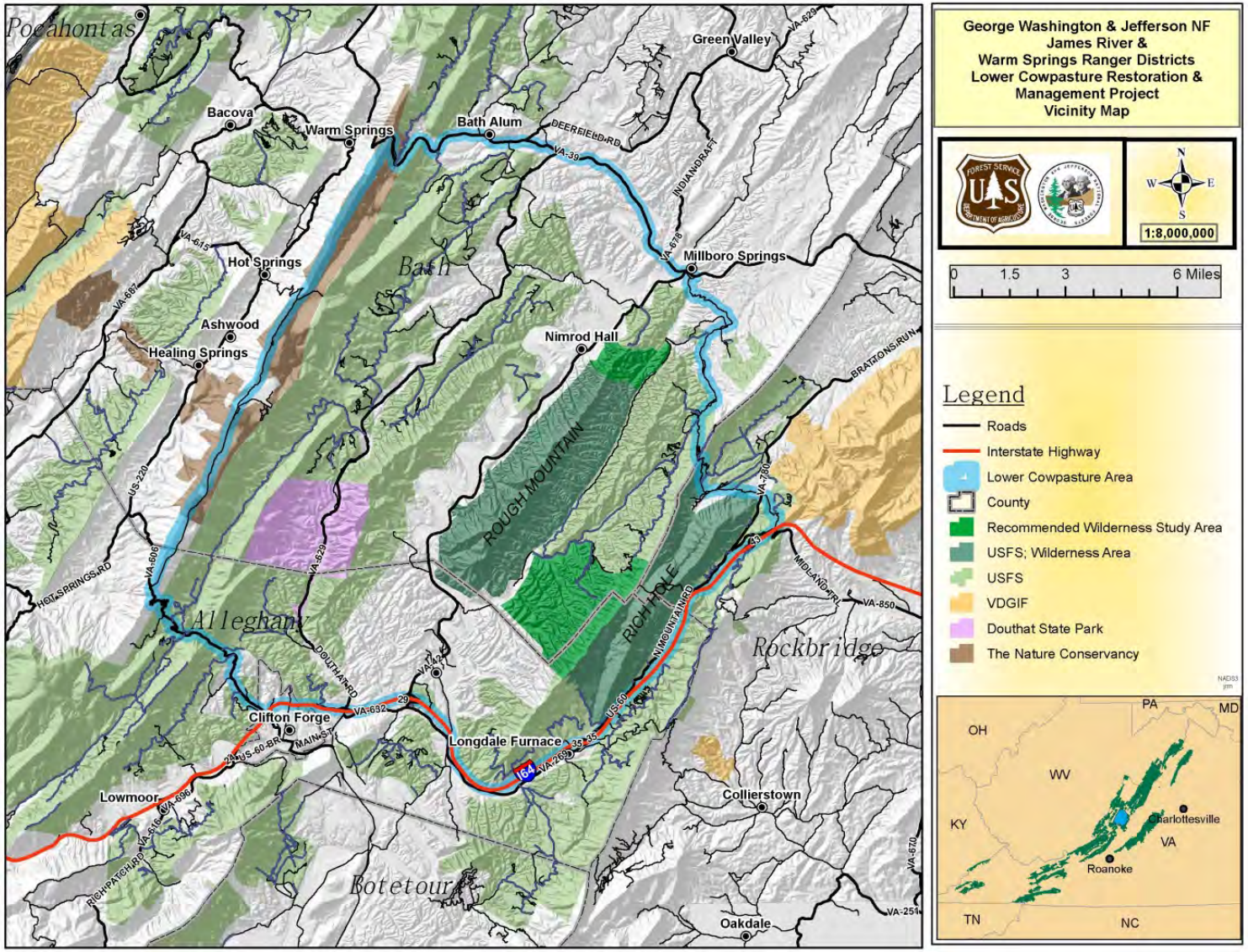
Chapter 2-Alternatives Considered: Provides a more detailed description of the agency's proposed actions as well as the alternative methods for achieving the stated purpose and need. Alternatives can be developed based on issues and concerns raised by the public, other agencies, and internally to the agency. A summary of the proposed projects associated with each alternative is provided.

Chapter 3-Environmental Effects: Describes the existing conditions and the environmental effects of implementing the proposed actions and other alternatives.

Chapter 4-Project Consultation and Coordination: Provides a list of preparers and Federal and State agencies consulted during the development of the EA.

The complete project planning record is located at the District Ranger's Office in Hot Springs, VA.

Lower Cowpasture Restoration and Management Project Vicinity Map



Chapter 1: Purpose and Need for the Project

1.1 Project Area Description

The Lower Cowpasture Restoration and Management (Lower Cowpasture) Project area is within the Warm Springs and James River Ranger Districts on the George Washington and Jefferson National Forests. The project area is located in northeast Alleghany, southeast Bath, and western Rockbridge Counties in the Cowpasture, Jackson, and Calfpasture River watersheds. The Lower Cowpasture project area is approximately 117,552 acres of public and private land bounded on the west by the ridge of Warm Springs Mountain, on the north by State Route 39, on the east by State Route 633 and Interstate 64, and on the south by Interstate 64 and State Route 606. Elevations within the project area range from 1,100 ft. along the lower Cowpasture River to 4,229 ft. on top of Warm Springs Mountain's Bald Knob. Approximately 77,680 acres are National Forest System lands and comprise compartments 891-893, 915-918, 921, 925-929, 931-935, 953-959, 961-984, 1004-1006, 1305-1306, 1308-1311, 1315, 1317, 1320, 1322, 1324-1328, 1348-1351, 1354, 1356-1359, 1369, and 1374.

The Revised Forest Land and Resource Management Plan (Forest Plan) for the George Washington National Forest has allocated the Lower Cowpasture project area to ten Management Prescription Areas. The management prescription allocation and acreage are summarized in Table 1-1 and Figure 1-1.

Table 1-1 Lower Cowpasture Project Area Management Prescription Allocation

Management Prescription		Acres
1A	Designated Wilderness	15,851
1B	Recommended Wilderness Study Area	5,658
2C3	Eligible Recreation River Corridor	552
4C1	Geological Area	2
4D	Special Biological Area	2,562
5C	Utility Corridor	331
7A1	Highland Scenic Tour Byway	1,082
7B	Scenic Corridors	4,691
12D	Remote Backcountry	18,204
13	Mosaics of Wildlife Habitat	28,747
	Total	77,680

Source: GIS Database

Management Prescription 1A (*Designated Wilderness*) contains portions of the forest that allow ecological and biological processes to progress naturally with little to no human influence or intervention. (Forest Plan, p. 4-27)

Management Prescription 1B (*Recommended Wilderness Study Areas*) emphasizes managing these areas to protect the qualities that were the basis for recommending wilderness study, pending legislation as to their classification, while also providing for existing uses where compatible with protecting wilderness character. (Forest Plan, p. 4-32)

Management Prescription 2C3 (Eligible Recreation River Corridor) emphasize river segments and their associated corridors eligible to be part of the National Wild and Scenic River System. They are managed to protect and perpetuate the outstandingly remarkable values that led to their eligibility status and classification as "recreational." (Forest Plan, p. 4-38)

Management Prescription 4C1 (*Geological Area*) areas are managed to highlight and protect unique geological resources. (Forest Plan, p. 4-50)

Management Prescription 4D (*Special Biological Area*) emphasize areas to perpetuate or increase existing individual plant or animal species and communities that are of national, regional, or state significance and identified as threatened, endangered, sensitive, or locally rare. (Forest Plan, p. 4-53)

Management Prescription 5C (*Utility Corridor*) are designated corridors containing special uses which serve a public benefit by providing a reliable supply of electricity, natural gas, or water essential to local, regional, and national economies. They include long linear features like high voltage electric transmission lines and buried pipelines for public drinking water or natural gas. These designated corridors serve uses that require at least 50 feet wide right-of-way. Local distribution lines are not included in this prescription area, but rather are part of the prescription area in which they are physically located. (Forest Plan, p. 4-76)

Management Prescription 7A1 (*Highland Scenic Tour Byway*) these areas showcase the natural scenery, forest vegetation, cultural, geological resources, and techniques used by the Forest Service to design and implement management activities in a manner that meets scenery integrity objectives and protects cultural and natural resources. (Forest Plan, p. 4-78)

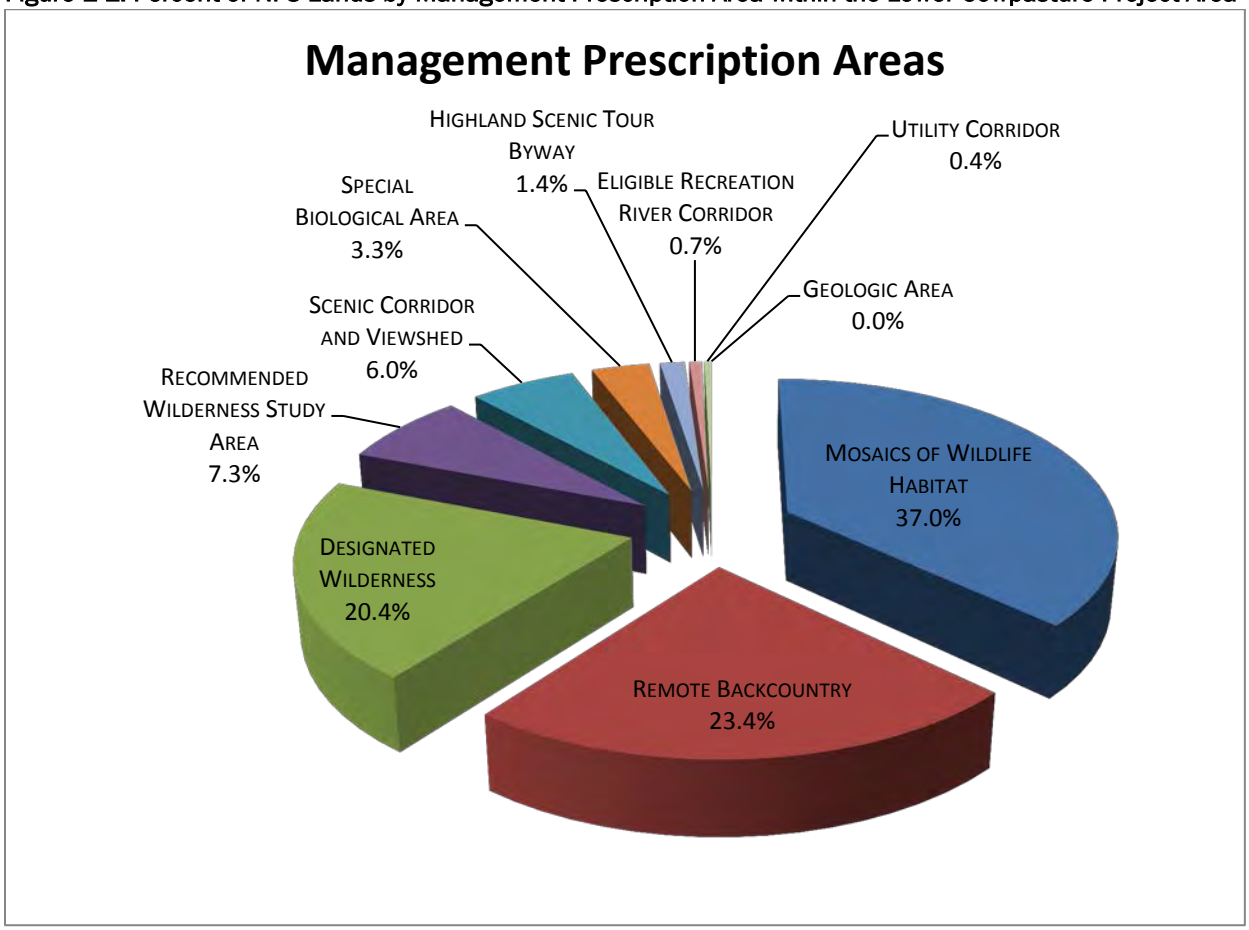
Management Prescription 7B (*Scenic Corridor*s) the emphasis in these areas is on providing, through maintenance or restoration and design, high quality scenery in sensitive recreational and travelway settings. (Forest Plan, p. 4-81)

Management Prescription 12D (*Remote Backcountry*) contains portions of the forest managed to provide mature successional forest with developing or well developed canopies, large woody material on the ground and den and cavity trees. (Forest Plan, p. 4-127)

Management Prescription Area 13 (*Mosaics of Habitat*) contains portions of the forest that emphasize the Forestwide vision for ecological systems diversity. This prescription area is also the predominant area where timber harvest will be used to create and maintain the ecosystem diversity objectives and where wildlife habitat management activities will be focused for both ecological objectives and recreational (hunting and wildlife viewing) objectives. Another objective will be meeting the demand for timber products through timber harvest. (Forest Plan, p. 4-131)

Management Prescription Area 11 (*Riparian Corridors – Streams, Lakes, Wetlands, and Floodplains*) are managed to retain, restore, and/or enhance the inherent ecological processes and function of the associated aquatic, riparian, and upland components within the corridor. Because these areas are intricately embedded within other areas they are not mapped on the Management Prescription Area map (Forest Plan, p. 4-118).

Figure 1-1. Percent of NFS Lands by Management Prescription Area within the Lower Cowpasture Project Area



The project area will be accessed using State Routes (SR) 39, SR 42, SR 606, SR 629, SR 632, SR 633, SR 683, SR 777, and SR 780; and Forest System Road (FSR) 125 (Sandy Springs), FSR 125S (Lick Block), FSR 129 (Pads Creek), FSR 194 (Limekiln), FSR 194A (Limekiln Spur), FSR 333 (Craft), FSR 336 (McGraw Hollow), FSR 336A (McGraw Hollow (Big Lake)), FSR 336B (McGraw Hollow Spur), FSR 337 (Walton), FSR 337G (Upper Boat Launch), FSR 361 (Beards Mountain), FSR 361A (Beards Mountain Spur), FSR 361E (Blueberry Hill), FSR 362 (Orebank), FSR 446 (Cliftondale), FSR 1901 (Brushy Ridge).

1.2 Purpose and Need for Action

The proposed action was developed to move the existing condition of the Lower Cowpasture project area towards the desired condition outlined in the Revised Land and Resource Plan for the George Washington National Forest (Forest Plan). The Forest Plan specifies the overall direction for managing all resources for the Forest, and consists of Forest-wide and Management Prescription Area-specific desired conditions, goals, objectives, standards, and guidelines that provide for land uses with anticipated resource outputs. The National Environmental Policy Act of 1969 (NEPA) established requirements for site-specific planning. This EA documents the site-specific analysis of implementing the Forest Plan in the Lower Cowpasture project area.

DESIRED CONDITIONS

Desired conditions describe the vision for achieving the Forest Service's mission on the George Washington National Forest. They portray the ecological, social and economic conditions the Forest is expected to provide in the future when the management direction in the Forest Plan has been successfully implemented. Desired conditions "paint a picture" of an area by describing the appearance and condition of various natural and social resources within the area, in part giving a sense of the type and extent of human influence that a forest visitor could expect. They were developed through an integration of input from the public comments received during Forest Plan revision, national and regional Forest Service goals, changes and trends affecting the George Washington National Forest, and sound science for various resources and uses of the forest.

Just like ecosystems, many desired conditions are interrelated across resource areas and are not mutually exclusive. A recurring theme that runs throughout the desired conditions for the George Washington NF is the focus on sustaining the diverse terrestrial, aquatic and vegetative communities unique to the central and southern Appalachians through the foundation of healthy watersheds, productive soils, and healthy airsheds.

This in turn will allow the Forest to continue to provide a large holding of public land that can offer many different social and economic contributions for current and future generations. In some cases, our desired condition matches the current condition, so our goal is to maintain what we have. In other cases, we need to work toward meeting the desired conditions and success in achieving them can only be measured over the long-term.

During the recent Forest Plan revision process, the GWNF did an ecological sustainability analysis to evaluate ecosystem diversity (Ecosystem Diversity Report, Appendix E, Final EIS) and species diversity for both terrestrial (Species Diversity Report, Appendix F, Final EIS) and aquatic diversity (Aquatic Ecological Sustainability Analysis, Appendix G, Final EIS). The ecological sustainability framework for this analysis was built around principles developed by The Nature Conservancy (TNC) in their Conservation Action Planning Workbook (TNC 2005) and used the best available science as documented in the Ecological Sustainability Evaluation (ESE) relational database tool.

Ecosystem Diversity Report

The Ecosystem Diversity Report identified the key compositions, structures and functions of the native biological and vegetative ecological systems on the Forest. All ecological systems on the GWNF were identified using NatureServe's International Ecological Classification Standards (NatureServe 2004). Each system was defined in terms of existing Forest Service forest types, the ecological system classification mapping completed by Steve Simon for the Forest, and the LANDFIRE Vegetation Dynamic Models (www.landfire.gov). These systems were also crosswalked with the Virginia Department of Conservation and Recreation Natural Heritage Program Vegetation Community types.

A total of 24 ecological systems were identified for the Forest that represented both major and rare community types. These systems were then aggregated into nine ecological system groups based on similar key attributes, indicators, and species associates. For each group, the environment, vegetation, dynamics (canopy conditions, natural disturbance regimes, longevity), stresses and threats were identified in the report. The ecological systems and ecological system groups are shown in Table 1-2.

Table 1-2. Ecological Systems and System Groups

Ecological System Group	Ecological System
Spruce Forest	Central and Southern Appalachian Spruce-Fir Forest
Northern Hardwood Forest	Appalachian (Hemlock)-Northern Hardwood Forest
	Southern Appalachian Northern Hardwood Forest
Cove Forest	Southern and Central Appalachian Cove Forest
Oak Forests and Woodlands	Northeastern Interior Dry-Mesic Oak Forest
	Central and Southern Appalachian Montane Oak Forest
	Central Appalachian Dry Oak-Pine Forest
	Southern Appalachian Oak Forest
	Southern Ridge and Valley/Cumberland Dry Calcareous Forest
Pine Forests and Woodlands	Southern Appalachian Montane Pine Forest and Woodland
	Central Appalachian Pine-Oak Rocky Woodland
	Southern Appalachian Low-Elevation Pine Forest
Mafic Glade and Barrens and Alkaline Glades and Woodlands	Southern and Central Appalachian Mafic Glade and Barrens
	Central Appalachian Alkaline Glade and Woodland
Cliff, Talus and Shale Barrens	North-Central Appalachian Circumneutral Cliff and Talus
	North-Central Appalachian Acidic Cliff and Talus
	Appalachian Shale Barrens
Floodplains, Wetlands, and Riparian Areas	Central Appalachian River Floodplain
	Central Appalachian Stream and Riparian
	Central Interior Highlands and Appalachian Sinkhole and Depression Pond
	Southern and Central Appalachian Bog and Fen
	North-Central Appalachian Acidic Swamp
	North-Central Appalachian Seepage Fen
Caves and Karstlands	Caves and Karstlands

Species Diversity Report.

The Species Diversity Report began with a comprehensive list of plant and animal species and was compiled by combining species lists from a variety of sources. These sources included federally-listed threatened and endangered (T&E) species; species that are tracked by the Virginia Department of Conservation and Recreation Natural Heritage Program and the West Virginia Division of Natural Resources; species identified in the Virginia and West Virginia State Comprehensive Wildlife Conservation Strategies as species of conservation concern; the Birds of Conservation Concern list compiled by the U.S. Fish and Wildlife Service; and the Regional Forester's list of sensitive species for the Southern Region.

For each species or species group, the ranges, habitat needs, limiting factors, threats, and specific habitat elements were identified. For example, the open area associates species group contains species (ruffed grouse, wood turtle, golden winged warbler) that require open areas for at least some part of their life cycle – for herbaceous and shrubby vegetation and insect opportunities. Most species' requirements are met by maintaining, restoring and protecting the nine ecological systems described above. For those species that have additional needs, key attributes and indicators were identified.

Aquatic Ecological Sustainability Analysis

The Aquatic Ecological Sustainability Analysis classified aquatic habitats using the basic structure of The Nature Conservancy (TNC) aquatic community classification, and the Virginia and West Virginia Comprehensive Wildlife Action Plans. Key factors related to the physical, chemical and biological integrity of aquatic ecosystems were evaluated. The current condition and anticipated trends of influences from disturbance processes and anthropogenic change processes were assessed. Aquatic species were reviewed in a manner similar to terrestrial species described earlier.

Key Findings from Plan Revision Ecosystem and Species Diversity Analyses

- Many high priority species depend on the juxtaposition of both overstory mature and a well-developed grassy/shrubby/herbaceous understory for their life cycle needs. Northern bobwhite quail, red-headed woodpecker, brown-headed nuthatch, northern flicker, Appalachian yellow-bellied sapsucker, eastern wood-pewee, golden-winged warbler, Indiana bat, pine snake, grizzled skipper, box huckleberry, shale-barren rockcress, small-spreading pogonia, sword-leaf phlox, variable sedge, and smooth coneflower are just a few high priority species dependent upon open woodland habitat. Open woodlands are characterized by an overstory of trees that are spaced far enough apart to allow sunlight to reach the forest floor. This structural condition allows the development of a grassy/shrubby/herbaceous/woody understory more typical of early successional forest and grassland/shrublands.

- Early successional forests are important because they are highly productive in terms of forage, diversity of food sources, insect production, nesting and escape cover, and soft mast. Early successional forests have the shortest lifespan (usually about 10 years) of any of the forest successional stages, and are typically in short supply and declining on national forests in the Southern Appalachians (SAMAB 1996:28), and in the eastern United States (Thompson 2001). These habitats are essential for some birds (ruffed grouse, chestnut-sided warbler, golden-winged warbler, prairie warbler, yellow-breasted chat, blue-winged warbler, Swainson's warbler) and key to deer, turkey, and bear in the South (Gobster 2001). Many species commonly associated with late successional forest conditions also use early successional forests periodically, or depend upon it during some portion of their life cycle (Hunter et al. 2001).

- The need for seedling/sapling conditions to provide habitat for birds associated with early successional habitats is a current topic of concern. Old fields can provide conditions required by many early seral species, but this habitat type itself is very uncommon on the National Forest. There is a group of forest songbirds, such as the prairie and golden-winged warblers, which require disturbance patches that are less than 10 years of age and greater than 2 acres is size. In addition to structure and patch size, the elevation at which early seral habitats exist plays a role in providing habitat for some species. The chestnut-sided warbler typically occurs at higher elevations on the GWNF. Thus, provision of seedling/sapling habitat needs to be considered at both high and lower elevations.

- Hard mast is a very important component for many wildlife species such as bear, squirrel, and turkey. The five major oak species (*Quercus alba, Q. prinus, Q. velutina, Q. rubra*, and *Q. coccinea*) all begin hard mast production at ages from 20 to 25 years old. Maximum acorn production is achieved at 40 to 50 years old. *Carya glabra, C. tomentosa*, and *Fagus grandifolia* produce hard mast in quantity at ages of 30 to 40 years. Finally, *Tilia americana* can begin producing adequate amounts of hard mast as early as 15 years old. (Burns and Honkala 1990.) Goodrum and others found that acorn yields tended to be largest in the classes from 40 to 49 years old up to 90 to 99 years old, but declined thereafter (Goodrum

et al. 1971). Shaw arrived at a similar conclusion when he found that stands in his study area ranging from 40 to 80 years old comprised 50% of the management unit, but produced 90 percent of the acorn crop. (Shaw 1971.)

- Permanent grass/forb and seedling/sapling/shrub habitats are important elements of early successional habitat. Permanent openings are used by a variety of wildlife, both game and non-game species such as pine warbler, ovenbird, and black-throated green warbler. The greatest number of avian species and highest bird species diversity was found within the edge zone of the openings. Mammals include species such as white-tailed deer, striped skunk, woodchuck, bobcat, black bear, red bat, eastern cottontail, opossum, and several other small mammals.

- The GWNF, for the most part, does not have major ecotypes that were converted to other forest types from previous activities. Forest vegetation structure and composition of the understory, however, are often key features in need of restoration.

- The greatest stresses and threats to the oak forest and woodlands system are the lack of open conditions needed to establish and maintain oak reproduction and the competition of faster growing species due to the exclusion of fire or infestations of non-native invasive species. Given its importance as a food source for many wildlife species, maintaining a high percentage of oak in ages that produce mast is also important.

- The greatest stresses and threats to the pine forest and woodlands system are lack of disturbance to create regeneration and open woodland structure, invasive species including the native pine bark beetle, and climate change that could reduce rainfall and make insect outbreaks more common.

- Aquatic species (such as brook trout) that are non-tolerant of warmer water that is a projected climate change trend may find their habitat reduced. High priority actions would be protection of good habitat, improving connectivity and access to existing habitat. Protect and restore riparian forests to moderate changes in stream temperature, maintain stream bank stability, and provide instream habitat. Remove migration barriers and re-establish habitat connectivity so that species can move to more suitable habitat, or move to or from refugia.

- Acid sensitive aquatic species were identified and acid deposition rates and the underlying geology were used to analyze Forest watersheds for their sensitivity to acidification. About 67% of perennial streams on the GWNF were within the highly sensitive watersheds.

Structural Diversity

Structural diversity involves both successional stage and canopy conditions that are important to all forested ecological systems. Structure is also important to non-forested systems. Every forested community requires a balance of structural classes representing a diversity of vertical structure that allows for recruitment of young growth to replace losses due to storm events, pest infestations, wildfires, and biological age. An appropriate balance of vertical structure within each community also provides habitat for associated terrestrial species that require either grass/forb-seedling/shrub (early seral), and/or trees (late seral) at some stage in their life cycle.

Early successional forest is defined as regenerating forest of 0 to 35 years of age, depending upon the ecological system. It is characterized by woody growth of regenerating trees and shrubs, often with a significant grass/forb component, and relatively low density or absent overstory. This condition is distinguished from permanent grass/shrubland habitats by having relatively dense

woody vegetation, as opposed to grasses and forbs. Such conditions may be created by even-aged and two-aged regeneration cutting, and by natural disturbance events, such as windstorms, wildfire, and some insect or disease outbreaks.

Ages defining the remaining successional stages vary by ecological system group. Mid-successional forest often begins to develop with the sapling/pole forest characterized by canopy closure of dense tree regeneration, with tree diameters typically smaller than 10 inches diameter at breast height. It then proceeds through stratification of over-, mid-, and understory layers. Late successional forests, from 50 to 100 years in age and older, include old growth conditions. This stage contains the largest trees and often has well-developed crown and canopy layers and scattered openings caused by tree mortality.

Another important type of condition that combines elements of both early and mid – to late successional forest is open woodlands. Created and maintained largely by periodic fire disturbance regimes, open woodlands are characterized by an overstory of trees that are spaced far enough apart to allow sunlight to reach the forest floor. This structural condition allows the development of a grassy/shrubby/herbaceous/woody understory more typical of early successional forest and grassland/shrublands. Many species depend on the juxtaposition of both overstory mature and a well-developed grassy/shrubby/herbaceous understory for their life cycle needs. In this stage canopy openings range from individual or multiple tree gaps to widely spaced trees with open-grown crowns.

Permanent grass/forb and seedling/sapling/shrub habitats are important elements of early successional habitat. Permanent openings typically are maintained for wildlife habitat on an annual or semi-annual basis with the use of cultivation, mowing, or other vegetation management treatments. These openings may contain native grasses and forbs or may be planted to non-native agricultural species such as clover, orchard grass, wheat, or small grains. Old fields are maintained on a less frequent basis (5-10 year intervals), usually with burning and mowing) or are succeeding to forest. They are largely influenced by past cultural activities and may be dense sod or a rapidly changing field of annual and perennial herbs, grasses, woody shrubs and tree seedlings.

Desired Conditions for Ecological Systems Diversity

DC ESD-01: Native ecological systems occupy appropriate sites. Native ecosystems sustain strong, resilient populations of associated terrestrial and aquatic species. (Forest Plan, p. 2-14)

DC ESD-02: There is a mix of closed canopy forest, intermittent canopy, and open canopy conditions. Forest and woodland ecological systems support a diversity of tree ages, from regeneration to old growth, providing a relatively stable mix of ecological conditions across the landscape over time. Openings occur in individual tree sized gaps and larger. Vegetation structure within patches of regenerating forest and woodland is diverse due to the presence of snags and live overstory trees. These forested systems are dominated by hardwoods, pines, or combinations of both. Non-forested systems are primarily dominated by shrubs, forbs, and grasses. Snags, downed wood, stumps, and other organic matter occur in sufficient abundance to support native species (Forest Plan, p. 2-14).

DC ESD-03: Ecological systems are intact and as resilient as possible to absorb negative effects associated with various natural and human-caused stresses. Forest ecosystems are in their natural state with limited infestations of invasive species to the fullest extent possible. Structural and compositional diversity occurs throughout the forest. (Forest Plan, p. 2-14).

DC ESD-04: Open areas (including permanent and semi-permanent grasslands, shrublands and old fields) occupy around 4% of the area. These areas are typically less than 100 acres in size, but could be up to 500 acres (Forest Plan, p. 2-14).

COVE FORESTS

DC ESD-07: Regenerating forests (0-10 years old) comprise around 4% of system acreage. Late successional forests (100 years old or older) comprise around 57% of system acreage. Fire is not a major disturbance in this system and typically occurs during the driest of conditions when fire may back and creep into these areas from upper slopes. Open canopy conditions are present on only about 9% of the area due to treefall gaps usually the result of downburst wind events and senescence or mortality of single trees. On the GWNF this type is interspersed with the oak dominated systems in concave landforms. Cove Forests often occupy land along riparian areas and adjacent to upland areas in concave landforms at upper ends of watersheds (Forest Plan, p. 2-15).

Desired Structural Conditions for Cove Forests

Structure	Early	Mid-Successional Closed Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
Desired % of ecological system	4	39	9	48
Age	0-10	11-99	100+	100+

OAK FOREST AND WOODLANDS

DC ESD-08: Regenerating forests (0-15 years old) comprise around 12% of system acreage. Fire is a very important component of this system (with a return interval of about 5 to 15 years) and results in open canopy structure on about 65% of the area. In many of the woodland areas native grasses are common. The mid and late successional open canopy represents most of the system where frequent low intensity fire and other disturbances such as ice and wind maintains open canopy conditions. The late successional closed canopy condition occurs where fire is excluded due to topographic and moist fuel conditions resulting in more mesophytic species composition that then makes opportunities for fire even more uncommon (Forest Plan, p. 2-16).

Desired Structural Conditions for Oak Forest and Woodlands

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
Desired % of ecological system	12	7	10	57	14
Age	0-15	16-69	16-69	70+	70+

PINE FORESTS AND WOODLANDS

DC ESD-09: Regenerating forests (0-15 years old) comprise about 13% of system acreage. Mid to late successional forests comprise approximately 87% of system acreage. Frequent fire occurring about every 3-9 years is a very important component of this system and results in open canopy structure on about 80% of the area (Forest Plan, p. 2-16).

Desired Structural Conditions for Pine Forests and Woodlands

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
Desired % of ecological system	13	3	25	54	5
Age	0-15	16-70	16-70	71+	71+

Desired Conditions for Species Diversity

DC SPD-04: Diverse habitats exist that range from early successional forests to late successional forests, in both open and closed overstory conditions. These early, late, closed, and open conditions will provide habitat structure for a wide range of native plant and animal species. Diverse habitat is provided for known populations of threatened and endangered species, sensitive species and locally rare species on the Forest. (2014 GWNF Plan, p. 2-20)

DC SPD-06: Habitat is provided for species requiring a mosaic of forest types and structures for their life cycle needs, including black bear, ruffed grouse, wild turkey, and white-tailed deer. Larger areas of early successional habitat in the form of old fields, wildlife openings, pastoral areas, and regeneration areas provide habitat for species such as yellow-breasted chat, northern bobwhite, prairie warbler, white-eyed vireos, golden-winged warbler, and cotton-tailed rabbits. Habitat is also provided for species associated with areas of mid- to late-successional forests. In cove and mesic hardwood/pine forests with predominantly closed canopies, species needing large areas of mature trees with some level of overstory structural diversity (canopy gaps) are present, including cerulean warblers, worm-eating warblers, wood thrushes, hooded warblers, pileated woodpeckers, woodland salamanders, and eastern gray squirrels. In mature mesic and xeric pine/hardwood open woodlands with a mosaic of grass/forb/shrub understories, species needing large areas of both mature trees and an open structure are present, including golden-winged warblers, whip-poor-wills, scarlet tanagers, eastern wood pee-wees, northern flickers, Indiana bats and other tree and cave bats, fox squirrels, and timber rattlesnakes near rock outcrops. In addition, xeric pine/hardwood open woodlands provide habitat for post-breeding and migratory stop-over needs for birds species normally associated with forest interior habitat for breeding. Open oak woodlands near riparian areas and in valley bottoms provide habitat for species such as fox squirrels, woodcock, and wood turtles. (2014 GWNF Plan, p. 2-20)

DC SPD-11: A combination of both dense shrub and relatively open understories exist across the landscape. Areas of blueberries, huckleberries, mountain laurel, and rhododendron are present. Hollow trees suitable for cavities and dens plus standing dead trees are common throughout the area. (Forest Plan, p. 2-20)

DC SPD-12: A blight-resistant American chestnut (*Castanea dentate*) is reestablished on the Forest as a dominant species. (Forest Plan, p. 2-20)

Desired Conditions for Fire

DC FRE-01: The forest, influenced by both past climatic and human forces, is a forest with diversity and resiliency that is well-adapted to fire occurrence. Many native oak species and yellow pines continue to be major components. (Forest Plan, p. 2-24)

DC FRE-03: The risk of losing key ecosystem components from the occurrence of high severity wildfire remains relatively low. (Forest Plan, p. 2-24)

DC FRE-04: Fire is used in a controlled, well-planned manner to manage vegetation, restore fire-dependent ecosystems and species, create desired wildlife habitat conditions, and modify uncharacteristic fuel conditions resulting from extended absence of fire and/or tree mortality from non-native insects and disease. (Forest Plan, p. 2-24)

DC FRE-05: Prescribed burning occurs under specific preplanned conditions, considering social concerns with smoke management, public health and safety, and welfare of private property. (Forest Plan, p. 2-24)

DC FRE-06: Wildland urban interface areas have a low risk of destructive wildfire. These areas are managed to reduce the risk of loss of human life, enhance protection of nearby homes and improvements, and provide an area where firefighters can safely conduct tactical operations to stop the spread of a wildland fire. (Forest Plan, p. 2-24)

Desired Conditions for Timber Management

Timber and other wood products are a byproduct of habitat management activities. The following desired conditions apply to lands suitable for timber production.

DC TIM-03: On areas suitable for timber production, trees and the products derived from them are highly valued forest resources, carefully managed to achieve the desired condition of a given area in a cost-effective manner. For societal use, forest products vary from high quality veneer and boards for furniture and flooring to small diameter pulp logs used in the production of paper, wood biomass energy, and personal use firewood. A stable supply of wood products contributes to the social and economic well-being of the people living in the area and helps maintain a way of life long associated with those living within the area.

Desired Conditions for Recreation

DC REC-01: The Forest provides spectacular scenery, unique ecosystems and adequate access for the American public to use and enjoy the resources and opportunities available. The Forest provides escapes from the urban environment and the rural lands are the "backyard" playgrounds and tourism attractions for many smaller communities. A spectrum of high quality, nature-based outdoor recreation opportunities that reflect the exceptional resources of the Forest and interests of the recreating public are provided in an environmentally sound and financially sustainable basis. The rugged mountain landscapes make premier sightseeing and trail use the focus of recreation. (Forest Plan, p. 2-25)

DC REC-08: The general forest area provides a variety of dispersed recreational opportunities (hunting, fishing, driving for pleasure, nature viewing, trails use, etc.). The setting is generally natural appearing, although forest management activities are present. Game and non-game wildlife populations are abundant and support viewing, photography, nature study, and hunting. Many areas of solitude and quiet are found. (Forest Plan, p. 2-25)

DC REC-16: The Forest provides trail opportunities for varied interests and skill levels ranging from quality day trips to long distance backpack or saddleback trips. The trail program is managed from a forestwide perspective and opportunities are offered where they are most responsive to demand, minimize conflicts between recreation user types, and can be managed in an environmentally sustainable and operationally efficient manner.

Desired Conditions for Cultural Resources

DC CUL-01: Cultural resources are protected. (Forest Plan, p. 2-29)

Desired Conditions for Roads and Facilities

DC RDF-03: Roads that are no longer needed have been decommissioned. Roads that are not needed for an extended period of time have been closed, stabilized and have native vegetation cover. (Forest Plan, p. 2-31)

Desired Condition for Watersheds

DC WTR-01: Watersheds within the Forest are resilient, have intact hydrologic function, and support the quality and quantity of water necessary for channel maintenance, aquatic habitats, riparian habitats and beneficial water uses, including public water supplies. Watersheds are not contributing sediment to streams at levels which adversely impact downstream uses, riparian ecosystems and aquatic lifecycles. (Forest Plan, p. 2-2)

Desired Condition for Riparian Corridors

DC-11-01: Riparian corridors are managed to emphasize the physical structure, biological components, and ecological processes that sustain aquatic, riparian, and associated upland functions and values. The preferred management for riparian corridors is one that maintains, or moves toward, the restoration of processes that regulate the environmental and ecological components of riparian areas. However, do to the high value that these areas have for many uses evidence of human activity (developed recreation areas, roads and trails, dams and reservoirs, and pastoral areas) may be present. (Forest Plan, p. 4-118)

EXISTING CONDITIONS

The Lower Cowpasture project area consists of approximately 117,552 acres of public and private land. Approximately 77,680 acres are National Forest System (NFS) lands. The remaining acres include Douthat State Park, a portion of The Nature Conservancy's Warm Spring Mountain Preserve, and private lands. The project area lies within the Cowpasture River (85,807 acres), Jackson River (27,263 acres), and Calfpasture River (4,482 acres) watersheds in Virginia's Alleghany, Bath and Rockbridge Counties. Elevations within the project area range from 1,100 ft. in the Cowpasture River valley to 4,229 ft. on top of Warm Springs Mountain's Bald Knob.

Past events have played a significant role in creating the vegetative condition existing today. Recent studies on the Forest and elsewhere in the Appalachians have analyzed the historic role of fire in our ecosystems. By examining basal fire scars in tree trunks using dendrochronology (study of tree rings) and microscopic charcoal in bog and pond sediments, it has been shown that fire was widespread and occurred frequently across our landscape. For example fire scar/tree ring studies at eight sites on or near the Forest show fires occurring at a frequency of approximately 3-9 years from the earliest chronology dates in the mid-1600s to mid-1700s and continued until the 1930s' when fires began to be effectively and actively suppressed.

Before European settlement, oak and oak-American chestnut forests on mesic slopes were maintained by a combination of lightning and human-set fires. Many communities and species require fire to sustain populations. Oak and southern yellow pine communities have been major components of these forests for thousands of years. These communities promote and require fire. Recurring fire has been a part of the ecosystem for thousands of years. Fire suppression, coupled with an array of other disturbances (e.g. logging and chestnut blight), has facilitated the increased dominance of shade-tolerant species such as red maple.

Most of the area, prior to Forest Service acquisition, was extensively harvested for lumber and pulpwood during the latter part of the 19th century and the early 1900s. The chestnut blight during the 1920s and 30s removed all the American chestnut from the overstory and created openings that

enabled previously overtopped trees, primarily oak species, to dominate the stand. Following the extensive logging that occurred, many of the forest streams in the project area lack adequate Large Woody Debris (LWD).

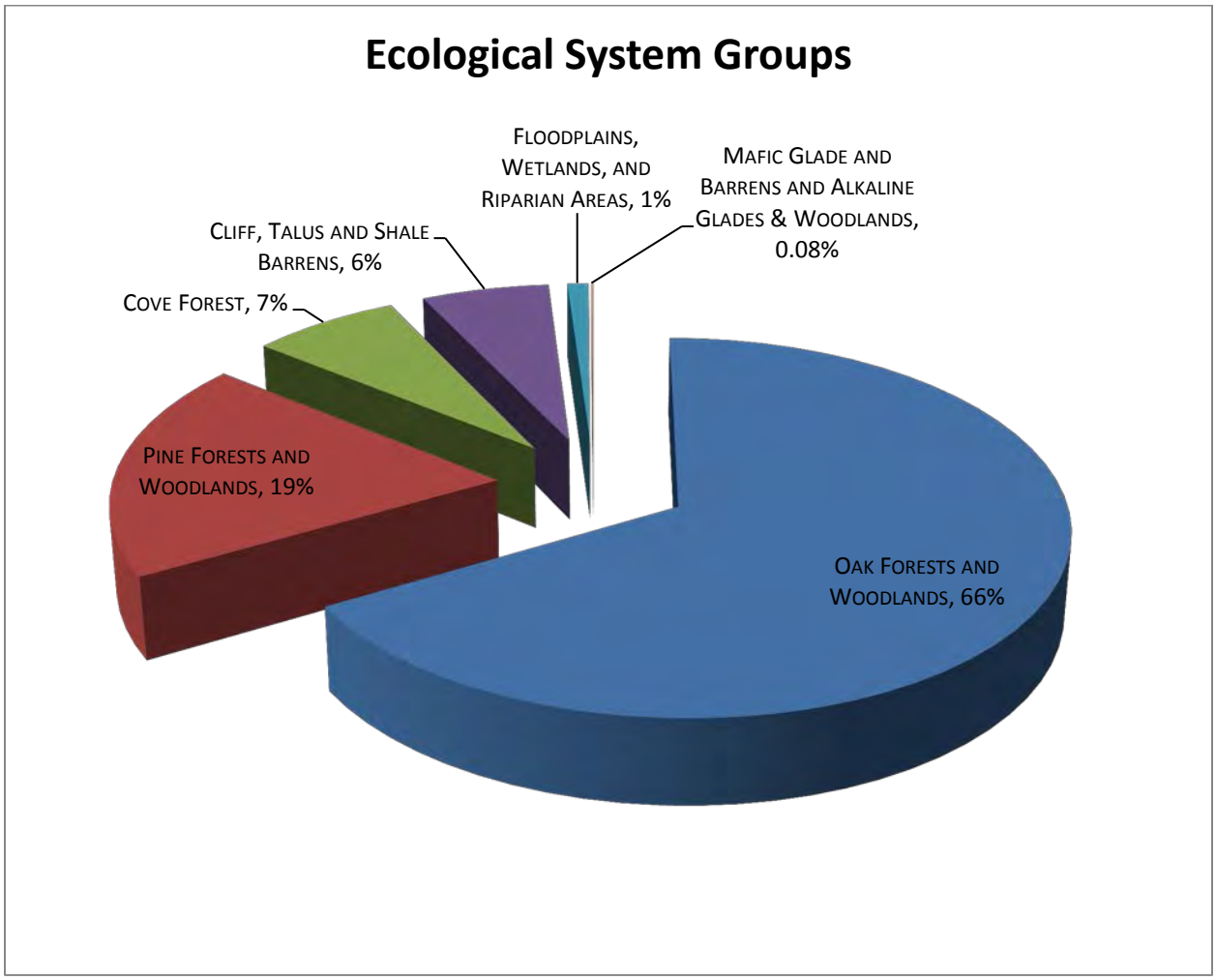
Vegetation in the project area is comprised primarily of forested stands of upland oaks with scattered stands of "yellow pine". The most common tree species found in the overstory include chestnut oak, white oak, scarlet oak, black oak, yellow poplar, white pine, Virginia pine, and pitch pine. Examples of common species found in the midstory include black gum, white oak, dogwood, chestnut oak, red maple, scarlet oak, and hickory. Examples of common species found in the understory include: red maple, hickory, white pine, blackgum, white oak, chestnut oak, black oak, scarlet oak, yellow poplar, dogwood, pitch pine, mountain laurel, and sassafras. The mixture of vegetation is typical of acidic soils developed over sandstone and shale bedrock in the ridge and valley portion of the Appalachian Mountains. Planting of white pine has occurred in some stands within the project area. Parts of the project area have been prescribed burned in the past decade. Wildfires in 2012 (Rich Hole and Porters Mill) burned across approximately 16,000 acres of the landscape.

Six of the nine ecological system groups identified in the Forest Plan are present in the project area. The ecological system groups identified on NFS lands in the Lower Cowpasture project area are summarized in Table 1-3 and Figure 1-2.

Table 1-3 Ecological System Groups in Lower Cowpasture Project Area

Ecological System Groups	Acres
Cliff, Talus and Shale Barrens	4,699
Cove Forest	5,814
Floodplains, Wetlands, and Riparian Areas	987
Mafic Glade and Barrens and Alkaline Glades & Woodlands	66
Oak Forests and Woodlands	51,633
Pine Forests and Woodlands	14,481
Total	77,680

Figure 1-2. Percent of NFS Lands by Ecological System Group within the Lower Cowpasture Project Area



NFS lands comprise approximately 249 acres of open areas of which approximately 45 acres are existing wildlife clearings, 110 acres are areas within utility corridors, and the remainder are open fields (GIS database). Resulting in approximately 0.3% of NFS lands providing open habitat in the project area.

The Rich Hole and Rough Mountain Wildernesses, 6,529 and 9,322 acres respectively, are within the project area. Two Recommended Wilderness Study Areas, Rich Hole Addition (4,616 acres) and Rough Mountain Addition (1,022 acres) are also within the project area. Twenty (20) National Forest System trails (NFST) provide approximately 71 miles of trails in the Lower Cowpasture area.

Three Inventoried Roadless Areas (IRAs) are located within the project area Beards Mountain, Mill Mountain, and Rough Mountain Addition IRAs. All of the IRAs that are not recommended for wilderness study are assigned to management prescriptions that maintain their roadless character and they will be managed consistent with requirements of the 2001 Roadless Area Conservation Rule.

Table 1-4. Inventoried Roadless Areas within the Lower Cowpasture Project Area

Roadless Area Name	Approximate Acres	Management Prescription		Percent
Beards Mountain	7,478	4D	Special Biological Area	4%
		12D	Remote Backcountry	96%
Mill Mountain	10,728	1B	Recommended Wilderness Study Area	43%
		4D	Special Biological Area	4%
		12D	Remote Backcountry	53%
Rough Mountain Addition	1,153	1B	Recommended Wilderness Study Area	89%
		12D	Remote Backcountry	11%

The Lower Cowpasture project area is home to 14 Special Biological Areas comprising approximately 5,500 acres. These areas are summarized in the following table. Special Biological Areas located in Wilderness or Recommended Wilderness Study areas retain the assigned prescription and are not allocated to management prescription 4D –Special Biological Areas.

Table 1-5 Lower Cowpasture Project Area Special Biological Areas

Special Biological Area	Approximate Acres
Beards Mountain	150
Chestnut Ridge Seep	81
Copeland Barrens	160
East Sharon Shale Barren	435
Forest Road 462 Barrens	74
Limekiln Hollow	48
McGraw Hollow	79
Mill Mountain Pond*	31
Millboro Tunnel Shale Barren	207
Nimrod Hall Ridge	202
Northeast Beards Mountain	854
Rough Mountain*	2,950
South Fork Pads Creek Barren	125
Warm Springs Mountain	146
Total	**5,542**

*Located in Designated Wilderness or Recommended Wilderness Study Areas.

More than 50 named and unnamed creeks are within in the project area totaling over 400 miles of potential aquatic stream habitat on National Forest System and private land. The Virginia Department of Game and Inland Fish uses a method of classifying trout streams based on aesthetics, productivity, resident fish population and stream structure. Classes I through IV rate wild trout habitat; Classes V through VII rate cold water habitat not suitable for wild trout but adequate for year-round hold-over of stocked trout. The stream miles in each Class are summarized in Table 1-6.

Table 1-6. Summary of Lower Cowpasture Project Area Coldwater Stream Habitat by VDGIF Classification

CLASS	Project wide (miles)	NFS (miles)
I	4.86	0.36
II	84.80	63.70
III	5.05	2.87
IV	0.00	0.00
V-VIII	17.28	13.15
Total Cold Water Fisheries	**111.98**	**80.07**

A 34.9 mile segment of the Cowpasture River flows through the project area and qualifies as a recreational river under the Wild and Scenic Rivers Act (FEIS, Appendix D, pp.D-6 thru D-8). National Forest System (NFS) land borders one side for only 3.3 miles and is spread out over six locations. NFS land border both sides of the river for 3 miles on the Walton Tract. One small dam is located near Millboro Springs. The shoreline of the Cowpasture is largely undeveloped and is a mixture of forested and agricultural land. The development that exists includes cabins, houses, and tilled farmland. The majority of the adjacent private land is posted. This portion of the Cowpasture has not been declared navigable.

Slope failure in the Simpson Creek drainage along the I-64 corridor is eroding and adding sediment to Simpson Creek. A LiDAR study completed by the Virginia Department of Transportation calculated a volumetric loss of approximately 2.814 cubic yards of soil from spring 2013 to March 2014.

Wilson Creek dam is also located within the project area on NFS lands. This concrete and stacked stone dam was constructed circa 1936 by the Civilian Conservation Corps (CCC) as a water supply dam for Douthat State Park and was part of the original CCC construction of the park. Douthat State Park is listed on the National Register of Historic Places for the role its design played in the development of parks nationwide. Wilson Creek dam is a contributing element of the Douthat State Park Historic Site. A section of the dam spillway has been destroyed by deterioration, erosion and water activity.

Twenty-two Forest Service timber sales have occurred within the current project area from 1989 to present. The following table summarizes historical stand treatments.

Table 1-7. Historic Stand Treatment Summary within the Lower Cowpasture Restoration Project Area Since 1989.

Timber Sale	Year	Compartment	Acres	Harvest Method*
Mares Run	In Progress	892, 893	165	SHW
Brattons Run Salvage	2005	1305	81	SAL
Shooting Range	2002	889	54	GS
Barranca	2000	983, 1005	48	SHW, TH
Little Mare	1998	892, 933	77	SHW
Diamond Mine	1998	926, 965	146	CC, SHW, TH
Gap	1996	1328	76	SHW, TH
McGraw Hollow	1996	1380	204	CC, SHW, TH
Lick Block Run	1996	953, 984	54	SHW
Nixon Road	1995	1305	30	GS
Blue Grass	1994	916	155	SHW, TH, GS
Big Hollow	1993	1319	102	SHW TH

Timber Sale	Year	Compartment	Acres	Harvest Method*
Black Water	1993	1319	70	SHW
Boneyard	1993	1319	43	TH
Slim Branch West	1993	981, 982	97	CC, SHW, GS
Jordon Run	1992	895	26	CC
Marchant	1991	1374	64	SHW
Smith-Thompson	1991	891, 984	38	GS
California	1991	1306	96	CC, GS, TH
Blueberry Hill	1990	917, 958	114	CC
Hickman	1990	931, 932	97	CC, GS
Cigar Ridge	1989	932, 958	50	CC

* Harvest Method: SHW = Shelterwood with Reserves, CC = Clearcut, GS = Group Selection, SAL = Salvage, TH = Thinning

The stands harvested during the above sales have regenerated and are no longer classed as early successional habitat which is important to the objectives of the area. Mares Run timber sale is in progress and regeneration harvest units from this sale will provide some early successional habitat over the next 15 years.

Approximately 92 miles of National Forest System roads are located within the project area (GIS database). Approximately 33 miles of these roads are open to the public year round and another 18 miles are open seasonally. The remaining roads provide administrative access and are either gated or closed with an earthen berm if they are not needed for an extended period of time. Approximately 10.68 miles of FSR roads have been approved under a separate decision for decommissioning in the project area of which 2.68 miles have already been decommissioned.

Road Number	Road Name	Length to Decommission (miles)	Segment BMP to EMP*	Open to Public	Status**
125A	Browns Hollow	1.50	1.0 - 2.5	N	D
333	Craft	1.40	3.10 - 4.50	N	P
333A	Spring Box	1.80	0.0 - 1.8	N	P
361A	Beards Mountain Spur	0.75	0.40 - 1.15	N	P
361C	Cigar Ridge	1.13	0.0 - 1.13	N	P
1919	Salt Pond Ridge	1.18	0.0 - 1.18	N	D
1923	Slicky Slide	2.02	0.0 - 2.02	N	P
6008	Mighty Fine	0.90	0.0 - 0.9	N	P
	Total	10.68			

*BMP = Beginning Mile Post; EMP = Ending Mile Post
**D = Decommissioned; P = Pending

This area is part of the larger Appalachian Fire Learning Network and includes the Warm Springs Mountain Restoration area, a 19,000 acre restoration project. The Appalachian Fire Learning Network is a cooperative effort among groups in eight states that include The Nature Conservancy (TNC), Department of Interior land management agencies, state forestry and wildlife agencies, numerous non-governmental organizations and the Forest Service with the goal of restoring the diversity of oak-hickory forests through the use of fire to the benefit of wildlife, timber management, and wildland homeowners.

There are homes and farmland near the project area and this land use is expected to remain the same. Approximately 850 acres of timber harvest has occurred on private lands in the vicinity of the project area within the past 20 years. Douthat State Park, Young Life youth camp, and a portion of TNC's Warm Springs Mountain Preserve are located within Lower Cowpasture project area. A portion

of Clifton Forge's municipal watershed is within the project area. A CSX railroad line also transects the project area.

EXISTING CONDITION COMPARED TO DESIRED

During the compartment prescription/stand examination process and the development of the proposed action, important differences were identified between the current habitat conditions and the desired habitat conditions for the project area. The following tables compare certain key components of the desired condition (DC) for ecological system areas with existing on-the-ground conditions in the project area. In response to these differences, the proposed action was developed.

Table 1- 8. Desired/Current Structural Conditions for Cove Forests in the Lower Cowpasture Project Area

Structure	Early	Mid-Successional Closed Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
Desired % of ecological system	4	39	9	48
Current % of ecological system	2	46	1	51
Age	0-10	11-99	100+	100+

Table 1-9. Desired/Current Structural Conditions for Oak Forest and Woodlands in the Lower Cowpasture Project Area

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
Desired % of ecological system	12	7	10	57	14
Current % of ecological system	6	8	0	3	83
Age	0-15	16-69	16-69	70+	70+

Table 1-10. Desired/Current Structural Conditions for Pine Forests and Woodlands in the Lower Cowpasture Project Area

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
Desired % of ecological system	13	3	25	54	5
Current % of ecological system	12	5	0	3	79
Age	0-15	16-70	16-70	71+	71+

NEED

To move toward the desired ecological systems diversity and species diversity there is a need to establish some young forests and thin other areas in this project area. There is also a need to create some open habitat. This, in turn, would provide forest products to the local economy. To move toward the desired conditions for watersheds there is need to stabilize slope failure in the Simpson Creek drainage, replace impassible culverts with passable structures, and remove culverts from Forest System roads to be decommissioned. To move toward the desired conditions for recreation, cultural resources, and transportation there is a need to create some additional trails in the Pads Creek area, stabilize Wilson Creek dam and decommission National Forest System roads that are no longer needed.

Management activities such as timber harvest, prescribed burns, wildlife clearings, waterholes, and other applicable habitat management techniques will primarily serve to promote ecological restoration by: 1) promoting desired structural conditions for ecological systems, 2) promoting oak reproduction, 3) enhancing habitat conditions for declining early successional species and other Species of Greatest Conservation Need in Virginia, 4) restoring low diversity stands and systems severely altered from their historic range of variability (e.g., stands <40 years old, systems converted to white pine plantations, fire-dependent systems), and promoting resilient ecological systems capable of absorbing negative effects associated with various natural and human-caused stresses.

Other management activities, such as culvert removal and replacement of standard culverts with crossing structures that allow for full passage of all aquatic organisms, will primarily serve to promote watershed restoration by improving connectivity of streams. Stabilizing slope failures in Simpson Creek will reduce potential for continued erosion and sedimentation.

1.3 Proposed Action

The actions proposed are to achieve the goals and objectives of the Revised Land and Resource Management Plan (Forest Plan) for the George Washington National Forest by: moving toward the desired structural conditions for ecological systems; enhancing habitat conditions for declining early successional and other Species of Greatest Conservation Need in Virginia; restoring low diversity stands and systems severely altered from their historic range of variability (e.g., stands <40 years old, systems converted to white pine plantations, fire-dependent systems); protecting cultural resources; decommissioning NFS roads that are no longer needed; creating additional open areas (e.g. wildlife clearing); improving connectivity of streams; stabilizing areas of slope failures in watersheds; planting blight resistant American chestnut; treating non-native invasive plant species; increasing trail opportunities within the project areas.

All the proposed actions are within National Forest System lands. The project area, approximately 77,680 acres, is within compartments 891-893, 915-918, 921, 925-929, 931-935, 953-959, 961-984, 1004-1006, 1305-1306, 1308-1311, 1315, 1317, 1320, 1322, 1324-1328, 1348-1351, 1354, 1356-1359, 1369, and 1374. The James River and Warm Springs Ranger Districts propose the following actions:

The following activities of the Proposed Action are those that were identified in the Scoping Letter that was available for public comment on July 14, 2014. The Preferred Alternative (Alternative 3) is a modification of the Proposed Action based on public input, further field study, and evaluation of potential effects. Alternative 3 is described in more detail in Chapter 2.

Vegetation Management/Wildlife Habitat Improvement

- Regenerate approximately 949 acres using the shelterwood with reserves method. This is the traditional regeneration method that has been used on the George Washington National Forest for the past 20 years. Approximately 10-20% of the canopy is left (15-25 square feet of basal area), creating a two-aged stand structure. Age is reset and a new age class is created while maintaining some hard mast production from the residual stems. Residual stems would be clumped in groups to maximize sunlight to the forest floor and enhance dense woody growth. Early successional habitat is created by this treatment.

- Harvest approximately 166 acres using the shelterwood method. This is the first cut of a two-step shelterwood regeneration treatment. Approximately 35-45% of the canopy is left (40 – 50 square feet of basal area) to provide a partial shade environment and foster the development of seedlings. The residual stand would be evenly distributed through the treated area. A new age class would not be created by this first entry, but ultimately all or most of the residual stand would be removed to release the regeneration and create a new age class in approximately 10 to 15 years. The second, or removal cut, would result in an even-aged or two-aged stand structure depending on the residual stand left at that time. This treatment is prescribed where site quality and tree size allow the second entry to be economically feasible and on relatively gentle slopes where damage to residual stems is less likely. Late-open habitat is created by this treatment until the final harvest 10 to 15 years later which would result in early successional habitat.

- Thin approximately 163 acres using the free thinning method. A free thinning is an intermediate stand treatment where trees from any crown class (intermediate, co-dominant, or dominant) may be removed to achieve the desired condition. In this case, we are using the term to describe a treatment that would look very much like the first cut of a two-stage shelterwood as described above. However, the residual stand would not be removed in the foreseeable future and the ultimate purpose is not to regenerate a new stand. Instead, prescribed fire, would be used to maintain the late-open habitat condition into the foreseeable future.

- Thin approximately 83 acres using the thinning from below method. This treatment is a commercial thinning that would remove trees in the intermediate and perhaps lower co-dominant crown positions. Generally 50-60% of the canopy would be retained (60-70 square feet of basal area). Late-open habitat conditions would be created, but open conditions are expected to last only 10-15 years as the canopy would close again over time.

- Thin approximately 534 acres using a commercial timber stand improvement (CTSI). This treatment is very similar to the thinning from below; 50-60% of the canopy would be retained (60-70 square feet of basal area). However, these stands are younger and have a smaller average diameter, resulting in stands that normally would not be economical to harvest commercially. The recent installation of a wood fired boiler at the MeadWestvaco mill in Covington provides a new market for this small diameter material that would be removed. Mid-open conditions would be created, but canopies would be expected to eventually close in 10-15 years.

- Conduct hardwood restoration on approximately 259 acres. This commercial treatment is assigned to white pine plantations considered to be in an uncharacteristic habitat condition. These stands were often oak dominated stands on somewhat poorer sites that were converted to white pine as long as 30 years ago. While white pine was planted, many stands

currently contain enough hardwood species to attempt restoring them back to a hardwood dominated stand in the future. The treatment would remove most, if not all, white pines and retain hardwood species. The percentage of the canopy left would vary widely depending upon the amount of hardwoods currently present in the stand; the residual canopy may be from 20% to 60% of the existing stand. This treatment would result in early successional or mid-open habitat conditions depending upon the density of the residual trees.

- Allow woody biomass removal on approximately 534 acres. Allow woody biomass (defined as vegetation removed from the forest, usually logging slash, small diameter trees, tops, limbs or trees not considered merchantable in traditional markets) removal on areas identified for commercial timber stand improvements. Woody biomass will not include below ground biomass, downed logs, or stumps. The amount of woody biomass left on site will vary according to the productivity of the site, the amount of existing down woody debris on the site, and the intensity of the harvest. However, at least 30 percent of all logging slash will be retained on regeneration sites. On poorer sites, like site index 50, about 60 percent of the logging slash will be retained.

- Conduct timber stand improvement (TSI) on approximately 1,450 acres. This is a non-commercial intermediate stand treatment in stands less than 25 years old. Approximately 20 to 25 crop trees per acre are identified. Any trees whose crowns are touching the crop tree are cut and left. Stands in this condition would remain in the mid-closed canopy habitat condition since not enough trees would be removed to result in open habitat conditions.

- Conduct site preparation natural (SPN) on approximately 949 acres. This treatment is applied soon after a regeneration harvest, a shelterwood with reserves in this case, to enhance the regeneration success of desirable species. Competing undesirable vegetation 2”-6” in diameter is cut and left. Spring-poles and broken saplings may also be cut. The occasional “flat topped” oak sapling that has lost apical dominance may also be cut to foster resprouting of a well formed and vigorously growing stem.

- Conduct non-commercial thinning on approximately 671 acres: This treatment is quite similar to SPN, but may be applied in non-regeneration harvests (e.g. thinnings from below, shelterwoods, and/or hardwood restoration). The purpose of this treatment is to improve the visual appearance of the commercially harvested stands by cutting spring-poles and any broken saplings.

- Construct approximately 320 acres of permanent wildlife clearings approximately 15-20% of the canopy is left (approximately 30 square feet of basal area). Clearings are to be disked, limed, fertilized, and seeded with a non-invasive wildlife mix.

- Construct up to 22 waterholes.

Associated actions for vegetation management activities include construction of approximately 11 miles of temporary roads, pre-haul maintenance on Forest System Roads, and construction of 94 landings. Following completion of the proposed management activities all landings, temporary road surfaces, and skid trails would be closed and revegetated with a non-invasive wildlife seed mixture following their use. Temporary road corridors necessary to access wildlife clearings would be gated, revegetated with a non-invasive wildlife seed mixture, and maintained as linear wildlife clearings.

No changes to National Forest System Roads (FSR) are proposed. FSR 108 (from mile post 0 to 1.34), FSR 125, FSR 129, FSR 194, FSR 364, and FSR 637 would remain open year round for public

use. FSR 108 (from mile post 1.34 to 2.24), FSR 125A, FSR 1745, FSR 194C, FSR 333, FSR 336 (from mile post 0 to 0.14), FSR 361, FSR 361A, FSR 362, FSR 446, and FSR 6021 would remain seasonally open for public use.

Chemically treat non-native invasive plants (NNIP) across approximately 1,400 acres after harvesting as needed. This treatment would utilize a directed foliar application of herbicides to control NNIP species soon after harvesting. Herbicides used will include glyphosate or triclopyr amine depending upon the species to be controlled. The herbicide would be applied by backpack sprayer to individual plants. The need for this treatment will be assessed on a case by case basis depending upon the severity of any NNIP infestations three growing seasons after harvest. It is anticipated that most regeneration treatments and many shelterwood and hardwood restoration treated areas will require this follow-up chemical treatment. The decision and environmental impacts of treating non-native invasive plants is covered under the George Washington and Jefferson National Forest Forest-Wide Non-Native Invasive Plant Control Project Environmental Assessment and Decision Notice and Finding of No Significant Impact dated December 14, 2010.

Table 1-11. Summary (in Acres) of Proposed Vegetation Treatments for the Proposed Action (Alternative 2)

Area	Regeneration Harvest	Shelterwood	Thinning	Restoration	TSI	Total
Beards Mountain	213	36	13	32	339	693
Cliftondale	40	0	35	18	0	93
Craft Road	56	0	27	0	0	83
Limekiln	449	130	393	113	567	1,652
McGraw Hollow	81	0	54	29	126	290
Pads Creek	0	0	95	67	72	234
Sandy Springs	110	0	163	0	286	559
TOTAL	**949**	**166**	**780**	**259**	**1,450**	**3,604**

Prescribed Burns

- Prescribe burn approximately 12,908 acres in thirteen (13) burn units. Most of the burn units will use existing roads, trails, and existing burn boundaries as burn boundaries. In addition, there is a need to construct approximately 7.4 miles of dozer line, another 5.4 miles of dozer line is located within existing corridors. This acreage does not include prescribed burns approved in the Warm Springs Mountain Restoration Project decision.

Aquatic Passage/Watershed Improvements

- Stabilize slope failures in Simpson Creek drainage by diverting water from the I-64 culvert outflow to the base of the slope via a flexible pipe extension. An outlet control protection measure would be utilized at the base of the pipe extension. The failed slopes would be cut back to facilitate revegetation of exposed slopes.

- Replace approximately fifteen (15) impassible culverts with passable structures and remove three (3) culverts on Slicky Slide road.

Non-native Invasive Species

- Chemically treat non-native invasive plants (NNIP) across approximately 280 acres as needed. This treatment would utilize a directed foliar application of herbicides to control NNIP species as needed along 55 miles of open and seasonally open National Forest System roads (FSR) and in the Mares Run and Walton Tract areas as needed. The herbicide would

be applied to individual plants. Herbicides used will include glyphosate or triclopyr amine depending upon the species to be controlled. The decision and environmental impacts of treating non-native invasive plants is covered under the George Washington and Jefferson National Forest Forest-Wide Non-Native Invasive Plant Control Project Environmental Assessment and Decision Notice and Finding of No Significant Impact dated December 14, 2010.

Transportation

- Reconstruct FSR 194 (Limekiln) in an entrenched section and close approximately 19 unauthorized roads.

Recreation/Wilderness

- Construct approximately 17 miles of National Forest System trails in the Pads Creek and Rich Hole areas. Trails would be constructed to the minimum standard necessary for protection of soil, water, vegetation, visual quality, user safety, and long-term maintenance.

- Construct/improve connector trail segments that connect with Douthat State Park.

American Chestnut

- Establish a minimum of one (1) chestnut progeny site in cooperation with The American Chestnut Foundation.

- Plant chestnut seedlings, on approximately 15 acres, as a supplemental planting in proposed harvest units after harvest.

Archeological Resources

- Stabilize Wilson Creek dam.

1.4 Scope of the Environmental Analysis

National Forest planning takes place at several levels: National, Regional, Forest, and project levels. The Lower Cowpasture Project EA is a project-level analysis; its scope is confined to addressing the purpose and need of the project, possible environmental consequences of the proposal, and alternatives. It does not attempt to address decisions made at higher levels. It does, however, implement direction provided at higher levels.

The Forest Plan embodies the provisions of the National Forest Management Act (NFMA, 1976), its implementing regulations, and other guiding documents. The Forest Plan sets forth in detail the direction for managing the land and resources of the George Washington (GW) National Forest. The Lower Cowpasture EA tiers to the Final Environmental Impact Statement for the Revised Land and Resource Management Plan (2014 FEIS). (40 CFR 1502.20)

This EA evaluates and documents the effects caused by the proposed activities and various alternatives. The site-specific proposed action and alternatives to it are identified in Chapter 2. The

administrative scope of this document can be defined as the laws and regulations that provide the framework for analysis.

This EA also tiers to the George Washington and Jefferson National Forest Forest-Wide Non-Native Invasive Plant Control Project Environmental Assessment.

1.5 Applicable Laws and Executive Orders

Shown below is a partial list of federal laws and executive orders pertaining to project-specific planning and environmental analysis on Federal lands.

- Multiple-Use Sustained-Yield Act of 1960
- National Historic Preservation Act of 1966 (as amended)
- Wild and Scenic Rivers Act of 1968, amended 1986
- National Environmental Policy Act (NEPA) of 1969 (as amended)
- Clean Air Act of 1977 (as amended)
- Endangered Species Act (ESA) of 1973 (as amended)
- Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (as amended)
- National Forest Management Act (NFMA) of 1976 (as amended)
- Clean Water Act of 1977 (as amended)
- American Indian Religious Freedom Act of 1978
- Archaeological Resources Protection Act of 1979
- Cave Resource Protection Act of 1988
- Executive Order 11593 (cultural resources)
- Executive Order 11988 (floodplains)
- Executive Order 11990 (wetlands)

1.6 Decision to be Made

The responsible official for the decision will be the District Ranger. The James River and Warm Springs District Ranger will decide whether or not to implement any of the proposed management activities. Based on the purpose and need identified for the Lower Cowpasture Restoration and Management Project, the decision to be made is whether timber harvesting and associated actions should occur in areas proposed, and if so, what level of treatment is optimum or appropriate. If it is decided to implement regeneration treatments, then a decision would also be made as to whether or not to implement the site preparation. The decision also includes whether other activities proposed for the project area should occur including wildlife clearing construction, temporary road construction, waterhole development, prescribed burns, aquatic passage/watershed improvements, transportation projects, NFS trail construction and improvements, American chestnut plantings, and stabilizing Wilson Creek Dam. If the District Ranger decides to conduct management activities, he will then decide any relevant mitigation measures and monitoring actions.

The decision to treat non-native invasive plants is covered under the George Washington and Jefferson National Forest Forest-Wide Non-Native Invasive Plant Control Project Environmental Assessment and Decision Notice.

The District Ranger will also decide if the proposed management activities would have a significant impact that would trigger the need to prepare an environmental impact statement.

Chapter 2: Alternatives, including the Proposed Action

Introduction

This chapter explains how the Forest Service informed the public of the proposal and how the public responded. It also describes and compares the alternatives considered for the Lower Cowpasture project. It includes a description and map of each alternative considered. This section presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker. Some of the information used to compare alternatives is based upon the design of the alternative (i.e., regeneration harvest versus intermediate harvest) and some of the information is based upon the environmental, social, and economic effects of implementing each alternative.

Alternative Development Process

Public collaboration is a key part of the planning process for the Lower Cowpasture project. Our goals for public collaboration associated with this planning process were: to ensure that all individuals and groups interested in or affected by the Lower Cowpasture project have the opportunity to be informed and participate in the process; to reach an informed understanding of the varying interests; and to consider these interests in developing the proposed action and alternatives.

A. Scoping and Public Input

Scoping is the process of gathering comments about a site-specific proposed federal action to determine the scope of issues to be addressed and for identifying the unresolved issues, which are related to the proposed action (40 CFR 1501.7).

This proposal first appeared on the District's quarterly Schedule of Proposed Actions (SOPA) in the second quarter of calender year 2013 as the Lower Cowpasture Restoration EA and has appeared as such on the schedule until the first quarter of calendar year 2015 when the name was changed to the Lower Cowpasture Restoration and Management EA. When developing the proposed action, the interdisciplinary team hosted nine public workshops and three public field tours between 2013 and 2014. The purpose of these workshops and tours was to share information and ideas on how to effectively reach the objectives listed above. Scoping was conducted by the District Interdisciplinary Team (IDT) to determine the issues and concerns related to the proposed action. Scoping letters were mailed on July 14, 2014 to interested and affected agencies, organizations, and individuals informing them of the proposed action and requesting their input. Prior to the July scoping letter, a request for input on the project was mailed to all interested parties on February 4, 2014, to assist the IDT in determining issues, concerns, and potential projects. Comments were received from two state agencies, numerous groups and individuals. In addition to issues generated by the public or internally there are several Federal laws, which require the consideration of certain effects. Laws such as the Clean Water Act, the Clean Air Act, the Endangered Species Act, and the Antiquities Act all require the protection of certain resources and for the analysis to clearly display the possible effects. All letters received are contained in the project file.

B. Issues Used to Formulate Alternatives

The purpose of soliciting comments is to determine whether there are any issues that affect the proposed action. Input gathered from all sources during the comment period was evaluated by the IDT for relevance to the Lower Cowpasture project. Comments were classified into two categories:

Project Issues – These issues are relevant to the project and are carried forward in the environmental analysis. Project issues are ones that are important in formulation or modification of an alternative. They are evaluated in the effects analysis, and are addressed through mitigation, if necessary.

Non-Project Issues – These issues are ones that are irrelevant to the project, usually for one of the following reasons: a) beyond the scope of the proposed action; b) have already been decided by law, regulation or policy; or c) are conjectural, or not supported by scientific evidence.

The disposition of comments received during the scoping period is found as Appendix K to this EA. The Interdisciplinary Team (IDT) reviewed the input received and project issues were identified. The following project issues were identified by the IDT and used to develop alternatives to the proposed action.

Project Issue 1: Concern about possible decreases in water quality resulting from project activities and the resulting effects on beneficial uses of streams and reservoirs.

Project Issue 2: Concern about increases in water yield resulting from timber harvests and other activities, and the potential for increased flooding.

Project Issue 3: Concern about the amount of prescribed burning and amount of dozer line construction.

Project Issue 4: Concern about the amount of woody biomass removal and impacts on soil productivity.

Alternatives Given Detailed Study

The following section describes each alternative given detailed study. The acres or miles identified for activities have been identified from mapping and should be considered estimates.

Alternative 1 – No Action

NEPA requires an EA to include a "no action" alternative to serve as a baseline to compare action alternatives. The no action alternative is based on the premise that ecosystems change, even in the absence of active management. It is essentially the "status quo" strategy that allows current activities and policies, such as road and wildlife opening maintenance, and fire suppression to continue. The No Action alternative provides the decision-maker with a clearer basis for a reasoned choice among the alternatives studied in detail.

Alternative 2 – Proposed Action

This is the proposed action identified in the Scoping Letter of July 14, 2014. The actions proposed are to achieve the goals and objectives of the Revised Land and Resource Management Plan (Forest Plan) for the George Washington National Forest by: moving toward the desired structural conditions for ecological systems; enhancing habitat conditions for declining early successional and other Species of Greatest Conservation Need in Virginia; restoring low diversity stands and systems severely altered from their historic range of variability (e.g., stands <40 years old, systems converted to white pine plantations, fire-dependent systems); enhancing trail opportunities within the project based on input from the public; protecting cultural resources; creating additional open areas (e.g. wildlife clearing); improving connectivity of streams; stabilizing areas of slope failures in watersheds; planting blight resistant American chestnut; and treating non-native invasive plant species. The

proposed action is summarized in Chapter 1 of this EA. Appendix A identifies the activities that would occur in each unit. Appendix B provides details regarding the temporal implementation of activities. Maps of Alternative 2 are in Appendix D.

Alternative 3 – Preferred Alternative

Alternative 3 is a modification of the Proposed Action based on public input, further field study and evaluation of potential effects. The actions proposed are to achieve the goals and objectives of the Revised Land and Resource Management Plan (Forest Plan) for the George Washington National Forest by: moving toward the desired structural conditions for ecological systems; enhancing habitat conditions for declining early successional and other Species of Greatest Conservation Need in Virginia; restoring low diversity stands and systems severely altered from their historic range of variability (e.g., stands <40 years old, systems converted to white pine plantations, fire-dependent systems); enhancing trail opportunities within the project based on input from the public; protecting cultural resources; decommissioning NFS roads that are no longer needed; creating additional open areas (e.g. wildlife clearing); improving connectivity of streams; stabilizing areas of slope failures in watersheds; planting blight resistant American chestnut; and treating non-native invasive plant species. This alternative is summarized below and Appendix A of this EA identifies the activities that would occur in each unit. Appendix B provides details regarding the temporal implementation of activities. Maps of Alternative 3 are in Appendix E.

Vegetation Management/Wildlife Habitat Improvement

- Regenerate approximately 837 acres using the shelterwood with reserves method. This is the traditional regeneration method that has been used on the George Washington National Forest for the past 20 years. Approximately 10-20% of the canopy is left (15-25 square feet of basal area), creating a two-aged stand structure. Age is reset and a new age class is created while maintaining some hard mast production from the residual stems. Residual stems would be clumped in groups to maximize sunlight to the forest floor and enhance dense woody growth. Early successional habitat is created by this treatment.

- Harvest approximately 166 acres using the shelterwood method. This is the first cut of a two-step shelterwood regeneration treatment. Approximately 35-45% of the canopy is left (40 – 50 square feet of basal area) to provide a partial shade environment and foster the development of seedlings. The residual stand would be evenly distributed through the treated area. A new age class would not be created by this first entry, but ultimately all or most of the residual stand would be removed to release the regeneration and create a new age class in approximately 10 to 15 years. The second, or removal cut, would result in an even-aged or two-aged stand structure depending on the residual stand left at that time. This treatment is prescribed where site quality and tree size allow the second entry to be economically feasible and on relatively gentle slopes where damage to residual stems is less likely. Late-open habitat is created by this treatment until the final harvest 10 to 15 years later which would result in early successional habitat.

- Thin approximately 163 acres using the free thinning method. A free thinning is an intermediate stand treatment where trees from any crown class (intermediate, co-dominant, or dominant) may be removed to achieve the desired condition. In this case, we are using the term to describe a treatment that would look very much like the first cut of a two-stage shelterwood as described above. However, the residual stand would not be removed in the foreseeable future and the ultimate purpose is not to regenerate a new stand. Instead,

prescribed fire would be used to maintain the late-open habitat condition into the foreseeable future.

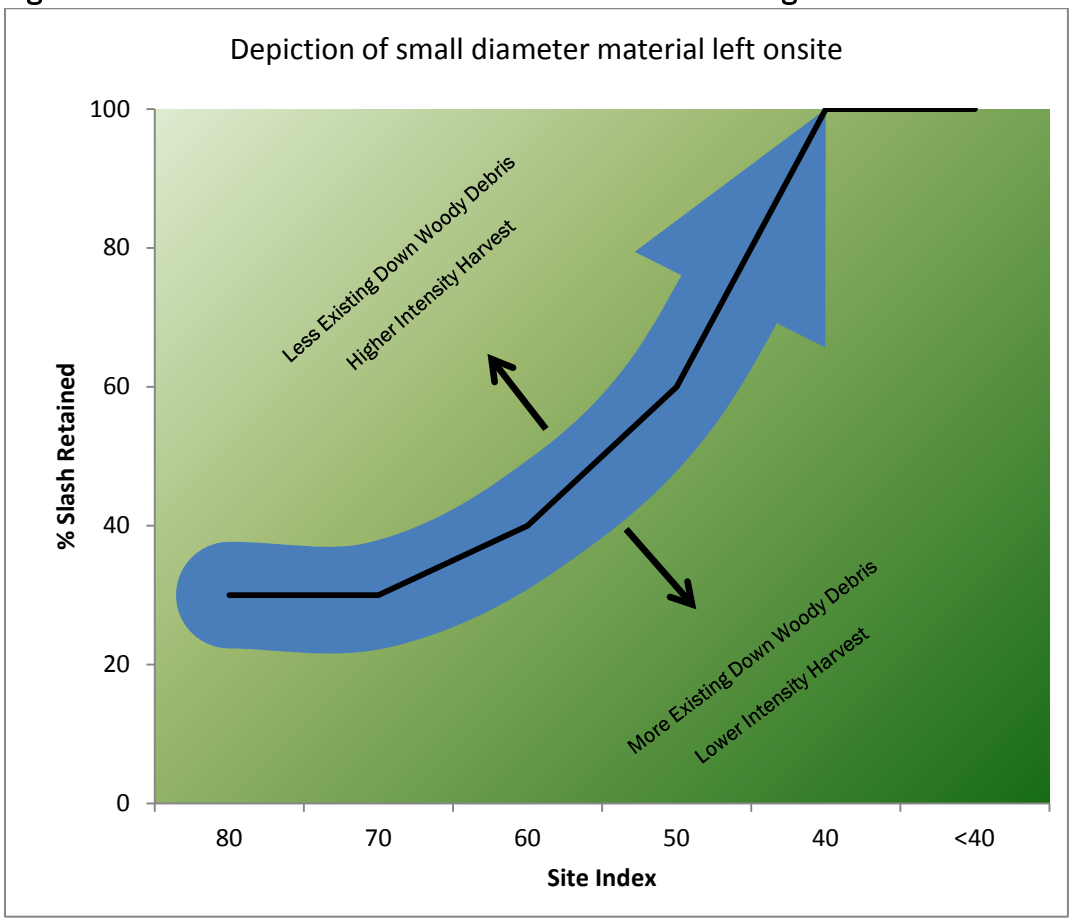
- Thin approximately 83 acres using the thinning from below method. This treatment is a commercial thinning that would remove trees in the intermediate and perhaps lower co-dominant crown positions. Generally 50-60% of the canopy would be retained (60-70 square feet of basal area). Late-open habitat conditions would be created, but open conditions are expected to last only 10-15 years as the canopy would close again over time.

