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Forest Service

Fremont and Pineknot East Restoration Project - Environmental Assessment

Project #39955

Eleven Point Ranger District, Mark Twain National Forest, Shannon and Carter Counties, Missouri

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COVER PHOTO: SHORTLEAF PINE RESTORATION THINNING UNIT IN PINEKNOT COMPLETED IN 2012 ADJACENT TO THE FREMONT PROJECT AREA.

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CHAPTER 1 – PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

The Mark Twain National Forest has prepared an environmental assessment to determine whether implementation of this project may significantly affect the quality of the human environment and thereby require the preparation of an environmental impact statement. By preparing this environmental assessment, we are fulfilling agency policy and direction to comply with the National Environmental Policy Act (NEPA). For more details of the proposed action, see the Proposed Action and Alternatives section of this document.

The Mark Twain National Forest proposes to conduct the ***Fremont and Pineknot East Restoration Project*** in order to achieve restoration objectives as defined in the Mark Twain National Forest Land and Resource Management Plan (herein referred to as the "Forest Plan"). The project is one of three resource management projects that will be completed within the large landscape Missouri Pine-Oak Woodland Restoration Project. For more details of the proposed action, see the Proposed Action and Alternatives section of this document.

The Fremont and Pineknot East Restoration Projectis part of a larger collaborative landscape restoration project known as the ***Missouri Pine-Oak Woodland Restoration Project*** (MoPWR). This is part of a national program to encourage the collaborative, science-based ecosystem restoration of priority forest landscapes that would restore and enhance resilient and functioning shortleaf pine/oak woodland communities.

The MoPWR project will implement a variety of integrated management activities designed to restore over 88,000 acres of National Forest System lands within the pine and pine/oak-bluestem woodlands of the Current River and Cane Ridge Pinery areas. To learn more about the Collaborative Landscape Restoration Program and the Missouri Pine-Oak Woodland Restoration Project please visit: http://www.fs.fed.us/restoration/CFLRP/index.shtml

Interested parties can view this document and a complete set of maps for all proposed activities on the Mark Twain National Forest Website at: http://www.fs.usda.gov/projects/mtnf/landmanagement/projects

PROPOSED PROJECT LOCATION

The Fremont-Pineknot East Restoration Project area is located on the Eleven Point Ranger District of the Mark Twain National Forest. The general project area is located near the community of Fremont, Missouri, approximately 2 miles east of the project area. The project area is located within Carter and Shannon Counties, Missouri. It generally lies east and southeast of Winona, Missouri, west and southwest of Van Buren, Missouri, west of the Current River, south of the forest proclamation boundary, and encompasses Fremont, Missouri. It falls within T. 27 N., R. 2 W.; T. 27 N., R. 3 W.; T. 27 N., R. 4 W.; T. 26 N., R. 1 W.; T. 26 N., R. 2 W.; T. 26 N., R. 3 W.; and T. 25 N., R. 1 W, fifth principal meridian.

The Fremont and Pineknot East Restoration Projectis one of several resource management projects that will be completed within the Missouri Pine-Oak Woodland Restoration Project. The Fremont and Pineknot East Woodland Restoration project consists of two distinct areas, Fremont (38,561 acres) and Pineknot East (9,537 acres) that are similar in land form and vegetative character (see Map 1). Table 1 shows the ownership for reach project area.

Table 1. Ownership within the Project Area

Ownership	Acres	Percent of Project Area

Ownership	Acres	Percent of Project Area
Fremont		
Missouri Department of Conservation	996	3%
Private	16,084	42%
USDA Forest Service	21,398	55%
Pineknot East		
L-A-D Foundation	328	3%
Private	924	10%
USDA Forest Service	8,286	87%

The Fremont and Pineknot East Project area occurs within the historic natural range of shortleaf pine on the dissected plains of the southern Current River Hills. It is distinguished as Missouri's largest remaining and most extensive cover of shortleaf pine dry chert woodland interspersed with sinkhole ponds, losing streams and several caves that harbor many species of conservation concern.

NEED FOR THE PROPOSAL

The purpose of this project is to restore and enhance fire-adapted pine and pine-oak bluestem woodlands to their full range of historic vegetation composition and structural conditions that occurred under natural disturbance regimes (e.g. fire and drought). There is a need to improve the resiliency, integrity, and sustainability of forest ecosystems. Ecosystems on the Mark Twain National Forest could be compromised if current conditions, such as dense canopy cover, high tree densities, and lack of fire are not addressed.

The need for this project was initially developed within the Mark Twain Forest Plan (USDA Forest Service, Mark Twain National Forest, 2005b), which provides guidance for all resource management activities on the forest. The 2005 Forest Plan can be found at: http://www.fs.usda.gov/land/mtnf/landmanagement.

The project area primarily falls within Management Prescription 1.1 – Natural Community Restoration, Roaded Natural Recreation Opportunity Spectrum, which emphasizes the restoration of natural communities (USDA Forest Service, Mark Twain National Forest, 2005, pp. 3-3 to 3-6). Natural communities are distinct assemblages of native plants, animals, and microorganisms that occur in repeatable and often mappable patterns across the landscape. The dominant natural community in the project area is shortleaf pine and pine-oak woodlands. Six million acres of shortleaf pine woodland once covered the Missouri Ozarks (Liming, 1946). Datasets of the General Land Office (GLO) notes compiled by J. Harlan (Missouri Historic Landscape Project, Geographic Resources Center, Department of Geography, and University of Missouri) shows a vastly different landscape in the 1820's as compared to today (Hanberry, Dey, & He, 2012). Periodic burning by Native Americans promoted pine regeneration and recruitment by removing leaf litter and needle cast and created favorable seedbeds for growth. As a result, open woodland conditions were created and maintained by this periodic burning. Historic logging and open-range grazing at the turn of the century, followed by fire suppression beginning in the 1930's, has resulted in a forest with a different composition and structure than the era prior to the mid 1800's. A comparison of species composition from the GLO surveys and contemporary data from USDA Forest Service Forest Inventory and Analysis (FIA) show a decrease of shortleaf pine from 54% to 15% in the Current River Hills subsection of the Ozarks (Hanberry, Dey, & He, 2012).

Other portions of the project area are designated as Management Prescription 8.1 – Designated "Special Areas" Other Than Wilderness. This includes the State of Missouri-designated Big Barren Creek Natural Area (99 acres) in the Pineknot East unit and several sinkholes and sinkhole ponds within the Fremont

unit [Fox Pond (3 acres), Grassy Pond (17 acres), Tan Bark Pond (23 acres), and Young Hollow Pond (11 acres)]. The project also includes approximately 672 acres within Management Prescription 2.1, General Forest, Roaded Natural Recreation Opportunity Spectrum on the eastside of Fremont and Pineknot East.

In addition to stated Forest Plan objectives, the need to implement shortleaf pine woodland restoration has been identified as a need in the following:

- Missouri's Forest Resource Assessment and Strategy (2010), seeking a Sustainable Future for Missouri's Forest Resources. Missouri Department of Conservation.
- Current River Hills and Eleven Point Hills Conservation Opportunity Area (COA) and Strategies. Missouri Department of Conservation (2010).
- Ozarks Ecoregional Conservation Assessment (2003), The Nature Conservancy.
- Setting Population and Habitat Objectives for Forest-associated Birds in the Central Hardwoods Bird Conservation Region (Central Hardwoods Bird Conservation Region Habitat Objectives 2012)

The 2005 Forest Plan provides ecological parameters that suggest Desired Conditions for the major Natural Community types that should occur within the Fremont and Pineknot East Project area (USDA Forest Service: Mark Twain National Forest, 2005b).

DESIRED CONDITION

Forest conditions within the project area are out of character in terms of species, structure, and composition. Refer to Table 2 for the 2005 Forest Plan ecological parameters, including canopy closure (the percent of a fixed area covered by the crown of the tree) and basal area (the cross-sectional area of the stem of the tree, generally expressed as square units per unit area), that suggest desired conditions for the major natural community types that should occur within the Fremont and Pineknot East project areas (USDA Forest Service: Mark Twain National Forest, 2005b).

Table 2. Range of Ecological Parameters for Natural Communities in Management Prescriptions 1.1. and 1.2

Natural Community Types	% Canopy	Basal area	Ground layer	% Ground Cover
Savanna	10-30	<30	Grassland, sedge and forb cover	90 – 100 grasses dominant
Open Woodland	30 - 50	30 - 50	Grass, sedge and forb cover; little accumulated leaf litter	60 – 80 grasses dominant
Closed woodland	50 – 80	50 - 90	Shallow leaf litter; mixed grasses, sedges and herbs	80 - 100
Upland Forest	80 – 100	80 – 100	Moderately deep leaf litter	50 – 70

Note: Adapted from 2005 Forest Plan, Table A-1 on p. A-2.

The proposed ecosystem management approach includes vegetation management methods to mimic historic disturbance regimes. Moving toward the Desired Condition may take 15-25 years for ground cover and more than 100 years to achieve the desired composition and structure of the respective canopy characteristics.

At least 82 breeding bird species, 47 migrant birds, and 87 overwintering birds occur in the project area (Fitzgerald & Pashley, 2000). Bird species that once occupied this area, but are no longer present, include Bachman's sparrow, Brown-headed nuthatch, and Red cockaded woodpecker. Target wildlife species benefiting from restoring pine-oak bluestem woodlands include:

Bachman's sparrow	Brown-headed nuthatch	Red cockaded woodpecker
Blue-gray gnatcatcher*	Yellow-breasted chat*	Eastern Wood-pewee*
Chuck-Will's-widow	Blue-winged warbler	Orchard oriole*
Field sparrow*	Eastern Tiger salamander	Wild turkey
Great Crested flycatcher	Summer tanager	White-eyed vireo*
Pine warbler	Bewick's wren*	Northern bobwhite
Pygmy rattlesnake	Copperhead	Ornate box turtle
Red-headed woodpecker*	Prairie warbler*	Eastern towhee
Western Glass lizard	Red bat	Indiana bat

*Denotes Partners in Flight (Fitzgerald & Pashley, 2000) "species in need of management attention" in the Central Hardwoods Bird Conservation Region.

An inventory of the over-story vegetation, consisting of 288 plots for the entire project area has been completed for the purpose of identifying restoration and analysis needs of this National Environmental Policy Act (NEPA) process (Schanta, 2012a). In addition, 59 fixed permanent vegetation plots designed to monitor understory ground flora have been established in the project area. These plots will be used to monitor understory vegetation response to thinning and prescribed fire treatments. The district's certified silviculturist has conducted site assessment and collected additional data (Project File, Stand Recon Sheet Field Notes, 2010-2012) for each stand proposed for resource management activities.

Bases on the grid inventory (Schanta, 2012a) and natural community mapping, the following charts display the existing versus desired structural components of canopy closure (the percent of a fixed area covered by the crown of the tree) and basal area (the cross-sectional area of the stem of the tree, generally expressed as square units per unit area, such as square feet per acre as used in this document).

Figure 1. Existing and desired canopy closure in acres within Fremont Project Area.

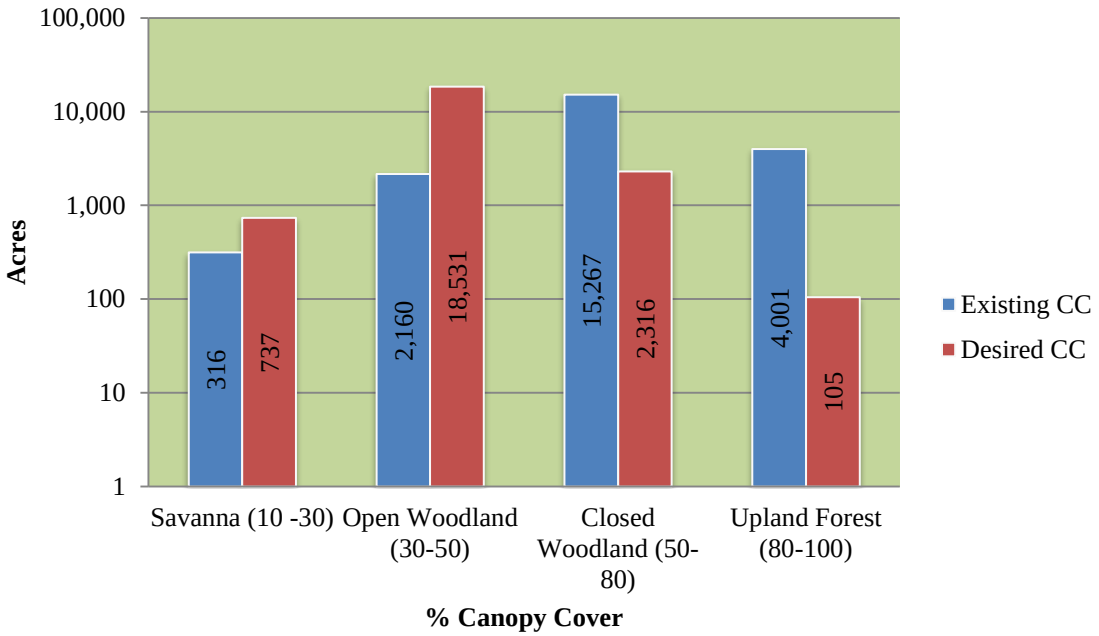


Figure 1 displays the difference between exiting canopy closure and desired canopy closure as identified in the Table 2 above. A disproportionate amount of closed woodland conditions exist compared to the desired amount of open woodlands based on natural community type mapping within the project area.

Figure 2. Desired basal area within Fremont Project Area.

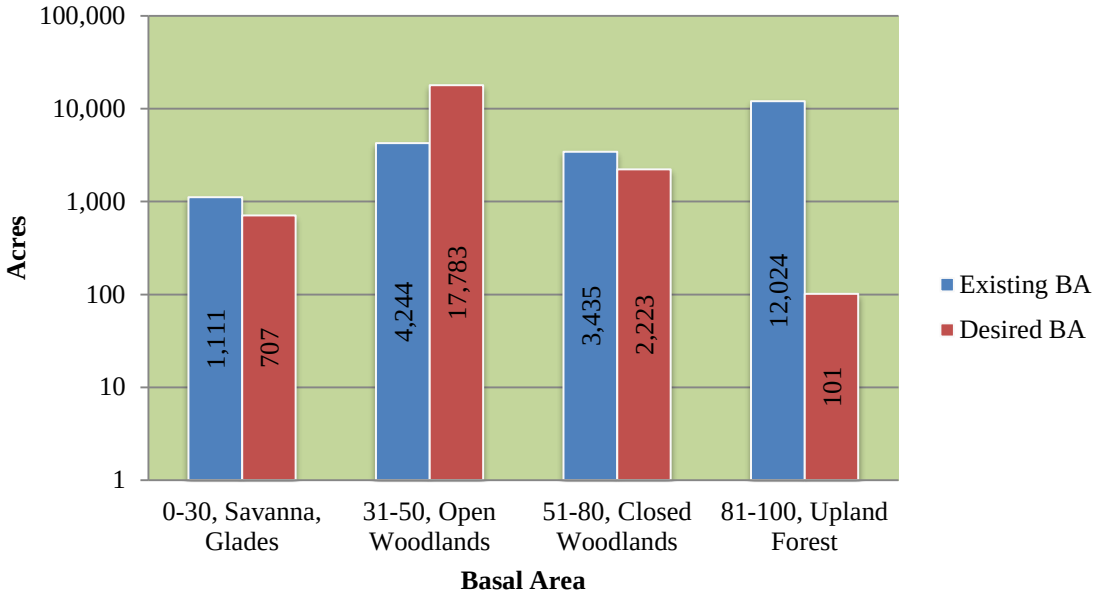


Figure 2 displays the difference in basal area between existing basal and desired canopy closure. Notice a disproportionate amount of basal areas in upland forest condition compared to what is desired in closed and open woodands.

Figure 3. Existing and desired canopy cover in Pineknot East Project Area.