- Thin approximately 500 acres using a commercial timber stand improvement (CTSI). This treatment is very similar to the thinning from below; 50-60% of the canopy would be retained (60-70 square feet of basal area). However, these stands are younger and have a smaller average diameter, resulting in stands that normally would not be economical to harvest commercially. The recent installation of a wood fired boiler at the MeadWestvaco mill in Covington provides a new market for this small diameter material that would be removed. Mid-open conditions would be created, but canopies would be expected to eventually close in 10-15 years.

- Conduct hardwood restoration on approximately 220 acres. This commercial treatment is assigned to white pine plantations considered to be in an uncharacteristic habitat condition. These stands were often oak dominated stands on somewhat poorer sites that were converted to white pine as long as 30 years ago. While white pine was planted, many stands currently contain enough hardwood species to attempt restoring them back to a hardwood dominated stand in the future. The treatment would remove most, if not all, white pines and retain hardwood species. The percentage of the canopy left would vary widely depending upon the amount of hardwoods currently present in the stand; the residual canopy may be from 20% to 60% of the existing stand. This treatment would result in early successional or mid-open habitat conditions depending upon the density of the residual trees.

- Allow woody biomass removal on up to approximately 1,217 acres. Allow woody biomass (defined as vegetation removed from the forest, usually logging slash, small diameter trees, tops, limbs or trees not considered merchantable in traditional markets) removal on areas identified for commercial timber stand improvements, free thinning, thinning from below, and hardwood restoration areas. Allow woody biomass removal on up to 25% of regeneration harvest areas (shelterwood and shelterwood with reserves methods) to monitor and study long, mid and short-term effects of small diameter woody biomass removal on soils and fauna in the area as part of a research proposal. Woody biomass will not include below ground biomass, downed logs, or stumps. The amount of woody biomass left on site will vary according to the productivity of the site, the amount of existing down woody debris on the site, and the intensity of the harvest. Figure 2-1 illustrates the variable levels of slash that would remain on-site in regeneration harvests that were biomassed. At least 30 percent of all logging slash will be retained on regeneration sites. On poorer sites, like site index 50, about 60 percent of the logging slash will be retained.

Figure 2-1. Small Diameter Material Retention Guideline for Regeneration Harvest Areas



- Conduct timber stand improvement (TSI) on approximately 1,467 acres. This is a non-commercial intermediate stand treatment in stands less than 25 years old. Approximately 20 to 25 crop trees per acre are identified. Any trees whose crowns are touching the crop tree are cut and left. Stands in this condition would remain in the mid-closed canopy habitat condition since not enough trees would be removed to result in open habitat conditions.

- Conduct site preparation natural (SPN) on approximately 837 acres. This treatment is applied soon after a regeneration harvest, a shelterwood with reserves in this case, to enhance the regeneration success of desirable species. Competing undesirable vegetation 2”-6” in diameter is cut and left. Spring-poles and broken saplings may also be cut. The occasional “flat topped” oak sapling that has lost apical dominance may also be cut to foster resprouting of a well formed and vigorously growing stem.

- Conduct non-commercial thinning on approximately 544 acres: This treatment is quite similar to SPN, but may be applied in non-regeneration harvests (e.g. thinnings from below, shelterwoods, and/or hardwood restoration). The purpose of this treatment is to improve the visual appearance of the commercially harvested stands by cutting spring-poles and any broken saplings.

- Construct approximately 297 acres of permanent wildlife clearings approximately 15-20% of the canopy is left (approximately 30 square feet of basal area). Clearing are to be disked, limed, fertilized, and seeded with a non-invasive wildlife mix.

- Construct up to 22 waterholes.

Associated actions for vegetation management activities include construction of approximately 10.1 miles of temporary roads, pre-haul maintenance on Forest System Roads, and construction of 87 landings. Following completion of the proposed management activities all landings, temporary road surfaces, and skid trails would be closed and revegetated with a non-invasive wildlife seed mixture following their use. Temporary road corridors necessary to access wildlife clearing would be gated, revegetated with a non-invasive wildlife seed mixture, and maintained as linear wildlife clearings.

Chemically treat non-native invasive plant (NNIP) across approximately 1,200 acres after harvesting as needed. This treatment would utilize a directed foliar application of herbicides to control NNIP species soon after harvesting. Herbicides used will include glyphosate or triclopyr amine depending upon the species to be controlled. The herbicide would be applied by backpack sprayer to individual plants. The need for this treatment will be assessed on a case by case basis depending upon the severity of any NNIP infestations three growing seasons after harvest. It is anticipated that most regeneration treatments and many shelterwood and hardwood restoration treated areas will require this follow-up chemical treatment. The decision and environmental impacts of treating non-native invasive plants is covered under the George Washington and Jefferson National Forest Forest-Wide Non-Native Invasive Plant Control Project Environmental Assessment and Decision Notice and Finding of No Significant Impact dated December 14, 2010.

Table 2-1. Summary (in Acres) of Proposed Vegetation Treatments for the Preferred Action (Alternative 3)

Area	Regeneration Harvest	Shelterwood	Thinning	Restoration	TSI	Total
Beards Mountain	209	36	13	32	399	689
Cliftondale	40	0	35	0	0	75
Craft Road	56	0	27	0	0	83
Limekiln	397	130	359	92	584	1,562
McGraw Hollow	81	0	54	29	126	290
Pads Creek	0	0	95	67	72	234
Sandy Springs	54	0	163	0	286	503
TOTAL	**837**	**166**	**746**	**220**	**1,467**	**3,436**

Prescribed Burns

- Prescribe burn approximately 11,971 acres in eleven (11) burn units. Most of the burn units will use existing roads, trails, and existing burn boundaries as burn boundaries. In addition, there is a need to construct approximately 5.8 miles of dozer line and 0.6 miles of hand line, another 4.4 miles of dozer line is located within existing corridors. This acreage does not include prescribed burns approved in the Warm Springs Mountain Restoration Project decision.

Aquatic Passage/Watershed Improvements

- Stabilize slope failures in Simpson Creek drainage by diverting water from the I-64 culvert outflow to the base of the slope via a flexible pipe extension. An outlet control protection measure would be utilized at the base of the pipe extension. The failed slopes would be cut back to facilitate revegetation of exposed slopes.

- Replace approximately fifteen (15) impassible culverts with passable structures and remove eight (8) culverts on Slicky Slide road.

- Restore and maintain amounts of Large Woody Debris (LWD) sufficient to maintain habitat diversity for aquatic and riparian-dependent species in 8 streams (Mares Run, Panther Run, Lick Run, Little Wilson, Lick Block, Left Prong Wilson, Smith Creek and Simpson Creek). Supplement existing LWD in streams to attain approximately 200 pieces of LWD per stream mile by directional felling or intentionally placing trees within the stream channel. A piece of LWD is defined as a piece of wood at least partially within the bank full channel width, with a diameter of at least 4 inches (10 cm), and length of at least 4 feet.

Non-native Invasive Species

- Chemically treat non-native invasive plants (NNIP) across approximately 280 acres as needed. This treatment would utilize a directed foliar application of herbicides to control NNIP species as needed along approximately 55 miles of open and seasonally open National Forest System roads (FSR) and in the Mares Run and Walton Tract areas as needed. The herbicide would be applied to individual plants. Herbicides used will include glyphosate or triclopyr amine depending upon the species to be controlled. The decision and environmental impacts of treating non-native invasive plants is covered under the George Washington and Jefferson National Forest Forest-Wide Non-Native Invasive Plant Control Project Environmental Assessment and Decision Notice and Finding of No Significant Impact dated December 14, 2010.

Transportation

- Reconstruct FSR 194 (Limekiln) in an entrenched section and close approximately 19 unauthorized roads.

- Decommission approximately 0.9 miles of FSR 125S (Lick Block). Decommissioning this road requires removing culverts including those from all live stream channels, restoring stream channels where culverts are removed, constructing a permanent closure, and removing 0.9 miles of FSR 125S from the Forest Transportation System. This road is currently closed to the public and will no longer be needed once timber harvest operations have been completed in the Sandy Springs area.

Recreation/Wilderness

- Construct approximately 14.6 miles of National Forest System trails in the Pads Creek and Rich Hole areas. Trails would be constructed to the minimum standard necessary for protection of soil, water, vegetation, visual quality, user safety, and long-term maintenance.

- Construct/improve connector trail segments that connect with Douthat State Park.

American Chestnut

- Establish a minimum of one (1) chestnut progeny site in cooperation with The American Chestnut Foundation.

- Plant chestnut seedlings, on approximately 15 acres, as a supplemental planting in proposed harvest units after harvest.

Archeological Resources

- Stabilize Wilson Creek dam.

No changes to open National Forest System Roads (FSR) are proposed. FSR 108 (from mile post 0 to 1.34), FSR 125, FSR 129, FSR 194, FSR 364, and FSR 637 would remain open year round for public use. FSR 108 (from mile post 1.34 to 2.24), FSR 125A, FSR 1745, FSR 194C, FSR 333, FSR 336 (from mile post 0 to 0.14), FSR 361, FSR 361A, FSR 362, FSR 446, and FSR 6021 would remain seasonally open for public use.

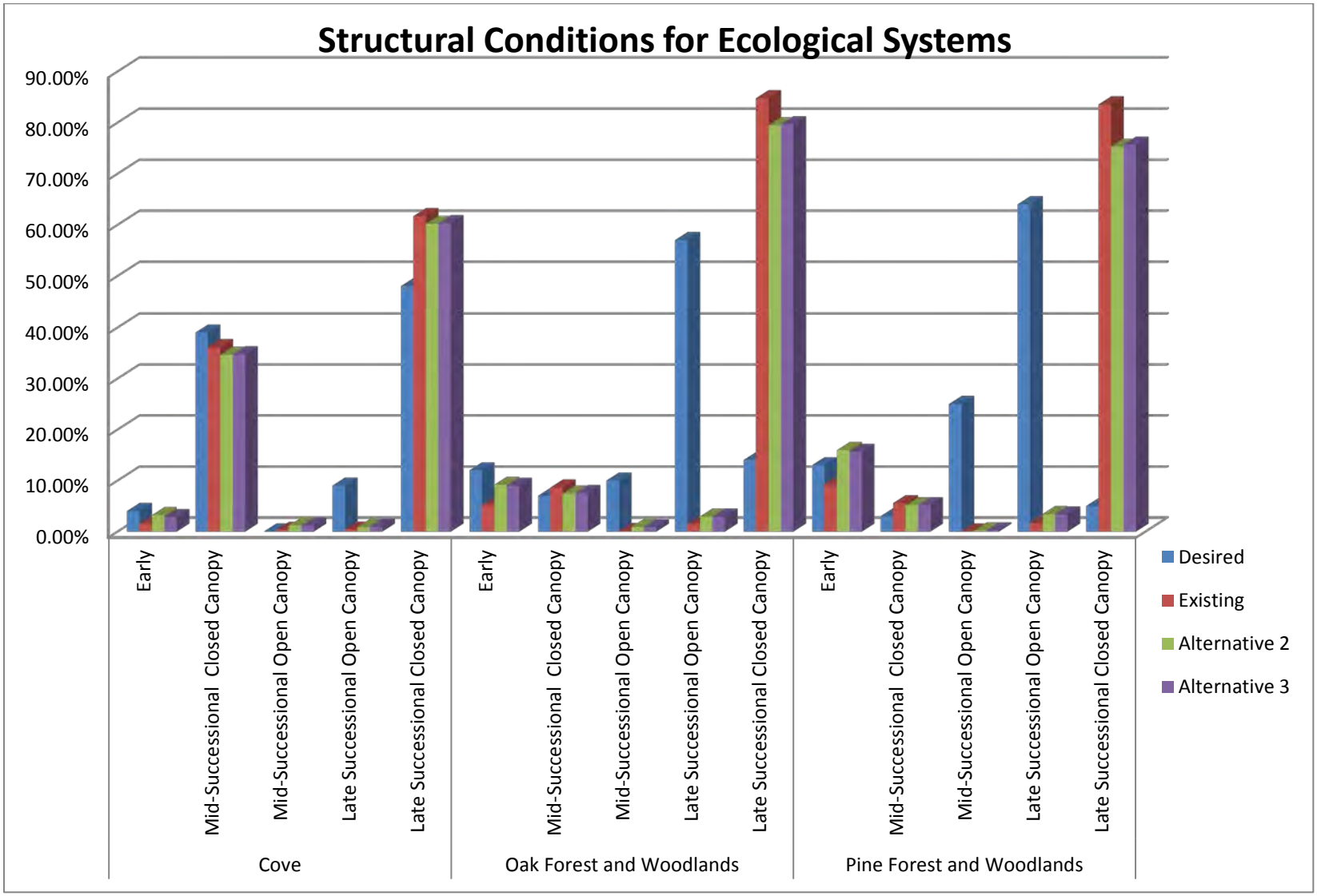
Table 2-2: Alternative Proposal Comparison

Activity	Alt 1 - No Action	Alt 2 - Proposed Action	Alt 3 - Preferred Action
Vegetation Management/Wildlife Habitat Improvement			
Shelterwood w/Reserves	0	949	837
Shelterwood	0	166	166
Thinning			
Free Thinning Method	0	163	163
Thinning from below	0	83	83
Commercial TSI (CTSI)	0	534	500
Hardwood Restoration	0	259	220
Timber Stand Improvement	0	1,450	1467
Site Preparation	0	949	837
Non-commercial thinning	0	671	544
Biomass	0	534	1,217
Wildlife Clearings	0	320	297
Waterhole Development	0	22	22
Temporary Roads	0	11	10.1
Landings	0	94	87
Prescribed Burns (NFS acres)	0	12,908	11,971
New Dozer line Construction (approximate miles)	0	7.43	5.78
New Hand line Construction (approximate miles)	0	0.00	0.64
Dozer line - Existing Corridors	0	5.41	4.41
Aquatic Passage/Watershed Improvements			
Stabilize Slope failures in Simpson Creek	0	1	1
Culvert Replacements	0	15	15
Slicky Slide Culvert Removal	0	3	8
Large Woody Debris Placement (#of streams)	0	0	8
Non-native Invasive Species*	0	280	280
Transportation			
Reconstruct FSR 194 (Limekiln) in entrenched section (project)	0	1	1
Close unauthorized roads (number)	0	19	19
Decommission NFS roads (miles)	0	0	0.9
Recreation/Wilderness			
Trail construction (approximate miles)	0	17	14.6
Construct/Improve connector trail segments with Douthat			
Chestnut Planting			

Activity	Alt 1 - No Action	Alt 2 - Proposed Action	Alt 3 - Preferred Action
Progeny Sites (number)	0	1	1
Supplemental Planting (acres)	0	15	15

*All non-native invasive plant species control projects listed in this EA are part of the George Washington and Jefferson National Forest Forest-Wide Non-Native Invasive Plant Control Project. The decision to treat non-native invasive species is covered under the George Washington and Jefferson National Forest Forest-Wide Non-Native Invasive Plant Control Project EA and Decision Notice.

Figure 2-2. Comparison of Structural Conditions for Select Ecological Systems in the Lower Cowpasture Project Area



Adaptive Management and Monitoring

Under Alternatives 2 & 3, there would be two primary treatment activities where adaptive management could be used during implementation: 1) hardwood restoration and 2) Simpson Creek slope failure. The adaptive management would occur after management actions have been implemented. This would allow us to conduct primary treatments appropriate to the initial site conditions and prescribe additional activities and achieve desired conditions over a larger portion of the project area than would otherwise be the case. Adaptation would take the form of an iterative process that would use monitoring data to inform and adjust implementation of the decision, rather than simply eliminating areas from treatment when conditions at the time of implementation do not match conditions at the time of the decision.

Hardwood Restoration

Uncertainty: The Lower Cowpasture Restoration Project includes a proposal to restore hardwood species on approximately 220-259 acres of young pine plantations. These stands contain varying amounts of hardwood stems and the distribution of these hardwoods is not always even throughout a given stand. Some of these stands, or portions of stands, are strongly dominated by white pine with very little hardwood species present. In other areas hardwoods comprise a significant component and even dominate the area. In the former situation it is unclear how well hardwoods will naturally regenerate and dominate the site, while in the latter situation it is readily apparent that hardwoods will easily be restored. Treatments subsequent to the harvest of the white pine will need to adapt to the site-specific situation in order to promote or reintroduce native hardwood, and in some cases yellow pine, species to a given site.

Monitoring and Trigger Point: Two years post-harvest a systematic sample will be performed to quantify the number of desirable native hardwood species (and in some cases yellow pine species) in terms of trees per acre that are free to grow. If areas greater than 1 acre in size are found that do not have at least 200 free to grow desirable stems per acre, remedial action may be taken. Desirable species include, but are not limited to, all oaks, yellow poplar, yellow pines, hickory, and even small amounts of black gum and red maple.

Adaptive Actions: Actions taken will vary depending upon the condition on the ground. In areas where the minimum number of desirable stems exist but they are simply not free to grow, then a mechanical treatment may be used. Mechanical treatments would be identical to the site-preparation treatments that occur after conventional regeneration treatments. In areas where the desirable stems simply do not exist, then desirable species would need to be planted. Species appropriate to the site, likely red oak or shortleaf pine since that is what is most readily available, would be planted on an approximate 15’x15’ or 20’x20’ grid.

Simpson Creek Slope Failure

Uncertainty: The Lower Cowpasture Restoration Project includes a proposal to stabilize slope failures in Simpson Creek drainage by diverting water from the I-64 culvert outflow to the base of the slope via a flexible pipe extension. An outlet control protection measure would be utilized at the base of the pipe extension. The failed slopes would be cut back to facilitate revegetation of exposed slopes. While this treatment diverts the outflow of water to the base of the slope, it is unclear how well this treatment will stabilize the slope failure to reduce the amount of sediment entering Simpson Creek. Treatments subsequent to the revegetation of the exposed slopes will need to adapt to the site-specific situation in order to stabilize the slope failure and reduce the amount of sediment entering Simpson Creek.

Monitoring and Trigger Point: Three years post-treatment a systematic review of monitoring data will be performed to quantify the amount of sediment entering Simpson Creek from the area of the slope failure. National Best Management Practices (BMP) protocol will be used in addition to photo points. Monitoring will be conducted during implementation and at 1 week, 2 months, 6 months, 1 year, and yearly after project implementation. If slopes are determined to be unstable, remedial action may be taken.

Adaptive Actions: After monitoring treatment effectiveness, if the proposed primary treatment is deemed ineffective, the treatment would be adapted to meet the purpose and need for action. Class II Rip Rap would be placed in the area of the slope failure to restore the slope to approximate contour post I-64 construction. The site would be accessed from I-64 side of Simpson Creek.

Monitoring

A description of the monitoring activities that would occur under Alternatives 2 and 3 are displayed in Appendix C.

Alternatives Considered but Eliminated from Detailed Study

The following is a summary of alternatives considered by the IDT but eliminated from detailed study, along with the rationale for dismissal.

Alternative 4: Uneven-aged Management

An alternative using uneven-aged management was considered but eliminated from detailed study. The interdisciplinary team determined that uneven-aged management in this area would not be consistent with the Forest Plan direction. Appendix C of the Forest Plan, states that three criteria must be met for uneven-aged management to be considered in an area. They include at least a stand of 100 acres to provide sufficient total volume harvested in any single entry to allow for an economically sale; slopes from 0% to 20% to minimize the potential damage to the soil and water resource due to greater number of temporary roads, skid roads, and skid trails required to implement uneven-aged management, as well as to facilitate the economic viability of the timber sale; and existing system roads in place for the same reasons identified above. (Forest Plan, p. C-7)

Alternative 5: Timber Harvesting

A timber harvesting alternative was considered by the interdisciplinary team. This alternative proposed harvesting approximately 1,691 acres and 1,770 acres of timber stand improvements in four areas. Some of the areas proposed for harvesting did not meet the criteria of being on land suitable for timber production as described by the Forest Plan, Appendix C. Thus, this alternative was eliminated from detailed study.

Alternative 6: Timber Harvesting

Another timber harvesting alternative was considered but eliminated from detailed study by the interdisciplinary team. This alternative proposed harvesting approximately 2,052 acres and 1,669 acres of timber stand improvements in seven areas. Some of the areas proposed for harvesting were not operable due to slope and biological issues. Thus, this alternative was eliminated from detailed study.

Alternative 7: Prescribed Burning

A prescribed burning alternative was considered by the interdisciplinary team. This alternative proposed prescribed burning approximately 23,000 acres in 25 burn units. Based on information we received from the public and access issues, some areas were determined not to be operable by the IDT. Thus, this alternative was eliminated from detailed study.

Alternative 8: Hemlock Restoration
A hemlock restoration alternative was considered by the interdisciplinary team. Comments received from the public recommended consideration of this alternative, including chemically treating known populations of hemlock in the Lower Cowpasture project area for hemlock woolly adelgid. After field reviews, we were unable to locate any hemlock populations on NFS lands with enough vigor and size required for the treatment to be effective. Thus, this alternative was eliminated from detailed study.

Alternative 9: American Chestnut Restoration
An American chestnut restoration alternative was also considered by the interdisciplinary team. Comments received from the public recommended additional plantings of blight resistant American chestnut in the project area specifically on the Walton Tract. After reviewing potential sites with the American Chestnut Foundation, the site was determined to be suitable as a progeny planting site. However, due to potential impacts to existing archeological sites this alternative was eliminated from detailed study.

Alternative 10: Wilson Creek Dam Removal
An alternative to remove Wilson Creek dam was considered but eliminated from detailed study by the interdisciplinary team. Comments received from the public recommended consideration of this alternative for aquatic/stream restoration. After reviewing the site with aquatic and stream restoration specialists, we learned the dam would have to be removed for aquatic/stream restoration. Wilson Creek dam is a contributing element of the Douthat State Park Historic Site. Douthat State Park is listed on the National Register of Historic Places for the role its design played in the development of parks nationwide. Thus, the dam is a signficant archeological site. Forest Plan standard FW-200 directs us to avoid, minimize, or mitigate negative effects on potentially significant cultural resources (Forest Plan, p. 4-19). Therefore, this alternative was eliminated from detailed study.

Alternative 11: No Temporary Road Construction
An alternative with no temporary road construction was considered. Comments received during scoping recommended consideration of this alternative. While this alternative fulfills some desired conditions for the project area, this alternative does not provide a stable supply of wood products which is one of the purposes of the Lower Cowpasture project. Thus, this alternative was eliminated from detailed study.

Alternative 12: Rewilding
An alternative reestablishing top predators like wolves and cougars to restore food webs and trophic functions that have been modified since European settlement was considered. Comments received during scoping recommended consideration of this alternative along with removing fences, closing unnecessary roads, removing culverts, re-contouring rutted drainages, and creating a series of passages beneath Interstate 64 to allow passage of wildlife north and south. While some components of this alternative fulfills some desired conditions for this project the scope and scale of this proposal is outside the scope of the project. Thus, this alternative was eliminated from detailed study.

Alternative 13: No Dozer Line Construction
An alternative with no new dozer line construction for the use of prescribed fire was considered. Comments received during scoping recommended consideration of this alternative. Firefighter and public safety is always the number 1 priority when implementing prescribed burns. We use existing corridors and natural features for prescribed fire boundaries when we can do so safely. Construction of dozer lines are used as a last option for prescribed burn boundaries and are needed to safely implement the burn. Thus, this alternative was eliminated from detailed study.

Alternative 14: Climate Reserve Areas
An alternative that would designate the Lower Cowpasture project area as a Climate Reserve Area was considered. Comments received during scoping recommended consideration of this alternative.

Climate change strategies for the George Washington National Forest focus on both adaptation (ways to maintain forest health, diversity, productivity, and resilience under uncertain future conditions) and mitigation (such as carbon sequestration by natural systems, ways to provide renewable energy to reduce fossil fuel consumption, and ways to reduce environmental footprints). These strategies focus on: 1) reducing vulnerability by maintaining and restoring resilient native ecosystems; 2) providing watershed health; 3) providing carbon sinks for sequestration; 4) reducing existing stresses; 5) responding to demands for cleaner energy including renewable or alternative energy; and 6) providing sustainable operations and engaging in partnerships across landscapes and ownerships. Specifics regarding many mitigation measures, such as the appropriate calculations for carbon offsets and how to consider carbon sequestration rates, are still being developed, so most of our focus at the forest level for now will be on using management options to improve resilience and adaptability of native ecosystems under changing conditions. Thus, this alternative was eliminated from detailed study.

Alternative 15: Carbon Reserves Areas

An alternative was considered that would provide an expansive network of carbon reserve areas within the Lower Cowpasture project area. Comments received during scoping recommended consideration of this alternative. Climate change strategies for the George Washington National Forest focus on both adaptation (ways to maintain forest health, diversity, productivity, and resilience under uncertain future conditions) and mitigation (such as carbon sequestration by natural systems, ways to provide renewable energy to reduce fossil fuel consumption, and ways to reduce environmental footprints). These strategies focus on: 1) reducing vulnerability by maintaining and restoring resilient native ecosystems; 2) providing watershed health; 3) providing carbon sinks for sequestration; 4) reducing existing stresses; 5) responding to demands for cleaner energy including renewable or alternative energy; and 6) providing sustainable operations and engaging in partnerships across landscapes and ownerships. Specifics regarding many mitigation measures, such as the appropriate calculations for carbon offsets and how to consider carbon sequestration rates, are still being developed, so most of our focus at the forest level for now will be on using management options to improve resilience and adaptability of native ecosystems under changing conditions. Thus, this this alternative was eliminated from detailed study.

Alternative 16: Old Growth

An alternative was considered that would provide an expansive network of old growth/potential old growth areas within the Lower Cowpasture project area. Comments received during scoping recommended consideration of this alternative. Through the allocation of management prescriptions areas, identification of lands unsuitable for timber production, and the current distribution of older aged stands across the Forest, the Forest Plan establishes a network of old growth areas. Large patches are greater than 2,500 acres and are established through the allocation of lands in large blocks to management prescriptions areas like wilderness, recommended wilderness, and remote backcountry. Approximately 51% of National Forest System lands within the Lower Cowpasture project area are allocated to management prescriptions that are unsuitable for timber production. Thus, this alternative was eliminated from detailed study.

Alternative 17: Additional Road Decommissioning

Comments received during scoping recommended decommissioning additional roads including: FSR 462 (Coffee Pot), FSR 336 (McGraw Hollow), FSR 328D, FSR 6008, FSR 125A (Browns Hollow), FSR 125F (Piney Branch), FSR 364 (Mare Run), FSR 1901 (between NFST 465 and NFST 620), FSR 1745 (Porters Hollow), FSR 337, FSR 365/243 (west of Clifton Forge), FSR 6032, and FSR 362 (Mill Mountain). Decommissioning unneeded roads is part of the desired condition for the Lower Cowpasture project. Currently there is an ongoing effort with regards to management of the Forest road system referenced as a Travel Analysis Process (TAP). This effort is aimed at the identification of the minimum road system necessary to meet management objectives and identify opportunities for increased resource protection, eliminating the backlog of deferred maintenance, optimal

performance of maintenance, and better service to Forest users. Road recommendations based on the TAP were incorporated into the Forest Plan and were reviewed for this project area and unneeded roads were incorporated into the Preferred Action (Alternative 3) as roads proposed for decommissioning. Specific roads mentioned by the public were also reviewed. Most of these roads are still needed for management activities; some are outside the project; and others have been decommissioned or are in the process of being decommissioned. Thus, this alternative was eliminated from detailed study.

Mitigation & Design Features Common to All Action Alternatives

Each action alternative will follow the Forestwide common standards stated in the Forest Plan, Chapter 4 on pages 4-1 thru 4-20 and 4-22 thru 4-23. In addition, management prescription area standards will also be followed and are stated in the Forest Plan on pages 4-27 thru 4-34, 4-39 thru 4-41, 4-50 thru 4-61, 4-76 thru 4-83, and 4-121 thru 4-135 . Potential effects can be reduced or eliminated by implementing design criteria specified in Forest Plan standards and Virginia's Forestry Best Management Practices For Water Quality (2002 Revision), Virginia Department of Forestry. The following summarizes these standards and guidelines that apply to all alternatives except the No Action alternative.

1. To protect soil productivity and water quality resources management activities that may affect soil and/or water quality meet or are more stringent than Virginia and West Virginia Best Management Practices, State Erosion Control Handbooks, and standards in this Forest Plan. (Forest Plan, Forestwide Standard FW-1, p. 4-1)

2. To protect long-term soil productivity and ecological sustainability Forestwide Standards FW-11 and FW-13 (Forest Plan, p. 4-2) applies:

- No woody biomass utilization is allowed in forested stands less than or equal to site index 40 or in stands with high risk soils.
- In forested stands greater than site index 40, leave at least 30% of the logging slash created by regeneration harvests.
- No below ground biomass, existing downed woody material, or stumps will be removed for woody biomass utilization.
- The determination of woody biomass utilization will depend upon site-specific analysis.
- Generally, logging slash should be distributed more or less evenly across the harvest areas.
- There are no woody biomass utilization limits for thinning operations that leave a fully stocked residual stand except as identified in the above.

3. To protect cultural resources, an inventory was conducted as part of this EA. Forest Plan Forestwide Standards FW-199 thru FW-207 will apply. If any cultural resources are found during project implementation, protect them following guidance in 36 CFR 800.4. (Forest Plan, pages 4-19 thru 4-20).

4. To protect soil productivity, harvesting operations will be suspended in periods of high soil moisture content. Forest Plan Forestwide Standards FW-1, FW-5, FW-6, and FW-8 thru FW-13 will apply (Forest Plan, pages 4-1 and 4-2).

5. To protect water quality and the fisheries resource, Forestwide Standards FW-15 thru FW-17, FW-19, FW-23 thru FW-27, FW-29, FW-32 thru FW-34, FW-139, FW-140, and FW-142 thru FW-145 will apply. Riparian Corridor Standards 11-001 thru 11-005, 11-019 thru 11-023, 11-031, 11-032, and 11-047 thru 11-056 also apply. (Forest Plan pages 4-2, 4-3, 4-15, and 4-121 thru 4-126)

6. To protect riparian areas, all alternatives were designed to avoid harvesting in floodplains, wetlands, and riparian corridors (Management Area 11), as delineated on the ground on the basis of soils, vegetation, and landform in accordance with Appendix X of the Forest Plan. Forestwide Standards FW -139, FW-140, FW-142 thru 145 also apply (Forest Plan p. 4-15).

7. Timber will be harvested only on National Forest System lands classed as suitable for timber production in accordance with Forest Plan pages 3-32 thru 3-35.

8. If any Threatened, Endangered, Sensitive, or Locally Rare (TESLR) species are located during implementation of the project, work will be suspended and a biologist and/or botanist will be consulted.

9. To promote potential summer roost trees and maternity sites for the Indiana bat Forestwide Standard FW-48 applies, leave all shagbark hickory trees greater than 6 inches diameter at breast height (dbh), except when they pose a safety hazard. In addition, retain a minimum residual 15 square feet of basal area per acre (including 6 snags or cavity trees) scattered or clumped. Residual trees are greater than 6 inches dbh with priority given to the largest available trees, which exhibit characteristics favored as roost trees by Indiana bats. (Forest Plan, p. 4-5)

10. To protect Indiana bats, Forestwide Standards FW-47 thru FW-60 will apply. (Forest Plan, pages 4-5 and 4-6)

11. To provide for soft producing species retain dogwood, black gum, hawthorne, grapes, serviceberry, etc., during vegetation management treatments when consistent with overall regeneration and species composition objectives. (Forest Plan Forestwide Standard FW-35, p. 4-4)

12. To reduce the spread of non-native invasive plant (NNIP) species Forestwide Standards, FW-91 thru FW-94 and FW-95 thru FW-100, pages 4-9 thru 4-10 will apply. This includes provisions to reduce the potential spread from equipment used for project implementation as follows: mechanical equipment, such as that used for logging, mowing, firefighting and earth moving (including road graders), should be free of soil, seeds, and other attached material prior to coming on the Forest or being moved from areas on the Forest with NNIP infestations to areas free from noticeable infestations.

13. When applying herbicide to treat NNIP, Forestwide Standards FW-106 thru FW-120 will apply (Forest Plan, pages 4-11 thru 4-12).

14. All temporary roads and skid trails will be stabilized, limed, fertilized and seeded with a suitable mixture of non-invasive, native, or naturalized grass species and subsequently closed.

15. "Caution Log Trucks" safety signs will be placed along State Route 629 and State Route 633 before the start of logging operations. Virginia Department of Transportation will sign State Routes 629 and 633 to standards.

16. To protect butternut Forestwide Standard FW-84 will apply. (Forest Plan, p. 4-8)

17. To protect aesthetics the scenery treatment guidelines, Forest Plan, pages 3-20 thru 3-21 will be implemented which lists vegetation management contrast reducing guidelines for shelterwood, shelterwood with reserves, thinnings, temporary road construction, and prescribed fire.

18. To protect sink holes found in the project area a 200 foot no harvest zone beyond the slope break will be implemented. (Forest Plan, Forestwide Standard FW-71, p. 4-7)

19. While cooperative scientific investigations of the effects of prescribed fire on shale barren rock cress continue, all known occurrences of shale barren rockcress in the project area will be excluded from active fire management until new information is known. This will occur through the implementation of low impact fire control lines with the use of leaf blowers being the preferred method.

20. To protect riparian resources the following guidelines will be used to identify riparian corridors. The following slope-dependent riparian corridor widths will be used in the project area. The slope-dependent riparian corridor widths are measured in on-the-ground surface feet perpendicular from the edge of the channel or bank (stream, water body, etc.) and extend out from each side of a stream. For ponds, lakes, sloughs, and wetlands (including seeps or springs associated with wetlands) the measurement would start at the ordinary high water mark and go around the perimeter. For braided streams, the outermost braid will be used as the water's edge. An interrupted stream (a watercourse that goes underground and then reappears) will be treated as if the stream were above ground. The riparian corridor includes human-created reservoirs, wildlife ponds, wetlands, and waterholes connected to or associated with natural water features. In addition, those areas not associated with natural water features, but support riparian flora or fauna, will have a riparian corridor designation. The riparian corridor management direction does not apply to constructed ponds developed for recreation uses; or to human-made ditches, gullies, or other features that are maintained or in the process of restoration.

Table 2-3: Minimum Riparian Corridor Widths (In Feet) On Each Side of Stream

	Slope Class		
	0-10% Core Area	11-45% Core Area Plus Extended Area†	45%+ Core Area Plus Extended Area†
Perennial*	100	125	150
Intermittent	50	75	100
Channeled ephemeral	25	25	25

*Perennial streams, lakes, ponds, wetlands, seeps, and springs
†The Extended Area is the outer 25 feet (on 11-45 % slopes) and 50 feet (on 45 % + slopes).

21. To protect a bald eagle nest near the Coffee Pot burn from any potential threat during aerial operations resulting from this burn. The nest must be checked for activity or avoided during aerial operations. During the breeding/nesting season (December 15-July 15), aircraft flyovers within 1000 vertical feet of the ground are restricted within the primary and secondary management zones of the occupied nest. If a helicopter is used during ignition phases of the project, the pilot and accompanying crew will be informed of the location of the eagle nest and aerial restrictions within the eagle nest management zones will be observed.

Chapter 3

Affected Environment and Environmental Consequences

Introduction

This chapter summarizes the existing condition of physical, biological, and social resources in the Lower Cowpasture project area as well as the direct, indirect or cumulative effects of carrying out the proposed alternatives. These effects can be either adverse or beneficial. The area of potential effects varies by resource but it can generally be considered to incorporate National Forest land within the Lower Cowpasture Project area.

The effects of the alternatives are discussed in terms of direct effects (effects that are caused by the action and occur at the same time and place), indirect effects (effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable), and cumulative effects (effects on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes the other actions). If any issues were identified either through public scoping, or through internal (Forest Service specialists) input, then they will be identified at the beginning of each resource section.

Past, Present, and Reasonably Foreseeable Future Actions

There are homes and farmland near the project area and this land use is expected to remain the same in the reasonably foreseeable future (next 10 years). Approximately 1,887 acres were harvested within the last 26 years on National Forest lands in the project area. One active timber sale (Mares Run), 165 acres, is in the project area. Approximately 850 acres of timber harvest has occurred on private lands in the vicinity of the project area within the past 20 years. Existing utility corridors comprise approximately 110 acres on NFS lands within the project area. Utility corridors receive periodic maintenance in the form of removing and/or cutting back vegetation. Approximately 2.68 miles of FSR roads were decommissioned in 2011; another 8 miles of NFS roads are in the process of being decommissioned.

The project area includes the Warm Springs Mountain Restoration (WSMR) project, which involves prescribe burning approximately 18,425 acres in eleven units in partnership with The Nature Conservancy. Approximately 9,800 acres of the WSMR burns are acres yet to be implemented.

Douthat State Park and Young Life youth camp are within the project area and these land uses are expected to remain the same in the reasonably foreseeable future. Douthat State Park could also implement some prescribe burning on approximately 478 acres as part of the Pine Spur Ridge and Brown Hollow burn units of the Lower Cowpasture Project.

TNC's Warm Springs Mountain Preserve is also located within Lower Cowpasture project area along with a portion of Clifton Forge's municipal watershed. A CSX railroad line also transects the project area this line is expected to remain active in the reasonably foreseeable future.

Aside from activities identified in the action alternatives, no reasonably foreseeable future actions on National Forest System lands within the project area are planned.

Section A - Physical Resources

A1 - Air Quality

Issues Related to the Resource

There were no project issues raised concerning this resource.

Scope of the Analysis

The boundary of the analysis for the air resource is the airshed in and around the project area.

A1.1 Introduction

Air pollution is the presence in the atmosphere of one or more contaminants of a nature, concentration, and duration to be hazardous to human health or welfare (Sandberg and others 1999). Air quality is a measure of the presence of air pollution. Ambient air quality is defined by the Clean Air Act as the air quality anywhere people have access, outside of industrial site boundaries. National ambient air quality standards (NAAQS) are standards of air quality designed to protect human health or welfare and are applied to six criteria pollutants. When measured concentrations of any of these pollutants consistently exceed the NAAQS, the area is usually designated as a "non-attainment" area by EPA. The six criteria pollutants are lead, sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x), ozone (O_3) and particulate matter (PM).

Resource Indicators and Measures

Although the proposed Lower Cowpasture project includes vegetation management, wildlife habitat improvements, non-native invasive plant management, recreation management, aquatic passage/watershed improvements, and controlled or prescribed burning, not all proposed activities result in air emissions. Thus, this air analysis will only focus on the one proposed activity, prescribed burning, that results in an increase in air emissions. We will address current emissions of air pollutants, emissions from the proposed prescribed fire activities, and the ambient air quality concentrations in nearby areas.

A1.2 Analysis Methods

Existing ambient air quality will be described using information from state-operated monitors located near the proposed burn units. An emissions inventory will be created for the typical annual burning program and compared to a current inventory of total emissions, compiled by Virginia and West Virginia state regulatory agencies as well the US Environmental Protection Agency, in order to assess potential impacts to air quality. Finally, emissions from the proposed burning activities will be assessed and compared to the total emissions previously described.

Information Sources

Ambient air quality information is available for download at http://www.epa.gov/airdata/. Emissions inventory information is available for download at http://www.epa.gov/ttnchie1/trends/ and ftp://ftp.epa.gov/EmisInventory/2011/2011neiv1_eventfire_countyscc_caphap.zip. Emission factor information is available from http://www.epa.gov/ttnchie1/ap42/.

Incomplete and Unavailable Information

None.

A1.3 Existing Condition

The proposed project area lies on the George Washington and Jefferson National Forests, James River and Warm Springs Ranger Districts, within northeast Alleghany, southeast Bath and western Rockbridge Counties, Virginia. Recreational opportunities abound on the Districts, include picnicking, camping, fishing, hiking, swimming and nature viewing, and as such the Districts are frequented by Forest visitors. Several populated communities surround the Ranger Districts, and there are secondary roads that border, cross, or are located in close proximity to National Forest lands. All of these areas are sensitive to impacts on air quality and could be affected by this proposal.

Emissions from wildland fire include carbon dioxide, water, carbon monoxide, particulate matter, hydrocarbons or volatile organic compounds, and nitrogen oxides. Carbon dioxide and water generally make up over 90 percent of the total emissions. Recently, the Environmental Protection Agency (EPA) has found that greenhouse gas emissions, including carbon dioxide, from motor vehicles contribute to the threat of global climate change. This determination resulted in greenhouse gas emissions from large stationary sources being subject to the permitting requirements under the Prevention of Significant Deterioration (PSD) program. However, at this time, EPA has not begun regulating greenhouse gases from activities such as prescribed fires, and therefore these emissions will not be addressed further in this analysis.

A brief discussion of the criteria air pollutants and whether they are emitted by prescribed fires is below.

- The lead and sulfur content of forest fuels is negligible, so these two forms of air pollution are not considered further.

- Carbon monoxide is the most abundant pollutant emitted from wildland fire. It is of concern to human health, because it binds to hemoglobin in place of oxygen and leads to oxygen deprivation and all of the associated symptoms, from diminished work capacity to nausea, headaches, and loss of mental acuity. (Details on the health effects of carbon monoxide can be found in Appendix H or Hardy et al. 2001.) Carbon monoxide concentrations can be quite high adjacent to the burn unit, but they decrease rapidly away from the burn unit toward cleaner air. Carbon monoxide exposure can be significant for those working the line on a prescribed fire, but due to rapid dilution, carbon monoxide is not a concern to urban and rural areas even a short distance downwind. Fortunately, most of the health effects from carbon monoxide are reversible because carbon monoxide is rapidly removed from the body once a person is in cleaner air.

- Nitrogen oxide emissions from wildland fires are very small, and hydrocarbon emissions are moderate. Alone they are not very important to human health, but they are precursors to the criteria pollutant, ozone. Ozone is formed in the atmosphere when nitrogen oxides and hydrocarbons combine in the presence of sunlight. Fire-related NOx and hydrocarbon emissions become more important to ozone levels only when other persistent and much larger pollution sources already present a substantial base load of precursors. To a limited degree, additional intermittent emissions may aggravate an already bad situation. Ozone will be discussed in this analysis.

- The most important pollutant from wildland fire emissions is fine particulate matter ($PM_{2.5}$) due to the amount emitted and the effects on human health and visibility (Hardy et al. 2001). The term fine particulate refers to particulate matter 2.5 microns or less in diameter. This

analysis will address effects of the fine particulate emissions from prescribed fire on air quality within the analysis area.

To understand how the proposed activities might affect air quality, current levels of pollution in the analysis area must be considered. State air regulators are responsible for monitoring air quality. Ambient air quality is described by comparing current pollutant concentrations, as measured by state air regulators, to the National Ambient Air Quality Standards (NAAQS). As mentioned above, NAAQS are threshold concentrations of the six criteria pollutants set by the EPA to protect human health and welfare. The NAAQS are set at conservative levels with the intent of protecting even the most sensitive members of the public including children, asthmatics, and people with cardiovascular disease.

The criteria pollutants of most concern on the George Washington & Jefferson National Forests are particulate matter and ozone. 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 Forests. Although air regulators monitoring ozone and fine particulate matter may occur at many locations, there are few monitors located near the proposed burn units associated with the Lower Cowpasture Project. There is just one ozone monitor within 50 kilometers of the Project, and there are no fine particulate matter reference monitors within that area, as shown in the map below. Ozone is monitored in Rockbridge County, VA, approximately 32 kilometers southeast of the nearest proposed burn unit.

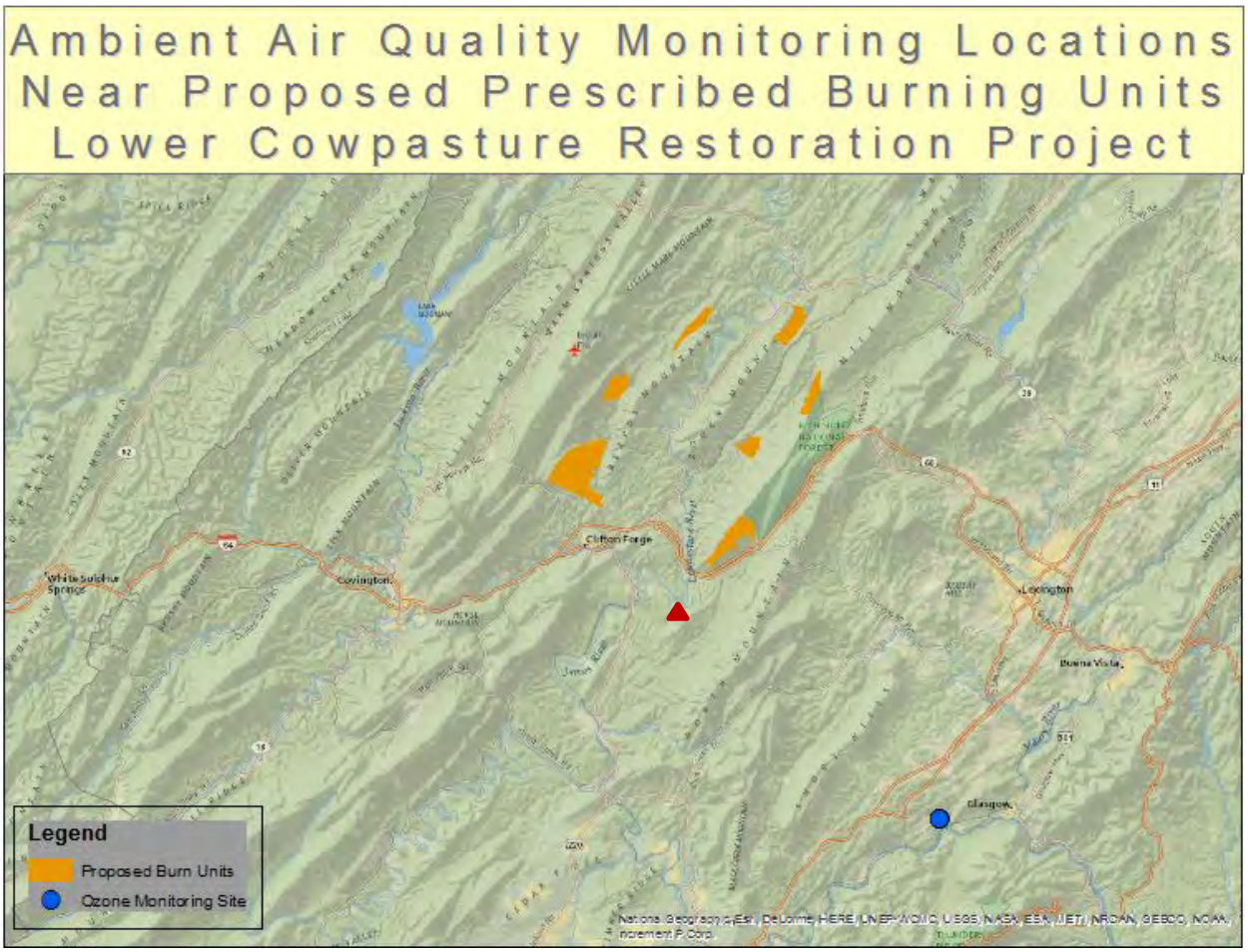


Figure 3A1-1. Ozone monitoring locations near the proposed burn units associated with the Lower Cowpasture Restoration and Management Project, George Washington & Jefferson National Forests. Source: http://www.epa.gov/airdata/

The Rockbridge County, VA ozone monitor does not have measured values greater than the air quality standards (NAAQS) set by EPA. Additionally, it should be noted that the counties where this project is proposed are not designated nonattainment for any criteria pollutants, including ozone and particulate matter (source: http://www.epa.gov/oaqps001/greenbk/index.html). The closest nonattainment area is the Washington, DC $PM_{2.5}$ and Ozone nonattainment areas, nearly 200 kilometers to the northeast.

The figure below shows the existing ambient concentrations of ozone as measured by the ambient air quality monitor located in Rockbridge County, VA.

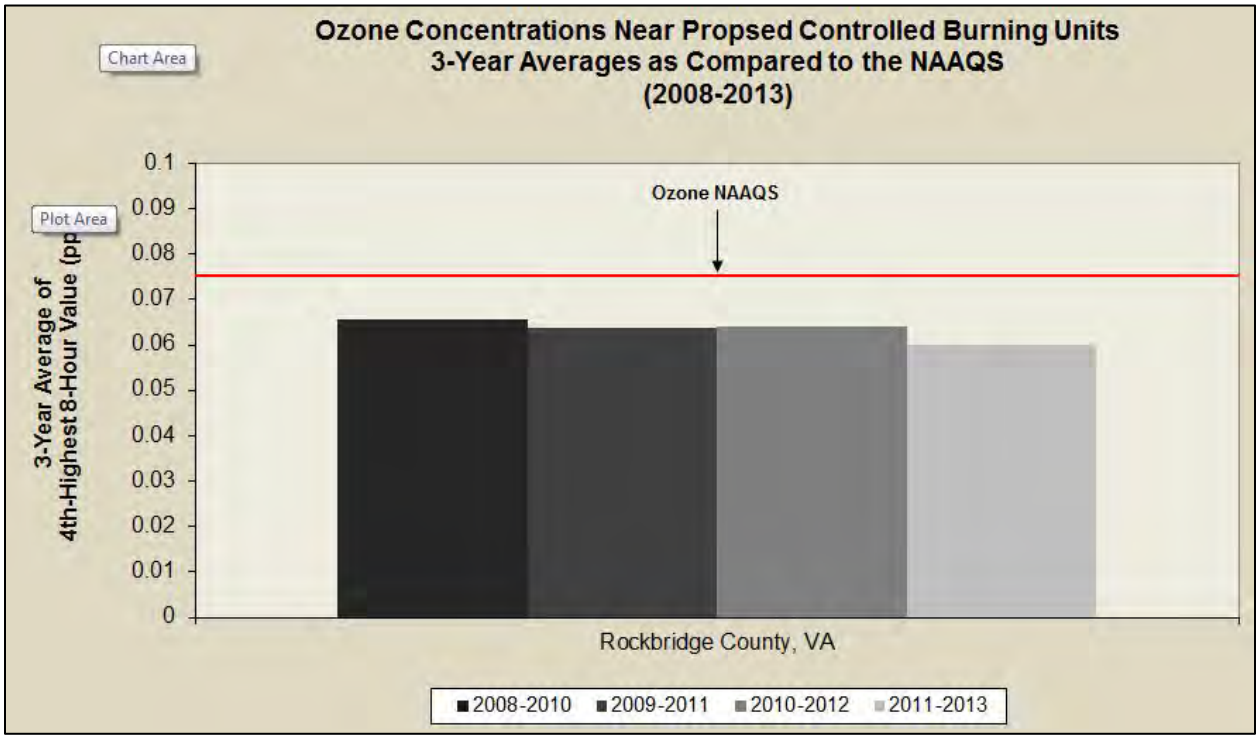


Figure 3A1-2. Ozone monitoring results as compared to the current NAAQS. The ozone standard is exceeded at a site if the three-year average of the fourth-highest 8-hour average ozone concentration is greater than 0.075 ppm. Source: http://www.epa.gov/airdata/.

Although there is not a fine particulate matter monitor located within 50 kilometers of the proposed burn units, there is an IMPROVE visibility monitor in Rockbridge County that is associated with the James River Face Class I Area. Although measurements from this monitor cannot be assessed to determine whether values meet or exceed the NAAQS for fine particulate matter, visibility measurements can be used a surrogate for whether concentrations have improved in an area. The standard visual range (SVR) at the James River Face IMPROVE monitor improved approximately 20% from 2005 to 2009 (Jackson 2013). See http://www.fs.fed.us/air/documents/IMPROVE_Data_Summary_JARI1.pdf for more information about visibility monitoring at James River Face.

While air quality monitoring describes ambient pollution levels, emissions inventories provide information on the contribution of various pollution sources to total emissions for specific geographic areas. Emissions from prescribed fires are unlikely to be a significant contributor to ozone. In much of the rural South, ozone formation tends to be NOx-limited and prescribed fires are usually not a major NOx source when compared to others, such as vehicles. Also, the amount of NOx and VOC coming from forestry activities is small compared to other sources. And most importantly, weather and climate conditions in this area tend to preclude prescribed burning from becoming a significant contributor to ozone formation. Most ozone events occur in mid-spring through late summer when hot temperatures and high-pressure air masses may stagnate over an area, and pollution is not dispersed. Prescribed burning is not typically conducted under these types of weather conditions because of the smoke dispersion issues. Conversely, fine particulate matter is emitted from prescribed fires and is a contributor to ambient levels of this pollutant. Figure 3A1-3 shows the sources of this air pollutant near the proposed project.

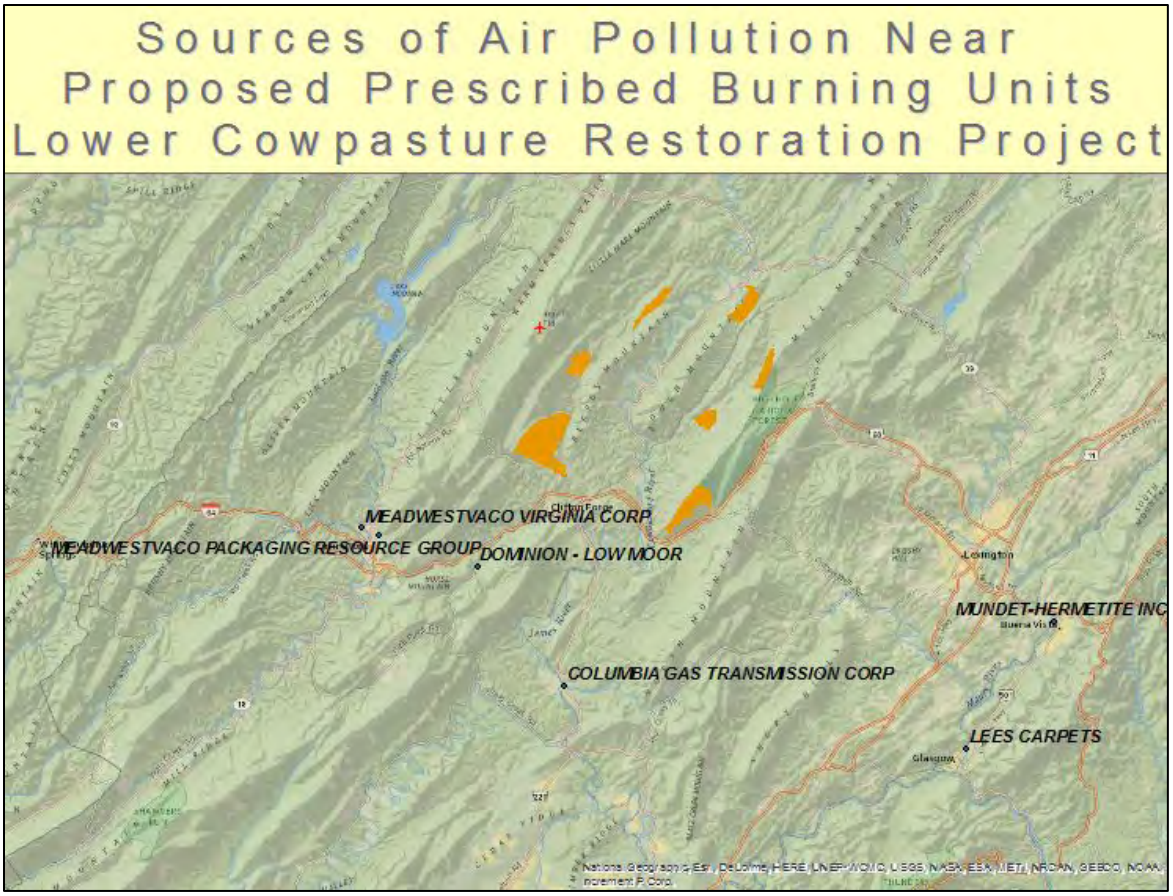


Figure 3A1-3. Sources of industrial emissions of fine particulate matter near the proposed burn units. Data obtained from the 2011 National Emissions Inventory (http://www.epa.gov/compliance/data/systems/air/afssystem.html)

Table 3A1-1 shows the total fine particulate matter emissions in the counties where burning is proposed, as well as the emissions from prescribed burning, based on EPA's most recent National Emissions Inventory. Since the Forest is the primary prescribed burner in the analysis area, it is easy to see the contribution of these emissions to overall fine particulate emissions. Within the counties where burning is proposed, prescribed fire emissions accounted for 19.6 percent of all fine particulate emissions. In the counties within 40 miles of the proposed project, prescribed fire emissions accounted for 9.9% of all fine particulate matter emissions. Other sources of fine particulate emissions include fuel combustion and operations at industrial facilities, waste disposal and recycling operations, construction, and agricultural activities.

Table 3A1-1. Fine particulate emissions (in tons per year) from the 2011 EPA National Emissions Inventory. Source: http://www.epa.gov/ttnchie1/trends/ and ftp://ftp.epa.gov/EmisInventory/2011/2011neiv1_eventfire_countyscc_caphap.zip

	Fine Particulate Emissions in Tons per Year		
Geographic Area	**From All Sources**	**From Prescribed Fires Only**	**Percentage of Prescribed Fire Emissions to All Emissions**
Within Alleghany, Bath and Rockbridge Counties, VA	991	194	19.6%
Counties Within 40 Miles of Proposed Project	5,325	528	9.9%

A1.4 Direct and Indirect Effects

Direct and Indirect Effects - Alternative 1

This alternative would have no immediate (direct) impacts on air quality since no actions would be implemented. Indirectly, this alternative could impact air quality later due to resulting build-up of forest fuels, which could cause more smoke over longer durations if wildfires were to burn areas not treated.

The cumulative impact of the no action alternative would result from the indirect effects over time on forest vegetation and litter, or "fuel loadings", and the resulting effect on wildfires. In the absence of prescribed burns brushy species replace grasses and fuel loading increases. Wildfires occurring in areas with increased fuel loadings produce more smoke and are more difficult to contain and therefore often burn for a longer duration. Wildfires may occur at times when wind carries smoke into sensitive areas, and at times when smoke dispersal is poor.

Direct and Indirect Effects - Alternatives 2 and 3

Prescribed burning is proposed on thirteen (13) units, for a total of 12,908 acres for Alternative 2. Most of the burn units will use existing roads, trails and burn boundaries as burn boundaries. In addition, there is a need to construct approximately 11.8 miles of dozer lines. The Alternative 3 proposal reduces prescribed burning to eleven (11) units, for a total of 12,449 acres. This acreage does not include prescribed burns approved under other projects.

Project Design Features and Mitigation Measures

The proposed prescribed burning is compatible with the Forest Plan, the desired conditions, and the standards within each management prescription that falls within the project area. The following effects are based on the prescribed fires being implemented in compliance with the USDA Forest Service Southern Region's Smoke Management Guidelines, dated September 2010 and included in Appendix I of this report. The smoke management objectives set forth in the guidelines are as follows:

- Minimize the amount and concentration of smoke entering populated areas;
- Prevent / minimize public health and safety hazards, including
    - Impacts to sensitive sites (schools, hospitals, etc.), and
    - Visual impairment on highways, airports, etc. (both day and night);
- Avoid exceedances of the National Ambient Air Quality Standards (NAAQS); and
- Protect visibility in Class I Areas.

Additionally, the Guidelines require that burn plans be prepared to ensure that the smoke management objectives meet USDA policy that prescribed fires may not cause or contribute to an exceedance of a National Ambient Air Quality Standards. Burn planning will include the appropriate analysis procedures to evaluate downwind smoke concentrations to ensure protection of public health and safety.

Additionally, the following design features will be implemented.

1. Each prescribed burn plan will include a smoke management plan that identifies smoke sensitive areas such as communities, health care facilities, airports, highways, homes of persons known to have chronic respiratory illness, schools, etc. The burn plan will be designed with conditions that will maximize smoke dispersion and minimize smoke impacts in these areas.

2. Each burn plan will include a public notification plan to inform those living nearby of when burns will occur.

3. The Prescribed Fire Burn Boss will obtain site-specific weather reports called "spot weather forecasts", provided by the National Weather Service, to check that parameters for good smoke dispersion are met on the day of the burn and that the forecast meets the conditions described in the burn plan. This will aid in reducing smoke impacts on sensitive areas.

4. It is recommended that the District seek assistance from the Air Specialists and that a more refined model, such as HYSPLIT is used to help make go/no-go decisions on the day before or day of the burn.

5. For some treatment units, even the most diligent planning will provide no option that can avoid all smoke sensitive targets. In these cases the project can be modified or the District will seek ways to mitigate the impacts of the smoke.

6. Despite the fact that regional air quality analyses and monitoring may show that prescribed fire emissions are not affecting the NAAQS, forecasted ozone levels should be taken into consideration prior to burning to avoid putting smoke into areas with forecasts for ozone levels above the NAAQS. This is primarily a growing season concern when prescribed burning and the ozone season coincide (April – October).

7. Once the decision to burn is made and firing has begun, fire and smoke behavior will be monitored for unanticipated and unacceptable situations (smoke dispersing in the wrong direction, smoke not dispersing vertically, etc.). The staff will be prepared to cease ignition and/or begin suppression if the situation cannot be controlled or mitigated. Also, staff will patrol smoke sensitive roadways through the night if the fire is still producing significant smoke at dusk.

8. The District will maintain records of any significant smoke management problems in the review section of the project burn plan.

Direct and Indirect Effects

The primary concerns when managing smoke from prescribed burns are impacting surrounding areas. Prescribed fire emissions have a direct, short-term effect on air quality in the project area. All prescribed burns on the George Washington and Jefferson National Forests are conducted in accordance with the Region 8 Smoke Management Guidelines in order to minimize impacts. The purposes of smoke management programs and guidelines are to mitigate the nuisance (such as

impacts on air quality below the level of ambient standards) and public safety hazards (such as visibility on roads and airports) posed by smoke intrusions into populated areas; to prevent significant deterioration of air quality of Class I areas, and to insure that National Ambient Air Quality Standards (NAAQS) are met. Potential smoke emissions from the prescribed burns will be evaluated using the Fire Emissions Production Simulator (FEPS) and the dispersion models VSMOKE and HYSPLIT to estimate direction of smoke dispersion and downwind concentrations prior to implementing the burns. These requirements and guidelines are the best practices available to avoid and minimize impacts to public health and visibility impairment on highways (safety).

Prescribed fire emissions from the proposed action would have a direct, short-term effect on air quality in the project area. Once the smoke has dispersed, the impact is gone. The amount of smoke and how it is dispersed depend on the size of the burn, the amount of fuel and the meteorological conditions at the time of the burn. In general, smoke from prescribed burning disperses into the atmosphere and combines with other existing pollutants. The wind transports the smoke and pollutants to areas many miles away where they are added to and possibly react with other gases/pollutants present in the atmosphere. The fate of emissions from prescribed fires is twofold. Most of the emissions are "lifted" by convection into the atmosphere where they are dissipated by horizontal and downward dispersion from the fire. The balance of the emissions remains in intermittent contact with the ground. Ground level smoke does not have enough heat to rise into the atmosphere. It stays in intermittent contact with the human environment and turbulent surface winds move it erratically. Human exposure to ground level smoke can be more intense, relatively brief (hours rather than days) and limited to a smaller area than exposure from smoke aloft. Smoke aloft is already dispersed before it returns to the human environment while ground level smoke must dissipate within that environment. Ground level smoke is dissipated through dispersion and deposition of smoke particles on vegetation, soil and other objects.

The direct effects of smoke include human health and safety issues (Hardy et al. 2001). Fine particulates, including those found in wildland fire smoke, affect human health through the respiratory system, although eye irritation is also common. Individuals with cardiopulmonary diseases are especially susceptible. (Details on the health effects of fine particulate can be found in Appendix H or Hardy et al. 2001.) Residents near the burn unit might have some respiratory discomfort from ground level smoke, however it is expected that most impacts would be in the form of nuisance smoke and/or smell. For example, ash fallout can soil personal property and people may complain about the odors from the smoke. These impacts can be minimized by implementing the burn under weather conditions that are good for dilution and dispersion of the smoke away from smoke sensitive targets.

Fine particulates can also reduce visibility at scenic views by scattering and adsorbing light. A sufficient concentration can result in a reduction in how far a person can see a distant object, and how well a person can see the color and texture of a distant object. Surveys indicate that viewing scenery is an important reason of why people visit National Forests. The visibility impairment caused by the proposed prescribed fires is likely to be short-term (less than 24 hours) in duration, and reductions in visibility (distance, color and texture) are likely to decrease as a person moves away from the prescribed fire.

Visibility on roads can be reduced by ground level smoke, causing a safety issue. This can be particularly of concern if smoke continues into the night when emissions are likely to be trapped near the ground and slowly transported from the burned area. The smoke will follow the drainages and collect in low lying areas. In a humid atmosphere the fine particles along with the water vapor released from the fuels can be a primary contributor to the formation of fog, which can become very dense. A person operating a vehicle in the vicinity of the prescribed fire may first experience good

visibility conditions and then suddenly have visibility reduced significantly when they drive into the fog formed by the smoldering emissions. Conditions like this can significantly increase the likelihood of highway accidents; however, the likelihood of traffic accidents can be reduced by assisting vehicles driving through the fog or directing the traffic along a different route away from the fog.

Recall that Table 3A1-1 showed the emissions of fine particulate matter currently within the counties where the Lower Cowpasture Restoration Project is proposed. Calculations of emissions from the proposed units were also conducted, with the resulting emissions shown in the table below. The emissions were calculated using a range of consumption values (in tons per acre) for each unit based on best available information and professional judgment. Consumption is assumed to be between four and ten tons per acre, with an average emission factor of 12 pounds of fine particulate matter per ton of fuel consumed.

Table 3A1-2. Fine particulate emissions (in tons per year) from the 2011 EPA National Emissions Inventory and projected maximum annual emissions increases from the Proposed Action.

	Fine Particulate Emissions in Tons per Year		
Geographic Area	Current (2011) Emissions	Total from Prescribed Fires in all of the Proposed Units (Estimated Range[a])	Percentage Increase[a]
Within Alleghany, Bath and Rockbridge Counties, VA	991	310 – 774	31.3% - 78.1%
Counties Within 40 Miles of Proposed Project	5,325	310 – 774	5.8% - 14.5%

[a] This assumes that each unit will be burned each year, which is unlikely given staffing, resources and the design of the proposal which calls for a burn return period of between one and eight years.

The indirect effects of smoke are similar to the direct effects, but are experienced at greater distances from the burn. These effects are usually the result of the "lifted" portion of the smoke. Prescribed fires are managed to disperse and dilute smoke to avoid the negative effects of emissions, especially downwind of the burn. However, mass ignition techniques (such as aerial ignition from helicopters) that have become more commonly employed in order to treat more acres over a shorter time period can also put more particulate matter into the atmosphere over a relatively short time. Once dispersion and dilution occurs, the effects are alleviated.

Again, all prescribed burning activities on the George Washington & Jefferson National Forests, including those proposed in this action, are conducted in accordance with the Region 8 Smoke Management Guidelines in order to alleviate the smoke related impacts outlined above. Smoke management planning in accordance with the Region 8 Smoke Management Guidelines has been successful in protecting health and safety during past activities. The Guidelines require that smoke dispersion modeling be conducted for all burn units that will consume more than four tons per acre to ensure that the smoke management objectives previously set forth are met; if modeling shows potential impacts, adjustments or mitigations will be necessary in order to go forward with the burn. Each burn unit will be planned in accordance with the Guidelines such that specific parameters are met, including wind speeds and directions. While a few of the larger units have the potential to transport smoke beyond the National Forest, potential impacts will be mitigated by burning with a wind direction away from the Forest boundary.

A1.5 Cumulative Effects

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

In addition to using prescribed fire as is proposed, the Forests may also conduct controlled burns in one of the other units or in nearby areas. Depending on the timing of the burns, both the short-term (24 hour) and long-term (annual) NAAQS for fine particulate could be affected. Cumulative impacts will be discussed as they relate to these standards.

Past Actions

Smoke from individual prescribed fires usually disperses quickly (in hours rather than days) and once the smoke has cleared the effect is over. Therefore prescribed burning from the previous year does not contribute to a cumulative effect. However, when prescribed fire is used on closely located burn units over consecutive days, then it is possible to have residual smoke accumulate and effects could be increased. Communication between prescribed fire managers can mitigate this to some extent by planning burns to minimize the number of consecutive days of burning in any particular area. This gives the smoke time to disperse and concentrations of fine particulate to diminish.

Present Actions

Multiple prescribed fires could occur on the same day within the analysis area if burning conditions are favorable, and equipment and staffing are available. Multiple burns, occurring at the same time, could cumulatively increase particulate levels. These short-term impacts are best assessed through smoke dispersion modeling to determine how plumes intersect, the resulting particulate concentrations and the likelihood of exceeding a 24-hour NAAQS. However, at this stage of planning, combinations of burn units that might be treated on the same day are not known and therefore modeling the cumulative impact on the 24 hour NAAQS is not an option. Communication between prescribed fire managers is essential to minimize the chances of smoke from multiple burns merging, whether they are ignited on the same or consecutive days.

Reasonably Foreseeable Actions

No additional impacts from reasonably foreseeable actions are anticipated.

Cumulative Effects-Alternative 1

The cumulative impact of the no action alternative would result from the indirect effects over time on forest vegetation and litter, or “fuel loadings”, and the resulting effect on wildfires. In the absence of prescribed burns brushy species replace grasses and fuel loading increases. Wildfires occurring in areas with increased fuel loadings produce more smoke and are more difficult to contain and therefore often burn for a longer duration. Wildfires may occur at times when wind carries smoke into sensitive areas, and at times when smoke dispersal is poor.

Cumulative Effects-Alternatives 2 and 3

The direct, indirect, and cumulative effects to air quality of the proposed prescribed burning in Alternatives 2 and 3 would be of short duration at most (less than 24-hours for 70 days or less each year). As a result of the pre-planning and effective smoke management as required throughout the burns, the overall magnitude of effects are well within the standards set to protect public health and safety. No significant cumulative effects would result from implementation of the action alternatives even with the Warm Springs Mountain burns.

A2 - Soils

Issues Related to the Resource

Project Issue: Biomass removal impact on soil productivity.

Scope of the Analysis

The scope of the analysis for the impacts to soils from the proposed alternatives will be the area contained within the ***activity areas*** for this proposed project. The ***activity areas*** are the treatment areas where there is potential for soil disturbance. These areas will be expected to produce biomass in the future. Examples are: prescribed burn areas, dozer constructed fire lines, and timber harvest areas including log landings and corridors of temporary roads and bladed skid roads. ***Activity areas*** are smaller in extent than the entire proposed project area and are intended to include only the areas being treated by the proposed project alternatives. The table below shows the extent of all the ***activity areas*** for each project alternative along with the activities proposed. This will define the scope of the effects analysis for each alternative and will be used as a basis for comparing the project alternatives for their effects to the soil resource. Activities that are not expected to have negative effects to long-term soil productivity for Lower Cowpasture Restoration and Management Project alternatives are decommissioning roads, hand tool fire line construction, road maintenance, herbicide treatments, non-commercial thinning, manual site preparation, tree planting and activity associated with creating wildlife openings. New system trail construction is not intended to be evaluated for impacts to soil productivity due to the dedication of these areas to a use other than supporting living biomass (Forest Service Handbook R8 2509.18-2003-2.2).

Table 3A2-1 Lower Cowpasture Soil Activity Areas by Alternative

Activity	Alternative 1 No Soil Disturbance	Alternative 2 Proposed Action	Alternative 3 Preferred Alternative
Prescribed burn units		12,908 acres	12,449 acres*
Commercial timber harvest acres outside the burn units.		1, 068 acres	997 acres
Acres of temporary road construction outside the burn units		17 acres	17 acre
TOTAL ACTIVITY AREA		13,993 acres	13,463 acres

*Two proposed burn units are on Douthat and NFS lands. Total combined acres (NFS and Douthat lands) were used.

The scope of the analysis considered for cumulative effects to soils for this project is the project area. The project area is about 77,680 acres and is identified on project location maps included in scoping letters and this environmental analysis. The project area gives a good estimate of the effects to soils from past, future and proposed actions for this area of the George Washington National Forest. Past actions and future planned actions in this project area, when combined with the proposed actions described in this document, will be considered for estimating the cumulative effects to soils.

A2.1 Introduction

Generally most areas within timber regeneration harvest, timber stand improvement, thinning and hardwood restoration treatment areas are expected to recover quickly. Research has shown that the upper few inches of soil recover quickly from any compaction occurring, except for rutting. This is due to organic matter additions from logging debris, soil biota activity, freezing and thawing and plant

root growth from existing and new vegetation. Recovery from compaction is slower in the 8 to 12 inch depth zone, but compaction is not expected at these depths unless rutting occurs. Log landings are expected to have a longer recovery period since these areas must recover from compaction and some soil displacement.

The extent and type of disturbance and the estimated short and long-term effects to soils for Alternatives 2 and 3 are displayed later in this analysis. In conventional harvesting operations, the impacts of unbladed primary skid trails are considered to be short-term impacts to soil productivity. Alternative 1 is considered to have no effect upon the soil resources in the area, since no soil disturbing activities are proposed with this alternative. The proposed activities of planting, chainsaw and herbicide work, road maintenance, decommissioning roads, hand tool fire line construction, road maintenance, pre-commercial thinning, manual site preparation, and activity associated with creating wildlife openings, proposed in Alternatives 2 and 3 are not expected to produce any long-term effects to soil productivity. These activities will not be displacing or deeply compacting the soil occurring in these areas. Short-term exposure of bare soil created by proposed activities will be re-vegetated and the soil surface is not expected to erode after a recovery period.

A2.2 Analysis Methods

Important information considered in evaluating effects to soil resources from this project are: preliminary logging plans, burn plans, the extent of the activity areas and the extent of the area where long-term soil productivity has been reduced. Estimated effects to the soils from this project proposal are considered not significant when at least 85 percent of the activity area retains its soil productivity (Forest Service Handbook, R8, 2509.18.2.2, Soil Quality Standards). Estimating cumulative effects uses past and planned future activities in the entire project area to determine long-term effects to soil productivity.

Soil Base Saturation - Estimation of effects from timber harvest on sensitive soils.

Fossil fuel burning emits air pollution in the form of sulfur dioxide (SO_2) and nitrogen oxides (NOx), while agricultural activities are the primary source of ammonia (NH_3) released to the atmosphere. These emissions go through chemical transformation in the atmosphere before deposited on Earth as sulfuric acid (H_2SO_4), nitric acid (HNO_3), and ammonium. Acid deposition has affected the acidity (pH) of streams, the acid neutralizing capacity (ANC) of streams, and can cause soil nutrient imbalances affecting plant growth. Impacts to soil nutrient cycling have occurred within the proposed project area, as well as the entire southern Appalachians. The result is an acidifying of the soil and an acceleration of the loss of base cations (nutrients) necessary for healthy vegetation and ecosystems. Calcium is an important base cation used in the cell walls of trees. Two other base cations used by trees include magnesium and potassium. Therefore, the removal of woody vegetation also decreases the amount of soil base cations. Overtime if the base cation loss from acidic deposition plus timber harvesting is greater than the amount replaced by the weathering of rocks and deposited from the atmosphere then soils will have reduced base cation availability.

Soil base saturation is one indicator of the health of a watershed and a base saturation value below 10 percent is an area where a risk of nutritional deficiencies may exist for sensitive trees (Fenn et al., 2011). No soil chemistry data are available for the project area, so the percent base saturation is unknown. However, between 1987 and 2011, water chemistry samples have been collected from 19 streams within or near the project area. Twenty-nine percent of the 390 samples collected had an ANC above 100 micro-equivalents per liter (μeq/L), which indicates the aquatic biota were unlikely to be impacted from acidification. Streams that historically had an ANC above 100 may have experienced a gradual decline in the abundance and diversity of aquatic biota as the ANC decreased, and acid tolerant brook trout experiencing sub-lethal effects during episodic episodes (ANC less than

20 µeq/L) (Fenn et al., 2011). The water samples collected within the proposed project area had 55% of the samples with an ANC below 50 µeq/L, and 20% below 20 µeq/L. Lethal effects to brook trout are likely to occur at an ANC below 0 µeq/L, which included 8% of the samples.

Steady-state sulfur critical loads were calculated for the George Washington/Jefferson National Forest using the Steady-State Water Chemistry model (SSWC). The software performed the steady-state sulfur critical loads calculations for each catchment within the George Washington/Jefferson National Forest proclamation boundary. The model predicts most of the Lower Cowpasture project area has a very high or high chance of maintaining or achieving an ANC of 50 µeq/L or greater (McDonnell et al. 2014). There is a correlation between ANC and pH, and ANC is the most commonly used indicator of stream health for the protection of streams from acidification. If a stream previously had an ANC of 100 µeq/L or greater, then an ANC of 50 µeq/L represents the level where the number of fish species may be reduced in half with the acid tolerant brook trout populations experiencing some effects. Furthermore, zooplankton communities begin to decline, followed by macro invertebrate and fish species richness (Cosby et al. 2006, Fenn et al. 2011).

McDonnell et al. (2013) used the MAGIC model to estimate changes in base saturation in 65 catchments in southern Appalachian National Forests. The base run using this model assumes that sulfur deposition remains the same as 2005, no change in streamflow, productivity remains constant, timber harvests occur on all suitable lands, and removal of 65% of the trees (boles and bark) in a catchment following a timber harvest. The base run of the MAGIC model estimates that the median base saturation decreased from 11% in 1860 to 10% in 2000 and will continue decreasing to 9% in 2050 and 8.5% in 2100. Base saturation decrease and base cation loss can also occur following the release of historical sulfur deposition currently bound in the soil. Streams in catchments with high concentrations of sulfates in the soil water and decreasing soil base cations availability are likely to experience a further decrease in stream ANC. McDonnell et al. (2013) also ran the MAGIC model under different scenarios and reported increases in soil base saturation are likely if tree removal in a catchment is 45% or less. Furthermore, increases in predicted stream ANC and soil base saturation with greater decreases in sulfur deposition.

Sulfur dioxide emissions have been decreasing through state and federal regulations that control air pollution emitted from new and existing facilities, and switching from coal to natural gas as a fuel source to produce electricity. Total sulfur deposition for the dynamic modeling was based upon 2005 estimates (McDonnell et al. 2013), but the wet sulfate deposition estimates for the nearby Rough Mountain Wilderness have decreased between 2005 and 2012 by about 60%. Therefore, the estimated sulfur reductions since 2005 are likely to result in increased soil base saturation. In addition, if removal of 45% or less of the boles from the catchments (instead of the base level of 65%) occurs then the base saturation may increase over the long-term. The base saturation is likely to increase because “new” base cations deposited from the atmosphere and from the weathering of rocks in the catchment will be greater than the amount removed from harvesting (McDonnell et al. 2013).

Effects on Soil Base Saturation: The SSWC calculations (McDonnell et al. 2014) for this analysis had a total sulfur deposition based on the average of 2009 – 2011 estimates. Four regeneration units, and no timber stand improvement or wildlife clearings are proposed for an area where the streams are predicted to have a low or very low likelihood of maintaining or achieving a stream ANC of 50 µeq/L or greater in the future. Since timber harvest would remove base cations in the boles and bark of trees and between 30 to 60% of the branches from the crown, we assessed the potential for the proposed harvests to exacerbate base cation deficiency. An analysis of the amount of harvesting in each catchment (Table 3A2-2 below) shows that the highest level of harvest removes trees from about 22% of the catchment, below the concern level of 45%. Based on the low amount of removal of branches, boles and bark from the sensitive catchments and the decreases in sulfur deposition it is likely that the base cation levels in the project area soils will continue to increase regardless of the timber harvest.

Table 3A2-2. Acres of silvicultural treatments proposed in Lower Cowpasture Vegetation Management Project Area (under the maximum harvest alternative, Alternative 2) by catchment areas that were identified as a low likelihood of achieving or maintaining a stream ANC of 50 μeq/L with an average 2009 – 2011 sulfur deposition estimates continuing into the future.

Catchment Area Number	*Timber Harvest*	*Timber Stand Improvement*	*Wildlife Clearing*	*No Treatment*	*Grand Total*	*% Acres Harvested in Catchment*
52272	15			355	370	4%
51888	2			48	50	4%
50720	82			283	365	22%
49785	5			63	68	7%
49467	16			71	87	18%

A2.3 Existing Condition

A detailed soil survey has been completed for the project area (see maps below). The information about the soils is obtained from the soil surveys for Bath, Alleghany and Rockbridge Counties as part of the National Cooperative Soil Survey. The soils potentially impacted by this project are derived primarily from sandstone and shale bedrock geology and colluvial material from surrounding uplands. Because of the large extent of this project area, the maps below contain soil survey information for areas with proposed commercial timber harvesting only. Soil survey spatial and tabular data for the entire project area may be obtained by using USDA NRCS Web Soil Survey.

Figure 3A2-1. Soils Map of Beards Mountain Area

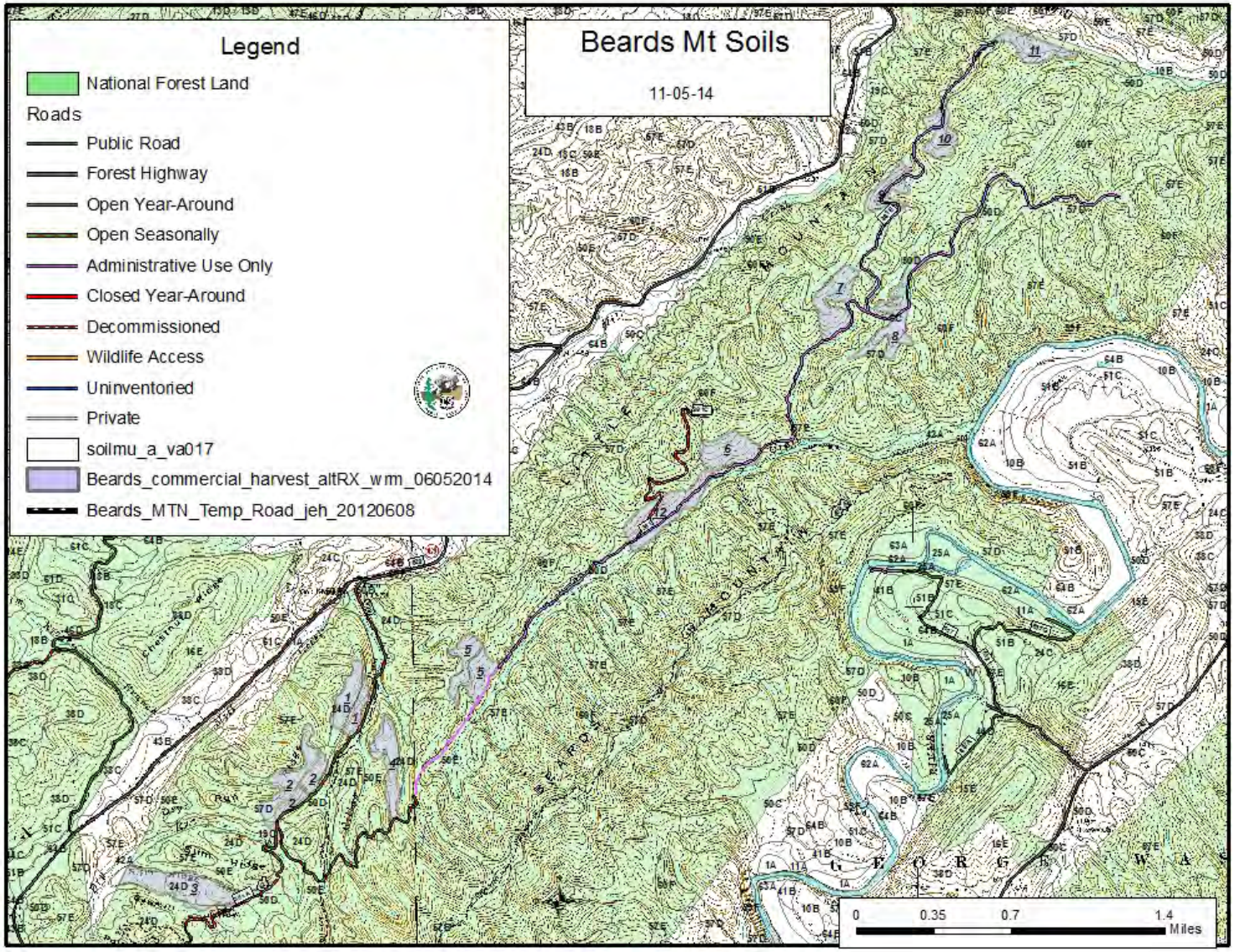


Figure 3A2-2. Soils Map of Cliftondale Area

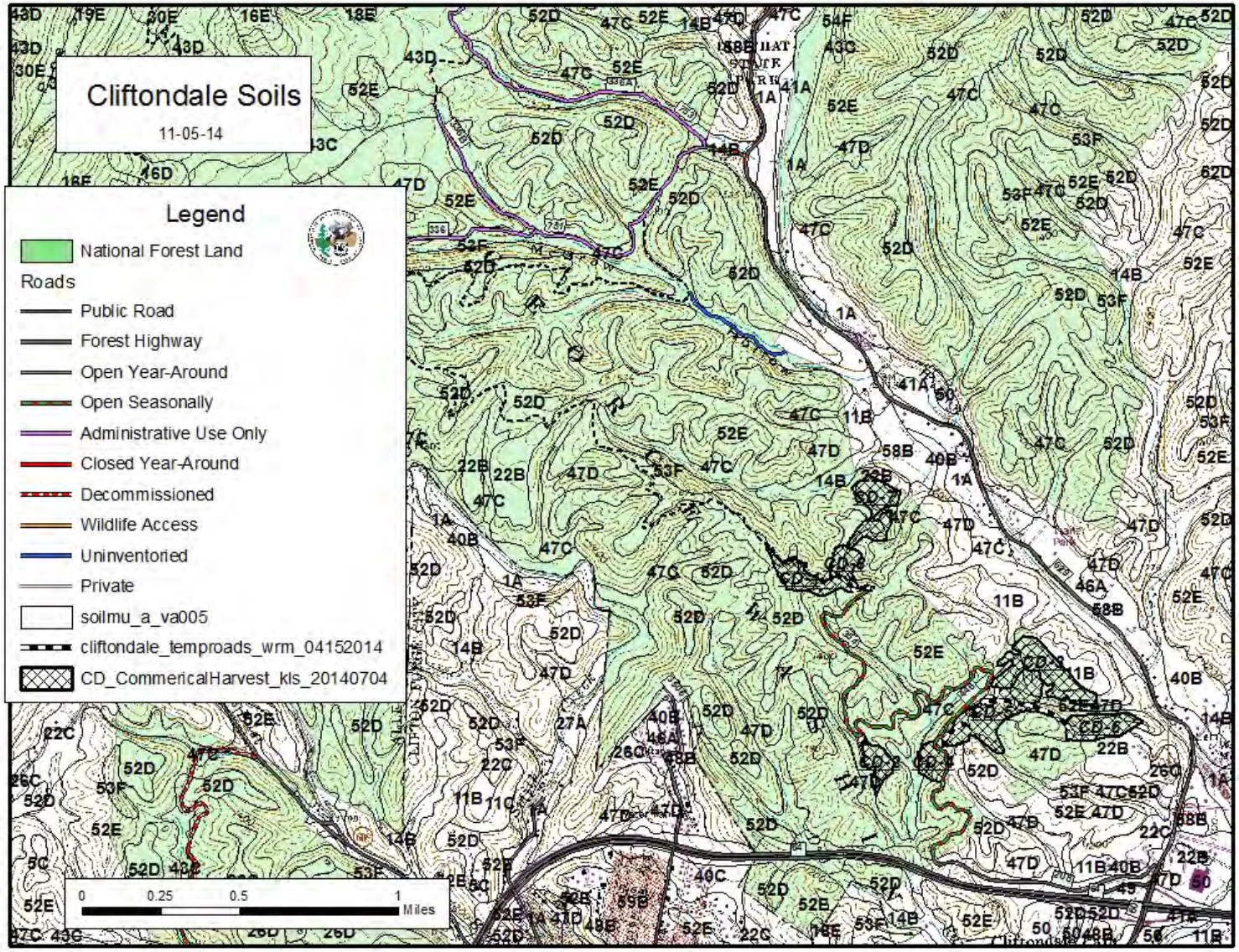


Figure 3A2-3. Soils Map of Craft Road Area

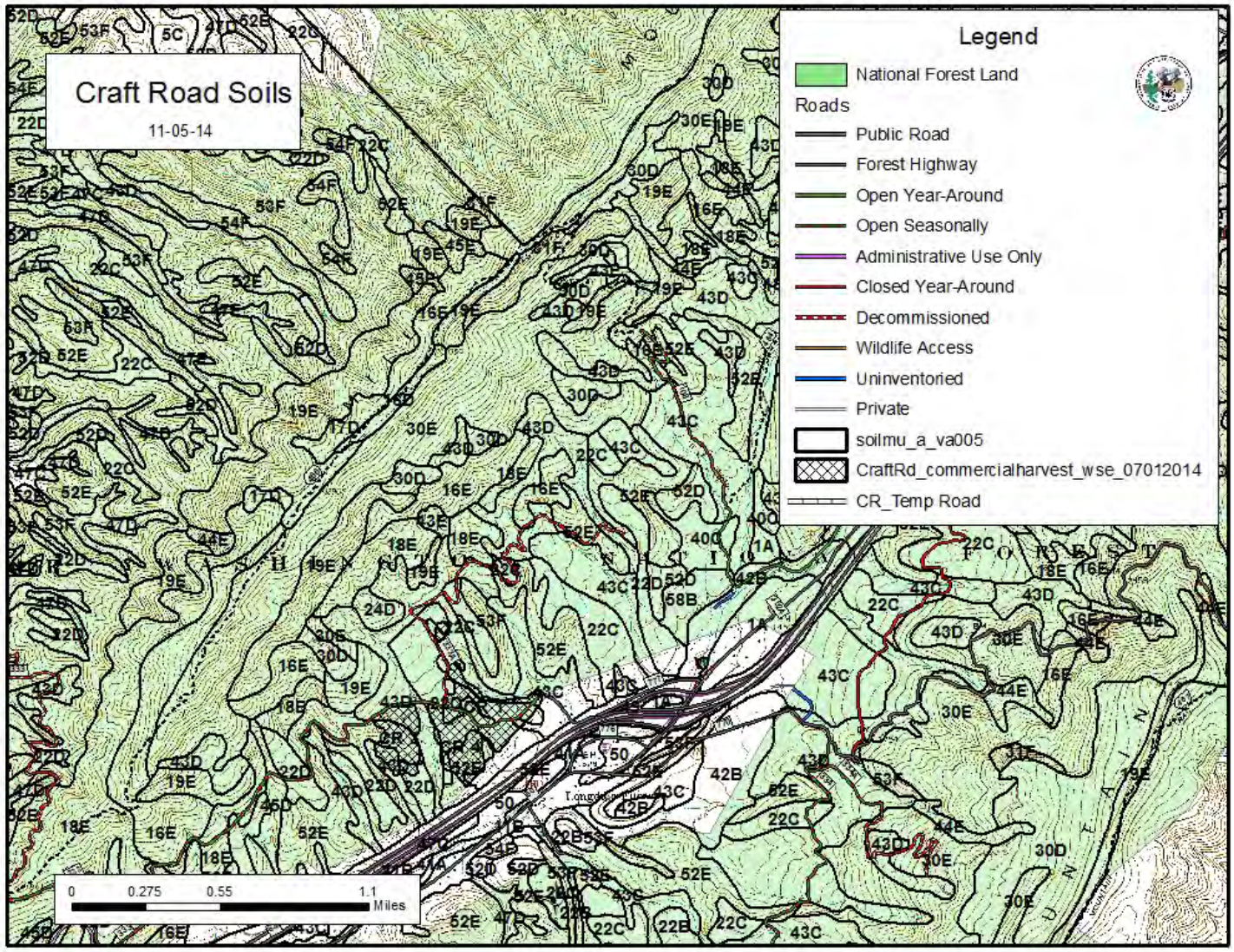


Figure 3A2-4. Soils Map of Limekiln Area. Map 1

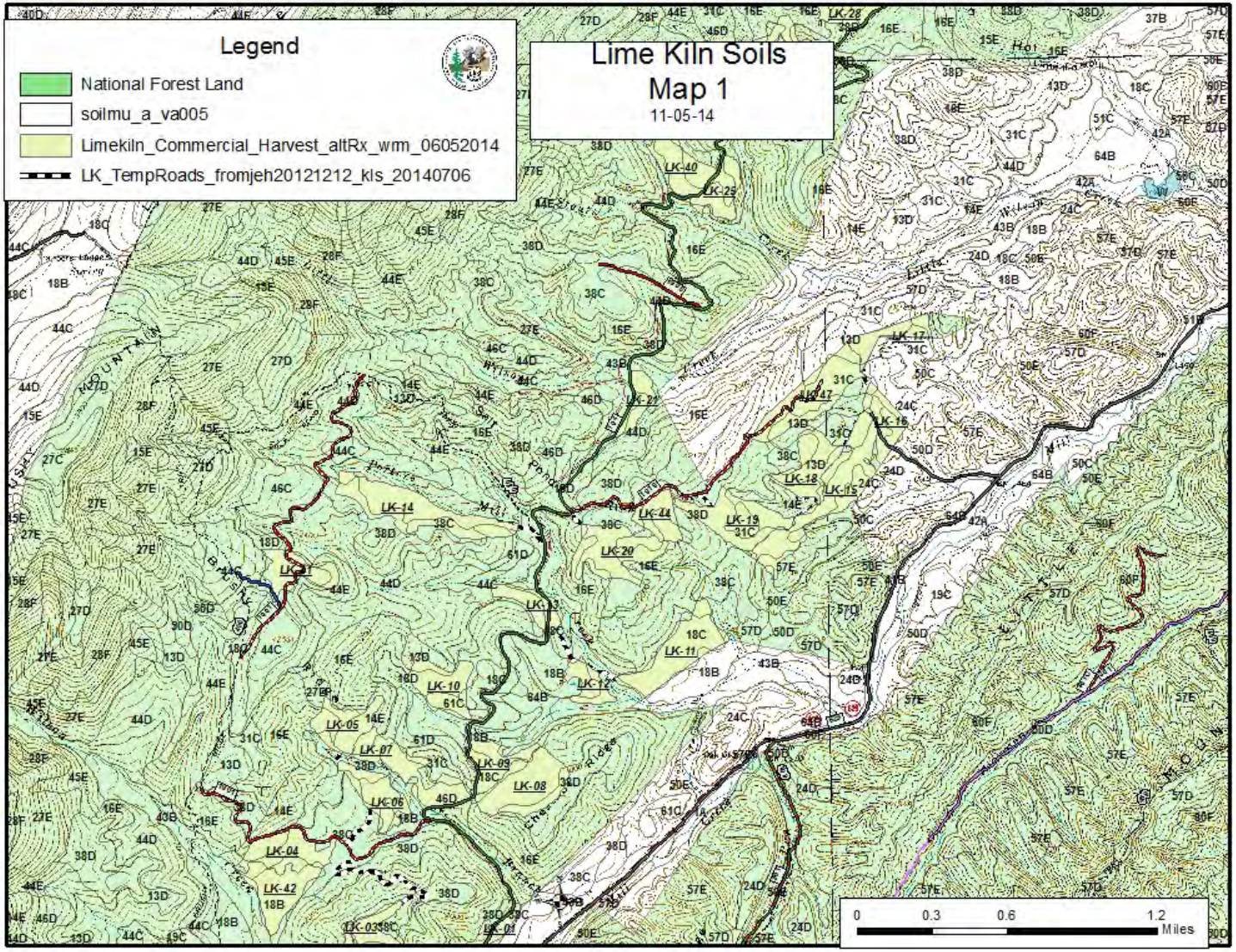


Figure 3A2-5. Soils Map of Limekiln Area. Map 2

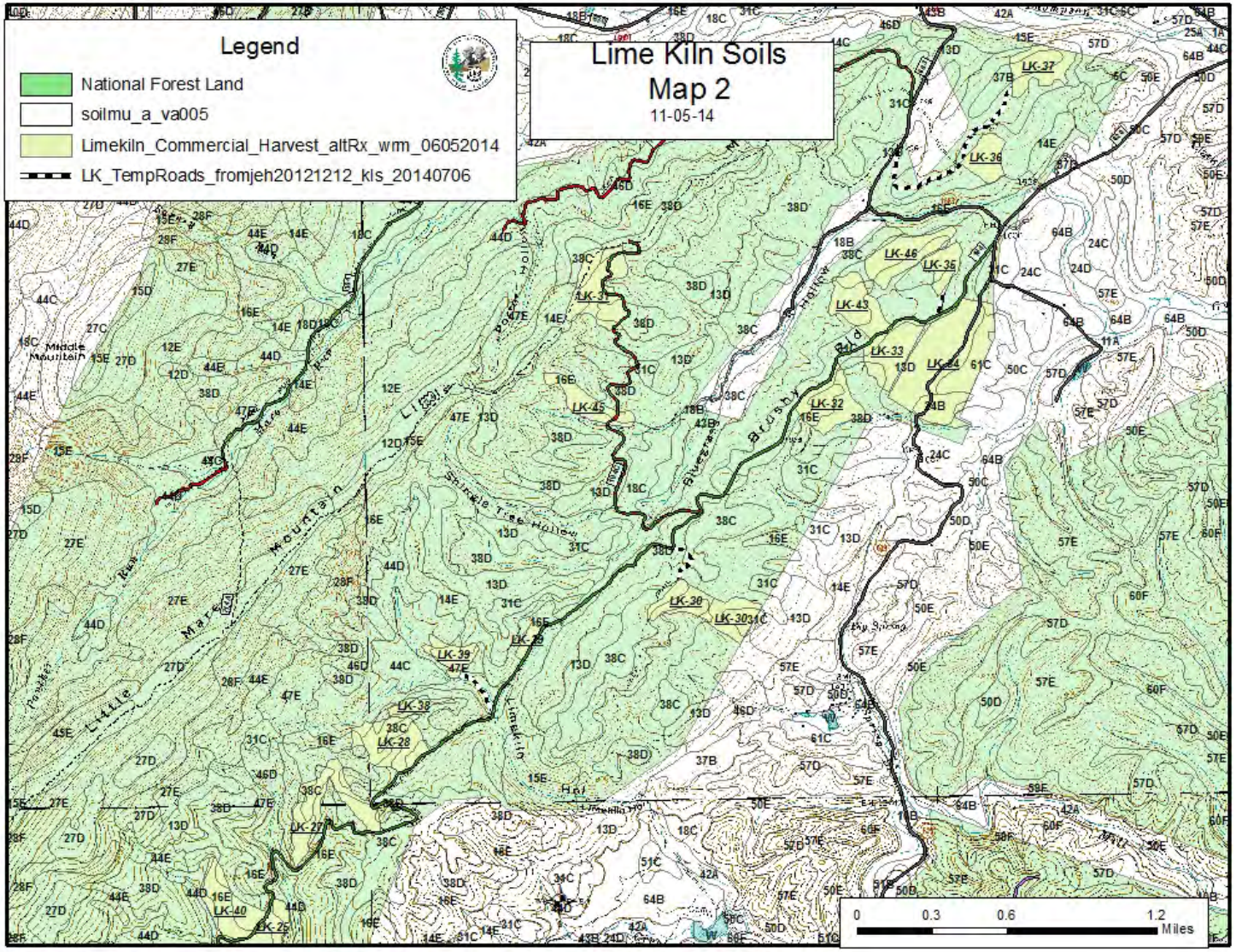


Figure 3A2-6. Soils Map of McGraw Hollow Area

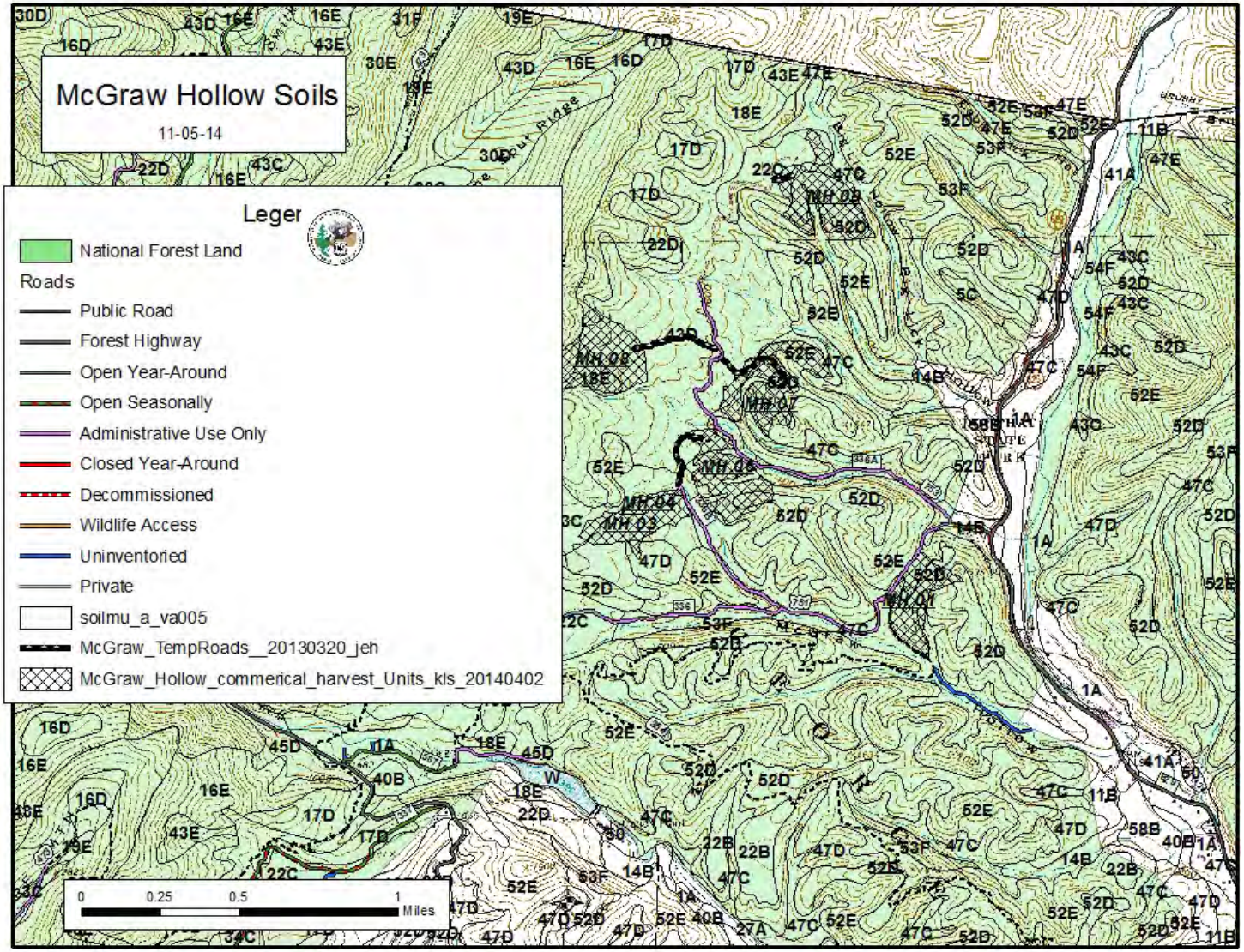


Figure 3A2-7. Soils Map of Pads Creek Area

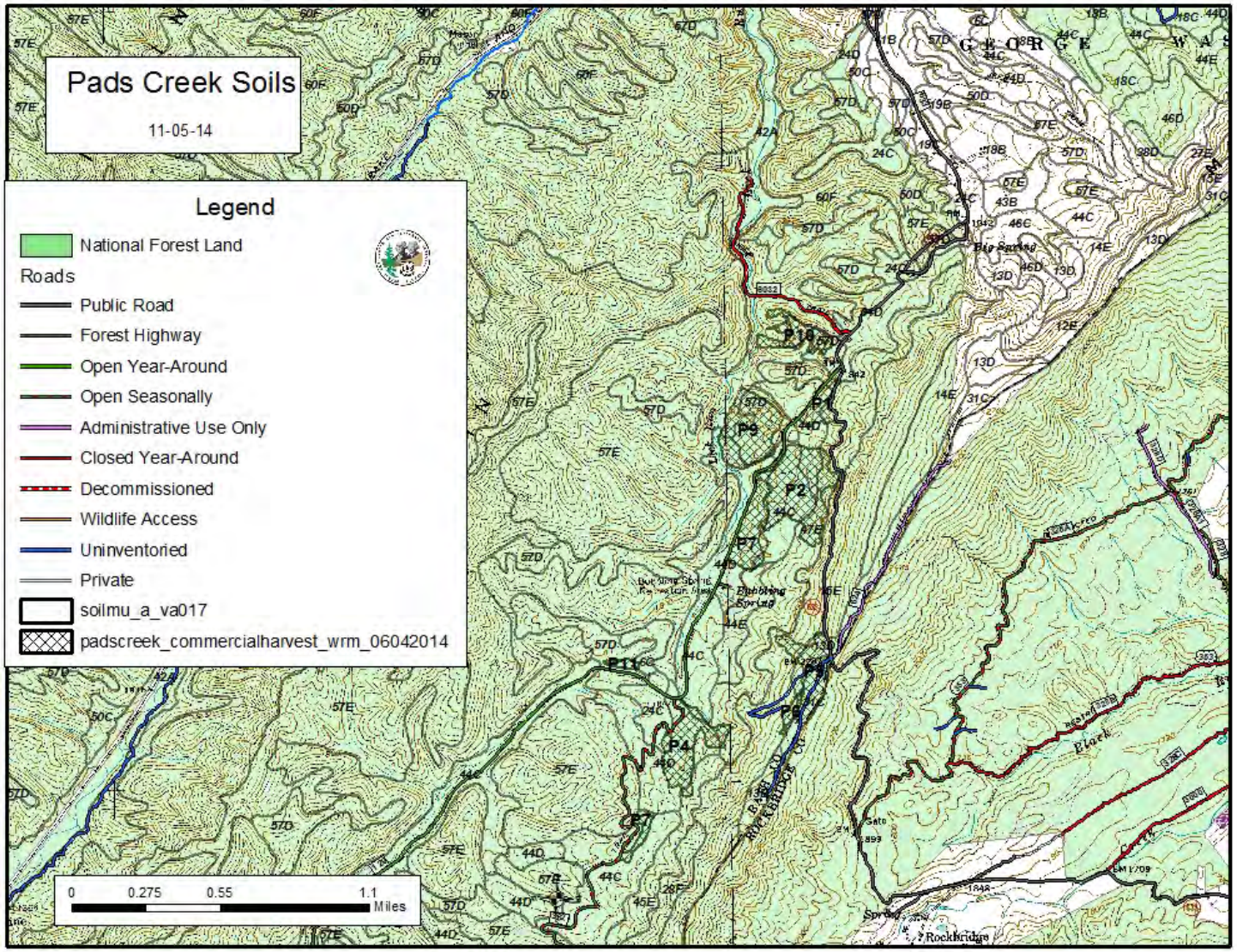


Figure 3A2-8. Soils Map of Sandy Springs Area. Map 1

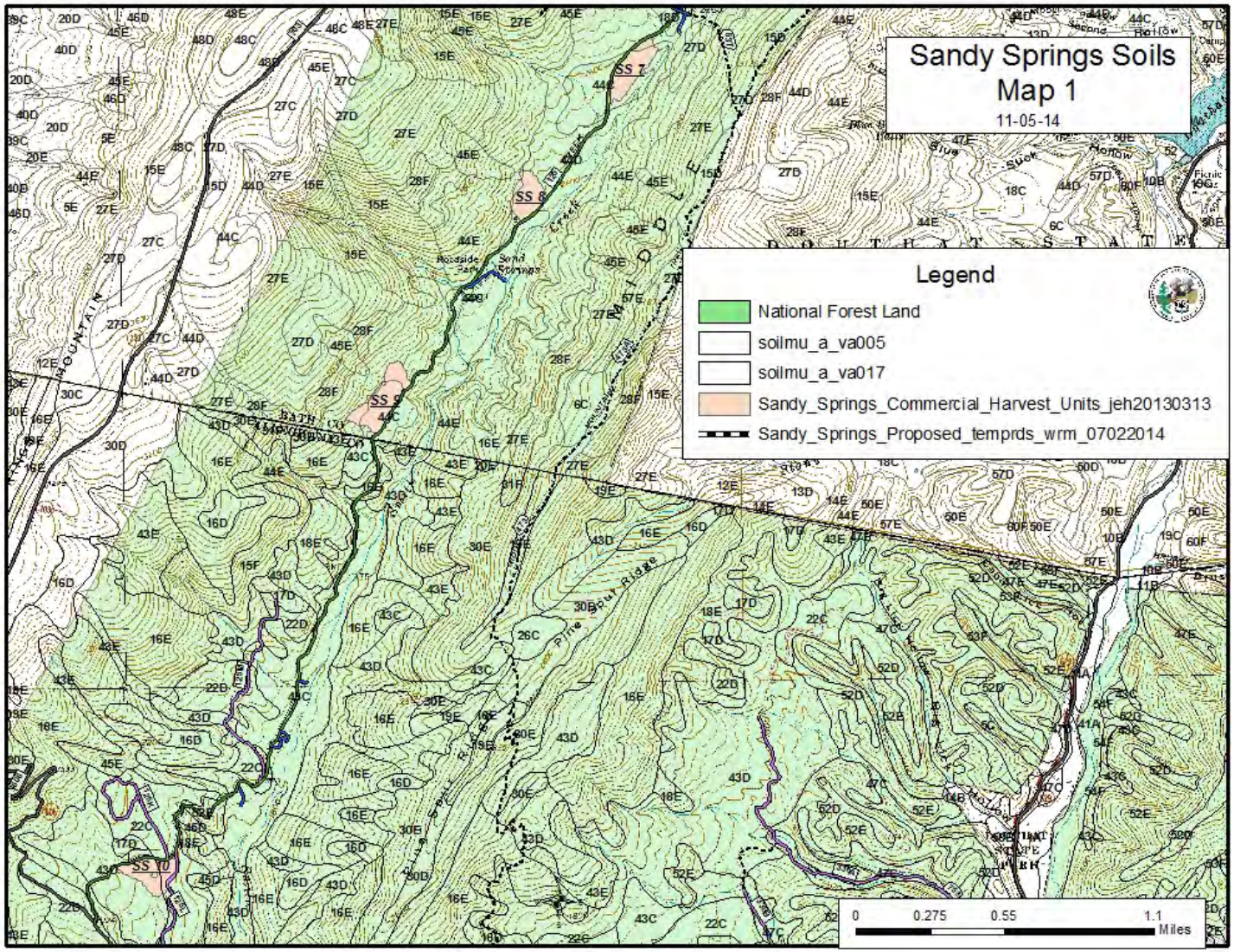
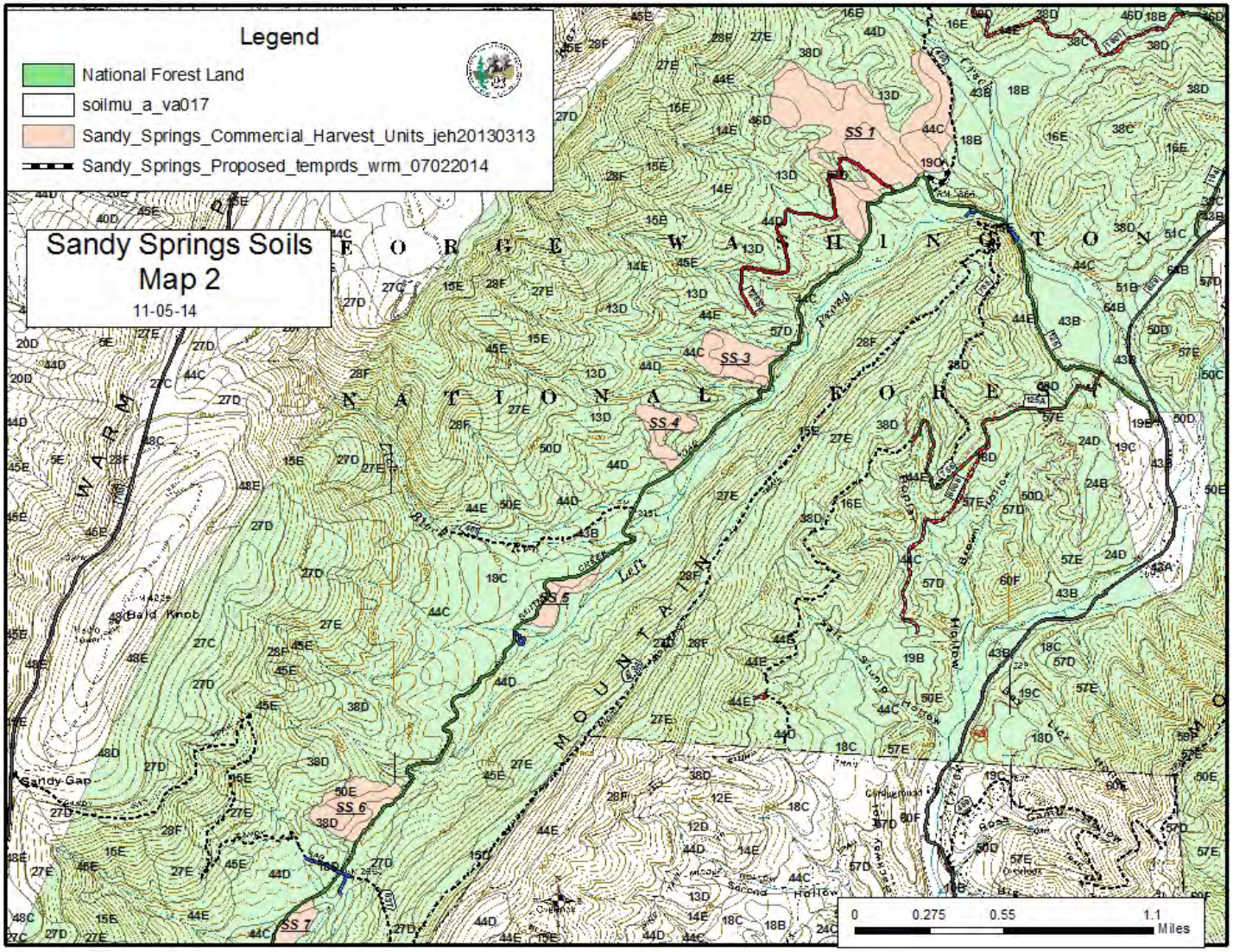


Figure 3A2-9. Soils Map of Sandy Springs Area. Map 2



Lower Cowpasture Restoration and Management Project Soil Map Legends

The soil map unit polygons on the above maps are numbered with map unit symbols. The soil map unit legends for these symbols are found in Appendix F. There is a map unit legend for each of the three counties associated with this proposed project. The soil map unit legends contain the name of the map units found on the maps above. The map unit names include the names of the soils found in the map unit and the slope range the map unit is mostly found upon and the texture of the soil. Soil maps and soil survey information for other areas of the project area can be found on the USDA Web Soil Survey. (http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) To obtain information about specific soils included in map units the Official Soil Series Description website can be used with a soil name. https://soilseries.sc.egov.usda.gov/osdname.asp

The Best Management Practices for Forestry (BMPs) in Virginia recommend ground based harvest systems to operate on slopes not exceeding 35%. The soil mapping used above was created at a scale of 1:24,000 and therefore may include areas of gentler slopes because they were too small to delineate at that mapping scale. Where there are small inclusions of steeper slopes in the harvest units, it will require winching logs to a skid road to mitigate the slope and avoid excessive skid road building. Winches will be required in the timber harvest contract. Also, the Forest Service has used slope as a critical factor in laying out the harvest units and has avoided most of the steeper slopes as recommended by Virginia's BMPs for Forestry and required by the Forest Plan.

Hydric Soils Presence

Hydric soils (a wetland primary indicator) have not been identified in an activity area for this project.

Prime Farmland Soils Presence

Prime farmland soils have been not been identified in an activity area for this project.

A2.4 Direct and Indirect Effects

Alternatives 2 and 3 have the potential to affect the soil resource as a result of the proposed actions of prescribed burning, timber harvesting and road building. The effects of these actions on soils in the activity areas can be described in terms of short and long-term effects on the productivity of the soils. Short-term effects are those lasting three years or less, and are associated with the recovery period in which non-displaced disturbed soils become reestablished with vegetative cover. Short-term effects imply that the existing soil profile remains mostly intact. Surface disturbances, such as compaction and removal of vegetation are the primary impacts. In contrast, long-term effects are associated with activities which displace the upper portions of the soil profile (topsoil). Many years are needed for the soil to recover its original productivity when the upper layers are removed. Topsoil formation is a slow process and typically occurs at a rate of one inch per 200-600 years, and depends on local climatic and ecological factors.

There is an additional indirect effect to areas which receive the displaced topsoil from excavated areas, such as fill slopes along roads. With this added mineral soil material and organic matter, productivity on these areas will be improved by increasing soil depth, soil moisture holding capacity, organic matter and nutrients. This is not to say that excavated sites, which have long-term direct effects to soil productivity, are offset by these areas where topsoil is deposited. It is mentioned here as an indirect effect of excavation activities associated with Alternatives 2 and 3. Topsoil deposition areas will not be used to offset any effects shown in the following analysis. It is an effect which is not easily estimated or displayed, but one that does occur.

Trail construction proposed in Alternatives 2 and 3 is not considered in the impacts to soil productivity since the trails will be part of the Forest trail system and will not be expected to grow biomass in the future. Potential sediment effects from this work are considered in the

water/hydrology section of this environmental assessment. The closing of 19 unauthorized roads put this area of approximately 6 acres (@ 0.25 mi. length and 10 ft. width per road) back into the land base for producing biomass at a reduced level of soil productivity. The effects of creating these old roads will be considered in the cumulative effects, since these roads were built prior to the current proposed activities.

Tables below display the estimated potential effects to soil productivity from the activities proposed in Alternatives 2 and 3 of this environmental analysis. Assumptions used to estimate the effects are also shown.

Some soil compaction would occur on areas of concentrated use, such as the log landings, temporary roads and primary skid trails and skid roads as a result of heavy equipment use with Alternatives 2 and 3. This compaction would increase the bulk density of the soils and result in a decrease in soil pore space, soil air and in the water holding capacity of the soils and would increase water runoff. These effects are considered detrimental to plant growth. The degree and depth of compaction depends on the number of passes the equipment makes and the moisture content of the soil at the time the passes are made. Changes in pore space do not normally occur on well drained soils, such as those that occur over most of the project area, until three or more passes have occurred. Heavily compacted areas are ripped and seeded to help minimize the effects of compaction and to promote revegetation and logging activity general ceases over winter months when soil moisture is high.

Soil movement (erosion) can occur on long unimpeded slopes with grade, where mineral soil material is exposed to raindrop impact and overland water flow. Soil movement can affect soil productivity when soil is transported by water offsite. Soils on upper slopes can lose productive topsoil as it moves down slope with water. Soil erosion may occur where bare soil is exposed on a slope as a result of equipment tracking difficulties (spinning wheels), bladed roads and landings, or where logs are dragged across the soil repeatedly. The placement of the landings on gentle slopes helps to prevent long unimpeded erosion surfaces. The presence of a natural organic surface layer covering the soil and logging debris, which is commonly found on harvested areas, would also prevent long unimpeded erosion surfaces. However, areas of soil impacted by log landings, skid trails and skid roads will increase the potential for soil movement.

Erosion control practices for minimizing soil movement pertain primarily to log landings, primary skid trails and skid roads. The use of logging slash, water bars and establishment of vegetation to check the flow of water down the travel way also interrupts the long unimpeded slopes referred to above. The potential for soil movement is expected to be temporary and limited to a recovery period time of approximately 1 to 3 years. Prompt seeding of the disturbed areas will help to minimize soil movement after sale closure.

Soil moisture content in the harvested areas is expected to increase initially during the post-harvest period with Alternatives 2 and 3. Soil moisture would return to pre-harvest levels as the vegetative canopy recloses and evapotranspiration increases. The initial higher soil moisture, created by removing vegetation, would benefit all vegetation growing on the sites by contributing more available moisture to plants during the growing season. It will also increase germination of seeds present onsite. Surface soil temperatures during the growing season would also increase until canopy closure. Short-term increases of 25 to 40 degrees F would be expected in the upper two inches of the organic layer with complete canopy removal. Conversely, surface soil temperatures would be lower than normal during the winter months as a result of canopy removal. No soil temperature changes would be expected below a depth of six inches. The degree of change in soil moisture and temperature would be a function of the extent of vegetative removal. Shading by leave trees would

reduce temperature extremes. Surface soil temperatures are not expected to reach levels lethal to plant growth with any of the proposed alternatives. Soil moisture and temperature effects would be temporary impacts, as canopy closure is expected to occur within ten years after harvest.

An initial surge of available plant nutrients would occur as the vegetative canopy is opened. The increase in soil moisture, surface soil temperatures and organic debris would produce ideal conditions for accelerated organic matter decomposition. This would result in the increased availability of nutrients in the upper part of the soil profile. The existing root systems, along with new plant germinations, would take advantage of the increased availability of nutrients. A surge of plant growth would occur. Likewise, many soil-borne organisms such as detritovores and predatory organisms further up the food chain would take advantage of the increased nutrient availability, soil temperature, and soil moisture availability. Burrowing animals, however, could be adversely impacted by the expected compaction. Possible losses of nutrients to groundwater through leaching and volatilization are expected to be offset by future leaf fall, atmospheric additions of nutrients, weathering of parent rock and organic material. Nutrient cycling would continue in the project area, with some expected loss from tree stem removal or nutrient leaching. Due to the rapid regrowth of the vegetation on the treated areas and long rotation intervals, these losses would be recovered and short-term.

Soil Effects from Biomass Removal

Woody biomass removal (logging slash, branches, tops, and small diameter trees typically considered non-commercial) is proposed in commercial timber stand improvement areas in Alternative 2 and 3 and in thinning and hardwood restoration areas and some regeneration harvest areas in Alternative 3. Recent interest in diversifying energy sources by expanding production of alternative fuels and renewable energy has led to increased attention on wood-based bioenergy as one component of a sustainable energy portfolio. Woody biomass utilization of smaller diameter trees not considered merchantable in traditional markets can be used to facilitate forest restoration, increase growth of higher valued trees and forest products, reduce wildfire risk and support removal of invasive species.

Biomass removal removes greater quantities of nutrients from the site than conventional harvesting systems by virtue of the larger amounts of biomass (foliage, branches and bolewood) being harvested and the higher concentration of nutrients in the foliage and branches relative to bolewood. The magnitude of this increase in nutrient removal is dependent upon a combination of factors, such as species being harvested, stand age and history, the inherent fertility of the site, the degree of harvest utilization, and the season of harvest.

Scientific evidence from sites across North America suggests that the productivity of most sites is largely resilient to removing residual harvesting biomass. In general, adopting Best Management Practices for forest harvesting and retaining appropriate amounts of down woody material, organic matter, live wildlife trees, and snags will adequately address the maintenance of ecosystem services. Rapid natural revegetation and long rotations reduce effects of nutrient removal and leaching from most sites. Protection of high risk soils is important in minimizing effects. High risk soils have been impacted by acidic deposition and have low buffering capacity against the effects of acidic deposition and nutrient removal. Biomass removal will be limited to soils identified as not having high risk for acidification and/or nutrient depletion. High risk soils are identified by using atmospheric deposition data, elevation, geology, site index of dominant trees and soil properties. It is also important to preserve existing downed woody material, stumps, existing snags, forest litter layer, shrubs and below ground biomass.

The methods of biomass removal to be used for Lower Cowpasture Project are in line with States which have existing guidelines and Best Management Practices for biomass harvesting and will be using guidelines developed by the Forest Guild Southeast Biomass Working Group, 2012. These are reflected in Forest Plan Standards FW-11 and FW-13.

- To protect long-term soil productivity and ecological sustainability:
    - No woody biomass utilization is allowed in forested stands less than or equal to site index 40 or in stands with high risk soils.
    - In forested stands greater than site index 40, leave at least 30% of logging slash created by regeneration harvests.
    - No below ground biomass, existing downed woody material or stumps will be removed for woody biomass utilization.
    - Generally logging slash should be distributed across the harvest area.
    - There are no woody biomass utilization limits for thinning operations that leave a fully stocked residual stand, except as identified as above.

The tables below display where biomass removal is proposed in Alternatives 2 and 3, what soils are present and the site index of the dominant trees onsite. Site index is an indicator of site productivity. Soil map unit symbols are shown for the treatment units and the county the soil map symbols are relevant to. Soil map unit legends for the counties are found in Appendix F. Table 3A2-3 shows biomass removal proposed for Alternative 2, which is all in commercial timber stand improvement units. Table 3A2-4 displays biomass removal for Alternative 3, which includes all areas in Alternative 2 plus hardwood restoration, free thinning, thinning from below and up to 25% of commercial regeneration harvests (shelterwood with reserves and shelterwood). Selection of the regeneration biomass removal units will use the guidelines discussed above to protect long-term soil productivity.

Table 3A2-3. Biomass Removal Alternative 2.

Total 541 acres all Timber Stand Improvement Treatment.

Treatment Unit	Soil Map Unit Symbol	County	Site Index for the Unit
CD-05	47D, 52D	Alleghany	60
CD-06	52D, 52E, 22B	Alleghany	60
CR-04	52E, 22C	Alleghany	60
LK-06	38D, 46D, 18B	Bath	82
LK-07	38D, 46D, 31C	Bath	87
LK-12	18B, 43B	Bath	75
LK-16	50D, 24C, 24D	Bath	70
LK-15	31C, 24C, 24D, 50C, 13D, 38D	Bath	70
LK-14	38C, 38D, 44D	Bath	77
LK-09	18B, 18C	Bath	75
LK-38	38D, 16E	Bath	100
LK-39	46D, 47E, 16E	Bath	100
LK-42	18B, 38C	Bath	70
LK-44	16E, 38C, 38D	Bath	70
LK-47	13D, 38D, 31C	Bath	60
MH 04	43C, 22C	Alleghany	85
SS-09	44C, 44E	Alleghany	80
SS-08	44D	Allegheny	91
SS-01	44C, 19C, 44D, 38D, 46D	Alleghany	97

CD=Cliftondale, CR=Craft Road, LK=Limekiln, MH=McGraw Hollow, SS=Sandy Springs

Table 3A2-4. Biomass Removal Alternative 3. Total 1,217 acres. Includes Alternative 2 acres in addition to hardwood restoration, free thinning and thinning from below treatments. Alternative 3 total acres also include up to 25% of the regeneration treatment areas. The table below displays hardwood restoration, free thinning and thinning from below areas.

Treatment Unit	Soil Map Unit Symbol	County	Site Index for the Unit
BM-05	57D	Bath	70
BM-12	50D, 57E	Bath	70
CD-08	52D, 52E	Alleghany	70
MH-03	22C, 43C, 47D	Alleghany	85
MH-07	52E, 43D	Alleghany	70
MH-09	52D, 22C, 47C	Alleghany	80
PC-02	44C, 47E	Bath	80
PC-04	44D	Bath	60
PC-05	31C, 13D, 15E	Bath	60
PC-06	15E, 31C	Bath	60
PC-07	44D	Bath	90
PC-09	57D, 44D, 57E	Bath	70
PC-08	44C	Bath	60
PC-01	47E, 44D	Bath	80
PC-11	57D	Bath	70
PC-10	57D, 57E	Bath	60
LK-34	13D, 24B, 61C	Bath	70
LK-40	38D, 16E, 44D	Bath	60
LK-43	31C, 38D	Bath	70
LK-45	38D, 16E	Bath	60
LK-46	31C, 13D	Bath	70

BM=Beards Mountain, CD=Cliftondale, CR=Craft Road, LK=Limekiln, MH=McGraw Hollow, SS=Sandy Springs

Earlier in this Soil Effects section a portion is entitled Soil Base Saturation – Estimation of effect from timber harvest on sensitive soils. It identifies catchment areas having soils sensitive to removal of vegetation due to past impacts from acidic deposition. These proposed treatment units are identified in the table below. Some treatment units have only portions of the unit identified as sensitive and others have sensitive soils across most of the unit. The treatment units are identified and proposed biomass treatment is displayed in the table.

Table 3A2-5. High Risk Soil Areas Due to Past Acidic Deposition.

Catchment Area Number	*Treatment Unit**	*Compartment /Stand*	*Proposed Treatment**	*High Risk Soil Area*	*Biomass Treatment*
52272	SS-07	1006/17	SWR	All	None
51888	SS-05	983/1	SWR	West ¼	None
50720	SS-01 LK-42 LK-04	953/36 982/3 982/5	CTSI CTSI SW	East ¼ All All	BMR West ¾ BMR 70% None
49785	LK-21	955/26	SW	Upper ½	None
49467	LK-40 LK-25	956/14 956/13	HWR SWR	Bottom ⅓ SW ⅓	BMR upper ⅔ None

*SWR= Shelterwood with Reserves, CTSI= Commercial Timber Stand Improvement, SW= Shelterwood
HWR= Hardwood Restoration, SS=Sandy Springs, LK=Limekiln, BMR=Biomass Removal

Table 3A2-6. Estimate of the Proportion of Weight Above and Below 4" Diameter by 2" Diameter Classes

DBH	Proportion of Stem Weight below 4" Diameter		Proportion of Stem Weight above 4" Diameter		70% Removed	
	Soft Hardwoods	*Hard Hardwoods*	*Soft Hardwoods*	*Hard Hardwoods*	*Soft Hardwoods*	*Hard Hardwoods*
2	0.00%	0.00%	100.00%	100.00%	70.00%	70.00%
4	19.12%	18.46%	80.88%	81.54%	56.62%	57.08%
6	77.19%	77.73%	22.81%	22.27%	15.97%	15.59%
8	93.29%	93.68%	6.71%	6.32%	4.70%	4.43%
10	97.53%	97.73%	2.47%	2.27%	1.73%	1.59%
12	98.92%	99.03%	1.08%	0.97%	0.76%	0.68%
14	99.46%	99.53%	0.54%	0.47%	0.37%	0.33%
16	99.71%	99.75%	0.29%	0.25%	0.20%	0.18%
18	99.83%	99.85%	0.17%	0.15%	0.12%	0.10%
20	99.90%	99.91%	0.10%	0.09%	0.07%	0.06%
22	99.93%	99.94%	0.07%	0.06%	0.05%	0.04%
24	99.95%	99.96%	0.05%	0.04%	0.03%	0.03%
26	99.97%	99.97%	0.03%	0.03%	0.02%	0.02%
28	99.98%	99.98%	0.02%	0.02%	0.02%	0.01%
30	99.98%	99.99%	0.02%	0.01%	0.01%	0.01%

Pulpwood Size Trees - Avg Percentage of the whole removed as "biomass" 7.33%
Sawtimber Sized Trees - Avg Percentage of the whole removed as "biomass" 0.16%

Woody biomass utilization would result in the additional removal of approximately 7.33% to 0.16% of the total stem weight of trees in the harvest areas. The higher number represents an estimate of additional small diameter utilization in pulpwood sized trees, which contain a proportionally higher weight in the stem portion smaller than 4" in diameter. The smaller number represents an estimate for sawtimber sized trees, where a vast majority of the weight of the trees is found in traditionally merchantable material. These estimates assume 30% of the small diameter material would remain on site. (Weight, Volume, and Physical Properties of Major Hardwood Species in the Upland-South. Alexander Clark III, Phillips, Douglas R., Frederick, Douglas J. 1986, Southern Forest Experiment Station, Research Paper SE-257 Table 23.)

After reviewing current literature, by using Forest Plan standards and by protecting sensitive soils, biomass removal, where proposed in either Alternative 2 or 3, is not expected to have long-term effects on soil productivity.

Soil Effects from Fire

Fire is a natural part of the ecosystems found in the project area. Effects to soils from the proposed burning are not expected to be a concern due to the following information. Effects from fire line construction are considered in the tables below in short and long-term effects.

Many physical, chemical, mineralogical, and biological soil properties can be affected by forest fires. The effects are chiefly a result of burn severity, which consists of peak temperatures and duration of the fire. Climate, vegetation, and topography of the burnt area control the resilience of the soil system. Low to moderate severity fires, such as most of those prescribed in forest management, promote renovation of the dominant vegetation through elimination of undesired species and a transient increase of pH and available nutrients. No irreversible ecosystem change occurs, but the enhancement of hydrophobicity can render the soil less able to soak up water and more prone to

erosion. However, despite common perceptions, if plants succeed in promptly recolonizing the burnt area, the pre-fire level of most properties can be recovered and even enhanced. The extent and duration of these effects depend first upon fire severity, which, in turn, is controlled by several environmental factors that affect the combustion process, such as amount, nature, and moisture of live and dead fuel, air temperature and humidity, wind speed, and topography of the site (Certini, Giacomo, Mar., 2005). Soil changes are most pronounced during the first year after burns, but these properties usually revert to their preburn level within a few years (Alban, David H., 1977).

Physical

Although the aerial parts of subordinate forest vegetation can be temporarily eliminated by fire, the underground stems and roots are not usually damaged (Scott, D.F. and D.B. Van Wyk, 1990). In general, most fires do not cause enough soil heating to produce direct changes in soil structure (Hungerford et al. 1990).

Soil Chemistry

Cations are generally increased in the soil following their oxidation from burning the surface organic matter. Potassium (K), calcium (Ca), magnesium (Mg), and phosphorus (P) were either increased or unchanged by under burns in ponderosa pine (Hungerford, et. al., 1990). Low—intensity prescribed fires may improve soil fertility. Long—term prescribed burning studies in the southern Coastal Plain showed that available phosphorus, exchangeable calcium, and organic matter of mineral soil on periodically burned plots were higher than those on unburned plots. However, nitrogen was lost from the forest floor due to volatilization. Calcium and phosphorus were also lost from the forest floor but were partially leached into the mineral soil, thus remaining in the ecosystem (Van Lear, D.H.; Waldrop, T.A. 1989). Most studies suggest a consistent pattern that fire can increase the availability of soil ammonium (NH4+) and nitrate (NO3-). The increases in soil NH4+ and NO3- have been attributed to the burning of organic material, increased N mineralization, and the leaching of N from the forest floor into the soil after fire (Wiuixs P. and D. Pakkinson, 1974).

Nitrogen inputs from precipitation approximating 5 lb/ac/yr have been measured in the southern Appalachians and in the upper Piedmont. Over the course of a rotation, it would appear that these inputs could balance nitrogen losses from burning. Nitrogen is continually being added to southern ecosystems (Van Lear, D.H.; Waldrop, T.A. 1989), (Hubbard et al. 2004), (Elliott, Katherine J. *and* James M. Vose, 2005). The post-fire flush of inorganic nitrogen is not solely due to the physical breakdown of plant and animal tissues by fire. It is also a function of the enhanced activity of microbes in the warmer and more alkaline soil of a recently burned forest. The soil ammonium pool can increase twofold immediately after fire, gradually declining to the pre-fire level within one year. In sum, a short-lived pulse of plant-available nitrogen can be expected after forest fires. This pulse will encourage the development of nitrogen-rich plant growth for at least a year post-fire (Elliott, Katherine J. *and* James M. Vose, 2005).

Losses of P through volatilization or leaching are small. Burning converts the organic pool of soil P to orthophosphate, the sole form of P available to biota (Certini, Giacomo, Mar., 2005). Burning has its most pronounced effect on the forest floor in which carbon (C), nitrogen (N), and sulfur (S) are volatilized, and calcium (Ca), magnesium (Mg), potassium (K), phosphorus (P), and other elements are left as ash. This ash is leached by rains into the mineral soil which increases its base saturation and pH. These changes also may have important effects on the microbial population of the soil. Such soil changes are most pronounced during the first year after burns, but these properties usually revert to their preburn levels within a few years. The ash is leached by rains into the mineral soil which increases its base saturation and pH (Alban, David H., 1977).

Erosion

Fires which burn completely to mineral soil may accelerate soil erosion in steep terrain. Such losses have not been documented in the South. Low-intensity burns have little, if any, adverse effect on soil

erosion, even on relatively steep slopes. Only minor soil losses have been seen following single prescribed burns in the Piedmont. Two low—intensity burns prior to harvest had no effect on nutrient or sediment concentrations in ephemeral streams in the Piedmont of South Carolina. Others failed to detect significant soil movement in established gullies following moderately intense backing fires in mature loblolly pine stands in the South Carolina Piedmont (Van Lear, D.H.; Waldrop, T.A. 1989). In the US Southern Coastal Plain erosion and leaching losses due to prescribed fire are usually negligible (Cartera, Mason C., C. Darwin Foster, November 2003).

Although the aerial parts of subordinate forest vegetation are temporarily eliminated by fire, the underground stems and roots are not usually damaged (Scott, D.F. and D.B. Van Wyk, 1990). Prescribed understory burns normally remove only part of the forest floor (Van Lear, D.H.; Waldrop, T.A. 1989). In the southern Appalachian Mountains of North Carolina, the residual forest floor was resistant to erosion over the range of burn intensities in their fire treatments, and sediment was prevented from leaving the site by unburned brush and undisturbed forest floor at the lower margins of the treatment areas (Elliott, Katherine J. *and* James M. Vose, 2005). No significant differences in root mat weight after burning were detected. The root mat provides a matrix of living and dead organic material that physically binds the mineral soil against the erosive action of precipitation (Van Lear, D. H. and S. J. Danielovich, 1988). Soil loss following treatment was within the normal range of soil loss for an uncut forest in the south (Field et al. 2003).

Organic Matter and Carbon

A principal effect of burning is the redistribution of the organic matter in the soil profile and not in any reduction. The results of several prescribed burning studies throughout the southeast concluded that burning generally resulted in a decrease in the forest floor but an increase in soil C in the top 5 to 10 cm within the first 10 years (Johnson, Dale W., 1992). Some found no significant differences in soil organic matter 25 years after broadcast burning (Johnson, Dale W., 1992). The quantity of organic matter decreases immediately after a fire, but in the long run generally exceeds the pre-fire level (Certini, Giacomo, Mar., 2005).

Soil Biota

The immediate effect of fire is to reduce the numbers of bacteria in the soil, this effect being due to the direct effect of heat. This returns to normal after 12 to 14 months. After rain the post-fire numbers of bacteria rise above the numbers in control (unburned) plots, due to the effects of nutrient release (Wiuixs P. and D. Parkinson, 1974). The lack of difference in litter decomposition between burned and unburned areas implies a rapid recovery of soil organisms following fire. Numbers of both bacteria and fungi are known to increase rapidly during the first growing season following an early-season fire in a jack pine forest in northeastern Minnesota (Grigal, D. F. and J. G. McColl, 1977).

Water

Most studies have shown that burning without cutting does not affect stream water quality in southeastern, U.S. ecosystems (Knoepp et al. 2003). Nutrient concentrations of lake waters and input streams were unaffected by the fire, due to immobilization of nutrients in the soil and to uptake by prolific post-fire revegetation and microbial (McColl, J. G. and D. F. Grigal, 1977).

With respect to cited recent research and relevant science, we do not have reason to anticipate negative effects to long-term soil productivity from the prescribed burning proposed in Alternatives 2 and 3. Parameters established within the burn plan for each of the burning actions will help avoid severe burn intensities, minimize fireline containment work in riparian ecosystems and utilize natural and existing fuel breaks to prevent escape and minimize the need for new fireline construction.

Direct and Indirect Effects-Alternative 1
There would be no effects to soil resources from this alternative.

Direct and Indirect Effects-Alternative 2

Table 3A2-7. Estimated Acreage of Potential Short and Long-Term Effects to Soil Productivity-Alternative 2

ACTIVITY	SHORT-TERM	LONG-TERM	TOTAL
Bladed Skid Roads (5.21 mi.)		7.6 acres	7.6 acres
Primary Skid Trails (30.11 mi.)	36.5 acres		36.5 acres
Log Landings (94)	11.8 acres	11.8 acres	23.6 acres
Fire line construction dozer (7.43 mi.)	5.4 acres	9 acres	14.4 acres
Temporary road construction (11 miles)	20 acres	26.7 acres	46.7 acres
Wildlife clearings (320 acres)	320 acres		320 acres
Totals	**393.7 acres**	**55.1 acres**	**448.8 acres**

Direct and Indirect Effects-Alternative 3

Table 3A2-8. Estimated Acreage of Potential Short and Long -Term Effects to Soil Productivity-Alternative 3

ACTIVITY	SHORT-TERM	LONG-TERM	TOTAL
Bladed Skid Roads (4.68 mi.)		6.8 acres	6.8 acres
Primary Skid Trails (29 mi.)	35.2 acres		35.2 acres
Log Landings (87)	11 acres	11 acres	22 acres
Fire line construction dozer (5.78 mi.)	4.2 acres	7 acres	11.2 acres
Fire line construction hand (0.64 mi.)	0.4 acre		0.4 acre
Temporary road construction (10.1 ~~9.86~~ miles)	18.3 acres	24.5 acres	42.8 acres
Wildlife clearings	297 acres		297 acres
Totals	**366.1 acres**	**49.3 acres**	**415.4 acres**

Assumptions used for above tables:

1. Bladed skid roads have 12 feet of bladed travel way (long-term impact).
2. Primary skid trails are unbladed, 10 feet wide, and a short-term impact.
3. Log landings have a 50% reduction in soil productivity due to blading and compaction and are 0.25 acre each.
4. Hand tool construction of fire line is a short-term impact to soil productivity due to the shallow depth of disturbance hand line is 5 feet wide.
5. Dozer line construction is a long-term impact due to soil displacement. Dozer line is 10 feet wide bladed area plus 3 feet of spoil on either side.

6. Temporary road has 35 feet of cleared right-of-way with 20 feet of travel way, including a cut slope. Temporary road has long-term effect on 20 feet of the cleared right of way.
7. Trail construction (Alternative 2 – 17 miles, Alternative 3 – 14.6 miles) is not considered in effects on soil productivity since the land use has changed from growing biomass to providing hiking opportunity. Not all miles of trail construction are new construction, most sections are using existing old roads.
8. Wildlife clearings are short-term impacts. The soil will be prepared for lime, fertilizer and seeded and will be exposed until cover returns. Soil is not expected to be displaced and the original soil profile will remain.
9. Chemical treatment of non-native invasive species, rehab of Simpson Creek slope failure, replacement of culverts, road maintenance, FSR 194 road reconstruction, American chestnut planting and Wilson Creek dam stabilization are not expected to impact soil productivity.

Summary

As shown in the above tables, Alternatives 2 and 3 are expected to have impacts to soil productivity. To put the magnitude of these impacts into perspective, the estimated acres impacted by Alternatives 2 and 3 above are compared to the acres in the activity area for each Alternative in the table below. This estimates the percentage of the activity area potentially impacted by the proposed activities.

Table 3A2-9. Estimated Percentage of the Activity Area Soils Affected by the Alternative.

Alternative	Extent of Activity Area	Estimated Effects		Percent of Activity Area Affected Long-Term
		Short-Term	Long-Term	
2	13,993 acres	393.7 acres	55.1 acres	0.4%
3	13,463 acres	366.1 acres	49.3 acres	0.4%

Table 3A2-9 shows that Alternatives 2 and 3 will affect a small part of the activity area with long-term effects. Effects to the soils from this project are considered not significant when 85 percent of the activity area retains its pre-activity long-term soil productivity (Forest Service Handbook, R8, 2509.18.2.2, Soil Quality Standards).

A2.5 Cumulative Effects

The Forest Service is charged with maintaining soil productivity on its land (Forest Service Manual 2502, Forest and Rangeland Renewable Resources Planning Act 1974, National Forest Management Act 1976). Cumulative effects to soils will consider past and future planned activities and their effects on soil productivity within this project area. Old temporary roads and bladed areas are considered not yet recovered from soil displacement. Soil displacement takes a long time to recover. Too much soil displacement in an area is not considered to be protecting the productivity of the land. Too much is when at least 85 percent of the project area **does not** retain its soil productivity (Forest Service Handbook, R8, 2509.18.2.2, Soil Quality Standards).

Past Effects

Table 3A2-10. Historical Stand Treatment Summary within the Lower Cowpasture Restoration Project Area.

Timber Sale	Year	Compartment	Acres	Harvest Method*
Mares Run	In Progress	892, 893	165	SHW
Brattons Run Salvage	2005	1305	81	SAL
Shooting Range	2002	889	54	GS
Barranca	2000	983, 1005	48	SHW, TH
Little Mare	1998	892, 933	77	SHW
Diamond Mine	1998	926, 965	146	CC, SHW, TH
Gap	1996	1328	76	SHW, TH
McGraw Hollow	1996	1380	204	CC, SHW, TH
Lick Block Run	1996	953, 984	54	SHW
Nixon Road	1995	1305	30	GS
Blue Grass	1994	916	155	SHW, TH, GS
Big Hollow	1993	1319	102	SHW TH
Black Water	1993	1319	70	SHW
Boneyard	1993	1319	43	TH
Slim Branch West	1993	981, 982	97	CC, SHW, GS
Jordon Run	1992	895	26	CC
Marchant	1991	1374	64	SHW
Smith-Thompson	1991	891, 984	38	GS
California	1991	1306	96	CC, GS, TH
Blueberry Hill	1990	917, 958	114	CC
Hickman	1990	931, 932	97	CC, GS
Cigar Ridge	1989	932, 958	50	CC
		TOTAL	1,887	

* Harvest Method: CC = Clearcut, GS = Group Selection, SAL = Salvage, TH = Thinning, SHW = Shelterwood with Reserves

Past timber harvest of 1,887 acres is estimated to have resulted in 2.8% (52.8 acres) of long-term effects to soil productivity. Direct Effects table for Alternative 2 was used to estimate long-term effects from past harvest (See assumptions from Table 3A2-11.

6.22 miles of previously constructed dozer fire line has resulted in an estimated 7.5 acres of long-term effects to soil productivity from soil displacement.

Unauthorized roads have resulted in approximately 6 acres of long term effect to soil productivity from soil displacement.

10.75 miles of old roads and fire line used for new trail locations are estimated to have resulted in 13 acres of long-term impact to soils.

Future Effects

Prescribed burning under the Warm Springs Mountain Restoration Project at Middle Mt, Bald Knob, Blue Grass, North and South Smith Creek and Panther Run will result in approximately 1.8 mi of dozer fire control lines. This will affect soil productivity long-term on approximately 2.2 acres.

Cumulative Effects

Table 3A2-11. Estimated Cumulative Effects to Long-Term Soil Productivity by Alternative

Project Alternative	Past Actions (older timber harvests, roads, firelines)	Proposed Actions	Future Planned Actions	Total Acres-long-term impact	% of the Proposed Project Area (77,680 acres)
1	79.3 acres	0 acres	2.2 acres	81.5 acres	0.1%
2	79.3 acres	55.1 acres	2.2 acres	136.6 acres	0.2%
3	79.3 acres	49.3 acres	2.2 acres	130.8 acres	0.2%

Assumptions for estimating cumulative effects:

1. This project area is 77,680 acres.
2. 1,620 acres of commercial timber harvest in Alt 2 results 46.1 acres of long-term impacts to soil productivity from temporary roads, log landings and skid roads see Table 3A2-6 for Direct Effects Alternative 2. This results in 2.8% of harvest acres having long-term impact. This was then used to estimate long-term impacts from past timber sales in the project area cumulative effects.
3. Dozer fireline has 10 feet of width.
4. Unauthorized roads have an average length of 0.25 mile and 20 feet of width.
5. Old roads and fireline used for new trail locations are assumed to have 10 feet of width.

Table 3A2-11 shows that when proposed, past and future actions are considered, soil productivity will be reduced on a small percentage of this project area. Cumulative effects to soil productivity are well within the Forest Plan standard (Soil Quality Standards, Forest Service Handbook, R8, 2509.18.2.2, Soil Quality Standards). The standard is that 85% of an area will retain its potential long-term soil productivity. The estimated cumulative effects to soil productivity above show this standard will be met in this area of the Forest for the proposed project alternatives in this analysis.

A3 - Riparian Areas

Scope of the Analysis

Activities proposed in the Lower Cowpasture project are located in the watersheds of Guys Run, Hickman Draft, Lick Run, Mill Creek, Pads Creek, Simpson Creek, and Thompson Creek, which are tributaries of the Cowpasture River, Smith Creek, and Wilson Creek, tributaries of the Jackson River. These watersheds are in the following sixth-level Hydrologic Units (sub-watersheds):

	Sub-Watershed Name	Sub-Watershed Number
Guys Run, Thompson Creek	Thompson Creek-Cowpasture River	020802010703
Hickman Draft, Mill Creek	Mill Creek-Cowpasture River	020802010801
Lick Run	Lick Run-Stuart Run	020802010704
Pads Creek	Pads Creek	020802010802
Simpson Creek	Simpson Creek-Cowpasture River	020802010803
Wilson Creek	Wilson Creek	020802010506
Smith Creek	Smith Creek-Jackson River	020802010507

The analysis area is the riparian areas, wetlands, and floodplains within and adjacent to project activities. The time period will be the length of the project.

A3.1 Introduction

In the vicinity of project activities, riparian areas are generally narrow, and streams are small. In the vicinity of timber harvests, riparian areas vary from about 20 to 200 feet in width and average 53 feet. This includes the riparian area on both sides of the stream, plus the stream channel width.

In the analysis area, the geology is predominately sandstone and shale, and streams are often intermittent and ephemeral. Where limestone geology is found, streams are more likely to be perennial.

A3.4 Direct, Indirect, and Cumulative Effects

Direct, Indirect, and Cumulative Effects-Alternative 1
There would be no effects on riparian areas, wetlands, or floodplains.

Direct, Indirect, and Cumulative Effects-Alternatives 2 and 3
Timber harvesting will be avoided in floodplains, wetlands, and riparian areas. All alternatives are consistent with the riparian corridors (or conservation zones) and common standards within the Forest Plan and the Federally Listed Fish and Mussel Conservation Plan.

Riparian areas will not always be excluded from prescribed burns, but these should burn much cooler, if at all, in riparian areas, due to the higher moisture found there.

In view of the above protective measures, no activity would adversely affect riparian areas, floodplains, or wetlands.

A4 - Water Quality

Issues Related to the Resource

Project Issue 1: Concern about possible decreases in water quality resulting from project activities and the resulting effects on beneficial uses of streams and reservoirs.

Scope of the Analysis

The boundary of the analysis area will be the watersheds of Guys Run, Hickman Draft, Lick Run, Mill Creek, Pads Creek, Simpson Creek, Thompson Creek, Smith Creek, and Wilson Creek. The time frame for the analysis will be until the sediment level returns to near pre-project levels.

A4.1 Introduction

On National Forest System land, sedimentation is the primary factor in water quality degradation. Sedimentation may be introduced into stream channels from soil disturbing activities such as timber harvesting and road construction.

No standard for sediment has been set by the State. Instead, sediment is addressed through the nonpoint source pollution regulations for Virginia. These regulations require the voluntary application of Best Management Practices (BMPs) to control sedimentation during timber management activities. The Virginia Department of Forestry has developed a handbook of BMPs for

forestry (revised 2011) that lists the "voluntary" BMPs. The Forest Plan requires the use of the Virginia BMPs, and the Plan lists specific BMPs to provide additional resource protection. See the mitigation section of this EA for those Forest Plan standards and/or State BMPs that were used in alternative design to reduce sedimentation.

All Forest Plan standards meet or exceed the Virginia BMPs for forestry activities. The Forest has initiated a monitoring program to evaluate the effectiveness of the standards. The result of this program will be a feedback process to continually adjust standards as needed to improve implementation and effectiveness.

Aquatic macroinvertebrate monitoring is being used as an indicator of the effectiveness of BMPs and Forest standards in protecting water quality and the aquatic biological community. Nine ecological metrics of the aquatic macroinvertebrate community are derived from macroinvertebrate samples, and a Macroinvertebrate Aggregated Index for Streams (MAIS) (range of scores 0-18) is computed using the nine metrics. Smith and Voshell (2013) compared pre-activity macroinvertebrate metrics with post-activity metrics for streams located below timber harvests and prescribed burns at various locations across the Forest and concluded that “management practices are successful at reducing effects on aquatic organisms” from these activities. The results showed no decline in macroinvertebrates following timber harvests and prescribed burns.

Prescribed burns, as well as wildfires, will only result in soil loss and sedimentation if the fire burns down to mineral soil. In the East, fires almost always leave most of the organic layer of the soil intact, thus maintaining infiltration and protecting the soil from erosion. The greatest potential source of sediment from fires is dozer-constructed fire lines, but, with implementation of BMPs including prompt rehabilitation and revegetation, sedimentation can be kept very low.

The Virginia Department of Forestry conducted water quality monitoring in association with timber harvests from 1989 to 1996 (Va. Dept. of Forestry, 1998). At sites in the mountains, Piedmont, and coastal plain, water temperatures were taken at 10-minute intervals, and water samples were collected automatically before, during, and after storm events, both upstream and downstream from logging. Aquatic macroinvertebrates were also sampled periodically. This monitoring showed that, when forestry BMPs are properly implemented, timber harvests can be accomplished without a large or persistent increase in sediment, an increase in stream water temperatures, or a shift in macroinvertebrate species composition.

In addition to Virginia's nonpoint source regulations, Virginia’s antidegradation policy (9VAC25-260-30) applies to this area. That policy says that actions may not interfere with or become injurious to existing beneficial uses unless the State Water Control Board determines that such action is socially or economically justified. Monitoring BMPs effect on protecting existing uses (validation monitoring) is also occurring, primarily by Forest Service research. Here again, BMPs will be adjusted as research indicates to further protect beneficial uses.

A4.2 Analysis Methods

The methodologies used in these analyses are the most appropriate methods available. Soil erosion was calculated using (1) erosion rates derived from research (Kochenderfer and Helvey, 1987) and (2) the Universal Soil Loss Equation, as adapted to forest land (Dissmeyer and Foster, 1984). The Universal Soil Loss Equation includes site-specific factors related to soil type and land slope. The percent of soil erosion reaching streams as sediment was determined using site-specific factors of sideslope, soil texture, and distance to the nearest channel or drainway, in accordance with the

procedural guide "An Approach to Water Resources Evaluation of Non-Point Silvicultural Sources" (1980).

A4.3 Existing Condition

In the analysis area, there are about 68 miles of cold water habitat, including all or portions of Mares Run, Mill Creek, Wilson Creek, Left Prong Wilson Creek, Little Wilson Creek, Lick Run, Smith Creek, and Simpson Creek. Portions of Pads Creek, South Fork Pads Creek, Wilson Creek, and Smith Creek are stocked or stockable waters. The downstream portions of Smith Creek, Wilson Creek, Pads Creek, and Lick Run provide cool water habitats. Wilson Creek flows through Douthat State Park, and Blue Suck Branch flows through Longdale Furnace Recreation Area. North Fork Simpson Creek, Blue Suck Branch, and Downy Branch have received exceptional waters (Tier 3) designations. Smith Creek is a public water supply watershed for the City of Clifton Forge.

Some sediment is expected from the Mare Run Timber Sale (2013-2015) in the Thompson Creek watershed and from the Tri-County Timber Sale (2014-2015) in the Simpson Creek watershed. Sediment from these sources is shown in Table 3A4-1.

There are about 84 miles of open unpaved roads in the analysis area. Some localized erosion, typical of unpaved roads, is coming from these roads. On Forest Service land, open unpaved roads have regular maintenance to ensure that all drainage structures are open and in working order. These structures keep the erosion from the road surface at a low level.

The watersheds of Lick Run, Mill Creek, Pads Creek, and Hickman Draft are almost completely forested. The watersheds of Simpson Creek, Wilson Creek, and Smith Creek are mostly forested but have other land uses, including Interstate 64. The watersheds of Thompson Creek and Guys Run have mixed land uses. Based on research (Patric, Evans, and Helvey, 1984) and USGS data for regional streams, the estimated annual sediment load for Lick Run is 440 tons, for Mill Creek 962 tons, for Pads Creek 1247 tons, for Hickman Draft 126 tons, for Simpson Creek 2846 tons, for Wilson Creek 3404 tons, for Smith Creek 1831 tons, for Thompson Creek 1645 tons, and for Guys Run 594 tons.

The 2012 Virginia Water Quality Assessment lists Porters Mill Creek as impaired due to low pH. The source is atmospheric deposition. Wilson Creek above Douthat Lake has a stream temperature impairment, with the source identified as drought related impacts, and “source unknown”, and may be due to natural conditions. Smith Creek within the city of Clifton Forge has a bacteria impairment. The source is listed as municipal, sanitary sewer overflows, and waste from pets and wildlife.