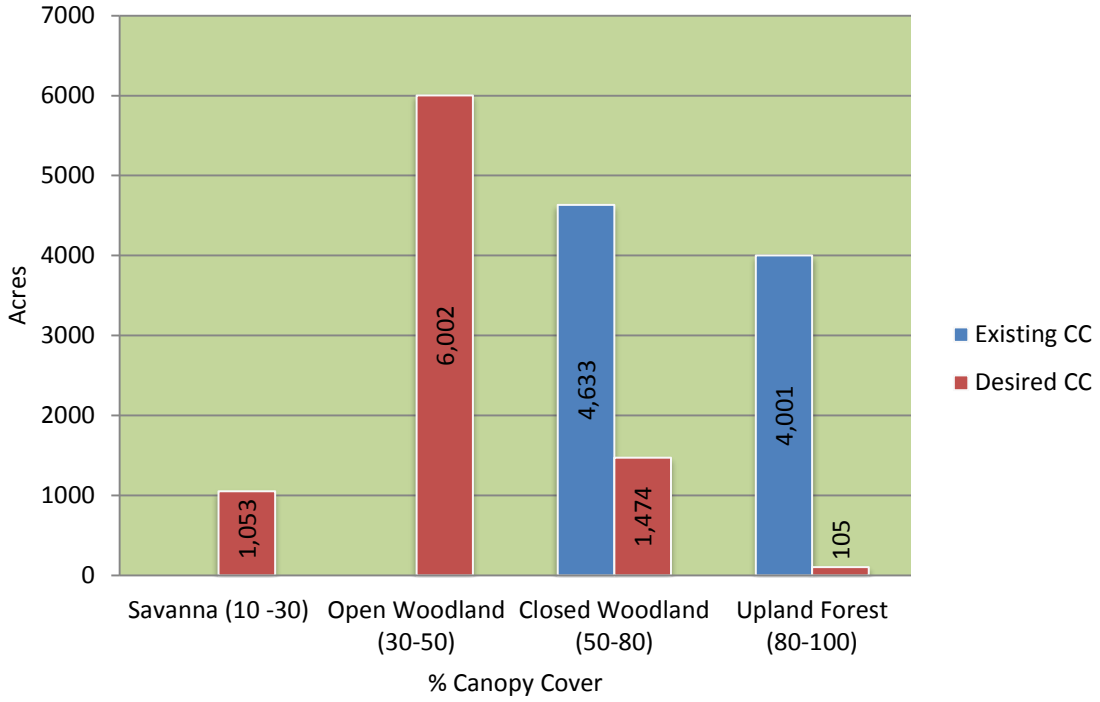


Figure 3 displays the difference between exiting canopy closure and desired canopy closure as identified in the Table 2 above. A disproportionate amount of closed woodland conditions exist compared to the desired amount of open woodlands based on natural community type mapping within the project area.

Figure 4. Desired basal area within Pineknot East Project Area.

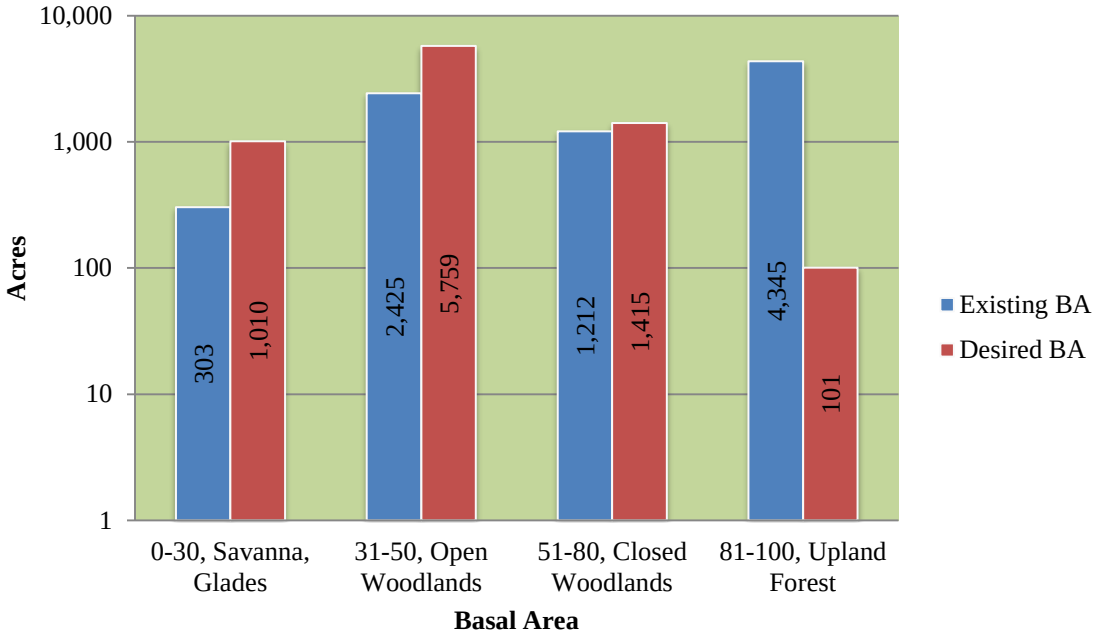


Figure 4 displays the difference in basal area between existing basal and desired canopy closure. Notice a disproportionate amount of basal areas in upland forest condition compared to what is desired in closed and open woodands.

The following specific needs have been identified for the Fremont and Pineknot East Restoration Projectand is consistent with the 2005 Forest Plan:

- Maintain healthy, sustainable, and diverse natural communities (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-3).
- Restore, enhance, and maintain the structure, composition, and function of distinctive terrestrial and aquatic natural communities (USDA Forest Service: Mark Twain National Forest, 2005b, p. 3).
- Use timber management, where appropriate, to restore or enhance degraded natural communities, sustain healthy and productive forests, and reduce hazardous fuels to reach the desired condition of the forest (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-5).
- Reduce wildland fire risk to communities (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-5).
- Restore fire regime condition class two or three lands to condition class one (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-4).
- Re-establish the role of fire in natural communities of the Ozarks by emulating the historic fire regime (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-4).
- Restore the ecological role of fire in natural communities (USDA Forest Service: Mark Twain National Forest, 2005b, p. 3).
- Develop and maintain a transportation system which provides the minimum permanent road system needed to meet resource management objectives (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-5).
- Restore and manage natural communities as the primary means of providing quality terrestrial, karst, and aquatic wildlife and rare plant habitat (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-3).
- Provide a diversity of recreational opportunities and benefits through a variety of settings (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-6).

In addition there may be some associated and connected actions or follow-up treatments which may be required to implement the above needs.

OTHER RELATED EFFORTS

The Mark Twain National Forest has authorized previous projects on the Eleven Point and Popular Bluff Ranger Districts that address similar purpose and needs for restoration of natural communities such as pine/oak woodland woodlands and were located in Management Areas 1.1 and 1.2 (Natural Community Restoration) . These analyses resulted with decisions resulting in a finding of no significant impact on resources.

Table 3. Treatments Authorized by Project Area

Project	Year Approved	Treatments Authorized
Pineknot Woodland Restoration	2003	Prescribed Fire (7,897 ac); Various Thinning of pine, pine/oak (3,489 ac); Timber Stand Improvements (1,225 ac)
Cane Ridge East	2008	Prescribed Fire (9,860 ac); Commercial Thinning (3,847 ac); TSI (1,199 ac); Non-Native and Invasive Plant Control (98 ac); Road Reconstruction and Maintenance.
Cane Ridge West	2009	Prescribed Fire (7,599 ac); Commercial Thinning (3,905 ac); TSI (775 ac); Non-Native and Invasive Plant Control (34 acres); Road Reconstruction and Maintenance.
Handy	2009	Prescribed Fire (8,695 ac); Salvage Cuts (2,038 ac); Clear cuts with reserves (443 ac); Seed Tree Cuts (60 ac); Commercial Thinning (1,655 ac); TSI (3,731 ac); Road Reconstruction and Maintenance

Past restoration efforts on the Mark Twain National Forest using timber harvest, precommercial thinning, and prescribed burns have demonstrated success in creating open woodland landscapes dominated by shortleaf pine and grass/forb groundcover. The Forest has conducted monitoring on all these projects and has found that the projects were or are being implemented as intended and that these actions are effective in meeting the objectives of the project.

Data collected in 2000, 2001, 2005, and 2010 on 100 monitoring plots in the Pineknot has shown progress toward restoring herbaceous understory with mechanical thinning, timber harvesting, and the application of prescribed fire at regular intervals starting in 2003. Table 4, shows the amount of acres treated with prescribed fire and mechanical treatments (harvest and non-harvest thinnings) from 2003 to 2010 in the Pineknot Woodland Restoration Project.

Table 4. Pineknot Treatments completed since 2003 (source: NRIS, FACTS)

Year	Prescribed Fire	Mechanical Treatments
2003	0	611
2004	2,330	0
2005	1,996	170
2006	1,324	228
2007	1,543	808
2008	717	795
2009	3,829	776
2010	2,914	0

The activities displayed above were authorized in the Record of Decision for the Pineknot Woodland Restoration Final Environment Impact Statement (FEIS). This project is still in its early stages and still in a restoration mode and will take up to 30 years to achieve optimal range for species richness and native cover.

The monitoring is beginning to show that the main goals of promoting ecosystem health and sustainability (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-1) and the objectives of applying management activities to move natural communities toward restoration and to meet desired conditions as delineated in the 2005 Forest Plan, Appendix A, Terrestrial Communities are being met. The two monitoring questions that serve as a focal points for determining if the Forest Plan goal of promoting ecosystem health and sustainability is being addressed are: (1) Are restoration activities increasing plant species richness for woodlands, glades and forest? and, (2) Are we moving toward desired condition for ground cover and natural community type structural characteristics? To answer the first question regarding increasing plant species richness the vegetation monitoring system is based on the concept of Floristic Quality Index (Taft & et al, 1997). Species richness is expressed as an index based on numerical values (between 0 and 10) assigned to each native vascular plant species and is referred to as the Coefficient of Conservatism (C) value. This numerical index is an expression of the fidelity of a species to its native plant community and is a measure of the relative integrity of the ecosystem (Swink & Wilhelm, 1994).

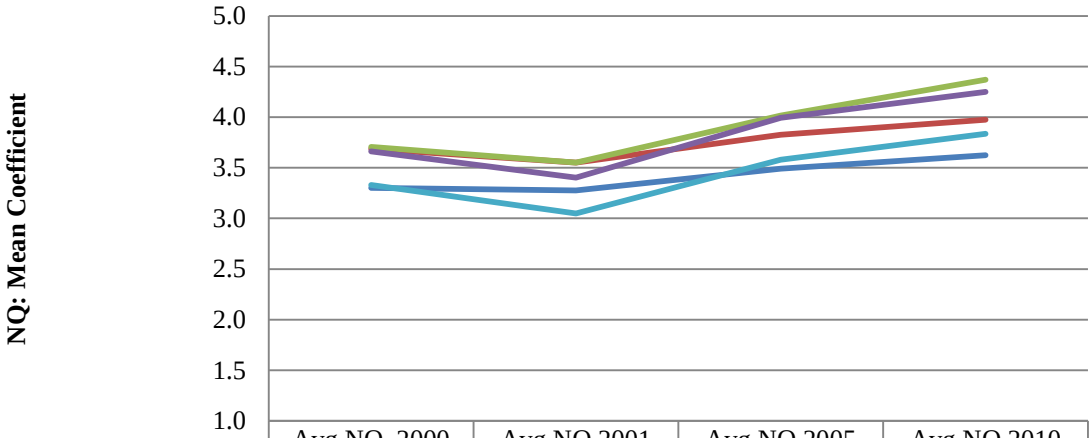
Table 5. FQI Plots stratified by Treatment Regime

Treatment Regime	# of FQI Plots
No Treatment	14
Rx Fire Only	5
Rx Fire Only (Multiple Burns)	38
Thin Only	14
Thin/Burn	2
Thin/Burn (Multiple Burns)	28

Figure 5 shows the mean coefficient(C) value per quadrat based on a stratification of the monitoring plots based on the treatment regime. A response in the C values shows an upward trend despite that fact that restoration efforts are just getting started.

The Mean-C is equal to the sum of all C-values in a plot divided by the number of species. For woodlands in Missouri, Mean-C values of 4 or greater generally indicate integrity or may also result from having achieved desired conditions for structure, composition, tree density, and prescribed fire. Compared to FQI monitoring of similar woodland restoration sites in the Ozarks, the Pineknot treatment areas are currently considered in a fair conditions (3.5 – 4.7) for Mean-C values. A good condition rating would be >4.8 and Mean-C over five would be considered natural area quality based on Missouri Natural Areas Committee criteria (Doug Ladd, personal communication, 2014).

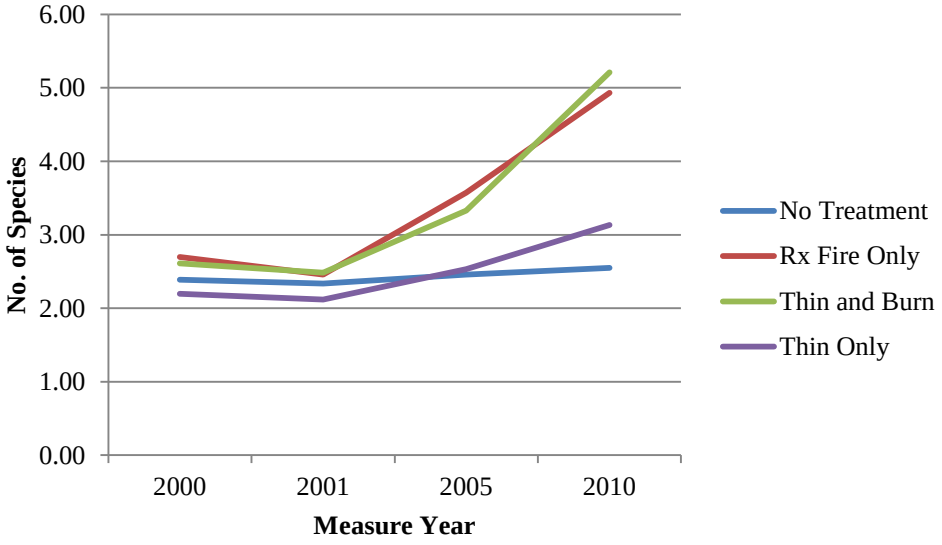
Figure 5. Mean coefficient (C) value per quadrat (Source: NRIS, FSVeg)



	Avg NQ 2000	Avg NQ 2001	Avg NQ 2005	Avg NQ 2010
No Treatment	3.3	3.3	3.5	3.6
RX Fire Only (1)	3.7	3.6	3.8	4.0
Rx Fire Only (2)	3.7	3.6	4.0	4.4
Thin and Burn	3.7	3.4	4.0	4.3
Thin Only	3.3	3.1	3.6	3.8

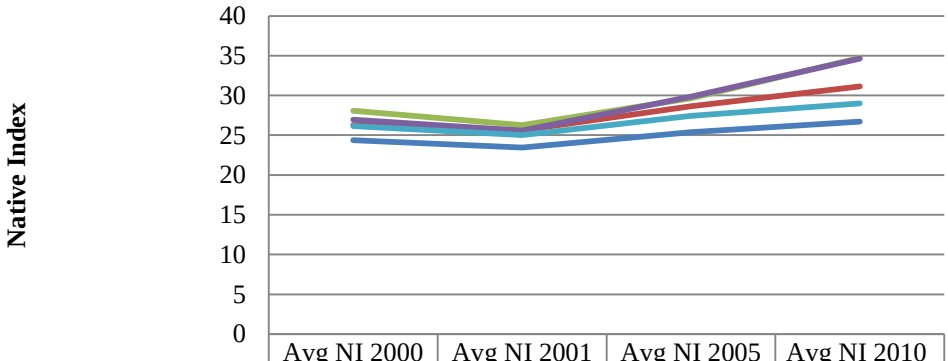
Another indices used to measure species richness is the relative change in total number of species per quadrat. Figure 6 shows that restoration activities in Pineknot are resulting in an increase in the number of native species being recruited into the under story. The relative changes in the number of species showing up in the plots are 2.24 for plots with prescribed fire only and 2.60 for plots that are thinned and burned.

Figure 6. Average # of species by quadrat (Source: NRIS, FSVeg)



Native Index is another index we use to measure species richness. Figure 7 shows the Native Index, which is the mean values of all species collected in each quadrat divided by the square root of total number of species.

Figure 7. Average Native Index by quadrat (Source: NRIS, FSVeg).



	Avg NI 2000	Avg NI 2001	Avg NI 2005	Avg NI 2010
No Treatment	24	23	25	27
RX Fire Only (1)	26	26	29	31
Rx Fire Only (2)	28	26	30	35
Thin and Burn	27	26	30	35
Thin Only	26	25	27	29

In addition to improvement in species richness, the total native cover for all treatment areas has increased substantially compared to pretreatment conditions. Similar results in herbaceous responses to thinning and prescribed fire activities are occurring at Cane Ridge, Grassy Pond, The Nature Conservancy Chilton Creek Research and Demonstration Area, Rocky Creek Conservation Area, Hawn State Park and other restoration areas across the Central Ozarks.

PUBLIC INVOLVEMENT AND TRIBAL CONSULTATION

The project was initiated with the mailing (hard copy or e-mail) of a scoping letter to the District mailing list, Tribal Governments, and Adjacent Neighbors on April 10th, 2013. This project was also entered in the forest-wide Schedule of Proposed Actions (SOPA) on October 01, 2012 and the information has been accessible through the Mark Twain National Forest website since this time.

Comments received during and after the scoping period were accepted and evaluated in the development of issues and alternatives to the proposed action. The scoping period resulted in fifteen comment letters summited from variousfrom individuals and organizations. All 15 timely comment letters were reviewed and evaluated by members of the Interdisciplinary Team (IDT) and the deciding official since the scoping period began. There were seven issues identified for further consideration and evaluation. Forest Service responses to scoping comments were developed (Project File, Results of Scoping Comments and Forest Service Response to Comments).

Between scoping and 30 day comment period, the Eleven Point Ranger District hosted two field days during the summer of 2014. The intent of the field days was to better inform stakeholders of the restoration project, listen to concerns and answer questions about the project. Stakeholders included private landowners, congressional delegations, industry and environmental groups.

On September 17, 2014 the District mailed a letter and e-mail to notify interested parties and neighbors of the projects 30 day comment period. The document Proposed Action and Preliminary Alternatives for 30-day Comment Period along with supporting documents and maps was posted on the Mark Twain National Forest website and was available for review as of September 19, 2013. The Prospect-News newspaper, Doniphan, Missouri (newspaper of record) published a legal notice on September 17, 2014 to begin the official 30 day comment period. After the 30 day comment period the ID Team and the District Ranger

reviewed the comments received both internally and externally to see if any new issues or alternatives were identified. None were identified or formed. The Eleven Point Ranger District received 13 responses as a result of the 30-day comment period which ended on October, 2014 and those commenters have standing to file an objection. Three comment letters were received after the close of the comment period and were reviewed by the ID Team as well. A summary of public concern statements and response to comments can be found in Appendix C, Results of 30-Day Comment Period and Forest Service Response to Comments.

On October 2, 2014 the Mark Twain National Forest's Eleven Point Ranger District hosted an open house at the Van Buren Coummunity Center to provide project information and take written comments on the proposed activities associated with the Fremont-Pineknot East Restoration Project. Thirteen individuals attended the openhouse.

From the beginning of the project a wide range of views surfaced about the project. Responses ranged from total support to opposition of some of the proposals. The IDT and the District Ranger have reviewed and evaluated and responded to public conerns brought forward during the 30-Day comment period. Responses to public concerns can be found in Appendix C of this document.

ISSUES

The Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act in Sec. 1501.7 require agencies to "identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review" (Sec. 1506.3). Some non-significant issues were raised during public involvement. These issues involved comments that were not directed toward site-specific actions, but were made in a general nature that the Forest Service should not build roads or conduct prescribed fire or timber harvest. These comments were outside the scope of the proposed action and involved higher level policy and decisions.

The Forest Service identified several preliminary issues during internal scoping with Forest Service staff as well as potentially significant issues that emerged during public involvement that would be carried forward for environmental analysis. The issues and concerns that will be considered in this environmental analysis include the following:

Issue 1. Concern about the lack of high quality natural communities and their need for restoration.

Issue 2. Concern that Short Leaf Pine Natural Community restoration activities could have a negative impact to the local economy.

Issue 3. Concern that the scale and intensity of landscape burning could result in high levels of tree mortality and tree damage.

Issue 4. Concern that landscape-level prescribed burning could negatively impact soil and water resources.

Issue 5. Concern about the availability of monitoring evidence to support the use of landscape-level prescribed fire.

Issue 6. Concern about the emphasis on restoration and the Forest Service's ability to address forest health issues.

Issue 7. Concern about understory treatments as it relates to market availability and its impacts when left on the forest floor.

CHAPTER 2 – PROPOSED ACTION AND ALTERNATIVES

ALTERNATIVE 1 – NO ACTION

Under this alternative, the Forest Service would not implement the activities listed in the proposed action or any other action alternative that would be developed. This alternative would not forego future management options.

ALTERNATIVE 2 - PROPOSED ACTION

The treatments described in this section are needed to move plant communities toward their naturally occurring historic structure and composition, and provide a variety of habitat conditions to meet the needs of plants, fish, and wildlife. Plant community composition and structure of much of the project area resembles that of a dense upland forest as a result of past logging and agricultural practices, and do not meet the desired conditions for open and closed woodland communities as described in the 2005 Forest Plan (USDA Forest Service: Mark Twain National Forest, 2005b, pp. A-2).

There are stands present within the project area that are densely stocked where thinning would reduce competition for light, water, and nutrients as well as improve growth of desired tree species. Thinning would emphasize creating appropriate openness within the canopy and allow light to reach the forest floor for ground vegetation such as grasses, sedges, and forbs as directed for natural community types in the 2005 Forest Plan.

There are stands in the project area that present regeneration opportunities. Harvesting and planting activities would begin a shift towards the desired shortleaf pine composition historically associated with the natural community type.

Oak decline is occurring on many of the sites where the red oak group replaced the original shortleaf pine forest of the past. Oak decline symptoms include progressive loss of vigor and eventual death of the tree. Environmental stresses such as drought, late freezes, poor soil conditions, insect defoliation, root disease, other insect and disease problems, and old age create an oak decline complex. Removal of dead, dying, or damaged trees provides an opportunity to move stands toward terrestrial natural communities and desired conditions, improve current forest health, provide timber and wood products to the local economy, and address hazardous fuel conditions.

Appendix A contains all the National Best Management Practices (BMP), Forest Plan standards and guidelines and mitigation measures that will be followed in the implementation of the proposed activities.

Appendix B contains the guiding principles for silvicultural practice that will be followed during the implementation of this project.

Appendix C contains the Forest Service responses to public comments to the proposed action submitted during the formal 30 day comment period.

Fremont Area

Restoration Thinning — 273 Stands, Approximately 4,931 Acres

Restoration Thinning would focus primarily on increasing open woodland conditions and reducing closed woodland/upland forest conditions in predominantly older pine and pine-oak stands. This treatment would be a single entry into stands that contain less than 130 basal area. Approximately 30-60 basal area of over-story trees would be retained. Poorer quality, declining or excess black and scarlet oak would be the primary focus of removal along with occasional poorer quality or excess white/post oak and hickory.

More vigorous, dominant, and co-dominant pine and oak-hickory would be favored for retention to enhance the natural community.

Thinning would increase the amount of light reaching the forest floor and stimulate the growth of existing oak and pine seedlings and herbaceous cover. Hardwood understory control would be implemented in the majority of these stands after thinning to further reduce canopy cover and increase light reaching the forest floor. This treatment would stimulate the development of ground flora and enhance the pine component.

Commercial Thinning — 211 Stands, Approximately 3,742 Acres

Commercial thinning is an intermediate harvest treatment that reduces the basal area of a stand by harvesting and removing trees by means of a commercial timber sale. Thinning would focus primarily on increasing open woodland conditions and reducing closed woodland/upland forest conditions in predominantly immature, smaller diameter pine and pine-oak stands. Thinning in these stands would focus on reducing competition in pine sawtimber and pole stands that have basal areas greater than 130. This treatment would improve growth and wind firmness (resistance) of residual trees, improve canopy openness, and begin development of ground flora (grasses and forbs). Approximately 60-80 basal area of over-story trees would be retained.

Salvage/Sanitation Harvest — 106 Stands, Approximately 1,949 Acres

Salvage harvests are implemented as to remove trees that are in danger of being killed or that have already been damaged or recently killed by injurious agents other than competition (Johnson, Shifley, & Rogers, 2002). Mortality associated with oak decline is occurring within the project area as a result of age, extended drought conditions, and insect and disease infestations.

At least 10-15% of the affected Salvage Sanitation Harvest stand areas would be left untreated in a variety of patch sizes distributed across the treated stand areas. These treated areas also represent regeneration opening opportunities in open and closed woodland natural communities, as well as opportunities to manipulate vegetation species composition closer to that resembles the natural community type. This treatment may be followed with site preparation, planting, and release of shortleaf pine.

Seed Tree Harvest with Reserves — 68 Stands, Approximately 978 Acres)

This treatment is the harvest of all trees, except for a small number of widely dispersed trees retained for seed production, and would produce a new age class in a fully exposed microenvironment. Some of the seed trees or other reserve trees are retained after regeneration has become established, sometimes indefinitely, to attain goals (such as providing wildlife habitat) other than regeneration. In Seed Tree Harvest, all overstory trees would be removed except for large pine seed trees and other species retained to achieve 10-15 basal area. This treatment would be followed with site preparation.

Shelterwood Preparatory Harvest — 2 Stands, Approximately 33 Acres

Shelterwood Preparatory Harvest involves reducing the number of trees in a stand to a residual basal area of 50-70 while leaving those trees needed to produce sufficient shade to promote a new age class in a moderated microenvironment. Shelterwood Preparatory Harvest would focus on preparing mature, even-aged stands for the establishment of new pine and oak-hickory seedlings. This treatment would stimulate the growth of existing seedlings by increasing the amount of light that reaches the forest floor.

Shelterwood Preparatory Harvest would remove low quality or declining black and scarlet oak, low quality other species, and mid-story trees, in addition to exposing some soil during harvest operations.

Soon after commercial harvest, site preparation for natural regeneration would take place by chainsaw felling of mid-story, noncommercial stems. This treatment would encourage development of shrub, grass, or forb habitat for wildlife.

Stand Clearcut with Reserves — 5 Stands, Approximately 78 Acres

These stands have been identified for regeneration due to age, poor quality, and low vigor. This is an even-aged regeneration or harvest method that removes most trees in the stand producing an exposed microclimate for the development of a new age class in one entry. Not all trees would be removed in the proposed clearcut treatment. At least 7%-10% of the harvest area would be retained in reserve trees or reserve tree groups (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 2-28). This treatment would be followed with site preparation, planting, and release of shortleaf pine.

The reserve(s) would include the largest, long-lived species present of pine, white oak, post oak, hickory, and gum. The reserve(s) would also include standing dead trees, cavity and den trees. These reserve and reserve tree groups would be spaced to mimic, as much as possible, natural community structure and composition. The groups would include a combination of at least five trees in each group.

Precommercial Thinning — 131 Stands, Approximately 2,073 Acres

These stands are not currently suitable for commercial thinning and would not achieve that condition within the next ten years. Precommercial Thinning is the selective removal of trees to improve the growth rate and health of the remaining trees in the stands. Trees removed have little or no current economic value, and are generally left on the forest floor to recycle into the soil. Precommercial Thinning also provides an opportunity to shift species composition to more closely reflect the natural community type.

Control of Understory Vegetation — 293 Stands, Approximately 5,169 Acres

Control of understory vegetation treatments would occur within many of the restoration thin and commercial thin harvest areas. This treatment involves a combination of manual and herbicide control of mid-story trees. These trees would be cut and left on the ground, sold as small diameter wood products or firewood, or utilized as biomass.

Plant and Release of Shortleaf Pine — 120 Stands, Approximately 2,115 Acres

Planting of shortleaf pine would occur in many of the areas identified for regeneration and salvage harvest activities. One year following harvest activities these sites would be planted. Two years following planting, site preparation would be conducted to stimulate sprouting and to release pine seedlings from hardwood competition. This action would allow the pine seedlings to become established and better compete with hardwood sprouts. Some areas may require additional release treatments involving a combination of manual or herbicide treatments.

Within 3-5 years following treatment, all regenerated areas would be fully stocked with pine and oak-hickory saplings. Herbaceous cover would increase significantly following harvest and remain a significant component of these sites as the canopy begins to close.

Glade Restoration — Approximately 15 Acres

Glade restoration would be conducted by mechanically removing eastern red cedar from 19 glades (15 acres) in the Turley and Lee Hollow prescribed burn units.

Pineknot East Area

Restoration Thinning — 56 Stands, Approximately 1,332 Acres

Restoration thinning would focus primarily on increasing open woodland conditions and reducing closed woodland/upland forest conditions in predominantly older pine and pine-oak stands. This treatment would consist of a single entry into stands that contain less than 130 basal area. Approximately 30-60 basal area of over-story trees would be retained. Hardwood understory control would be implemented in the majority of these stands after thinning to further reduce canopy cover. This treatment would increase the amount of light reaching the forest floor, stimulate the development of ground flora, and enhance the pine component.

Commercial Thinning — 24 Stands, Approximately 469 Acres

Thinning would focus primarily on increasing open woodland conditions and reducing closed woodland/upland forest conditions in predominantly immature, smaller diameter pine and pine-oak stands. Thinning in these stands would focus on reducing competition in pine sawtimber and pole stands that have basal areas greater than 130. Approximately 60-80 basal area of over-story trees would be retained.

This treatment would improve growth and wind firmness of residual trees, improve canopy openness, and promote development of ground flora (grasses and forbs). Hardwood understory control would be conducted after thinning in some stands to further reduce canopy cover and increase the amount of light reaching the forest floor to stimulate the development of ground flora, and to enhance the pine component. Multiple commercial entries may be required to obtain desired results.

Salvage/Sanitation Harvest — 23 Stands, Approximately 430 Acres

This treatment involves the removal of damaged or declining trees. At least 10-15% of the affected Salvage/Sanitation Harvest stand areas would be left untreated in a variety of patch sizes distributed across areas. These treated areas also represent regeneration opening opportunities in open and closed woodland natural communities, as well as opportunities to move vegetation species composition closer to the natural community type. This treatment would be followed with site preparation. Planting of suitable native species, if needed, would be addressed on a stand-by-stand basis, generally after first- or second-year stand checks are completed by the silviculturist.

Precommercial Thinning—5 Stands, Approximately 59 Acres

These stands are not currently suitable for commercial entry and would not reach that condition within the next ten years. Precommercial Thinning is the selective removal of trees undertaken to improve the growth rate or health of the remaining trees in the stands. Trees removed have little or no current economic value, and are generally left on the forest floor to recycle into the soil. Precommercial Thinning provides an opportunity to shift species composition closer to the natural community type.

Control of Understory Vegetation—53 Stands, Approximately 1,279 Acres

Control of Understory Vegetation treatments would occur within many of the Restoration and Commercial Thinning areas. This treatment involves a combination of manual and herbicide control of mid-story trees. These trees would be cut and left on the ground, sold as small diameter wood products or firewood, or utilized as biomass.

Plant and Release of Shortleaf Pine—23 Stands, Approximately 430 Acres

Planting of shortleaf pine would occur in many of the areas identified for salvage harvest activities. One year following harvest activities these sites would be planted. Two years following planting, site preparation would be conducted to stimulate sprouting and to release pine seedlings from hardwood competition. This would allow the pine seedlings to become established and better compete with the hardwood sprouts. Some areas may require additional release treatments involving a combination of manual or herbicide treatments. Within 3-5 years, all regenerated areas would be fully stocked with pine and oak-hickory saplings. Herbaceous cover would increase significantly following harvest and remain a significant component of these sites as the canopy begins to close. Prescribed burning would likely be used to prepare the site for planting. After planting, prescribed burning would not be implemented until successful recruitment of the planted shortleaf pine would be possible, approximately 8 to 15 years (Stambaugh, Guyette, & Dey, 2007).

Fremont and Pineknot East Area

Prescribed Fire—Approximately 25,508 acres

Prescribed fire would be used to restore the ecological role of fire in shortleaf pine and pine oak communities.

One of the purposes of this project is to reduce the risk of uncharacteristic wildfire and use fire for ecological restoration and maintenance, and reestablish natural fire regimes, where appropriate. The 2005 Forest Plan (p. 5) provides several relevant goals, paramount of which for this project is to restore fire regime condition class two or three to class one.

The Forest Service uses standardized tool for determining the degree of ecological departure from historical or reference conditions, vegetation, fuels, and disturbance regimes referred to as Fire Regime Condition Class (FRCC). FRCC ranges from 1 to 3 as described in the following paragraphs.

FRCC 1 is a fire regime within the natural (historical) range and the risk of losing key ecosystem components is low. Vegetation attributes (species composition, structure, and pattern) are intact and functioning within the natural (historical) range. There are no areas in the project area identified as meeting FRCC 1.