A4.4 Direct, Indirect, and Cumulative Effects

Direct, Indirect, and Cumulative Effects-Alternative 1

There would be no additions of sediment that might affect water quality. However, the Interstate 64 gully would continue to contribute detrimental amounts of sediment to Simpson Creek.

Direct, Indirect, and Cumulative Effects-Alternatives 2 and 3

Minor sedimentation can be expected from the Lower Cowpasture project. Table 3A4-1 shows, by watershed, potential sediment increase from the project, as well as from past and ongoing timber harvests. This sediment will have no significant impact on the beneficial uses of area streams and reservoirs. The minor sediment increases are unmeasurable and insignificant in comparison to the sediment loads of the area streams and will have no significant effect on habitat for fish or other

aquatic life. The mitigation section of this EA contains measures that will be used to reduce sedimentation and protect the beneficial uses.

Amelioration of the Interstate 64 gully will result in a long-term decrease of about 2.8 tons of sediment per year in Simpson Creek. This will eliminate the gully as a significant sediment source and allow the stream to recover over time.

Project activities will not add to the bacteria impairment of Smith Creek or the pH impairment of Porters Mill Creek. With riparian buffers providing shade, project activities will not contribute to the temperature impairment in Wilson Creek.

Table 3A4-1. Potential Sediment Production (tons) by Alternative, Watershed, and Year

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Guys Run:												
Alternative 2			0.2	0.3	1.0	2.0	1.5	1.0	0.3	0.1	0.1	
Alternative 3			0.2	0.3	1.0	1.9	1.5	1.0	0.3	0.1	0.1	
Hickman Draft:												
Alternative 2		0.6	0.4	1.2	0.8	0.1						
Alternative 3		0.6	0.4	1.2	0.8	0.1						
Lick Run:												
Alternative 2			1.9	0.6	1.2	0.7	0.6	0.1				
Alternative 3			1.0	0.5	1.2	0.7	0.6	0.1				
Mill Creek:												
Alternative 2	0.4	1.1	2.5	3.9	2.5	2.5	1.5	0.7	0.3	0.2	0.1	0.1
Alternative 3	0.4	1.1	2.4	3.8	2.5	2.5	1.4	0.7	0.3	0.2	0.1	0.1
Pads Creek:												
Alternative 2		0.3	0.6	0.9	0.6	0.4	0.1					
Alternative 3		0.3	0.7	0.7	0.2	0.3	0.1					
Simpson Creek:												
Alternative 2					0.2	0.3	0.1	0.2	0.3			
Alternative 3					0.2	0.3	0.1	0.2	0.1			
Tri-County	0.8	0.6	0.2	0.1								
Smith Creek:												
Alternative 2		0.1	0.3	0.5	0.6	0.2						
Alternative 3		0.1	0.3	0.5	0.6	0.2						
Thompson Creek:												
Alternative 2							0.1					
Alternative 3							0.1					
Mares Run	0.7	0.4	0.1									
Wilson Creek:												
Alternative 2		0.7	3.0	3.5	2.6	2.8	0.9	0.6	0.2	0.1	0.1	0.1
Alternative 3		0.7	2.5	3.1	2.5	2.6	0.9	0.6	0.2	0.1	0.1	0.1

A5 - Water Quantity

Issues Related to the Resource

Project Issue 2: Concern about increases in water yield resulting from timber harvests and other activities, and the potential for increased flooding.

Scope of the Analysis

The boundary of the analysis area will be the same nine watersheds used in the water quality analysis. The time frame for the analysis will be until water yields return to near pre-project levels.

A5.1 Introduction

Foresters and other professional land managers have long observed that cutting trees in forested stands increases water production. Trees respire through a mechanism known as transpiration. In this process, trees draw up water through their roots and pass it out through their leaves into the atmosphere as water vapor. If trees are cut, respiration of the water is eliminated and more water reaches the ground, increasing soil moisture. When it begins to rain, the harvested areas already have increased soil moisture so more water flows through the ground to enter streams. Most of this increase occurs during the summer low-flow period and adds to summer base flow, since that is the period of greatest transpiration (Douglas and Swank, 1975). The increased water yield will diminish and eventually be eliminated as the forest regrows. Wildfires and, to a lesser extent, prescribed burns can also cause a temporary increase in water yield when they result in patches of tree mortality. On the other hand, Hibbert (1969) found that conversion of an entire watershed from forest to grass resulted in a long-term increase in water yield of about 15 percent.

Studies in North Carolina, in which entire watersheds were clearcut, have shown first-year increases in peak flows of 10 to 15 percent for smaller storms only (Swank, Douglass, and Cunningham, 1982). With reduced evapotranspiration, there is a quicker storm response because the soil moisture is higher at the start of the rainstorm, thereby accelerating movement of water through the soil and causing a more rapid expansion of the source area for contributions to the stream channel. Research, however, has also generally shown that clearcutting does not significantly affect peak flows or storm flow volumes from larger, flood-producing storms. This would be expected since large storms result in soil saturation, thereby eliminating any significant difference in soil moisture between harvested and unharvested areas.

Moreover, any possible effects are greatly reduced where only a small portion of a watershed is harvested at any given time. Also, partial harvests, such as thinnings, have a much reduced effect on flows (Lull and Reinhart, 1972). Hewlett (1982) concluded that "The consequences of forest harvesting are sufficiently predictable from the evidence provided by the best conducted watershed experiments to say that forest harvesting, without subsequent cultivation or overgrazing of the basin, has negligible effects on flood levels in the valleys below the operations." Eisenbies et. al. (2006) stated that "There is presently little evidence that forests or forestry practices have any substantive influence on the outcome of extreme flow events."

An analysis of annual water yield increases resulting from timber harvests can give an indication of the small effect of harvests on streamflow (Table 3A5-1). Most of this flow increase would be base flow, not storm flow.

A5.2 Analysis Methods

The Douglas and Swank (1972) model, used to estimate water yield increases, is an appropriate method when very detailed and localized climatic and site data is unavailable. Eisenbies, M. H., et. al. (2006) found no models that have been specifically designed to directly address questions of extreme flooding, in relation to forestry practices.

A5.3 Existing Condition

Small increases in water yield have resulted from recent wildfires and prescribed burns, from ongoing and past timber harvests, and from the construction of wildlife clearings. These increases are included in Table 3A5-1, in the column labelled "Other". The largest increases were from the

2012 Easter Complex wildfires, but these increases are already greatly reduced as a result of the rapid regrowth of vegetation.

A5.4 Direct and Indirect Effects

Direct and Indirect Effects-Alternative 1

There would be no timber harvests or other manipulation of vegetation, and thus no increase in water yield.

Direct and Indirect Effects-Alternatives 2 and 3

Table 3A5-1 shows the water yield increases by watershed and year from timber harvests, prescribed burns, and wildlife clearing construction. Background water yields are also shown for each watershed. The greatest percentage increase is only 6.0% (Hickman Draft, in 2019). Most of the flow increase would be base flow, not storm flow. There would be no measureable or significant effect on flooding.

A5.5 Cumulative Effects

Cumulative Effects-Alternative 1

There would be no cumulative effects.

Cumulative Effects-Alternatives 2 and 3

In Table 3A5-1, the column labelled "Other" gives water yield increases from wildfires and from other prescribed burns, timber harvests, and wildlife clearing construction. Considered cumulatively with Alternatives 2 and 3, the greatest percentage increase is only 6.2% (Hickman Draft, in 2019). Again, most of the flow increase would be base flow, and there would be no measureable or significant effect on flooding in any of the watersheds.

At their confluence, the annual water yield for the Jackson River is 695,600 acre-feet, and for the Cowpasture River 389,000 acre-feet. The maximum cumulative water yield increase is only 0.2% for the Jackson River, and only 0.5% for the Cowpasture River. Clearly, there would be no measureable or significant effect on flooding in these rivers.

Very small long-term increases in water yield are shown for eight of the watersheds. These result from the conversion of forest to wildlife clearings.

Table 3A5-1. Water Yield Increases (acre-feet), by Alternative, Watershed, and Year

	Guys Run			Hickman Draft			Lick Run			Mill Run			Pads Creek			Simpson Creek			Smith Creek			Thompson Creek			Wilson Creek		
Background>	*4630*			*2098*			*7316*			*15991*			*20732*			*22155*			*14252*			*12808*			*26497*		
Year	Alt 2	Alt 3	Other	Alt 2	Alt 3	Other	Alt 2	Alt 3	Other	Alt 2	Alt 3	Other	Alt 2	Alt 3	Other	Alt 2	Alt 3	Other	Alt 2	Alt 3	Other	Alt 2	Alt 3	Other	Alt 2	Alt 3	Other
2015			70			18	256	197	66	25	25	400			739									454	10	10	345
2016			52	18	18	14	237	194	54	82	82	292			594			415	18	18	415			337	76	76	274
2017			40	36	36	11	216	182	30	177	177	228			444			301	29	29	301			377	139	118	222
2018	34	34	32	68	68	8	201	174	26	212	212	369	291	287	172			235	30	30	235			293	226	196	689
2019	62	62	25	126	126	5	183	161	21	184	184	280	222	209	137	31	31	230	23	23	230	7	7	229	181	155	673
2020	92	92	20	95	95	3	145	128	18	181	181	221	342	330	104	39	39	339	18	18	339	7	7	181	148	127	516
2021	60	60	17	76	76	2	155	140	15	177	177	179	417	408	75	29	29	353	13	13	253	5	5	146	115	99	410
2022	68	68	14	62	62	1	120	108	11	129	129	144	374	304	49	24	24	200	11	11	200	4	4	118	92	78	327
2023	53	53	10	50	50		94	85	9	98	98	115	310	258	26	183	183	161	9	9	161	3	3	95	72	61	262
2024	42	42	8	45	45		74	67	7	74	74	90	246	206	4	133	133	128	7	7	128	2	2	71	56	48	216
2025	32	32	6	34	34		56	51	4	53	53	70	195	164	2	105	105	102	6	6	102	2	2	52	42	36	177
2026	26	26	4	31	31		41	37	3	36	36	51	156	131	2	83	83	82	4	4	82	1	1	35	32	27	141
2027	19	19	2	24	24		28	26	1	24	24	34	130	109	1	66	66	95	4	4	95	1	1	22	22	20	109
2028	14	14	1	18	18		20	19		15	15	24	106	90		53	53	49	4	4	49			15	17	15	81
2029	10	10	1	13	13		17	16		13	13	16	83	71		44	44	38	4	4	38			10	17	15	55
2030	10	10		7	7		12	12		11	11	8	64	54		34	34	27	4	4	27			6	17	15	31
2031	10	10		3	3		9	9		11	11	4	46	39		26	26	16	4	4	16			3	17	15	20
2032	10	10		3	3		8	8		11	11	3	32	27		21	21	9	4	4	9			2	17	15	15
2033	10	10		2	2		7	7		11	11	1	18	14		15	15	6	4	4	6			1	17	15	7
2034	10	10		1	1		6	6		11	11		12	10		10	10	4	4	4	4			1	17	15	1
2035	10	10		1	1		6	6		11	11		9	7		6	6	1	4	4	1			1	17	15	
2036	10	10		1	1		5	5		11	11		4	3		5	5		4	4				1	17	15	
2037	10	10		1	1		5	5		11	11					4	4		4	4				1	17	15	
2038	10	10		1	1		5	5		11	11					2	2		4	4				1	17	15	
2039	10	10		1	1		5	5		11	11					1	1		4	4				1	17	15	

A6 - Climate Change

Issues Related to the Resource

There were no project issues identified regarding this resource.

For the George Washington National Forest (GWNF) and much of the southeastern United States, climate variability and weather events such as strong winds and heavy rains from hurricanes, droughts, heat waves, episodes of warm winters, floods, ice storms, and lightning storms have long been part of the natural environment. From a climate perspective, the southeast has some of the warmest temperatures, generally receives more rainfall than any other region, and experiences many extreme climate events (U.S. Global Change Research Program 2001).

These climate variables and associated disturbances have always influenced the makeup and geographical distribution of many ecological communities and landscapes across the South. However, the increasing changes in climate and disturbances projected for the future are expected to lead to substantial alterations in our forests and the services they provide (U.S. Climate Change Science Program 2008a). The International Panel on Climate Change (IPCC 2007) has identified future impacts of temperature warming, changes in precipitation, extreme weather events, severe droughts, earlier snowfall, rising sea levels and other changes that could significantly affect forest ecosystems.

Forest Service scientists have been studying various aspects of climate change on forests for many years. Yet, our knowledge of how plants and ecosystems respond to the threats of a changing climate and how to react appropriately at local levels where management actions are most effective is still very limited (Solomon 2008). Uncertainties about outcomes will require flexibility, and land management strategies based on current or historical conditions will need to be adjusted or replaced with approaches that support adaptation to changing conditions (USDA Forest Service October 2008).

It has been recognized that forests can play an important role in both mitigating and adapting to climate change. Mitigation measures focus on strategies such as carbon sequestration by natural systems, ways to increase carbon stored in wood products, ways to provide renewable energy from woody biomass to reduce fossil fuel consumption, and ways to reduce environmental footprints. Adaptation measures address ways to maintain forest health, diversity, productivity, and resilience under uncertain future conditions. Adaptation and mitigation activities must also complement each other and balance with other ecosystem services (USDA Forest Service October 2008).

At this time, the science of climate change modeling is at the stage of stepping down global models to regional scales (Davis 2007), so a combination of national projections, regional-level climate trends for the southeastern United States, and a recent report prepared for the state of Virginia provides the most reliable context for describing expected climate changes and impacts for the George Washington National Forest. Specifics regarding many mitigation measures, such as the appropriate calculations for carbon offsets and how to consider carbon sequestration rates, are still being developed, so most of our focus for the Lower Cowpasture Project area for now will be on using management options to improve resilience and adaptability of native ecosystems under changing conditions (Forest Plan EIS).

National Climate Change Trends and Expectations

Warming temperatures, altered precipitation patterns, rising sea levels, and increases in the number and intensity of extreme weather events are already causing observed ecological responses across the United States (U.S. Climate Change Science Program 2008a). Although there are variations by region, overall temperatures across the nation warmed during the 20th century, with 11 of the 12 years from 1995-2006 among the warmest since instrumental record keeping was started in 1850 (U.S. Climate Change Science Program 2008b; IPCC 2007). Precipitation patterns and distribution also vary regionally, but the total annual precipitation in the contiguous United States has increased 6.1 percent over the last century, with about half of the increase attributed to increased storm intensity (U.S. Climate Change Science Program, 2008b; Karl and Knight, 1998). Warming temperatures, along with land subsidence, contribute to sea level rise. Relative sea levels have risen 3-4 mm per year in the Mid-Atlantic States and 5-10 mm per year in the Gulf states (U.S. Climate Change Science Program 2008b; U.S. Environmental Protection Agency 2007).

Anticipated increases in extreme weather events outside the historic range of natural variability may alter the frequency, intensity, duration, and timing of disturbances such as fire, drought, invasive species, and insect and pathogen outbreaks. Changes in forest composition and growth may also have associated impacts on wildlife habitats, the supply of wood products, specialty markets, and recreational opportunities (U.S. Climate Change Science Program 2008b; Marques 2008).

Forests provide a wealth of services and products including clean water, clean air, biological habitats, recreation opportunities, carbon storage, timber, specialty commodities, fuel, and aesthetic and cultural values. Scientists have indicated that a changing climate can affect the future biodiversity and alter the function of the forest ecosystems that support these services and products (U.S. Climate Change Science Program 2008a). Species distributions may shift, some species are likely to decline while others expand, and whole new communities may form. Forest productivity may be reduced in some instances due to a decline in photosynthesis caused by increased ozone, and productivity may be enhanced in other settings where elevated levels of carbon dioxide (CO_2) have a fertilizing effect on overall tree growth.

Fishing is highly valued in the U.S. as both a commercial enterprise and as a recreational sport. Fish populations and other aquatic resources are likely to be affected by warmer water temperatures, changes in seasonal flow regimes, total flows, lake levels, and water quality. These changes will affect the health of aquatic ecosystems, with impacts on productivity, species diversity, and species distribution (IPCC 2007).

Stream habitats are projected to decline across the U.S. by 47 percent for coldwater, 50 percent for coolwater, and 14 percent for warmwater species. In the southern Great Plains, summer water temperatures already approach the limits for survival of many native stream fish (IPCC 2002). An 8°F increase in average annual air temperature is projected to eliminate more than 50 percent of the habitat of brook trout in the southern Appalachian Mountains. The Northern pike, which spawn in flooded meadows in early spring and whose young remain in the meadows for about 20 days after hatching, would be especially affected by low spring water levels. Higher winter temperatures have been observed to decrease the survival rate of the eggs of yellow perch (a coldwater species). On the other hand, one study found that higher winter temperatures (by 2°C) were beneficial for rainbow trout but the same temperature increase in summer caused negative effects (IPCC 2007).

Southern Region Climate Change Trends and Expectations

Over the past decade, a number of models have been developed to simulate climatic effects anticipated in the future. These scenarios are based on historical data, trends, and analysis of different plausible assumptions. While climate model simulations are continuing to be developed and refined, climate projections typically do not yet accurately address expected conditions below the regional scale in the United States. In the report by the United States Global Change Research Program on Climate Change Impacts on the United States (2001), the two principal models that were found to best simulate future climate change conditions for the various regions across the country were the Hadley Centre model (developed in the United Kingdom) and the Canadian Climate Centre model. Unless otherwise noted, the following discussions of climate change expectations for the southeastern United States are based on findings from the 2001 U.S. Global Change Research Program report and more recent projections in the U.S. Climate Change Science Program Reports (SAP 4.3 May 2008a SAP 4.4 June 2008b).

The climate is going to get warmer, especially warmer minimum winter temperatures. Both the Hadley and Canadian models show increased warming in the southeast but at different rates (see inset on Future Climate Scenarios for the southeast). Overall regional temperature changes are projected to be equivalent to shifting the climate of the Southern U.S. to the central U.S. and the central U.S. climate to the northern U.S.

The heat index, which is a measure of comfort based on temperature and humidity, is going to rise. The principal climate model simulations agree that the heat index will increase more in the southeast than in other regions. By 2100, the heat index under the Hadley model is projected to increase by as much as 8-10°F and by over 15°F in the Canadian model. The Northeast may feel like the southeast does today, the southeast is likely to feel more like today's south Texas coast, and the south Texas coast is likely to feel more like the hottest parts of Central America.

Threats to coastal areas will increase, including rising sea levels, beach erosion, subsidence, salt water intrusion, shoreline loss, and impacts to urban development.

Precipitation is more likely to come in heavy, extreme events.

For other aspects, models tend to differ on expectations. The southeast is the only region where climate models are simulating large and opposite variations in precipitation patterns over the next 100 years. The Canadian model projects more extensive and frequent droughts in the southeast, starting with little change in precipitation until 2030 followed by much drier conditions over the next 70 years. The Hadley model, in contrast, suggests there will be a slight decrease in precipitation over the region during the next 30 years followed by increased precipitation. There is also uncertainty over the extent of effects of El Nino and La Nina cycles. El Nino events typically result in cooler, wetter winters in the southeast and fewer Atlantic tropical storms, while La Nina events tend to have the opposite effects with warmer, drier winters and more hurricanes.

Unexpected interactions among multiple disturbances happening at the same time add to the level of uncertainty. For example, tree growth is generally projected to be stimulated by increases in CO_2, but limits on availability of water and soil nutrients during droughts often weaken tree health leading to insect infestations or disease, which in turn promotes future fires by increasing fuel loads and further weakening tree health (Marques 2008).

Based on current projections, the following discussion highlights some of the potential impacts of a changing climate on forests in the southeastern United States and on the George Washington National Forest.

Forest productivity. In general, biological productivity of southeastern forests will likely be enhanced by increased levels of CO_2, as long as there is no decline in precipitation and as long as any increases in moisture stress due to higher air temperatures are low enough to be offset by CO_2 benefits. Hardwoods are more likely to benefit from increased CO_2 and modest temperature increases than pines, since pines have greater water demands than hardwoods on a year-round basis. Without management adaptations, simulations using the Hadley model show pine forest productivity will likely increase 11 percent by 2040 and then exhibit a declining trend to an 8 percent increase by 2100 compared to 1990 productivity estimates. Hardwood productivity will likely continue to rise, with projections of a 22 percent increase by 2040 and 25 percent by 2100. This shift in productivity could have significant effects in the South. Forest productivity increases may be offset, however, by escalating damage from forest pests and more extreme weather disturbances.

Forest pests. The potential for a changing climate to increase the distribution of forest insect and disease pests is a concern, particularly for pests that already cause widespread damage such as Southern pine beetles. Higher winter temperatures are expected to increase over-wintering beetle survival rates, and higher annual temperatures will produce more generations each year leading to increased beetle infestations. Other factors, however, complicate projections of future infestation levels. Field research has demonstrated that moderate drought stress increases pine resin production thus reducing colonization success, while severe drought stress reduces resin production and increases pine susceptibility to beetle infestation. Insufficient evidence currently exists to predict which of these factors will control future beetle populations and impacts (McNulty et al. 1998).

Fires. Fire frequency, size, intensity, and seasonality are directly influenced by weather and climate conditions. Nationwide projections show seasonal fire severity is likely to increase by 10 percent over the next century, with possibly larger increases in the southeast. At least two ecosystem models run under the Canadian climate change scenario suggest a 25-50 percent increase in fires, and a shift of some southeastern pine forests to pine savannas and grasslands due to moisture stress. Under a hotter, drier climate, an aggressive fire management strategy could prove critical to maintaining regional vegetation patterns.

Shifts in major vegetation types for the Southeast. The broad variety of ecosystem types found across the southeast ranges from coastal marshes to mountaintop spruce-fir forests. Although the South is one of the fastest growing population regions in the country, forests are still common in many parts of the southeast, and forestland averages approximately 30 percent of each state. Potential changes in vegetation distribution due to climate change vary with different model scenarios. Under the Hadley model, forests remain the dominant natural vegetation in the southeast, but the mix of forest types changes. Under the Canadian model, savannas and grasslands expand and replace parts of the southeastern pine forests along the Coastal Plain due to increased moisture stress. In this scenario, the current southeastern forest moves into the north-central part of the United States. Both drought and increased fire disturbance play an important role in the potential forest breakup.

Increased forest disturbances. Increases in extreme events and changes in disturbance patterns may have more significant impacts, at least in the near future, than long-term changes in temperature or precipitation. Natural disturbances that may be associated with climate change include hurricanes, tornadoes, storms, droughts, floods, fires, insects, diseases, and non-native invasive species. Although disturbances are a natural and vital part of southern ecosystems, it is the

change in frequency, intensity, duration, and timing exceeding the natural range of variation that is a concern (Marques 2008). Multiple disturbances interact and further exacerbate damages. Hurricanes can cause severe disturbance that not only results in direct loss of biological communities and habitat, but the widespread damages can also shift successional direction leading to higher rates of species change and faster biomass and nutrient turnover. Invasive species and insect pests often have high reproductive rates, good dispersal abilities, and rapid growth rates enabling them to thrive in disturbed environments.

Water stresses. The difficulty in predicting whether precipitation will increase or decrease in the southeast over the next 30-100 years extends to uncertainties over future water quantity and quality conditions. Current water quality stresses across the southern region of the country are primarily associated with intensive agricultural practices, urban development, and coastal processes such as saltwater intrusion. Although water quality problems are generally not critical under current conditions, stresses are expected to be more frequent under extreme conditions, particularly in low stream flow situations associated with droughts. Under the Hadley model, stream flow in the southeast has been projected to decline as much as 10 percent during the early summer months over the next 30 years. The Chattahoochee and Tombigbee River basins are projected to have decreased water availability over the next 50 years, and as stream flow and soil moisture decrease, agricultural fertilizer applications and irrigation demands tend to increase creating further stress and conflicts over competing uses. Parts of the southeast that depend more on ground water are particularly vulnerable to depletion of aquifers, which can take centuries to recharge after chronic drought conditions (Hoyle 2008).

Local Level Climate Change Trends and Expectations

The Template for Assessing Climate Change Impacts and Management Option (TACCIMO) was used to estimate the range of changes in precipitation and temperature that can be expected on the George Washington National Forest. The template uses models from Canadian Centre for Climate Modeling & Analysis (Canadian-CGCM3), Hadley Centre for Climate Prediction and Research (Hadley-HadCM3), and US Dept. of Commerce/NOAA/Geophysical Fluid Dynamics Laboratory (Commerce-GFDL-CM2.0). The models are run using three scenarios regarding the level of carbon emissions.

Table 3A6-1. Climate Change Model Scenarios

Emissions Path	Description
“Higher” emissions path	Technological change and economic growth more fragmented, slower, higher population growth.
“Middle” emissions path	Technological change in the energy system is balanced across all fossil and non-fossil energy sources, where balanced is defined as not relying too heavily on one particular energy source.
“Lower” emissions path	Rapid change in economic structures toward service and information, with emphasis on clean, sustainable technology. Reduced material intensity and improved social equity.

Based on data from TACCIMO, the predicted changes in precipitation and temperature are shown in the following tables:

Table 3A6-2. Predicted Changes in Precipitation on the GWNF

Precipitation, annual average from 2009-2099 (in)			
Emissions Path	Commerce CFDL-CM2.0 Model	Canadian CGCM3 Model	Hadley HadCM3 Model
Middle Emissions	46.3	43.9	47.7
Higher Emissions	47.0	43.9	44.7
Lower Emissions	44.4	44.8	45.8
Average of all emission options	45.9	44.2	46.1
Historical Average (PRISM 1970-2000)	43.5	43.5	43.5

Table 3A6-3. Predicted Changes in Temperature on the GWNF

Average temperature (°F, Monthly Average spanning 2009-2099)			
Emissions Path	Commerce CFDL-CM2.0 Model	Canadian CGCM3 Model	Hadley HadCM3 Model
Middle Emissions	56.3	56.8	57.7
Higher Emissions	56.8	57.0	57.2
Lower Emissions	55.2	55.2	56.1
Average of all emission options	56.1	56.5	57.0
Historical Average (PRISM 1970-2000)	52.5	52.5	52.5

All of the models predict an increase in precipitation ranging from less than a half inch to more than four inches per year. All of the models also predict an increase in temperature ranging from 2.7°F to 5.2°F.

In December 2008, the Governor‘s Commission on Climate Change released a “Final Report: A Climate Change Action Plan” for the state of Virginia. The report included expected impacts of climate change on Virginia‘s natural resources, the health of its citizens, and the economy which included the industries of forestry and tourism. It also identified what Virginians can do to prepare for the likely consequences of climate change as well as an estimation of the amount of, and contributors to, the state‘s greenhouse gas emissions through 2025. The Governor‘s Executive Order 59 (2007) set a greenhouse gas emission target of 30% below the business-as-usual projection of emissions by 2025.

The Governor‘s Commission on Climate Change used the Intergovernmental Panel on Climate Change‘s (IPCC) Fourth Assessment Report as the primary reference point on the science of climate change, and also included testimony of a variety of experts. Estimates provided in the recent Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC) report, “Climate Change and the Chesapeake Bay: State-of-the-Science Review and Recommendations” (Pyke et al. 2008) were also incorporated because of its regionally-specific nature. The findings of the expected impacts of climate change for Virginia from the Commission‘s report, as they relate to national forest management in Virginia include the following. These impacts could be further compounded by Virginia‘s growing human population. As of July 2009, the Virginia Employment Commission estimates that, between 2010 and 2030, Virginia‘s human population will increase by almost 23 percent (http://www.vec.virginia.gov/vecportal/lbrmkt/plugins/lmiapp.cfm/popproj#).

Virginia should prepare for a minimum of a 3.6°F increase in air and water temperatures but these temperatures could increase as high as 10.8°F by 2100. Changes in precipitation and weather patterns are more difficult to estimate, although there has been scientific consensus that most of Virginia will experience a slight (0-10%) increase in precipitation and an increase in coastal storm intensity (IPCC 2008; Pyke et al. 2008).

There will likely be a projected sea level rise for coastal Virginia of 2.3–5.2 feet by 2100. Oxygen levels in the Chesapeake Bay are expected to decrease due to increasing temperatures and increasing storm runoff. Acidification of the Bay and Atlantic Ocean also is a concern as waters absorb more carbon dioxide (CO_2). Though the George Washington National Forest lies along the western mountains of Virginia, all of the forest is in the headwaters of the Chesapeake Bay watershed.

At varying rates, vegetation ranges will move from current locations to higher altitudes and latitudes, such that suitable habitat for some species will decline, other species will become extirpated, and other species will become extinct. Virginia's freshwater streams and high elevation areas currently offer essential habitat to many species that require cooler conditions. As temperatures increase and precipitation patterns change, these habitats will no longer support the same suite of species they do today.

Threats already faced by Virginia's ecosystems, such as invasive species, pathogens and pollution will become exacerbated. Many new exotic or invasive species may move into Virginia and existing pest species may flourish and cause more widespread damage than they are now.

There is a lack of research and specific information on the impacts of climate change on Virginia's forestry industries, and commercial and sport fishing industries.

Virginia's forestlands sequester approximately 23 million metric tons of CO_2 per year but an average of 27,000 acres of forestland is lost annually to development. The George Washington National Forest encompasses about 1 million acres (or seven percent) of the forestlands in the state.

The three largest sources of greenhouse gas emissions in Virginia are electricity generation, transportation, and non-utility uses of fuel in industrial, commercial and residential facilities. Demands for electricity, transportation and fuel would likely increase as population increases.

The Virginia Department of Mines, Minerals and Energy (DMME) projects that natural gas consumption will grow 3.6 percent from 2007 through 2016 under a business-as-usual scenario. Natural gas increasingly is being used for electric generation because it is the cleanest of the fossil fuels, which may cause an even greater increase in demand for natural gas supply.

DIRECT, INDIRECT AND CUMULATIVE EFFECTS

Based on current projections, the primary regional-level and state-level predicted effects of climate change that would impact the Forest include: (1) warmer temperatures; (2) extreme weather events; and (3) increased outbreaks of insects, disease, and non-native invasive species (Forest Plan EIS, p. 3-83)

Increased variation in temperature and moisture can cause stress and increase the susceptibility of forest ecosystems to invasions by insects, diseases, and non-native species. New environmental conditions can lead to a different mix of species and tend to be favorable to plants and animals that can adapt their biological functions or are aggressive in colonizing new territories (Whitlock 2008).

However, changes in adaptability may be too slow given the predicted rate of change. Species that are already broadly adapted may become more prevalent, and species with narrow adaptability may become less prevalent. Disturbance factors that create more vulnerability in native ecosystems or require extensive controls to maintain the status quo are likely to affect desired conditions for healthy and diverse forests.

Desired conditions for healthy forests include resilience to dramatic change caused by abiotic and biotic stressors and mortality agents (particularly the southern pine beetle, gypsy moth, hemlock woolly adelgid and emerald ash borer on the GWNF) and a balanced supply of essential resources (light, moisture, nutrients, growing space). For the GWNF, gypsy moth epidemics have caused the greatest insect damage to date. The hemlock woolly adelgid affects only one species of trees but the loss of hemlocks in the riparian corridors has had widespread impacts, especially when coupled with the continuing effects of acid deposition. The forest has experienced several localized outbreaks of southern pine beetle. Emerald ash borer has been found in the northern parts of Virginia so far.

One of the natural disturbances that are an integral part of the forest is fire. Many of the native ecosystems that make up the George Washington National Forest, such as the pine and pine-oak forests, are adapted to or dependent on some level of periodic fire. Fire frequency, size, intensity, seasonality, and severity are highly dependent on weather and climate. As noted earlier, model results predict that seasonal severity of fire hazard is likely to increase by 10 percent over much of the United States during the 21st century, with possibly larger increases in the southeast (U.S. Global Climate Change Program 2001). The warmer Canadian model scenario which anticipates increased drought stress, projects a 30 percent increase in fire severity for the southeast. If extreme events such as hurricanes further increase forest fuel levels with widespread downed trees, there is a potential for larger, more catastrophic fires that could impact many of the desired conditions for the George Washington National Forest.

We have always experienced droughts, flooding, extreme weather events, catastrophic fire, insects and diseases, and to a more gradual degree, movement in the ranges of flora and fauna species. Many of our current management strategies already strive to maintain or enhance the health and resiliency of various forest resources to better withstand environmental stresses and human-induced pressures. However, the effects of an accelerated rate of change and an increase in the intensity of these impacts on forest resources and ecosystems are still unpredictable. Climate change effects are multiple, varied, and interact with many other stressors/variables.

The effects of the alternatives focus on both adaptation (ways to maintain forest health, diversity, productivity, and resilience under uncertain future conditions) and mitigation (such as carbon sequestration by natural systems, ways to provide renewable energy to reduce fossil fuel consumption, and ways to reduce environmental footprints). These effects focus on: 1) reducing vulnerability by maintaining and restoring resilient native ecosystems; 2) providing watershed health; 3) providing carbon sinks for sequestration; and 4) reducing existing stresses.

Reduce Vulnerability by Maintaining and Restoring Resilient Native Ecosystems

Alternative 1

Alternative 1 focuses on passive restoration and relies predominantly on natural processes to reduce vulnerability. Passive restoration is an important component to any management strategy, but reliance as the main tool is problematic for several reasons. Disturbance regimes do not currently operate at the large scale they did in the past. For example, due to the intermixed ownership, naturally ignited fires do not spread very far on the landscape or remain burning for a very long time period. Without large scale disturbances, large blocks of forest tend towards the same age and

condition, making them more susceptible to damage by insects or disease. In addition, the rapid change in climate that is predicted may result in changes in community composition and natural processes may not be able to adapt to these changes due to the rapid pace.

Alternatives 2 and 3

Alternatives 2 and 3 use a mix of active and passive restoration strategies. Prescribed burning in both action alternatives contribute towards moving the prescribed burned areas towards a community closer to its historic fire regime which may be more resilient to changes in climate. Active vegetation management through timber harvest and prescribed fire, maintain and restore the ecological systems within the project area and the species with special needs. Thus, the project area is expected to be more resilient to possible climate change impacts such as changes in productivity and less susceptible to damage by insects or disease. Both action alternatives utilize planting of blight-resistant American chestnuts in cooperation with the American Chestnut Foundation to establish progeny sites and as restoration tool.

Alternatives 2 and 3 maintain or restore ecological conditions that are rare on the GWNF, such as high elevation grasslands and early successional habitat, open woodlands, and old fields.

In addition, Alternative 3 would reduce National Forest System roads in the project area by 0.9 miles which may improve the ability for some species to disperse, reduce sedimentation in streams, and reduce the spread of non-native invasive species. The reduction of roads would also reduce access to areas for management activities that could improve diversity.

Watershed Health

Projected climate changes to the hydrologic cycle through warmer water temperatures, more intense storms, and greater inter-annual variability in precipitation, indicate the importance of maintaining and protecting healthy watersheds. Bakke (2008) describes three key components relating climate change processes to management and conservation of aquatic resources: resilient habitat, refugia, and restoration.

Alternative 1

Watershed and streamside vegetation and soil would remain unchanged and continue to provide shading, a future source of nutrients, and large woody debris. Alternative 1 focuses on passive restoration and relies predominantly on natural processes to reduce vulnerability. Passive restoration is an important component to any management strategy, but reliance as the main tool is problematic for several reasons. For example, slope failures in the Simpson Creek drainage would not be stabilized. The gully resulting from a culvert draining I-64 will continue to erode and deposit sediment into the headwaters of Simpson Creek. Impassable culverts would not be replaced with passable structures eliminating the potential to restore connectivity of streams and increase the health and resilience of local fish populations and aquatic organisms.

Alternative 2

Under this alternative activities were designed to avoid harvesting in floodplains, wetlands, and riparian areas. Narrow riparian areas would be further protected by streamside management zones. Thus, no activity would adversely affect riparian areas, floodplains, or wetlands. Under Alternatives 2, fifteen (15) culverts are proposed to be improved to allow aquatic organism passage. Short-term impacts to the stream are expected because of the need to remove the existing culvert and place the new structure. However, following project completion, the road crossing should no longer be a barrier and also allow for more natural hydrology; thereby re-establishing habitat connectivity so

species can move to more suitable habitat, or move to or from refugia. In addition, culverts are proposed to be removed from the Slicky Slide road as it is decommissioned; Alternative 2 would remove three major culverts.

The Simpson Creek slope failure was proposed to be stabilized by diverting water from the I-64 culvert outflow to the base of the slope via a flexible pipe extension. The failed slopes would be cut back to facilitate re-vegetation of exposed slopes. This will reduce the input of sediment into the headwaters of Simpson Creek by approximately 2.8 tons per year.

Alternative 3

Alternative 3 proposes the same projects as Alternative 2, with a slight reduction in the proposed harvest acres and prescribed burns acres; therefore, the effects will be similar to Alternative 2. In addition to these projects, after further field review, we learned there were more culverts within the Slicky Slide road prism; therefore, Alternative 3 would remove nine culverts from Slicky Slide road as it is decommissioned. This alternative would also decommission 0.9 miles of National Forest System road (FSR) 175S (Lick Block), culverts would be removed and stream channels will be restored as the road is decommissioned. Under Alternative 3, eight streams have been identified for large woody debris (LWD) additions. Recruitment of LWD is expected to improve the amount and distribution of pool habitat in the future; thereby promoting stream health.

Watershed health is also discussed in the Aquatic Organism and Water Quality sections of this EA.

Carbon Sequestration

Trees and forests represent major biological "carbon sinks," places where carbon is sequestered. Carbon accrues in trees, soil, and wood products and the use of wood-based substitutes for fossil fuel-based products decreases the amount of greenhouse gas emissions.

The single most important aspect for sequestering carbon is to keep forests as forests. All of the alternatives meet this objective. Older forests sequester large quantities of carbon. 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 (Harmon et al. 1990). However, harvest and regeneration of young to middle-aged forests for long-lived forest products can help with carbon storage (Ryan 2008).

The issue of carbon balance in the forest is complicated and affected by many factors. While it is true that forest management activities such as prescribed burning release carbon dioxide into the atmosphere, growing forest vegetation recaptures carbon dioxide. A prescribed burn is, by definition, a low-severity fire that leaves the large trees alive and intact where they continue to store carbon. These fires also tend to stimulate regrowth of grasses and other herbaceous vegetation, which recapture carbon. And low-intensity fires have little effect on the large stores of carbon in the soil. The Environmental Protection Agency (US Environmental Protection Agency 2010) has concluded that when forest management activities (including fire emissions) are considered together with storage/sequestration activities (reforestation, etc.) the cumulative result is a net sequestration of carbon dioxide. This assumes that the proposed activity does not change the land use and the area remains forested, as is the case with prescribed burning within the Lower Cowpasture project area. (Forest Plan EIS, p. 3-87)

Alternative 1

Under the No Action Alternative, there would be no change to carbon sequestration on National Forest System lands within the Lower Cowpasture Project area. The rate of accumulation will slow as

the stands age. Carbon stocks will continue to accumulate, although at a declining rate, until impacted by future disturbances which may release existing carbon stocks.

Alternatives 2 and 3

The impacts of the action alternatives on global carbon sequestration and atmospheric concentrations of carbon dioxide are miniscule. However, the forests of the United States significantly reduce atmospheric concentrations of carbon dioxide resulting from fossil fuel emissions. The forest and wood products of the United States currently sequester approximately 200 teragrams[1] of carbon per year (Heath and Smith, 2004). This rate of carbon sequestration offsets approximately 10% of carbon dioxide emissions from burning fossil fuels (Birdsey et al., 2006). U.S. Forests currently contain 66,600 teragrams of carbon. The short-term reduction in carbon stocks and sequestration rates resulting from the proposed project are imperceptibly small on global and national scales, as are the potential long-term benefits in terms of carbon storage.

The currently large carbon sink in U.S. forests is a result of past land use changes, including the re-growth of forests on large areas of the eastern U.S. harvested in the 19th century, and 20th century fire suppression in the western U.S. (Birdsey et al., 2006). The continuation of this large carbon sink is uncertain because some of the processes promoting the current sink are likely to decline and projected increases in disturbance rates such as fire and large-scale insect mortality may release a significant fraction of existing carbon stocks (Pacala et al. 2008; Canadell et al. 2007). Management actions - such as those proposed – that improve the resilience of forests to climate-induced increases in frequency and intensity of disturbances such as fire, and utilize harvested trees for long-lived forest products and renewable energy sources may help sustain the current strength of the carbon sink in U.S. forests (Birdsey et al. 2007).

The action alternatives will alter the carbon cycle in that they affect the carbon stock. Alternatives 2 and 3 will remove biomass as a result of timber harvest. This will reduce the amount of carbon stored in the treated stands. A portion of the carbon removed will remain stored for a period of time in wood products.

The actions affect greenhouse gases in that the associated prescribed burning will release carbon into the atmosphere and carbon will be released during decomposition. However, overall forestry practices (including harvesting and prescribed burning) have been shown to act as a net carbon sink (EPA 2010).

There will be a direct, short-term increase in carbon emissions during the prescribed burn and a short-term increase due to an increase in dead vegetation following the burn. However the short-term loss of biomass resulting from a fire may be offset by the burned area's increased ability to produce herbaceous biomass. There is a direct beneficial effect on climate change of decreased greenhouse gas emissions from the acres to be burned because the risk of acres being burned by uncharacteristically severe wildfires would be reduced. There is also an indirect beneficial effect by treating these acres because live stands of trees will retain higher capacity to sequester carbon dioxide compared to stands killed by uncharacteristically severe wildfires, especially if not immediately reforested.

The regeneration of forested stands also has the advantage of creating a diversity of ages and structure in the forest to provide multiple strategies for addressing carbon storage. Forest management can also increase the ability of forests to sequester atmospheric carbon while

[1] 200 teragrams, or Tg, equals 196,841,306 US tons.

enhancing and restoring native ecosystems; thereby improving the resilience of the area to climate-induced increases in the frequency and intensity of disturbances.

Planting new trees and improving forest health through thinning and prescribed burning will increase forest carbon in the long run.

Existing Stresses

Aside from the stresses identified in watershed health and restoring resilient native ecosystems, non-native invasive species is a key existing stress on systems.

Alternative 1
Alternative 1 would reduce the spread of many non-native invasive species by passive management. Management activities that create openings in the forest canopy would not occur. While passive management can be an important component of any management strategy, reliance on this type of management can be problematic. For example, known locations of non-native invasive species would not be treated to reduce the potential spread, thus these locations of non-native invasive species will continue to be a source for further spread in the project area.

Alternatives 2 and 3
Alternatives 2 and 3 take a more aggressive approach to controlling non-native invasive species and preventing spread. Treatment of established invasive species will help maintain desired conditions for healthy forests under a changing climate. Due to the fragmented land ownership patterns, success in reducing forest pests will sometimes require going beyond national forest boundaries, and continued work with partners will be needed.

In addition, management practices (such as thinning and age class diversity) that sustain healthy forests and provide adequate nutrients, soil productivity, and hydrologic function promote resilience and reduce opportunities for disturbance and damage.

Section B - Biological Resources

B1 - Vegetation

Issues Related to the Resource
No project issues were identified regarding this resource.

Scope of the Analysis
This section summarizes the existing condition of vegetation in the Lower Cowpasture analysis area and explains how the alternatives may impact it. It addresses whether the alternatives help meet the desired future conditions of the area, which include achieving varying percentages of successional stage and structural conditions for different ecological system groups (ESG) as described in the Forest Plan.

B1.1 Existing Condition

Table 3B1-1 summarizes the existing vegetative conditions in terms of structural diversity (successional stage and canopy conditions) by ESG on NFS lands only. Successional stage is characterized in three categories; early, mid, and late. Early successional forest is defined as regenerating forest of 0 to 35 years of age, depending upon the ecological system. Mid-successional

forest often begins to develop with the sapling/pole forest characterized by canopy closure of dense tree regeneration and is defined by different age classes depending on ESG. Late successional forests, from 70 to 100 years in age and older depending upon ESG, include old growth conditions. This stage contains the largest trees and often has well-developed crown and canopy layers and scattered openings caused by tree mortality. Since we do not have information regarding stand ages on non-NFS lands, we cannot display the existing condition in the entire Lower Cowpasture area in Table 3B1-1.

Structural diversity conditions are described as one of 5 combinations of successional stage and canopy conditions, the so called 5 Box Model; early, late-closed, late-open, mid-closed, or mid-open. The Forest Plan identifies desired conditions for the successional stage and canopy conditions for each ESG as a 5 Box Model (Forest Plan, pp. 2-15 through 2-16), based on the Ecological Diversity Report (Forest Plan FEIS, Appendix E). These conditions are a culmination of the effect of past vegetation manipulation activities in the Lower Cowpasture analysis area and thus reflect the cumulative impact of past actions including timber harvest, prescribed fire and wildfire. Canopy conditions were identified through the use of aerial imagery, satellite imagery produced after the Easter Complex fire, and ground review.

Table 3B1-1. Desired Conditions, Existing Condition, and Departure from Desired Condition of Vegetation on NFS lands in the Lower Cowpasture Area

ESG	Early	Mid - Closed	Mid - Open	Late - Open	Late - Closed	Grand Total
Cove						
DC %	4.00%	39.00%	0.00%	9.00%	48.00%	100%
Exist %	1.50%	36.13%	0.31%	0.37%	61.69%	100%
Departure %	*-2.50%*	*-2.87%*	*0.31%*	*-8.63%*	*13.69%*	
Floodplains						
DC %	0%	0%	0%	0%	0%	
Exist %	0.27%	46.82%	0.01%	0.04%	52.87%	100%
Departure %						
Mafic Glade/Alk. Glade						
DC %	0%	0%	0%	0%	0%	
Exist %	5.29%	7.75%	0.00%	0.00%	86.96%	100%
Departure %						
Oak Forest and Woodlands						
DC %	12.00%	7.00%	10.00%	57.00%	14.00%	100%
Exist %	5.07%	8.63%	0.08%	1.46%	84.76%	100%
Departure %	*-6.93%*	*1.63%*	*-9.92%*	*-55.54%*	*70.76%*	
Pine Forest and Woodlands						
DC %	13.00%	3.00%	25.00%	54.00%	5.00%	100%
Exist %	9.24%	5.55%	0.04%	1.63%	83.54%	100%
Departure %	*-3.76%*	*2.55%*	*-24.96%*	*-52.37%*	*78.54%*	
Cliff, Talus, and Shale						
DC %	0%	0%	0%	0%	0%	
Exist %	3.33%	2.21%	0.04%	1.05%	93.38%	100%
Departure %						
Total %	5.42%	10.21%	0.09%	1.36%	82.93%	100.00%

It is important to note that the identification of ESG is based upon Ecological Zones on the George Washington National Forest First Approximation Mapping (Simon 2011). As with any model, accuracy of the predictions are rarely perfect. Overall accuracy for Ecological Zones is 77% and for

Nature Serve Ecological Systems map units is 83%. Accuracy for Floodplains is 77%. (Simon 2011). Indeed, the Cliff, Talus, and Shale Barrens and Floodplains identified within proposed harvest units are not accurate and one area of Alkaline Woodland within a proposed harvest unit is questionable; it certainly does not have an open structure expected of a woodland.

Oak Forest and Woodlands comprise approximately 66% of the NFS lands in the Lower Cowpasture area and 63% of the entire analysis area. This ESG can be viewed as the primary forest in which all other vegetation types occur. Oak forests range from those found on moist (or mesic) sites to dry sites that then grade into yellow pine. Overstory trees on mesic sites are typically dominated by red oak, white oak and hickory with chestnut oak, black oak and scarlet oak on drier sites. Heath shrubs such as blueberry, huckleberry and mountain laurel are common in the understory, especially on drier sites and often form a dense shrub layer along with grasses and sedges. Fewer heath shrubs are found on mesic sites and the understory often consists of various perennial herbaceous plants.

Pine Forest and Woodlands comprise approximately 19% of the NFS lands in the Lower Cowpasture area and 17% of the entire analysis area. This ESG occupies the upper slopes and south to west exposures. Overstories are typically dominated by table mountain pine, pitch pine, and some Virginia pine along with dry site oaks such as chestnut oak, scarlet oak, and bear oak. A dense heath shrub layer is almost always present. Mountain laurel is most typical and dominant, but species of blueberry and huckleberry along with fetterbush may also be dominant. Native grasses and sedges are common along with dry site herbs and forbs. Their density varies depending on shrub cover.

Cove Forests comprise approximately 7% of the NFS lands in the Lower Cowpasture area and 8% of the entire analysis area. This ESG is found on concave landforms and is often associated with riparian areas. Overstories are typically dominated by yellow poplar, hemlock, birch, magnolia, basswood, and red maple. Midstories are well developed and fairly diverse. In acidic coves, rhododendron is often abundant. Understories have a well-developed herb layer, often very dense and usually high in species richness, in all but the acid coves. Well-developed and fairly diverse subcanopy and shrub layers are often also present in all but the acid coves. This system can support populations of associated rare species, such as ginseng.

Cliffs, Talus and Shale Barrens comprise approximately 6% of the NFS lands in the Lower Cowpasture and 7% of the entire analysis area. Vegetation on and near shale barrens is mostly classified as woodland, but may include large open areas of sparse vegetation. Dominant trees are primarily chestnut oak, pitch pine, table mountain pine, and Virginia pine; although on higher-pH substrates the common trees include eastern red cedar and white ash. Shale barren endemic plants are diagnostic in the herb layer. The substrate includes areas of solid rock as well as unstable areas of shale scree, usually steeply sloped. The Cliff and Talus system comprises sparsely vegetated to partially wooded cliffs and talus slopes. It consists of vertical or near-vertical cliffs and the talus slopes below. In some cases, this system may take the form of upper-slope boulderfields without adjacent cliffs, where talus forms from freeze/thaw action cracking the bedrock. Most of the substrate is dry and exposed, but areas of seepage are often present. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places.

Floodplains and Mafic Glades and Alkaline Glades comprise 1% or less of the NFS lands in the Lower Cowpasture. Floodplains and Mafic Glades and Alkaline Glades comprise 4% and less than 1%, respectively, of the entire analysis area. Floodplain overstories are typically dominated by the same trees occupying the oak and cove forest types. Midstories and understories are often well developed and diverse. Alkaline Glades and Woodlands and Mafic Glades and Barrens support a patchy mosaic of open woodland and grassy herbaceous vegetation sometimes with a predominant woody short-shrub community present. The canopy species are species tolerant of dry, shallow soils, most

commonly chestnut oak, pines and eastern red cedar. Shrubs may be dense, with species determined by soil chemistry and often include redbud and fragrant sumac. The herb layer is usually fairly dense and dominated by grasses, both in treeless areas and beneath open canopy. The forbs include species characteristic of other rock outcrops and grassland species, with a smaller number of forest species present.

Because no desired condition is identified in terms of a 5 Box Model in the Forest Plan for Floodplains, Mafic and Alkaline Glades, or Cliff, Talus, and Shale, the Desired Condition in Table 3B1-1 is simply entered as 0 and no departure is presented. In all other ESGs, the Departure is presented as Desired Condition minus Existing Condition. Therefore a negative Departure indicates a desire for more of that successional stage/structure combination and a positive number less. In all of the major ESGs, there is a not enough early and open habitat and too much closed canopy conditions related to the desired condition, with the exception of mid-open in the cove ESG and that departure is less than a half of one percent.

We estimate an additional 385 acres of early, and 101 acres of open structure has been created on non-NFS lands as a result of prescribed and wildfire. This early structure equates to about 1% of the non-NFS lands and the open less than a half of one percent. We also estimate approximately 520 acres of recent harvesting on non-NFS lands resulting in approximately 900 acres of early structure on non-NFS lands equating to just under 1% of the entire analysis area. About 600 acres of this early is in Oak Forest and Woodlands and 250 acres in Pine Forest and Woodlands, with very small percentages in the other ESGs. This equates to an additional 1% (approximate) of early in both the Pine and Oak Forest and Woodlands when considering the entire analysis area. Again, without accurate age data we cannnot present this in terms of the 5 box model. However, if we assume that all of the early is created from the Late-Closed condition, then the overall conclusion regarding conditions in the entire analysis area remain unchanged. There is still too much late-closed and not enough early or open structure.

There are approximately 45 acres of existing grass/forbs openings in the form of wildlife clearings on NFS lands in the analysis area. An estimated 6,100 acres of pasture/agricultural/residential uses exist on non-NFS lands in the analysis area. Thus, approximately 6% of the analysis area is in a grass/forbs or analgous condition and the vast majority of that exists on non-NFS lands.

Old Growth: Currently approximately 22,800 acres of NFS lands are possible old growth, that is stands which meet one or more of the preliminary inventory criteria from Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forest in the Southern Region (R8 Guidance) (USDA 1997). These forested acres are inventoried in the FSVeg database with ages that are older than the minimum age specified for the relevant old growth community type. This represents about 23% of the entire analysis area. The spatial distribution of this possible old growth occurs in very large blocks with apparent connectivity; very few isolated stands of possible old growth are present. We cannot reliably estimate the amount of old growth on non-NFS lands since we do not have age data, but it is almost certainly a much lower percentage than that found on NFS lands.

Through the course of field surveys, several areas were identified as meeting the R8 Guidance criteria for inventorying old growth. All or portions of compartment/stands 981/55, 954/49, 955/30, 956/1, 956/16, 934/16, 916/37, 953/35, 984/33, and 1005/9 meet all four operational criteria defining old growth. These areas total approximately 110 acres.

Non-Native Invasive Plant Species (NNIPS): NNIPS are known to occur along open and seasonally open Forest Service Roads, on the Walton Tract, existing wildlife openings, and in the Mares Run area. Surveys also found isolated occurrences of NNIPS within or adjacent to proposed harvest

units, especially where they border non-NFS lands. Species known to exist in the area include but are not limited to crown vetch, garlic mustard, tree-of-heaven, shrub lespedeza, sericea lespedeza, Japanese stiltgrass, broadleaf plantain, heal-all, common comfrey, dandelion, autumn olive, black bindweed, common barberry, common chickweed, tall fescue, great mullen, multiflora rose, musk thistle, oxeye daisy, common periwinkle, poison hemlock, princess-tree, sweet yellow clover, common speedwell, common yellow wood sorrel, oriental bittersweet, coralberry, weeping lovegrass, and colt's foot.

B1.2 Direct, Indirect, and Cumulative Effects

Alternative 1 (No Action)

No vegetative treatment or prescribed burning would be implemented under this alternative. Conditions described in the 'Existing Condition' portion of this section would continue to exist over the landscape. Over time, this condition would change to a near exclusively closed canopy forest and early succession and open canopy conditions would be greatly diminished. Table 3B1-2 below shows the potential condition of the landscape in the year 2030 within the Lower Cowpasture project area if this Alternative were chosen.

Table 3B1-2 – Desired Condition, Cumulative Effect of Alternative 1 and Departure from Desired Condition of Vegetation on NFS Lands in the Lower Cowpasture Area in the year 2030.

ESG	Early	Mid - Closed	Mid - Open	Late - Open	Late - Closed	Grand Total
Cove						
DC %	4.00%	39.00%	0.00%	9.00%	48.00%	100%
Alt 1 %	0.88%	17.54%	0.00%	0.64%	80.96%	100%
Departure %	*-3.12%*	*-21.46%*	*0.00%*	*-8.36%*	*32.96%*	
Floodplains						
DC %	0.00%	0.00%	0.00%	0.00%	0.00%	
Alt 1 %	0.00%	6.94%	0.00%	0.00%	93.06%	100%
Departure %						
Mafic Glade/Alk. Glade						
DC %	0.00%	0.00%	0.00%	0.00%	0.00%	
Alt 1 %	0.00%	12.99%	0.00%	0.00%	87.01%	100%
Departure %						
Oak Forest and Woodlands						
DC %	12.00%	7.00%	10.00%	57.00%	14.00%	100%
Alt 1 %	2.00%	9.33%	0.00%	0.63%	88.04%	100%
Departure %	*-10.00%*	*2.33%*	*-10.00%*	*-56.37%*	*74.04%*	
Pine Forest and Woodlands						
DC %	13.00%	3.00%	25.00%	54.00%	5.00%	100%
Alt 1 %	3.73%	6.38%	0.00%	1.02%	88.87%	100%
Departure %	*-9.27%*	*3.38%*	*-25.00%*	*-52.98%*	*83.87%*	
Cliff, Talus, and Shale						
DC %	0.00%	0.00%	0.00%	0.00%	0.00%	
Alt 1 %	1.13%	2.39%	0.00%	0.74%	95.74%	100%
Departure %						
Total %	2.16%	8.95%	0.00%	0.70%	88.20%	100.00%

The long-term hard mast production capabilities in the area would be affected since the forest would become more mature thus decreasing the amount of forest in mast bearing ages (age 40-100). Stands would become older and less diverse while fire-adapted ecosystems would continue to change from plant communities dominated by species most beneficial to wildlife to species less resistant to fire. Over 88% of all NFS lands in the project area would be in the late successional, closed canopy condition with another 9% in mid-successional, closed canopy resulting in over 97% of the forested landscape characterized as closed canopy by the year 2030. Furthermore, yellow pine ecosystems are expected to decline in the project area due to age related death of dominant trees and lack of regeneration due to wildfire suppression and lack of adequate canopy gaps.

Catastrophic events, such as windstorms, wildfires, and ice damage cannot be predicted or assumed, so over time this alternative would allow for natural plant succession to progress toward the overall older-aged, closed canopy forest community as described above. This progressive aging of the forest would bring associated changes in the wildlife habitat capabilities, species richness, species composition, and species abundance.

Prescribed burns as part of the Warm Springs Mountain Restoration Project (WSMRP) would continue to be implemented. Approximately 9,800 acres of the WSMRP burns are acres yet to be implemented. Effects on vegetation would be determined on factors existing on the day of each individual burn. These factors include weather, topography, and human influences. Burns would only take place when within burning prescription as defined by the Forest and Regional fire staff. Creation and maintenance of early and late-open successional types would occur within each burn unit. The amount of early or open would vary by burn block due to the factors listed above but would be expected to follow canopy gap creation trends. These trends are reflected through a canopy gap analysis of the project area.

The Mares Run Vegetation Management Project is currently being implemented in the northwestern corner of the Lower Cowpasture project area. This project consists of 165 acres of regeneration harvest. These 165 acres will be early succession until canopy closure at which time it will fall into the mid-closed successional stage. These 165 acres comprise 0.2% of the total NFS lands in the Lower Cowpasture project area. By the year 2030 the canopies of these regenerated stands would be nearing closure.

Over time, the cumulative effects of this alternative would result in 2.16% early succession on NFS lands in the project area and about 0.7% in the open structural stage. The majority of this change would be in the oak ESG with most of the remaining in the pine ESG. These percentages are a direct result of the planned continued burning as a part of the WSMRP, which is exclusively located on the western side of the Lower Cowpasture project area.

All Action Alternatives

There are a number of silvicultural systems proposed for the Lower Cowpasture project area that includes different regeneration harvests and intermediate treatments. Below is a detailed explanation of silvicultural treatments used for all action alternatives.

Shelterwood with Reserves: This is a two-aged silvicultural system where two distinct age classes are maintained in the same stand and some or all of the shelter trees are retained after regeneration has become established to attain goals other than regeneration (Helms 1998). In the case of this project, the goals and objectives are typically wildlife driven. This prescription is used to create conditions favorable for establishment and growth of shade intolerant species while maintaining

scenic quality of the forest, maintaining some level of hard mast production, and increasing vertical diversity within the stands. This treatment would create an early successional condition.

The primary means of regeneration is from stump sprouts (coppice) of hardwood species. Coppice regeneration potential for oak is high but the probability that an oak stump sprout will become a dominant or co-dominant stem in the future stand decreases with increased tree diameter and age (Johnson 1977). Research has shown that the best opportunity to regenerate upland oak is by using existing advanced oak regeneration on site index 70 and above (Loftis 1990). The majority of the stands proposed for this type of harvest generally do not contain large advanced oak regeneration and are generally on site indices 70 and below, although there are some instances where this system is proposed on higher sites. In those instances, the forest types are oak dominated and stump sprouts are expected to carry over oak into the next stand.

A range of 15 to 25 square feet of basal area per acre would be retained in these stands and distribution of the residual trees would be clumped together. These trees would be carried forward indefinitely with the new regeneration. Some recent work by Stringer (2006) has shown this system of shelterwood with reserves to 'life boat' species that would otherwise be eliminated from a stand if the area were clearcut. This concept would be used to maintain species at risk of not being carried over into the new regenerated stand, such as oak species on higher sites. Species such as chestnut oak, northern red oak, and white oak would be retained to continue sexual reproduction and acorn production in the new stand.

Residual trees would be selected to meet management objectives and would consist of clumpings of den trees and large remnant trees and healthy oak and hickory that are expected to survive several more decades. Following harvest, site preparation would take place by slashing down residual trees between 1-inch and 6-inches dbh. The healthiest and largest soft mast producing trees (service berry and dogwood) would be retained.

Prescribed fire would be used when a shelterwood with reserves unit falls within a prescribed burn block. Cooper et. al. (1999) found that a high-intensity spring fire or a low to medium intensity summer fire conducted a few years following a regeneration harvest can enhance the competitive position of oak regeneration. This research is echoed by Brose et al (1999) finding high mortality of red maple and yellow poplar seedlings in a medium to high intensity spring fire 3 to 5 years after a shelterwood with reserves harvest.

<u>Traditional Shelterwood:</u> This is an even-aged regeneration method where most of the trees in a stand are cut, leaving those needed to produce sufficient shade to produce a new age class in a moderated microenvironment (Helms). A shelterwood typically consists of two entries, the first entry (called the establishment cut) leaves an overstory of dominant and co-dominant trees to 'shelter' the new age class emerging as a result of newly available growing space. The second entry (removal cut) typically takes place 10 to 15 years after the establishment cut and removes the overstory (or overwood). The time frame depends on the development of the new age class.

Approximately 40 to 50 square feet per acre of basal area (35% to 45% of the canopy) would be retained after the establishment cut to provide a partial shade environment and foster developing seedlings that are shade intermediate in tolerance, such as oak species. The residual trees would be evenly distributed through the treated stands. This type of environment would create a late successional, open canopy condition that would persist on the landscape for 10 to 15 years. After the removal cut, the successional stage would convert to early successional.

Stands that are slated for this type of treatment have relatively good site quality and tree size to allow for the second entry to be economically feasible. These stands also are on reasonably gentle slopes where damage to residual stems is less likely to occur.

Free Thinning: This is a cultural treatment made to reduce stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality (Helms). More specifically a free thinning removes trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position (Helms). The stands slated for this type of thinning in the Lower Cowpasture project would retain 40 to 50 square feet of basal area per acre (an average of 45) and is designed to leave large, healthy northern red, chestnut, and white oaks with crown ratios greater than 30%, den trees, and other hard mast producing species to make up the remainder of the residual basal area.

This treatment would look much like the first cut of the traditional shelterwood as described above. However, the residual stand would be slightly denser and would not be removed in the foreseeable future and the ultimate purpose is not to regenerate a new stand.

Prescribed fire is planned to be used in these stands in order to maintain the open conditions created by thinning. The stands would be considered in the late, open canopy successional class and be maintained in this state through the use of fire.

Thinning From Below: This is an intermediate treatment that removes trees from the lower crown classes to favor those in the upper crown classes (Helms). This treatment is specific to unit 34 in the Limekiln area equating to approximately 83 acres. This unit also straddles State Route 629 (Douthat State Park Road) and is in management prescription 7B (Scenic Corridor) making the protection of the visual resource an emphasis.

Generally 60 to 70 square feet of basal area per acre (no less than 50% canopy cover) would be retained leaving dominant and co-dominant oaks (primarily white and chestnut oaks). Trees from the suppressed and intermediate crown classes would be removed with the occasional co-dominant tree being removed to meet specific basal area targets. A late successional, open canopy condition would be created but would not be expected to be maintained due to the exclusion of fire.

This type of treatment may create favorable conditions for the development of large advanced oak regeneration due to a change in the light regime. Oak seedlings are shade intermediate in their tolerance to shade and growth in height and diameter is near maximum at light intensities between 50% and 70% of full sunlight (Dey 2002). Oak regeneration problems and reduction in oak stocking are more likely on higher quality sites (site index 70 and above) and appear to be successionally stable on poorer sites (site index less than 65) (Johnson 1993). Limekiln unit 34 is on a site index of 70 for upland oak. The goal of this prescription is to protect the visual resource while creating favorable light conditions so that oak species can develop in the understory and be able to be carried over into the future stand as natural succession occurs.

Hardwood Restoration: Stands that are identified for treatment under this prescription are typically around 40 years old and have been planted with white pine. Ecological concepts, such as succession, site quality, and physiography, has created an understanding that these stands are sites that are ideal for upland hardwoods. These stands were planted with white pine because of the species ability to grow wood fiber quickly and out-compete almost any other species on almost any quality of site. With a shift in focus toward landscape ecology and management, these sites are considered to be an uncharacteristic habitat condition. Although white pine was planted and is the

dominant species in these stands, there remains some hardwood species on site in a competitive crown position.

The prescription for these stands involves removing most or all white pine and retaining hardwood species. Since the distribution of hardwood species varies from acre to acre, it is not possible to give a specific basal area target for retention. Instead, the prescription would be based on current conditions on a stand to stand basis and residual basal area will vary with the presence of hardwood species. Residual canopy cover should generally be within the range of 20% to 60%. On the higher end of remaining canopy cover, this treatment is expected to result in a mid-successional, open canopy condition while lower residual canopy cover would be expected to create an early successional condition. The vast majority of material removed from these stands would be smaller-diameter trees utilized as either pulpwood or be chipped for use as biomass (Alternative 3 only).

Commercial Timber Stand Improvement: Stands slated for treatment under this prescription are between 30 and 50 years old and currently are in a mid-successional, closed canopy condition. Timber Stand Improvement (TSI) is an intermediate treatment made to improve the composition, structure, condition, health, and growth of stands (Helms). TSI can take on many forms from herbicide use to eliminate non-native invasive species to pruning branches to increase wood quality. The specific TSI treatment that would be implemented in the Lower Cowpasture project is known as an area-wide thinning. Area-wide thinning is a method of promoting the development of more desirable tree species or trees with better form and vigor. In the case of the Lower Cowpasture project, area-wide thinning would be utilized to enhance the crowns of hard mast producing species and increase the likelihood of these trees producing mast and surviving into the mature stand. Currently these stands average an 8-inch diameter at breast height (dbh). A typical mature hardwood stand in the Appalachians has approximately 50 dominant and co-dominant trees per acre (Smith and Lamson 1986). Using work by Roach and Gingrich (1968), a 100% stocked stand of 8-inch dbh trees equates to approximately 315 trees per acre and 105 square feet of basal are per acre. Only 50 of these 315 trees per acre would remain in the mature stand. Area-wide thinning allows for selection of those 50 trees per acre to meet habitat and Forest Plan objectives.

The prescription for these stands would use the Roach and Gingrich charts to thin down to the 'B-level' or 55% to 60% of fully stocked. This would leave approximately 170 trees per acre or about 60 square feet per acre of basal area. Much more than 50 trees per acre would remain so that stands would not be considered as understocked. This method of TSI would be done commercially and the material utilized mainly as biomass. Post-harvest, these stands would be in the mid-successional, open canopy condition but would be expected to revert back to a closed canopy 10 years after treatment.

Non-Commercial Silviculture Treatments: Non-commercial TSI would be performed given the same rationale of the area-wide thinning treatment described above. This type of TSI is known as crop tree release (CTR). The differences between the commercial area-wide thinning and CTR treatments are that stand age in the CTR is typically between 20 and 30 years old and only 20 to 25 trees per acre would be released. Trees to be cut would be specified as any tree whose crown is interfering with the development of the upper half of the selected crop tree's crown. In this project, 'interfering' would be defined as within five feet of the designated crop tree's crown. It is expected that more than 60% of the canopy would remain; therefore this treatment does not result in a change in structural condition per the 5 Box Models. These stands would remain in the mid-closed condition.

Site preparation would occur in regeneration harvests to enhance the regeneration success of desirable species. Competing undesirable vegetation 1" to 6" dbh would be cut and left on site.

A non-commercial thinning is also proposed. This treatment is similar to site preparation but would be performed in non-regeneration treatments. The purpose of this treatment is to improve the visual appearance of the commercially harvested stands by cutting spring-poles and broken saplings.

Lastly, non-native invasive plant species (NNIPS) would be controlled through chemical treatment. This treatment is proposed to be used in areas known to contain relatively large numbers of NNIPS (e.g. roadsides and Walton tract), as well as in harvested areas and would be assessed on a case by case basis depending on the severity of infestation at least one growing season post-harvest.

Alternative 2 (Proposed Action)

Under this alternative approximately 2,154 acres would be managed commercially using a combination of even-aged, two-aged, and intermediate systems of silviculture. Of this 2,154 acres, 949 acres would be harvested using a shelterwood with reserves method, 166 acres using the traditional shelterwood method, 163 acres harvested as a free thinning, 83 acres harvested using a thinning from below method, 534 acres of commercial timber stand improvement, and 259 acres of hardwood restoration.

Other activities under this alternative that affect the vegetation resource include prescribed burning in 13 separate blocks equaling 12,908 acres, non-commercial timber stand improvement on 1,450 acres, wildlife clearing construction on 320 acres, non-commercial thinning on 671 acres, site preparation in regenerated units on 949 acres, planting of American chestnut on 16 acres, and treatment of non-native invasive species on approximately 1,680 acres as needed.

Table 3B1-3 summarizes the direct effect of implementing Alternative 2. The table displays the departure analysis completed for this alternative that shows just how much the landscape has departed from the desired condition (DC) in the five successional classes. The table breaks out the major ESGs that exist in the project area. This analysis includes an estimate of the effect of prescribed fire in creating early and open structure based upon historic prescribed fire and examination of aerial imagery to identify early and open canopies within the burned areas in the Lower Cowpasture area. It should be noted that gains and losses in various categories in Table 3B1-3 may not equate directly to the treated acres due to the interaction of previous actions and fire. Some areas of proposed harvest include early or open areas created by fire, both wildland and prescribed and so not all acres in a regeneration harvest, for example, may result in a change in condition.

Oak Forest and Woodlands is the most dominant ESG making up approximately 66% of NFS lands within the project area. This is also the ecological zone where the majority of the vegetative treatments would occur. When compared to the existing condition, in this ESG alone, the amount of early succession increases by 4.1%, the late successional, closed canopy forest decreases by 5.3%, late, open increases by 1.5%, mid-successional, closed canopy decreases by 1.2% and mid, open increases nearly 1%. In the case of this ESG 1% represents approximately 516 acres.

The Pine Forests and Woodland would also be affected as this ESG makes up approximately 19% of the NFS lands in the project area. Fire would play an important role in creating and maintaining this ecotype on the landscape as much of the change in successional stages is due to prescribed fire as part of Alternative 2. Early succession in the pine forests would increase by 6.7% as a direct effect of implementing this alternative. Also, the late successional, open canopy forest would increase by 1.8% across this ESG.

All other ESGs are affected but to a much lesser degree than that of oak forests and pine forests and woodlands. The percent departure displayed in Table 3B1-3 shows the difference in the effect of the

proposed treatments and the DC of the landscape. Although 2,154 acres are proposed for commercial treatment and many more acres in other types of treatments, the Lower Cowpasture project is still highly departed from the DC but provides for more diversity of successional classes than the existing condition.

Table 3B1-3. Desired Condition, Direct Effect of Alternative 2 and Departure from Desired Condition of Vegetation on NFS Lands in the Lower Cowpasture Area.

ESG	Early	Mid - Closed	Mid - Open	Late - Open	Late - Closed	Grand Total
Cove						
DC %	4.00%	39.00%	0.00%	9.00%	48.00%	100%
Alt2 %	3.20%	34.63%	1.17%	0.89%	60.17%	100%
Departure %	*-0.80%*	*-4.37%*	*1.17%*	*-8.11%*	*12.17%*	
Floodplains						
DC %	0%	0%	0%	0%	0%	
Alt2 %	0.65%	46.45%	0.05%	0.08%	52.77%	100%
Departure %						
Mafic Glade/Alk. Glade						
DC %	0%	0%	0%	0%	0%	
Alt2 %	5.41%	7.76%	0.00%	8.29%	78.54%	100%
Departure %						
Oak Forest and Woodlands						
DC %	12.00%	7.00%	10.00%	57.00%	14.00%	100%
Alt2 %	9.18%	7.46%	0.91%	2.94%	79.48%	100%
Departure %	*-2.82%*	*0.46%*	*-9.09%*	*-54.06%*	*65.48%*	
Pine Forest and Woodlands						
DC %	13.00%	3.00%	25.00%	54.00%	5.00%	100%
Alt2 %	15.95%	5.15%	0.19%	3.42%	75.28%	100%
Departure %	*2.95%*	*2.15%*	*-24.81%*	*-50.58%*	*70.28%*	
Cliff, Talus, and Shale						
DC %	0.00%	0.00%	0.00%	0.00%	0.00%	
Alt2 %	5.87%	2.07%	0.08%	2.43%	89.54%	100%
Departure %						
Total %	9.69%	9.23%	0.74%	2.81%	77.51%	100%

Other direct impacts on vegetation include the shift of 320 acres of wooded vegetation to a grass/forb condition through the creation of wildlife openings representing less than one-half of one percent of the analysis area. The revegetation of approximately 16 acres of temporary roads, 24 acres of landings, and 4.5 acres of new dozer line would create an additional 44.5 acres of grass/forb habitat.

The effect of site preparation treatments on 949 acres would be a reduction in less desirable woody competition such as red maple, black gum, and sassafras in favor of more desirable hard mast producers, primarily oak and hickory species. These treatments are expected to enhance the adequate stocking of desirable species in regeneration harvests.

The effect of non-commercial TSI on 1,450 acres is somewhat similar with more desirable species such as oaks and hickory being released from any immediately adjacent stems that are competing for light and nutrients. Future hard mast production in these treated areas is expected to be improved.

Planting of hybrid American chestnut on approximately 1 acre of a "progeny style" test planting would be expected to further the understanding of the competitive status and blight resistance of the various hybrid families produced by The American Chestnut Foundation (TACF). This treatment would take place in the Mares Run area. Supplemental planting of hybrid American chestnut on approximately 15 acres of a harvest unit in the Pads Creek area may help re-establish some blight resistant chestnuts in the ecosystem.

The cumulative effects, in part, of implementing Alternative 2 are shown in Table 3B1-4. This is what the landscape in the project area is expected to reflect in the year 2030 (15 years after implementing the first projects). It would be around this time that the second entry of the traditional shelterwood treatment would be implemented. This treatment would create 166 acres of early succession across the landscape. It is likely that other vegetation management projects would be associated with this second entry but that cannot be predicted nor assumed. By 2030, this would be the only early succession created mechanically on National Forest in the project area. Table 3B1-4 shows a total of 4.47% early succession in the project area. The acreage is accounted for as prescribed fire would remain on the landscape as planned over time.

Cumulative actions include approximately 165 acres of regeneration harvest from the current Mares Run Timber Sale and about 9,800 acres of prescribed fire from the Warm Springs Mountain Restoration Project burns. The combined effect of these actions would be to increase the early successional stage by approximately 2% of the analysis area and a fraction of one percent of the analysis area to the open structural stage. About three quarters of the early acres are created in the Oak Forest and Woodlands with the Pine Forest and Woodlands receiving the bulk of the remaining 25%. Impacts to open structural conditions are much the same; 70% in the oaks and most of the remaining in the pines. The vast majority of these changes are coming from the late successional stage, thus the late stage is slightly reduced in the entire analysis area. Cumulatively, these actions move the landscape closer to the desired conditions for early and open in the Oak and Pine Forests and Woodlands, but are still well below those desired conditions.

Table 3B1-4 – Desired Condition, Cumulative Effect of Alternative 2 and Departure from Desired Condition of Vegetation on NFS Lands in the Lower Cowpasture Area.

ESG	Early	Mid - Closed	Mid - Open	Late - Open	Late - Closed	Grand Total
Cove						
DC %	4.00%	39.00%	0.00%	9.00%	48.00%	100%
Alt2 %	0.70%	18.22%	0.00%	0.54%	80.53%	100%
Departure %	*-3.30%*	*-20.78%*	*0.00%*	*-8.46%*	*32.53%*	
Floodplains						
DC %	0%	0%	0%	0%	0%	
Alt2 %	0.03%	7.02%	0.00%	0.03%	92.92%	100%
Departure %						
Mafic Glade/Alk. Glade						
DC %	0%	0%	0%	0%	0%	
Alt2 %	8.48%	12.98%	0.00%	0.00%	78.54%	100%
Departure %						
Oak Forest and Woodlands						
DC %	12.00%	7.00%	10.00%	57.00%	14.00%	100%
Alt2 %	4.49%	8.97%	0.00%	1.04%	85.49%	100%
Departure %	*-7.51%*	*1.97%*	*-10.00%*	*-55.96%*	*71.49%*	

ESG	Early	Mid - Closed	Mid - Open	Late - Open	Late - Closed	Grand Total
Pine Forest and Woodlands						
DC %	13.00%	3.00%	25.00%	54.00%	5.00%	100%
Alt2 %	6.83%	6.09%	0.00%	1.72%	85.36%	100%
Departure %	*-6.17%*	*3.09%*	*-25.00%*	*-52.28%*	*80.36%*	
Cliff, Talus, and Shale						
DC %	0.00%	0.00%	0.00%	0.00%	0.00%	
Alt2 %	2.57%	2.27%	0.00%	1.38%	93.77%	100%
Departure %						
Total %	4.47%	8.70%	0.00%	1.14%	85.68%	100.00%

Compared to Table 3B1-2, Alternative 2 in the year 2030 has some open canopy conditions remaining on the landscape (1.14% or approximately 885 acres) and maintains 2.3% more early succession. Some early and open conditions would occur from the continued use of fire in the WSMRP. Although still highly departed, the cumulative effect of Alternative 2 results in more diverse habitat across the landscape.

Old Growth: All stands proposed for harvesting were analyzed per Forest Plan direction and using the Region 8 guidance for inventorying old growth.

A field review was conducted for old growth in all mature stands proposed for harvest in this project. The field review specifically looked at the four criteria set forth in the regional guidance: 1) minimum age of the oldest age class, 2) disturbance criteria, 3) minimum basal area, and 4) diameter at breast height of the largest trees. While several stands were identified as meeting all four operational definitions as old growth, upon further review of the area after the scoping notice was released, four more units were determined to exhibit old growth characteristics. This alternative includes those units and will analyze the effects of harvesting in all units.

Alternative 2 would regenerate 949 acres, of which 96 acres meet the criteria for old growth. The specific areas that meet old growth criteria are Lime Kiln unit 5 (981/55) for 23 acres and a 17 acre portion of Lime Kiln unit 31 (916/37). Sandy Springs units 3 (984/33) and 6 (1005/9) for 26 and 30 acres, respectively, are the other two units meeting the old growth criteria. This amounts to 10% of the proposed regeneration harvests and 0.1% of the project area as a whole. The regeneration harvests equate to 1.2% of NFS lands within project area.