FRCC 2 is a fire regime that is moderately altered from the natural (historical) range. Risk of losing key ecosystem components is moderate. Fire frequencies have departed from natural frequencies by one or more return intervals (either increased or decreased). This leads to moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation and fuel attributes have been moderately altered from their natural (historical) range. Only 1% of the entire project area is classified as FRCC 2.

FRCC 3 is a fire regime that is substantially altered from the natural (historical) range. The risk of losing key ecosystem components is high. Fire frequencies have departed from natural frequencies by multiple return intervals. Dramatic changes occur to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been substantially altered from the natural (historical) range. Within this project, 90% of the Fremont area and 95% of Pineknot East area is classified as FRCC 3. The rest of the area are not classified (water, agricultural lands etc.)

Historically fire played a role in maintaining pine and pine/oak communities. Guyette and Dey (2000), Guyette and others (2006), and Stambaugh and others (2006) provide accurate records in the modeling of historic fires across the Eastern United States and the Ozark region. Currently these pine and pine oak woodlands are out of character, especially as it relates to structure (basal area and canopy structure).

Prescribed fire would be used as a tool to control some understory woody vegetation which diminishes the amount of light that reaches the ground, cycle nutrients, and reduce fuel loadings.

This proposed action would utilize prescribed fire on approximately 25,508 acres (19,018 acres in Fremont and 6,490 acres in Pineknot East) to emulate the natural and anthropogenic fire disturbance (e.g. Nelson, 2010, Guyette & Dey, 2000; McCarty, 1998). Prescribed fire intervals would be based on monitoring of vegetation attributes, but would typically be every 2 to 5 years during the restoration phase. Prescribed fire would be used to restore the ecological role of fire, enhance natural communities, and reduce hazardous fuels and wildfire risk. Some private lands of agency cooperators may also be burned with landowner agreement.

In addition, there are 8,459 acres identified as wildland urban interface (WUI) areas within the project boundary. These areas include ¼ mile buffers around any structure (houses) or infrastructure (powerlines) that contain National Forest System Land. Approximately 3,745 acres of WUI have been identified for mechanical treatment and 1,859 acres to be treated with prescribed fire. These treatments would reduce the amount of hazardous fuels and likelihood of having high intensity fires.

Construct Approximately 24 Miles of Fireline

The project area currently contains approximately 162 miles of perimeter fireline that consists of existing barriers such as roads, creeks, and handlines. This project would construct approximately 24 miles of new dozer line to complete to complete the perimeter. This addition will allow more efficient burn operations, decrease the amount of new fireline needed as compared to the use of multiple smaller burn units, benefit firefighter safety, and reduce the cost of fire operations.

Transportation Activities

There are approximately 38 miles of Forest Service System roads (FR) in the Fremont and Pineknot East Project area. Forest Service System roads are under the jurisdiction of the Forest Service and determined to be needed for long-term motorized access. There are approximately 29 miles of non-System roads in the Fremont and Pineknot East Project area. Non-System roads are roads on National Forest System lands that are not managed as part of the Forest Transportation System. Implementation of actions described in the following paragraphs would provide needed transportation and improve watershed health.

Road Maintenance and Reconstruction

There are approximately 25.6 miles of existing Forest Service System Roads that require road maintenance to facilitate resource management, public access, and safe transportation. There are approximately 12.5 miles of existing Forest Service System Roads that require reconstruction to facilitate resource management, public access, and safe transportation. The following roads are identified for reconstruction:

Table 6. Forest Service System Road Management Activities

System Road Number	Road Name	Length (Miles)	Surface Type	Maintenance Level	Road Activity
3145A	Little Bear	0.4	Aggregate	2	Reconstruct
3165	Unknown	1	Native	2	Reconstruct
3169E	Old Tram Spur E	1.3	Native	2	Reconstruct
3169Q	Curvy	1.4	Aggregate	2	Maintain

System Road Number	Road Name	Length (Miles)	Surface Type	Maintenance Level	Road Activity
3253	Hog Hollow	2.8	Aggregate	2	MP 0.0-2.65 Maintain MP 2.65-2.8 Reconstruct
3253A	Hog Hollow Spur A	0.5	Native	2	Reconstruct
3254F	Unknown	0.4	Native	2	Reconstruct
3254G	Unknown	0.6	Native	2	Reconstruct
3254L	Belleview	1.5	MP 0.0-0.5 Aggregate MP 0.5-1.5 Native	2	MP 0.0-0.5 Maintain MP 0.5-1.5 Reconstruct
3261	Little Pike Creek	3.5	MP 0.0-2.75 Aggregate, MP 2.75-3.5 Native	2	MP 0.0-2.75 Maintain MP 2.75-3.5 Reconstruct
3261C	Windes Creek	1.3	Aggregate	2	Maintain
3261F	Little Pike Creek Spur F	1.1	Aggregate	2	Maintain
3262A	Unknown	0.2	Native	2	Decommission
3270	Fremont Tower Rec Area	0.2	Convert to aggregate as asphalt deteriorates	Change ML from 4 to 3 when converted to aggregate surface	Maintain east entrance (0.1 mile). Decommission west entrance (0.1 mile)
3274	Windes Hill	1.2	Aggregate	2	Maintain
3278	Pike Creek	1	Native	2	Reconstruct
4006	Unknown	0.8	Aggregate	2	Maintain
4036	Cottage Grove	0.4	Native	2	Reconstruct
4045	Retort Hill	2.4	Aggregate	2	Maintain
4072A	Turley Hollow	1.4	MP 0.0-1.0 Aggregate MP 1.0-1.4 Native	2	MP 0.0-1.0 Maintain MP 1.0-1.4 Reconstruct
4088	Green Mountain	1.6	MP 0.0-1.1 Aggregate MP 1.1-1.6 Native	2	MP 0.0-1.1 Maintain MP 1.1-1.6 Reconstruct

System Road Number	Road Name	Length (Miles)	Surface Type	Maintenance Level	Road Activity
4097	Patty Hollow	2.7	Aggregate	2	Maintain
4097A	Unknown	0.3	Native	2	Reconstruct
4097B	Unknown	0.4	Native	2	Reconstruct
4100	Ebb Spring	0.5	Native	2	Reconstruct
4101	Exchange	0.5	Native	2	Reconstruct
4102	Kennedy	0.7	Native	2	Reconstruct
4113	Lost Hollow	1.2	Aggregate	2	Maintain
4248	Bull Camp Hollow	0.9	Aggregate	2	Maintain
4249	Edmundson Pond	1.4	Aggregate	3	Maintain
4261	Grassy Pond	0.7	Aggregate	2	Maintain
4719	Pleasant Site	1.5	Aggregate	2	Maintain
4728	Unknown	0.4	Native	2	Reconstruct
4737	Bristol Cemtery	1.3	Native	2	Reconstruct
4981	Pine Tree	0.9	Aggregate	2	Maintain

Road Decommissioning

Approximately 0.3 miles of System roads and 20.7 miles of non-System roads would be decommissioned as consistent with the 2005 Forest Plan. Decommissioning unneeded roads and unauthorized and illegal user-created roads and trails would improve watershed conditions and reduce other resource damage. Road decommissioning would result in the stabilization and restoration of unneeded roads to a more natural state. Decommissioning activities may include blocking access with earthen or rock berms, boulders or slash piles, re-contouring, and re-vegetating by seeding, planting, and fertilizing.

FR - 3262A (0.2 mi); 3270 (0.1 mi); 4050 (0.1 mi); 4072 (0.3 mi); NS – 9100 (0.25 mi); 9584 (0.3 mi); 9585 (0.7 mi); 9595 (0.15 mi); 9596 (0.7 mi); 9597 (0.5 mi); 9599 (1.0 mi); 9600 (0.4 mi); 9603 (0.2 mi); 9608 (0.5 mi); 9611 (0.1 mi); 9613 (0.35 mi); 9615 (0.2 mi); 9616 (0.6 mi); 9621 (0.4 mi); 9624 (0.6 mi); 9625 (0.4 mi); 9630 (0.9 mi); 9647 (0.25 mi); 9654 (0.45 mi); 9655 (0.25 mi); 9656 (0.4 mi); 9657 (0.15 mi); 9659 (0.4 mi); 9661 (0.3 mi); 9664 (0.1 mi); 9667 (0.3 mi); 9690 (0.8); 9691 (0.45 mi); 9694 (0.85 mi); 9696 (0.2 mi); 9697 (0.6 mi); 9698 (0.1 mi); 9701 (0.75 mi); 9702 (0.9 mi); 9703 (0.45 mi); 9704 (0.35 mi); 9749A (0.1 mi); 9749B (0.3 mi); 9751 (0.01 mi); 9771 (0.15 mi); 9999 (0.6 mi); 3145A (0.2 mi); 3253A (0.3 mi); 3254F (0.15 mi); 3254G (0.2 mi); 3260 (0.75 mi); 4088 (0.1 mi); 4102 (0.4 mi); 4113 (0.6 mi).

Public Access and Recreation

Install gates: An access gate would be installed on System Road 3261 at approximately the 3.0 mile post to limit access to the Fremont Tower.

Ozark Trail Relocation: Relocate approximately 1.4 miles of the Ozark Trail.

Pond Activities

Maintenance would be performed on approximately 10 wildlife ponds to remove woody shrubs and tree from the dams which weaken dam structural integrity and eventually leads to dam failure. Preliminary analysis suggests that 2 ponds need reconstruction. Needed maintenance and or reconstruction may be performed on other wildlife ponds in the project area as they are encountered and evaluated during project implementation.

Connected Actions

Temporary Road Construction: Approximately 5 miles of temporary roads would be constructed to implement project activities. These temporary roads would be closed after use.

Associated Activities: The Eleven Point Ranger District will continue implementation of forest management activities directed by the 2005 Forest Plan including:

- Manage designated State Natural Areas and special areas (Big Barren Natural Area, Fox Pond, Grassy Pond, Tan Bark Pond ,and Young Hollow Pond).
- Signage and boundary, tail improvements management and closure of woods roads and trails.
- Conduct non-native and invasive plant species control.
- Eradicate feral hogs.
- Remove hazard trees along roads and trails.
- Remove trash dumps.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). In general, external comments (public) and internal concerns received in response to the Proposed Action would provide suggestions for alternative methods for achieving the purpose and need, as discussed above.

An alternative that with no prescribed fire activities and utilizing mechanical vegetation treatments only was considered and dropped from further analysis.

This alternative was dropped from further review because it would not fully meet the purpose and need for the project. To meet Management Prescription 1.1 goals and desired conditions requires re-establishing the role of fire in the the natural communities within the project area. Without the use of prescribed fire the changes in forest overstory, reduction of hazardous fuels and recovery of ground cover species would not be met. Mechanical treatment only would make some changes in vegetative structure and composition but it would not result in changing the ground cover species composition.

This alternative was dropped from further review because it would not met the following Forest Plan Goals and Objectives:

> **Goal 2.2 Prescribed Fire, Fuels and Wildland Fire Management** (USDA Forest Service: Mark Twain National Forest, 2005b, pp. 1-4):

- Re-establish the role of fire in the natural communities of the Ozarks by emulating the historic fire regime.
- Restore fire regime condition class two or three lands to condition class one.
- Reduce hazardous fuels.
- Reduce wildland fire risk to communities.

Objective 2.2b Use prescribed fire to reduce hazardous fuels and improve Fire Regime Condition Class on 45,000 acres or more per year.

An alternative that would reduce the amount of prescribed burning and reduce the burn unit size to 250 to 500 acres was considered and droped from further analysis.

Public comments suggested reducing the number of acres of the prescribed burning and limit burn units to approximately 250-500 acres in size for the project. There would be some restoration improvements accomplished on the landscape associated with this approach but it would not fully meet the desired conditions or the purpose and need for the project nor would it result in timely restoration at the scale suggested in the Forest Plan. The Fremont-Pineknot East project area is considered a highly ranked area for natural community restoration purposes based on ecological assessments where much of the species composition and structural component were identified as being present (Ozark Ecoregional Assessment Team, 2003, Nelson & Moore, 2006). To reduce prescribed burn acres in a highly restorable landscape would limit species viability for woodland wildlife species dependent on this habitat The limited burn unit size would not provide the connectivity needed to promote wildlife life cycle needs in an already impaired ecosystem. Reducing burn unit size and burning acres would not mimic natural patterns and the range of variability to ensure the natural community is present in the amounts, distributions, and variability characteristic of Missouri's presettlement landscape (Forest Plan, p. 3-3). To create burn units in the 250 to 500 acre size across the project area creates the potential for more ground disturbing activities due to the need for additional fire control lines. This increase in ground disturbance has the potential to adversely impact soil and water resources. This alternative was considered and dropped from consideration because it would not fully meet the purpose and need to achieve the goals and objectives in Management Prescription 1.1 (Forest Plan, pp. 3-3 to 3-5).

PROJECT SUMMARY

Summaries of proposed project activities are provided in Table 7 and Table 8.

Table 7. Summary of Project Activities in the Fremont Area

Proposed Activity	# of Stands/Units	% of Project Area	Acres/Miles
Restoration Thinning	273	12.8	4,931
Commercial Thinning	211	9.7	3,742
Salvage/Sanitation Harvest	106	5.1	1,949
Seed Tree Harvest with Reserves	68	2.5	978
Shelterwood Preparatory Harvest	2	0.1	33
Stand Clearcut with Reserves	5	0.2	78
Precommercial Thinning	131	5.4	2,073
Control of Understory Vegetation	293	13.4	5,169
Plant and Release of Shortleaf Pine	120	5.5	2,115
Glade Restoration	19	0.1	15
Prescribed Fire Management	28	49.4	19,018
Road Maintenance	15		24.6 mi.
Road Reconstruction	12		10 mi.
Road Decommissioning	34		16 mi.

Table 8. Summary of Project Activities in the Pineknot East Area

Proposed Activity	# of Stands/Units	% of Project Area	Acres
Restoration Thinning	56	14.0	1,332
Commercial Thinning	24	4.9	469
Salvage/Sanitation Harvest	23	4.5	430
Precommercial Thinning	5	0.6	59
Control of Understory Vegetation	53	13.4	1,279
Plant and Release of Shortleaf Pine	23	4.5	430
Prescribed Fire Management	4	68.0	6,490
Road Maintenance	3		3 mi.
Road Reconstruction	7		5 mi.
Road Decommissioning (non-system roads)	11		3 mi.
Ozark Trail Relocation	1		1.4 mi.

CHAPTER 3 - ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES

This Chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter.

The following are definitions of terms used in discussing the environmental effects of proposed activities.

Affected environment (40 CFR 1502.15) is a brief description of the area(s) to be affected by the proposed activities. The description shall be no longer than is necessary to understand the effects of the alternatives. **Direct effects** (40 CFR 1508.8) are those occurring at the same time and place as the triggering action (e.g. Prescribed fire activities impacts to vegetation). **Indirect effects** (40 CFR 1508.8) are those caused by the action, but occur later, or at a distance from the triggering action, (e.g. Sediment input into streams due to a loss of vegetative cover from prescribed fire). **Cumulative effects** (40 CFR 1508.7) are the effects on the environment that results from incremental effect of the action added to the effects of other past, present, and reasonably foreseeable future actions, regardless of whether or not the agency or person undertakes them and regardless of land ownership on which other actions occur. An individual action when considered alone may not have a significant effect, but when its effects are considered in addition to effects of other past, present, and reasonably foreseeable future actions, the effects may be significant (e.g. the effects of herbicide use on water quality).

The cumulative effects analysis for each alternative is evaluated separately for each resource and may have different spatial and temporal boundaries. Agencies are not required to list or analyze the effects of individual past actions unless such information is necessary to describe the cumulative effect of all past actions combined. The analysis of cumulative effects begins with consideration of the direct and indirect effects on the environment that are expected or likely to result from the alternative proposals for agency action. Agencies then look for present effects of past actions that are, in the judgment of the agency, relevant and useful because they have a significant cause and effect relationship with the direct and indirect effects of the proposal for agency action and its alternatives.

The USDA Forest Service uses the best available science and most reliable and timely data available. Accuracy from the Geographical Information Systems (GIS), Natural Resource Information System (NRIS), Forest Service Activity Tracking System (FACTS), and other databases vary in accuracy. All attempts to verify and update this information have been made where possible. The IDT is keenly aware of the need to ensure the scientific integrity of the information used in this analysis.

SOILS

AFFECTED ENVIRONMENTS

The project area lies within the Current River Hills subsection of the Ozark Highlands State Natural Division. The subsection consists of the hilly to deeply dissected portion of the Current, Black, and Eleven Point drainage basins. Soils are rocky and formed mainly from carbonate and sandstone bedrock. Local karst, losing streams, and large springs are characteristic to this area (Nigh & Schroeder, 2002).

Soils are closely related to bedrock and landscape position in this subsection. Soils formed the Roubidoux Formation are low in soluble bases, such as calcium and magnesium. These soils include the VIBURNUM and TONTI series on interfluves. TONTI soils have a root-restricting fragipan in the subsoil. Backslope soils that formed in Roubidoux residuum include the very deep COULSTONE and CLARKSVILLE series and the moderately deep BENDER series, all which are very cherty. Soils formed in residuum from the Gasconade and Eminence-Potosi Formations are higher in soluble bases; these soils include the RUETER and SCHOLTEN soils on summits SCHOLTEN soils have subsoil fragipans. The shallow, clayey GASCONADE soils are associated with glades in this subsection.

The dominant soil types in the project area are somewhat excessively drained to well drained Paleudults and Paleudalfs on ridges and side slopes; the moderately well drained Fragiudults on slopes; the somewhat excessively drained, shallow Hapludolls, and areas of rock outcrop on steep dissected landscapes; and the Udifluvents on flood plains and Hapludalfs on terraces in stream valleys. The dominant soil mapping units are the CLARKSVILLE, COULSTONE and CAPTINA soils.

Management Considerations: Management considerations describe soil characteristics that may be affected by implementation of Alternative 2, the Proposed Action. Primary management concerns for soils in the project area are rutting, compaction, and erosion; especially for ridgetop soils with a fragipan that can perch water tables. The dominant soil types in the project area are SCHOLTEN-POYNOR-TONTI complex and COULSTONE-SCHOLTEN-CAPTINA complex which are moderately well-drained to somewhat excessively drained. Fragipans may slow drainage on SCHOLTEN and TONTI soils.

The use of heavy equipment required to harvest trees creates a risk of soil disturbances that could reduce the productivity of forest soils. The resulting soil disturbances could contribute to reduced water infiltration rates, increased runoff and sediment delivery to streams, and demonstrated poor land management. Soil disturbances resulting from timber harvests can be limited by using the appropriate equipment, avoiding operations during wet periods, and by careful monitoring during harvest operations. When disturbances occur, potentially negative effects can be reduced by remedial actions such as tillage, the re-establishment of drainage patterns, and or implementing erosion control.

A brief listing of potential soil issues and concerns associated with timber harvests include the following:

- Compaction: Compaction is likely one of the leading causes of soil degradation resulting from timber harvest operations (Brais, 2001). The immediate (direct) effects of heavy equipment on soil properties are: a) increased soil resistance to penetration; b) reduced conductivity of soil to water and gas flow through a reduction in the size, continuity, and total volume of pores, especially large pores; and c) reduced number, size, and/or strength of structural aggregates. The distribution of these effects within the soil profile is a function of ground pressure and total load (ground pressure X contact area of the tire or track), soil characteristics (e.g., texture, structure), and moisture conditions at the time of operation.

  Soil compaction commonly reduces growth of young trees that regenerate on the site following conventional harvest (Greacen & Sands, 1980). Severely compacted forest soils could remain compacted for decades (Froehlich, Miles, & Robbins, 1985). In cold climates where freezing and thawing are assumed to loosen soil to considerable depths, the bulk density of compacted soil decreases slowly (Corns, 1988; Voorhees, 1983).

- Displacement: Displacement refers to the excessive mechanical relocation or removal of surface minerals and or organic soil layers sufficient to reduce long-term productivity and the biodiversity of soil dependent flora and fauna. This is especially important because most of the soil nutrients are held in the surface horizons (Brady, 1974). Mixing mineral and organic soil materials is not considered detrimental soil displacement. However, its effects must be assessed on a case-by-case basis.
- Puddling: Puddling is the result of the destruction of the natural structure of a mineral soil when the ground is too wet or saturated. Fine-textured soils containing high amounts of clay are more susceptible to puddling type disturbances. Puddling usually results in a reduction of macropore space by 50% or more in severely damaged areas; this condition may restrict or even prevent the infiltration of water at the ground surface, causing erosion by surface runoff conditions.
- Ground Cover: A lack of adequate effective ground cover usually results in accelerated surface erosion. Effective ground cover can include low growing vegetation, including lichens and mosses, or rock, litter, and duff. The amount of effective ground cover needed to prevent erosion varies by local climate, slope, and soil texture.

Another consideration is logging on soils located on steeper slopes. Soils on steep slopes are susceptible to erosion, especially on droughty, south-facing aspects. When disturbed by harvest activity, soils with steep slopes and southern aspect conditions may be subject to erosion levels in excess of standards specified in the 2005 Forest Plan. Portions of stands with slopes exceeding 35% would be excluded from logging. Timber harvests would not occur in stands with predominant slopes exceeding 35%, in accordance with the 2005 Forest Plan (USDA Forest Service: Mark Twain National Forest, 2005b).

Soil Surveys of Shannon and Carter Counties were reviewed and considered during this soil analysis. The Soil Surveys of Shannon and Carter Counties, Missouri, describes numerous soil characteristics that are relevant to the Fremont and Pineknot East Pine-Oak Restoration Project. Ground cover in the project area is primarily leaves, sticks, and other organic matter. Rocks are scattered on the surface. Puddling and soil compaction are concerns due to seasonal perched water tables extending 2-3 feet below the ground surface in some soils.

According to the soil survey, the project area is gently sloping to steep, with soils that are somewhat excessively drained and moderately well-drained. They are formed in residuum from sandstone and dolomite. Erosion hazard is slight on slopes less than 35% and moderate to severe on slopes greater than 35%. Equipment limitations are slight to moderate on slopes less than 35% and severe on slopes exceeding 35%.

Permeability is moderately rapid. Permeability is moderate in the upper layers and slow in soils with fragipans. Extended periods of rain or seasonal high water tables may make slowly permeable soils inoperable at times.

DIRECT AND INDIRECT EFFECTS ON SOILS

Alternatives 1 and 2 were evaluated to determine if implementation would result in any detrimental effects to the soil resource. Potential concerns associated with proposed timber harvests, temporary haul road activities, and prescribed burning activities include: impacts due to erosion; impacts on microorganisms such as fungi and bacteria in the soil; compaction and nutrient removal from the soil; and increased ground temperatures.

Because soil is eroded off the surface horizon, erosion results in a loss of nutrients for forest productivity (Pritchett & Fisher, 1987). It also results in a loss of biodiversity of thousands of species of soil microorganisms which are lost where soil erosion takes place (Pierzynski, Sims, &

Vance, 2000; Roesch, et al., 2007). In addition, erosion can result in a loss of carbon sequestered in the surface horizon (Boyle, 2002).

Erosion Hazard is rated according to the risk of erosion on forestland where normal practices are used in managing and harvesting trees. A *Slight* erosion hazard rating indicates soil loss is not an important concern. A *Moderate* erosion hazard rating indicates that some attention to soil loss is required. A *Severe* erosion hazard rating indicates that intensive treatments (such as seeding and mulching disturbed areas, water diversions, etc.) or special equipment and methods of operation are required to minimize erosion. Potential erosion hazard is principally based on slope and erodibility, as well as soil depth.

In addition to erosion, most soils on the Mark Twain National Forest are generally susceptible to compaction, puddling, and displacement, particularly when land management treatments resulting in ground disturbance are applied haphazardly.

All soils are generally susceptible to displacement during heavy equipment-based management treatments or other activities that result in ground disturbance and loss of ground cover. During non-heavy equipment-based land management activities displacement is largely dependent on soil texture, soil structure, soil moisture, rock fragments, and ground cover. Soils are typically most susceptible to displacement when they have sandy textures, weak structure, are dry, and have few rocks and ground cover.

Direct and indirect effects to soils include soil compaction, soil puddling, soil displacement, and soil surface erosion from heavy equipment operation on sites where management activities would occur. Soil surface disturbance is important because it has an impact on soil quality and sustainability. This disturbance would be expected to occur on log skid trails and landings during harvest activities, and may persist until the soils have recovered.

ALTERNATIVE 1 – NO ACTION

Under Alternative 1, no new management activities would take place, nor any activities associated with Alternative 2. Therefore, no appreciable management-related changes in productivity of the land would occur. Resource management activities by the Forest Service approved under other project decisions or management authorities would be implemented. There would be no impacts to the soil resource from Fremont and Pine Knot East Project management activities since none would be implemented.

Soils would be impacted by both system road use and maintenance as well non-system roads. Erosion and sediment production from non-system roads and trails will continue unchecked and increase with expanded use.

In the absence of wildfire, current runoff and erosion patterns would continue with no appreciable increases expected. Disturbance to the soil and water resources would generally occur only at natural rates. An upland erosion rate of 0.027 ton/acre/year is predicted by Water Erosion Prediction Project (WEPP) modeling for stands on steep slopes in similar soils in the absence of disturbance (Elliot & Hall, 2010; Heikens, Karlen, Erbach, Hanna, & Jensen, 1999).

Natural processes and functions would continue to occur as dead material decomposes. Actual soil organic matter may increase with an accompanying increase in microorganisms and fungi. Since there would be no harvesting, no carbon would be removed from the forest. Dead and dying trees would decay with carbon released to the atmosphere.

Existing conditions would continue as described in the *General Effects of Soil Disturbance* section. Forest areas would remain normally functioning, and soils would remain in good condition unless they are disturbed in areas where the terrain is hilly or steep. The only disturbances to soil and water would be abnormal rainfall (excessively high or low amounts) and

possible wildfire. Otherwise, natural conditions would continue. Organic matter would continue to increase, with expected dead and blown-down trees contributing to the overall organic matter collecting on the ground.

Under Alternative 1, the No Action Alternative, fuel-loading conditions would not be reduced nor would biomass be removed through silvicultural treatments. Wildfires could occur under conditions of increased fuel loading and be expected to burn at a higher intensity and over a larger area than would have occurred if fires had burned at historical fire frequencies (Guyette & Spetich, 2003).

ALTERNATIVE 2 - PROPOSED ACTION

Under Alternative 2, the Proposed Action, three proposed resource management activities have the greatest potential to affect the soil resource: 1) timber harvests, and associated temporary road construction; 2) prescribed burning and dozer fireline construction; and 3) road reconstruction and maintenance.

Timber Harvest: Timber harvests have the potential to adversely impact soil resources. Timber harvest operations can result in short- and long-term effects to soil productivity. Short-term effects generally last 3 years or less, and include the recovery period in which disturbed soils become re-established with vegetative cover. Short-term effects imply that the existing soil profile is left essentially intact. Surface disturbances, such as shallow compaction and removal of vegetation are possible short-term impacts.

Long-term effects are associated with activities which displace the topsoil. Many years are needed for the soil to recover its original productivity when surface layers are removed. Soil formation typically occurs at a rate of one inch per 200-1,000 years, and depends on many local environmental factors. Severe compaction caused by rutting is an example of a long-term impact. Salvage operations should be suspended during wet periods to limit the risk of rutting.

In conventional salvage operations, the impacts of unbladed primary and lateral skid trails should be short-term. Anticipated soil disturbances caused by skidding include minor soil displacement and tracking. Temporary roads and log landings are expected to have more adverse impacts to the soil due to the high amount of traffic they receive.

Log landings would be no larger than necessary (approx. 1/4 acre or less) and located on stable, adequately drained soils where skidding is directed away from stream courses. No log landing cleared to mineral soil in the Fremont and Pineknot East Project would require more than one acre of land.

Areas within harvest units adjacent to skid trails should recover quickly. Research has shown that the upper few inches of soil recovers quickly, within 5 years from minor compaction (Reisinger, Pope, & Hammond, 1992). This is due to additions of organic matter 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 8-12 inch soil depth zone, but compaction is not expected at these depths unless equipment operates in wet conditions.

Soil compaction would occur on log landings and primary skid trails as a result of heavy equipment use with Alternative 2. Areas of concentrated use, such as log landings and primary skid tails, are expected to receive the most use and impacts. Specific impacts include rutting and compaction which could increase soil bulk density, decrease pore space, decrease the infiltration rate**,** and decrease the water holding capacity. These effects are considered detrimental to plant growth. Jordan, Ponder, and Hubbard (2003) reported decreased rates of height growth, dry weight, and nitrogen uptake of red oak (*Quercus rubra*) and scarlet oak (*Quercus coccinea*) as compared to a control area following 6 months of growth in highly compacted soil.

The degree and depth of compaction depends on the number of passes made by the equipment, and moisture content of the soil at the time 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. Compacted areas should be ripped and seeded to help mitigate the effects of compaction and promote re-vegetation.

Compaction potential would be greater during periods of wet soil conditions. Rutting would occur if equipment operates on wet soils; therefore wet soils should be avoided in logging plans. Seasonal soil wetness is difficult to predict, but when soils are prone to high seasonal water tables, logging during the summer-dry season or on frozen soil is preferred. Harvesting equipment is moderately suited to this ground during periods of dry weather.

When rutting occurs in the harvest area, it is considered a long-term effect. The time required for natural recovery from compaction is determined by a variety of factors, such as the soil's physical characteristics, chemical characteristics, climate, and the severity of compaction. Recovery may be faster where soils are subject to freezing-thawing or wetting-drying cycles. In the absence of site-specific information, the effects of compaction on forest soils may be assumed to persist for several decades (Miller, Colbert, & Morris, 2004).

Soil movement (erosion) can occur on long, unimpeded slopes, where mineral soil material is exposed to raindrop impact and overland water flow. Soil on upper slopes can lose productive topsoil as it moves downslope with water. Soil erosion may occur where bare soil is exposed on a slope as a result of equipment tracking difficulties (such as spinning wheels), bladed skid roads and landings, or where logs are dragged across the soil repeatedly.

Placing landings on gentle topography prevents long, unimpeded runs. Vegetative soil cover, water diversions, and slash mats from logging debris, which is commonly found on harvested areas, would prevent long, unimpeded runs, and reduce the likelihood of soil erosion.

No timber harvest activities are planned for riparian areas of intermittent or permanent streams. Any existing riparian areas downslope from harvest sites would receive minimal effects because they would be protected by buffer strips. These buffer strips should keep erosion from reaching streambeds.

Soil microbial communities are not expected to be adversely impacted by timber harvests because residual logging debris (tops, limbs, and cull logs) and rotting trees would be left to decay on-site. In a study of the effects of logging methods on soils, Ponder and Tadros (2002) found no significant differences in microbial biomass following whole tree and bole only harvests. Therefore, a logging-related soil disturbance effect on microbial activity does not appear to be long-term.

WEPP modeling predicts erosion from unmitigated skid trails to range from 1.88 tons/acre/year on 0-10% slopes, to 4.57 tons/acre/year on 30-35% slopes. All applicable 2005 Forest Plan standards and guidelines would be implemented to minimize or prevent adverse effects to soil and water resources. In addition to 2005 Forest Plan guidance, the Mark Twain National Forest commonly uses Best Management Practices such as those suggested by Waters (1995). Forest practices to protect soil and water resources and stream courses typically include locating roads on appropriate sites, and the use of water barring, drainage diversions, and so on to reduce impacts from temporary roads, skid trails, and other management actions. Using methods prescribed by the 2005 Forest Plan and Best Management Practices (Appendix A), erosion levels would be expected to return to pre-harvest levels within 2-3 years after treatment.

Road Management

Temporary Haul Road Construction: Erosion and sediment production are generally highest during road construction and gradually decreases over time, as disturbed areas are stabilized by vegetation or creating an armored surface, such as gravel addition. Erosion rates may increase when roads are maintained or reconstructed as the previously stabilized surfaces are re-disturbed. Road surfaces and ditches can continue to produce large amounts of sediment as long as traffic or road maintenance operations prevent re-vegetation or surface stabilization.

Maintenance: There are approximately 38 miles of FS system roads and 29 miles of non-system roads within the project area. 25.6 miles of FS system roads have been identified for maintenance, 12.5 miles of FS system roads have been identified for reconstruction, and 1.2 miles of non-system roads have been identified for reconstruction and would be converted to FS system roads.