A result of implementing Alternative 2 would be a loss of 96 acres of old growth, which may have impacts on wildlife habitat as well as biological diversity. Cumulatively, the continued aging of the forest would progress toward old growth conditions as defined by the regional guidance. By the year 2030 there would be a net gain in forests in the late successional class even if these 96 acres were harvested. Approximately 88% of the project area would be in this late successional stage compared to 84% in the existing condition.

Fire is a natural disturbance process common to most old growth communities, but is very infrequent in northern hardwoods, spruce/fir, and riverfront forests (USDA 1997; Trombulak 1996). Thus, the impact of prescribed fire would not be expected to affect overall amount of old growth across the analysis area, but instead would restore and maintain vegetation in species composition and structure more typical of the fire regime these forests experienced prior to active fire suppression (~1930s) (adapted from Forest Plan FEIS).

Cumulative actions include the removal of the residual trees in the traditional shelterwood treatments in 10-15 years. This treatment would reset stand age in those stands. Considering the proposed action and these cumulative actions, just over 40,000 acres of NFS lands would be possible old growth. This represents approximately 40% of the analysis area. The spatial distribution of this possible old growth occurs in very large blocks with apparent connectivity; very few isolated stands of possible old growth would be present.

Non-native Invasive Plants: Any activities that cause disturbance and/or opening-up of the forest canopy have the potential to facilitate the introduction and spread of invasive plants. The level of disturbance it takes to do so varies by species, habitat type disturbed, and environmental conditions. As a result, harvesting proposed under Alternative 2 is expected to create conditions that could increase the spread of invasive plants.

Although the increase in light and disturbance from these treatments could increase the spread of existing invasive species, this is expected to be short-term. Past Forest monitoring has shown that within 10 years, herbaceous and shrubby vegetation are overtopped and are subsequently shaded out. Invasive tree species, such as tree-of-heaven and princess-tree, would be treated as these species would not become overtopped and quickly become a part of the upper canopy of a stand. The use of chemicals to pre-treat invasive species in harvest units and areas identified for transportation access may also occur to prevent further spread of invasive species.

Under Alternative 2, approximately 1,680 acres would be treated chemically to prevent the spread of invasive plants. These areas include Walton Tract, areas along Forest Service roads, and the regeneration harvests (shelterwood with reserves and traditional shelterwood). There is a Forest-wide environmental document that discloses the effects of using herbicide on National Forest System lands. The herbicides to be used would be glyphosate or triclopyr depending on the species targeted. The need for this treatment would be assessed on a case by case basis depending upon the severity of any invasive plant infestation one growing season after harvest. The implementation of herbicide use at the Walton Tract and along Forest Service roads would be performed as individual plants are identified.

Alternative 3 (Preferred Alternative)

Under this alternative approximately 1,969 acres would be managed commercially using a combination of even-aged, two-aged, and intermediate systems of silviculture. Of this 1,969 acres, 837 acres would be harvested using a shelterwood with reserves method, 166 acres using the traditional shelterwood method, 163 acres harvested as a free thinning, 83 acres harvested using a thinning from below method, 500 acres of commercial timber stand improvement, and 220 acres of hardwood restoration.

Other activities under this alternative that affect the vegetation resource include prescribed burning in 11 separate blocks equaling 11,971 acres, non-commercial timber stand improvement on 1,467 acres, wildlife clearing construction on 297 acres, non-commercial thinning on 544 acres, site preparation in regenerated units on 837 acres, and treatment of non-native invasive plant species on approximately 1,200 acres associated with mechanical treatments as well as the 280 acres associated with roads, fields, and wildlife openings. The need for NNIPS treatment will be assessed on a case by case basis depending upon the severity of any NNIPS infestations one growing season after harvest. It is anticipated that most regeneration treatments and many shelterwood and hardwood restoration treated areas will require this follow-up chemical treatment.

Table 3B1-5 summarizes the direct effect of implementing Alternative 3 on vegetative conditions in terms of structural diversity (successional stage and canopy conditions) by ESG on NFS lands only.

This analysis includes an estimate of the effect of prescribed fire in creating early and open structure based upon historic prescribed fire and examination of aerial imagery to identify early and open canopies within the burned areas in the Lower Cowpasture area. It should be noted that gains and losses in various categories in Table 3B1-5 may not equate directly to the treated acres due to the interaction of previous actions and fire. Some areas of proposed harvest include early or open areas created by fire, both wildland and prescribed, and so not all acres in a regeneration harvest, for example, may result in a change in condition.

Table 3B1-5 – Desired Conditions, Direct Effect of Alternative 3, and Departure from Desired Condition of Vegetation on NFS lands in the Lower Cowpasture Area

ESG	Early	Mid - Closed	Mid - Open	Late – Open	Late - Closed	Grand Total
Cove						
DC %	4.00%	39.00%	0.00%	9.00%	48.00%	100%
Alt3 %	2.85%	34.75%	1.17%	0.94%	60.29%	100%
Departure %	*-1.15%*	*-4.25%*	*1.17%*	*-8.06%*	*12.29%*	
Floodplains						
DC %	0%	0%	0%	0%	0%	
Alt3 %	0.65%	46.46%	0.04%	0.08%	52.77%	100%
Departure %						
Mafic Glade/Alk. Glade						
DC %	0%	0%	0%	0%	0%	
Alt3 %	5.41%	7.76%	0.00%	8.29%	78.54%	100%
Departure %						
Oak Forest and Woodlands						
DC %	12.00%	7.00%	10.00%	57.00%	14.00%	100%
Alt3 %	8.99%	7.52%	0.85%	2.92%	79.67%	100%
Departure %	*-3.01%*	*0.52%*	*-9.15%*	*-54.08%*	*65.67%*	
Pine Forest and Woodlands						
DC %	13.00%	3.00%	25.00%	54.00%	5.00%	100%
Alt3 %	15.62%	5.16%	0.19%	3.34%	75.69%	100%
Departure %	*2.62%*	*2.16%*	*-24.81%*	*-50.66%*	*70.69%*	
Cliffs, Talus, and Shale						
DC %	0.00%	0.00%	0.00%	0.00%	0.00%	
Alt3 %	5.80%	2.07%	0.08%	2.41%	89.64%	100%
Departure %						
Total %	9.47%	9.28%	0.70%	2.79%	77.74%	100%

As was the case for Alternative 2, the effect of Alternative 3 occurs primarily in the Pine Forest and Woodlands and the Oak Forest and Woodlands. While both mechanical and fire treatments affects both ESGs, especially when used in combination, fire is generally expected to affect the structure in pine communities more, and mechanical treatments would impact oak communities. For the Pine Forest and Woodland ESG, early successional stage is increased by about 6.4% and open structural stages are increased by about 1.8% when compared to the existing condition. Much of this is created from the late-closed condition, which is reduced by approximately 7.8%. Impacts are somewhat similar for the Oak Forest and Woodland ESG: both early and open conditions are increased by 3.9% and 2.2% respectively and much of this is created from the late-closed condition, which is reduced by approximately 5%. In summary, this alternative moves toward the overall desired condition of the area by increasing the early, late-open, and mid-open vegetation conditions and reducing the amount of closed vegetation.

All other ESGs are affected but to a much lesser degree than that of Oak and Pine Forests and Woodlands. The percent departure displayed in Table 3B1-5 shows the difference in the effect of the proposed treatments and the DC of the landscape.

Other direct impacts on vegetation include the shift of 297 acres of wooded vegetation to grass/forb vegetation through the creation of wildlife openings. The revegetation of approximately 15 acres of temporary roads, 22 acres of landings, and 3.5 acres of new dozer line would create an additional 41 acres of grass/forb habitat. This represents less than one-half of one percent of the analysis area, bringing the total percentage of such habitat up to approximately 6.5%.

The effect of site-preparation treatments on 837 acres would be a reduction in less desirable woody competition such as red maple, black gum, and sassafras in favor of more favored hard mast producers, primarily oak and hickory species. These treatments are expected to enhance the adequate stocking of desirable species in regeneration harvests.

The effect of non-commercial TSI on 1,467 acres is somewhat similar; more desirable species such as oaks and hickory are released from any immediately adjacent stems that are competing for light and nutrients. Future hard mast production in these treated areas is expected to be improved.

The vegetative impact of NNIPS treatment on roughly 1,500 acres would be to reduce the incidence of species such as oriental bittersweet, ailanthus, autumn olive, multiflora rose, etc. on those acres. This in turn would reduce the seed production of these species and decrease the incidence of future colonization of disturbed areas throughout the entire analysis area. NNIPS treatment would also provide an opportunity for native vegetation to reoccupy some sites dominated by NNIPS.

The impact of planting hybrid American chestnut would be identical as that stated under Alternative 2.

The future effects to successional and canopy conditions on NFS lands as a result of implementing Alternative 3 are shown in Table 3B1-6. This is what the landscape in the project area is expected to reflect in the year 2030 (15 years after implementing the first projects). It would be around this time that the second entry of the traditional shelterwood treatment would be implemented. This treatment would create 166 acres of early successional habitat across the landscape. It is likely that other vegetation management projects would be associated with this second entry but that cannot be predicted nor assumed. For this analysis it is assumed that thinnings that originally created open conditions would close by 2030 unless they were within a prescribed fire treatment. We also assumed that an early or open conditions created by prescribed fire were simply maintained by subsequent fire entries as opposed to additional acres of early or open being created.

Cumulative actions include approximately 165 acres of regeneration harvest from the current Mares Run Timber Sale and about 10,278 acres of prescribed fire from the Warm Springs Mountain Restoration Project and the Pine Spur Ridge and Brown Hollow burns that partially occur within the boundaries of Douthat State Park. The combined effect of these actions would be to increase the early successional stage by 1.6% of the analysis area and about one half of one percent of the analysis area to the open structural stage. About three quarters of the early acres are created in the Oak Forest and Woodlands with the Pine Forest and Woodlands receiving the bulk of the remaining 25%. Impacts to open structural conditions are much the same; 70% in the Oaks and most of the remaining in the Pines. The vast majority of these changes are coming from the late successional stage, thus the late stage is slightly reduced in the entire analysis area. Cumulatively, these actions move the landscape closer to the desired conditions for early and open in the Oak and Pine Forests and Woodlands, but are still well below those desired conditions.

Table 3B1-6 - Desired Conditions, Cumulative Effects of Alternative 3, and Departure from Desired Condition of Vegetation on NFS lands in the Lower Cowpasture Area in the Year 2030.

ESG	Early	Mid - Closed	Mid - Open	Late - Open	Late - Closed	Grand Total
Cove						
DC %	4.00%	39.00%	0.00%	9.00%	48.00%	100%
Alt3 %	0.77%	17.81%	0.00%	0.58%	80.84%	100%
Departure %	*-3.23%*	*-21.19%*	*0.00%*	*-8.42%*	*32.84%*	
Floodplains						
DC %	0%	0%	0%	0%	0%	
Alt3 %	0.00%	7.01%	0.00%	0.00%	92.93%	100%
Departure %						
Mafic Glade/Alk. Glade						
DC %	0%	0%	0%	0%	0%	
Alt3 %	8.48%	12.98%	0.00%	0.00%	78.54%	100%
Departure %						
Oak Forest and Woodlands						
DC %	12.00%	7.00%	10.00%	57.00%	14.00%	100%
Alt3 %	4.25%	9.02%	0.01%	1.03%	85.70%	100%
Departure %	*-7.75%*	*2.02%*	*-9.99%*	*-55.97%*	*71.70%*	
Pine Forest and Woodlands						
DC %	13.00%	3.00%	25.00%	54.00%	5.00%	100%
Alt3 %	6.47%	6.12%	0.00%	1.64%	85.77%	100%
Departure %	*-6.53%*	*3.12%*	*-25.00%*	*-52.36%*	*80.77%*	
Cliffs, Talus, and Shale						
DC %	0.00%	0.00%	0.00%	0.00%	0.00%	
Alt3 %	2.48%	2.30%	0.00%	1.36%	93.87%	100%
Departure %						
Total %	4.24%	8.71%	0.00%	1.12%	85.93%	100%

Compared to Table 3B1-2, Alternative 3 in the year 2030 maintains more early and open structure at 2% and 0.4% more, respectively. Although still highly departed, the cumulative effect of Alternative 3 results in more diverse habitat across the landscape.

Old Growth: Alternative 3 avoids harvesting any area identified as meeting all four operational criteria defining old growth in the R8 Guidance. Therefore, no direct impact to old growth forests as a result of harvesting is expected. Indirectly, approximately 212 acres would be regenerated that would otherwise have moved into the possible old growth category in 15 years. Cumulative actions include the removal of the residual trees in the traditional shelterwood treatments in 10-15 years. This treatment would reset stand age in those stands. Considering this preferred alternative and these cumulative actions, just over 40,000 acres of NFS lands would be possible old growth. This represents approximately 40% of the analysis area. The spatial distribution of this possible old growth occurs in very large blocks with apparent connectivity; very few isolated stands of possible old growth would be present.

B2 – Mast Production

Issues Related to the Resource

No project issues were identified specifically relating to mast production.

Scope of the Analysis

The geographic scope of this vegetation analysis for terrestrial plants and animals is the LCRMP area. The projects direct vegetation management will occur in Management Area 13, also known as Mosaics of Wildlife Habitat; with some vegetation management occurring in Scenic Corridors known as Management Area 7B. A summary of mast production of lands considered suitable for timber harvest was also included, as much of the LCRMP is designated to areas where old forest will predominate (Wilderness, Remote Backcountry etc.). The temporal bounds include past harvest, prescribed burns, and wildfire activities that affect the current vegetative condition in the project area and any foreseeable vegetative manipulation within the next 15 years. This analysis also projects forest mast production 40+ years in the future. Vegetative changes from disturbances such as wind, ice storms, and small wildfires are generally not mapped or tracked in the Forest vegetation layers. Changes in vegetation resulting in proposed prescribed burns were predicted using averages and observations of past prescribed burns on the Warm Springs and James River Districts.

B2.1 Introduction

The hard nutty fruit of oaks, hickory, beech, and chestnut trees are known collectively as hard mast. Hard mast provides a vital food source for many game and nongame wildlife including mice, voles, opossum, woodrats, rabbits, raccoons, foxes, quail, grouse, turkey, mallards, wood ducks, various woodpeckers, jays, nuthatches, titmice, towhees, among others. The MIS species of northern flying squirrel, black bear, whitetail deer, pileated woodpecker, and wild turkey rely heavily on mast production for survival and fitness. The relationship between mast and the food habits of several game species, such as deer, bear, and squirrels has been documented extensively (Kirkpatrick 1989, Kurzejeski 1989, Pelton 1989, Wentworth and others 1989, Fridell and Litvaitis 1991). Some larval forms of insects, including weevils and moths, require acorns for food and shelter (Williams 1989). These insects, in turn provide invertebrate food sources for other species as well.

Hard mast is an especially critical energy source for winter survival and hibernation. Providing potential sources of hard mast through time is an integral part of wildlife management on the George Washington National Forest (GWNF). Over 25% of the management indicator species utilize hard mast as a seasonal food source. Many factors affect the production of mast including site productivity, crown and basal area, climate and site microclimate, genetics, among many other variables. In general, the timeframe of 40 and 100 years old represents the ages of *primary mast production* in the timber types dominated by mast bearing trees (Burns and Honkala 1990). These vigorous stands will become more rare in management areas where late successional to old growth conditions will prevail (i.e. MA 1A and 12D), particularly under fire suppression conditions. This is not to say that mast production will be nonexistent in the Late-closed conditions across much of the George Washington NF landscape, but that mast production will generally decline through time. Having a mosaic of stand ages across the landscape has long been a general strategy to ensure that consistent acorn crops for regeneration and wildlife forage are attained. (Christisen 1955, Collins 1961).

B2.2 Analysis Methods

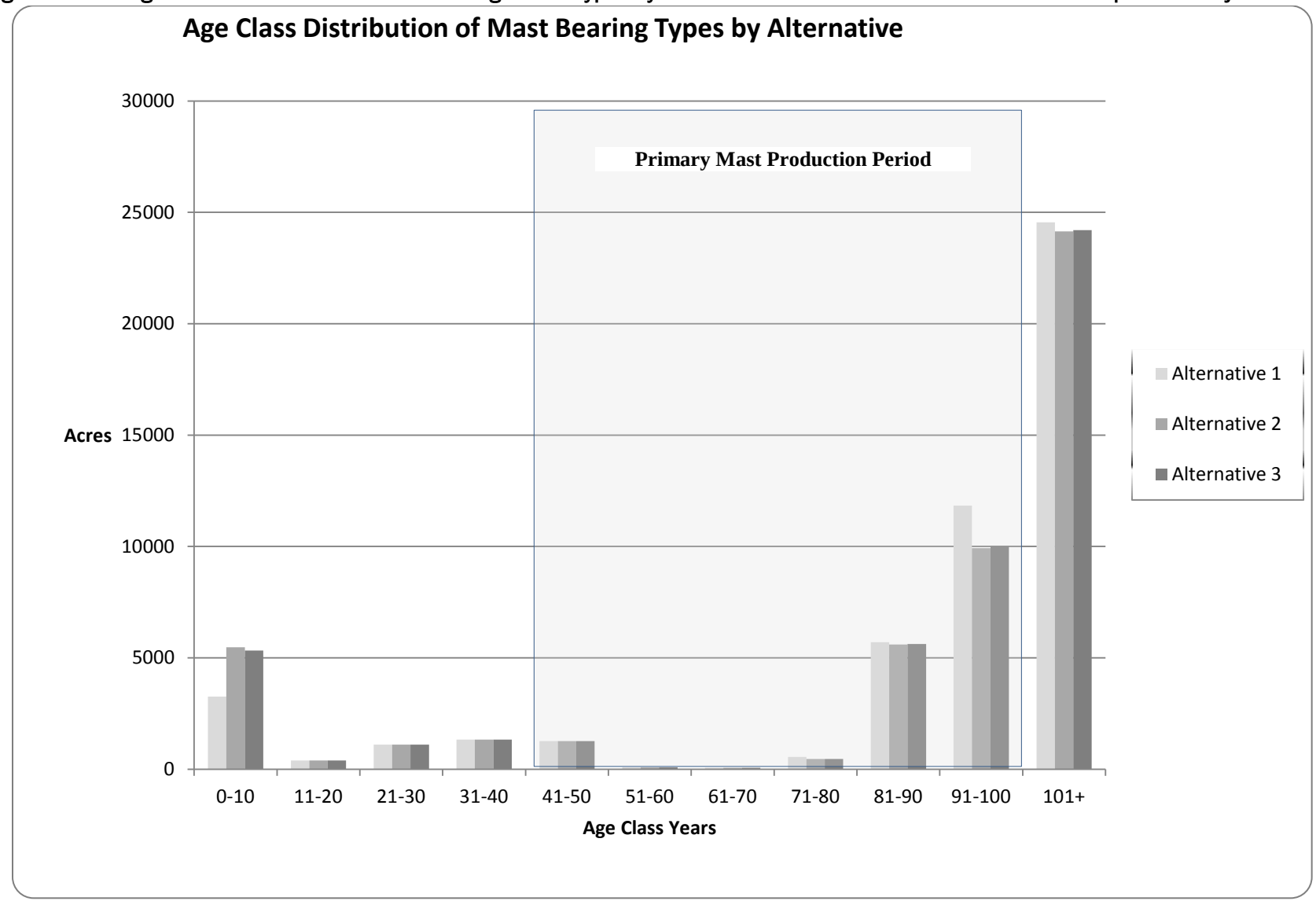
This analysis was conducted using current and predicted forest stand conditions throughout the project area on different spatial scales. The analysis of mast production focuses on forest type and forest age distribution. When a stand is regenerated through timber harvest or prescribed fire, the stand is considered zero years old immediately afterwards. For this project Hardwood Restoration and Shelterwood with Reserves treatments would reset the age to zero. The Shelterwood treatments would reset to the zero age class in 15 years upon re-entry. It is assumed that stand age would not change for all intermediate treatments. It was also assumed that all harvest would occur simultaneously, typically however, timber sale contracts are two to three years in length and the LCRMP represents at least 10 years of ground activities. To determine the resulting age-class distribution following completion of each alternative, all stand age changes are projected to occur in the year 2015, however the trends and percentages are consistent regardless of the particular year the activity takes place.

B2.3 Existing Condition

The compartments encompassed by the LCRMP boundary are composed of a mixture of forest types and ages that are the result of site quality, past harvest, and natural disturbances. Currently approximately 74% of the forested stands in the LCRMP are dominated by hard mast producing tree species (hardwood and hardwood-pine forest types). The remaining 26% of stands do not produce hard mast. This analysis will focus on the land base as a whole and not just those stands that can produce mast.

Overall, 26% of the total project area is in primary mast production age classes (40-100 yrs old), of those stands (60%, 12000+ acres) are in the 90-100 year age class and soon will decline in mast production. A general breakdown of primary mast production is presented in Figure 3B2-1. These numbers include the existing conditions from past harvest and prescribed fire as well as changes in age class from vegetative treatments, predicted changes from proposed prescribed burns, and permanent loss of production due to conversion to permanent grassy openings. This does not include cumulative effects from the Mares Run timber sale or any vegetative changes from the Warm Springs Mountain Restoration project prescribed fire.

Figure 3B2-1. Age Class Distribution of Mast Bearing Forest Types by Alternative on NFS lands within the Lower Cowpasture Project Area.



B2.4 Direct and Indirect Effects

Direct and Indirect Effects-Alternative 1

No new vegetation treatments would occur under Alternative 1. In the project area approximately 18,000 acres will be aging out of primary mast production within the next forty years. In contrast, 6,000 acres of previously regenerated stands will be moving into primary mast production over this same period. Much of these regeneration acres are a direct result of Easter Complex wildfires and previous prescribed burns. This will result in an overall decrease of 12,000 acres (61% of current production) in mast production in the year 2055 if no vegetative management were to occur. Suitable timber lands are also included in Table 3B2-1 to provide a general idea of the mast production on lands where active management occurs. Suitable lands represent approximately 35% of the NFS lands of the LCRMP.

Table 3B2-1. Primary Mast Production by Alternative

Area	% in Mast Bearing Timber Types	% of Entire Area in Primary Mast Production 2015	% of all Mast bearing types in Primary Production	% of Entire Area in Primary Mast Production 2055
Entire LCRMP	73.6	24.6	35.7	9.4
Suitable timber lands	79.7	32.1	40.3	24.0
Entire LCRMP				
Alternative 1	73.6	24.6	35.7	9.4
Alternative 2	73.6	21.9	31.8	12.2
Alternative 3	73.6	22.1	32.1	12.0

The indirect effect of the no action alternative would be a continued lowering of forest mast production in the future and a continued decline in fall foraging habitat quality for those species that utilize hard mast.

Direct and Indirect Effects-Alternative 2

Alternative 2 would result in the estimated initial loss of approximately 2,220 acres (2.7%) of forest types currently in primary mast production. This takes place in the form of regeneration harvest and canopy gap production from planned prescribed burns. Some timber harvest and burning activities will occur in non-mast-bearing timber types and some activities occur in aged stands not in primary production. In addition, shelterwood cuts would continue to produce mast for an additional 15 years until re-entry removal of the residual trees. This alternative will result in the most future mast production and increase primary mast production acreage by 2.7% by the year 2055 (28% more than Alt.1).

Alternative 2 would increase early successional habitat component and edge habitat required by many wildlife species in the near future while eventually providing future, highly productive mast-bearing stands. Several stands in the LCRMP are in need of thinning to promote healthier forest conditions and to improve overall diversity and benefits to wildlife. Thinning will release and promote the growth and succession of future mast-bearing trees. Prescribed burns will result in more open woodlands (see vegetation section for departure analysis) that could provide an increase in mast production from released trees and improved oak regeneration. Alternative 2 would remove 271 acres permanently from mast production in the form of grassy wildlife clearings.

Direct and Indirect Effects-Alternative 3

Alternative 3 would result in the estimated initial loss of approximately 2075 acres (2.5%) of forest types currently in primary mast production. This takes place in the form of regeneration harvest and gap production from planned prescribed burns. Some timber harvest and burning activities will occur in non-mast-bearing timber types and some activities occur in aged stands not in primary production. In addition, shelterwood cuts would continue to produce mast for an additional 15 years until re-entry removal of the residual trees. This alternative will result in the future mast production and increase primary mast production acreage by 2.5% by the year 2055 (27% more than Alt.1).

Alternative 3 would increase early successional habitat component and edge habitat required by many wildlife species in the near future while eventually providing future, highly productive mast-bearing stands. Several stands in the LCRMP are in need of thinning to promote healthier forest conditions and to improve overall diversity and benefits to wildlife. Thinning will release and promote the growth and succession of future mast-bearing trees. Prescribed burns will result in more open woodlands (see vegetation section for departure analysis) that could provide an increase in mast production from released trees and improved oak regeneration. Alternative 3 would remove 248 acres permanently from mast production in the form of grassy wildlife clearings.

B2.5 Cumulative Effects

Cumulative Effects- All Alternatives

Under all of the alternatives, the LCRMP area will see the completion of the Mares Run Timber Sale and the continued prescribed burning of the Warm Springs Mountain Restoration Area.

Prescribed burns as part of the Warm Springs Mountain Restoration Project (WSMRP) would continue to be implemented. Approximately 9,800 acres of the WSMRP burns are acres yet to be implemented. Effects on vegetation would be determined on factors existing on the day of each individual burn. These factors include weather, topography, and human influences. Burns would only take place when within burning prescription as defined by the Forest and Regional fire staff. Creation and maintenance of early and late-open successional types would occur within each burn unit. The amount of early or open would vary by burn block due to the factors listed above but would be expected to follow canopy gap creation trends. These trends are reflected through a canopy gap analysis of the project area.

The Mares Run Vegetation Management Project is currently being implemented in the northwestern corner of the Lower Cowpasture project area. This project consists of 165 acres of regeneration harvest. These 165 acres will be early succession until canopy closure at which time it will fall into the mid-closed successional stage. These 150 acres comprises 0.2% of the total NFS lands in the Lower Cowpasture project area. By the year 2030 the canopies of these regenerated stands would be nearing closure.

Over time, the cumulative effects of this alternative would result in 2.16% early succession on NFS lands in the project area and about 0.7% in the open structural stage. The majority of this change would be in the oak ESG with most of the remaining in the pine ESG. These percentages are a direct result of the planned continued burning as a part of the WSMRP, which is exclusively located on the western side of the LCRMP area.

The long-term hard mast production capabilities in the area would be affected by the addition of nearly 2% increase in mast production in 40 years. The majority of the forest would continue to mature thus decreasing the amount of forest in mast bearing ages.

B3 – Wildlife

Issues Related to the Resource
No project issues were identified specifically relating to wildlife.

Scope of the Analysis
The geographic scope of this biological analysis for terrestrial plants and animals is the LCRMP project area. The geographic scope of this analysis for aquatic organisms includes the aquatic habitats within the project area and those geographic bounds of the Water Quality analysis. The temporal bounds include past harvest activities that affect current fish and wildlife habitat in the project area and any reasonably foreseeable management activities within the next 10 years. This assessment also analyzes forest habitat and mast production to 40 years in the future. Wildlife and fish species on National Forest lands are managed in cooperation with the Virginia Department of Game and Inland Fisheries (VDGIF). The VDGIF sets policy for hunting and fishing and law enforcement programs. The Forest Service, on the other hand, manages wildlife habitat conditions.

B3.1 Introduction

Native wildlife species have varying habitat requirements, critical habitat components, and ecosystem preferences. As part of a strategic plan for species diversity, the GWNF developed the Species Diversity Report (FEIS Appendix F) as a supplement to the Ecosystem Diversity Report (Forest Plan FEIS, Appendix E), which describes how the ecological characteristics for ecosystems on the GWNF were identified and incorporated into the Plan. To assess species diversity, a comprehensive list of plant and animal species was compiled by combining species lists from a variety of sources. Federally threatened and endangered species (T&E), sensitive species, locally rare species and other species with management concerns (e.g., demand species) were identified and a total of 295 species were evaluated. Species were then linked to the terrestrial ecological systems. Where appropriate, species were grouped before linking them to systems. Many species needing differing habitat characteristics throughout their life cycle occurred in multiple groups. All species have at least some of their needs covered by ecosystem diversity, but some species required additional plan components based on their major limiting factors. These components are described in the Forest Plan Chapter 3 and Chapter 4.

Timber harvest, prescribed fire, mechanical clearing, water source development, and other activities can provide for the ecological needs of wildlife species through a mosaic of different age classes and habitats, well distributed throughout the planning area. This mosaic helps ensure that critical habitat requirements are available on the landscape, when localized habitat conditions are lacking.

B3.2 Analysis Method

The Forest Plan identifies 14 management indicator species and considers all 10 federally listed species that occur on the GWNF (Tables 3B3-1 and 3B3-2). Forest MIS populations are monitored at the Forest level and the effects of management actions on MIS are considered at the local scale. MIS are used to monitor and/or estimate the impacts of activities on overall ecosystems. These

species are used as indicators for groups of organisms that occupy similar niches or are related within the same ecosystem (i.e. they depend upon each other or upon a common factor within the ecosystem).

Table 3B3-1. MIS Species of the George Washington Forest Plan

Common Name	Category (s)	Reason for Selection
Cow Knob Salamander	Special Interest Species Indicator	Indicates effectiveness of management activities designed specifically to meet conservation objectives for this Forest Service Sensitive species
Pileated Woodpecker	Special Habitat Indicator	Indicates the effectiveness of management in maintaining desired condition relative to abundance of snags
Ovenbird	Special Habitat Indicator	Indicates the effectiveness of management in maintaining desired conditions relative to forest interior habitat within mature mesic deciduous forests
Chestnut-sided Warbler	Special Habitat Indicator	Indicates effectiveness of management in achieving desired conditions within high elevation early successional habitats
Acadian Flycatcher	Special Habitat Indicator	Indicates the effectiveness of management in achieving desired conditions within mature riparian habitats
Hooded Warbler	Biological Community Indicator	Indicates the effectiveness of management at providing dense understory and midstory structure within mature mesic deciduous forests
Scarlet Tanager	Biological Community Indicator	Indicates effectiveness of management at establishing desired conditions in drier mid- and late-successional oak and oak-pine forests
Pine Warbler	Biological Community Indicator	Indicates effectiveness of management at maintaining mature pine forests
Eastern Towhee	Biological Community Indicator	Indicates effectiveness of management in achieving desired conditions in early successional habitats
Wild Brook Trout	Biological Community Indicator, Demand Species Indicator	Indicates effects of acidification of stream systems, and the effectiveness of management in mitigating these effects and effectiveness of management in meeting public demand for this species
Eastern Wild Turkey	Demand Species Indicator	Trends in harvest levels and hunting demand will be used to indicate effectiveness of management in meeting public demand for this species
Black Bear	Demand Species Indicator	Trends in harvest levels and hunting demand will be used to indicate effectiveness of management in meeting public demand for this species
Deer	Demand Species Indicator	Trends in harvest levels and hunting demand will be used to indicate effectiveness of management in meeting public demand for this species
Beaver	Riparian Ecological System Indicator	Indicates wetland restoration

Table 3B3-2. Federally Threatened and Endangered Species of the GWNF

Species	Federal Status	Primary Ecosystem(s)
Indiana Bat	Endangered	Caves and Karstlands
Virginia Big-Eared Bat	Endangered	Caves and Karstlands
Virginia Northern Flying Squirrel	Endangered	Spruce & Northern Hardwood Forests
James Spinymussel	Endangered	Floodplains, Wetlands and Riparian Areas
Madison Cave Isopod	Threatened	Caves and Karstlands
Shale Barren Rock Cress	Endangered	Appalachian Shale Barrens
Smooth Cone Flower	Endangered	Central Appalachian Alkaline Glade and Woodland
Virginia Sneezeweed	Threatened	Floodplains, Wetlands and Riparian Areas
Swamp Pink	Threatened	Floodplains, Wetlands and Riparian Areas
Northeastern Bulrush	Endangered	Floodplains, Wetlands and Riparian Areas

The general effects of each alternative on these MIS and their habitat needs will be discussed in separate sections dealing with demand species, ecological indicators, and threatened and endangered species. Discussion will center on actual and relative differences of each alternative on habitat factors, vegetative changes, and ecological system group differences, now and in the future. The action alternatives (2 & 3) will be discussed together as the relative differences between then are slight in regards to wildlife and fisheries habitat. Table 3B3-3 displays those MIS that were known to or had some possibility to be present in the project area, in the grouping that corresponds to each following section.

Table 3B3-3. MIS and TEP Species of the Lower Cowpasture

Management Indicator Species (MIS)	Threatened & Endangered Proposed Species (TEP)
Pileated Woodpecker	Indiana Bat (E)
Ovenbird	James Spinymussel (E)
Chestnut-sided Warbler	Shale Barren Rock Cress (E)
Acadian Flycatcher	Northern Long-eared Bat (P)
Hooded Warbler	
Scarlet Tanager	
Pine Warbler	
Eastern Towhee	
Beaver	
Wild Brook Trout	
Eastern Wild Turkey	
Black Bear	
Deer	

E = Endangered, P = federally proposed endangered

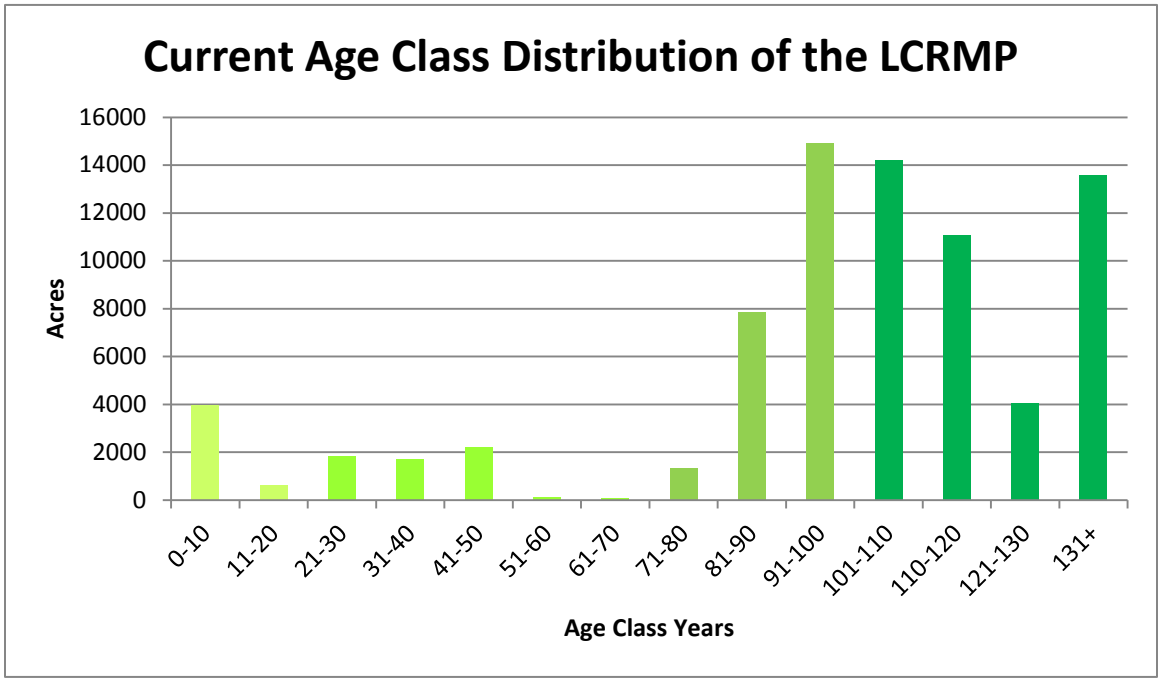
B3.3 Existing Condition

Past events have played a significant role in creating the vegetative condition existing today. Most of the area, prior to National Forest acquisition, was extensively harvested for lumber and pulpwood during the latter part of the 19th century and the early 1900s. The chestnut blight during the 1920s and 30s removed all of the American chestnut from the over-story and created openings that enabled previously overtopped trees, primarily oak species, to grow and replace the American chestnut in the over-story. Parts of the sale area have been subjected to recurrent wildfires in the past as evidenced by charred stumps and basal fire scars.

NFS land within the project area consists of a forest matrix of old forest with over 55% of all timber stands being over 100 years old and 75% of the LCRMP being over 90 years old, just under 6% of the project area is young or in early age classes (0-20 years) (Figure 3B3-1). This acreage does not include the 45 acres of permanent grassy wildlife clearings. Current condition, described in terms of ecological system diversity, is discussed in the Vegetation Section. The most common tree species found in the overstory include red oak, chestnut oak, white oak, scarlet oak, black oak, yellow poplar, cucumber magnolia, black locust, red maple, black cherry, mockernut hickory, with scattered eastern white, short-leaf, Virginia, and pitch pines. Examples of common species found in the midstory include: serviceberry, black gum, sassafras, eastern white pine, grape, witch hazel, white oak, chestnut oak, red maple, scarlet oak, mockernut hickory, yellow poplar, black locust, post oak, mountain laurel, big-toothed aspen, ailanthus, Japanese barberry, deerberry, and dogwood. Examples of common groundcover species include: bracken fern, white oak, scarlet oak, red maple, corymbed spirea, deerberry, dwarf iris, sassafras, black gum, grape, Canada cinquefoil, ditany, Virginia creeper, spotted wintergreen, Christmas fern, hog peanut, large- leaf twaybladec, grasses, red cedar, huckleberry, false foxglove, panic grass, maple-leaved viburnum, dogwood, common blue violet, witch hazel, trailing arbutus, black locust, morning glory, sericea lespedeza, mealy bellwort, yellow stargrass, striped maple, hornbeam, downy rattlesnake plantain, botrychium, whorled loosestrife, dewberry, minibush, Pyrola, serviceberry, poison ivy, ox-eyed daisy, slender bluetts, American holly, cancerroot, Veronica, corylberry, blueberry, greenbrier,

black oak, Indian cucumberroot, white avens, St. Andrew's cross, hay-scented fern, broad beech fern, wild yam, white pine, and teaberry. The mixture of vegetation is typical of acidic soils developed over sandstone and shale bedrock in the Ridge and Valley portion of the Appalachian Mountains.

Figure 3B3-1: Age Class Distribution of the NFS lands within the Lower Cowpasture Management Project



Aquatic habitat in the form of spring seeps and rocky headwater streams are found throughout the project area. Water sources are generally sparse, especially in the higher elevations. A more detailed physical account of the aquatic resources within and adjacent to the proposed harvest units can be found in the Water Quality section.

An abundance and variety of wildlife species exist in the project area. During field surveys wildlife seen or detected include black bear, white-tailed deer, wild turkey, pileated woodpecker, ovenbird, and worm-eating warbler, and common flicker, coyote, bobcat, raccoon, gray squirrel, shrew, red-tailed hawk, barred owl, common raven, American crow, yellow-billed cuckoo, white-breasted nuthatch, hooded warbler, American redstart, chickadee, eastern tufted titmouse, downy and hairy woodpeckers, red-eyed vireo, ruffed grouse, American goldfinch, blue gray gnatcatcher, eastern wood peewee, scarlet tanager, and box turtle, northern metalmark, among others.

The other MIS species were not selected for the LCRMP effects analysis because they do not occur within the proposed project area based on the known range for the species, or the species does not occur in close proximity to any activity areas based on field surveys. Some of these excluded MIS are TES species. For further analysis of these MIS see the TES discussion in this EA and the Biological Evaluation/Biological Assessment (BE/BA) for this project. Much of the following information is taken from the Forest Plan FEIS, Section B2 Terrestrial Species Diversity (FEIS pp. 3-134 to 3-228).

B3A Demand Species

B3A.1 Existing Condition (Demand Species)

These species were selected as MIS in the Forest Plan because they are species of high demand in Virginia. The National Forest provides key habitat attributes for bear in Virginia including remoteness and the availability of den trees and mast. Many Virginia hunters must utilize public lands to pursue deer and turkey, thus management activities will influence their success and experience. The Virginia Department of Game and Inland Fisheries tracks annual harvest for these species.

Eastern Wild Turkey

Eastern wild turkey (*Meleagris gallopavo*) occupies a wide range of habitats, with diversified habitats providing optimum conditions (Schroeder 1985; VDGIF 2013). This includes mature mast-producing stands during fall and winter, shrub dominated stands for nesting, and herb dominated communities, including grasslands, for brood rearing. Habitat conditions for wild turkey can be enhanced by management activities such as prescribed burning and thinning (Hurst 1978; Lafon et al. 2001; Norman et al. 2001; Pack et al. 1988; Steffen et al. 2002; VDGIF 2013), and the development of herbaceous openings (Nenno and Lindzey 1979; Healy and Nenno 1983).

For the eastern hardwood region, Wunz and Pack (1992) recommended maintaining 50 to 75% of the area in mast producing condition and approximately 10% in well distributed permanent grassland/shrublands and/or open woodlands, in addition to the early successional woody habitats that result from timber harvest and other activities. Forest thinning is recommended to enhance the herbaceous component of mid-successional forests. Prescribed burning to create and maintain open woodland structural conditions is important for brood and year-round foraging habitat. Other important habitat components include spring seeps, especially in areas with regular snow cover, and a diversity of soft mast producing plants (e.g. dogwood, black gum, grape, blueberries, etc.). Especially in northern hardwoods and high elevations in western Virginia, conifer cover (e.g., pines, cedars) provides an important roosting habitat for wintering birds (VDGIF 2013).

Eastern wild turkeys are present throughout the Region. Population densities generally are medium to high in the Northern Ridge and Valley, Allegheny Mountains, Northern Cumberland Mountains, and Southern Appalachian Piedmont Sections, and low to medium in the remainder of the SAA area (SAMAB 1996; VDGIF 2013). High population densities are associated with greater amounts of oak forest and cropland, and lesser amounts of developed and coniferous forestland. Wild turkey populations have expanded in range and density in the last 25 years. As with deer, this increase likely is related to both nonhabitat factors such as extensive restoration efforts, protection, and conservative harvest strategies as well as increased acorn capability resulting from the increase in mid-to late successional oak forests.

Wild turkey population trends are monitored by the Virginia Department of Game and Inland Fisheries (VDGIF) and West Virginia Division of Natural Resources (WVDNR). Population trends, in terms of harvest/square mile, vary over the years, but indicate an overall stable to decreasing trend in counties with GWNF lands. WVDNR reported a decreasing trend in spring gobbling rate in 2012 (34.8 gobblers heard/ 100 hours), which was 17% lower than 2011 and 34% lower than the 30 year average of 52.6 gobblers heard/100 hours (WVNDR 2013). Total turkey brood observations in 2012 were 38.8% less than the 5-year average. Eastern Wild Turkeys were observed, their calls heard, or evidence of their presence was noted during field surveys, throughout the Lower Cowpasture project areas.

Table 3B3-4. Population Trends Based on Spring Gobbler Harvest on Counties with GWNF in Virginia, 2003-2012 (Source: VDGIF 2013)

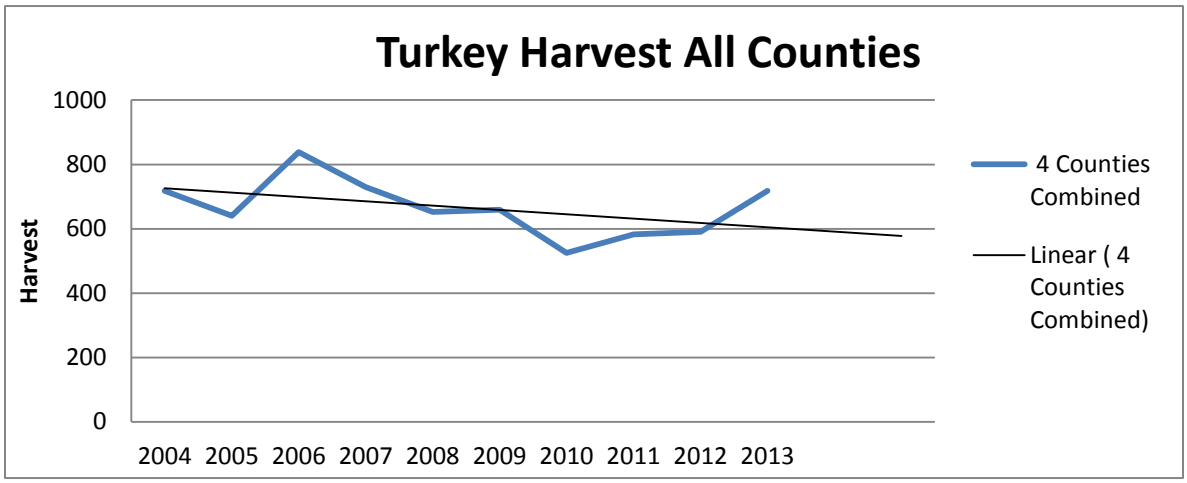
County	Population Growth		
	Annual Growth (%)[1]	P-Value[2]	Trend Status[3]
Alleghany	-4.4	0	Decreasing
Amherst	-5.8	0.005	Decreasing
Augusta	-1.7	0.452	Stable
Bath	-6.4	0.012	Decreasing
Botetourt	-4.1	0.03	Decreasing
Frederick	-2.3	0.237	Stable
Highland	-3.7	0.22	Stable
Nelson	-3.3	0.068	Decreasing
Page	-3.8	0.15	Stable
Rockbridge	-3.2	0.016	Decreasing
Rockingham	-7.7	0	Decreasing
Shenandoah	-1.7	0.44	Stable
Warren	1.4	0.515	Stable

[1] Based on the 10-year (2003-2012) exponential regression, $N_{10}=N_0*\lambda^{10}$; where N_0 = spring gobbler kill in 2012, N_0=spring gobbler kill in 2003, and λ= finite population rate of change. The average growth rate (R) is: $R = 100*(\lambda-1)$.
[2] Probability that the growth trend was not significant.
[3] Trends that were either not significant (P>0.1) or had annual growth between -2.0% and 2.0% were considered stable. Counties with significant trends (P<0.1) and rates that exceeded 2.0% growth were considered increasing. Decreasing counties had significant growth rates less than -2.0%.

Table 3B3-5. Turkey Harvest by County (Public and Private Lands, VDGIF)

County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Alleghany	186	185	190	173	166	167	151	152	147	185
Bath	173	136	215	175	148	130	96	130	124	151
Highland	86	63	108	132	90	104	63	77	74	80
Rockbridge	273	256	325	250	248	258	215	224	246	302

Figure 3B3-2. Virginia Turkey Harvest (Alleghany, Bath, Highland Rockbridge Counties)



Black Bear

The black bear (*Ursus americanus*) uses a wide variety of habitats in the southern Appalachians, occurring on National Forests and National Parks of the Southern Blue Ridge, Northern Cumberland, and Allegheny Mountains and the Northern Ridge and Valley. These public lands in Virginia, West Virginia, North Carolina, Tennessee, and Georgia connect to form a forested landscape of over 6 million acres where bears are generally distributed at low to medium densities. The increase of older oak forests in this large block of habitat, along with increased protection and conservative hunter harvest, has allowed bear populations throughout the southeastern mountain region to moderately increase over the past 30 years.

Black bears are opportunistic omnivores and consume a variety of seasonal plant and animal foods including flowering plants, grasses, various roots and tubers, and especially soft mast (grapes, berries, apples, etc.). More than 75% of the annual black bear diet consists of vegetative matter; the other 25% consists mostly of insects, insect larva, carrion, and small rodents and other mammals such as groundhogs, deer, and occasionally livestock (VDGIF 2013). Availability of hard mast (acorns and hickory nuts) is critical throughout the winter, and reproductive success can be closely related to this food source (Eiler 1981; Wathen 1983; Eiler et al. 1989, VDGIF 2013). Total production of hard mast and production by individual trees can fluctuate from year to year due to climatic and other factors (Downs and McQuilkin 1944; Fowells 1965). During time of poor mast crops, drought during summer months, and times of the year when food is naturally scarce (early spring), bears may forage around areas of human habitation and are more likely to impact agricultural crops, bee hives, livestock, and other food associated with humans (garbage, birdseed, pet food)(VDGIF 2013). Since bears utilize nearly any abundant plant or animal food, they are likely to thrive when a diversity of forest age classes and food sources are available. Vegetation management can provide much of this diversity (Reagan 1990; VDGIF 2013). Naturally occurring events such as ice storms, wildfires, and hurricanes provide habitat diversity, but at random intervals and locations, making benefits sometimes limited and unreliable.

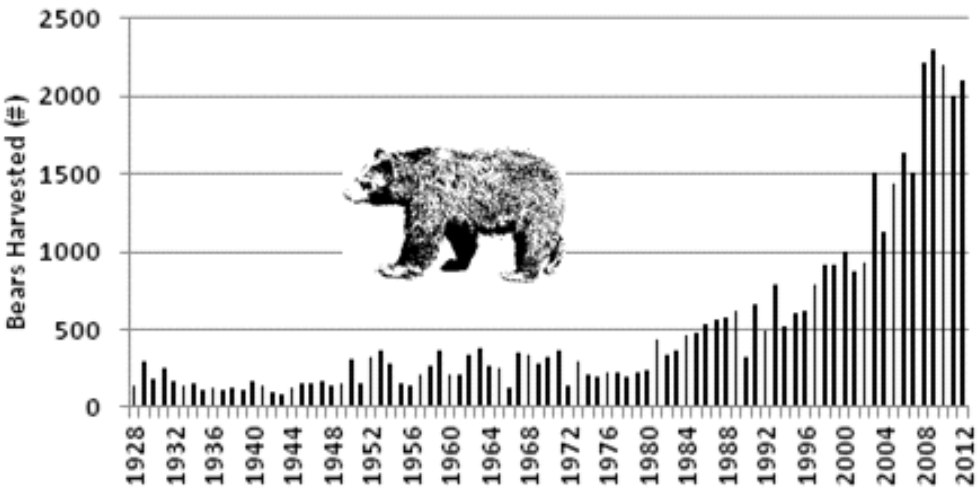
Bears den in a wide variety of sites including bush piles, large snags, rock cavities and crevices, road culverts, abandoned buildings, and in vegetation (Carlock et al. 1983; VDGIF 2013). In western Virginia, nearly 70% of all den sites are in hollow trees (VDGIF 2013). Large northern red and chestnut oaks are almost exclusively selected as den trees. Den re-use in Virginia is less than 10%, although some bears may prefer the same type of den (e.g. trees, rock cavities) year after year.

Preference may be related to availability and may be a learned behavior (Brody 1984). Timing of den entrance depends upon age, sex, female reproductive status, weather conditions, and food availability (VDGIF 2013). Bears may enter winter dens earlier during poor mast years to conserve accumulated resources. When mast crops are good, bears typically enter dens later in order to take advantage of additional opportunities to feed and gain weight. During particularly mild winters, some bears (especially males and females with yearlings) may not den at all. Usually pregnant females enter dens first, followed by subadults, then adult males. Individual bears enter dens in Virginia and West Virginia as early as the end of October and as late as the beginning of January (VDGIF 2013). Den emergence usually occurs in reverse order of den entrance. Females with cubs are the last to emerge from winter dens, typically between mid-March and mid-April.

Despite their adaptable food habits, black bears require extensive areas of diverse habitat types (VDGIF 2013). Although they are often considered a wilderness species, black bears can thrive in areas where forested habitats are interspersed among other land uses. Black bears are often found in large, contiguous tracts of forested lands, and smaller blocks of forested habitat that are linked by forested corridors. Based on known and apparently viable black bear populations within the southeast, the observed minimum areas that support bear populations are at least 79,000 acres for forested wetlands, and 198,000 acres for forested uplands (VDGIF 2013). Land-use changes that create isolated populations through fragmentation of black bear habitats have serious implications for population viability. Roads with heavy traffic volumes have been shown to limit bear movements (VDGIF 2013). Bear movements that are restricted by heavily used roads may interrupt habitat linkages and contribute to fragmentation concerns.

With extensive forested areas and a variety of habitat types in all ecoregions, most of Virginia and eastern West Virginia can be considered potential bear habitat (VDGIF 2013; WVDNR 2013). The black bears in western Virginia and eastern West Virginia belong to the largest contiguous bear population in the southeast and mid-Atlantic. Bear population status on the GWNF is monitored by the state agencies of Virginia and West Virginia and uses a combination of indices derived from harvest, age structure, nuisance activity, and miscellaneous mortalities (VDGIF 2013; WVDNR 2013). These indices, coupled with computer modeling, provide a current statewide population estimate of 16,000-17,000 bears in Virginia and 10,000-12,000 in West Virginia. While monitoring indices may provide rough estimates of bear population size, their primary values are to reflect population trends and relative densities. Black Bear were observed, or evidence of their presence was noted during field surveys, throughout the Lower Cowpasture project areas.

Figure 3B3-3. Virginia Black Bear Harvest (VDGIF)

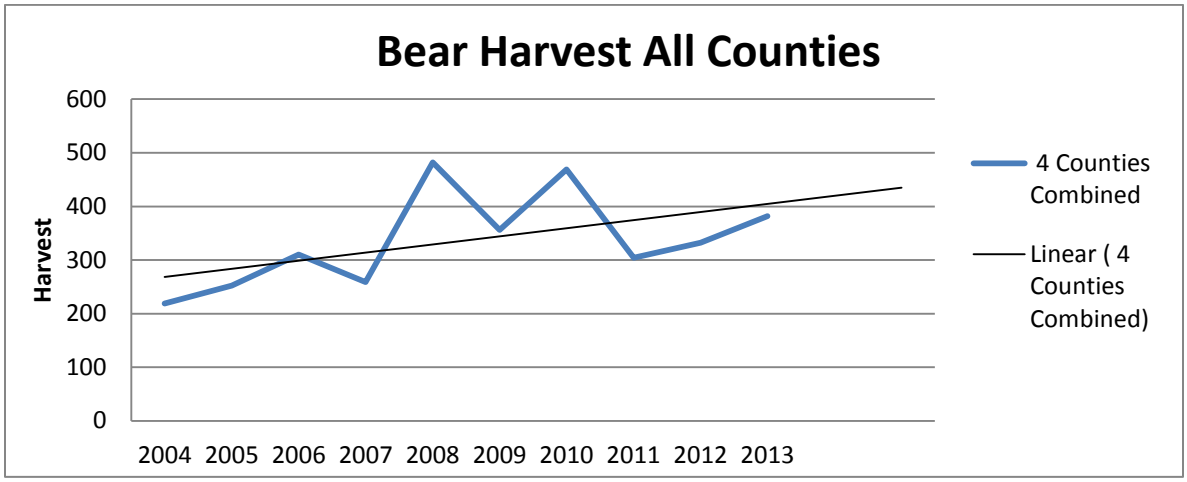


Multi-year harvest trends for both states have indicated significant increases since 1974. Since 2001, trends in harvest and population modeling suggest that the bear population throughout the area encompassing the GWNF has been increasing at about 9% annually (VDGIF 2013; WVDNR 2013). Similar trends have been seen in the LCRMP project area and surrounding counties.

Table 3B3-6. Black Bear Harvest by County (VDGIF)

County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Alleghany	79	87	114	54	126	81	103	81	73	100
Bath	70	55	75	60	120	92	146	75	92	95
Highland	47	48	52	65	132	81	114	54	91	104
Rockbridge	23	62	69	80	104	102	106	94	76	83

Figure 3B3-4. Virginia Black Bear Harvest (Alleghany, Bath, Highland Rockbridge Counties)



Access management is important in maintaining preferred habitat for black bear (Lentz 1980, Carlock et al. 1983, Hamilton and Marchinton 1980, Miller 1975, Pelton 1980, Brody 1984). Building or upgrading existing roads for a temporary use is not as critical as the subsequent access management. It is not the existence of roads, but the unmanaged use of roads by the public that affects the black bear (2004 M&E Report). Road management policies influence black bear movement and occupancy of suitable habitat (Brody and Pelton 1989; Carpenter 1973; Hillman, 1986; Warburton 1986). The LCRMP has visitor and hunter access that ranges from individual hikers to year-round road access. In addition, Virginia does allow hound chase/training seasons that run for approximately two months in the late summer and a chase/harvest season that runs for an additional month in the early winter.

Dense, nearly impenetrable thickets of escape cover are necessary, especially in areas where disturbance is likely. Laurel and Rhododendron thickets on steep terrain provide this type of cover in the moutains (Dickson, ed. 2001). In addition to dense understories in mature stands, escape cover can also be provided by young forests and regeneration areas.

In the Central and Southern Appalachians, including the GWNF, important habitat elements are habitat remoteness, habitat diversity, den site availability, and availability of hard mast. Quality vegetative components of black bear habitat are early successional forest created by timber management and prescribed fire, open woodland habitat restored and maintained through prescribed fire, grassland/shrubland, mid-late successional hard mast producing forest, and the availability of cavities and den trees.

White-Tailed Deer

White-tailed deer is the principal big game species in the project area, and the most sought after demand species on the National Forest. White-tailed deer (*Odocoileus virginianus*) use a wide variety of forest types and successional stages to meet their year-round needs. In the central Appalachians, deer are found in all forest types and use various successional stages during their annual life cycle (Johnson et al. 1995; VDGIF 2007; WVDNR 2011). Older forests are important in the fall and winter, when acorns become a dominant fall and winter food item (Wentworth et al. 1990a). Deer nutrition, reproduction, weights, and antler characteristics can be influenced by the availability of acorns (Harlow et al. 1975; Feldhammer et al. 1989; Wentworth et al. 1990a, 1992). Year-round use of vegetation in the form of woody browse, soft mast, forbs and grasses is extremely important and found most abundantly in early successional woody habitat, open woodland, grasslands, and shrublands of varying sizes (Wentworth et al. 1990b; Ford et al. 1993; VDGIF 2007). High quality deer habitat is characterized by the interspersion of mature forested and other habitats that provide not only food sources, but escape cover (VDGIF 2007). In eastern hardwood forests, Barber (1984) recommended that at least 50% of the landscape should consist of mature mast trees, with the remainder containing an interspersion of evergreens, shrubs and vines, and openings with herbaceous and early successional woody vegetation. Based on utilization data, current deer densities in the Southern Appalachians can be maintained by providing approximately 5% of the landscape in regenerating forest vegetation (Wentworth et al. 1990b). Wentworth and others (1989) concluded that approximately 2% of the area in high quality grasslands and shrublands would be necessary to adequately buffer the effects of a poor acorn year.

White-tailed deer are present throughout the Region. Population densities generally are medium to high in the Northern Ridge and Valley, Allegheny Mountains, Northern Cumberland Mountains, and Southern Appalachian Piedmont Sections, and low to medium in the remainder of the Southern Appalachian Assessment area (SAMAB 1996). High population densities are associated with greater

amounts of cropland and lesser amounts of developed and coniferous forestland. Current deer densities are generally higher on private lands than on national forest and state lands in Virginia (VDGIF 2007).

The GWNF comprises approximately 960,000 acres (90%) in thirteen Virginia counties and 105,000 acres (10%) in four West Virginia counties, for a total of 1,065,000 total acres, of which 1,058,000 is forested. There are approximately 240,000 hunters in Virginia and 245,000 in West Virginia that hunt deer (VDGIF 2007, WVDNR 2011). Recreation generated primarily by deer hunting produces approximately $221 million in Virginia and $247 million in West Virginia annually (USFWS 2011). Ninety-two percent of available deer habitat in Virginia exists on private land, whereas eight percent is found on public land (state, federal, other public ownership)(VDGIF 2007). Eighty-seven percent of available deer habitat in West Virginia is also found on private land, with 13 percent on public land (WVDNR 2011).

Virginia. Current population reconstruction models indicate that Virginia's statewide deer population has been relatively stable over the past decade, fluctuating between 850,000 and 1,000,000 animals (VDGIF 2012). In Virginia, deer population trends were evaluated by examining the annual rate of change in the population index (i.e., antlered buck harvest per unit area) over the 10-year period from 2000-2010. An exponential regression (y = aert; where, y = population index, a = intercept, e = 2.718, r = instantaneous rate of change, and t = year) was used to determine trends in population. The annual rate of change (R) = er – 1. The status of the deer population in each county was considered to be increasing or decreasing if the annual rate of change in the population index was >2.26% (either positive or negative) and the statistical significance level of the exponential regression model was p < 0.10 (r2 Value > 0.301). Annual rates of change that exceeded 2.26% represent a change of at least 25% in the population index over the decade (1.022610 = 1.25). Counties that displayed a rate of change between 0 and +2.26 were deemed to be stable. Overall on the GWNF in Virginia, 9 counties, representing 660,476 acres (69% of the 960,000 of total acres in Virginia) demonstrated stable population trends, and 4 counties, representing 295,788 acres (31%) demonstrated decreasing trends. Since 2000, VDGIF harvest data has suggested a more substantial decline across much of the GWNF. In contrast, private land in the same counties ranges from stable to increasing trends (VDGIF 2013). Deer were observed, or evidence of their presence was noted during field surveys, throughout the Lower Cowpasture project areas.

Table 3B3-7. White-tailed Deer Population Index Trend across the GWNF in Virginia, 2000 to 2010 (Source: VDGIF)

County	Percent GWNF in County	Number of GWNF Acres in County	Ranger Districts Included	*R*[1]	p[2] Value	Status
Alleghany	49	141,873	James River, Warm Springs	-3.23%	0.180	Stable
Amherst	19	57,877	Pedlar	-6.90%	0.762	Decreasing
Augusta	30	196,057	North River, Pedlar	-1.80%	0.168	Stable
Bath	51	173,705	North River, Warm Springs	-4.70%	0.299	Stable
Botetourt	4	13,047	James River,	-3.04	0.325	Decreasing
Frederick	2	4,885	Lee	-4.58	0.297	Stable
Highland	22	58,267	North River, Warm Springs	-4.80%	0.269	Stable
Nelson	7	19,825	Pedlar	-4.39%	0.254	Stable
Page	13	27,082	Lee	-0.12%	0.002	Stable
Rockbridge	12	45,542	North River, James River, Pedlar	-3.85%	0.374	Decreasing
Rockingham	25	139,783	North River, Lee,	-5.15%	0.545	Decreasing
Shenandoah	23	76,057	Lee	-1.98%	0.284	Stable

County	Percent GWNF in County	Number of GWNF Acres in County	Ranger Districts Included	*R*[1]	p[2] Value	Status
Warren	5	6,290	Lee	2.95%	0.150	Stable

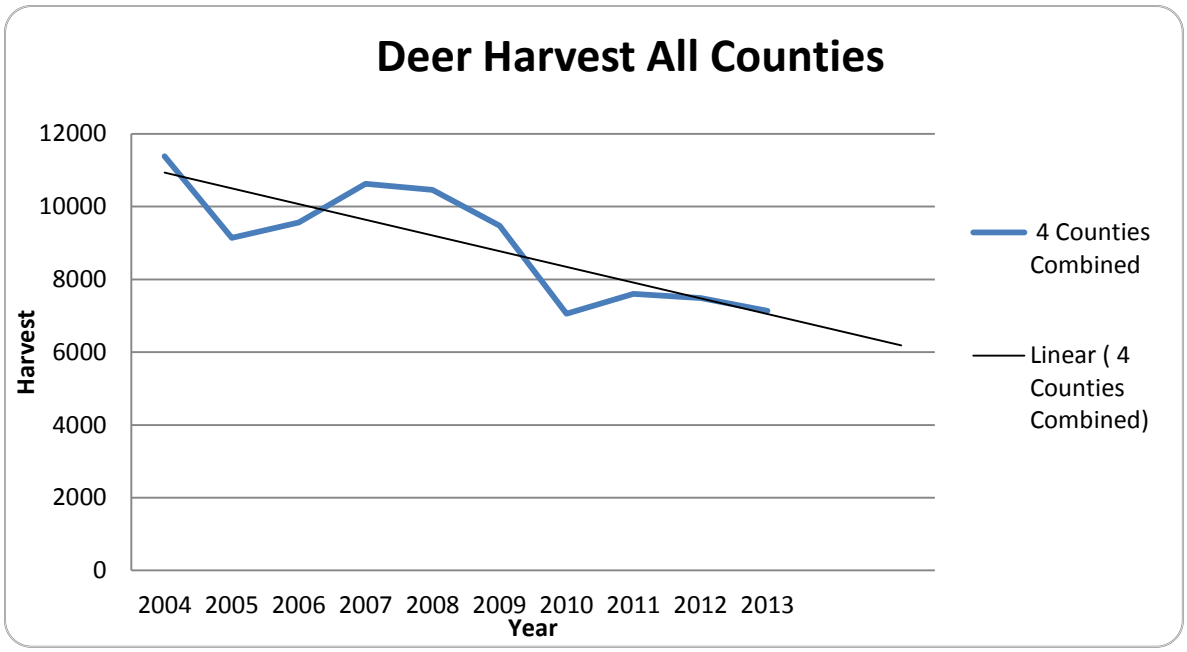
[1] *R* = Percent annual change in population index. Values less than -2.26% and values greater than 2.26% are considered significant (1.0226^{10} = 1.25 or a 25% increase or decrease over the 10-year period).
[2] *p* = Statistical significance level of exponential regression model. Values ($p < 0.10$) are considered significant.

Statewide, VDGIF reports an 8% decrease in total number of deer harvested in 2012 compared to 2011, with the total number harvested 8% below the last 10-year average of 232,573. The Department's primary deer management effort over the past five years has been to increase the female deer harvest over much of the state, especially on private lands. This higher level of deer harvest is intended to lead to a decrease in the statewide deer herd. The deer harvest totals over of the past three years would appear to suggest these management efforts have been successful (VDGIF 2013).

Table 3B3-8. Deer Harvest by County (Public and Private Lands, VDGIF)

County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Alleghany	2075	1639	1772	1973	1840	1569	1172	1088	1271	1171
Bath	3244	2666	2696	3012	3044	2344	1777	1845	1728	1532
Highland	2624	2077	2358	2451	2665	2517	1594	2148	1823	1769
Rockbridge	3437	2758	2734	3190	2909	3046	2517	2522	2665	2664

Figure 3B3-5. Virginia Deer Harvest (Alleghany, Bath, Highland Rockbridge Counties)



VDGIF deer management objectives are based on the Cultural Carrying Capacity (CCC) and are intended to stabilize the deer population on public lands on all thirteen Virginia counties of the GWNF (VDGIF 2007). The quality of deer habitat has declined in recent years on GWNF lands in many western Virginia and eastern West Virginia counties because of maturing forest habitat conditions, declining early successional woody habitat for browse and cover, and a declining number of maintained grassy/shrubby openings. The Virginia Department of Game & Inland Fisheries (VDGIF) and West Virginia Division of Natural Resources recommends implementation of habitat management improvements that are beneficial to deer on over 1% annually of the total GWNF acreage (VDGIF 2011; WVDNR 2011). This includes an increase in timber harvest and prescribed fire that creates early successional woody and open woodlands habitat, and restoration and maintenance of grasslands and shrublands. Such habitat creation should be well dispersed across the otherwise mature forested landscape of the GWNF.

B3A.2 Direct Indirect and Cumulative Effects (Demand Species)

Wild Turkey

Wild turkeys require a mixture of various successional stage habitats to meet their year-round habitat needs, as previously mentioned. Key requirements include the interspersion of mature mast producing forest during fall and winter, early successional woody habitat, grassland/shrublands and open woodlands for nesting (early successional habitat), and grasslands and open woodlands for brood range and year-round foraging (Lafon et al. 2001; Norman et al. 2001; Steffen et al. 2002; VDGIF 2013).

Four management activities that have a significant influence on wild turkey habitat quality are early successional forest created by timber management, open woodland habitat restored and maintained through prescribed fire and some silvicultural treatments, grassland/shrubland restoration and maintenance, and mid- to late- successional hard mast producing forest development.

Direct and Indirect Effects-Alternative 1

Early successional forest: The LCRMP currently contains about 4000 acres (5%) of early successional habitat (0-10 age class) created by past timber management, wildfires, and prescribed burns. This closely matched the departure analysis totals of "early" ecological condition despite the age class ranges differing from ecological system groups. In both cases these areas typically have a diverse cover of forbs and softmast plants including blueberry, huckleberry, blackberry, pokeweed, sassafras, and grapes that are a focal point for foraging wildlife including wild turkey and their young polts. These areas also provide preferred nesting sites as well as hiding and escape cover for turkey and their polts. Alternative 1 would not provide any more early successional habitats now and in the future beyond the projected 2% generated by natural disturbances across the planning area (FEIS).

Open woodland restoration: The LCRMP currently has just 1.5% in open woodland condition. This ecological system group condition represents the greatest departure from the desired condition on the GWNF. Reciprocally, closed condition forest is the most common condition throughout the GWNF (See Vegetative Section departure analysis). Open woodland conditions allows the development of woody browse, grasses, forbs, and soft and hard mast producing shrubs in the understory, while maintaining an overstory of hard and soft mast producing trees species for turkey and many other species including other MIS. Open woodland is primarily a direct effect of moderate to intense fire. The departure analysis shows that Alternative 1 would not provide any more open woodland now and in the future, beyond the projected 2% generated by natural disturbances across the planning area.

Grassland/shrubland restoration and maintenance: The LCRMP currently has approximately 130 acres in permanent grassy clearings (wildlife clearings and Walton Tract fields) that provide excellent foraging areas for young turkey and minimal amounts of shrublands. No new habitats of this type will be produced through Alternative 1.

Mid-late successional hard mast producing forest: Mast production can be addressed in light of the ecological systems departure analysis and more directly through the primary mast production model. Although the departure analysis age classes include many years where mid-aged stands will not produce mast, and the late age class contains mostly old forest in declining mast production, open woodland structural conditions (in appropriate forest types) in an otherwise closed canopy forested landscape, can provide high quality year-round food and cover for turkey. The primary mast production model shows nearly 63% of the LCRMP mast producing stands will be older than 100 years and declining in mast production by 2025. There would be no lack of late forest in any alternative including Alternative 1.

Direct and Indirect Effects-Alternatives 2 & 3

Early successional forest: The highest projected acreage of early successional forest created by Alternative 2 with 9.7% versus 9.5% in Alternative 3. Both action alternative show an addition of greater than 4% of early successional forest classes, providing more soft mast foraging and escape cover, as well as future vigorous stands for mast production.

Open woodland restoration: The success of prescribed fire in improving wild turkey habitat depends on many factors, including site quality, stand conditions, and fire prescriptions (VDGIF 2010). Prescribed fire that restores open woodland structural conditions (in appropriate forest types) in an otherwise closed canopy forested landscape can provide high quality year-round food, nesting, brood-rearing habitat, and seasonal cover for wild turkeys. Open woodland conditions allows the development of woody browse, grasses, forbs, and soft and hard mast producing shrubs in the understory, while maintaining an overstory of hard- and soft- mast producing trees species for wild turkeys and many other high priority species. While early successional forest is ephemeral, changing locations over time across the GWNF, open woodlands, when maintained by fire, creates permanent habitat for turkeys.

Both Alternatives 2 and 3 provide for nearly 16 percent of the landscape to be within a prescribed burn unit, with expected benefits of open woodlands and early successional habitats among other ecological benefits. This relatively low percentage is a direct result of the intricacies and physical limitations of implementing large scale prescribed fires across the landscape in Virginia. Most areas in the LCRMP proved to have major factors limiting the implementation of safe and effective prescribed fire across the landscape. Despite these limitations, both Alternative 2 and 3 more than double the amount of open woodland as a result of all treatments (silvicultural and fire).

Grassland/shrubland restoration and maintenance: Proposed permanent wildlife clearings represent very open woodland/ grassland habitats. Alternative 2 proposes 320 acres of wildlife clearings averaging 3.4 acres in size and Alternative 3 proposes 297 acres of clearings that averages 3.1 acres. Proposed openings range in size from 0.2 acres to 13.8 acres for both alternatives. Most opening creation would take place in close association and proximity of silvicultural treatments. Both action alternatives represent a threefold increase in this habitat type.

Mid-late successional hard mast producing forest: Both departure analysis and mast analysis show some movement towards higher mast production under both action alternatives. The long-term primary mast production will be approximately 30% higher in the two action alternatives. This will improve the habitat for those species relying on the mast resource over the next 40 to 100 years,

while providing a more diverse mosaic of habitat. Other silvicultural treatments will improve the vigor and species composition of existing stands and directly improve long-term habitat quality for most species including black bear.

The alternative with the highest combination of projected early successional forest habitat, open woodlands, and grassland/shrublands from active management activities is Alternative 2 with no significant difference for wildlife diversity between the two action alternatives. The alternative with the lowest combination early forest, open woodlands, and grassland/shrublands is Alternative 1, the no action alternative. The availability of grasslands/shrublands, open woodlands, and early successional woody habitat for nesting, brood range, and year-round forage is the most limiting factor to wild turkey populations on the GWNF (VDGIF 2013). The combination of habitat components important for wild turkeys are projected to slightly increase (combination of early forest, open woodlands, and grasslands/shrublands) or stay relatively stable (mid- to late-successional mast producing forest) over the next 10 years under Alternatives 2 and 3. Wild turkey populations are expected to decline in the next 5 years and may stabilize under these alternatives over the next decade.

Turkey Cumulative Effects

Cumulative actions include approximately 165 acres of regeneration harvest from the current Mares Run Timber Sale and about 18,425 acres of prescribed fire from the Warm Springs Mountain Restoration Project burns. The combined effect of these actions would be to increase the early successional stage by approximately 3% of the analysis area and a fraction of one percent of the analysis area to the open structural stage. About three quarters of the early acres are created in the Oak Forest and Woodlands with the Pine Forest and Woodlands receiving the bulk of the remaining 25%. Impacts to open structural conditions are much the same; 70% in the oaks and most of the remaining in the pines. The vast majority of these changes are coming from the late successional stage, thus the late stage is slightly reduced in the entire analysis area. Cumulatively, these actions move the landscape closer to the desired conditions for early and open in the Oak and Pine Forests and Woodlands, but are still well below those desired conditions.

Under all Alternatives long-term turkey populations in the LCRMP are expected continue to decrease or perhaps stabilize. The amount of early successional forest, grassland/shrublands, and mid- to late successional hard mast producing forest acres stay relatively constant under each alternative.

Black Bear

Direct and Indirect Effects-Alternative 1

Early successional forest: The LCRMP currently contains about 4,000 acres (5%) of early successional habitat (0-10 age class) created by past timber management, wildfires, and prescribed burns. This closely matched the departure analysis totals of “early” ecological condition despite the age class ranges differing from ecological system groups. In both cases these areas typically have a diverse cover of forbs and softmast plants including blueberry, huckleberry, blackberry, pokeweed, sassafras, and grapes that are a focal point for foraging wildlife including black bear. These areas also provide hiding and escape cover for bears. Alternative 1 would not provide any more early successional habitats now and in the future beyond the projected 2% generated by natural disturbances across the planning area (FEIS).

Open woodland restoration: The LCRMP currently has just 1.5% in open woodland condition. This ecological system group condition represents the greatest departure from the desired condition on the GWNF. Reciprocally, closed condition forest is the most common condition throughout the GWNF

(See Vegetative Section departure analysis). Open woodland conditions allows the development of woody browse, grasses, forbs, and soft and hard mast producing shrubs in the understory, while maintaining an overstory of hard- and soft- mast producing trees species for black bear and many other high priority species. Open woodland is primarily the product of fire on the landscape. The departure analysis shows that Alternative 1 would not provide any more open woodland now and in the future, beyond the projected 2% generated by natural disturbances across the planning area.
Grassland/shrubland restoration and maintenance: The LCRMP currently has approximately 130 acres in permanent grassy clearings and shrublands (wildlife clearings and Walton Tract fields). No new habitats of this type will be produced through Alternative 1.

Mid-Late successional hard mast producing forest: Mast production can be addressed in light of the ecological systems departure analysis and more directly through the primary mast production model. Although the departure analysis age classes include many years where mid-aged stands will not produce mast, and the late age class contains mostly old forest in declining mast production, open woodland structural conditions (in appropriate forest types) in an otherwise closed canopy forested landscape, can provide high quality year-round food and cover for black bear. The primary mast production model shows nearly 63 % of the LCRMP mast producing stands will be older than 100 years and declining in mast production by 2025. There would be no lack of denning trees in this alternative.

Remote habitat: Areas free from the regular presence of humans is an important component of bear habitat quality. Prescriptions with remoteness as a desired condition are found in Wilderness and Recommended Wilderness Study Areas (1A, 1B) and Remote Backcountry (12D). Currently, 40,000 acres of the LCRMP (51%) are in prescriptions with remoteness as a desired condition. This remains the same for all alternatives; however, no habitat management will improve conditions within those areas under Alternative 1.

Direct and Indirect Effects-Alternatives 2 & 3

Early successional forest: The highest projected acreage of early successional forest created by Alternative 2 with 9.7% versus 9.5% in Alternative 3. Both action alternatives show an addition of greater than 4% of early successional forest classes, providing more soft mast foraging and escape cover, as well as future vigorous stands for mast production.

Open woodland restoration: Both Alternatives 2 and 3 provide for nearly 16 percent of the landscape to be within a prescribed burn unit, with expected benefits of open woodlands and early successional habitats among other ecological benefits. This relatively low percentage is a direct result of the intricacies and physical limitations of implementing large scale prescribed fires across the landscape in Virginia. Most areas in the LCRMP proved to have major factors limiting the implementation of safe and effective prescribed fire across the landscape. Despite these limitations, both Alternative 2 and 3 more than double the amount of open woodland as a result of all treatments (silvicultural and fire).

Grassland/shrubland restoration and maintenance: Proposed permanent wildlife clearings represent very open woodland/ grassland habitats. Alternative 2 proposes 320 acres of wildlife clearings averaging 3.4 acres in size, and Alternative 3 proposes 297 acres of clearings averaging 3.1 acres in size. Proposed openings range in size from 0.2 acres to 13.8 acres for both alternatives. Most opening creation would take place in close association and proximity of silvicultural treatments. Both action alternatives represent a threefold increase in this habitat type.

Mid-late successional hard mast producing forest: Both departure analysis and mast analysis show some movement towards higher mast production under both action alternatives. The long-term

primary mast production will be approximately 30% higher in the two action alternatives. This will improve the habitat for those species relying on the mast resource over the next 40 to 100 years, while providing a more diverse mosaic of habitat. Other silvicultural treatments will improve the vigor and species composition of existing stands and directly improve long-term habitat quality for most species including black bear.

The alternative with the highest combination of projected early successional forest habitat, open woodlands, and grassland/shrublands from active management activities is Alternative 2 with no significant difference for wildlife diversity between the two action alternatives. The alternative with the lowest combination early forest, open woodlands, and grassland/shrublands is Alternative 1, the no action alternative. The combinations of habitat components important for black bear habitat are projected to steadily increase (combination of early forest, open woodlands, and grasslands/shrublands) under both action alternatives. Given the current increasing population trend for black bears on the GWNF, black bear populations should be stable or increase under all alternatives over the next decade.

Black Bear Cumulative Effects

Cumulative actions include approximately 165 acres of regeneration harvest from the current Mares Run Timber Sale and about 18,425 acres of prescribed fire from the Warm Springs Mountain Restoration Project burns. The combined effect of these actions would be to increase the early successional stage by approximately 3% of the analysis area and a fraction of one percent of the analysis area to the open structural stage. About three quarters of the early acres are created in the Oak Forest and Woodlands with the Pine Forest and Woodlands receiving the bulk of the remaining 25%. Impacts to open structural conditions are much the same; 70% in the oaks and most of the remaining in the pines. The vast majority of these changes are coming from the late successional stage, thus the late stage is slightly reduced in the entire analysis area. Cumulatively, these actions move the landscape closer to the desired conditions for early and open in the Oak and Pine Forests and Woodlands, but are still well below those desired conditions.

Under all Alternatives long-term black bear populations in the LCRMP are projected to continue to increase or stabilize.

White-Tailed Deer

Deer habitat quality and numbers are directly associated with soil quality, habitat type, successional stage, and the amount of habitat interspersion or edge (VDGIF 2007). The importance of a diversity of hard mast producers, successional habitat for browse, and grasslands/shrublands, each being well distributed across the landscape to meet the year-round needs of deer, has been previously discussed.

The four habitat factors that have the greatest influence on deer habitat quality is early successional forest created by timber management, open woodland habitat restored and maintained through prescribed fire, grassland/shrubland restoration and maintenance, and mid- to late- successional hard mast producing forest.

Direct and Indirect Effects-Alternative 1

Early successional forest: The LCRMP currently contains about 4000 acres (5%) of early successional habitat (0-10 age class) created by past timber management, wildfires, and prescribed

burns. This closely matched the departure analysis totals of "early" ecological condition despite the age class ranges differing from ecological system groups. In both cases these areas typically have a diverse cover of forbs and softmast plants including blueberry, huckleberry, blackberry, pokeweed, sassafras, and grapes that are a focal point for foraging wildlife including deer and fawns. These areas also provide preferred fawning sites because of hiding and escape cover. Alternative 1 would not provide any more early successional habitats now and in the future beyond the projected 2% generated by natural disturbances across the planning area (FEIS).

Open woodland restoration: Open woodland conditions allows the development of woody browse, grasses, forbs, and soft and hard mast producing shrubs in the understory, while maintaining an overstory of hard- and soft- mast producing trees species for deer and many other high priority species. While early successional forest is ephemeral, changing locations over time across the GWNF, open woodlands, when maintained by fire, creates permanent habitat for deer. In addition, open woodland habitat is restored at a larger scale than early successional forest habitat Dense grassy/shrubby escape cover for fawns vulnerable to predators such as coyotes and black bears is more effective when it is in a 500 to 1,000 acre patch of open woodlands (average prescribed burn block) than a 25-40 acre patch of early successional forest habitat (average timber treatment unit) or a 1-5 acre grassland/shrubland patch (average size of wildlife opening). The LCRMP currently has just 1.5% in open woodland condition. This ecological system group condition represents the greatest departure from the desired condition on the GWNF. Reciprocally, closed condition forest is the most common condition throughout the GWNF (See Vegetative Section departure analysis). Open woodland conditions allows the development of woody browse, grasses, forbs, and soft and hard mast producing shrubs in the understory, while maintaining an overstory of hard and soft mast producing trees species for turkey and many other species including other MIS. Open woodland is primarily a direct effect of moderate to intense fire. The departure analysis shows that Alternative 1 would not provide any more open woodland now and in the future, beyond the projected 2% generated by natural disturbances across the planning area.

Grassland/shrubland restoration and maintenance:. The LCRMP currently has approximately 130 acres in permanent grassy clearings (wildlife clearings and Walton Tract fields) that provide excellent foraging areas for young turkey and minimal amounts of shrublands. No new habitats of this type will be produced through Alternative 1.

Mid-late successional hard mast producing forest: Mast production can be addressed in light of the ecological systems departure analysis and more directly through the primary mast production model. Although the departure analysis age classes include many years where mid-aged stands will not produce mast, and the late age class contains mostly old forest in declining mast production, open woodland structural conditions (in appropriate forest types) in an otherwise closed canopy forested landscape, can provide high quality year-round food and cover for deer. The primary mast production model shows nearly 63% of the LCRMP mast producing stands will be older than 100 years and declining in mast production by 2025. There would be no lack of late forest in any alternative including Alternative 1. Under this alternative, white-tailed deer populations should remain stable, due to lack of available habitat components other than mid- to late successional mast producing forest.

Direct and Indirect Effects-Alternatives 2 & 3

Early successional forest: The highest projected acreage of early successional forest created by Alternative 2 with 9.7% versus 9.5% in Alternative 3. Both action alternatives show an addition of greater than 4% of early successional forest classes, providing more soft mast and forb foraging and escape cover, as well as future vigorous stands for mast production.

Open woodland restoration: Open woodland conditions allows the development of woody browse, grasses, forbs, and soft and hard mast producing shrubs in the understory, while maintaining an overstory of hard- and soft- mast producing trees species for deer and many other high priority species. While early successional forest is ephemeral, changing locations over time across the GWNF, open woodlands, when maintained by fire, creates permanent habitat for deer. In addition, open woodland habitat is restored at a larger scale than early successional forest habitat Dense grassy/shrubby escape cover for fawns vulnerable to predators such as coyotes and black bears is more effective when it is in a 500 to 1,000 acre patch of open woodlands (average prescribed burn block) than a 25-40 acre patch of early successional forest habitat (average timber treatment unit) or a 1-5 acre grassland/shrubland patch (average size of wildlife opening). The success of prescribed fire in improving habitat depends on many factors, including site quality, stand conditions, and fire prescriptions (VDGIF 2010). Prescribed fire that restores open woodland structural conditions (in appropriate forest types) in an otherwise closed canopy forested landscape can provide high quality year-round food, nesting, brood-rearing habitat, and seasonal cover for wild turkeys. Open woodland conditions allows the development of woody browse, grasses, forbs, and soft and hard mast producing shrubs in the understory, while maintaining an overstory of hard- and soft- mast producing trees species for deer and many other high priority species. While early successional forest is ephemeral, changing locations over time across the GWNF, open woodlands, when maintained by fire, creates permanent habitat for many wildlife.

Both Alternatives 2 and 3 provide for nearly 16 percent of the landscape to be within a prescribed burn unit, with expected benefits of open woodlands and early successional habitats among other ecological benefits. This relatively low percentage is a direct result of the intricacies and physical limitations of implementing large scale prescribed fires across the landscape in Virginia. Most areas in the LCRMP proved to have major factors limiting the implementation of safe and effective prescribed fire across the landscape. Despite these limitations, both Alternative 2 and 3 more than double the amount of open woodland as a result of all treatments (silvicultural and fire).

Grassland/shrubland restoration and maintenance: Proposed permanent wildlife clearings represent very open woodland/ grassland habitats. Alternative 2 proposes 320 acres of wildlife clearings averaging 3.4 acres in size, and Alternative 3 proposes 297 acres of clearings averaging 3.1 in size. Proposed openings range in size from 0.2 acres to 13.8 acres for both alternatives. Most opening creation would take place in close association and proximity of silvicultural treatments. Both action alternatives represent a threefold increase in this habitat type.

Mid-Late successional hard mast producing forest: Both departure analysis and mast analysis show some movement towards higher mast production under both action alternatives. The long-term primary mast production will be approximately 30% higher in the two action alternatives. This will improve the habitat for those species relying on the mast resource over the next 40 to 100 years, while providing a more diverse mosaic of habitat. Other silvicultural treatments will improve the vigor and species composition of existing stands and directly improve long-term habitat quality for most species including deer. All alternatives have an abundance of mature hard mast producing forest to provide hard mast and seasonal cover for white-tailed deer (VDGIF 2007).

The alternative with the highest combination of projected early successional forest habitat, open woodlands, and grassland/shrublands from active management activities is Alternative 2 with no significant difference for wildlife diversity between the two action alternatives. The alternative with the lowest combination early forest, open woodlands, and grassland/shrublands is Alternative 1, the no action alternative. The availability of grasslands/shrublands, open woodlands, and early successional woody habitat are projected to slightly increase (combination of early forest, open woodlands, and grasslands/shrublands) or stay relatively stable (mid- to late-successional mast

producing forest) over the next 10 years under Alternatives 2 and 3. Deer populations are expected to be stable over the next decade.

Land ownership patterns on the GWNF are characterized by a high percentage of ridges and sideslopes, with less than 10% percent in valley land. Valley land has historically been more profitable to own and has therefore tended to stay in private ownership. In the ridge and valley areas of Virginia, valley lands are characterized by a mixture of open fields, crops, some woodlands, and farms and communities. Deer populations routinely forage in the mix of valley habitats and move upslope onto mostly forested ridges and sideslopes to rest and forage when hard mast is seasonally available (Knox 2012; WVDNR 2011). Since much of the valley land where GWNF lands are found is privately owned, it is reasonable to assume many deer herds on the GWNF incorporate some percentage of adjacent private land in their home ranges. Mixed ownership patterns can affect deer population distribution on the GWNF in several ways. A mix of habitats may be provided on adjacent private lands that can help meet forage needs for deer along the public/private ownership zone Deer movement on and off GWNF lands and adjacent private lands can potentially cause damage to crops and pastures, becoming a nuisance to private landowners. Such movements can result in private landowner requests for kill permits and demands for increased harvest objectives on private lands to address these issues (Knox 2012; VDGIF 2007). The opportunity for hunting deer on the GWNF can be positively affected by increased foraging opportunities to local deer herds from adjacent private land, and can also be negatively affected by lower deer populations on GWNF, due to higher harvest objectives and kill permits on adjacent private lands where deer are consider a nuisance. Increased early successional habitat, open woodlands, and grasslands on GWNF in a number of alternatives will help provide year-round habitat for deer populations, but with the high amount of adjacent private land ownership in predominately richer valley habitat, it is reasonable to expect deer herds to continue moving on and off GWNF lands and adjacent private land as part of their home ranges, and therefore be impacted by higher private land harvest objectives and deer kill permits.

In addition to habitat quality, white-tailed deer populations can be regulated by other factors, such as predation and disease. In recent decades, both black bear and coyote populations have increased across the state of Virginia and are known to opportunistically prey on white-tailed deer, especially fawns and older or diseased adults (Knox 2011; VDGIF 2012). The current and long-term impacts of these and other predators on the white-tailed deer population are unknown at this time (Knox 2011). Chronic Wasting Disease (CWD) was discovered in the wild deer population in Hampshire County, WV in 2005 and 2009 in Frederick County, VA (WVDNR 2011; VDGIF 2013). CWD is a fatal neurological disease impacting deer and other large herbivores such as elk and moose (VDGIF 2013). The long-term impacts to deer, elk, and moose populations are of serious concern to state and federal wildlife management agencies. Recent years have also shown local outbreaks and mortality of Epizootic Hemorrhagic disease (EHD) in areas on the Warm Springs and James River ranger Districts.

Whitetail Deer Cumulative Effects

Cumulative actions include approximately 165 acres of regeneration harvest from the current Mares Run Timber Sale and about 18,425 acres of prescribed fire from the Warm Springs Mountain Restoration Project burns. The combined effect of these actions would be to increase the early successional stage by approximately 3% of the analysis area and a fraction of one percent of the analysis area to the open structural stage. About three quarters of the early acres are created in the Oak Forest and Woodlands with the Pine Forest and Woodlands receiving the bulk of the remaining 25%. Impacts to open structural conditions are much the same; 70% in the oaks and most of the remaining in the pines. The vast majority of these changes are coming from the late successional stage, thus the late stage is slightly reduced in the entire analysis area. Cumulatively, these actions

move the landscape closer to the desired conditions for early and open in the Oak and Pine Forests and Woodlands, but are still well below those desired conditions.

Under all Alternatives long-term deer populations in the LCRMP are expected continue to stay stable. The amount of early successional forest, grassland/shrublands, and mid- to late successional hard mast producing forest acres stay relatively constant under each alternative. In summary, the combination of habitat components important for white-tailed deer habitat are projected to slightly increase (combination of early forest, open woodlands, and grasslands/shrublands) or stay relatively stable (mid- to late-successional mast producing forest) over the next 10 years under all Alternatives. In response to increased favorable habitat conditions, white-tailed deer populations would be expected to stabilize. The high percentage of public/private interface on the LCRMP will impact the deer population along this interface, as long as adjacent private lands have higher harvest objectives and are allowed kill permits in response to damage complaints.

B3B Ecological Indicators

B3B.1 Existing Condition (Ecological Indicators)

Pileated Woodpecker

The pileated woodpecker (*Dryocopus pileatus*) was selected as an MIS because it requires large snags for nesting and feeding. The occurrence of this species may be correlated with forested habitats containing abundant large dead trees and fallen logs (Hamel 1992), which also are used by other birds, mammals, and amphibians. This species is selected to help indicate the effects of management activities on the availability of forests with desired abundance of snags. Population monitoring would be combined with information on forest age-class distribution and snag densities to provide a full picture of management effects on this species and other snag-dependent wildlife.

USGS Breeding Bird Survey (BBS) data indicates an increasing population trend of pileated woodpeckers in the Appalachian Region. USFS avian point count data from the GWJNFs indicate an overall stable population trend. Pileated woodpeckers are common throughout the LCRMP and were observed or their calls heard during field surveys throughout the Lower Cowpasture project areas.

Figure 3B3-6. Trend in BBS Data of Pileated Woodpeckers across the Appalachian Region, 1966 To 2010.
Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

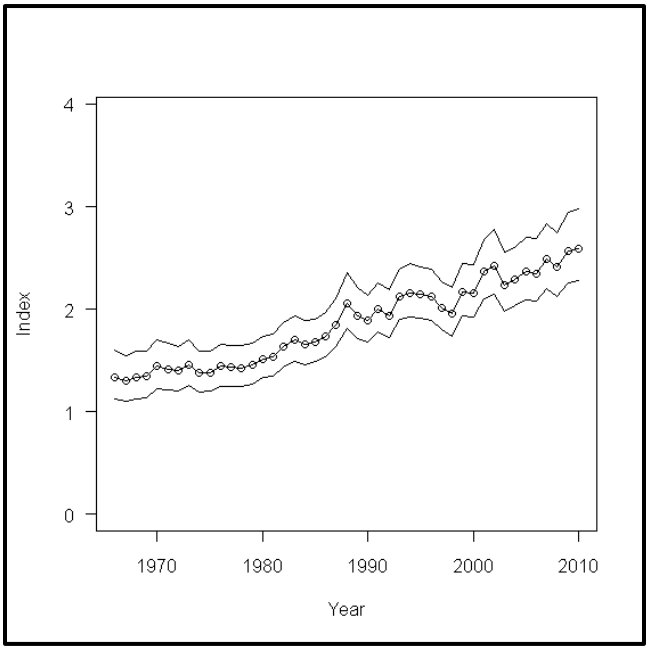
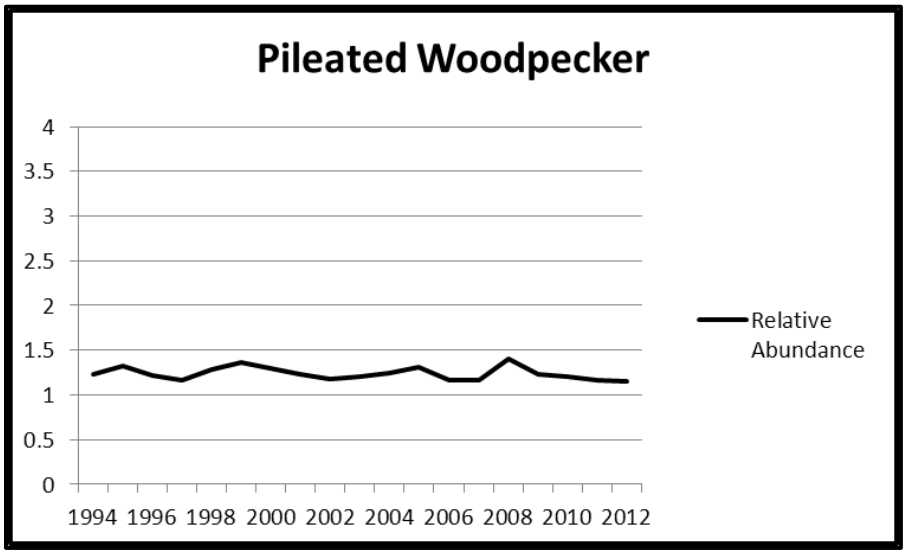


Figure 3B3-7. Trend in USFS Avian Point Count Data of Pileated Woodpeckers across the GWJNF, 1994 to 2012
Source: Southern Region Avian Monitoring Database



Pileated woodpeckers generally prefer mature forests near riparian areas and are primary cavity nester/excavator. Generally, this species requires trees greater than 15 inches dbh for cavities, but prefers trees greater than 20 inches dbh. Based on the results of monitoring data, this species is showing stable population trends on the GWJNFs and increasing trends across the Appalachian Region. Pileated woodpeckers have the abundance and distribution across the Forest that will provide for its persistence into the foreseeable future. Important habitat components for this species are mid-late successional hard mast producing forest.

Ovenbird

The ovenbird *(Seiurus aurocapillus)* was selected as a MIS because it is associated with mid-successional to mature forest interior habitats (Hamel 1992; Crawford et al. 1981). This species is selected to help indicate the effects of management on the availability of suitable mature forest interior habitats. Other elements, such as landscape analysis of forest fragmentation using remote sensing data, would supplement information received from monitoring this species.

USGS Breeding Bird Survey data indicates stable to increasing trends in the Appalachian region. USFS Avian point count data from the GWJNFs for ovenbird also indicates an overall stable to increasing population trend.

Figure 3B3-8. Trend in BBS Data of Ovenbirds across the Appalachian region, 1966 To 2010.
Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

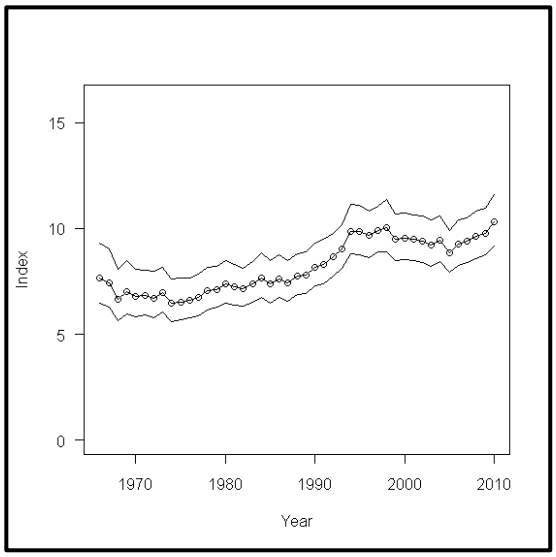
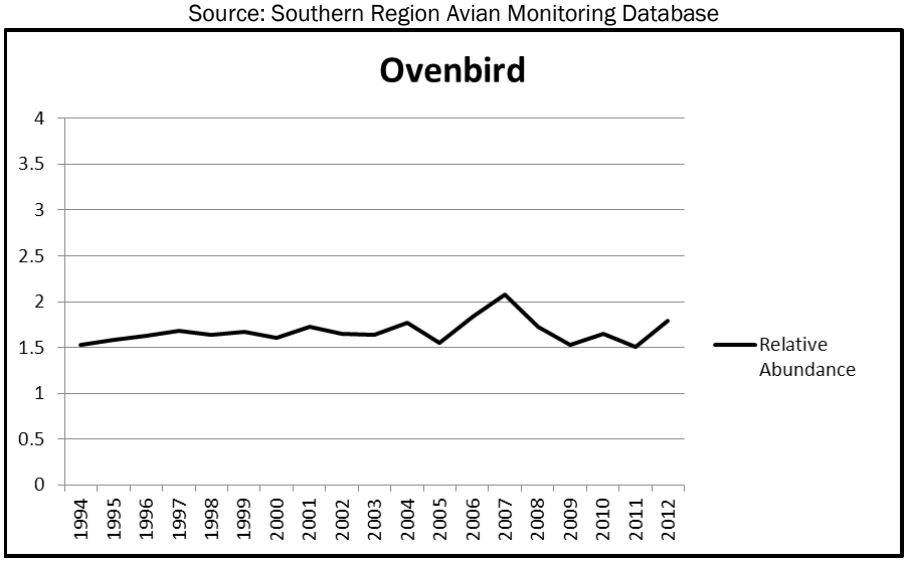


Figure 3B3-9. Trend in USFS Avian Point Count Data of Ovenbirds across the GWJNF, 1994 To 2012
Source: Southern Region Avian Monitoring Database



Ovenbirds breed in upland deciduous or mixed deciduous/pine forests with a moderately dense understory. They nest on the ground and build a covered nest from leaf litter. They require large

patches of mature forest for nesting. While the need for large patches of mature forested habitat has been well documented for many migratory bird species, including ovenbirds, evidence is mounting that early successional woody habitats are also important during the critical time period just after breeding and during migration (Bulluck and Buehler 2006). These areas provide safe havens for adult and fledgling ovenbirds for the following needs: molting, abundant food for the buildup of fat reserves for migration, and protection from predators. Studies strongly recommend conservation strategies that maintain large tracts of mature forest, within which there is a mosaic of different forest types and ages (early and mid-successional forest stands), to provide the habitat requirements needed by migratory birds such as ovenbirds during all of their life stages here in North America. Based on the results of monitoring data, this species exhibits stable to increasing population trends on the GWNF, as well as region-wide, and have the abundance and distribution across the Forest that will provide for their persistence into the foreseeable future. Ovenbirds were observed or their calls heard during field surveys throughout the Lower Cowpasture project areas, particularly the forest interior habitat within mature mesic deciduous forests. Important habitat components for this species are mid-late successional hard mast producing forest.

Chestnut-Sided Warbler

The chestnut-sided warbler (Dendroica pensylvanica) was selected as a MIS because of its association with high-elevation early successional habitats. This species is selected to help indicate the effects of management on the availability of higher elevation early successional habitat. Trends for these species will be evaluated along with trends in total acres, age-class distribution, and level of restoration and maintenance activities to provide a more complete picture of effects of management on this community.

USGS Breeding Bird Survey data indicates a relatively stable trend in chestnut-sided warblers in the Appalachian region. USFS Avian point count data also indicates an overall stable population trend across the GWJNFs. Chestnut-sided Warblers were not observed nor their calls heard during field surveys throughout the Lower Cowpasture project areas.

Figure 3B3-10. Trend in USGS BBS Data of Chestnut-sided warblers across the Appalachian region, 1966 To 2010.
Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

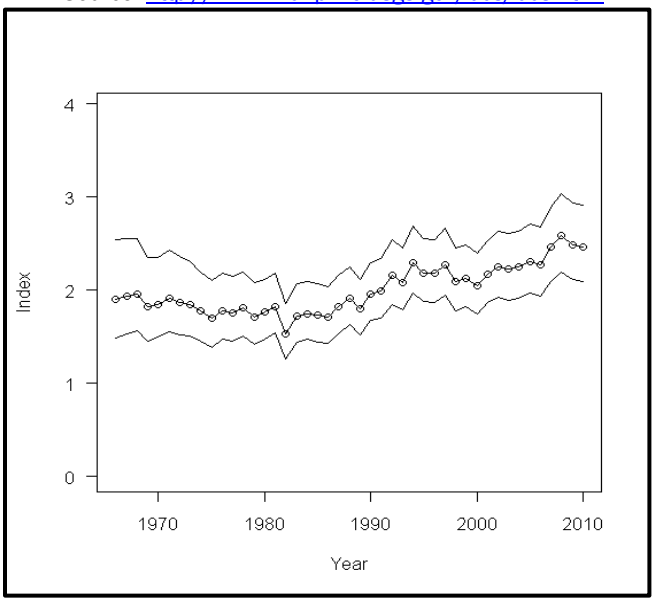
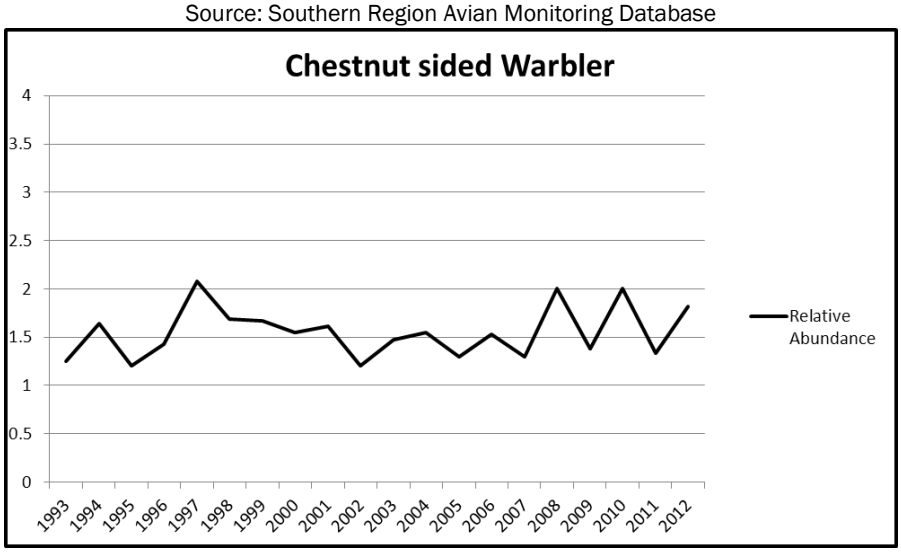


Figure 3B3-11. Trend in USFS Avian Point Count Data of Chestnut-sided warblers across the GWJNFs, 1994 To 2012
Source: Southern Region Avian Monitoring Database



Chestnut-sided warblers are associated with larger patches (e.g. greater than 12 acres) of early successional woodlands, mountain laurel thickets, and forest edge habitat above 2,000 feet (Hamel 1992; Hunter et al. 2001). Chestnut-sided warblers have exhibited significant continental population declines in the last couple of decades, mirroring an overall trend of decline of disturbance-dependent bird species associated with open habitats in eastern North America (Vickery 1992; Askins 2000; Hunter et al. 2001). A significantly greater proportion of bird species exhibiting steep population declines are associated with disturbance-mediated habitats than in forested or generalist habitat types (Brawn et al. 2001). Combined with recent research highlighting the importance of early successional woody habitat for post-breeding and migratory stop-over needs of forest-interior migratory bird species in a larger landscape of mature forest (see sections on ovenbirds, worm-eating warblers, and hooded warblers), the role of early successional habitat in largely mature, forested landscapes and the need to restore/maintain disturbance regimes creating such habitats is of vital importance in conservation planning (Brawn et al. 2001; Hunter et al. 2001). Based on the results of monitoring data, chestnut-sided warblers show a stable population trend on the GWNF, and the Appalachian region, with an abundance and distribution across the Forests that will provide for their persistence into the foreseeable future. Important habitat components for this species are early successional forest and open woodland.

Acadian Flycatcher

The Acadian flycatcher (*Empidonax virescens*) was selected as MIS because of its association with riparian habitat in deciduous and mixed deciduous/coniferous forests. It is highly associated with riparian habitat streams and bottomland hardwoods (Hamel 1992).

USGS Breeding Bird Survey data indicates declining trends in the Appalachian region. Data from the GWJNF point count data for the Acadian flycatcher indicate an overall stable trend on the GWJNFs.

Figure 3B3-12. Trend in USGS BBS Data of Acadian flycatchers across the Appalachian region, 1966 To 2010.
Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

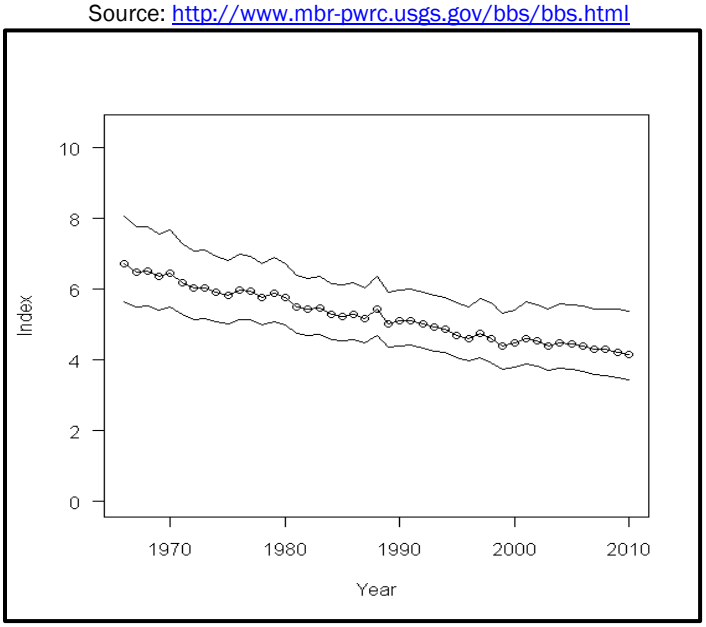
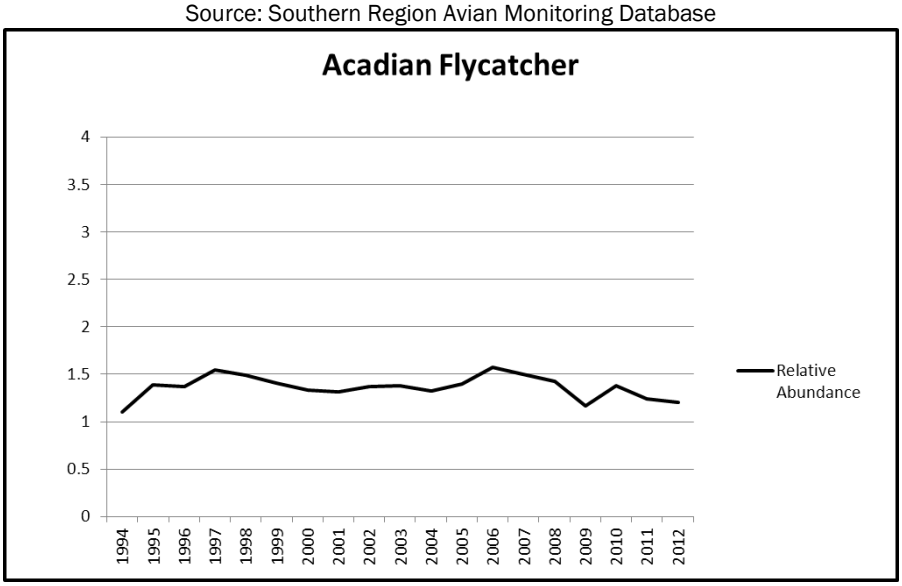


Figure 3B3-13. Trend in USFS Avian Point Count Data of Acadian flycatchers across the GWJNFs, 1994 To 2012
Source: Southern Region Avian Monitoring Database



Acadian flycatchers occur in deciduous, mixed deciduous/coniferous forest types, in riparian areas (Hamel 1992). Acadian flycatchers are often associated with closed overstory canopies and open understories. After breeding, Acadian flycatchers utilize open scrub and early successional woody habitat during migration. With overall stable population trends of Acadian flycatcher on the GWJNFs, Acadian flycatchers have the abundance and distribution across the Forests that will provide for their persistence into the foreseeable future. Though such trends are not apparent on the GWJNFs, of concern are declining trends shown by USGS BBS data in populations of Acadian flycatcher throughout the larger Appalachian region. Acadian Flycatchers were observed or their calls heard during field surveys throughout the Lower Cowpasture project areas, particularly within mature

riparian habitats. The most important habitat component for this species is riparian forest and its protection.

Hooded Warbler

The hooded warbler (*Wilsonia citrina*) was selected as an MIS for mid- to late-successional mesic deciduous forests. The hooded warbler is heavily associated with moist deciduous forests with fairly dense understories, where it breeds and feeds (Hamel 1992; Crawford et al. 1981). Management opportunities exist to increase the structural diversity of closed canopied habitats in this type to favor species, such as the hooded warbler, that optimize their life history in forests with canopy gaps and patches of dense understory. This species is expected to respond positively to management actions (including thinning and moderate frequency burning) that are designed to stimulate advanced oak regeneration and perpetuation of the forest type on these mesic sites. This species is deemed appropriate for helping to indicate the availability of mid- and late-successional mesic deciduous habitats and the efficiency of management intended to favor its habitat.

USGS Breeding Bird Survey data indicates stable to slightly increasing population trends for hooded warbler in the Blue Ridge Mountain and Ridge and Valley regions. Data from the GWJNFs point count data for hooded warbler indicate an overall stable trend on the GWJNFs. Hooded Warblers were observed or heard during field surveys throughout the Lower Cowpasture project areas, particularly within mature mesic deciduous forests.

3B3-13. Trend in USGS BBS Data of Hooded warblers across the Appalachian region, 1966 To 2010.
Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

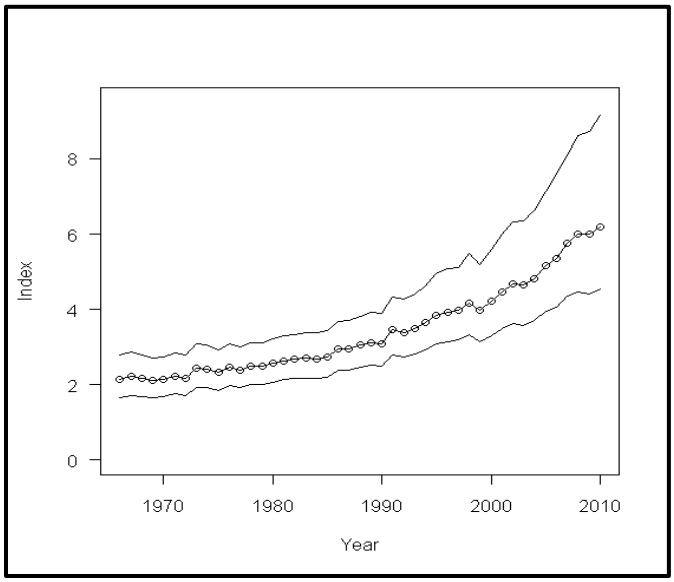
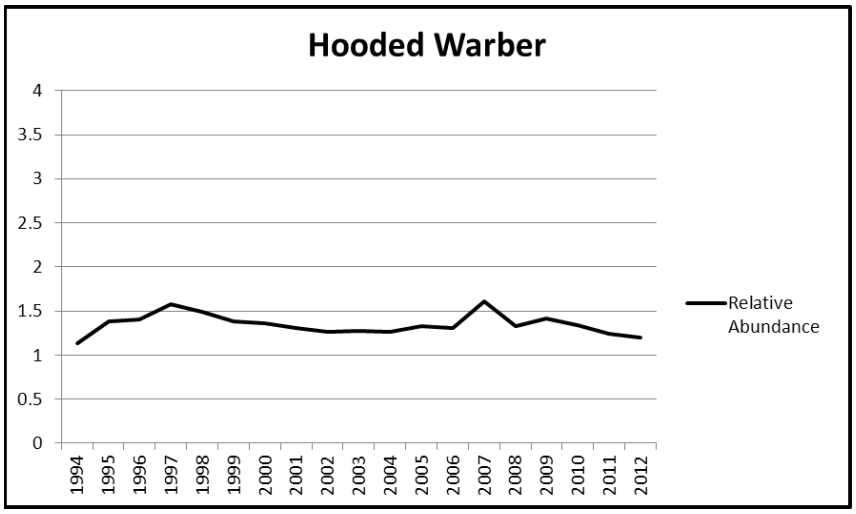


Figure 3B3-14. Trend in USFS Avian Point Count Data of Hooded warblers across the GWJNFs, 1994 To 2012
Source: Southern Region Avian Monitoring Database



Hooded warblers occur in deciduous, mixed deciduous/coniferous forest types, near or in riparian areas (Hamel 1992; Robbins et al. 1989). Hooded warblers are associated with canopy gaps and other small patches of dense woody vegetation in an otherwise mature forest (Robbins et al. 1989; Hunter et al. 2001). After breeding, both fledglings and adults move to areas characterized by dense, woody vegetation, abundant insect availability, and the presence of ripe fruits (Morton 1990; Evans Odgden and Stutchbury 1997; Anders et al. 1998; Vega Rivera et al. 1998, 1999). These areas provide safe havens for molting, abundant food for the buildup of fat reserves for migration, and protection from predators. Habitats supporting this kind of vegetation include open oak, oak/pine, and pine woodlands, patches of early successional habitat resulting from insect infestation and natural disturbance such as ice storms, patches of early successional habitat where the overstory had been thinned or harvested in some way (modified shelterwood, clear cut, high-grading), areas of second growth scrub/deciduous saplings located along forest borders and old fields, and mature riparian forests with a dense understory (Anders et al. 1998; Vega Rivera et al. 1998, 1999). Recent studies strongly recommend conservation strategies that maintain large tracts of mature forest, within which there is a mosaic of different forest types and ages (early and mid-successional forest stands), as well as mature riparian forest, to provide the habitat requirements needed by migratory birds during all of their life stages here in North America, including the hooded warbler (Kilgo et al. 1999; Suthers et al. 2000; Hunter et al. 2001). With overall stable population trends of hooded warbler on the GWJNFs and stable to increasing trends at the regional level, hooded warblers have the abundance and distribution across the Forests that will provide for their persistence into the foreseeable future. Important habitat components for this species are open woodland of mid-late successional forest.

Scarlet Tanager

Drier oak forests support a slightly different mix of species due to their more open woodland condition. To represent this upland oak community, the scarlet tanager (*Piranga olivacea*) is selected as an MIS. This species is most abundant in upland mature forest (Hamel 1992). Trends for these species will be evaluated along with trends in total acres, age-class distribution, and level of restoration and maintenance activities in this forest type to provide a more complete picture of effects of management on this community.

USGS Breeding Bird Survey data indicates stable to slightly increasing population trends of scarlet tanagers for the Blue Ridge Mountain and increasing population trends in the Ridge and Valley regions. Data from the GWJNFs point count data for scarlet tanager indicate an overall stable trend on the GWJNFs.

Figure 3B3-15. Trend in USGS BBS Data of Scarlet tanagers across the Appalachian region, 1966 To 2010.
Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

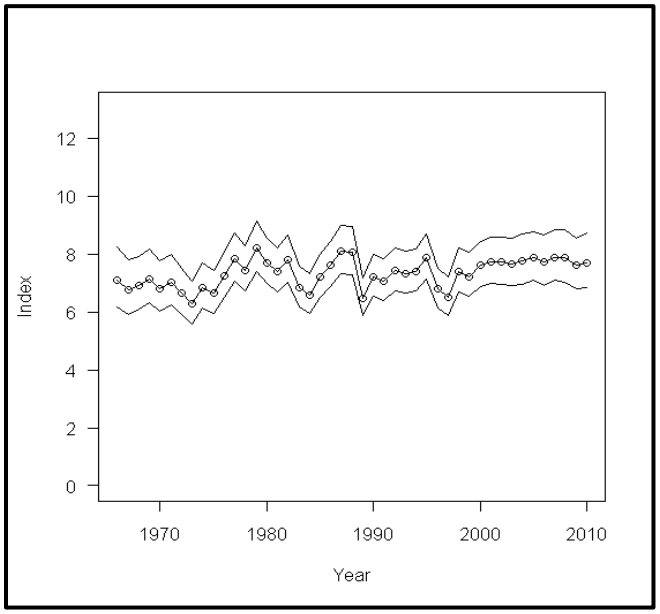
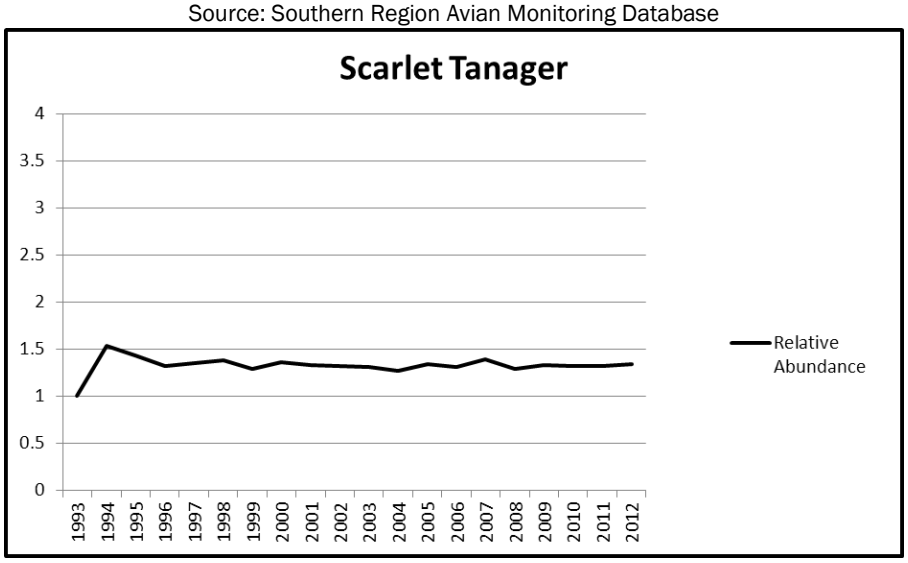


Figure 3B3-16. Trend in USFS Avian Point Count Data of Scarlet tanagers across the GWJNFs, 1994 To 2012
Source: Southern Region Avian Monitoring Database



Scarlet tanagers occur in deciduous, mixed deciduous/coniferous and coniferous forest types in the Appalachian region (Rosenburg et al. 1999). In the Appalachian region, research has indicated that scarlet tanagers do not show area sensitivity in moderately or heavily forested landscapes (Rosenburg et al. 1999). With overall stable to increasing population trends of scarlet tanagers on

the GWJNFs and at the regional level, scarlet tanagers have the abundance and distribution across the Forests that will provide for their persistence into the foreseeable future. Scarlet Tanagers were observed or their calls heard during field surveys throughout the Lower Cowpasture project areas, particularly within the drier mid- and late-successional oak and oak-pine forests. Important habitat components for this species are mid-late successional hard mast producing forest.

Pine Warbler

Pine forests have been in decline on the national forest as a result of southern pine beetle epidemics and lack of fire needed to maintain their dominance. Therefore, they will be the focus of ecological restoration and maintenance on some portions of the national forest. The pine warbler (*Dendroica pinus*) is closely associated with pine and pine-oak forests, generally occurring only where some pine component is present. It therefore is an appropriate indicator of the effects of management in restoring and maintaining pine forests. It should be noted, however, that this species does not discriminate as to the condition of pine stands relative to mid and understory, and so would indicate little more than the presence of pine. Other bird species that may be associated with desired fire-maintained conditions were not deemed sufficiently likely to be present to be appropriate MIS. Understory plant species also were considered and found to be too universal in association to be appropriate MIS. Therefore, pine warbler and various habitat-based elements, such as amount and effectiveness of prescribed burning, will be used to indicate effects of management on species associated with this community.

USGS Breeding Bird Survey data indicates stable population trends of pine warblers for the Blue Ridge Mountain and stable to slightly increasing trends in the Ridge and Valley regions. Data from the GWJNF point count data for pine warbler indicate an overall stable trend on the GWJNFs.

Figure 3B3-17. Trend in USGS BBS Data of Pine Warblers Across the Appalachian Region, 1966 To 2010.
Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

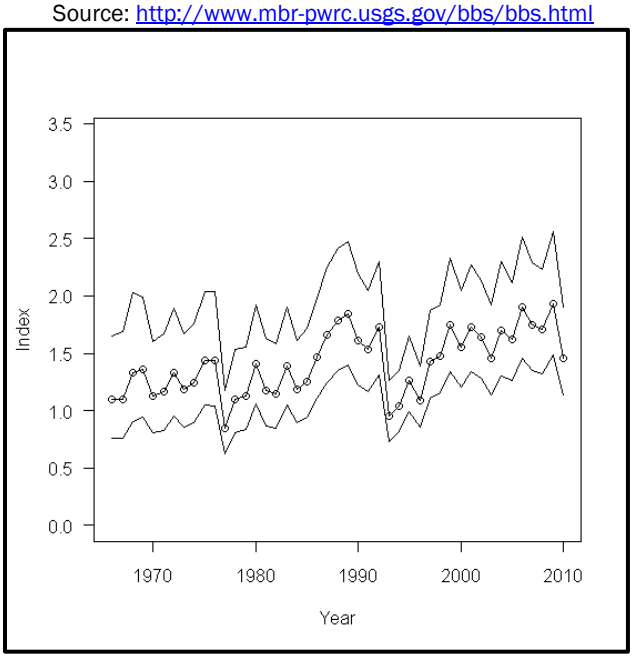
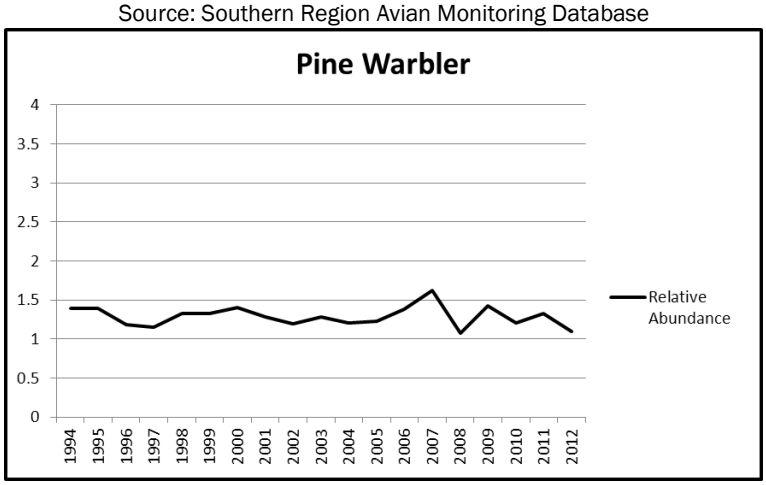


Figure 3B3-18. Trend in USFS Avian Point Count Data of Pine Warblers Across the GWJNFs, 1994 To 2012
Source: Southern Region Avian Monitoring Database



Pine warblers occur in mid- to late-successional pine and pine/oak forest types throughout its range (Hamel 1992). It is rarely found in pure hardwood forest types. Pine warblers are temperate migrants in the Appalachians, shifting to the Piedmont and Coastal Plain during the winter months. They are mainly insectivorous during the breeding season, but shift to insects, berries, and small seeds the rest of the year. With overall stable population trends of pine warbler on the GWJNFs and stable to increasing trends in the Blue Ridge and Ridge and Valley regions, pine warblers have the abundance and distribution across the Forests that will provide for their persistence into the foreseeable future. Pine Warblers were observed or their calls heard during field surveys throughout the Lower Cowpasture project areas, particularly within the mature pine forests. The most important habitat component for this species is pine woodlands.

Open woodland restoration acres will be used as a surrogate for habitat improvement for this species. The departure analysis also gives insight into potential changes of pine forests and woodlands (See Table 3B3-9).

Eastern Towhee

The eastern towhee (*Pipilo erythrophthalmus*) was selected as the most appropriate MIS to represent early successional forests. Eastern towhees are shrubland nesting birds that require thickets or brushy places on the ground or in shrubs or saplings to 5 feet high for nesting. Providing early successional and open woodland forest is necessary to support populations of this species.

USGS Breeding Bird Survey data indicates decreasing to stable population trends of eastern towhees for the Blue Ridge Mountain and decreasing trends in the Ridge and Valley regions. Data from the GWJNF point count data for eastern towhee indicate an overall stable trend on the GWJNFs.

Figure 3B3-19. Trend in USGS BBS Data of Eastern towhees across the Appalachian region, 1966 To 2010.
Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

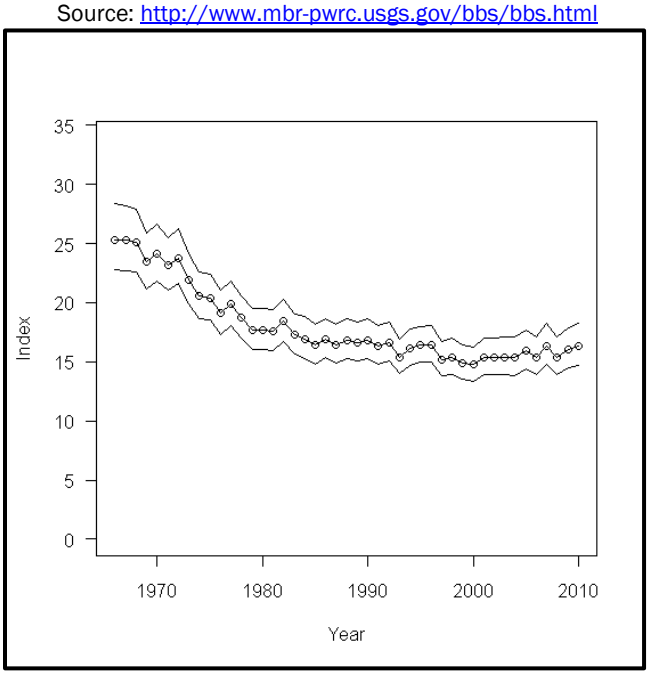
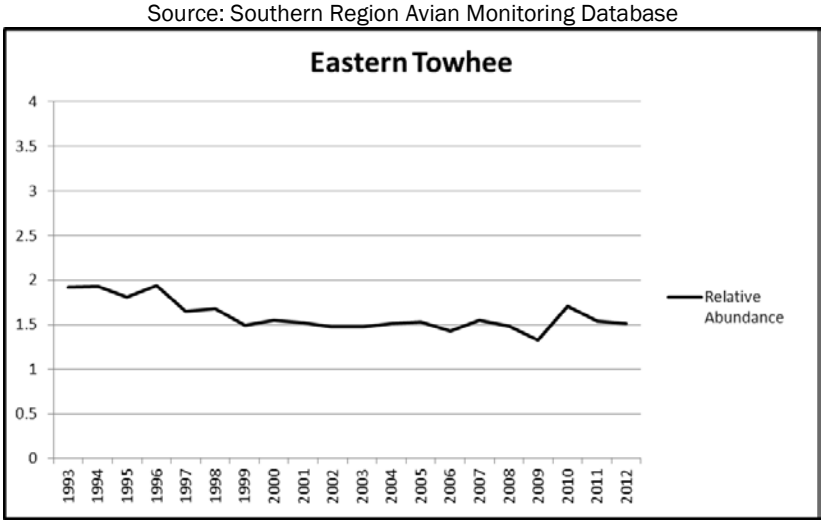


Figure 3B3-20. Trend in USFS Avian Point Count Data of Eastern towhee across the GWJNFs, 1994 To 2012
Source: Southern Region Avian Monitoring Database



Eastern towhees inhabit early successional habitat associated with dense second growth, dense vegetation associated with open woodlands, and forest edge habitat (Hamel 1992; Hunter et al. 2001). Eastern towhees have exhibited significant continental population declines in the last couple of decades, mirroring an overall trend of decline of disturbance-dependent bird species associated with open habitats in eastern North America (Vickery 1992; Askins 2000; Hunter et al. 2001). A significantly greater proportion of bird species exhibiting steep population declines are associated with disturbance-mediated habitats than in forested or generalist habitat types (Brawn et al. 2001). Forty percent of all North American species associated with some type of disturbance-mediated habitat (grassland, shrub-scrub, open woodlands) have been significantly decreasing in population since 1966 (Brawn et al. 2001). Combined with recent research highlighting the importance of early successional woody habitat for post-breeding and migratory stop-over needs of forest-interior migratory bird species in a larger landscape of mature forest (see sections on ovenbirds and hooded

warblers), the role of early successional habitat in largely mature, forested landscapes and the need to restore/maintain disturbance regimes creating such habitats is of vital importance in conservation planning (Brawn et al. 2001; Hunter et al. 2001). With overall stable population trends of eastern towhees on the GWNF, and in the Blue Ridge region, eastern towhees have an abundance and distribution across the Forests that will provide for their persistence into the foreseeable future, though the steadily declining trends in the Ridge and Valley region are cause for concern. Eastern Towhees were observed or their calls heard during field surveys throughout the Lower Cowpasture project areas, particularly within the early successional habitats. Important habitat components for this species are early successional forest.

Beaver

Beavers (*Castor canadensis*) were selected as an MIS because they are a keystone species that create wetland habitat with many physical and biological benefits. Beavers alter ecosystem hydrology, biogeochemistry, vegetation, and productivity with consequent positive effects on the plant, vertebrate, and invertebrate populations that occupy beaver-modified landscapes. Their impoundments trap fine textured sediments that act as water storage reservoirs, resulting in slow, sustained discharge that maintains streamflows during dry periods; afford protection from flooding of downstream areas; and produce a raised water table that enhances riparian zones. Additionally, beaver habitat modifications can reduce pollution and improve water quality in aquatic ecosystems, by trapping sediment and nutrients; reducing downstream turbidity; and purifying water from acidification and other non-point source pollutants. The capability of beavers to store water, trap sediment, reduce erosion, and enhance riparian vegetation can be used as a management tool to restore degraded aquatic and riparian ecosystems. Beavers are a habitat-modifying species and play a pivotal role in influencing community structure in many riparian and wetland systems. Restoring beaver populations to their maximum viability on public lands is desirable because of the beaver's capability to restore and maintain healthy riparian ecosystems. Key conservation elements for the beaver on National Forest System lands are, therefore, protection and enhancement of aquatic and riparian habitats by management of water resources and riparian vegetation, beaver population enhancement by natural recolonization and transplants where necessary, and proactive management of beaver damage issues.

The primary conservation concerns are to ensure that existing beaver populations remain viable and to restore beaver populations to unoccupied habitat where appropriate to take advantage of their capability to restore and strengthen the ecological integrity of aquatic and riparian ecosystems. Beaver management plans must take into account landscape-scale habitat management. To maintain viable populations, managers should ensure that land uses maintain connectivity between watersheds to facilitate long-range dispersal and gene flow. This scale of management maintains metapopulation dynamics and allows natural dispersal to repopulate watersheds where beavers have been reduced or extirpated by natural or human causes. At project-level scales, management practices that potentially affect riparian vegetation and stream hydrology or morphology should mitigate adverse impacts to beaver habitat, and enhance beaver habitat where possible.

Beavers are vulnerable to overharvest because of the relative ease of capture, their dependence on aquatic habitat, delayed sexual maturity, and a slow reproductive rate. Since beavers are regulated by the state wildlife agencies as a furbearer species, maintaining viable beaver populations will require cooperative management plans that account for overharvest vulnerability, to ensure that local or regional populations are not decimated by excessive exploitation and that National Forest wetland habitat conditions are being met. Ensuring a sustainable harvest may include designating some areas as off limits to trapping.

Though commonly seen in the mainstem Cowpasture drainage, beaver are uncommon in the LCRMP. Significant beaver pond complexes are known in the Limekiln drainage near Slim Ridge and downstream of the Chestnut Ridge Seep Special Biological Area. Beavers are ephemeral residents of many of the larger stream systems (second order) of the LCRMP. The most important habitat component for this species is riparian forest and its protection.

Wild Brook Trout

Wild brook trout (*Salvelinus fontinalus*) were chosen as a MIS because many of the trout streams on the GW National Forest support wild native brook trout. Wild trout are indicative of cold water streams, good water quality and sedimentation rates that are in equilibrium with the watershed. In addition, trout are commonly fished and are a demand species. Brook trout (Salvelinus fontinalis) require coldwater habitat and high quality water conditions, it requires a water temperature less than 69 degrees Fahrenheit, dissolved oxygen values greater than 7.0 parts per million, and sedimentation rates that are in equilibrium with the watershed. Optimal habitat would also include 125 to 300 pieces of large woody debris (LWD) per stream mile (Forest Plan, page 3-93). The amount and distribution of coldwater habitat and water quality have the potential to be influenced by management activities like timber sales that have potential to raise stream temperatures and increase the rate of sediment to the stream channel.

Some management activities, such as large wood placement and stream liming are specifically designed to improve brook trout habitat and increase their populations. MIS population trends and changes are analyzed for wild trout, rather than hatchery reared fish, since many stocked streams are not suitable for year-round survival or recruitment of a self-sustaining population. VDGIF tracks wild brook trout populations on selected Forest streams. Wild trout are also a species that could be highly sensitive to stream temperature changes associated with climate change. This MIS and effects of alternatives are discussed under the Aquatic section of this chapter. The most important habitat component for this species is riparian forest and its protection as well as water quality.

B3B.2 Direct Indirect and Cumulative Effects (Ecological Indicator Species)

Direct and Indirect Effects-Alternative 1

Pileated Woodpecker, Ovenbird, Scarlet Tanager
These species are grouped because their primary habitat component is mid-late successional hard mast producing forest.

Mid-late successional hard mast producing forest: Under Alternative 1 the LCRMP will continue to have over 89% (70,000 acres) in mature late-successional (80+ years old) and 83% in the Late-closed ecological group condition class, both representing the primary habitat component for these species. These species are expected to remain stable or increase with the continued aging of the LCRMP forests.

Pine Warbler, Hooded Warbler
These species are grouped because their primary habitat needs come about as the results of prescribed burning. The habitat component directly related to this is open woodland.

Open woodland: The LCRMP currently has just 1.5% in open woodland condition. This ecological system group condition represents the greatest departure from the desired condition on the LCRMP. Reciprocally, closed condition forest is the most common condition throughout the LCRMP (See Vegetation section departure analysis). Open woodland conditions allows the development of woody

browse, grasses, forbs, and soft and hard mast producing shrubs in the understory which is preferred habitat for hooded warblers. Open woodland is primarily the product of fire on the landscape, which should help pine forest regeneration and therefore improve habitat conditions for the Pine Warbler. The departure analysis shows that Alternative 1 would not provide any more open woodland now and in the future, beyond the projected 2% generated by natural disturbances across the planning area (Forest Plan). No prescribed fire is associated with this alternative. Alternative 1 would not improve habitat conditions for these species. Populations are expected to be stable under this alternative.

Chestnut-sided Warbler, Eastern Towhee
These species are grouped because their primary habitat component is early successional forest.

Early successional forest: The LCRMP currently contains about 4000 acres (5%) of early successional habitat (0-10 age class) created by past timber management, wildfires, and prescribed burns. This closely matched the departure analysis totals of "early" ecological condition despite the age class range differing from ecological system groups. In both cases these areas typically have a diverse cover of forbs and soft mast plants including blueberry, huckleberry, blackberry, pokeweed, sassafras, and grapes that are a focal point for foraging wildlife. These areas also provide preferred habitat for this species group. Alternative 1 would not provide any more early successional habitats now and in the future beyond the projected 2% generated by natural disturbances across the planning area (FEIS).

Acadian Flycatcher, Beaver, Brook Trout
These species are grouped because their primary habitat component is riparian forest.

Riparian Forest: Under Alternative 1, no activities will take place in or near riparian forest habitat (aquatic and terrestrial). Under this alternative, watershed and streamside vegetation and soil would remain unchanged and continue to provide shading and a future source of nutrients and large woody debris. There will be no impact to any aquatic MIS or the biodiversity of the aquatic and riparian ecosystem due to management activities. There will, however, be impacts due to the lack of management activities. Since impassable culverts will not be replaced, connectivity of the stream systems and aquatic organism passage will not be improved. For more discussion see the Aquatics section of this document.

Direct and Indirect Effects-Alternatives 2 & 3

Pileated Woodpecker, Ovenbird, Scarlet Tanager
These species are grouped because their primary habitat component is Mid-Late successional hard mast producing forest.

Mid-late successional hard mast producing forest: Both action alternatives represent minor reductions (less than 1.5%) of mature forest throughout the planning area. These species would remain at current population levels or increase even under the action alternatives.

Pine Warbler, Hooded Warbler

These species are grouped because their primary habitat needs come about as the results of prescribed burning. The habitat component directly related to this is open woodland for hooded warbler. Open woodlands and total departure from the desired condition for pine forests are used to infer pine warbler habitat quality.

Open woodland: The LCRMP departure analysis shows an approximately 1.5% increase in open woodlands under both action alternatives. Alternatives 2 and 3 provide for nearly 16 percent of the landscape to be within a prescribed burn unit, with expected increase of open woodlands, early successional habitats, and improved pine regeneration and stand health, among other ecological benefits. Pine Warbler habitat quality should improve with the changes associated with the prescribed burns that bring about these changes. For pine habitats the departure analysis shows a total of 162 points of departure in pine ecological groups, whereas both alternatives show approximately 151 points of departure. The action alternatives move the landscape closer towards the desired condition for pine forests than no action. Neither open woodlands nor pine forests departure numbers address directly the total acres of pine forest habitat on the landscape.

Table 3B3-9. Percent Departure summary for pine forests and woodlands

Pine Forests and Woodlands	Early	Mid closed	Mid Open	Late Closed	Late Open	Points of Departure
Alternative 1	-3.76	2.55	-24.96	78.54	-52.37	162.18
Alternative 2	2.95	2.15	-24.81	70.28	-50.58	150.77
Alternative 3	2.62	2.16	-24.81	70.69	-50.66	150.94

Chestnut-sided Warbler, Eastern Towhee

These species are grouped because their primary habitat component is early successional forest.

Early successional forest: The highest projected acreage of early successional forest is created by Alternative 2 with 9.7% versus 9.5% in Alternative 3. Both action alternatives show an addition of greater than 4% of early ecological group type age class, providing over 5,600 acres of early successional habitat.

Acadian Flycatcher, Beaver, Brook trout

These species are grouped because their primary habitat component is riparian forest.

Riparian Forest: The use of BMPs and avoidance of impacts in riparian areas would result in negligible impact to aquatic/riparian MIS. Larger more comprehensive buffering of riparian forests from management activities will leave existing riparian forests intact and connected.

Water Quality: Some minor sedimentation can be expected from harvest activities, as discussed in the Water Resources section. The sediment increases are not significant in comparison to the background sediment load of streams in the analysis area and will have no significant effect on habitat of fish or other aquatic life. The mitigation section of this EA contains measures that will be used to reduce sedimentation and protect the beneficial uses.

Alternative 2 would not directly increase the amount of LWD in any stream. However, protection of the riparian area would allow for the natural recruitment of LWD in the future. Future recruitment of LWD is expected to improve the amount and distribution of pool habitat in area streams in the future. This riparian area would also provide shading of the stream to maintain current thermal characteristics and microbial (algal, bacteria) structure and productivity.

In Alternative 3, within the LCRMP area, the following streams have been identified for LWD additions within the 10 year timeframe of the project: Mares Run, Panther Run, Lick Run, Little Wilson, Lick Block, Left Prong Wilson, Smith Creek, and Simpson Creek. In addition, protection of the

riparian area would allow for the natural recruitment of LWD in the future. This would improve habitat quality for the Brook Trout.

B3C - Threatened, Endangered, Proposed, Sensitive Species

B3C.1 Existing Condition (Threatened, Endangered, Proposed, Sensitive)

The James River/Warm Springs Ranger Districts (Districts) support known occurrences and suitable habitat for several federally listed threatened, endangered, and proposed species. Forest Service Manual (FSM) Section 2672.41 requires a biological evaluation (BE) and/or biological assessment (BA) for all Forest Service planned, funded, executed, or permitted programs and activities. The objectives of this BE/BA are to: 1) ensure that Forest Service actions do not contribute to trends toward federal listing, 2) comply with the requirements of the Endangered Species Act (ESA) so that federal agencies do not jeopardize or adversely modify critical habitat (as defined in ESA) of federally listed species, and 3) provide a process and standard to ensure that threatened, endangered, proposed, and sensitive species receive full consideration in the decision-making process using the best available science.

The document known as the Biological Evaluation/Biological Assessment of Threatened, Endangered, Proposed and Forest Service Sensitive Species of the Lower Cowpasture Restoration and Management Project dated October 31, 2014, considered all known federally listed species. This Biological Evaluation/Biological Assessment (BE/BA) documents the analysis of potential effects of the proposed project alternatives to these species and associated habitat, as well as, analyzing effects on Forest Service Sensitive species and is included here by reference. It serves as biological input into the environmental analysis for project-level decision making to ensure compliance with the ESA, National Environmental Policy Act (NEPA), and National Forest Management Act (NFMA). All Forest Plan mitigation measures will be integrated into all applicable management activities.

The BE/BA was submitted to the US Fish and Wildlife Service as part of the on-line project review system of the Virginia Field Office as part of the informal consultation process. Concurrence of effect determination was received on March 30, 2015.

In addition to federally listed species, the Forest Service also has a list of species determined by the Regional Forester to be sensitive to management. This Southern Region specific list is made up of nearly 800 species, identified by the Regional Forester, for which population viability is a concern. These species are chosen through an analysis of significant current or predicted downward trends in population numbers or density, or in habitat capability that would reduce a species' existing distribution. Effect of management on Sensitive species was also analyzed in the BE/BA with the intent of avoiding or minimizing the impacts to the species. If impacts cannot be avoided the BE/BA analyzes the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole. Table 3B3-10 shows the Region 8 sensitive species considered for in depth analysis in the LCRMP Biological Evaluation. The final determination for each Sensitive species is also summarized below.

Table 3B3-10. USFS Sensitive Species of the LCRMP

Sensitive Species	Taxa
Sweet Pinesap	Plant
Swordleaf Phlox	Plant
Roughhead Shiner	Fish
Orangefin Madtom	Fish
Yellow Lance	Mollusk
Maureen's Minute Moss Beetle	Insect
Eastern Small-footed Bat	Mammal
Bald Eagle	Bird

Determination of Effect for Federally Listed Threatened, Endangered, Proposed

Shale Barren Rock Cress:

All known populations of shale barren rockcress on the Forest are protected in prescription 4D-Special Biological Areas. Special Biological Areas are managed for the rare resources they support. Monitoring of shale barren rockcress populations and inventorying for new populations will continue through joint efforts by the Forest Service, VDNH, and WVDNR. Because of the protective measures in the Plan for this species a determination of "not likely to adversely affect" is made for shale barren rockcress.

Because all known occurrences and potential habitat for this species is being excluded from ground disturbing activities, and in the interim of more scientific effects analysis, being excluded from burn areas, the determination of effect of the proposed project on the shale barren rock cress is "no effect".

James Spinymussel:

For the James spinymussel, this project will be in compliance with the George Washington and Jefferson National Forest's Federal Listed Threatened and Endangered Mussel and Fish Conservation Plan. This project would comply with the specific project level direction found within the Conservation Plan that was developed through informal consultation with the U. S. Fish and Wildlife Service, a finding of the effect to the James spinymussel for this proposed project is: may effect: not likely to adversely affect.

Any effects from management activities will be insignificant or discountable; therefore, there will be no adverse direct or indirect watershed effects to the James spinymussel. Since it does not occur on the National Forest, the main avenues for the Forest to aid in this species recovery are through educating and working with landowners to protect streams and streamside habitat, and assisting efforts to identify additional suitable habitat and restore these species to historical habitats as appropriate. In some cases, acquisition of lands within the Forest's Proclamation Boundary may also be part of recovery actions.

Indiana Bat

The LCRMP includes all Forest-wide protection and project monitoring standards for Indiana bat management (FW-47 to FW-62 - inclusive) of the 2014 Revised GW Forest Plan pages 4-5 to 4-7. Implementation of activities included in the LCRMP (prescribed fire, timber harvest, salvage activities, wildlife habitat management, and special use activities) has the potential to adversely affect the Indiana bat through the possible "take" (as defined by ESA) of individual bats as described in the GW Revised Plan Biological Assessment and programmatic consultation. The level of anticipated take for this project is incidental and not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat. The USFWS stated in their review of this project on March 30, 2015 that, "The U.S. Fish and Wildlife Service's Biological Opinion (as modified by letters of March 5, 2014 and April 21, 2014) authorizes incidental take of 23,513 acres annually of potential Indiana bat habitat. For 2015, the George Washington National Forest has disturbed 10 acres of potential Indiana bat habitat. The additional 3,705 acres of vegetation disturbance proposed for this project does not exceed the take coverage from the 2013 Biological Opinion therefore, these activities are covered."

Northern Long-eared Bat

For the Northern long-eared bat, based on the standards of Indiana bat management, the Forest-wide standards for Cave management in the 2014 Revised GW Forest Plan pages 4-7 to 4-8 (FW-71 thru FW-77), the closing caves and mines to visitation by Regional Forester in June 2014 (Order Number FS-RO-08-01-2014), and the habitat objectives in the Plan to maintain a variety of successional classes within a matrix of a predominantly mature forest structure the management activities implemented as part of LCRMP will not jeopardize the continued existence of the northern long-eared bat.

Additionally, while the species was proposed for listing as an endangered species effects were discussed with the USFWS in a Conference Report prepared by the Forest Service on August 4, 2014 and the Service agreed on August 27, 2014 that continued implementation of conservation measures in place for the Indiana bat were sufficient for the northern long-eared bat and Forest management actions would not result in jeopardy to the species.

Specific to the LCRMP, in reviewing the Biological Assessment/Biological Evaluation for the LCRMP the USFWS stated in their response to the Forest on March 30, 2015 that, "We also concur with your non-jeopardy determination for the federally proposed endangered Northern-long eared bat (*Myotis septentrionolis*)."

Determination of Effect Forest Service Sensitive Species:

Sword-leaf Phlox and Sweet Pinesap:

For sensitive plant species, Phlox buckleyi and *Monotropsis odorata*, there will be no negative impacts that would cause loss of species viability on the Forest or cause a trend towards federal listing under the Endangered Species Act. Therefore "no impact" is determined.

Roughhead Shiner, Orangefin Madtom, Yellow Lance, Maureen's minute moss beetle:

For the above species, this project will be in compliance with the George Washington and Jefferson National Forest's Federal Listed Threatened and Endangered Mussel and Fish Conservation Plan. Because this project will comply with the specific project level direction found within the Conservation Plan that was developed through informal consultation with the U. S. Fish and Wildlife Service, a finding of the effect to the roughhead shiner, orangefin madtom, yellow lance, Maureen's minute moss beetle for this proposed project there will be no negative impacts that would cause loss of species viability on the Forest or cause a trend towards federal listing under the Endangered Species Act. Therefore "no impact" is determined.

Eastern Small-footed Bat

For the Eastern small-footed bat, due to the lack of documented species occurrence and desirable habitat within the project area, the implementation of this project will have no negative impacts that would cause loss of species viability on the Forest or cause a trend towards federal listing under the Endangered Species Act. Therefore "no impact" is determined.

Bald Eagle

Bald eagles (*Haliaeetus leucocephalus*) in the Chesapeake Bay Region are most often associated with rivers, lakes, and shorelines, selecting large trees that are open and accessible for roosting and nesting, in relatively large forested blocks adjacent to large open corridors or open woodlands (USFWS 1990). The nesting season for the bald eagle in Virginia is from mid-October to the end of July (Guidelines). Their foraging strategy is broad and opportunistic, including a wide range of birds, mammals, and fish, both live and dead. Open woodland restoration through the use of prescribed fire, as proposed in this project, will improve habitat for bald eagles, creating more accessible roosting and nesting areas within foraging distance (several miles) of suitable rivers and lakes on the George Washington National Forest.

On August 8, 2008, the US Fish and Wildlife Service Removed the Bald Eagle from the Federal List of Threatened and Endangered Species (72 FR 37346). Due to the continuing need for conservation of this species and its habitat, the Regional Forester has added the Bald Eagle to the Regional Forester's Sensitive Species List, effective August 8, 2008 (Regional Forester 2670 Official Memorandum, July 17, 2007). As a result, the legal status of the Bald Eagle has been changed from a Federally Threatened species to a Regional Forester's Sensitive Species.

There are no known Bald Eagle nesting sites on National Forest land in the LCRMP, however, one historical location does exist near the intersection of SR 39 and SR 42, which was last known to be active in 2009. This nest tree is 1.3 miles from the proposed Coffee Pot prescribed burn and over 4 miles from any timber harvest unit, well outside of the 330 or 660 foot restriction zones identified in USFWS protection guidelines. Given the current high level of traffic on these surrounding roads no effect from hauling timber from the proposed harvest areas would be expected. These factors lead to the exclusion of this species from further analysis in the BE/BA, however it is included here to track the need to follow this and any unforeseeable nesting sites in the LCRMP.

An unlikely, but potential threat would be during aerial operations of the Coffee Pot burn and perhaps any prescribed burn in the northern portion of the LCRMP. Currently it is unknown if the nest will be active during the implementation of any of these burns and must be checked for activity or avoided during aerial operations. During the breeding/nesting season (December 15-July 15),

aircraft flyovers within 1000 vertical feet of the ground are restricted within the primary and secondary management zones of the occupied nest. If a helicopter is used during ignition phases of the project, the pilot and accompanying crew will be informed of the location of the eagle nest and aerial restrictions within the eagle nest management zones will be observed.

With the lack of proximity to nearly all proposed project activities the implementation of this project will have no negative impacts that would cause loss of species viability on the Forest or cause a trend towards federal listing under the Endangered Species Act. Therefore "no impact" is determined.

There are no other sensitive species present in the proposed activity areas; the project will have no impact to any other Southern Region sensitive species.

Locally Rare Species

National forest lands are significant from an ecological perspective in being relatively large parcels of vegetated and undeveloped lands with focused management goals. National forest lands contain a range of habitats and natural features that support a variety of locally rare species. These aspects plus the continued loss of forested land to developed uses on private lands is likely to make national forest lands even more important in the future for supporting ecological diversity.

Locally rare species are those species that are rare at a local geographic scale but are otherwise secure globally. There is some subjectivity towards those species to be addressed as locally rare. In general the GWJ NF considers those species with a State ranking of S1 or S2 with a global rank of G-4 or less (See BE/BA Appendix A for rankings and their meaning). Currently approximately 325 species fall within these categories on the GW/Jeff NF. Of these, perhaps 25-30 could possibly occur on the LCRMP. Locally rare species are searched for as part of the general field survey technique of focusing efforts on areas of highest impact and active management and ground disturbance. The following locally rare species were observed in close proximity to LCRMP activities: Shale Barren Buckwheat, *Eriogonum allenii,* (G4- VA S2, WV S2), Kate's Mountain Clover, *Trifolium virginicum,* (G3- VA S2, WV S3), Northern Metalmark, *Calephelis borealis,* (G3G4-VA S2S3, WV S2) Nodding Pogonia, *Triphora trianthophora,* (G3G4-VA S1, WV S2).

Both Kate's Mountain Clover and Shale Barren Buckwheat are found in areas within or peripheral to shale barrens and shale woodlands. Current element occurrence records do not track locations for these species. One or both of these species were found while surveying proposed prescribed burn control lines in the Cigar Ridge burn unit area and Coffeepot burn unit area, and in proximity to harvest units in the Beards Mountain area and in one proposed harvest unit of McGraw Hollow (Unit 5). The McGraw harvest unit has since been dropped and made into a Special Biological Area due to the occurrence of shale barren rock cress and its associated shale barren/woodland habitat and species. No impacts are expected to these species in the Beards Mountain harvest area. In other areas where Kate's mountain clover was found the proposed control lines were on the edge of this species habitat and did not directly affect individual plants. Overall the LCRMP activities are expected to have no impact on the Kate's mountain clover and shale barren buckwheat.

Nodding pogonia (aka three birds orchid) was observed at 4 separate sites within or in close proximity to some Limekiln units (Units 3, 18, 30). No other occurrences of this species have been documented in the LCRMP. The effects of proposed LCRMP activities depend on the amount and intensity of disturbance. Road building and log landing construction will have severe impacts and

should be avoided if possible, however, several populations of nodding pogonia on the Forest occur in and near previously disturbed sites such as old roads and trails. Overall, the effects of this project will not eliminate nodding pogonia from the Forest because there are a number of populations distributed across the Forest, some of which are in Special Biological Areas, and because this plant has been seen to occupy disused road beds and other disturbed sites. Overall the LCRMP is expected to have no impact on the nodding pogonia.

One adult northern metalmark was observed along the FR 336 in the McGraw Hollow area. This species prefers limestone outcrops/quarries and shale barrens, where its host roundleaf ragwort (*Senecio obovatus*) is found. It is usually found in close proximity to water sources including road cuts through woodlands. Northern metalmark occurrences are documented in 3 other areas of the LCRMP in similar habitats. Planned road improvements may reduce the habitat quality of the sale area for this species in the short-term. Overall the LCRMP is expected to have no impact on the northern metalmark.

B4 - Aquatic Organisms

Issues Related to the Resource

Issue 1: Concern that the project will adversely impact water quality and aquatic communities in the project vicinity.

Scope of the Analysis

The project area lies within the Cowpasture River (85,807 acres), Jackson River (27,263 acres), and Calfpasture River (4,482 acres) watersheds in Virginia's Bath and Alleghany Counties. Some of the proposed LCRMP activities are located within a 6th level Hydrologic Unit Codes (HUC) watershed listed in the George Washington and Jefferson National Forests Federally Listed Threatened and Endangered Mussel and Fish Conservation Plan (Mussel Plan) established in consultation with the U.S. Fish and Wildlife Service in 2004. The LCRMP contains 4 such watersheds; Thompson Creek - Cowpasture River (#020802010703), Mill Creek - Cowpasture River (#020802010801) Simpson Creek - Cowpasture River (#020802010803) and small portion of Cabin Creek – Mill Creek (#020802020106).

With regards to impacts to the aquatic ecosystem, the geographic scope of this analysis will be identical to that analyzed for the water quantity and sedimentation aspect of the water resource. The boundary of the analysis will be the watersheds draining the project area down to their confluence with either the Jackson River or Cowpasture River: Guys Run, Hickman Draft, Lick Run, Mill Creek, Pads Creek, Simpson Creek, Thompson Creek, Wilson Creek, and Smith Creek. This analysis area was chosen because it is estimated that effects below these points would be insignificant and immeasurable. The time periods used for the cumulative analysis will be similar to those used for analyzing sedimentation effects to the water resources.

B3.3 Existing Conditions

Streams

The LCRMP contains more than 50 named and unnamed creeks, totaling over 400 miles of potential aquatic stream habitat on National Forest System and private land. This stream habitat is classified

by the physical characteristics of the stream and the biota it supports; for example, cold water, cool water, and warm water. The cold or cool water habitat will often support trout and other associated species such as the FS sensitive Maureen's shale stream beetle, while the warm water streams may support freshwater mussels and species adapted to that temperature regime.

The Virginia Department of Game and Inland Fish uses a method of classifying trout streams based on aesthetics, productivity, resident fish population and stream structure. Classes I through IV rate wild trout habitat; Classes V through VII rate cold water habitat not suitable for wild trout but adequate for year-round hold-over of stocked trout; Class VIII is too warm to hold trout year round, but can be stocked. The stream miles by stream in each Class are summarized in Table 3B4-1.