Road maintenance activities could result in direct sediment delivery to streams. Ground disturbance from road blading, particularly where the road is adjacent to streams, constitutes the greatest risk from increased sediment production (Sheehy, 2001). The potential adverse effects of road maintenance must be considered in the context of performing maintenance versus possible consequences of not maintaining roads. Road maintenance is necessary to prevent damage to the road, to maintain safety by reducing dust, washboards and raveling, and to minimize adverse impacts to resources resulting from lack of road maintenance. Proper and timely road maintenance is proven to minimize sediment delivery to streams from open roads (Sheehy, 2001). Lack of maintenance can produce severe rutting and gullying during wet periods, thus contributing large amounts of sediment into the watershed. Road maintenance and decommissioning may require the use of heavy equipment to re-contour the road surface or to rip deeply compacted soil. Short-term increases in dust and sediment may result until new vegetation is established.

Decommissioning: Approximately 0.3 miles of FS system roads and 20.7 miles of non-system roads have been identified for decommissioning. Any non-system roads used as temporary roads to perform vegetation management activities would be decommissioned after activities are completed. Additionally any unauthorized and user-created trails that are observed in the project area would be decommissioned. Road decommissioning would result in stabilization and restoration of unneeded roads to a more natural state.

Decommissioning roads in the Fremont and Pine Knot East Project area would benefit soil and water resources by reducing or eliminating the potential for adverse road effects. The presence of roads can influence overland flow, geomorphology, and ecosystem processes (Switalski, Bissonette, DeLuca, Luce, & Madej, 2004). Roads reduce soil infiltration and can be chronic erosion sources. Even abandoned roads, if untreated, can continue to produce substantial amounts of sediment over time as they slowly re-vegetate; thus re-contouring and re-vegetating roads would provide immediate stabilization and reduction of watershed impacts.

Prescribed Fire: Prescribed fire would be implemented on approximately 25,508 acres within the project area. 24 miles will require dozer line construction, the remainder would utilize roads, creeks, and hand lines. Prescribed burns would be timed and conducted in accordance with the 2005 Forest Plan and the burn plan for the project area.

When conducting prescribed burns, dozer fireline construction poses the greatest risk of detrimental soil disturbance. Combustible fuels are removed by blading, resulting in topsoil displacement and exposed mineral soil. Removal of the protective vegetative layer leaves the soil vulnerable to wind and rain erosion until vegetation is re-established. Constructed fire lines may alter infiltration rates, become sediment sources, and may alter surface runoff patterns (Van Lear & Waldrop, 1989). Hand line is typically constructed using only leaf blowers and leaf rakes, resulting in negligible surface soil disturbance. Nonetheless, exposed soil in firelines, would likely produce sediment during intense rain events, until they are re-vegetated. In the absence of

severe erosion, detrimental soil disturbance associated with dozer line construction is expected to be minimal.

It is important to understand the difference between fire intensity and fire severity. Fire severity is best described as the amount of energy (heat) that is released by a fire, and the degree that it affects soil physical and chemical properties. Fire intensity is a term used to describe the rate at which fire produces thermal energy (heat); fire intensity is best measured by fireline flame length, where fire intensity is the rate at which an on-going fire produces thermal energy (Van Lear & Waldrop, 1989). Although the two terms can be closely related, they may also be unrelated. For example, a burn that completely consumes the organic matter layer and alters mineral soil structure and color would be classified as a severe burn. While a high-intensity fire in heavy fuels occurring when the soil and forest floor are moist would leave a large amount of residual forest floor, and not alter soil structure and color. Thus, in this example, a high intensity fire would be classified as of light severity.

High intensity broadcast burns generally leave portions of the forest floor intact, because rarely do these types of fires burn uniformly across an entire landscape. Prescribed fire is a random process (Johnson V. J., 1984), and there are usually areas that fail to burn or burn only lightly, even in generally intense fires. The quantity of forest floor left unconsumed can be controlled by terrain and weather conditions.

Prescribed burns conducted when soil and fuel moisture conditions are too dry can cause severe damage. Especially on BENDAVIS, GATEWOOD, and POYNOR soils which are found throughout the project area. Broadcast burns conducted under these conditions can remove all materials on the forest floor and cause accelerated erosion in steep terrain. Fires which burn completely down to mineral soil may accelerate soil erosion in steep terrain.

CUMULATIVE EFFECTS ON SOILS

The spatial boundary used to evaluate soil effects is the activity area within the project area boundary because this is the area that would be directly impacted by the proposed activities. The temporal boundary of analysis considers soil development through geologic time with the historic effects to soils created by humans and other impacts that have affected soil resources.

Under Alternative 1, no new management activities would take place, or any activities proposed in the Fremont and Pineknot East Pine-Oak Restoration Project. Therefore, no appreciable management-related changes in productivity of the land would occur. Soils would be impacted by both system road uses as well non-system roads. Erosion and sediment production from non-system roads and trails would continue unchecked and increase with use. Sediment delivery to stream channels would increase, resulting in decreased water quality.

Under Alternative 2, past measurable detrimental impacts to soil and water, primarily associated with grazing and timber harvests would still exist on the landscape. Compacted or eroded areas would remain and natural recovery of these areas would continue at current rates. Some additional direct soil impacts, such as compaction or removal of protective ground cover, would result from construction of temporary haul roads, dozer lines, and parking areas. Conversely, restoration actions, associated with Alternative 2 would occur, thereby enhancing watershed hydrologic function, stabilizing degraded roads and trails, and accelerating natural recovery. Foreseeable future effects may result from unauthorized use of temporary haul roads and dozer lines. However, the effects can be mitigated through adherence to the standards outlined in the 2005 Forest Plan and State Best Management Practices.

On national forest lands, past activities have included timber harvests and associated road building and maintenance, the creation of log landings and haul roads, mining, and the

construction and maintenance of wildlife openings. Past resource management activities have affected the soils to some degree.

Alternative 2, the Proposed Action, has potential to affect soil resources as a result of activities associated with timber harvests and prescribed fire. The effects of these activities on soil resources in the project area can be described in terms of short- and long-term effects on soil productivity. Short-term effects are those lasting 3 years or less, and are associated with a recovery period in which disturbed areas re-vegetate. Short-term effects imply that the existing soil profile is left essentially intact. Surface disturbances, such as shallow compaction and removal of vegetation are potential short-term 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 surface layers are removed.

Estimated acres impacted by the proposed activities are listed in Table 9. Estimates are classified as related to potential short-term or long-term impacts to soil productivity. Total impacted acres would be in addition to those affected by current and past use in the Fremont and Pineknot East Pine-Oak Restoration Project area.

Past projects (date signed) potentially within the soil cumulative effects boundary include the following:

Van Buren (9/7/2011): Activities commercial harvesting 600 acres, non-commercial thinning 1,098 acres.

Cane Ridge West (10/25/2009)*:* Construction of 0.7 miles of new system road. Prescribed burn on 7,599 acres, and 8.4 miles of new fireline. Commercial harvest on 3,905 acres.

Handy (10/21/2009): Prescribed burn on13,498 acres, commercial harvest 7,661 acres, construct 5 miles of temporary road, and construct 20 miles of dozer fireline.

Cane Ridge East (3/18/2008): Commercial harvest 4,684 acres. Prescribed burn on 9,860 acres, with 7.8 miles of new fireline.

Possum Trot (8/12/2005): Commercial harvest 1,797 acres, construct 20 miles of skid trail, and decommission 34 miles of road.

Actions planned for National Forest land include the Briar Project (approximately 13,000 acres) which is scheduled for a Decision Notice to be signed in 2015. The Forest Service is not aware of any large scale management actions planned on the land owned by the State of Missouri near Fremont and Pineknot East Pine-Oak Restoration Project area. There are approximately 996 acres of State land inside the project area itself. Reasonable foreseeable actions on private lands, based on past trends in the area, could include some timber harvesting and prescribed burning. Other activities on private land may include pasture conversion and housing development. Lands most suitable for pasture are already in pasture; new housing developments have a close correlation to good access. Based on 2010 aerial photos, between 40%-60% of the private land within the cumulative effects area is openland, predominately in pastures. Activities on private land within the Fremont and Pineknot East Pine-Oak Restoration Project area do not appear to be causing detrimental impacts to soil stability or function.

Table 9. Estimated Acres of Soil Impacted by Activities Proposed in Alternative 2

Project Activity- Alternative 2	**Short-Term Soil Effects**	**Long-Term Soil Effects**	**Total**
System Road Maintenance: 25.6 miles	78.29 acres	0	78.29 acres
System Road Reconstruction: 12.5 miles	22.73 acres	0	22.73 acres
Temporary Road Construction: 49.0 miles	11.86 acres	59.39 acres	71.25 acres
Road Decommissioning: 21.0 miles	25.45 acres	0	25.45 acres
Dozer Fireline: 24 miles	26.19 acres	2.90 acres	29.09 acres
Log Landing Construction: 400@ 0.5 acres each 200 acres	100 acres	100 acres	200 acres
Primary Skid Trails: 500 ft. per Landing	111.60 acres	12.40 acres	124 acres
Totals	**376.12** acres	**174.69** acres	**550.81** acres

Assumptions used for Table 9:

1. Haul roads have 10 feet of travelway and 12 feet of cleared right-of-way.
2. System roads have 15 feet of travelway and 17 feet of cleared right-of-way.
3. Temporary haul road construction impacts areas that are currently and those that would continue to be expected to produce biomass in the future. Temporarily using these sites for roads would cause some long-term impacts to soil productivity.
4. Haul road travel way is bladed, and topsoil is displaced.
5. Primary skid trails are unbladed and have a 12-foot width.
6. Dozer-constructed fireline displaces some topsoil and is 10 feet wide.

Log landings would be constructed at the end of each temporary road. Log landings are 0.25 acres each and 50% of this area is a long term impact due to blading and compaction where trucks are loaded, while the balance of the area is unbladed and considered a short term impact.

Under Alternative 2, the amount of land and soils impacted would not be significant. To put the magnitude of land and soil impacts into perspective, the Fremont and Pineknot East Pine-Oak Restoration Project Activity Area consists of 11,666 acres, or 39% of the project area would be receiving one or more forms of treatment. Short-term effects are limited to an estimated 376 acres, or 3.22% of the activity area. Long-term effects may occur on an estimated 175 acres, or 1.50% of the activity area. A total of 550 acres or 4.71% of the activity area is expected to receive some degree of soil disturbance; either by timber harvests or prescribed fire activities.

Irreversible or Irretrievable Commitment on Soils Resources

Unauthorized use by motor vehicles over time could permanently degrade soil and water resources of the project area. Irreversible effects may occur if temporary haul roads and dozer lines are not properly decommissioned.

Based on review of existing field conditions and the project proposal, activities proposed in this project combined with existing activities are unlikely to produce sufficient long-term impacts to the soil resource to move the Fremont and Pineknot East Pine-Oak Restoration Project area into a detrimentally disturbed condition.

FIRE/FUELS EFFECTS

AFFECTED ENVIRONMENTS

Fire management on the Mark Twain National Forest is guided by National Fire Policy, the 2005 Forest Plan and the Mark Twain National Forest Fire Management Plan. Fire is a natural disturbance process that was present throughout the landscape during the time when native natural communities developed. Most historical natural communities and vegetation patterns have changed significantly in the past 100 years resulting in the loss of grass-forb dominated woodlands, glades and savannas; and the loss of their diverse structural openness on the National Forest.

Current literature provides evidence illustrating fire's role in shaping and maintaining closed and open woodland types that historically existed in the project area. Throughout history, fire played a role in maintaining pine and pine-oak communities. Guyette and Dey (2000), Guyette and others (2006), and Stambaugh and others (2006) provide accurate records in the modeling of historic fires across the Eastern US and the Ozark regions. Currently, these pine and pine-oak woodlands are out of character, particularly in terms of forest structure (basal area and canopy structure). Prescribed fire is a tool that can control understory woody vegetation to re-establish the herbaceous layer, aid in nutrient cycling and reduce hazardous fuel loading. This is consistent with Forest-wide goals and objectives (USDA Forest Service: Mark Twain National Forest, 2005b, pp 1-4 to 1-5).

Within the project area, plant community composition and structure currently resemble a dense upland forest, which is a substantial alteration from what historically would have been open and closed woodlands. Ninety percent (90%) of the Fremont project area and ninety-five percent (95%) of the Pineknot East project area is classified within Fire Regime Condition Class 3. The use of prescribed fire and silvicultural methods in Management Prescription 1.1 areas are the primary means of providing the natural habitats necessary to support native plant and wildlife populations.

Modern settlement, which included land-clearing, large scale deforestation, open-range domestic livestock grazing, intentional repetitive fires, and more recently, fire suppression, has significantly altered the ecosystem. Currently, there is a pine-hardwood forest type consisting of hardwood leaf litter and a pine needle cast ground layer, represented by Fuel Model 9. Fuel loading in the project area has been determined to be approximately 16 tons per acre (Project File). Historically, this area would have been a pine-hardwood woodland type with an herbaceous understory flush with grasses and perennial vegetation, represented by Fuel Model 2. Fuel Model 2 is commonly represented by stands with an understory of fine herbaceous fuels and a pine overstory that may cover 1/3 to 2/3 of the area, with a typical fuel load of approximately 4 tons per acre. The current fuel loading in the project area is out of character for the historical range and can increase the risk of wildfire.

The deliberate use of prescribed fire within the scope of this natural community restoration project would provide the appropriate response needed in order to meet the desired conditions while also reducing fuel loading to historic levels and lower wildfire risk. The District fire management program implements prescribed fire projects in the fall and spring of the year. The focus of the fire program is within Management Prescription 1.1 areas only. No prescribed fire is implemented outside of this management area. There would be a total of 63,031 acres available for applying prescribed fire, which includes this project area. For the past 5 years, the district has averaged 9,745 acres of prescribed fire treatments per year. This results in applying prescribed fire practices on 2.7 percent of the district annually. The additional acres associated with the Fremont-Pineknot East project will result in increasing this annual percentage to 4.4 percent. This would equate to nineteen percent (19%) of the district available for prescribed fire activities. The remaining eighty-one percent (81%) of district acres would not undergo prescribed fire treatment.

Forest Plan Direction: The 2005 Forest Plan provides specific guidance on the use of prescribed fire and fire management activities.

The 2005 Forest Plan specifically states under Forest Wide Goals and Objectives (pp. 1-4 to 1-5):

Goal 2.2 – Prescribed Fire, Fuels, and Wildland Fire Management

- Re-establish the role of fire in the natural communities of the Ozarks by emulating the historic fire regime.
- Restore fire regime class two or three lands to condition class one.
- Reduce hazardous fuels.
- Reduce wildland fire risk to communities.
- Manage prescribed fires so that emissions do not hinder the State's progress toward attaining air quality standards and visibility goals.
- Provide well-planned and executed fire protection and fire-use programs that are responsive to values at risk and management area objectives.

The Forest Service uses a standardized tool for determining the degree of ecological departure from historical conditions, vegetation, fuels, and disturbance regimes. This tool is referred to as Fire Regime Condition Class (FRCC). FRCC ranges from Class 1 to 3 as follows.

- FRCC 1 is a fire regime within the natural (historical) range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition, structure, and pattern) are intact and functioning within the natural (historical) range.

  There are no areas in the project area identified as meeting FRCC 1.
- FRCC 2 is a fire regime that is moderately altered from the natural (historical) range, and the risk of losing key ecosystem components is moderate. Fire frequencies have departed from natural frequencies by one or more return intervals (either increased or decreased). This causes moderate changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation and fuel attributes have been moderately altered from their natural (historical) range.

  One percent (1%) of the entire project area is represented by FRCC 2.
- FRCC 3 is a fire regime that is substantially altered from the natural (historical) range, and the risk of losing key ecosystem components is high. Fire frequencies have departed from natural frequencies by multiple return intervals. Dramatic changes occur to one or

more of the following: fire size, intensity, severity, and landscape patterns. Vegetation and fuel attributes have been substantially altered from the natural (historical) range.

Ninety percent (90%) of the Fremont and ninety-five percent (95%) of the Pineknot East project area is represented by FRCC 3.

Scope of the Analysis: The spatial boundary used to evaluate direct and indirect effects is limited to the project area. This spatial boundary encompasses the area that will be affected by the application of fire to the landscape. Effects from smoke will be the exception with the spatial boundary defined as within 5.0 miles of the project boundary. The spatial boundary used to address cumulative effects is also the project area, because no effects are expected outside of the project area and therefore there would be no cumulative effects on lands beyond this boundary. Effects from smoke will be the exception with the spatial boundary defined as within 100 kilometers of the project boundary. The temporal boundary used to assess direct, indirect, and cumulative effects is ten years, because approximately three burn cycles will be feasible to complete within this time frame and silvicultural treatments will likely follow.