Table 3B4-1. Summary of Lower Cowpasture Project Area Coldwater Stream Habitat by VDGIF Classification

STREAM NAME	TROUT CLASS	Project wide (miles)	National Forest (miles)	WILD BROOK	WILD RAINBOW
Alum Creek	VI	1.5	1.5		
Alum Creek	II	3.0	3.0	Y	
Bear Loop Branch	II	0.7	0.7	Y	
Barney Run	II	0.9	0.9	Y	
Brattons Run	II	4.2	4.2	Y	
Copeland Creek	VII	1.0	1.0		
County Line Run	II	1.5	1.5	Y	
County Line Run Trib	II	8.6	8.6	Y	
Jordan Run	II	4.7		Y	
Lick Block Run	II	2.0	2.0	Y	
Lick Run	II	6.3	6.3	Y	
Little Wilson Creek	II	4.6	4.6	Y	
Mill Creek	I	2.8	2.8	Y	
Mill Creek Trib	I	2.0		Y	
Mare Run	II	6.5	6.5	Y	
North Branch Simpson Creek	II	3.9	3.9	Y	
Pads Creek	VIII	7.2	7.2		
South Fork Pads Creek	VI	3.7	3.7		
Portage Run	VII	2.4	2.4		
Piney Branch	II	2.3	2.3	Y	
Panther Run	II	1.2	1.2	Y	
Porters Mill Creek	III	3.5	3.5	Y	
Smith Creek	V	3.4	3.4		
Smith Creek	II	4.8	4.8	Y	
Smith Creek Trib	II	5.0	5.0	Y	
Spring Branch	II	0.8			Y
Simpson Creek	II	7.7	7.7		Y
Simpson Creek Trib	II	8.7	8.7	Y	
Thompson Creek	III	1.6		Y	
Waterfall Branch	II	1.8	1.8	Y	
Wilson Creek	II	6.6	6.6	Y	

STREAM NAME	TROUT CLASS	Project wide (miles)	National Forest (miles)	WILD BROOK	WILD RAINBOW
Wilson Creek Trib	II	3.3	3.3	Y	
Left Prong Wilson Creek	II	3.5	3.5	Y	
Left Prong Wilson Creek Trib	II	6.9	6.9	Y	
		128.4	119.3		

There is approximately 35 miles of warm water habitat (specifically, the Cowpasture River) within the LCRMP area. Portions of this habitat support the Forest Service sensitive fishes roughhead shiner and orangefin madtom, and freshwater mussel yellow lance. There are also records of occurrence for the Federally endangered James spinymussel within this area and downstream.

Lakes/ponds
A summary of the National Hydrological dataset of waterbodies within the LCRMP area includes 86.5 acres of lake/ponds and 3 acres of swamp/marsh. The majority of this is on private (Clifton Forge Reservoir) or State (Douthat State Park Reservoir) land. Although, there are many small wetlands, springs, seeps, and waterholes on National Forest land in the area. These provide habitat for many of wetland plants and animals, such as the locally rare dragonflies *Gomphus quadricolor* and *Aeshna tuberculifera*.

Management Indicator Species
Brook trout are the aquatic Management Indicator Species (MIS) for cold water habitat. They were chosen as a Biological Community and Demand Species Indicator. Table 3B4-1, above, lists the brook trout streams in the project area. Habitat objectives for this MIS include water temperature below a maximum temperature of 69 degrees Fahrenheit, dissolved oxygen values greater than 7.0 parts per million, and sedimentation rates that are in equilibrium with the watershed and stabilize or improve the biological condition of the stream. Optimal habitat would also include greater than 200 pieces of large woody debris (LWD) per stream mile. Pool habitats occupy from 35% to 65% of the stream.

Large Woody Debris
It has long been recognized that LWD is important in perennial streams as a source of habitat complexity, and is positively correlated with increased fish production (Richards and Hollingsworth 2000); the importance of allochthonous matter (leaves and wood) increases as stream size decreases, and is thus important in intermittent and ephemeral channels, as well. In addition to leaves and twigs being the basis of the food chain in headwater streams, large pieces of wood influence flow velocity, channel shape, and sediment storage and routing. The stairstep profile created by woody debris dams dissipates much of the energy in small, high-gradient streams (Dolloff and Webster 2000).

To achieve stream habitat complexity in form and function, the Forest Plan has objective OBJ WTR-3: "Streamsides are managed in a manner that restores and maintains amounts of Large Woody Debris (LWD) sufficient to maintain habitat diversity for aquatic and riparian-dependent species (approximately 200 pieces[2] per stream mile)."

[2] A piece of LWD is defined as a piece of wood at least partially within the bank full channel width, with a diameter of at least 4 inches (10 cm), and length of at least 4 feet.

Smaller size classes of LWD are added to the stream as dead trees standing in the riparian area begin to shed branches, and larger size classes are added as these trees continue to decompose and eventually fall across the stream channel. Natural additions of LWD can come through slow attrition or in large pulses if stands are impacted by events such as hurricanes. It is expected that streams will move toward the objective through natural process if riparian forests are allowed to mature and more trees are left in the vicinity for recruitment of future LWD. However, following the extensive logging that occurred over much of the Forest in the past 200 years, many of the forest streams lack adequate LWD; directional felling or intentionally placing trees within the stream channel can help speed this natural process.

Connectivity

Increasing the number of connected stream miles increases the health and resilience of local fish populations. Cold water species, such as brook trout, have been a priority for maintaining connected habitat, especially in the face of potential stream warming or more frequent extreme weather events that could isolate populations. The ability to re-colonize and move to refugia is becoming increasingly important as suitable habitat changes or disappears. Road crossings are often a barrier for aquatic organisms because culverts can create a jump barrier, velocity barrier, or depth barrier; or all three. They are often under-sized, restrict the natural hydrology and can become blocked. The subsequent road washout not only deposits sediment into the stream, it can be hazardous, and it is a costly to repair. George Washington NF partnered with the Center of Aquatic Technology Transfer (CATT) in 2014 to prioritize among crossing improvement options within the project area. The passage status for many crossings in the project area was obtained from the CATT passage dataset collected between 2005 and 2009. Additional crossings that lacked passage information were visited in 2014. The completed dataset was used in a GIS model to prioritize among replacement options, looking at both private and Forest Service land.

Specific to FS land, the Crossing Assessment Decision Support System (CADSS) analysis identified several groups of clustered crossings that are a priority for replacement because of the large number of stream miles that would be connected. There are four in the South Fork Pads Creek watershed, and four in the Mill Creek watershed. The Left Prong Wilson Creek watershed is also a priority because of the number of crossings and amount of cold water habitat. All of the crossing information within the LCRMP area should be evaluated in an iterative process as projects are planned and implemented to maximize stream connectivity. CADSS not only assesses road crossings, but other natural and human created barriers as well. On FS land, network tracing upstream and downstream of the Wilson Creek dam, just below the confluence with Left Prong Wilson Creek, showed that removal would connect a 20 km reach upstream of the dam to a 19 km reach downstream of the dam, for a total connected reach of 39 km. Removing the dam would provide a greater increase in connectivity than improvement of any single road crossing within the Lower Cowpasture project area.

Bioindicators

Aquatic macroinvertebrate communities integrate the physical, chemical, and biological components of the riparian ecosystem and have been successfully used as bioindicators to monitor change and impacts (EPA 1989). A Macroinvertebrate Aggregated Index for Streams (MAIS) (range of scores 0 to 18) incorporates nine ecological aspects (metrics) of the aquatic macroinvertebrate community to evaluate the current condition of a stream relative to others within that ecological section (Smith and Voshell 1997). A Rapid Bioassessment report provides raw data on the taxa collected in addition to the metric scores and the overall MAIS score. Adjectives of “very good” (MAIS = 17-18), “good” (MAIS = 13-16), poor/fair (MAIS – 7-12), and “very poor” (MAIS = 0-6) are added to the report to make it user friendly to non-technical managers and decision makers. The GWJNF uses the MAIS score as “coarse filter” screening tool on some projects to establish current “stream health” and to

establish a baseline to evaluate effectiveness of standards, guidelines and mitigation measures in preventing changes and impacts to the aquatic community. When the MAIS score is low or has changed from previous monitoring, biologists examine the individual metric scores and/or raw data to identify limiting factors. The individual metrics often point to a limiting factor or trigger a more rigorous and quantitative monitoring effort.

Sample sites were selected downstream of management activity areas to monitor the impacts on stream health of projects including but not limited to timber sales and prescribed burns. Other samples were collected to create a baseline of stream conditions within the forest. Only samples collected from March through the first week in June were compared to minimize seasonal variability in structure of macroinvertebrate communities. Across the Forest, 1857 samples were collected, analyzed and assigned an overall MAIS score (0-18). Of these samples, 76% were in the "good" and "very good" categories. An analysis of benthic and water quality data by Smith and Voshell (2013) indicated that the macroinvertebrate condition is significantly correlated to a stream's acid neutralizing capacity (ANC) and pH, and that several specific benthic metrics (Ephemeroptera taxa, Percent ephemeroptera, Percent scrapers and HBI) are responding to changes in ANC and pH. The greatest values of the benthic metrics tend to occur at ANC values that are 20 or greater. As described above, roughly 20% of the sites had trends in ANC and pH; except for limed streams the majority of those trends were decreasing. These sites with low ANC or pH would have "poor" or "fair" MAIS scores.

Smith and Voshell (2013) also compared pre-activity macroinvertebrate metrics with post-activity metrics for streams located below timber harvests and prescribed burns at various locations across the Forest and concluded that "management practices are successful at reducing effects on aquatic organisms" from these activities. The results showed no decline in macroinvertebrates following timber sales or prescribed burns.

Within the project area, macroinvertebrate samples have been collected from numerous streams. Most appear to have healthy, diverse aquatic macroinvertebrate communities. The importance of long-term trend data should be noted since the scores can range depending on local variables (see Table 3B4-2, below).

Table 3B4-2. MAIS scores from LCRMP area streams

Site #	Stream Name	Sample Date	MAIS Score	Assessment
3002	Smith Creek	6/22/1993	16	Good
3002	Smith Creek	8/30/1995	16	Good
3002	Smith Creek	4/15/1996	17	Very Good
3002	Smith Creek	4/23/1996	16	Good
3002	Smith Creek	4/22/1997	16	Good
3002	Smith Creek	4/30/1998	18	Very Good
3002	Smith Creek	4/2/1999	16	Good
3002	Smith Creek	3/28/2000	17	Very Good
3002	Smith Creek	3/27/2002	18	Very Good
3002	Smith Creek	4/2/2007	16	Good
3009	Smith Creek	7/12/1993	14	Good
3009	Smith Creek	8/30/1995	12	Poor/Fair
3018	Brattons Run	6/23/1992	13	Good
3018	Brattons Run	5/2/1997	14	Good
3030	Piney Branch	4/23/1996	16	Good
3030	Piney Branch	4/2/1999	17	Very Good
3030	Piney Branch	3/28/2000	16	Good

Site #	Stream Name	Sample Date	MAIS Score	Assessment
3031	Brattons Run (2)	4/26/1996	12	Poor/Fair
3050	Simpson Creek (NB)	4/15/1995	16	Good
3050	Simpson Creek (NB)	4/26/1996	15	Good
3089	Simpson Creek	5/25/2006	16	Good
3089	Simpson Creek	4/30/2013	18	Very Good
3089	Simpson Creek	4/8/2014	16	Good
6008	South Fork Pads Creek	7/9/1993	16	Good
6008	South Fork Pads Creek	3/18/1998	4	Very Poor
6008	South Fork Pads Creek	3/19/1999	4	Very Poor
6008	South Fork Pads Creek	3/23/2001	10	Poor/Fair
6008	South Fork Pads Creek	4/8/2002	18	Very Good
6008	South Fork Pads Creek	4/3/2003	15	Good
6008	South Fork Pads Creek	3/18/2004	17	Very Good
6008	South Fork Pads Creek	3/15/2006	16	Good
6008	South Fork Pads Creek	5/27/2009	18	Very Good
6009	Mare Run	6/22/1993	15	Good
6009	Mare Run	3/1/1994	17	Very Good
6009	Mare Run	3/15/1997	15	Good
6009	Mare Run	4/22/1998	15	Good
6009	Mare Run	5/6/2003	16	Good
6009	Mare Run	4/30/2009	14	Good
6009	Mare Run	4/6/2012	17	Very Good
6009	Mare Run	4/25/2013	17	Very Good
6011	Wilson Creek	3/1/1994	17	Very Good
6011	Wilson Creek	3/24/2000	16	Good
6011	Wilson Creek	3/23/2001	15	Good
6011	Wilson Creek	3/30/2011	16	Good
6012	Left Prong Wilson	3/1/1994	15	Good
6012	Left Prong Wilson	4/1/1997	16	Good
6012	Left Prong Wilson	3/24/2000	17	Very Good
6012	Left Prong Wilson	3/23/2001	16	Good
6012	Left Prong Wilson	4/9/2002	15	Good
6012	Left Prong Wilson	4/1/2003	17	Very Good
6012	Left Prong Wilson	4/1/2004	15	Good
6013	Lick Block	3/1/1994	17	Very Good
6013	Lick Block	4/10/1997	15	Good
6018	Panther Run	6/22/1993	16	Good
6018	Panther Run	4/1/1998	16	Good
6018	Panther Run	4/3/2009	15	Good
6018	Panther Run	4/6/2012	15	Good
6038	Brown Hollow	3/23/2001	16	Good
6038	Brown Hollow	4/1/2005	17	Very Good
6048	South Fork Pads Creek n.	3/23/2001	17	Very Good
6048	South Fork Pads Creek n.	4/8/2003	11	Poor/Fair
6048	South Fork Pads Creek n.	5/6/2003	15	Good
6048	South Fork Pads Creek n.	3/18/2004	14	Good
6048	South Fork Pads Creek n.	3/31/2005	15	Good
6048	South Fork Pads Creek n.	4/1/2007	13	Good
6055	Porters Creek	3/15/1998	16	Good

Site #	Stream Name	Sample Date	MAIS Score	Assessment
6055	Porters Creek	4/1/2005	17	Very Good
6060	Barney Run	4/30/2009	15	Good
6062	Lick Run	3/18/2004	17	Very Good
6062	Lick Run	3/31/2005	17	Very Good
6062	Lick Run	5/1/2006	14	Good
6062	Lick Run	4/1/2007	11	Poor/Fair
6062	Lick Run	4/21/2010	18	Very Good

Water quality

Several streams in the LCRMP area are on the VA DEQ impaired stream list; these are discussed in the Water Resources section of the EA.

Water quality samples were likewise collected by the FS from many of the area streams to evaluate the current conditions of water chemical properties and to monitor changes over time. Nine chemical parameters associated with the effects of acid deposition and nutrient loading are measured in each sample, including pH, acid neutralizing capacity (ANC), and nitrate (NO3). Several of the streams are in the long-term monitoring program the Virginia Trout Stream Sensitivity Study, started in 1987 (indicated an "*" in Table 3B4-3, below). In general the streams can be divided into three different groups. Those with stable, circum-neutral pH, adequate buffering capacity (based on ANC and calcium levels), and little anthropogenic input, as indicated by sodium, chloride, or other nutrients; these streams are indicated with a G in Table 3B4-3. Several streams have adequate buffering capacity and pH, but the chemistry indicates anthropogenic impacts from roads, since the sodium and chloride levels are higher that what would naturally be found in this area; these are indicated with an R in Table 3B4-3. The third group includes streams that are acidic or episodically acidic based on their ANC and pH levels; they are indicated with an A in Table 3B4-3.

Table 3B4-3. Water quality groups for LCRMP area streams

STREAM	GROUP
BARNEY RUN	A
BLUE SUCK*	G
BRATTONS RUN	R
LEFT PRONG WILSON	G
LICK BLOCK	G
LICK RUN [BUBBLING SPRINGS]	G
MARE RUN*	A
PANTHER RUN*	G
PINEY BRANCH	G
PORTERS MILL CREEK*	A
NORTH BRANCH SIMPSON CREEK*	A
SIMPSON CREEK	R
SMITH CREEK	G
SOUTH FORK PADS CREEK	G
WILSON CREEK	A

The long-term monitoring site at North Branch Simpson Creek (NBSC) provided an exceptional opportunity when for 10 days in April 2012 a human caused wildfire occurred within the 1837 acre watershed of NBSC, located entirely within the boundary of the Rich Hole Wilderness Area. It was estimated that ninety-five percent of the understory was burned to the forest floor with about five percent single and group torching. Water samples were collected immediately following the wildfire during and after rain events, to compare to the pre-fire quarterly water chemistry data collected since 1987. The geology of the upper reach is sandstone with limited or no natural carbonate, and the stream is acidic until it encounters limestone geology low in the watershed. Soil tests indicated increased pH and bicarbonate due to ash in the burned forest over the unburned area, and it was expected that these would likewise be increased in the stream. However, pre and post fire data for NBSC indicate that the stream was discharging increased calcium and magnesium during the study period following the wildfire, while both pH and ANC were lower, but not statistically significant. Other parameters also were not statistically different. No discernable effect attributable to the wildfire was detected in the stream water chemistry. While there was 75-100% tree mortality in some areas, mostly on rocky dry ridges, in other areas, there was little to no damage to the canopy. The soil layer was unaffected and in most places the organic duff layer was affected only low to moderate. Stream transport of sediment levels did not change as a result of the fire. It is possible but doubtful that future storms would erode the NBSC watershed, introduce sediment and change water chemistry, because of the 2012 wildfire.

Water quality samples from the headwaters of Simpson Creek indicate roadway contamination, because of the extremely high levels of sodium and chloride. As found from visual inspection and fish surveys, high levels of sediment and a reduced wild brook trout population also point to problems with habitat that are affecting biota. In the fall of 2011, Forest Service employees discovered the long-term catastrophic failure of a storm drain along Interstate 64 in Alleghany County, near mile marker (MM) 40.5, which resulted in the erosion of the downhill slope, development of a ravine, and deposition of tons of fine material into Simpson Creek. Several other gully erosion sites originating from I-64 culverts were located within the drainage. The Virginia Department of Transportation initiated a Lidar study of the MM 40.5 gully to determine slope movement, and found a net loss of material from the slope into the stream channel. At that location, the stream channel is only about 3 feet wide, and is choked with sediment. The gully erosion has changed the stream from a cobble/bedrock step-pool configuration to one with a silty, fine-grained streambed with much of the pool volume filled in with sediment. Direct evidence from this impact can be found downstream for at least 0.5 miles, and is certainly affecting more of the channel as the sediment is flushed downstream. See Water Resources section for further discussion.

3B4.4 Direct, Indirect, and Cumulative Effects of the Alternatives

Alternative 1 (No Action)

Under this alternative, watershed and streamside vegetation and soil would remain unchanged and continue to provide shading and a future source of nutrients and large woody debris. There will be no impact to any aquatic MIS or the biodiversity of the aquatic ecosystem due to management activities. There will, however, be impacts due to the lack of management activities. Since impassable culverts will not be replaced, connectivity of the stream systems and aquatic organism passage will not be improved. In addition, the Wilson Creek Dam will remain unchanged and continue to block fish passage in a wild trout stream and alter the natural stream hydrology. The Simpson Creek gully resulting from a culvert draining I-64 will continue to erode and deposit tons of sediment into the headwaters of Simpson Creek, a wild trout stream.

Alternative 2

Timber Harvest and associated activities

There are 3,705 acres planned to be silviculturally treated in this alternative, with 94 log landings, and 11 miles of temporary road. All alternatives were designed to avoid harvesting in floodplains, wetlands, and riparian areas. Narrow riparian areas would be further protected by streamside management zones. Thus no activity would adversely affect riparian areas, floodplains, or wetlands.

No timber harvest or ground disturbing activities would occur in protected riparian buffers for perennial and intermittent streams under any action alternative. Forest harvesting can directly affect sediment transport in streams if it increases (or decreases) the supply of sediment, if it alters the peak flow or the frequency of high flows, and if it changes the structure of the channel by removing the supply of large woody debris that forms sediment storage sites. Bank erosion and lateral channel migration also contribute sediments if protective vegetation and living root systems are removed (Chamberlin et al. 1991). Through application of mitigation measures and Best Management Practices, these impacts can be largely avoided. The physical removal of timber at sites away from the streams poses very little direct threat to the aquatic resource or organisms. The use and construction of temporary roads, skid trails, and log landings would increase the amount of sediment entering the stream system during periods of high flow. Sediment loading in streams affects the aquatic fauna directly and indirectly. Direct effects include damage to gills by abrasion of suspended particles. Indirect effects come from a reduction in available dissolved oxygen, and reduced surface area and spawning habitat due to substrate being covered with sediment. Application of mitigation measures and Best Management Practices will minimize the amount of sediment actually reaching the streams.

If a riparian buffer zone were not left along the streams in the project area, reduction of streamside canopy could affect the physical characteristics of the stream channel and can also affect food quality and quantity for stream organisms directly and indirectly. Direct effects occur by changing the input of particulate food (leaf litter). Indirect effects come from alteration of the structure and productivity of the microbial food web through shading and modifying the levels of dissolved organic carbon and nutrients. A 2-5 degree C warming of small streams can affect life history characteristics of macroinvertebrates and developmental time of fish eggs (Sweeney, 1993). These potential impacts will be negligible since, under all alternatives, a buffer zone will be left along each stream. The width of this zone depends on the size/characteristics of the stream and is consistent with the Forest Plan direction for riparian areas. The primary function of this zone is to manage the area for riparian dependent resources. An additional function of this zone is to stabilize the stream bank, to moderate water temperature and promote the growth of desirable algae via shading, to provide soil/water contact area for biogeochemical processing of nutrients, and to contribute necessary organic detritus and LWD to the stream ecosystem.

The use of BMPs and avoidance of impacts in riparian areas would result in negligible impact to aquatic MIS. Some minor sedimentation can be expected from harvest activities. As discussed in the Water Resources section, no alternative will produce sediment that will have a significant impact on the beneficial uses of area streams. The minor sediment increases are unmeasurable and insignificant in comparison to the sediment load of streams in the analysis area and will have no significant effect on habitat for fish or other aquatic life. The mitigation section of this EA contains measures that will be used to reduce sedimentation and protect the beneficial uses.

Alternative 2 would not increase the amount of LWD in any stream. However, protection of the riparian area would allow for the natural recruitment of LWD in the future. Future recruitment of LWD is expected to improve the amount and distribution of pool habitat in area streams in the future. This riparian area would also provide shading of the stream to maintain current thermal characteristics and microbial (algal, bacteria) structure and productivity.

Prescribed Burning
Under Alternative 2, 12,907 acres of prescribed fire are proposed with almost 12 miles of dozer lines; portions of the area streams will be within the prescribed burning area. Prescribed burning conditions are specifically chosen to achieve effects to target vegetation while maintaining a duff layer and soil structure, not exposing mineral soil. When used as a fire line or fire break, streamside riparian vegetation rarely burns because of a moist environment and humid microclimate. When constructed, firelines are either handlines or wetlines within the riparian area to minimize soil disturbance and erosion as per Forest Plan direction. Erosion and sedimentation from dozer lines poses the greatest risk from the prescribed burning activity. Recent research on the Forest showed no change in water quality following an extreme wildfire event that burned an entire watershed (Downey and Haraldstadt, 2013). The fire activity and effect to vegetation and within the proposed project watersheds will be much less than was described in that study. Based on previous monitoring, recent research, and plan standards, there will be no direct, indirect or cumulative effects to the fisheries or aquatic resource.

Stream Connectivity
Under Alternative 2, 15 culverts are proposed to be improved to allow aquatic organism passage. Short term impacts to the stream are expected because of the need to remove the existing culvert and place the new structure. But, following project completion, the road crossing should no longer be a barrier and also allow for more natural hydrology; thereby reducing sediment and road maintenance. In addition, 3 culverts are proposed to be removed from the Slicky Slide road as it is decommissioned.

The Wilson Creek Dam was proposed to be stabilized in Alternative 2, because of archeology concerns. This would continue to be a barrier to aquatic species as well as eliminate the natural form and function of the stream at that location.

Trail construction
Alternative 2 proposes 17 miles of new trail. Erosion and sedimentation from the trail pose the greatest threat to streams, along with compaction and permanent loss of vegetation in the riparian area. Trail construction should follow Forest Plan standards, designed to minimize trail impact to riparian areas and streams.

Simpson Creek Gully
Under Alternative 2, the Simpson Creek slope failure was proposed to be stabilized by diverting water from the I-64culvert outflow to the base of the slope via a flexible pipe extension. An outlet control protection measure would be utilized at the base of the pipe extension. The failed slopes would be cut back to facilitate re-vegetation of exposed slopes. This will reduce the input of sediment into the headwaters of Simpson Creek by approximately 2.8 tons per year. With the sediment tap turned off, the stream should be able to rebuild a rocky channel as the fines are moved downstream.

Alternative 3
Timber Harvest and associated activities
There are 3,427acres planned to be silviculturally treated in Alternative 3 (only 278 acres less than Alternative 2); with 87 log landings, and 10.1 miles of temporary road. All alternatives were designed to avoid harvesting in floodplains, wetlands, and riparian areas. Since slightly fewer acres are proposed for timber harvest and thinning in this alternative, the effects will be similar, but even less than Alternative 2. Narrow riparian areas would be further protected by streamside management zones. Thus no activity would adversely affect riparian areas, floodplains, or wetlands.

The use of BMPs and avoidance of impacts in riparian areas would result in negligible impact to aquatic MIS. Some minor sedimentation can be expected from harvest activities. As discussed in the Water Resources section, no alternative will produce sediment that will have a significant impact on the beneficial uses of area streams. The minor sediment increases are unmeasurable and insignificant in comparison to the sediment load of streams in the analysis area and will have no significant effect on habitat for fish or other aquatic life. The mitigation section of this EA contains measures that will be used to reduce sedimentation and protect the beneficial uses.

In Alternative 3, within the LCRMP area, eight streams have been identified for LWD additions within the 10 year timeframe of the project. In addition, protection of the riparian area would allow for the natural recruitment of LWD in the future. Future recruitment of LWD is expected to improve the amount and distribution of pool habitat in area streams in the future. This riparian area would also provide shading of the stream to maintain current thermal characteristics and microbial (algal, bacteria) structure and productivity.

Prescribed Burning
Under Alternative 3, 11,971 acres of prescribed fire are proposed; portions of the area streams will be within the prescribed burning area. The effects should be the same as in Alternative 2.

Stream Connectivity
Under Alternative 3, 15 culverts are proposed to be improved to allow aquatic organism passage, similar to alternative 2. Short-term impacts to the stream are expected because of the need to remove the existing culvert ad place the new structure. But, following project completion, the road crossing should no longer be a barrier and also allow for more natural hydrology; thereby reducing sediment and road maintenance. In addition, 9 culverts are proposed to be removed from the Slicky Slide road as it is decommissioned.

Nothing is proposed for the Wilson Creek Dam in Alternative 3, because of archeology concerns. This would continue to be a barrier to aquatic species as well as eliminate the natural form and function of the stream at that location

Trail construction
Alternative 3 proposes 14 miles of new trail. Erosion and sedimentation from the trail pose the greatest threat to streams, along with compaction and permanent loss of vegetation in the riparian area. Trail construction should follow Forest Plan standards, designed to minimize trail impact to riparian areas and streams.

Simpson Creek Gully
Under Alternative 3, the Simpson Creek slope failure is proposed to be stabilized the same as in Alternative 2, with the same effects of reducing approximately 2.8 tons of sediment per year in to the headwaters of Simpson Creek. However, it is planned for adaptive management; meaning, if the proposed fix does not seem to be meeting the management goals, then an alternative fix will be implemented.

B5 - Fire

Issues Related to the Resource

Issue 1: Concerns that burning will occur in areas where it should not be or is not needed.

Scope of the Analysis

This section summarizes the departure from historical fire regime, its relationship to desired condition and explains how the alternatives may impact it. It addresses whether the alternatives help meet the desired conditions of the area as described in the Forest Plan.

B5.1 Introduction

The presence of fire begins long before humans arrived in North America. Evidence of lightning fires exists as fusain in coal layers and as lightning scars on petrified trees (Pyne 1982). Even today, lightning and thunderstorms are abundant, and Pyne surmised, "A phenomenon of such magnitude and longevity has unquestionably kindled profound evolutionary consequences". This great and persistent selecting force has influenced ecosystem traits and characteristics since fuels and lightning first interacted. The result is a forest with diversity and flexibility that is well adapted to fire occurrence. Fire has no doubt been a major selection force in our forest ecosystems, both lightning and anthropogenic. Many communities and species require fire to sustain populations. Oak and southern yellow pine communities have been major components of these forests for thousands of years. These communities promote and require fire. Recurring fire has been a part of the ecosystem for thousands of years. Burning is the oldest sustained land management force on these forests. No other practice can be said to have such a track record with known results.

A clearer picture of change over time is gained when we focus on the period since the last ice age. Dramatic changes in plant and animal communities have occurred during this post-glacial period. Importantly, humans made their way onto the North American scene during this period. The ecosystems developed within the influences of both climatic and human forces. The question often debated is whether human ignition, for those thousands of years, should be considered when determining the “natural” state of ecosystems. Several points seem clear. The forests have been continually changing. The diversity and flexibility of these natural systems are necessary to react to change. Fire is an important mechanism to retain that diversity and flexibility.

Early human occupation of Virginia dates back to approximately 11,500 BP during the Paleoindian period (Barber 1996). European contact was relatively early in the region of the George Washington and Jefferson National Forests, Barber (1996) notes European contact did not occur in the Ridge and Valley area until the 1670s, and the written historical record of fire is rich with accounts from travelers and explorers. The obvious conclusion, common to each account, was the extensive use of fire by Native Americans. The effect, likewise, was extensive. Early observations describe vast areas of grassy savannas, commonplace smoke and fire, clearings and fields and apparent utilization of fire-managed vegetation (Maxwell 1910; Day 1953; Pyne 1982; Hammett 1992; Brown 2000). Maxwell contains a great number of accounts, but his perspective certainly reflects the bias and prejudices of the opponents to light burning. From all accounts, regardless of their perspective, burning by the Native Americans was a commonplace practice, serving many needs.

The George Washington National Forest was established in 1918 and the national direction regarding fire was quite clear in the early days of the Forest Service (Pyne 1982)..."Forest fires have no place in any forest but as a result of ignorance, carelessness, and indifference (Anonymous

1936)". The practitioners of "controlled burning" battled against an enormous campaign set at the national level to stop all fire. With that new direction of suppressing all fires, that major force of selection that had been present since the ice age was suddenly altered. The consequences of that well-intentioned but misguided policy would not be obvious for several decades. The selection process that influenced plant and animal communities now changed with the absence of fire.

Perhaps, though, in defense of the dedicated firefighters during these times, this is the way it had to happen. The use of fire-fighting equipment, intelligence, weather forecasts, budgets and fire behavior prediction have only recently enabled prescribed burning on a substantial level. Recent scientific literature regarding plant and animal reactions and effects are now better known. We have better data on pre-Euro-American settlement conditions. And now we are beginning to understand some of the more dramatic long-term impacts of fire exclusion, as plant and animal populations and conditions of forest ecosystems are altered.

Several other studies have approached the issue of fire occurrence, what it has been in the past and the implications of fire exclusion. Dendropyrochronology studies provide valuable information such as the season of fire occurrence since trees lay down early season and late season wood in each tree ring per year; the number of fire scars on an individual tree provides data on fire frequency; and, by cross dating fire scars on different trees that occurred in the same year one is able to approximate the spatial extent of a fire.

Sutherland and others (1993) sought to “reconstruct the historical relationship between fire and community structure using both the age and species composition approach in combination with tree-ring fire history analysis”. Their study was one of the first in the Central Appalachians to use fire scars on pines to examine fire history. The study site on Brush Mountain in southwest Virginia west of Blacksburg, noted the loss of table mountain pine (*Pinus pungens*) recruitment since fire suppression in the late 1930s. Major recruitment of *P. pungens* occurred twice during the 1800s, probably due to exceptionally hot fires. The fire scar chronology indicated that fire occurred frequently (every 9-11 years) throughout the 19th century and early 20th century.

Most of those fires occurred during the dormant season, most likely in early spring. The hot recruitment fires may have been during the growing season. They stated, “Fire suppression is most likely the cause of a dramatic change in the composition of the Brush Mountain communities during the last 60 years (Williams and Johnson 1990). In the past, fire clearly promoted integrity of the *Pinus pungens* community on Brush Mountain”.

Subsequent fire history studies using dendrochronology at multiple sites and a larger sample size of scarred trees on both the GWNF and Jefferson National Forest found that the fire interval from the early 1700s to the 1930s ranged from 2 to 9 years (Aldrich et al. 2010; DeWeese 2007; Lafon and Grissino-Mayer 2005). Additional unpublished work by Aldrich has pushed this timeframe back to the mid-1600s which pre-dates European settlement in western Virginia. Work by Lafon in the southern Blue Ridge has found similar intervals for the same timeframe.

To examine fire history further back in time, recent studies have examined and dated charcoal found in soil layers. A study on southwestern North Carolina found that fires burned regularly across the studied landscape for at least the past 4,000 years. These fires were not confined to the dry oak-pine dominated ridges but extended downslope into areas that are today dominated by mesic hardwood forests (Fesenmyer and Christensen 2010).

The fire-oak hypothesis suggests that periodic fire has been an integral disturbance in the upland oak ecosystems of eastern North America for millennia, and the sudden end of this fire return

interval with the advent of aggressive suppression policies is one of the major causes of the current oak regeneration problem. The Appalachian Mountain region showed no change in Mean Fire Interval (MFI) between pre and post European settlement before fire exclusion through aggressive suppression efforts. The MFI was 5.8 years before European settlement and 5.3 years afterwards. In the Appalachian Mountains, dormant season fires were the overwhelmingly dominant type. These seasonal tendencies did not change through time. (Brose et al. 2014)

Dendroecological studies show a MFI on the George Washington National Forest of between 6 and 8 years. Fire frequency remained fairly constant until effective fire suppression began in the early 20th century, after which burning virtually ceased. (Aldrich et al. 2014)

Fire Regime Condition Class (FRCC), developed by the Forest Service with partners in nine other land management agencies and nongovernmental organizations, is a "standardized tool for determining the degree of departure from natural vegetation, fuels and disturbance regimes". (For detailed information on this subject, visit http://www.frcc.gov). Agencies involved in developing the FRCCs were the Forest Service, National Park Service, US Fish and Wildlife Service, The Nature Conservancy, US Geological Survey, Systems for Environmental Management, Bureau of Land Management, Missoula Fire Lab, and Bureau of Indian Affairs.

Condition Classes are a function of the departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, stand structure, successional stage, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire exclusion, timber harvesting, grazing, introduction and establishment of non-native invasive plant species, insect and disease (introduced or native), or other management activities.

Fire Condition Class is a measure of general wildfire risk and ecosystem condition defined as follows:

Condition Class 1:

Fire regimes are within or near an historical range.
The risk of losing key ecosystem components is low.
Fire frequencies have departed from historical frequencies by no more than one return interval.
Vegetation attributes (species composition and structure) are intact and functioning within an historical range.

Condition Class 2:

Fire regimes have been moderately altered from their historical range.
The risk of losing key ecosystem components has increased to moderate.
Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one return interval. This results in moderate changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns.
Vegetation attributes have been moderately altered from their historical range.

Condition Class 3:

Fire regimes have been significantly altered from their historical range.
The risk of losing key ecosystem components is high.
Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns.
Vegetation attributes have been significantly altered from their historical range.

There is a need to change the Fire Regime Condition Class (FRCC) on the GWNF from a FRCC 3 towards a FRCC 2 and eventually perhaps a FRCC 1 on as much of the Forest as possible. FRCC 3 is a condition of the landscape that is highly departed from its natural (historical) regime of vegetation characteristics; fire frequency, severity and pattern; and other associated disturbances. FRCC 2 defines a condition that has moderately departed from the natural (historical) regime and FRCC 1 defines a fire regime that is within the natural (historical) range of variability. (Forest Plan EIS pp. 285-286)

Prescribed fire treatments are designed to restore fire regimes and condition class within or near an historical range. These treatments are also utilized to reduce the risk of intense and unplanned wildfires by decreasing the amount of available fuel that the fire is able to consume and thus carry the fire. Though there is not a one-to-one correlation between acres treated and suppression dollars saved or fewer acres burned, there is sufficient evidence to show that areas that have been treated typically exhibit lower rates of spread, less intensity, less severity, and a smaller final fire size under normal conditions. Goals and objectives specific to the need of each unit are developed which in turn result in the development of specific prescription limits such as temperature, wind, fuels moisture and soil moisture which have a direct impact on fire intensity and thus fire effects.

Example of desired condition after three prescribed fire entries reestablishing the historic fire regime (photo by Steve Croy)

B5.2 Existing Condition

Vegetation is comprised primarily of forested stands of upland oaks with sections of cove hardwoods and bottomland. The most common tree species found in the overstory include red oak, chestnut oak, white oak, yellow poplar, black oak, scarlet oak, hickory, black gum, and pitch pine, with occurrences of sycamore, green ash, sugar maple, American basswood, white pine, eastern hemlock and sweet birch.

Examples of common species found in the understory include: witch hazel, serviceberry, sassafras, red maple, striped maple, hawthorne, American chestnut, mountain laurel, and dogwood. Examples of common herbaceous species (ground layer) include: blueberry, huckleberry, maple-leaf viburnum, spotted wintergreen, wild yam, coreopsis, yellow star-grass, may apple, Virginia creeper, greenbrier, trailing arbutus and a variety of fern species.

Example of current condition (photo by Steve Simon)

See the Air Quality, Vegetation, and Wildlife sections of the EA for further details on the existing condition for the Lower Cowpasture planning area.

B5.3 Direct, Indirect and Cumulative Effects

Prescribed fire is also a valuable tool to provide wildlife habitat; for managing rare communities that require periodic fire to maintain plant viability; for pine species such as pitch and table mountain pine; for a silvicultural site preparation tool; for increasing forage; and for regenerating oak stands on productive sites (Brose and Van Lear 1999).

Alternative 1 (No Action)

The forest would continue to mature, decreasing the amount of forest in early and open age classes. Stands would become older and less diverse. These fire-adapted ecosystems would continue to change from plant communities dominated by species most beneficial to wildlife to species less resistant to fires, such as red maple. The closed oak overstory and the shade-tolerant midstories will continue to shade the majority of the forest floor preventing understory vegetation, especially oak regeneration from growing, thus reducing wildlife habitat diversity. Assuming that no catastrophic events occur, this alternative will over time allow for natural plant succession to progress towards an overall older-aged forest community. With this progressive aging of the forest will come associated decline in the wildlife habitat capabilities, species richness, species composition, and species abundance. More detail on vegetation and structural diversity is provided in the Vegetation section of this EA. More detail on wildlife is provided in the Wildlife section of this EA

Additionally, exclusion of fire will allow for the continued buildup of forest fuels that have the potential to contribute to the severity and potential impacts of a wildfire. Such a wildfire can endanger firefighters, the visiting public, structures and the natural resource.

Prescribed fire has previously been implemented in the Lower Cowpasture units listed in Table 3B5-1. Without continued prescribed fire, these areas will regress toward a landscape that is highly departed from its natural (historical) regime of vegetation characteristics; fire frequency, severity and pattern; and other associated disturbances.

Table 3B5-1. Previous Burn History of Proposed Units

	Previously Burned Units	Approximate Acres and Years Burned	
		Acres	Year(s)
1	Orebank	1,969	2000, 2005 and 2012 (Rich Hole Wildfire)
2	North Short Mountain	2,259	2000, 2004 and 2010
3	Mill Mountain	546	2005 and 2012 (Rich Hole Wildfire)
4	Short Mountain	1,576	2000 and 2006
	Total	6,350	

Under the No Action alternative, current management plans would continue to guide management of the project area. Thus, Warm Springs Mountain Restoration project would continue to be implemented under this alternative.

Direct, Indirect and Cumulative Effects -Alternative 2

Alternative 2 (Proposed Action)

Under this alternative, utilizing prescribed burning in 13 separate blocks equaling 12,908 acres (see Appendix A, page A-9 for more detail on burn units) we would strive to restore the historic fire regime to an interval and condition class to a structure and composition that resembles the pre-European settlement forest creating forest conditions as specified in the Forest plan. Once the desired condition is met then subsequent entries with fire can be conducted within prescription parameters that would produce fire behavior conducive to maintaining these conditions while keeping fire regimes near historic intervals. Periodic fire under controlled conditions will also remove fuel accumulations that can lead to damaging wildfires that could endanger firefighters, the visiting public, structures and the natural resource.

Fire favors plant species that are fire tolerant (those with thick bark and underground rhizomes) and shade intolerant due to increased opening of the area to sunlight. Plant growth and revegetation would be rapid following fire due in part to nutrient release and availability after combustion. The above-ground portion of vegetation with small stem diameters is usually consumed by the fire. Rarely do fires burn more than the topmost layers of leaf litter or duff and do not scorch or heat the underlying mineral soil to high temperatures. This is due to the fact that in all but the most extreme drought conditions (when prescribed fires would not be implemented), the lower duff layer – mineral soil contact zone remains moist and will not burn. Therefore, plant roots remain alive and able to re-sprout even though their above-ground parts may be killed. This rapid growth and remaining duff reduces soil movement and loss.

See the vegetation and wildlife sections of the EA for further details on the current and desired condition for the Lower Cowpasture planning area.

Under Alternative 2, current management plans would continue to guide management of the project area. Under this alternative prescribed burning will still occur on units within the Warm Springs Mountain Restoration area.

Direct, Indirect and Cumulative Effects-Alternative 3

Alternative 3 (Preferred Alternative)

This alternative removes Slicky Slide and Big Hollow burn units as well as changing the proposed dozer line for the White Rocks Tower burn unit to hand line. This would eliminate approximately 1 mile of new dozer line which in turn will reduce the potential negative impacts of dozer line construction in the project area. Removing the two burn units would eliminate all proposed burn acres in Wilderness Study Areas and any associated impacts.

Under this alternative, utilizing prescribed burning in 11 separate blocks equaling 12,449 acres (includes 478 acres of Douthat State Park see Appendix A, page A-9 for more details), we would strive to restore the historic fire regime to an interval and condition class to a structure and composition that resembles the pre-European settlement forest creating forest conditions as specified in the Forest Plan. Once the desired condition is met then subsequent entries with fire can be conducted within prescription parameters that would produce fire behavior conducive to maintaining these conditions while keeping fire regimes near historic intervals. Periodic fire under controlled conditions will also remove fuel accumulations that can lead to damaging wildfires that could endanger firefighters, the visiting public, structures and the natural resource.

Fire favors plant species that are fire tolerant (those with thick bark and underground rhizomes) and shade intolerant due to increased opening of the area to sunlight. Plant growth and revegetation would be rapid following fire due in part to nutrient release and availability after combustion. The above-ground portion of vegetation with small stem diameters is usually consumed by the fire. Rarely do fires burn more than the topmost layers of leaf litter or duff and do not scorch or heat the underlying mineral soil to high temperatures. This is due to the fact that in all but the most extreme drought conditions (when prescribed fires would not be implemented), the lower duff layer – mineral soil contact zone remains moist and will not burn. Therefore plant roots remain alive and able to re-sprout even though their above-ground parts may be killed. This rapid growth and remaining duff reduces soil movement and loss.

See the vegetation and wildlife sections of the EA for further details on the current and desired condition for the Lower Cowpasture planning area.

Section C – Social and Economic Factors

C1 - Recreation

Issues Related to the Resource

There were no project issues identified regarding this resource.

Scope of the Analysis

The geographic scope of the environmental effects analysis of the alternatives on recreation resources is limited to National Forest System lands within the Lower Cowpasture project area. The temporal bounds include past road and trail activities affecting current recreation access and use of the area, and any reasonably foreseeable recreation projects.

C1.1 Existing Condition

The primary recreational uses in the Lower Cowpasture project area includes many forms of dispersed recreation including hunting, fishing, hiking, biking, horseback riding, and driving for pleasure. The area contains the Rich Hole and Rough Mountain Wilderness areas, two Recommended Wilderness Study Areas, Bubbling Springs picnic area, and two canoe access sites along the Cowpasture River.

There are approximately 71 miles of National Forest System trails (NFST) within the project area. Most of these trails are designated as multiple or shared use trails. NFST are categorized by Trail Class based on management intent, which may or may not reflect the current condition of the trail. Trail Class 1 are Minimally Developed trails with intermittent or indistinct trail tread, numerous obstacles, and few to no trail structures. Trail Class 5 are Fully Developed trails with firm, wide and stable tread, no trail obstacles, frequent high standard trail structures, and full accessibility for persons with physical disabilities. Most NFSTs in the project area are Trail Class 3 – Developed, with continuous obvious tread, with insubstantial obstacles, and frequent trail structures.

The tables below describe NFSTs in the Lower Cowpasture project area and NFST classes.

Table 3C1-1. National Forest System Trails within the Lower Cowpasture Project Area

Trail Number	Trail Name	Trail Class	Allowed Trail Use			Part of the AHTS	Total Length	Management Prescription*
			Foot Travel	Bicycle	Horse			
459	Beards Mountain	3	✓	✓	✓		5.69	4D, 13
459A	Beards Mountain Spur	3	✓	✓	✓		1.76	4D, 13
756	Brown Hollow	3/2	✓	✓	✓	✓	3.00	7B, 13
755	Brown Hollow Spur	3	✓	✓	✓	✓	1.08	7B, 13
456	Brushy Ridge	3	✓	✓	✓	✓	4.60	4D, 12D, 13
454	Crane	1	✓				2.87	1A
752	Douthat Connector	3	✓	✓	✓	✓	1.50	13
473	Fore Mountain	3	✓	✓	✓	✓	3.47	7B, 13
638	Gillam Run	3	✓	✓	✓		1.86	7B, 12D, 13

Trail Number	Trail Name	Trail Class	Allowed Trail Use			Part of the AHTS	Total Length	Management Prescription*
			Foot Travel	Bicycle	Horse			
461	Lick Block	2	✓	✓	✓		1.58	13
714	Little Mare Mountain	3	✓	✓	✓		7.16	13
714A	Little Mare Mountain Spur	3	✓	✓	✓		0.70	12D, 13
354	McGraw Horse	3	✓	✓	✓		5.68	13
753	McGraw Loop	3	✓	✓	✓		5.55	4D, 7B, 13
473A	Middle Mountain South	3	✓	✓	✓		5.50	13
621	Polecat Hollow	2	✓	✓	✓		1.49	13
464	Rich Hole	1	✓				5.70	1A
620	Salt Pond Ridge	3	✓	✓	✓	✓	2.37	13
637	Sandy Gap	3	✓	✓	✓		2.80	12D, 13
754	Sandy Gap (misnamed)	3	✓	✓	✓	✓	0.8	13
751	Short Cut	3	✓	✓	✓	✓	0.48	13
466	White Rock Tower	3	✓	✓	✓		5.68	12D

AHTS: Alleghany Highlands Trail System.
*Management Prescription: 1A – Designated Wilderness, 4D – Special Biological Area; 7B – Scenic Corridor; 12D – Remote Backcountry; 13 – Mosaics of Wildlife Habitat

Table 3C1-2. National Forest System Trail Classes

Trail Class	Description
1	Tread intermittent and often indistinct
2	Tread continuous and discernible, but rough and narrow
3	Tread continuous and obvious
4	Tread wide and relatively smooth with few irregularities
5	Tread wide, firm, stable, and generally uniform. Commonly hardened with asphalt

Two congressionally-designated Wildernesses are located within the project area. Rich Hole Wilderness (6,529 acres) in Alleghany and Rockbridge Counties, and Rough Mountain Wilderness (9,322 acres) in Bath County. Both Wildernesses were designated in 1988.

The project area also contains two Recommended Wilderness Study Areas. The Rich Hole Addition contains approximately 4,616 acres. This area adjoins Rich Hole Wilderness. Rough Mountain Addition contains approximately 1,022 acres and adjoins the Rough Mountain Wilderness.

The two Walton Tract Canoe access sites are located on the Cowpasture River. Bubbling Springs Day Use Area is a picnic area open all year. No fees are charged. Amenities at this site include picnic tables, grills, and a vault toilet.

Table 3C1-3. Developed Recreation Sites

Site Name	Site Type	Recreation Opportunity Spectrum
Walton Tract Canoe Access	Boating Site (2 access sites)	Roaded Natural
Bubbling Springs	Picnic Site	Roaded Natural

C1.2 Direct, and Indirect Effects

Alternative 1 (No Action)

Under Alternative 1 (No Action), current management plans would continue to guide management of the project area and no change in recreation opportunities would occur. Conditions described in the 'Existing Condition' portion of this section would continue to exist over the landscape.

There would be no short-term recreation/leisure effects. There would be some long-term indirect effects if the no action alternative was selected. The area would become less desirable to forest users who enjoy hunting and viewing species that require early to mid-successional habitats. This results in lower user satisfaction among those users. On the other hand, people who prefer hunting or viewing species found in late successional forest habitats will have increased opportunities and increased satisfaction.

Alternative 2 (Proposed Action)

Under Alternative 2 (Proposed Action) the Forest Service would construct approximately 17 miles of National Forest System trails in the Pads Creek and Rich Hole areas. Trails would be constructed to the minimum standard necessary for the protection of soil, water, vegetation, visual quality, user safety, and long-term maintenance. The Forest Service will also improve the trail segments connecting with Douthat State Park to help promote Alleghany County tourism. See the Decision Notice and Environmental Assessment for the Alleghany Highlands Trail System Decision Notice signed March 2, 2006 and associated Environmental Assessment for more information.

Table 3C1-4. National Forest System Trails Proposed in Alternative 2

Trail Segment	Construction Method	Length (miles)	Management Prescription*
Segment 1	Hand	0.5	1B
Segment 2	Hand	0.4	1B
Segment 3	Hand	2.3	1B
Segment 4	Hand	1.8	1B
Segment 5	Hand	2.9	1A,1B
Segment 6	Trail Dozer	3.3	1B
Segment 8	Hand	1.9	1B
Segment 9	Trail Dozer	1.4	1B
Segment 10	Trail Dozer	0.2	1B
Segment 11	Hand	1.8	1B
Segment 12	Trail Dozer	0.6	1B

*Management Prescription: 1A – Designated Wilderness, Rich Hole Wilderness; 1B – Recommended Wilderness Study Area, Rich Hole Addition Recommended Wilderness Study Area.

Harvest Units

Depending on the timing of the timber harvest and other silvicultural treatments, hunters and other recreation visitors would potentially see and hear logging activities and encounter log trucks on Forest System roads. Temporary roads constructed for timber harvesting will be closed once timber harvest activities are completed.

Users of the trail system may experience a short-term impact when areas are harvested. The preparation and execution of a timber sale can temporarily close trails, which may result in short-term dissatisfaction by trail users who need to postpone a recreation trip or find an alternative trail. Forest wide standard (FW-171) will be used to reduce/mitigate impacts.

The commercial harvesting activities proposed for this project will not adversely affect the trail construction project in the area since they are limited in scope, duration and location. Impacts to

future trail designations from the non-commercial treatments are negligible since they have very limited visual impact from potential trail locations.

Prescribed Burns
The preparation and execution of a prescribed burn can temporarily close trails, which may result in short-term dissatisfaction by trail users who need to postpone a recreation trip or find an alternative trail. Trails used as control lines during a prescribed burn can result in physical damage to the trail tread and/or trail profile. Firelines that use trails and then veer off may appear to trail users to be a new trail. Forest Plan standards require trails be repaired and any firelines that merge into trails be rehabilitated following a prescribed fire, but the full restoration may require vegetative growth that takes time. The physical impacts to the trail environment can negatively impact the trail user's experience.

During prescribed burns trails included will be closed to public. When trails are used for control lines they will be restored to pre-burn conditions as soon as practicable (FW-147). If control lines tie into a trail it will be obliterated and the topography restored to its original contour (FW-148).

Alternative 3 (Preferred Alternative)
After further field review of trails proposed in Alternative 2 by district personnel, it was determined that sections of the proposed trails did not meet the criteria of a sustainable trail. Thus, new trail segments were located to replace these sections. Under Alternative 3, the Forest Service would construct approximately 14 miles of National Forest System trails in the Pads Creek and Rich Hole areas. Trails would be constructed to the minimum standard necessary for the protection of soil, water, vegetation, visual quality, user safety, and long-term maintenance. The Forest Service will also construct and improve the trail segments connecting with Douthat State Park to help promote Alleghany County tourism.

Table 3C1-5. National Forest System Trails Proposed in Alternative 3

Segment	Construction Method	Length (miles)	Management Prescription*
Segment 1	Hand	0.04	1B
Segment 2	Hand	1.29	1B
Segment 3	Hand	1.47	1B
Segment 4	Hand	1.49	1B
Segment 5	Hand	1.39	1B
Segment 8	Hand	2	1B
Segment 10	Hand	0.71	1B
Segment 11	Hand	0.34	1B
Segment 13	Trail Dozer	0.36	1B
Segment 14	Trail Dozer	1.9	1B
Segment 15	Trail Dozer	0.35	1B
Segment 16	Hand	0.46	1A
Segment 17	Trail Dozer	1.43	1B
Segment 18	Hand	1.32	1B

*Management Prescription: 1A – Designated Wilderness, Rich Hole Wilderness; 1B – Recommended Wilderness Study Area, Rich Hole Addition Recommended Wilderness Study Area.

Harvest Units
Effects will be the same as Alternative 2.

Prescribed Burns
Effects will be the same as Alternative 2.

C1.3 Cumulative Effects
No significant cumulative impacts to the recreation resource are expected to result from this action coupled with past and reasonably foreseeable actions in the area.

C2 - Scenic Quality

Issues Related to the Resource

There were no project issues identified regarding this resource.

Scope of the Analysis

The scenery analysis area is bounded by State Route 39 to the north, Warm Springs Mountain and U.S. 220 to the west, and Interstate 64 to the south and east. The specific projects comprising the Lower Cowpasture projects are Limekiln, Beards Mountain, Sandy Springs, McGraw Hollow, Cliftondale, Craft Road and Pads Creek.

The proposed vegetation and timber treatment units, wildlife clearings, hardwood restoration units, and prescribed fire units were evaluated to determine potential effects on the Scenery resource and identify treatments that will help mitigate those effects and meet the Scenic Integrity Objectives (SIOs) established in the Revised Land and Resources Management Plan for the George Washington National Forest (Forest Plan).

Non-commercial thinning activities and trails projects were not analyzed as their potential effect on scenery is minimal or negligible.

C2.1 Methodology Used to Conduct Scenery Analysis

Maps contained in scoping for the proposed action and in the National Forest's GIS inventory were used to identify viewpoints and travelways for the scenery analysis. A field survey was conducted during leaf-off in November 2014 to determine effects on scenery as viewed from roads throughout the project area. Analysis for potential effects to scenery viewed from trails was conducted using topographic maps and satellite imagery. To determine potential effects to the view from the Warm Springs Mountain Overlook on State Route 39, a viewshed analysis was conducted in ArcMap.

For analyzed viewpoints, some of the views would be seen as the observer is moving (in a vehicle, hiking, mountain biking, etc.), others are from stationary vistas. Views may be partially filtered or screened by foreground vegetation, others are open and unobstructed. The degree of potential impact varies with these and several other factors, such as distance from viewer and viewer position; as well as the slope, size, shape, and type of proposed actions. All of these factors are considered when determining what activities would meet assigned SIOs, and what scenery design features should be incorporated to mitigate potential adverse effects. The following table identifies viewpoint locations considered in the analysis.

Table 3C2-1. Lower Cowpasture Viewpoints Considered in the Analysis

Area	Viewpoint
Craft Road Project Area	Interstate 64 near Longdale Furnace
	US 60 in the vicinity of Longdale Furnace
	SR 770 at its junction with US 60 near Longdale Furnace
Cliftondale Project Area	Interstate 64 near Cliftondale/Clifton Forge
	SR 629 at Cliftondale north of Interstate 64
	McGraw Horse Trail (NFST 354 and FSR 446)
Limekiln Project Area	SR 39 between the overlook on Warm Springs Mountain and the junction with SR 629
	SR 629 from north of Douthat State Park to the junction with SR 39
	SR 683 between SR 39 and 629
	FSR 194
	Little Mare Mountain Trail (NFST 714)
	Salt Pond Ridge Trail (NFST 620)
	Shingle Tree Hollow (FSR 194C (Limekiln Spur))
Beards Mountain Project Area	SR 629 north of Douthat State Park
	FSR 361c
	Beards Mountain Trail (NFST 459) and Bears Mountain Trail Spur (NFST 459A)
	Gilliam Run Trail (NFST 638)
	Polecat Hollow Trail (NFST 621)
	Middle Mountain South Trail (NFST 473)
Sandy Springs Project Area	FSR 125
	Middle Mountain South Trail (NFST 473)
	Brushy Ridge Trail (NFST 456)
	Lick Block Trail (NFST 461)
	Sandy Gap Trail (NFST 637)
McGraw Hollow Project Area	SR 629 south of Douthat State Park
	McGraw Horse Trail (NFST 354)
Pads Creek Project Area	SR 633
	FSR 129
	FSR 624
	Bubbling Springs Picnic Area
	Blacks Run Trail (NFST 353)
Other Viewpoints Considered	Cowpasture River
	Douthat State Park
	Rockbridge Alum Springs – Young Life Camp
	Fore Mountain Trail (NFST 473)

SR – State Route, FSR – National Forest System Road; US – United States; NFST – National Forest System Trail

C2.2 Existing Situation

The project areas include mountainous landscapes typical of the Appalachians. At the large scale, the mountains are characterized by long, roughly parallel ridges with stream valleys separating them. When viewed as background or far middleground, the scenery offers interesting forms and shapes, but is somewhat uniform in texture and color. A closer view shows individual peaks along the ridges and deep drainages cutting into the sides of the ridges resulting in numerous smaller ridges descending from the main ridge at all angles and converging into the stream valleys, and their sideslopes steepen in some places and level out in others, the whole of which is predominantly covered in a mixed hardwood forest canopy, as well as mid- and under-story trees and shrubs, and

shade-loving groundcovers. When viewed as foreground or near middleground, this landscape scenery offers a variety shapes, forms, textures, and seasonal colors. When viewed from within as immediate foreground, the project areas offer views to beautiful vegetation, rockforms and streams adjacent to the travelway.

Within the viewsheds for the Lower Cowpasture analysis area, there is a mix of natural appearing forest and areas that contain evidence of past timber management in the form of logging roads, timber harvest areas, prescribed burn units and wildlife openings. Most past timber treatment areas have regenerated to a point where the vegetative cover is similar in color and texture to the adjacent forest area that was not treated. Most prescribed burn areas are not noticeable to the casual observer after one year. Some prescribed burns result in blackened trunks that extend a distance of five or more feet above the ground; and some of these areas are noticed by the casual observer. Mares Run is a recently completed project that has not yet returned to a natural-appearing vegetative cover.

Many of the roads that pass through or adjacent to the project areas on national forest lands also pass through privately owned lands. For the visitor traveling on roads, their experience includes this mix of views to national forest and to non-national forest lands, and the boundaries between them are not obvious. Visually, this provides a patchwork of natural appearing forested landscapes and altered landscapes. The altered landscapes on national forest and non-national forest lands include roads, pullouts, culverts, bridges, signs, utility corridors, and past timber harvest units. On private lands there are openings of various sizes, many containing structures that accommodate residential housing, farming, retail services and industry. The majority of these altered landscapes on private lands are located in the valleys and at lower elevations, while national forest lands are located at all elevations within the analysis area.

Attractions within the scenery analysis area include Rich Hole Wilderness, Rough Mountain Wilderness, Douthat State Park, Bubbling Springs Picnic Area, numerous trails and minimally developed trailheads, and the Cowpasture River and put-in/take-out points along the river.

The Scenery Management System

The USDA Forest Service Scenery Management System (Agriculture Handbook Number 701, Landscape Aesthetics, A Handbook for Scenery Management), often referred to as the SMS Handbook, provides direction for inventorying and classifying scenery. The primary purpose, ultimately, is its use in establishing Scenic Integrity Objectives (SIOs) in the Forest Plan.

The scenery inventory process begins by assigning concern levels to all open, public roads and trails (on and off national forest lands), as well as to recreation sites, and water bodies such as lakes and rivers. Since the level of use and primary purpose of the users vary for different roads, trails, rivers, etc., the relative importance of landscape scenery varies as well. Concern levels range from high importance (concern level 1) to relatively low importance (concern level 3). Then the “seen area” from each travelway and viewpoint is mapped. A particular area of landscape may, and often is, viewed from more than one viewpoint and/or travelway. The SMS Handbook provides a hierarchy for mapping areas seen from multiple locations. Generally, a CL 1 or 2 travelway some distance away takes precedence over a CL 3 travelway that passes through or adjacent to the area.

The inventory maps prepared at the national forest planning level takes a broad brush approach to assigning “seen area” status. At the project planning level, the area mapped as potentially seen from specific viewpoints and travelways is verified and often found to be overstated (and sometimes, but rarely, found to be understated). Small ridges and knobs, rock outcrops, road cuts, vegetation, and

other landscape elements often prevent areas from actually being visible from the travelways that primarily drove the assigning of a Scenic Class.

Concern level, distance viewed to the landscape, and the degree to which the existing landscape character is intact, combine to create an inventory of scenery ranked from 1 to 7 in relative importance; these are called Scenic Classes. SIOs are then assigned for every management prescription area by Scenic Class. As the prescription for each area of land varies, the assignment of SIOs may vary.

SIOs are developed as measurable standards for the visual management of public lands. SIOs include a range from Very High to Very Low as this pertains to the degree of scenic integrity or level of intactness of the desired landscape character. Within the project areas, the SIOs range from High to Low.

- Under the High SIO, landscapes exist where the valued landscape character appears intact, natural and unaltered even though disturbances may be present. These deviations remain unnoticed to the casual observer because they have been designed to repeat attributes of form, line, color texture and scale found in the valued scenery. This SIO level is achieved as soon after project completion as possible or within three years maximum.
- Under the Moderate SIO, landscapes exist where the valued landscape character appears slightly altered. Noticeable human-created deviations are minor and remain visually subordinate to the landscape character being viewed because they repeat its form, line, color, texture, pattern and scale. This SIO level is achieved as soon after project completion as possible or within three years maximum.
- Under the Low SIO, landscapes exist where the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect, and pattern of natural openings.

The proposed activities included in the Lower Cowpasture project areas are located within management areas 1B Recommended Wilderness Area, 4D Special Biological Area, 7A1 Highlands Scenic Byway, 7B Scenic Corridor, and 13 Mosaics of Habitat. The SIOs by Scenic Class associated with these management areas include High, Moderate and Low, as follows:

Management Areas		Scenic Classes						
		1	2	3	4	5	6	7*
1B	Recommended Wilderness	High	High	High	High	High	High	High
4D	Special Biological Area	High	High	Mod	Mod	Mod	Mod	Mod
7A1	Highlands Scenic Byway	High	Mod	Mod	Mod	Mod	Mod	Mod
7B	Scenic Corridor	High	High	Mod	Mod	Mod	Mod	Mod
13	Mosaic of Habitat	High	Mod	Mod	Mod	Mod	Low	Low

*No acres are inventoried as Scenic Class 7.

C2.3 Direct, Indirect, and Cumulative Effects

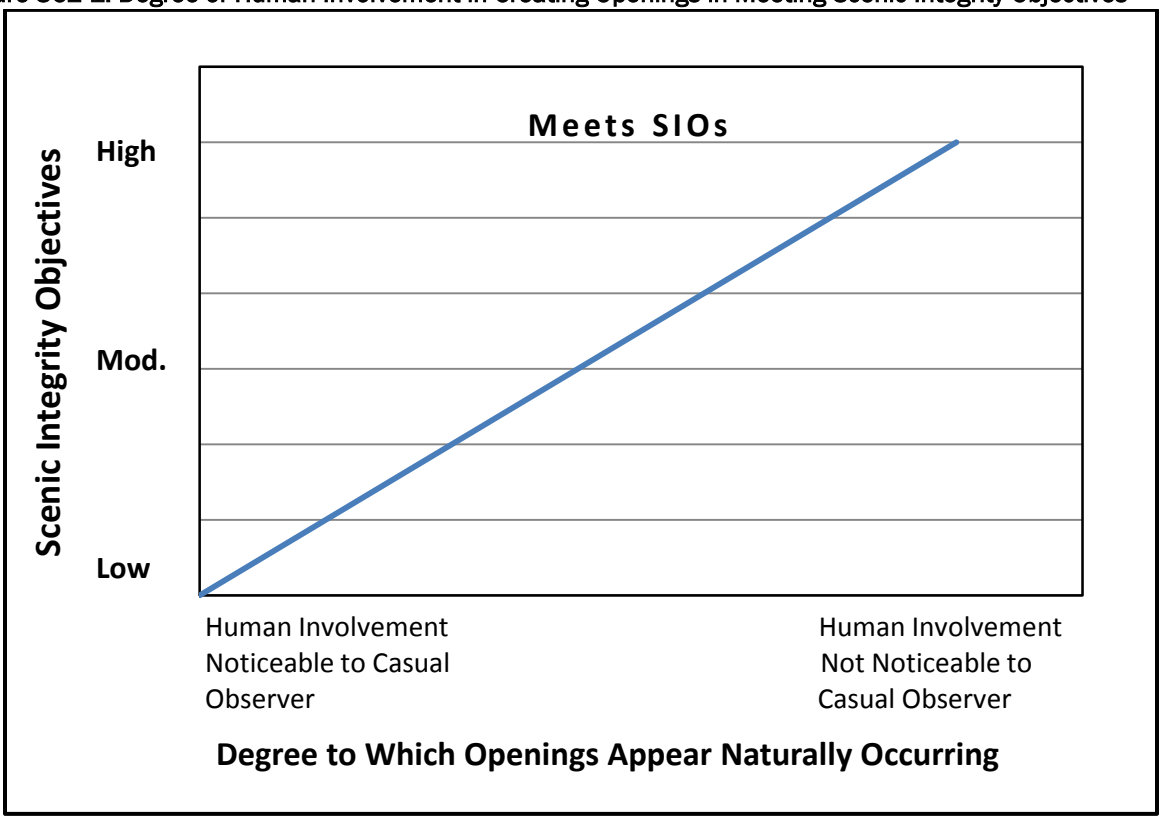
Transition from Continuous Forest Canopy Landscape Character to Historic Landscape Character: Effects on scenery are stated in terms of the degree to which the proposed management activities visually deviate from the valued landscape character. As stated in the Forest Plan for the George Washington National Forest, disturbances to scenery allow for restoration of the landscape character

that was influenced historically by wildfires (DC SCE-04) and natural appearing landscapes that include areas such as open woodlands (DC SCE-04).

This vision intends for the definition of valued landscapes visible from viewpoints (roads, trails, overlooks, recreation sites) to transition from the existing one that is characterized by continuous, nearly intact forest canopy to the historic landscape character that was predominantly forested but included openings and open woodlands that resulted from natural wildfires. Within the High SIO, this would mean that the evidence of human intervention to create the mix of forest communities including openings and open woodlands would not be evident to the casual observer from an established viewpoint (roads, trails, overlooks, etc.). Within the Moderate SIO, evidence of human intervention to create openings and open woodlands may be noticeable, but should not dominate the landscape character that is visible. Within the Low SIO, evidence of human intervention to create natural appearing openings may be noticeable and may even begin to dominate the characteristic landscape.

The graph below shows a generalization of the degree of human involvement in creating openings, as perceived by a casual observer, that would meet the High, Moderate and Low SIOs.

Figure 3C2-1. Degree of Human Involvement in Creating Openings in Meeting Scenic Integrity Objectives



The percentage of the visible landscape that is converted from the current condition of predominantly intact, continuous forest canopy to open areas should also be a consideration in determining whether SIOs are met. The Revised Forest Plan's Vision, Strategy and Standards for the Scenery resource do not specify the percent of land that was historically in openings due to wildfire. However, the Background statements under the Fire resource in the Vision section of the Revised Forest Plan indicates that as much as 80% of the national forest acreage had frequent fire while 20% had infrequent and low intensity fire (page 2-23). For ecological systems, the Vision in the

Revised Forest Plan establishes 10% for the amount of open areas (DC ESD-04), 12% for the amount of regenerating oak forests and woodlands (DC ESD-08), and 13% of regenerating pine forests and woodlands (DC ESD-09; fire is an important component of the latter two.

General Discussion Relative to All Action Alternatives - Direct & Indirect Effects - Proposed non-commercial treatments will have minimal impacts to scenery. In some areas dead or dying understory vegetation may be visible after treatment, but will decay over time and be unnoticeable to most viewers within one to three growing seasons. Other treatments may improve scenic quality by opening views into the understory to a greater variety of plants and other natural elements, or removal of NNIS plants.

The effects of prescribed burns on scenery generally are not noticeable to the casual observer after one year, particularly when viewed from the Middleground or Background Distance Zones. Even within the Foreground Distance Zone, the fast regrowth of herbaceous plants in this climate covers the blackened ground in one full growing season. The exception is when bark of trees and rock outcrops and other natural elements are blackened above the average height of the groundcover vegetation.

When viewed in the Middleground Distance Zone, the relatively high leave-tree density of a shelterwood harvest (a two-age harvest method) and the free thinning harvest methods result in a moderate to low contrast in texture and color between the treated area and the adjacent forest. In leaf-on season, Middleground views of two-age treatments may allow varying degrees of visible ground beneath the remaining overstory trees, and in certain lighting conditions shadows beneath residual trees may create the appearance of a more coarse texture than the adjacent forest. Within two to three growing seasons, crowns of residual over-story trees expand to create a denser canopy, and under-story vegetation grows to obscure views of ground exposed during harvest. In leaf-off season, two-age treatment areas would be almost indistinguishable from adjacent uncut stands except for the color contrast and lines created by roads and log landings.

The shelterwood harvest with reserves is similar to the shelterwood method described above except that the density of leave trees is lower and those trees are clumped to maximize sunlight that reaches the forest floor. This will be more noticeable when viewed in the Middleground Distance Zone due to the change in texture and color from the adjacent forest. Little can be done to reduce the texture and color change, except to follow scenery treatments provided for reducing the visibility of temporary roads, skid trails and landings.

For some shelterwood and shelterwood with reserves units that may be visible from viewpoints, leave-tree density is transitioned (or feathered) from the desired density within the unit to the density of trees in the adjacent uncut stands. This technique eliminates a hard shadow-line and helps blend treatment areas into the adjacent forest canopy. In addition to increased leave-tree densities and edge feathering, other scenery design features used in these proposals are to drop unit boundaries below a ridge to prevent canopy gaps along the ridgeline, retain uncut or higher density buffers along trails, and maintain screening vegetation below visible log landings and/or roads.

These and other design features effectively soften visual impacts of timber harvest, and allow assigned SIOs to be met. Scenery treatments for specific proposed treatments and units are provided in the Scenery Mitigation Treatments section at the end of this report.

Alternative 1 (No Action): There would be no effect on the existing scenic resources in the area. This alternative would not contribute to restoring the historic landscape character theme, which includes

scenery that was influenced by the role of natural wildfires that resulted in a mix of forest communities including openings.

Alternatives 2 and 3: These alternatives, with their combination of proposed management treatments, would contribute to restoring the historic landscape character that was influenced by natural wildfire and that included a mix of forest communities including openings. Adverse effects to the scenery resource could result, however, if the completed actions are perceived by the casual observer to be the work of humans rather than of nature in areas with a High SIO, or the completed actions are perceived to be the work of humans and this dominates the landscape character in areas with a Moderate SIO.

As described in the Scenery Management System section above, the SIOs are determined, in part, by the sensitivity level of the viewpoint with the highest concern level, which might not be the road or trail that passes through or closest to the proposed unit or project area.

Proposed timber treatment units in areas with a High SIO are as follows:

- Craft Road units in the Scenic Corridor and Highlands Scenic Tour Byway management areas as potentially viewed from Interstate 64, U.S. 60 and S.R. 770 – Due largely to the significant amount of evergreens (pines) adjacent to the north side of the interstate, the location of the interstate at the base of numerous road cuts, and to some extent intervening topography, this project area will likely not be noticeable to the casual observer traveling on I-64, with the possible exception of a short duration of view near the Longdale Furnace interchange where the interstate is somewhat elevated. The CR-1 and CR-3 units may be noticeable to the casual observer from spots as they travel along U.S. 60 and potentially from S.R. 770 where it meets U.S. 60. It is unlikely that these units would be noticeable to the casual observer during leaf on seasons, but they may be noticeable to the casual observer during the leaf off season. Increasing the percentage of leave trees toward the upper reaches of the units and feathering the top and side edges will help mitigate the visibility of the units.

- Cliftondale units in the Scenic Corridor management area potentially viewed from SR 629 –
    - CD-2 and CD-4 are shelterwoods with reserves north of I-64. A portion of each of these units may be visible for a very short duration of view to travelers looking up these drainages at a right angle from the direction of travel (east or west). They are not expected to be noticeable to the casual observer traveling along I-64.
    - CL-3 is a shelterwood with reserves west of SR 629. Due to intervening topography with the majority of the unit located behind a ridge from the viewing platform, the orientation of SR 629 nestled into the base of the slope below the northeast boundary of the unit, and a component of evergreen between the road and the unit, it is not believed that CL-3 will be noticeable to the casual observer traveling on SR 629.

- Limekiln units in the Mosaics of Habitat management area potentially viewed from State Routes 39 and 629 –
    - LK-34 is a thinning unit through which State Route 629 passes north of Douthat State Park. This road passes in and out of Forest Service and private landownership when approaching from the north or south, providing a patchwork of landscape character types including closed canopy forest, open canopy forest, timber activity on private lands, evidence of past management treatments on Forest Service land, and recreational developments within the State Park south of this location. The road also crosses a powerline and its open corridor several times.

The elements of the proposed action that may be most obvious are the landing and the slash. The casual observer may not take particular note of the landscape character resulting from this thinning activity three years after project completion, provided the mitigations listed in the Scenery Treatment Guide for thinning treatments in High SIO areas are applied. Specifically, slash should be removed, burned, chipped or lopped to within an average of 2 feet of the ground when visible within 100 feet from the State Route; leave tree or unit markings should be applied so as not to be visible within 100 feet of the State Route; and flowering and other visually attractive understory trees and shrubs should be retained. Also, straight lines along the north and south boundary of the unit (boundaries through which the road passes) should either be redesigned with more natural curved boundaries or the edges of the units approaching the boundaries should be "feathered", that is increasing the basal area progressively so that the edges are not easily discernible.

- LK-36 is a shelterwood west of SR 629. The state route adjacent to this unit has open area on private land to the east and forested national forest land to the west. The road sits at the base of the slope and there is a fair amount of evergreen adjacent to the west side of the road. Topography and evergreen vegetation will assist in screening views to the unit. A portion of the unit may be visible to the casual observer, therefore mitigations to eliminate evidence of the landing and skid trails should be followed.
- LK-37 is a shelterwood west of SR 629 and south of SR 39. The field visit revealed that the mapped inventory for national forest area visible from these routes is overly generous. The topography in the area of LK-37 becomes far less steep than the sideslopes down to the roads below, so that travelers on those roads cannot see the somewhat level area on top. It may be possible for a brief duration of view that the north edge along the national forest border may be visible. It is recommended that the feathering technique be utilized along this unit boundary to help prevent increased daylighting as viewed from SR 39.

All of the remaining proposed timber treatments and wildlife clearing actions occur in areas that have a Scenic Integrity Objective of Moderate in the Mosaic of Habitats management area. These are addressed below by the travelways from which they may be seen.

- Limekiln Proposed Projects:
  - S.R. 39 and the S.R. 39 Overlook (CL 1): A GIS ArcMap viewshed analysis indicated that these units would not be visible from the overlook on S.R. 39.
  - S.R. 629 (CL 1): The foreground visible from this route is High SIO and was addressed in a prior section. The middleground visible from this route is Moderate SIO. Units that lie within the middleground zone include LK-30, LK-32, LK-33, LK-35 and the northeast portion of LK-46. A wide margin of intervening vegetation as well as topography screen from view units LK-30 and LK-32. LK-33 may be noticeable to the casual observer in the form of increased lighting penetrating to the forest floor, particularly once the thinning is accomplished in unit LK-34. Units LK-35 and a portion of LK-46 may be visible to southbound travelers on S.R. 629 during leaf off seasons for a short duration of view, although this is doubtful; roadside vegetation may screen these areas from view.
  - S.R. 683 (CL 3): The hardwood restoration units (LK 43 and 46) may be noticeable to casual observers for a very short duration of view for those traveling south on S.R. 683 where it meets Wilderness Ranch Road.
  - FS Road 194 (CL 3): A number of units are adjacent to or accessed just off of this road. With a Concern Level of 3, this road gets a lot of user by hunters and dispersed recreationists,

many or most of which desire to see wildlife. Although there are a great many proposed units along FS Road 194, about half of them are TSI and will not have a significant effect on scenery. Some others are just tangent to the road, while a few do propose fairly wide openings along the road. The Scenery Treatment section describes mitigation measures to address these units so that they will meet the SIOs.

- Little Mare Mountain Trail (FST 714): Most of the proposed Limekiln timber units will not be visible from Little Mare Mountain Trail, except LK31, and possibly LK43 and LK46. Landings and skid trails need to be properly designed initially to keep these features out of view to the extent possible, and then they need to be properly addressed at the completion of the project. Unit LK31 should not cross over Little Mare Mountain Trail, and the length/distance of the edge of the unit that's open to the trail should be reduced. The upper edge of the LK43 and LK46 units should also be feathered to reduce the shadow line effect.

- Salt Pond Ridge Trail (FST 620): LK13 and LK11 units should not cross the Salt Pond Ridge Trail. It would be better if there was a slight buffer between the trail and the units.

- Beards Mountain
  - State Route 629 (CL 1): The proposed timber units will not be visible from S.R. 629.
  - FS Road 361 (CL 3): This is similar to FS Road 194 above in terms of effects, except the majority of these units are shelterwood with reserves and there is one hardwood restoration project. For the Concern Level, and incorporating scenery treatments provided below, the units will meet the SIO.
  - Beards Mountain Trail: This trail runs along the ridge of Beards Mountain with the units in the stream valley below. Due to vegetation and distance, the units will not be visible from Beards Mountain Trail. However, Beards Mountain Trail drops down off the ridge and runs tangent to unit BM6. With careful design of the landing and any skid trails, and utilizing the scenery treatments provided below, this unit will meet the SIO.
  - Gilliam Run Trail and Polecat Hollow Trail: Collectively, these trails run adjacent to BM1, BM2, and BM3. With careful design of the landing and skid trails, and employing the scenery treatments described below, this unit will meet the SIO.

- Sandy Springs
  - FS Road 125 (CL 2): The effects for FS Road 125 are similar to that of FS Road 194 and FS Road 361 described above. Numerous units lie along this road; they are fairly well spread out. With careful design of the landings and skid trails, and utilizing the scenery treatments provided below, these units will meet the SIO.
  - Middle Mountain South Trail (NFST 473): This trail runs along the ridge while the proposed harvest units are in the stream valley below. Due to the distance, it is unlikely that users of the Middle Mountain South Trail will be able to see the units, although there is a chance during leaf off that the upper reaches of SS-03 and SS-04 might be visible. Reducing the geometric shape of SS-03, feathering the top edge of the unit, and carefully designing the skid trails and landing to reduce their visibility will help to meet the SIO.
  - Brushy Ridge Trail (NFST 456): This trail will run adjacent to a proposed TSI unit. The potential effects to the scenery resource as viewed from the trail will be minor.

- Lick Block Trail (FST 461) and Sandy Gap Trail (NFST 637): These trails will not pass through or immediately adjacent to any of the proposed units. Lick Block will run near a wildlife opening, and Sandy Gap Trail will run through one. Users of Sandy Gap Trail may be able to notice through the trees a portion of unit SS 6. These effects will be minor.

- McGraw Hollow
  - State Route 629 (CL 1): None of the proposed units will be visible from S.R. 629.
  - McGraw Horse Trail (CL 3): The only unit that will be visible from this trail is a TSI unit. FS Road 336 runs along a portion of unit MH-01 and this road may be used by some to access the trail. If so, careful design is needed to assure the opening appears natural and the landing is either not visible or it appears to be associated with the road as a pullout.
- Cliftondale
  - McGraw Horse Trail (FST 354 and FS Road 446): The CD-01 timber unit is proposed for an area adjacent to FS Trail 354 for a fairly lengthy distance. The unit rises from the trail to the top of a small knob.
- Pads Creek
  - State Route 633: There are three thinning units along this State Route. The effects on scenery from these units will be minimal if scenery treatments provided below are incorporated in the design of the units.
  - FS Road 129 (CL 2): There are two hardwood restoration units proposed for this access route to the Bubbling Springs day use area.

<u>Cumulative Effects</u>

Past timber harvests, clearings, roads, prescribed burns, and other landscape modifications may be visible from various analyzed viewpoints. The degree to which these modifications impact scenic quality varies greatly with feature type, scale, and contrast with the surrounding natural landscape. Proposed treatments in this project would create small to moderately sized openings, or the canopy may appear thinner in places; and road improvements, skid roads or trails, and log landings may be visible from some locations.

In the action alternatives, multiple harvest units, associated roads, and landings would be seen in conjunction with other proposed and existing landscape modifications to such an extent that SIOs for cumulative effects would not be met. However, scenery design features (Appendix G) were developed for the proposed actions with consideration for cumulative effects of proposed and existing landscape modifications; thus allowing assigned SIOs to be met.

No foreseeable future actions which may have cumulative impacts to scenery are known within the analysis area.

C3 - Roads

Issues Related to the Resource

There were no project issues identified regarding this resource.

Scope of the Analysis

The road analysis is bounded on the west by the ridge of Warm Springs Mountain, on the north by State Route 39, on the east by State Route 633 and Interstate 64, and on the south by Interstate 64 and State Route 606.

C3.1 Existing Condition

Approximately 92 miles of National Forest System roads are located within the project area (GIS database). Approximately 33 miles of these roads are open to the public year round and another 18 miles are open seasonally. The remaining roads provide administrative access and are either gated or closed with an earthen berm if they are not needed for an extended period of time. Approximately 10.68 miles of FSR roads have been approved for decommissioning in the project area of which 2.68 miles have already been decommissioned. For more information on National Forest System roads in the project area see Appendix J.

Currently there is an ongoing effort with regards to management of the Forest road system referenced as a Travel Analysis Process (TAP). This effort is aimed at the identification of the minimum road system necessary to meet management objectives and identify opportunities for increased resource protection, eliminating the backlog of deferred maintenance, optimal performance of maintenance, and better service to Forest users. Road recommendations based on the TAP were incorporated into the Forest Plan and were reviewed for the project area.

Browns Hollow Spur (FSR 125A), and Salt Pond Ridge (FSR 1919) are decommissioned roads within the project area.

Alternative 1 (No-Action) No changes to the existing road system would occur. Routine maintenance would continue to occur.

Alternative 2 No changes to the existing National Forest System roads would occur under this alternative. An entrenched section of FSR 194 (Limekiln) would be reconstructed to build up the road and reduce further entrenchment.

Forty-seven temporary roads totaling 11 miles would be constructed to facilitate access to harvest units throughout the project area. Temporary roads leading to harvest units would be revegetated and closed with an earthen berm after use. Temporary roads leading to wildlife clearings would be re-vegetated, maintained as linear wildlife openings, and closed with a gate to allow access for maintenance. No changes to the existing Forest System Roads would occur by implementing this alternative. No new Forest System Roads would be constructed.

Alternative 3
After reviewing recommendations from the TAP, the IDT determined a section of Lick Block (FSR 125S) should be decommissioned after timber harvest activity is completed in the Sandy Springs area. This system road provides administrative access and will no longer be needed once harvesting is completed in the area. It is closed year round and is not open for public vehicular access. The decommissioned length would be 0.9 miles and the segment of road would begin at the 0.10 mile

post. The decommission treatment prescribes culvert removal, stream channel restoration, and re-vegetation of the site. A permanent closure structure would close the road. The decommissioned road corridor would not be converted to a National Forest System trail; however, it would provide foot travel access to forest users.

Forty-five temporary roads totaling 10.1 miles would be constructed to facilitate access to harvest units throughout the project area. Temporary roads leading to harvest units would be re-vegetated and closed with earthen berms after use. Temporary roads leading to wildlife clearings would be re-vegetated, maintained as linear wildlife openings, and closed with a gate to allow access for maintenance.

No new Forest System Roads would be constructed under this alternative.

Cumulative Effects No changes to open or seasonally open National Forest System roads would occur under Alternatives 1 and 2. Within the project area, past and current road decommissioning removes approximately 10.68 miles of National Forest System roads that are/were closed to public motorized access. The cumulative effects of implementing Alternative 3 with past and current road decommissioning would be the reduction of approximately 11.58 miles of closed National Forest Systems roads.

C4 - Cultural, Historical, and Archaeological Resources

Issues Related to the Resource

There were no project issues identified regarding this resource.

C4.1 Direct, Indirect, and Cumulative Effects

All Alternatives: A Phase 1 archaeological survey was conducted in the project area by USFS Archaeologists in 2014. These findings were forwarded to the Virginia State Historic Preservation Officer for their review and information. Letters of concurrence are on file in the Supervisor's Office in Roanoke from the Department of Historic Resources. A copy of the archaeological survey is on file at the Warm Springs District and Supervisor's Offices. If further evidence of sites is discovered during project implementation, work would be stopped in and around the discovery and the Forest Archaeologist would be called in to evaluate the evidence and determine what should happen next. None of the alternatives will adversely affect cultural resources.

Normal cultural resources inventory and analysis will offer the same level of investigation and guarantees against inadvertent destruction of a cultural resource in all alternatives. (Final EIS Standards and Guidelines for the Southern Region, page 4-7).

C5– Potential Wilderness and Inventoried Roadless Areas

Issues Related to the Resource

There were no project issues related to this resource.

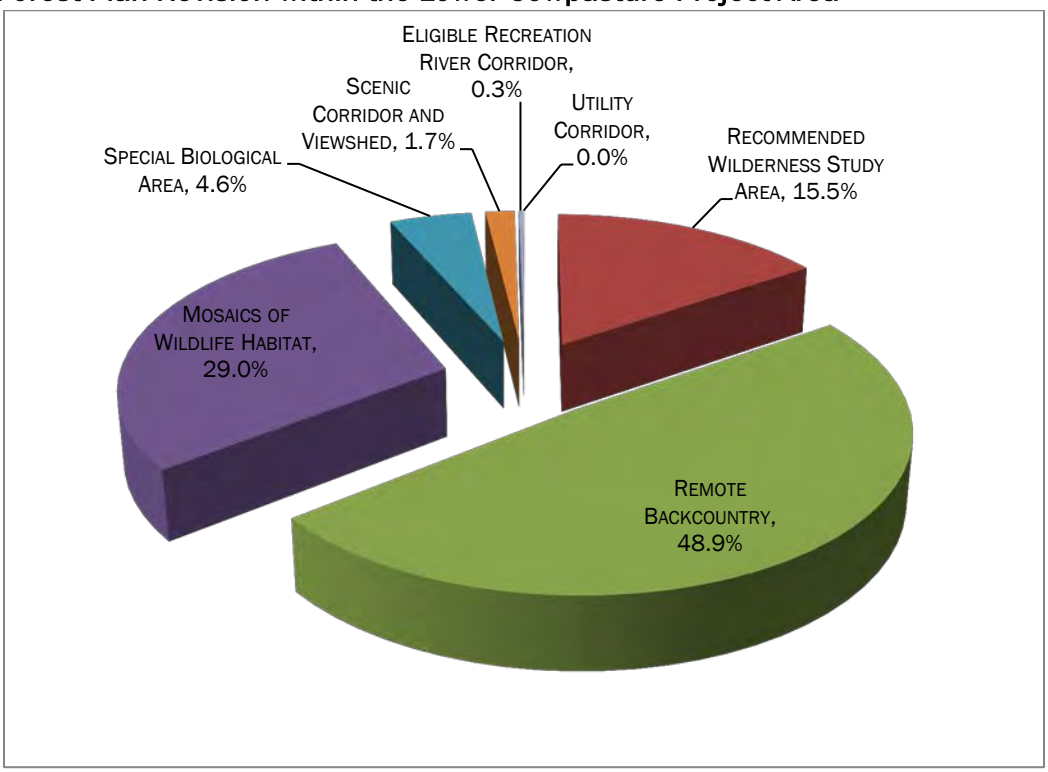
Scope of the Analysis

The scope of the analysis for this resource will be National Forest System lands within the Lower Cowpasture project area.

C1.1 Existing Condition

During Forest Plan revision approximately 47% of the National Forest System lands within the Lower Cowpasture Project met the potential wilderness area inventory criteria according to Forest Service Handbook (FSH) 1909.12 Chapter 71. Four Potential Wilderness Areas (PWAs) were identified in the project area specifically Beards Mountain, Little Mare Mountain, Rich Hole Addition and Rough Mountain Addition Potential Wilderness Areas. Of these areas portions of two were recommended as wilderness study areas, Rich Hole Addition and Rough Mountain Addition. (Forest Plan EIS) The Forest Plan allocated the Potential Wilderness Areas to seven management prescriptions. Figure 3C5-1 displays the percent of Potential Wilderness Areas assigned to each management prescription.

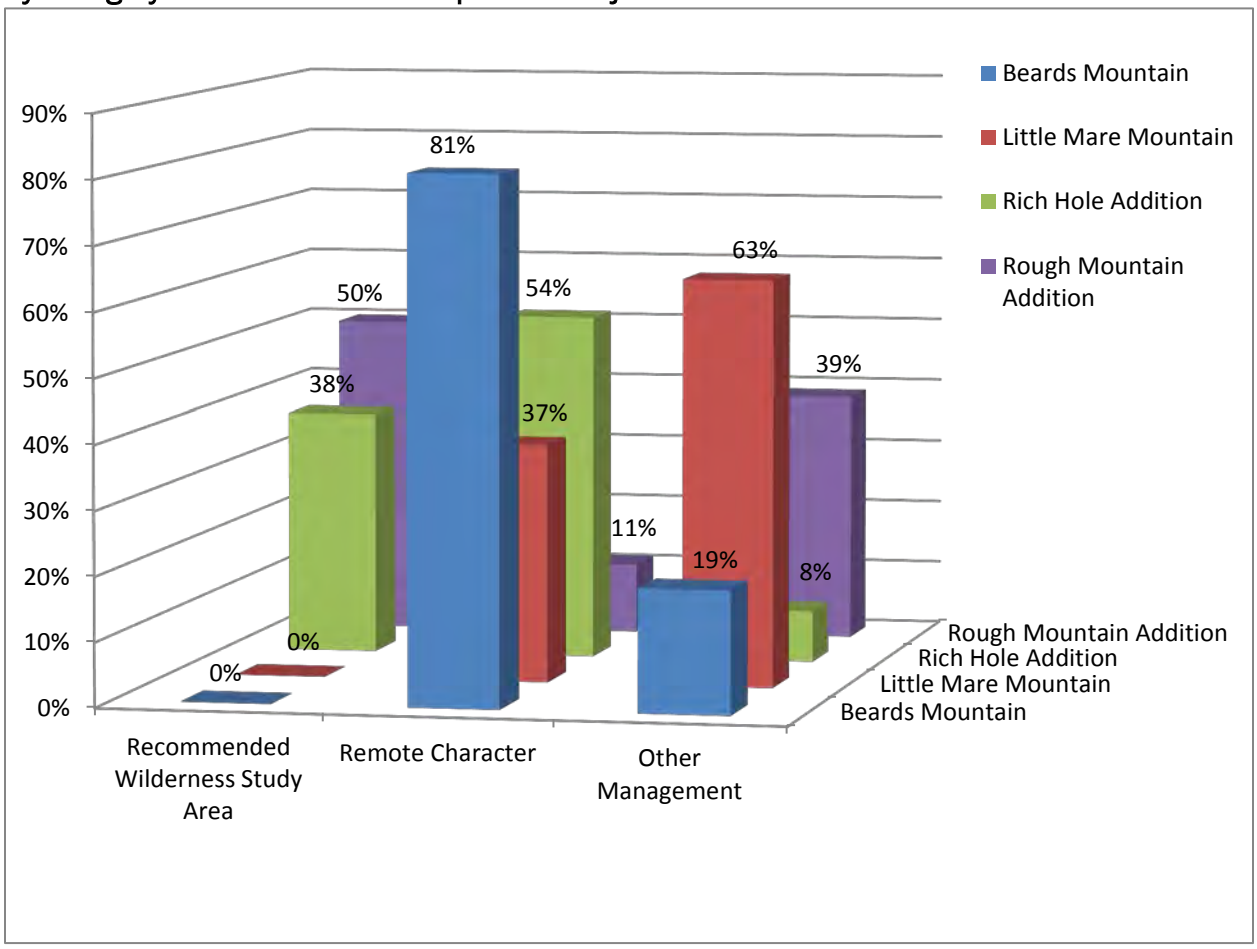
Figure 3C5-1. Management Prescription Allocation of Potential Wilderness Areas Identified during Forest Plan Revision within the Lower Cowpasture Project Area



Three categories are used to summarize how each Potential Wilderness Area was allocated by the Forest Plan. These categories are: 1) Recommended Wilderness Study; 2) Remote Character (includes Remote Backcountry, Special Biological Areas and Wild and Scenic River

Corridors); and 3) Other. (Forest Plan EIS, p. 3-317) Figure 3C5-2 summarizes Potential Wilderness Area allocations by category.

Figure 3C5-2. Allocation of Potential Wilderness Areas Identified during Forest Plan Revision by Category within the Lower Cowpasture Project.



C1.2 Direct, Indirect and Cumulative Effects

Alternative 1 – No Action

No activities would be implemented by this alternative including closing unauthorized roads in the Little Mare Mountain area or decommissioning a portion of National Forest System Road (FSR) 125S (Lick Block) also within the Little Mare Mountain area. Additionally, culverts in the Slicky Slide Road would not be removed in the Rich Hole Addition area. However, a portion of National Forest System Road (FSR) 333 (Craft Road) and FSR 1923 (Slicky Slide) will still be decommissioned in the Rich Hole Addition along with a portion FSR 361A (Beards Mountain Spur). These activities or lack of activities will not disqualify these areas from consideration in a future potential wilderness inventory conducted according to Forest Handbook 1909, Chapter 70 (effective 1/30/2015).

Alternatives 2 & 3

Beards Mountain Area –Timber harvest has occurred in the past in the 24% of the Beards Mountain area outside of the roadless area. In the past 25 years, approximately 184 acres or 7% of this area has been harvested. Of the eight harvest units currently proposed for harvest within the area (Alternative 2 – 149 acres; Alternative 3 – 145 acres), four are along roads that are open to the public seasonally. Access to the remaining harvest units within the area exists but vehicular access is limited to agency administrative use. No new National Forest System road construction is proposed within this area. FSR 361E (Blueberry Hill) is a closed (bermed) level 1 road between Units BM-10 and BM-11. This road will be opened to administrative use during harvesting to facilitate the logging and landing of products to be hauled from this unit. Once this unit is harvested, this road will be revegetated and closed to all vehicle traffic. FSR 361B (Beards Mountain Spur) is also a closed (bermed) level 1 road starting at approximately 0.4 mile from the beginning terminus. This road will be opened to administrative use during harvesting to facilitate the logging and landing of products to be hauled from BM-03. Once this unit is harvested, this segment will be revegetated, closed and decommissioned per the James River/Warm Springs Road Decommissioning II Project (09/27/2012). Alternatives 2 and 3 would not change the current assigned maintenance level or use of existing roads open to the public within this area. No prescribed burns are proposed within the Beards Mountain area.

Little Mare Mountain Area – Timber harvest has occurred in the past within the Little Mare Mountain area. In the past 25 years, approximately 373 acres or 3% of the area has been harvested. Alternative 2 would harvest approximately 629 acres in 24 units while Alternative 3 would harvest approximately 503 acres in 20 units. Harvest units include commercial timber stand improvements (Alt. 2 – 307 ac., Alt. 3 – 290 ac.); hardwood restoration (Alt. 2 - 58 ac., Alt. 3 – 37 ac.); shelterwood (Alt. 2&3 – 26 ac.); and shelterwood with reserves (Alt 2. – 238 ac., Alt. 3 – 150 ac.). Alternatives 2 and 3 would regenerate approximately 2% and 1% respectively of the Little Mare Mountain area. No new NFS road construction is proposed within this area.

Of the 24 harvest units currently proposed in Alternative 2, seventeen are along roads that are open to the public for year-round vehicular access. Two units are along a road that is open to the public seasonally. Access to the remaining harvest units within the area exists but vehicular access is limited to agency administrative use. Some units will require segments of temporary road to facilitate the logging and landing of products to be hauled from these units. Temporary roads range in length from approximately 31 ft. to 4,377 ft. The two longest segments of temporary road are located in old road corridors that are no longer utilized. Once these units are harvested, these temporary roads will be revegetated and closed to all vehicle traffic. Temporary roads that access wildlife clearings will be revegetated, gated and maintained as linear wildlife clearings. FSR 125S (Lick Block) is a closed (bermed) level 1 road. This road will be open to administrative use to facilitate the logging and landing of products from Unit SS-01. Once this unit is harvested, this segment will be revegetated and closed with a gate to allow administrative access to maintain a wildlife clearing; it will remain a level 1 road.

Of the 20 harvest units in Alternative 3, fourteen are along roads that are open to the public for year-round vehicular access. Two units are along a road that is open to the public seasonally. Access to the remaining harvest units exists but vehicular access is limited to agency administrative use. Temporary roads needed to facilitate the logging and landing of products for this alternative is the same as Alternative 2; they will also be revegetated and closed in the same manner. After Unit SS-01 is harvested, FSR 125S (Lick Block) will be decommissioned starting at approximately at approximately 0.1 mile from the beginning terminus. The decommissioned length would be approximately 0.9 miles. The decommission treatment prescribes culvert removal, stream channel restoration, and re-vegetation of the site. A permanent closure structure would close this segment of FSR 125S. The decommissioned road corridor would not be converted to a National Forest System trail; however, it would provide foot travel access to forest users. The first 0.1 mile of FSR 125S will be revegetated and closed with a gate to allow administrative access to maintain a wildlife clearing; it will remain a level 1 road.

Although no prescribed burns are proposed in the Little Mare Mountain area; approximately 86% of the area is within the Warm Springs Mountain Restoration Project. Portions of 5 burn units are within the Little Mare Mountain area. Most of the burn units use existing roads and trails as burn boundaries; however approximately 2.2 miles of dozer line has been constructed and revegetated to facilitate burning these units. No additional dozer line construction is expected to occur.

Rich Hole Addition Area –The Rich Hole Addition area covers approximately 12,165 acres. A portion of the Rich Hole Addition Potential Wilderness Area (approximately 4,616 acres or 38% of the area) was allocated to Management Prescription 1B (Recommended Wilderness Study Area) by the Forest Plan. This management prescription emphasizes managing these areas to protect the qualities that were the basis for recommending wilderness study, pending legislation as to their classification, while also providing for existing uses where compatible with protecting wilderness character. Thus, standards and guidelines for this prescription are designed to meet this emphasis. Alternatives 2 and 3 propose activities within this area.

Alternative 2 proposes constructing and adding 16.9 miles of National Forest System Trails (NFST) to this area. Approximately 11.5 miles of proposed trail are located on existing old road corridors or old trail corridors. The remainder would require new trail corridors to be constructed. We anticipate using a trail dozer to construct these segments. Trails would be constructed to minimum standard necessary for the protection of soil, water, vegetation, visual quality, user safety, and long term maintenance as outlined in the plan for Management Prescription 1B. These trail corridors provide a system of loop trails and a linkage to Rich Hole Wilderness. Alternative 2 also proposes prescribed burning four burn units within the Rich Hole Addition area. Table 3C5-1 summaries the burn units in the PWA and how each unit overlaps with the Recommended Wilderness Study areas.

Table 3C5-1. Prescribed Burn Units within the Rich Hole Addition Area.

Prescribed Burn Unit Name	Rich Hole Addition PWA	Rich Hole Addition Wilderness Study Area
Mill Mountain	✓	
Orebank	✓	
Slicky Slide	✓	✓
White Rocks Tower	✓	

Most of the burn units use existing roads and trails as burn boundaries; however approximately 0.64 miles of dozer line would be constructed along the crest of Mill Mountain in order to burn the White Rocks Tower unit. A dozer line is also proposed in an existing corridor along the southwest border of the Slicky Slide burn unit to secure the burn boundary. Orebank and Mill Mountain Units have been previously prescribed burned and will use the same burn boundaries previously used. No additional dozer line construction is expected to occur.

Timber harvesting has occurred in the past within the area; however none has occurred since 1993. Seven harvest units are proposed for harvest within the area; five are along roads that are open to the public year round for vehicular access. The remaining two are along roads that are open to the public seasonally. Approximately 107 acres would be harvested using free thinning (87 ac.) and hardwood restoration (20 ac.) silvicultural treatments. No new National Forest System road construction is proposed within this area. Some units will require short segments of temporary road to facilitate the logging and landing of products to be hauled from these units. A total length of approximately 360 feet of temporary road is proposed for the Rich Hole Addition area. Once units are harvested, temporary roads will be revegetated and closed to all vehicle traffic. Temporary roads that access wildlife clearings will be revegetated, gated and maintained as linear wildlife clearings.

Slicky Slide road (FSR 1923) will be decommissioned as outlined in the James River/Warm Springs Road Decommissioning II Project (9/27/2012). FSR 1923 is a closed (bermed) level I road; however, culverts are located within the road prism. Although these culverts were not previously identified, three culverts will be removed, stream channels restored at culvert removal sites and disturbance sites revegetated when the road is decommissioned.

Alternative 3 is relatively the same as Alternative 2 for the Rich Hole Addition area with a couple of exceptions. Only 14.1 miles of NFST are proposed for construction of which approximately 10.1 miles are located on existing old road corridors or trails. The remaining proposed trails would be constructed with a trail dozer in the same manner as Alternative 2. Alternative 3 drops the proposed Slicky Slide burn unit. A hand line would replace the dozer line proposed for White Rocks Tower burn unit; timber harvest and temporary road proposals remain the same. Eight culverts will be removed from FSR 1923 (Slicky Slide) along with channel restoration in these areas when the road is decommissioned.

Rough Mountain Addition Area - The Rough Mountain Addition area covers approximately 2,063 acres. A portion of the Rough Mountain Addition Potential Wilderness Area (approximately 1,022 acres or 50% of the area) was allocated to Management Prescription 1B (Recommended Wilderness Study Area) by the Forest Plan. This management prescription emphasizes managing these areas to protect the qualities that were the basis for recommending wilderness study, pending legislation as to their classification, while also providing for existing uses where compatible with protecting wilderness character. Thus, standards and guidelines for this prescription are designed to meet this emphasis.

Alternatives 2 and 3 propose prescribed burn activities within the Rough Mountain Addition area. Two burn units are proposed in Alternative 2, Big Hollow and Coffee Pot. Big Hollow requires construction of new dozer line (approximately 1.6 miles) along the southern and western boundaries. The remainder of the Big Hollow unit and Coffee Pot use existing corridors, trails, and features as burn boundaries. The bulk of the Big Hollow burn unit is with the Rough Mountain Addition Recommended Wilderness Study area. The design of this prescribed burn unit is in compliance with the Forest Plan for Management Prescription 1B. FSR 462 (Coffee Pot) provides administrative access to the area and will be used as western boundary for the Coffee Pot unit. A small portion of the Coffee Pot Burn Unit is within the Rough Mountain Addition Roadless Area. No new dozer line is proposed for the Coffee Pot unit.

Alternative 3 does not include the Big Hollow prescribed burn unit and associated dozer line construction. Therefore, no activities are proposed within the Rough Mountain Addition Wilderness Study Area under Alternative 3.

Summary

Prescribed burning in both action alternatives contribute toward moving prescribed burned areas toward a community closer to its historic fire regime which may be more resilient to change. Active vegetation management through timber harvest and prescribed fire, maintain and restore ecological systems within the project area. No new National Forest System Roads are proposed under any of the action alternatives, and no new permanent structures are proposed. Both action alternatives propose removing culverts from FSR 1923 (a level 1 road) which will help restore aquatic systems; in addition, Alternative 3 would decommission approximately 0.9 miles FSR 125S another level 1 road. Trails proposed in both action alternatives are within Rich Hole Addition Wilderness Study Area as identified in the Forest Plan. Trails would be constructed to minimum standard necessary for the protection of soil, water, vegetation, visual quality, user safety, and long term maintenance as outlined in the Forest Plan for Management Prescription 1B. The majority of the new trails would be located within old road or trail corridors. Timber harvest, prescribed burning, and wildfires have been evident in the area where vegetation management activities are proposed in Alternatives 2 and 3. Therefore, these activities would not be substantially noticeable within the context of impacts on wilderness character or on future wilderness inventories. Neither of the action alternatives would substantially alter the undeveloped character of any of the potential wilderness areas within the Lower Cowpasture Project area. Thus, implementing any of the alternatives would not disqualify these areas from consideration in a future potential wilderness inventory conducted according to Forest Service Handbook 1909.12, Chapter 70 (effective 1/30/2015).

C6 – Economics

Issues Related to the Resource

There were no project issues identified regarding this resource.

Scope of the Analysis

The scope of the economic analysis is limited to a comparison of the expenditures and revenues associated with the commercial timber sale component of the project, as well as an estimation of the cost associated with implementing the other vegetative treatments in each alternative. The cost of analyizing the no action alternative is also considered. It is important to note that not all effects can be quantified monetarily. It is difficult to reduce the benefits and costs of a proposed management action on wildlife, soil, water, visuals, recreation, or other non-market resources to a single dollar amount. There is no single accepted methodology for such an evaluation, and it is considered beyond the scope of this economic analysis. The environmental effects of the alternatives on these other resources are described and disclosed in the previous sections of this chapter.

C6.1 Existing Condition

Analyzing the major sectors of an economy allows insight into how diverse and what industries may be driving its growth. Manufacturing is the most significant part of the area economy for counties within the George Washington National Forest boundary. The Manufacturing sector includes lumber and wood products, furniture, and pulp and paper products. From 1990 to 2000, the employment share from manufacturing decreased by 0.9 percent to 19.4 percent of the economy's employment.

The project area is located in a rural region with agriculture driving much of the local economy. The MeadWestvaco paper mill in Covington, approximately 25 miles from the project area, is a major employer and uses pine and hardwood pulpwood from the National Forest to help supply the mill. The recent installation of a biomass incinerator has increased the demand for wood chips to power the mill and has led many local loggers to purchase chippers. This new market allows for more merchantable material to be removed and sold, thus further improving local economies. The demand for sawtimber is also strong in the area as a number of sawmills use National Forest timber as a source of raw material for lumber production. Approximately 36% of the total jobs in the Covington area are timber related jobs and include: forestry and logging; sawmills and wood preservation; pulp, paper and paperboard; wood products manufacturing; and nonemployer timber jobs.

b. Future Actions

The only foreseeable future project in the Lower Cowpasture project area is the removal of the overwood from the traditional shelterwood units in 10 to 15 years from implementation of this project. This action is likely to be in conjunction with other vegetative treatments to allow for increased economy of future sales and for diversity of wildlife and vegetative habitat.

c. Direct, Indirect, and Cumulative Effects of Alternatives

Table 3C6-1 provides a comparison of the costs and revenues of the project planning and timber harvest activities in each alternative. Costs are displayed as negative numbers. The values presented are estimates based on recent stumpage and unit cost estimates of activities on the Forest from the fourth quarter of Fiscal Year 2014. The numbers given do not represent the actual numbers that will be found under any given alternative, but rather show the relative difference between alternatives for comparison purposes. This analysis also does not attempt to analyze all

resource values. We recognize that many of the values generated by the various alternatives (both positive and negative) involve goods and services that are not priced in the marketplace and are thus not represented in this comparison. These goods and services involve such things as habitat for native species, birding, fishing, hunting, hiking, scenic beauty, and water quality. The effects each alternative has on these types of non-quantifiable goods and services are disclosed in the environmental effects section of this EA.

Table 3C6-1. Cost/Revenue of the Lower Cowpasture Project by Alternative

Activity	Alt. 1	Alt. 2	Alt. 3
Estimated Harvest Volume			
TOTAL HARVEST VOLUME (CCF)	0	33,158	29,990
Project Planning Cost*			
NEPA-EA & Support ($9.00/CCF)	**-298,422**	**-298,422**	**-298,422**
Timber Sale Implementation Cost			
Timber Sale Preparation	0	-198,948	-179,940
Timber Sale Administration	0	-109,421	-98,967
Total	**0**	**-308,369**	**-278,907**
Timber Sale Revenue ($)			
Gross Stumpage	0	904,556	817,416
Road Costs	0	-47,625	-47,625
Net Stumpage (Gross - Road Costs)	0	**856,951**	**769,791**
Reforestation	**0**	**-78,672**	**-68,576**
Total Net Revenue (dollars)	**-298,422**	**171,468**	**123,866**
Post Sale Activities ($)			
Rx Burning - 12,908 acres / 11,971 (Alt 3)	0	-516,320	-478,840
TSI - 1,450 acres / 1,515 (Alt 3)	0	-348,000	-352,080
Wildife Openings – 322 acres / 297 (Alt 3)	0	-2,255,400	-2,080,291
Waterholes – 22 units	0	-44,000	-44,000
Trails – 17 miles /14.6 miles (Alt 3)	0	-425,000	-365,000

* Project planning costs are calculated based on the original estimated volume of the proposed action and do not vary by alternative.

Planning Cost: This is the cost of complying with federal environmental planning laws. NFMA (National Forest Management Act) requires inventorying all lands every ten years and completing land management plans. Most of these costs occur with or without the proposed action. NEPA requires full public involvement in planning and the preparation of an environmental impact statement or environmental assessment. Planning costs include all cost leading up to a decision to proceed or not to proceed with a proposal. The planning costs are calculated based on the original estimated volume of the proposed action and do not vary by alternative.

Timber Sale Implementation Costs: This is the direct cost of preparing a timber sale including marking, cruising, and preparing the timber sale contract. It also includes the cost of administering

the contract to ensure the designated timber is cut and the purchaser performs all contract requirements.

Timber Sale Revenue: Gross stumpage is based on the estimated volume at current market conditions. It is based on current lumber prices minus logging cost to get the timber to a mill, allowing for normal profit and risk for the loggers. Net stumpage is the gross stumpage minus the cost of road maintenance, construction, and reconstruction. This is the amount of cash that is available to be returned to the National Treasury or used to fund additional sale area improvement projects such as watershed, timber, wildlife, and recreation improvements.

Total Net Revenue: This is the difference between the net stumpage and the planning and implementation costs. This is the net direct cash flow from a federal taxpayer's perspective. It does not consider any indirect, value-added revenue for the local or state area or any additional federal income from corporate or individual income taxes.

Post Sale Activities: These sale area improvement projects are part of all action alternatives. These activities would likely be funded with sale area improvement funds from the timber sale net revenue. Proposed wildlife projects will be implemented with sale and/or other funding. Not all prescribed burns will be in conjunction with post sale activities.

Table 3C6-2. Value-Added to Virginia's Economy

	Alt. 1	Alt. 2	Alt. 3
Timber Sale Revenue ($) Gross Stumpage	0	904,556	817,406
Total Value-Added to Virginia's Economy ($) (in millions)	0	37.828	34.184

The concept of *value-added* is the increased worth of a product as additional processing takes place. Each step harvested timber takes, from stump to final product, adds value to a product and to the economy of Virginia. *Virginia's Forests Our Common Wealth*, published by the Virginia Department of Forestry in 2006, indicates the average of $41.82 worth of total value added to Virginia's economy for every dollar paid to landowners for stumpage.

For this project, Alternative 2 has the potential to generate over 37.8 million dollars of added value to Virginia's economy. Alternative 3 has the potential to generate over 34.1 million dollars of added value to Virginia's economy. The planned overwood removal of the shelterwood units in 10 to 15 years will cumulatively affect economics in a positive direction by again adding to the local economy as wood product demand should remain high.

Chapter 4: Interdisciplinary Team Members; List of Agencies; and Persons Consulted (40 CFR 1508.9(b))

4.1 List of Preparers (ID Team Members)

- Emily Ellis, USFS, Recreation Assistant, George Washington and Jefferson National Forests, James River and Warm Springs Ranger Districts – Provided input for recreation and analysis of the visual resource.
- Seth Ellis, USFS, Timber Management Assistant, George Washington and Jefferson National Forests, James River and Warm Springs Ranger Districts - Provided input for logging system plan, and prescriptions, and vegetation. - Conducted stand exams and contributed to alternative(s) development.
- Jenny Henning, USFS, Biological Technician, George Washington and Jefferson National Forests, James River Ranger District – Conducted field surveys, provided input for Wildlife and TESPLR species sections of EA.
- Steve Tanguay, USFS, Wildlife Biologist, George Washington and Jefferson National Forests, James River and Warm Springs Ranger Districts - Provided input for Wildlife and TESPLR species sections of EA, and prepared the Biological Evaluation.
- Josh Beyer, USFS, George Washington and Jefferson National Forests, James River Ranger District - Conducted field surveys.
- Jeff Matthews, USFS, George Washington and Jefferson National Forests, James River Ranger District, Zone Timber Management Assistant – Provided input for logging system plan, and prescriptions, and vegetation. - Conducted stand exams and contributed to alternative(s) development.
- Jason Hattersley, USFS, George Washington and Jefferson National Forests, Warm Springs Ranger District, Zone Timber Sale Administrator/GIS - Provided input for logging systems plan and maps.
- Lorraine Thomas, USFS, Recreation Assistant, George Washington and Jefferson National Forests, Warm Springs District - Provided input for recreation and analysis of the visual resource.
- Karen Stevens, USFS, ID Team Leader, George Washington and Jefferson National Forests, James River and Warm Springs Ranger Districts - Coordinated project; compiled specialist input; and provided input on NEPA/NFMA.
- Tom Bailey, USFS, Soil Scientist, George Washington and Jefferson National Forests, Supervisor's Office - Provided input for the analysis of the soil and water resources.
- Mike Madden, Archeologist, George Washington and Jefferson National Forests, Supervisor's Office- Consulted on heritage resources within the project area.
- Richard Patton, Forest Hydrologist, USFS, George Washington and Jefferson National Forests, Supervisor's Office - provided input for the analysis of the soil and water resources.

- Dawn Kirk, USFS, Fisheries Biologist, George Washington and Jefferson National Forests, Supervisor's Office – Reviewed the BE and provided input for the transportation analysis and aquatic resources.

- Shamina Dillard, Forest Engineer, USFS, George Washington and Jefferson National Forests, Supervisor's Office

4.2 Other Forest Service Employees Consulted

- Karen Overcash, Land Management Planner, USFS, George Washington and Jefferson National Forests, Supervisor's Office – Provided input for NEPA compliance, reviewed the document and provided comments.

- Karen Landgraf, Forest Staff Officer, USFS, George Washington and Jefferson National Forests, Supervisor's Office – Provided input for NEPA compliance, reviewed the document and provided comments.

- Patrick Sheridan, District Ranger, James River Ranger District, USFS, George Washington and Jefferson National Forests – reviewed document and provided comments.

- Steve Croy, USFS, Botanist/Ecologist, George Washington and Jefferson National Forests - Consulted on T & E plant inventory within the project area.

- Carol Croy, USFS, Wildlife Biologist, George Washington and Jefferson National Forests – Consulted on wildlife and TES species within the project area.

- Fred Huber, USFS, Botanist, George Washington and Jefferson National Forests, Supervisor's Office – Consulted on TESRR species.

- Mike Donahue, USFS, Biological Technician, George Washington and Jefferson National Forests – conducted field surveys, provided input for Wildlife and TESLR species sections of EA.

- David Armstrong, USFS Civil Engineering Technician, George Washington and Jefferson NFs – Consulted on roads needs, locations, and design.

- Erin Brown, Archeologist, George Washington and Jefferson National Forests, Supervisor's Office- Consulted on heritage resources within the project area.

- Rich Guercin, Archeologist, George Washington and Jefferson National Forests, Supervisor's Office- Consulted on heritage resources within the project area.

- Krissy Sherman, USFS, Forestry Technician (Recreation), George Washington and Jefferson National Forests, James River and Warm Springs Ranger Districts – Conducted field surveys, provided input for Recreation section of EA.

- John Moncure, USFS, Fuels Technician, George Washington and Jefferson National Forests, James River and Warm Springs Ranger Districts – Conducted field surveys, provided input for prescribed fire and GIS support.

- Ginny Williams, USFS, Recreation Specialist, George Washington and Jefferson National Forests, Supervisor's Office – Consulted on Scenery and prepared Scenery section of the EA.

- Peter Irvine, USFS, Recreation Specialist, George Washington and Jefferson National Forests, Supervisor's Office – Consulted and provided input on Recreation section of the EA.

- Steve Woods, Civil Engineer, USFS, George Washington and Jefferson National Forests, Supervisor's Office – Consulted on roads.

4.3 Other Agencies Consulted

Al Bourgeois, Virginia Department of Game and Inland Fisheries, District Wildlife Biologist; Alleghany, Bath, and Highland Counties. VDGIF , P.O. Box 996, Veorna, Virginia 24482; 540-248-9360.

Mark Banker, Biologist; Ruffed Grouse Society, P.O. 1171, Lemont, PA 16851. 814-867-7946.

S. Rene` Hypes, Virginia Department of Conservation and Recreation, Division of Natural Heritage - consulted on Natural Heritage and TESLR species inventory within the project area.

Sumalee Hoskins, United States Department of Interior, Fish and Wildlife Service, 6669 Short Lane, Gloucester, VA 23061.

Cindy A. Schulz, United States Department of Interior, Fish and Wildlife Service, 6669 Short Lane, Gloucester, VA 23061.

4.4 Literature Cited and Personal Communication

Abrams, Marc D., 1992, "Fire and the Development of Oak Forests", BioScience, Vol. 42, No. 5 (May, 1992), pp. 346-353. 2.10

Adams, MB. 1999. Acidic deposition and sustainable forest management in the central Appalachians. *Forest Ecology and Management* 122:17-28. *PDF*

Adams, MB, JA Burger, AB Jenkins, and L Zelazny. 2000. Impact of harvesting and atmospheric pollution on nutrient depletion of eastern hardwood forests. *Forest Ecology and Management* 138: 301-319. *PDF*

Adams, Paul W. and James R. Boyle, 1982, Soil Fertility Changes following Clearcut and Whole-tree Harvesting and Burning in Central Michigan, Published in Soil Sci Soc Am J 46:638-640 (1982).

Alban, David H., 1977, "Influence on Soil Properties of Prescribed Burning Under Mature *Red Pine", North Central Forest Experiment Station, Forest Service U.S. Department of* Agriculture Research Paper NC- 13 9. 3.8

Aldrich et al. 2014. Fire history and its relations with land use and climate over three centuries in the central Appalachian Mountains, USA. Journal of Biogeography 41, 2093–2104.

Anders, A., Faaborg, J. and Thompson, F. 1998. Postfledgling dispersal, habitat use, and home-range size of juvenile wood thrushes. The Auk 115(2):349-358.

Arthur, M. A., R. D. Paratley, B. A. Blankenship, "Single and Repeated Fires Affect Survival and Regeneration of Woody and Herbaceous Species in an Oak-Pine Forest", Journal of the Torrey Botanical Society, Vol. 125, No. 3 (Jul. - Sep., 1998), pp. 225-236. 1.28

Askins, R.A. 2000. Restoring North America's birds: lessons from landscape ecology. Yale University, New Haven, Connecticut, USA.

Bailey, S. W., S. B. Horsley, and R. P. Long, Thirty Years of Change in Forest Soils of the Allegheny Plateau, Pennsylvania, SOIL SCI. SOC. AM. J., VOL. X, _–_ 2005, May-June; 69(3): 681-690.

Barber, H. L. 1984. Eastern mixed forest. Pages 345-354. in L. K. Halls, ed. White-tailed Deer: Ecology and Management. Stackpole Books, Harrisburg, Pa.

Biomass Use and Feedback Issues, Journal of Forestry, October/November 2011.

Bitner, Kelly, Bruce Gallaher and Ken Mullen, 2001, "Review of Wildfire Effects on Chemical Water Quality, Los Alamos National Laboratory, LA-13826-MS Issued: May 2001. 0.44

Bormann, F.H., Likens, G.E., 1979, Pattern and Process in a Forested Ecosystem, School of Forestry and Environmental Studies, Yale University, New Haven, CT, pub. Springer Verlag, New York, NY, 253 pp.

Brawn, J.D., Robinson, S.K., Thompson, F.R. III. 2001. The role of disturbance in the ecology and conservation of birds. Annu. Rev. Ecol. Syst. 32:251–276

Brody, A.J. 1984. Habitat use by black bears in relation to forest management in the Pisgah National Forest, North Carolina. Unpublished M.S. Thesis, Univ. of Tenn., Knoxville. 123 pp.

Brody and Pelton. 1989: Brody, A.J. and M.R. Pelton. 1989. Effects of roads on black bear movements in western North Carolina. Wildl. Soc. Bull. 17:5-10.

Brose, P.H.; Van Lear, D.H.; Keyser, P.D. 1999. A shelterwood-burn technique for regenerating productive upland oak sites in the Piedmont region. Southern Journal of Applied Forestry. 23 (3).

Brose et al. 2014. The Fire–Oak Literature of Eastern North America: Synthesis and Guidelines. General Technical Report NRS-135.

Bulluck, L.P. and Buehler, D.A. 2006. Avian use of early successional habitats: are regenerating forests, utility right-of-ways and reclaimed surface mines the same? Forest Ecology and Management, 236 (2006), pp. 76–84

Burns, R.M. and B.H. Honkala. 1990. Silvics of North America. Volume 2, Hardwoods. Agriculture Handbook 654. Forest Service, United States Department of Agriculture, Washington, D.C. 834 pp. + appendices

Carlock, D.M., R.H. Conley, J.M. Collins, P.E. Hale, K.G. Johnson, and M.R. Pelton. 1983. The tri-state black bear study. Tennessee Wildlife Resources Agency Tech. Rep. #83-9. 286 pp.

Caro, T.M. and G. O'Doherty. 1999. On the use of surrogate species in conservation biology.

Conservation Biology 13(4):805-814.

Carpenter, M. 1973. The black bear in Virginia. Virginia Comm. Game Inland Fish., 22 pp.

Cartera, Mason C., C. Darwin Foster, November 2003, "Prescribed burning and productivity in southern pine forests: a review", Forest Ecology and Management 191 (2004) 93–109. 0.24

Certini, Giacomo, Mar., 2005, Effects of Fire on Properties of Forest Soils: A Review, Oecologia (2005) 143: 1-10 DOI 10.1007/s00442-004-1788-8. 2.3 0.28

Chamberlin, T.W., R.D. Harr, and F.H. Everest. 1991. Timber harvesting, Silviculture, and Watershed Processes, in: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitat. American Fisheries Society Special Publication 19:181-205.

Christisen, D. M. 1955. Yield of Seeds by Oaks in the Missouri Ozarks. J. Forestry 53: 439-441.

Collins, J. O. 1961. Ten-year Acorn Mast Production Study in Louisiana. La. Wildlife and Fisheries Comn., New Orleans.

Connolly, S.J., T.C. Cain, J.S. Vestral and P.J. Edwards, The Potential Effects of Acid Deposition: What's a National Forest to Do?, M Furniss, C Clifton, and K Ronnenberg, eds., 2007. *Advancing the Fundamental Sciences: Proceedings of the Forest Service National Earth Sciences Conference, San Diego, CA, 18-22 October 2004*, PNWGTR-689, Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Cooper, R.D.; Van Lear, D.H.; Brose, P.H. 1999. Oak advanced regeneration following seasonal prescribed fires in mixed hardwood shelterwood stands.

Cosby, BJ, Webb, JR, Galloway, JN, and Deviney, FA. 2006. Acid deposition impacts on natural resources in Shenandoah National Park. Technical Report NPS/NER/NRTR-2006/066. National Park Service, Philadelphia, PA.

Covington, W. Wallace and S.S. Sackett, 1991, "Soil Mineral Nitrogen Changes Following Prescribed Burning in Ponderosa Pine", Forest Ecology and Management, 54 (1992) 175-191. 0.89

Crawford H.S., R.G. Hooper, and T.W. Titterington. 1981. Songbird response to silvicultural practices in central Appalachian hardwoods. J. Wildl. Manage. 45(3):680-692

Cronan and Schofield, 1979; **Aluminum Leaching Response to Acid Precipitation: Effects on High-Elevation Watersheds in the Northeast,** *Science* 20 April 1979: Vol. 204. no. 4390, pp. 304 - 306

Cronan, Christopher S., David F. Grigal, 1995, Use of Calcium/Aluminum Ratios as Indicators of Stress in Forest Ecosystems, Published in J Environ Qual 24:209-226 (1995).

DeBano, L.F., 1999, "The role of fire and soil heating on water repellency in wildland environments: a review", Journal of Hydrology 231–232 (2000) 195–206. 0.34

Dey, D. 2002. The Ecological Basis for Oak Silviculture in Eastern North America. W. J. McShea, W. M. Healy eds. Oak Forest Ecosystems, John Hopkins University Press. Baltimore, MD 2002: pp. 60-79.

Dickson, J.G. 2001. Wildlife of Southern Forests: Habitat and Management. Hancock House Publishers, Ltd. Surrey, B.C. and Blaine, WA.

Doerr, Stephan H., Artemi, Cerda, 2005, "Fire Effects on Soil System Functioning: New Insights and Future challenges", Intl. Journal of Wildland Fire, 2005, 14, 339-342. 0.185

Dolloff, C. A. and J. R. Webster. 2000. Particulate Organic Contributions from Forests and Streams: Debris isn't so bad, in Riparian Management in Forests of the Continental Eastern United States, edited by E. S. Verry, J. W. Hornbeck, and C.A. Dolloff. Lewis Publishers, CRC Press LLC, Washington D.C.

Douglas, James E., and Wayne T. Swank. 1972. Streamflow modification through management of Eastern forests. USDA Forest Service Res. Paper SE-94.

Douglas, James E., and Wayne T. Swank. 1975. Effects of management practices on water quality and quantity: Coweeta Hydrologic Laboratory, North Carolina. In: Watershed Management Symposium Proceedings. USDA Forest Service General Technical Report NE-13, Northeastern Forest Experiment Station, Upper Darby, PA, pp. 1-13.

Downey, D.M. and J.P. Haraldstadt. 2013. Water Chemistry of North Branch Simpson Creek and the Rich Hole Wilderness Fire. A Report for the US Forest Service George Washington and Jefferson National Forests, by Environmental Chemistry Group, James Madison University. February 2013.

Downs A. and W. McQuilkin. 1944. Seed production of southern Appalachian oaks. J. Forestry 42:913-920.

Driscoll, CT, GB Lawrence, AJ Bulger, T Butler, CS Cronan, C Eagar, KF Lambert, GE Likens, JL Stoddard, and KC Weathers. 2001. Acidic deposition in the northeastern US: sources and inputs, ecosystem effects, and management strategies. *BioScience* 51:180-198. *PDF*

During the Fire: Direct Effects of Fire on Forest Soil, *Forest Fire in the U.S. Northern Rockies: A Primer*, *http://northernrockiesfire.org/default.htm* 0.05

Edwards, Pamela J. and Charles A. Troendle, "Water Yield and Hydrology", Forest Service, U.S. Department of Agriculture, Northern Research Station, Parsons, WV 26287 and Forest Service, U.S. Department of Agriculture, Rocky Mountain Research Station. 0.72

Eiler, J. 1981. Reproductive biology of black bears in the Smoky Mountains of Tennessee. M.S. Thesis, University of Tennessee, Knoxville. 83 pp.

Eiler, J., G.Wathen and M. Pelton. 1989. Reproduction in black bears in the southern Appalachian Mountians. J. Wildl. Manage. 53:353-360.

Eisenbies, M. H., et. al. 2006. Hydrologic modeling approaches to evaluate forest management effects on extreme flooding events. Proceedings, Hydrology and Management of Forested Wetlands International Conference.

Elliott, Katherine J. *and* James M. Vose, 2005," Initial Effects of Prescribed Fire on Quality of Soil Solution and Streamwater in the Southern Appalachian Mountains", South. J Appl. For. 29(1):5-15. 0.29

Elliott, Katherine, J., Jennifer D. Knoepp, 2005, The effects of three regeneration harvest methods on plant diversity and soil characteristics in the southern Appalachians, Forest Ecology and Management 211 (2005) 296–317.

Environmental Protection Agency (EPA). 1989. Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish. USEPA Report 444/4-89/001. Office of Water Regulations and Standards. USEPA. Washington, DC.

Evans Odgden, L. J., B. J. M. Stutchbury. 1997. Fledgling care and male parental effort in the HoodedWarbler (Wilsonia citrina). Canadian Journal of Zoology 75:576–581.

Federer, CA, JW Hornbeck, LM Tritton, CW Martin, RS Pierce, and CT Smith. 1989. Long-term depletion of calcium and other nutrients in eastern US forests. *Environmental Management* 13(5):593-601.

Feldhammer, G. A., T. P. Kilbane, and D. W. Sharp. 1989. Cumulative effect of winter on

acorn yield and deer body weight. J. Wildl. Manage. 53:292-295.

Fenn, ME, Lambert, KF, Blett, TF, Burns, DA, Pardo, LH, Lovett, GM, Haeuber, RA, Evers, DC, Driscoll, CT, and Jeffries, DS. 2011. Setting Limits: Using air pollution thresholds to protect and restore U.S. ecosystems. Issues in Ecology 14: 22 pp.

Fernholz, Kathryn, Dr. Steve Bratkovich, Dr. Jim Bowyer, Alison Lindburg; 2009, Energy from Woody Biomass: A Review of Harvesting Guidelines and a Discussion of Related Challenges, Dovetail Partners, Inc., Minneapolis, MN, www.dovetailinc.org

Field, J. P., K. W. Farrish, E. A. Carter , August 2003, "Soil and Nutrient Losses Following Site Preparation Burning in a Harvested Loblolly Pine Site" ASAE Vol. 46(6): 1697-1703 (2003 American Society of Agricultural Engineers). 0.06

Ford, W. M., A. S. Johnson, P. E. Hale, and J. M. Wentworth. 1993. Availability and use of spring and summer woody browse by deer in clearcut and uncut forests of the Southern Appalachians. South. J. Appl. For. 17:116-119.

Forest Guild Southeast Biomass Working Group, 2012, Forest Biomass Retention and Harvesting Guidelines for the Southeast, *forest*GUILD, PO Box 519, Santa Fe, NM 87504.

www.forestguild.org/publications/research/2012/FG_Biomass_Guidelines_SE.pdf

Fowells, H. 1965. Silvics of forest trees of the United States. Agriculture Handbook No. 271. USDA Forest Service, Washington, DC. 762 pp.

Fox, T.R., 2000, Sustained productivity in intensively managed forest plantations, Forest Ecology and Management 138 (2000) 187±202

Freedman, B., 1990, Nutrient removals during forest harvesting: implications for site fertility, Department of Biology and School for Resources and Environmental Studies, Dalhousie University, Halifax, Nova Scotia, Canada; Publication n° 19, novembre, 1991, réédité par Le Groupe de Coordination sur les Bois Raméaux Département des Sciences du Bois et de la Forêt Faculté de Foresterie et de Géomatique **Université Laval** Québec G1K 7P4 QUÉBEC Canada.

Fridell, R. A. and J. A. Litvaitis. 1991. Influence of resource distribution and abundance on home-range characteristics of southern flying squirrels. Canadian Journal of Zoology 69:2589-2593.

Garren, Kenneth H., 1943, "Effects of Fire on Vegetation of the Southeastern United States", Botanical Review, Vol. 9, No. 9 (Nov., 1943), pp. 617-654. 1.08

Gonza´lez-Pe´reza, Jose´ A., Francisco J. Gonza´lez-Vila a, Gonzalo Almendrosb, Heike Knickerc, 2004, "The effect of fire on soil organic matter—a review", Environment International 30 (2004) 855– 870. 0.39

Gordon, A.G., 1983, Nutrient Cycling dynamics in Differing Spruce and Mixedwood Ecosystems in Ontario and the Effects of Nutrient Removals Through Harvesting, in Resources and Dynamics of the Boreal Zone, pp 97-118, Ontario Tree Improvement and Forest Biomass Institute, Ontario Ministry of Natural Resources, Sault St. Marie, Ontario, Canada

Graham, Russell T., Don Minore, Alan E. Harvey, Martin F . Jurgensen and Deborah S. Page-Dumroese, 1990, "Soil Management as an Integral Part of Silvicultural Systems", Paper presented at the Symposium on Management and Productivity of Western-Montane Forest Soils, Boise, ID, April 10-12, 1990. 0.67

Grigal, D. F. and J. G. McColl, 1977, "Litter Decomposition Following Forest Fire in Northeastern Minnesota", Journal of Applied Ecology, Vol. 14, No. 2 (Aug., 1977), pp. 531-538. 1.00

Hamel, P. 1992. The Land Manager's Guide to Birds of the South. The Nature Conservancy and the Southern Region, US Forest Service. U.S. Forest Service General Technical Report SE-22. 437pp.

Hamilton, R.J. and R.L. Marchinton. 1980. Denning and related activities of black bears in the coastal plain of North Carolina. Pages 121-126 in C.J. Martinka and K.L. McArthur eds. Bears -- their biology and management. Bear Biol. Asso. Conf. Series No. 3, Glacier Natl. Pk., West Glacier, MT.

Harlow, R.F., P.A. Shrauder, and M.E. Seehorn. 1975. Deer browse resources of the Chattahoochee National Forest. U.S. For. Serv. Res. Rep. SE-136, 16 pp.

Hauerl, F. Richard and Craig N. Spencer, 1998, "Phosphorus and Nitrogen Dynamics in Streams Associated with Wildfire: A Study of Immediate and Longterm Effects", *Intl.. J. Wildland Fire 814*): *183-198, 1998.* 0.97

Healy, W. M., and E. S. Nenno. 1983. Minimum maintenence versus intensive management

of clearings for wild turkeys. Wildl. Soc. Bull. 11:113-120.

Helms, John A. 1998. The Dictionary of Forestry. United States of America: Society of American Foresters. 210 p.

Hewlett, John D. Forests and floods in the light of recent investigation. 1982. Keynote Paper, Canadian Hydrology Symposium 82, Univ. of New Brunswick, Fredericton, New Brunswick, Canada.

Hibbert, A. R. Water yield changes after converting a forested catchment to grass. 1969. Water Resources Research, Vol. 5, No. 3, pp. 634-640.

Hillman, L.L. and D.L. Yow. 1986. Timber Management for Black Bear. In: Proceedings of the Eighth Eastern Black Bear Workshop on Research and Management. pp. 125-136.

Hubbard, Robert M., James M. Vose, Barton D. Clinton, Katherine J. Elliott, Jennifer D. Knoepp, October 2003, "Stand restoration burning in oak–pine forests in the Southern Appalachians: Effects on Aboveground Biomass and Carbon and Nitrogen Cycling", Forest Ecology and Management 190 (2004) 311–321. 0.183

Hungerford, Roger D., Michael G. Harrington, William H. Frandse, Kevin C. Ryan, Gerald J. Niehoff, Influence of Fire on Factors that Affect Site Productivity, Paper presented at the Symposium on Management and Productivity of Western-Montane Forest Soils, Boise, ID, April 10-12, 1990. 2.17

Hunter, W.C., D.E. Buehler, R.A. Canterbury, J.L. Confer, P.B. Hamel. 2001. Conservation of disturbance dependent birds in eastern North America. Wildlife Society Bulletin 29(2):440-455.

Hunter, W.C., J.D. Dickson, D.N. Pashley, and P.B. Hamel. 2001. Bird communities of southern forests. Pages 322-348 in J.G. Dickson, ed. Wildlife of Southern Forests: Habitat and

Management. Hancock House Publishers, Blaine, WA.

Huntington, T.G., R.P. Hooper, C.E. Johnson, B.T. Aulenbach, R. Cappellato and A.E. Blum , 2000, Calcium Depletion in a Southeastern United States Forest Ecosystem, *Soil Science Society of America Journal* 64:1845-1858 (2000).

Hurst, G. A. 1978. Effects of controlled burning on wild turkey poult food habits. Proc. Ann. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 32:30–37.

Hylton, R. 2002. Personal communication, USDI Fish and Wildlife

I. Ahlgren, F. and C. E. Ahlgren, 1960, "Ecological Effects of Forest Fires", Botanical Review, Vol. 26, No. 4 (Oct. - Dec., 1960), pp. 483-533. 1.47

Jenkins, A.B., Sencindiver, J.C. Bhumba, D.K., 1998. Biogeochemical relationships of calcium and magnesium in high elevation forest soils of West Virginia. Agronomy Abstracts.

Johansen, Mathew P., Thomas E. Hakonson1 and David D. Breshears, 2001, "Post-fire runoff and erosion from rainfall simulation: contrasting forests with shrublands and grasslands", Hydrological Processes *Hydrol. Process.* 15, 2953–2965 (2001) DOI: 10.1002/hyp.384. 0.14

Johnson, D. W., D. C. West, D. E. Todd and L. K. Mann, 1982, Effects of Sawlog vs. Whole-Tree Harvesting on the Nitrogen, Phosphorus, Potassium, and Calcium Budgets of an Upland Mixed Oak Forest, Published in Soil Sci Soc Am J 46:1304-1309 (1982).

Johnson, Dale W., 1992, "Effects of Forest Management on Soil Carbon Storage", *Water, Air, and Soil Pollution 64:* 83-120, 1992. 2.11

Johnson, D.W., Todd, D.E., 1998. Harvesting effects on long-term changes in nutrient pool of mixed oak forest. Soil Science Society of America Journal. 62, 1725-1735.

Johnson, James E., David Wm. Smith, James A. Burger, 1985, Effects on the Forest Floor of Whole-Tree Harvesting in an Appalachian Oak Forest, American Midland Naturalist, Vol. 114, No. 1 (Jul., 1985), pp. 51-61.

Johnson, P.S. 1977. Predicting oak stump sprouting and sprout development in the Missouri Ozarks. U.S.D.A. Forest Service Research Paper, North Central Experiment Station. 11 pp.

Johnson, P. S. 1993. Sources of Oak Reproduction. In: Loftis, David; McGree, Charles E. eds. Oak Regeneration: Serious problems, practical recommendations. Symposium Proceedings; 1992 September 8-10; Knoxville, Tennessee. Presented by the Center for Oak Studies. Gen. Tech. Rep. SE-84. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: pp. 112-131.

Johnson, A. S., P. E. Hale, W. M. Ford, J. M. Wentworth, and O. F. Anderson. 1995. Whitetailed deer foraging in relation to successional stage, type, and management of Southern

Appalachian Forests. Am. Midl. Nat. 133:18-35.

Kilgo, John C., Karl V. Miller, Winston P. Smith. 1999. Effects of Group-Selection Timber Harvest in Bottomland Hardwoods on Fall Migrant Birds. J. Field Ornithology, 70(3):404-413

Kirkpatrick, R. L. 1989. Value of acorns for ruffed grouse and wild turkeys. Pages 15-17 in C. E. McGee, ed. Proceedings workshop Southern Appalachian mast Management. USDA For. Serv. and Univ. Tennessee.

Knoepp, J.D., and Swank, W.T., 1997. Long-term effects of commercial sawlog harvest on soil cation concentrations. Forest Ecology and Management. 93, 1-7.

Knoepp, Jennifer D., James M. Vose, and Wayne T. Swank, 2003, "Long-Term Soil Responses to Site Preparation Burning in the Southern Appalachians", FOR. SCI. 50(4):540–550. 1.06

Knox, M. 2012. What is wrong with the National Forest deer herd? Part 3. Liberal either-sex deer hunting day regulations enacted on adjacent private lands: Is this the smoking gun? Whitetail Times 27(4):10-11.

Knox, M. 2012. What is wrong with the National Forest deer herd? Part 4. The Summary. Whitetail Times 28(2):14-17.

Kurzejeski, E. W. 1989. Squirrel populations and oak mast. Pages 12-14 In C. E. McGee, Editor. Southern Appalachian Mast Management. University Of Tennessee, Dept. of Forestry, Wildlife and Fisheries. Farmhouse Gallery, Unicoi, TN.

Lafon, N.W., G.W. Norman, D.E. Steffen, J.C. Jeffreys, and R.D. Fell. 2001. Forest clearings management: insects and vegetation for wild turkey broods. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 55:547-559.

Landres, P.B., Verner, J., and J.W. Thomas. 1988. Ecological Uses of Vertebrate Indicator

Species: A Critique. Conservation Biology 2(4):316-328.

Lear, David H. Van, Thomas A. Waidrop, History, Uses, and Effects of Fire in the Appalachians, Appendix E, "Vegetation Management in the Appalachian Mountains, Volume II, DEIS, USDA Forest Service, Management Bulletin R8 MB24. 4.9

Lentz, W.M., Sr. 1980. Aspects of habitat and denning requirements of black bear in northeastern Georgia M.S. Thesis, Univ. of Georgia, Athens. 82 pp.

Lewis, Jr., William M., 1974, "Effects of Fire on Nutrient Movement in a South Carolina Pine Forest", Ecology, Vol. 55, No. 5 (Late Summer, 1974), pp. 1120-1127. 1.04

Loftis, D.L. 1990. A shelterwood method for regenerating red oak in the Southern Appalachians. Forest Science. 36 (4): 917-929.

Lovett, G.M., and T.H. Tear. 2008. Threats from Above: Air Pollution Impacts on Ecosystems and Biological Diversity in the Eastern United States. The Nature Conservancy and the Cary Institute of Ecosystem Studies.

Lull, Howard W. and Kenneth G. Reinhart. 1972. Forests and floods in the eastern United States. USDA Forest Service Research Paper NE-226.

Maliondo, S.M., 1988, Possible effects of intensive harvesting on continuous productivity of forest lands, Information Report M. X. Maritimes Forest Research Centre, Canadian Forestry Service.

Maliondo, S.M., Mahendrappa, M.K., 1990, Distribution of Biomass and Nutrients in Some New Brunswick Forest Stands: Possible Implications of Whole-Tree Harvesting, Information Report Forestry Canada Maritimes Region (MX170E/F: 40 pp.

Marion, G.M., 1979, Biomass and Nutrient Removal in Long-Rotation Stands, in Proceedings: Impact of Intensive Harvesting on Forest Nutrient Cycling, 1979, 98-110, State University of New York, College of Environmental Science and Forestry.

McColl, J. G. and D. F. Grigal, 1977, "Nutrient Changes Following a Forest Wildfire in Minnesota: Effects in Watersheds with Differing Soils", Oikos, Vol. 28, No. 1 (1977), pp. 105-112. 0.37

McDonnell TC, Sullivan TJ, Cosby BJ, Jackson WA, and Elliott KJ. 2013. Effects of climate, land management, and sulfur deposition on soil base cation supply in National Forest in the Southern Appalachian Mountains. Water Air Soil Pollut. 224: 1733.

McDonnell, TC, Sullivan TJ, Hessburg, PF, Povak, NA, Cosby, BJ, Jackson, W, and Salter, RB. 2014. Steady-state critical loads and exceedances for protection of aquatic ecosystems in the U.S. southern Appalachian Mountains. Journal of Environmental Management. 146: 407-419.

Michigan Woody Biomass Harvesting Guidance, Michigan Department of Natural Resources and Environment Forest Management Division, 2010.

Miller, T.O. 1975. Factors influencing black bear habitat selection on Cheat Mountain, West Virginia. M.S. Thesis, West Virginia Univ., Morgantown. 61 pp.

Miller, G.W.; Schuler, T.M.; Smith, H.C. 1995. Method of applying group selection in Central Appalachian hardwoods, Northeastern Forest Experiment Station, U.S.D.A. Forest Service, NE-696, 11 pp., Radnor, PA.

Miller, Gary W. 2000. Effects of Crown Growing Space on the Development of Young Hardwood Crop Trees. Northern Journal of Applied Forestry. 17(1): 25-35.

Morrison, I.K., Foster, N.W., 1979, Biomass and Element Removal by Complete-Tree Harvesting of Medium Rotation Forest Stands, in Proceedings: Impact of Intensive Harvesting on Forest Nutrient Cycling, 1979, 111-129, State University of New York, College of Environmental Science and Forestry.

Morton, E. S. 1990. Habitat segregation by sex in the hooded warbler: experiments on proximate causation and discussion of its evolution. Am. Nat. 135:319-333.

Nenno, E. S., and J. S. Lindzey. 1979. Wild turkey poults feeding activity in old field, agricultural clearings, and forest communities. Trans. Northeastern Sect. Wildl. Soc. 36:97–109.

Norman, G.W., J.C. Pack, C.I. Taylor, D.E. Steffen, and K.H. Pollock. 2001. Reproduction of eastern wild turkeys in Virginia and West Virginia. J. Wildl. Management 65(1):1-9.

Noss, R.F. 1990. Indicators for Monitoring Biodiversity: A Hierarchical Approach. Conservation Biology 4:355-364.

Pack, J. C., W. K. Igo, and C. I. Taylor. 1988. Use of prescribed burning in conjunction with thinnings to increase wild turkey brood range habitat in oak-hickory forests. Trans. Northeastern Sect. Wildl. Soc. 44:37–44.

Pelton, M.R., L.E. Beeman, and D.C. Eager. 1980. Den selection by black bears in the Great Smoky Mountains National Park. Pages 149-151 in C.J. Martinka and K.L. McArthur eds. Bears -- their biology and management. Bear Biol. Assoc. Conf. Series No. 3, Glacier Natl. Pl., West Glacier, MT.

Pelton, M. R. 1989. The impacts of oak mast on black bears in the southern Appalachians. Pp. 7–11 In: Proc. Workshop Southern Appalachian Mast Management. Edited by C. E.

McGee. USDA Forest Service and Univ. Tennessee.

Perala, D.A., Alban, D.H., 1982, Rates of Forest Floor Decomposition and Nutrient Turnover in Aspen, Pine, and Spruce Stands on Two Soils, Research Paper, North Central Forest Experiment Station, USDA Forest Service, (NC-227, 5pp, St. Paul, MN.

Rapid Bioassessment Reports, GWJNF, 2014.

Reagan, S. 1990. Habitat use by female black bears in a southern Appalachian bear sanctuary. M.S. Thesis, University of Tennessee, Knoxville. 110 pp.

Richards, C. and B. Hollingsworth. 2000. Managing Riparian Areas for Fish, in Riparian Management in Forests of the Continental Eastern United States, edited by E. S. Verry, J. W. Hornbeck, and C.A. Dolloff. Lewis Publishers, CRC Press LLC, Washington D.C.

Roach and Gingrich, 1968 B.A. Roach, S. F. Gingrich. Even-Aged Silviculture for Upland Central Hardwoods. USDA For. Serv. Agriculture Handbook 355 (1968), p. 39.

Robbins, C.S., D.K. Dawson, and B.A. Dowell. 1989b. Habitat area requirements of breeding forest birds of the Middle Atlantic states. Wildlife Monograph. 103. Washington, DC: The 1Wildlife Society.

Rosenberg, K.V., R.W. Rohrbaugh, Jr., S.E. Barker, J.D. Lowe, R.S. Hames, and A.A. Dhondt. 1999. A land managers guide to improving habitat for scarlet tanagers and other forest-interior birds. The Cornell Lab of Ornithology. 24 pp.

Rowei and, J. S., G. W. Scotter, Fire in the Boreal Forest, March 20, 1973, Quaternary Research, 444-464 (1973). 10.8

SAMAB. 1996e. The Southern Appalachian Assessment (SAA) Terrestrial Technical Report. Report 5 of 5. USDA Forest Service, Southern Region, Atlanta, GA.

Schroeder, R. L. 1985. Habitat suitability index models: Eastern wild turkey. U.S. Fish Wildl.

Serv. Biol. Rep. 82(10.106). 33pp.

Scott, D. Andrew, John Novosad and Gala Goldsmith, 2004, **Ten-Year Results from the North American Long-Term Soil Productivity Study in the Western Gulf Coastal Plain;** Furniss, M , C Clifton, and K Ronnenberg, eds., 2007. *Advancing the Fundamental Sciences: Proceedings of the Forest Service National Earth Sciences Conference, San Diego, CA, 18-22 October 2004*, PNWGTR-689, Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Scott, D.F. and D.B. Van Wyk, 1990, "The Effects of Wildfire on Soil Wettability and Hydrological Behaviour of an Afforested Catchment", *Journal of Hydrology,* 121 (1990) 239-256. 1.02

Silkworth, D.R., Grigal, D.F., 1982, Determining and Evaluating Nutrient Losses Following Whole-Tree Harvesting of Aspen, Soil Science Society of America Journal, 1982;46(3): 626-631.

Simberloff, D. 1998. Flagships, umbrellas and keystones: is single species management pass´e in the landscape era? Biological Conservation 83:247–257.

Simon, Steven A. 2011. Ecological Zones on the George Washington National Forest: First Approximation Mapping. The Nature Conservancy, Virginia Field Office, Unpublished Report.

Smith, E.P. and J. Reese Voshell, Jr. 1997. Studies of benthic macroinvertebrates and fish in streams within EPA Region 3 for the development of biological indicators of ecological condition. Part 1 Benthic macroinvertebrates. Final Report January 24, 1997 Virginia Polytechnic Institute and State University, Blacksburg, VA 24061; Cooperative Agreement CF821462010, 23p.

Smith, Eric P., and Reese Voshell. 2013. Analysis of Benthic Metrics in GWJ. Final Report Submitted to the George Washington & Jefferson National Forest, June 29, 2013.

Smith, H. C. and N. I. Lamson. 1986. Cultural Practices in Appalachian Hardwood Sapling Stands: If done, how to do them. P. 46-61 in Proc Guidelines for managing immature Appalachian

hardwood stands. Smith, H.C. and M.C. Eye (eds.) SAF Publ. 86-02. West Virginia University Books, Morgantown, WV.

Sponaugle, C., J. Skousen, P. Edwards, S. Connolly, and J. Sencindiver, Properties and Acid Risk Assessment of Soils in Two Parts of the Cherry River Watershed, West Virginia, Contribution of the West Virginia Agricultural and Forestry Experiment Station, Article # .

Steffen, D.E., N.W. Lafon, and G.W. Norman. 2002. Turkeys and oaks. Pages 241-255 in W.J. McShea and W.M. Healy, editors. Oak forest ecosystems: ecology and management for wildlife. Johns Hopkins University Press, Baltimore, Maryland, USA.

Stringer, J.W. 2006. Two-Age System and Deferment Harvests. University of Tennessee, UT Extension. Knoxville, TN, p. 11.

Suthers, H.B., J.M. Bickal, P.G. Rodewald. 2000. Use of successional habitat and fruit resources by songbirds during autumn migration in central New Jersey. Wilson Bulletin 112:249-260.

Swank, Wayne T., James E. Douglass, and G. Bryant Cunningham. 1982. Changes in water yield and storm hydrographs following commercial clearcutting on a Southern Appalachian catchment. In: Proc. Symp. Hydrolog. Research Basins.

Sweeney, B.W. 1993. Effects of streamside vegetation on macroinvertebrate communities of White Caly Creek in eastern North America. Proceedings of the Academy of Natural Sciences of Philadelphia. 144:291-340.

Swift, Jr., Lloyd W. and Katherine J. Elliott, 1993, "Site preparation burning to improve southern Appalachian pine-hardwood stands: Fire characteristics and soil erosion, moisture, and temperature", Can. J. For. Res.23 : 2242-2254. 1.44

Timmer, V.R., Savinsky, H.M., Marek, I.R., 1983, Impact of Intensive Harvesting on Nutrient Budgets of Boreal Forest Lands in Resources and Dynamics of the Boreal Zone, 131-147, Ottawa, Canada: Association of Canadian Universities for Northern Studies, Conference Paper.

Trombulak, S.C. 1996. The Restoration of Old Growth: Why and How. In *Eastern Old-Growth Forests*, edited by M.B. Davis, 305-20. Washington, DC: Island Press.

Turner, R.S., Olson. R.J., Brandt, C.C., 1986. Areas having soil characteristics that may indicate sensitivity to acidic deposition under alternative forest damage hypotheses. ORNL/TM – 9917, Oak Ridge National Laboratory, TN.

USDA Forest Service. 1997. Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region. Report of the Region 8 Old-Growth team. Forestry report R8-FR 62. Southern Region Atlanta, GA, 188pp.

United States Department of Agriculture Forest Service Pacific Northwest Research Station General Technical Report, PNW-GTR-222, March 1989.

U.S. Department of Agriculture, Forest Service. 2004. Monitoring and Evaluations Report, George Washington and Jefferson National Forests – 2004. USDA Forest Service, George Washington and Jefferson National Forests, Roanoke, VA.

USDA Forest Service. 2012. Visitor Use Report, George Washington-Jefferson NF, National Visitor Use Monitoring, Data collected FY2011.

USDI Fish and Wildlife Service. 1990. James Spinymussel (Pleurobema collina) Recovery Plan. Newton Corner, MA.

USGS, 1999. *Soil-Calcium Depletion Linked to Acid Rain and Forest Growth in the Eastern United States*. US Department of Interior, Washington, D.C.

Vanderberg, Michael R., Mary Beth Adams, Mark S. Wiseman; 2012, Evaluating Forest Biomass Utilization in the Appalachians: A Review of Potential Impacts and Guidelines for Management, United States Department of Agriculture, Forest Service, Northern Research Station, General Technical Report NRS-106.

Van Lear, D. H. and S .J. Danielovich, 1988, "Soil Movement after Broadcast Burning in the Southern Appalachians", South Journal. Appl. For. 12(1):49-53. 0.12

Vega Rivera, J., Rappole, J., McShea, W., and Haas, W. 1998. Wood thrush postfledgling movements and habitat use in northern Virginia. The Condor 100:69-78.

Vickery 1992: Vickery, P.D. 1992. A regional analysis of endangered, threatened, and special concern birds in the northeastern United State. Transactions of the Northeast Section of the

Virginia Department of Forestry. 2010. Virginia Statewide Assessment of Forest Resources: A Comprehensive Analysis of Forest Conditions, Trends, Threats and Priorities. 129 pp.Wildlife Society 48:1-10.

Virginia Department of Game and Inland Fisheries. 2005. Virginia's Wildlife Conservation Action Plan.

Virginia Department of Game and Inland Fisheries. 2007. Virginia Deer Management Plan 2006-2015. Wildlife Information Publication 07-1. 89 pp.

Virginia Department of Game and Inland Fisheries. 2013. Virginia 2012-2013 Deer Harvest Summary. Report. http://www.dgif.virginia.gov/wildlife/deer/harvestsummary.asp

Virginia Department of Game and Inland Fisheries. 2013. Black bear Management Plan 2012-2021. 113 pp.

Virginia Department of Game and Inland Fisheries. 2013. Virginia Wild Turkey Management Plan 2013-2022. Technical Background Draft. Report.

Vose, James M. and Wayne T. Swank, 1993, "Site preparation burning to improve southern Appalachian pine-hardwood stands: aboveground biomass, forest floor mass, and nitrogen and carbon pools", Can. J. For. Res. Vol. 23, 1993. 0.31

Vose, James M., Wayne T. Swank, Barton D. Clinton, Jennifer D. Knoepp, Lloyd W. Swift, 1999, "Using stand replacement fires to restore southern Appalachian pine-hardwood ecosystems: effects on mass, carbon, and nutrient pools", Forest Ecology and Management 114 (1999) 215-226. 0.21

Wan, Shiqiang, Dafeng Hui, Yiqi LuoSource, Oct., 2001, "Fire Effects on Nitrogen Pools and Dynamics in Terrestrial Ecosystems: A Meta-Analysis", Ecological Applications, Vol. 11, No. 5 (Oct., 2001), pp. 1349-1365 Published. 2.7

Wathen, G. 1983. Reproduction and denning of black bears in the Great Smoky Mountains.M.S. Thesis, University of Tennessee, Knoxville. 135 pp.

Weaver, J.C. 1995. Indicator Species and Scale of Observation. Conservation Biology 9(4):939-942.

Wells, C.G., Jorgensen, J.R., 1979, Effect of Intensive Harvesting on Nutrient Supply and Sustained Productivity, in Proceedings: Impact of Intensive Harvesting on Forest Nutrient Cycling, pages 212-230, pub. Syracuse, N.Y.: State University of New York, College of Environmental Science and Forestry, Conference paper.

Wentworth, J. M, A. S. Johnson, and P. E. Hale. 1989. Influence of acorn abundance on white-tailed deer in the Southern Appalachians. Pages 2-6 in C. E. McGee, ed. Proceedings workshop Southern Appalachian mast Management. USDA For. Serv. and Univ. Tennessee.

Wentworth, J. M., A. S. Johnson, and P. E. Hale. 1990a. Influence of acorn use on nutritional status and reproduction of deer in the Southern Appalachians. Proc. Annu Conf. Southeast.Assoc. Fish and Wildl. Agencies 44:142-154.

Wentworth, J. M., A. S. Johnson, P. E. Hale, and K. E. Kammermeyer. 1992. Relationships of acorn abundance and deer herd characteristics in the Southern Appalachians. South. J. Appl. For. 16: 5–8.

West Virginia Division of Natural Resources, Wildlife Resources Section. 2011. West Virginia White-tailed Deer Operational Plan 2011-2015.

West Virginia Division of Natural Resources, Wildlife Resources Section. 2013. Big Game Bulletin 2012. Report. http://www.wvdnr.gov/hunting/PDFFiles/BGB_2012.pdf

White, E.H., Harvey, A.E., 1979, Modification of intensive management practices to protect forest nutrient cycles, Proceedings: Impact of intensive harvesting on forest nutrient cycling, 1979; 264-278, pub. Syracuse, N.Y.: State University of New York, College of Environmental Science and Forestry, Conference paper.

Wiensczyk, Alan. 1992. A Brief Review of the Issues Surrounding Full Tree Harvesting, Northwestern Ontario Forest Technology Development Unit, TN-13.

Williams, C.E. 1989. Acorn Insects. Michigan Entomology Notes No. 20; Michigan Entomology Society, East Lansing MI (22-xi-89).

Wiuixs P. and D. Pakkinson, 1974, "The Effects of a Forest Fire on Soil microfungi", Soil Biol. Biochem. Vol. 7, pp125-138. 1.43

Wunz, G. A., and J. C. Pack. 1992. Eastern Turkey in eastern oak-hickory and northern hardwood forests. Pp. 232-264. in J. G. Dickson, ed. The Wild Turkey: Biology and Management. Stackpole Books, Harrisburg, PA.

Zaccherio, Meredith T. and Adrien C. Finzi, 2007, Atmospheric Deposition May Affect Northern Hardwood Forest Composition By Altering Soil Nutrient Supply, Ecological Applications, 17(7), 2007, pp. 1929–1941, 2007 by the Ecological Society of America.