Methodology: *Fuel loading* data was evaluated following the protocol outlined in the Handbook For Inventorying Downed Woody Material to collect pre-burn fuel loading data using the commonly referred to "Brown's Transects" (Brown J. K., 1974). Fuel loading projections post-burn were based on field data results from similar district fuels projects. The projected reduction in fuels post-burn was determined to be consistent with predicted post-burn fuel loading using the First Order Fire Effects Model (FOFEM).

Prescribed fire *prescription parameters* have been identified to limit and focus the range of fire behavior to achieve the natural community restoration objectives, improve the fire regime condition class, and to meet hazardous fuels reduction objectives. Limits on the range of parameters within which a prescribed fire can occur is restricted by a Mark Twain National Forest supplement to Forest Service Manual 5140, Prescribed Fire. District fire managers may further restrict the prescription to achieve specific objectives. Typical restrictions include limits on wind speed, relative humidity, and fuel moistures. These restrictions, or range of parameters, directly affect the fire behavior on the landscape.

The predicted *fire behavior* for this project was evaluated based on professional experience implementing similar district prescribed fire projects. In addition, the Fire Behavior Prediction and Fuel Modeling System (BehavePlus5) was used to predict fire behavior outputs for this prescribed fire. Based on prescription parameter inputs such as fuel model, fuel moisture, wind speed and direction, slope steepness, and aspect, the model predicts fire behavior outputs such as rate of spread, flame length, and fireline intensity.

The predicted *prescribed fire frequency, fire scale (size of burns), and fire intensity* for this project were evaluated using existing science and professional experience. Prescribed fire frequency is determined based on existing knowledge and fire history for a pine woodland, fire-adapted natural community. Fire scale, or the size of prescribed fires, was evaluated based on existing science and fire history as well as maximizing benefits for other resource values within the project area. Fire intensity is predicted based on expected fire behavior from fuel modeling and from specialized fire experience in conducting landscape scale activities.

The predicted *smoke effects* for this project were evaluated using the Simple Approach Smoke Estimation Model (SASEM) and the First Order Fire Effects Model (FOFEM). SASEM is a screening and smoke dispersion model designed to predict ground level particulate matter and visibility impacts from burning. A limitation of SASEM as a screening model is that it tends to over predict impacts. If violations of air quality standards are not predicted by SASEM, it is unlikely that they will occur. FOFEM is designed to make quantitative predictions of fire effects.

Within the project area, 8,459 acres were identified as *wildland urban interface* (WUI). These areas are defined by a quarter (¼) mile area around any structure (e.g. house) or infrastructure (e.g. powerline) that falls on National Forest System lands. Of the total WUI acres identified, approximately 3,745 acres have been identified for mechanical treatment and 1,859 acres has been identified for prescribed fire implementation.

All spreadsheets, calculations, inventory protocols, and modeling outputs are included in the project file along with a model disclosure document detailing the methodology of the fire models used for this project.

DIRECT AND INDIRECT EFFECTS ON FIRE/FUELS

Fire suppression would continue on all wildfires, regardless of cause (human or natural). This suppression will use an appropriate management response that is based on an assessment of the threat to human life, property and the landscape, and the potential fire severity. Tools available for fire suppression are dozers, helicopters, air tankers, engines, and ground forces. Prevention education and detection activities will continue to occur regardless of management decisions for the Fremont-Pineknot East Restoration Project.

ALTERNATIVE 1 – NO ACTION

If Alternative 1 – No Action is selected the following direct and indirect effects could be expected to occur or continue to occur concerning the following issues:

Fuel Loading: Under Alternative 1 – No Action, fuel loading would remain at or near current levels, while remaining much higher than historical conditions. Communities and residences within the project area would remain in an elevated fuel condition in excess of three times the historical fuel load (approximately 4 tons per acre) for an open woodland natural community. Many residences and structures within the project area would continue to be at risk of wildfire. Natural community restoration of the pine dominated woodland would not be achieved and plant and animals species dependent upon this habitat would continue to decline.

Communities At Risk: There are several communities within or in close proximity to the project area that are classified in the Federal Register as Urban Wildland Interface Communities Within the Vicinity of Federal Lands That Are at High Risk from Wildfire (66 Fed. Reg. 43435, Aug. 17, 2001). Under Alternative 1 – No Action, these communities (including Fremont, Eastwood, New Liberty, Handy, Low Wassie, Winona, and Van Buren) would remain in a high risk category from wildfire. Under Alternative 1 – No Action, the high risk could be realized by a variety of possible wildfire ignition sources documented on the district including downed powerlines, escaped private debris burning, and most commonly, arson. Wildfires on the district often involve private lands and threaten existing structures. The district has lost structures to wildfires in the recent past including a shop building on the Private Fire in 2005 and the Old Davis House (an eligible structure for the National Register of Historic Places) on the Davis Fire in 2006. The Railroad Hollow Fire in 2006 burned 264 acres including National Forest System lands and five inter-mixed privately owned parcels. Several structures were threatened and a heavy airtanker was ordered to help suppress the fire. The Mud Pond Fire in 2011 lasted eight days, burned 3,521 acres, including several hundred acres of private lands, and threatened multiple structures. If Alternative 1 – No Action is selected, fuel loading would remain at more than three times the historical level and continue to pose a wildfire threat to these communities at risk **.**

Prescription Parameters, Fire Behavior, and Smoke Effects: Under Alternative 1 – No Action, prescription parameters would not be used, and fire behavior and smoke effects cannot be predicted, because no prescribed fire treatment would occur. However, wildfires would continue to occur as unplanned events without regard to any management burning prescription. The largest and most intense of these wildfires would likely occur under weather conditions indicative of

very high to extreme fire behavior (drought, high winds, low relative humidities, etc.). Without management action to reduce fuel loading, extreme fire behavior conditions combined with the presence of hazardous fuels will continue to threaten structures in and around the communities at risk. Wildfire smoke would continue to impact public roads, private landowners, and communities. Without prescribed fire treatments to reduce fuel loading and manage the smoke effects to meet specific smoke management objectives, the existing high fuel load will contribute to increased smoke impacts as wildfires occur. (BEHAVE model runs with input and output data redicting fire behavior for the Fremont-Pineknot East Prescribed Burns are included in the project file.)

ALTERNATIVE 2 – PROPOSED ACTION

Under Alternative 2 – Proposed Action, emulating historical fire regimes would stimulate ground vegetation, reduce leaf litter, and allow light to reach the forest floor, thereby increasing species diversity. This would create variable patterns of vegetation that meet habitat needs for associated wildlife. Application of prescribed fire would also begin the process of restoring natural communities which represent a range of vegetation composition and structural conditions. Prescribed fire objectives for the existing conditions would be to reduce the understory vegetation (to less than six 6 inches in diameter) to promote a more diverse herbaceous understory, reduce hazardous fuels and the risk of severe wildfires. The timing of prescribed fire would be in concert with silvicultural treatments to meet desired conditions and ensure the removal of commercial resources.

In total, 33 prescribed fire units involving 25,508 acres are planned as part of the Fremont-Pineknot East Restoration Project. Prescribed fire is planned on 50 percent (50%) of the Fremont project area, equating to twenty-nine prescribed fire units involving 19,018 acres of the 38,561 Fremont project area. Prescribed fire is planned on sixty-eight percent (68%) of the Pineknot East Project Area, equating to four prescribed fire units involving 6,490 acres of the 9,537 Pineknot East project area. The project would utilize prescribed fire on a two to five year rotation to restore the ecological role of fire. Cooperative burning with private landowners may be included within the project area through the use of the Wyden Act.

The proposed action would utilize prescribed fire on approximately 25,508 acres (19,018 acres in Fremont project area and 6,490 acres in Pineknot East project area) on a two to five year rotation to restore the ecological role of fire, which helps to restore natural communities, and reduce hazardous fuels and wildfire risk as described in the 2005 Forest Plan. Cooperative burning with private landowners may be included within the project area through the use of the Wyden Act.

If Alternative 2 – Proposed Action is selected, the following direct and indirect effects could be expected to occur or continue to occur concerning the following issues:

Prescribed fire is the application of carefully controlled burns under defined fuel and weather conditions (prescription parameters) to meet land management or ecological objectives. Prescribed fire also involves making decisions about the components of the ecosystem and what role fire played in its development. This project area is located in a Management Prescription 1.1 area where restoring the role of fire into the ecosystem is considered a priority. Prescribed fire examined in this analysis must also be approved through the completion of a Prescribed Burn Plan. The Burn Plan details specific weather conditions, personnel required to accomplish the project, details on mitigation of smoke production, contingency planning if burning conditions exceed planned limits, notification of public, and expected cost.

Fuel Loading: Under Alternative 2 – Proposed Action, fuel loading would decrease by thirty to fifty percent (30-50%) within the project following the initial prescribed fire treatment. Rotational treatments of prescribed fire treatments will continue to consume naturally occuring fuels.

Activity fuels generated by silviculture treatments would also be consumed as these fuels cure and become available to burn. Frequency of prescribed fire treatments will continue to reduce overall wildfire risk by consuming carrier fuels Although spikes of heavier activity fuels are expected to increase fuel loading, it is not expected to increase wildfire risk due to active treatment and management of those activity fuels with prescribed fire. Approximately 25% of the total fuel load is comprised of fine fuels (1 hour and 10 hour) fuels. These fuels carry the fire and are typically consumed during prescribed fire implementation. These carrier fuels are considered cyclic in nature with fuel loads from leaf fall, pine needle cast, and small branches beginning to approach preburn levels within a few years following treatment. The First Order Fire Effects Model (FOFEM) also predicts a reduction in the 100 hour and 1000 hour fuels. This reduction in larger diameter fuels is far less cyclic in nature and will result in a long-term, improved natural community condition, and a reduced availability of hazardous fuel in the project area.

Fire Frequency: Historic wildland fire size and scale in the Ozarks was highly variable. Fire size and scale was less during moist years and possibly extensive during drought years.

> Between 1748 and 1810 the Ozarks sites in Arkansas and Missouri were burned over 310% in 60 years. This yields a rotation interval of about 19.3 years for fires that occurred under moderate or severe drought conditions. In other words, an area the size of the Ozarks (12,950,000 ha or 50,000 sq. mi.) burned about every 20 years (Guyette, Spetich, & Stambaugh, 2006).

Under Alternative 2 – Proposed Action, prescribed fire would be introduced into the project area in coordination with timber and silvicultural prescriptions, wildlife personnel, adjacent landowners, and the general public. The frequency in which fire is applied to the project area under Alternative 2 – Proposed Action would range from two to five years. The frequency of prescribed fire implementation needed to restore the historic natural community will lengthen over time. The current condition of the project area is so removed from the desired condition, that in the beginning of the restoration process, closer burn intervals will be needed to obtain some trajectory for ecological restoration and moving toward the desired condition. As logging removes canopy cover and reduces basal area closer to the historical range, it will deposit activity fuels (logging slash) on the ground. Multiple prescribed fires will be applied to these activity fuels in a in a manner which will reduce the activity fuel incrementally. The fire prescription will not call for fire behavior that removes all the logging slash in one entry, as it would also kill and damage the trees that were selectively not harvested. Thus, the objective is to utilize prescribed fire for removing small diameter vegetation and creating ground cover without resulting in overstory tree mortality.

For the Fremont-Pineknot East Restoration Project, the fire prescription will call for low to moderate fire behavior in order to meet objectives that will gradually reduce the hazardous fuel loading without damaging the desired mature large diameter trees. This fire prescription will also return nutrients to the soil and incrementally displace small diameter (six inches or less) seedlings and saplings that will be competing for the established trees resources. One result of logging is that the energy stored in the harvested or thinned tree root systems will continue to sprout, producing a large amount of vigorous understory.

By implementing prescribed fire on a two to five year rotation in these areas of dense new understory, it will eventually defeat the energy stored in the root systems of the harvested trees, seedlings and saplings, leaving a more diverse and desired floristic quality. As the prescribed fire is applied to the project area, the root systems will decline and the floristic quality will be restored.

The frequency of implementation of prescribed fire will be lessened to the historic natural fire return interval of seven to fifteen years Guyette and Dey (2000) and Guyette and others (2006)

and Stambaugh and others (2006). When the project area is returned to the desired Fire Regime Condition Class 1 (FRCC1), the frequency of prescribed fire implementation needed to maintain this condition class will drop significantly.

Under Alternative 2 – Proposed Action, prescribed fire (planned ignition) will be one tool used to restore the Fremont-Pineknot East Restoration Project area from FRCC 3 to FRCC 1. The Mark Twain National Forest Fire Management Plan states that "prescribed fire may be employed to accomplish a variety of resource management activities including, but not limited to, oak and other species regeneration, hazardous fuels reduction, wildlife habitat management, ecological restoration, maintenance of fire dependent plant communities, timber-stand improvement and other management objectives. Preference should be given to landscape-scale burns. When practical, natural or existing features, such as streams, roads, and trails, should be used as firebreaks." (Forest Fire Management Plan, pp. 2-15 to 2-16).

In summary, the fire frequency of two to five year entries is consistent with intervals needed to restore natural communities which have been substantially altered from their natural (historical) range, where the risk of losing key ecosystem components is high, and where fire frequencies have departed from natural frequencies by multiple return intervals. This frequency will result in moving towards the desired conditions to restore natural communities through changing the condition class from three to one. This frequency will also begin to reduce fuel loading from 16 tons per acre towards the historical 4 tons per acres and will reduce wildfire risk.

Fire Scale (Size): Determining the appropriate prescribed fire size is important to provide for firefighter and public safety, meet prescribed fire prescriptions and Forest Plan goals and objectives, and accommodate adjacent landowners. The average size of a prescribed fire burn unit for this project area ranges from several hundred acres up to several thousand acres. This range allows the flexibility to garner the ecosystem benefits needed for a rare and distinctive ecosystem, address weather conditions and smoke management outcomes, and consider terrain features and adjacent private land ownership concerns. Landscape scale prescribed fire provides a mixed severity burn pattern across the affected area, leaving a desired mosaic burn pattern. This range allows the flexibility to achieve the "natural" rates of certain ecological, chemical, and physical processes and or to replace damaged or missing biotic elements that smaller burn units would not achieve. That is, restoration is often fundamentally about enhancing ecological integrity. "A system has integrity when its dominant ecological characteristics (e.g., elements of composition, structure, function, and ecological processes) occur within their natural ranges of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human disruptions (Walker, 2013, Parrish, Braun, & Unnasch, September 2003). Fire, as a natural disturbance mechanism used in conjunction with a silvicultural prescription, will move the trajectory of natural community land restoration project forward in a timely manner. Landscape scale prescribed fire covers a large, contiguous block of land that sets the trajectory for restoration to move forward to a desired fire regime condition class. Small prescribed burn units could move restoration ahead to a limited degree but it does not emulate the natural disturbance regime of fire to achieve desired conditions.

There are approximately twenty five thousand acres in the Fremont-Pineknot East Restoration Project area identified for treatment with recurrent prescribed fire. There are thirty three individual burn sub-units identified in the project area ranging in size from 121 acres to 2,747 acres earmarked for fire re-introduction. Implementation would take place over a number of years in coordination with other resource objectives in the project area to ensure proper removal of commercial resources, provide for wildlife and plant habitat needs, and work with the public to address concerns. The burn units in the project area are divided into individual sub-units that use existing roads as prescribed fire control lines. In some cases, a bull dozer will be used to construct a control line that connects two existing roads. These control lines (both existing roads and

constructed bull dozer lines) provide strategic and tactical opportunities to safely stop the burning if needed. Control lines will be fertilized and seeded, and water structures will be placed in order to reduce sedimentation or erosion concerns (USDA Forest Service, Mark Twain National Forest, 2005b pp. 2-15 to 2-16).

Burn units and their size are determined by alignment on the landscape and where the most logical and efficient control lines occur. Burn unit size will vary depending on the conditions, adjacent private land ownership, smoke parameters, and weather conditions. The scale prescribed for this project is consistent related to the size of natural communities such as dry chert woodlands that existed historically in the project area (Nelson P. W., 2010). Landscape scale prescribed fires do not burn hotter or cooler than smaller scale prescribed fires. The project area is a pine-hardwood forest type consisting of hardwood leaf litter and a pine needle cast ground layer, represented by Fuel Model 9, which burns in a highly predictable manner. The British Thermal Units (BTU's) released at the flaming front of the prescribed fire in Fuel Model 9 are well documented and consistent; the size of the burn is irrelevant. Topography and wind can have an adverse effect on fire behavior. An unforeseen change in wind direction or wind speed can increase fire behavior just as easily on a small prescribed fire as it can on a large prescribed fire, but controlled lighting techniques and burning in favorable weather conditions greatly reduces the occurrence of burning hotter than prescription parameters call for.

The Fremont-Pineknot East Restoration Project area includes both National Forest System lands as well as private land. In many cases, private land is excluded from individual burn units. Bulldozers are used to build fire control lines that will isolate a private in-holding from the burn unit. This leads to additional ground disturbance and increased cost per acre of prescribed fire implementation. The Mark Twain National Forest has been very successful in using the Wyden Act on prescribed fire implementation projects to include private landholders interested in the use and benefits of prescribed fire on their lands. This works as a positive collaboration tool that directly allows the forest to reduce labor and equipment costs by using existing control lines on private land, thus substantially reducing ground disturbing activities. The landowner then gains the positive land management effects of prescribed fire without incurring the responsibility or costs associated with burning private land. There are approximately twenty-five landowners who have expressed interest in cooperatively burning with the Forest Service within the Fremont-Pineknot East Restoration Project area.

In summary, the overall size of the burns would range from several hundred acres to several thousand acres depending on the burn units, cooperative agreements, and coordination with other resources. The scale is consistent with moving from condition class three to condition class one in a manner that leads to a less fragmented, more desirable burn pattern and thus more floristic coverage and species richness. This scale will also provide for reducing fuel loading from 16 tons per acre to 4 tons per acre where the impact will be at a landscape size to reduce wildfire risk.

Fire Intensity & Fire Behavior: The implementation of prescribed fire can be well controlled in the project area by burning at different times of the year (depending on what intensities and effects are desired). By planning the ignition date, fire managers and prescribed fire bosses can control the intensity of the fire and affect the patch sizes within the landscape scale prescribed fire area. Prescribed fire will generally occur during dormant seasons (fall, winter, and early spring) with only limited use outside the dormant season to achieve specific management objectives. Implementation of prescribed fire during the dormant season will have less impact on reptiles and amphibians while they are hibernating.

Prescribed fire is a useful tool which can effectively alter fire behavior by modifying fuel bed characteristics. Reducing the load of fine fuels, duff, woody fuels, shrubs, and other surface fuels

changes the fuel energy stored on the site and lowers the potential spread rate and intensity. Fire behavior is affected by fuel compactness and continuity. Prescribed fire treatments reduce the horizontal fuel continuity which disrupts the growth of surface fires, limits wildfire intensity, and reduces the probability of spot fire ignition. Over time, burning can decrease the vertical continuity between surface fuels and canopy fuels through consumption of lower branches and scorch, effectively raising the live crown above the surface fuels.

Fire behavior research and modeling shows that physical setting, fuel composition, and weather combine to determine wildfire intensity (the rate at which it consumes fuel) and severity (the effect fire has on vegetation, soils, buildings, watersheds, etc.). Prescribed fire burn units would be treated in any given year, with a two to five year rotation as the treatment frequency. The prescribed fire cycle would occur based on the monitored results of the first treatment, thus allowing for timing, interval, adjustment of the firing methodology, and fire behavior prescription adjustments. Prescribed fire to achieve restoration and hazardous fuels objectives is accomplished through a careful balance of fire intensity that is controllable and safely executed.

These treatments will be used to mimic natural fire disturbance for ecosystem restoration, managing hazardous fuels, and improving stand conditions and wildlife habitat. The effects for prescribed fire on the Range of Natural Variability (RNV) should influence ecosystems that have evolved with frequent, low to moderate intensity fires such as: savannas, open and closed woodlands, glades, and fens. The application of fire would increase the abundance of grasses and forbs and species diversity where fire is applied repeatedly in the same area. Shortleaf pine, white oak, and post oak may move toward the RNV with corresponding decreases in red cedar, black oak, scarlet oak, red oak, and some red maple. These shifts would occur gradually in areas where prescribed fire is applied. This may take decades to achieve where the historical dominant tree association is currently subordinate to another species. As previously mentioned, the prescribed fire treatments should stimulate the recovery of native ground cover vegetation. These fire-adapted grasses and forbs are a key component of natural (historic) woodland and savanna communities.

Under Alternative 2 – Proposed Action, the predicted fire behavior for this project was evaluated based on professional experience implementing district prescribed fire projects in addition to the Fire Behavior Prediction and Fuel Modeling System (BehavePlus5) tool that predicts fire behavior outputs for this prescribed fire burn area. Based on prescription parameter inputs such as fuel model, fuel moisture, wind speed and direction, slope steepness, and aspect, the model predicts fire behavior outputs such as rate of spread, flame length, and fireline intensity. This model predicts fire behavior outputs expected to be observed on the ground. The proposed prescribed fire treatment for this project with a focused and restricted prescription for managed results is in direct contrast to an unplanned wildfire event with the potential to occur under extreme fire behavior conditions as discussed in Alternative 1 – No Action. Without management action to reduce fuel loading, extreme fire behavior conditions combined with the presence of hazardous fuels will continue to threaten structures in and around the communities at risk.

In summary, the burn intensity and fire behavior planned at the low to moderate level is consistent with restoring natural communities. This will be a low impact fire in which the objectives would be to remove the midstory and small diameter vegetation thereby encouraging the establishment of ground cover species. The low to moderate fire intensity could impact overstory trees on a site specific small scale dependent upon fire severity conditions in a given area. Some limited mortality should be expected but not at a scale which would impact commercial values. Based on past prescribed fire projects and post-burn monitoring, there is less than 1% mortality associated with overstory trees. The planned fire intensity provides for the reduction of fuels to reduce wildfire risks on a recurring basis which will gradually reduce fuel loading from 16 tons per acre to the desired 4 tons per acre.

Communities At Risk: There are several communities within or in close proximity to the project area that are classified in the Federal Register as Urban Wildland Interface Communities Within the Vicinity of Federal Lands That Are at High Risk from Wildfire (66 Fed. Reg. 43435, Aug. 17, 2001). These communities include Fremont, Eastwood, New Liberty, Handy, Low Wassie, Winona, and Van Buren. Under Alternative 2 – Proposed Action, the risk from wildfire to these communities would decrease. Treatments from prescribed fire would reduce the presence of hazardous fuels by thirty to fifty percent (30-50%) with the initial treatment. Hazardous fuel reduction benefits are expected to be long-term in the larger fuel component and more cyclic in the fine fuels. Frequency of prescribed fire is expected to consume carrier fuels with each treatment and reduce and mitigate any activity fuels generated as they cure and become available to burn. Prescribed fire implementation would follow a specific burn plan and a prescribed fire complexity analysis to determine control line establishment, site specific hazards, values at risk, landowner contacts, mitigation measures, and contingency plans.

Prescription Parameters: Under Alternative 2 – Proposed Action, prescription parameters would be used to limit and focus the range of fire behavior to achieve the natural community restoration objectives, improve the fire regime condition class, and meet the hazardous fuels reduction objectives. The mid-flame wind speed is limited to 6.6 miles per hour or less. Wind direction and smoke mixing height is prescribed to minimize smoke and related impacts to public roads, private landowners, and communities. The relative humidity, temperature, fuel moisture, and drought index are also limited by the prescription. The predicted rate of spread is limited to a maximum of fifteen chains per hour to minimize any risk of escape. The predicted probability of ignition is limited to sixty-seven percent (67%) to manage risk of spotting. The predicted flame length is limited to a range of 1.0 to 3.9 feet to minimize risk and meet restoration objectives. The mid-range and optimum fire behavior for this project would have an associated flame length of 1.5 to 2.5 feet.

Smoke Effects: Under Alternative 2 – Proposed Action predicted smoke effects were evaluated using the Simple Approach Smoke Estimation Model (SASEM) and the First Order Fire Effects Model (FOFEM). Results from these models predicted no exceedance of the National Ambient Air Quality Standards (NAAQS) for implementing this project within the prescription parameters identified in the project file. In addition, no visibility impacts are expected for Mingo National Wildlife Refuge (Class 1 area) located 80 kilometers east of the project area due to the smoke management prescription parameters identified in the project file. There is some potential for short range (<1 mile) and short duration (<1 hour) visual impacts to adjacent roads related to prescribed fire implementation. These impacts are mitigated with burn day prescription parameters for meeting smoke management objectives and with onsite traffic control or law enforcement as necessary. With the SASEM model, downwind smoke receptors are entered as model inputs to predict smoke impacts to those downwind receptors. Prescription parameters are adjusted to minimize smoke impacts to these downwind receptors such as highways, schools, and communities. Smoke from wildfires and both private and agency prescribed fire is common across the district and public complaints of nuisance smoke occur occasionally. Most public interest related to smoke has been calls from the public that have seen smoke and reported it thinking it was a wildfire. Adjacent private landowners are notified prior to implementing any prescribed fire and the burn areas are identified on the Mark Twain National Forest website. Public notification includes radio announcements, phone calls to adjacent landowners, phone calls to local law enforcement and others.

CUMULATIVE EFFECTS ON FIRE/FUELS

The spatial boundary used to address cumulative effects is the project area, because no effects are expected outside of the project area and therefore there would be no cumulative effects. Effects

from smoke will be the exception with the spatial boundary defined as within 100 km of the project boundary.

The temporal boundary used to assess cumulative effects is ten years, because approximately three burn cycles will be able to be completed within this time frame and silvicultural treatments will likely follow.

Cumulative effects were not considered pertinent to this analysis for any of the issues addressed except potential smoke impacts. The predicted direct and indirect smoke effects for this project were evaluated using the Simple Approach Smoke Estimation Model (SASEM) and the First Order Fire Effects Model (FOFEM). Results from these models predicted no exceedance of the National Ambient Air Quality Standards (NAAQS) for implementing this project within the prescription parameters identified in the project file. In addition, no visibility impacts are expected for Mingo National Wildlife Refuge (Class 1 area) located 80 kilometers east of the project area due to the smoke management prescription parameters identified in the project file. Cumulative effects from smoke are not expected since no agency or private prescribed fires are likely to occur of sufficient size or within reasonable proximity on the burn day with the necessary transport wind parameters to mix smoke columns in the upper atmosphere.

AIR QUALITY

AFFECTED ENVIRONMENTS

Major physiographic features influence the climate, movement, and dispersion of smoke in the project area. Under certain weather parameters, valleys can act as cold sinks and trap smoke. Additionally, creeks and other small drainages could possibly act as corridors for smoke dispersion.

Climate in the area is defined by hot humid summers with high temperature averages in the 80s^{o} Fahrenheit (F) and low temperature averages ranging from 57 to 65° F. Autumns are warm and moist with average daytime temperatures ranging from 57 to 70° F; average low temperatures from 35 to 44°F. Winters can be cold and snowy, with average high temperatures in the mid-40s^{o} F and lows from 21 to 25° F. The monthly precipitation ranges from a low of 2.2 inches in winter to a high of 4.9 inches in spring. The average annual precipitation is 46 inches (Midwest Regional Climate Center, 2014).

The Clean Air Act of 1963 was developed to protect humans against negative health or welfare effects from air pollution. Air pollution can be defined as the presence in the atmosphere of one or more contaminants of nature, concentration, and duration to be hazardous to human health or welfare (Sandberg, et al., 1999). Within the Clean Air Act exists the National Ambient Air Quality Standards (NAAQS). NAAQS are defined as amounts of air pollutant above which detrimental effects to public health or welfare may result. National Ambient Air Quality Standards have been developed for six criteria pollutants. These pollutants consist of carbon monoxide (CO), particulate matter (PM-2.5 and 10), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and lead (Pb). NAAQS are established as primary and secondary levels. Primary NAAQS are set at levels to protect human health; secondary NAAQS are set to protect human welfare effects to include visibility as well as plant and materials damage. In general, air quality in the proposed project area meets National Ambient Air Quality Standards (Service, 1999). The pollutant of most concern in smoke from fire is fine particulate matter (PM), both PM10 and PM2.5. Studies indicate that ninety percent (90%) of all smoke particles emitted during wildland burning are PM10, and ninety percent (90%) of PM10 is PM2.5 (Schwatz et. al., 1999). Past studies of human health with regard to the effects of particulate matter have shown that fine particles, especially

PM2.5, are largely responsible for health effects (Dochery et. al., 1993). The following table identifies levels of human health concerns based on measured PM2.5 concentrations, Air Quality Indices, and visibilities.

Table 10. Human Health Concerns based on PM 2.5 Smoke Emissions (Source: http://airnow.gov/)

$PM_{2.5}$ 24-hr Avg. Concentration (ug/m^3)	**$PM_{2.5}$ 1-hr Avg. Concentration (ug/m^3)**	**EPA Air Quality Index Values**	**Visibility (Miles)**	**Level of Health Concern**	**Cautionary Statements**
0.0 – 15.4	0.0 – 40.0	0-50	> 10	Good	None
15.5 – 40.4	40.1 – 80.0	51 – 100	5.1 – 10.0	Moderate	None
40.5 – 65.4	80.1 – 175.0	101 - 150	3.1 – 5.0	Unhealthy for Sensitive Groups	People with respiratory or heart disease, the elderly, and children should limit prolonged exertion.
65.5 – 150.4	175.1 – 300.0	151 – 200	1.6 – 3.0	Unhealthy	People with respiratory or heart disease, the elderly and children should avoid prolonged exertion, everyone else should limit prolonged exertion.
150.5 – 250.4	300.1 – 500	201 – 300	1.0 – 1.5	Very Unhealthy	People with respiratory or heart disease, the elderly and children should avoid any outdoor activity, everyone else should avoid prolonged exertion.
250.5 +	500.0 +	301 - 500	< 1.0	Hazardous	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly and children should remain indoors.

The proposed project lies within lands designated as Class II with respect to air resources. The Clean Air Act (CAA) defines a Class II area as, “A geographic area designated for a moderate degree of protection from future degradation of the air quality” (U.S. Environmental Potection Administration, 2014) The closest Class I area is the Mingo National Wildlife Refuge under US Fish & Wildlife Service management, approximately 54 miles east of the project area (USEPA 2011) The only other Class I area in the state is the USDA-Forest Service’s Hercules Glades Wilderness, approximately 112 miles west of the proposed project area on the Ava Unit of the Ava-Cassville-Willow Springs Ranger District (USEPA 2011).

Proposed activities are within Shannon County, Carter County, and Oregon County, Missouri. Non-attainment areas for the State of Missouri can be found at http://www.epa.gov/oar/oaqps/greenbk/ancl.html. St. Louis, Missouri, including the surrounding four counties in and around the City, is the closest non-attainment area, approximately 150 miles to the northeast. These counties include St. Louis, Franklin, St. Charles, and Jefferson. This determination is based on the Environmental Protection Agency's (EPA) Aerometric Information Retrieval System (AIRS) and data maps (USEPA 2000). EPA defines non-attainment areas, as "a geographic area in which the level of a criteria air pollutant is higher than the level allowed by the federal standards" (U.S.EPA 2001). The Fremont-Pineknot East Restoration Project area is designated as attainment for all six NAAQS criteria pollutants. EPA defines attainment areas as "A geographic area in which levels of a criteria air pollutant meets the health-based primary standard (NAAQS) for the pollutant" (USEPA 2001).

The Forest Service is exempt from State Rule 10 CSR 10-3.030, 4 (c.7), which addresses open burning in Missouri. Because the proposed activities are in an attainment area, the conformity requirement would be met. No further conformity analysis is needed at this time. Thus, the project would comply with all federal, state, and local regulations relating to air quality, as well as, the Forest Plan.

The main sources of carbon monoxide are from combustion engines associated with vehicles, and outdoor burning. The main sources of PM-10 and PM-2.5 are from local wood burning home units, debris and broadcast burning on private, state and federal lands, wildland fires, fugitive dust from un-surfaced roads and other agricultural activities. There are no main sources of ozone in the proposed area. There are a few activities such as burning, which can produce some of the precursors to ozone such as oxides of nitrogen and organic carbon.

DIRECT AND INDIRECT EFFECTS ON AIR QUALITY

Analysis for the proposed project is based on potential impacts to identified smoke sensitive receptors with respect to the NAAQS levels for carbon monoxide, PM-10, PM-2.5, ozone, and visibility. Table 11 shows the smoke sensitive receptors areas that are within 5.0 air miles of the project:

Smoke sensitive receptors were used in the analysis to estimate impacts of the Alternative 2 – Proposed Action at these locations. They were chosen, in part, based on proximity to the proposed project, known smoke concerns, safety concerns, and ability to represent similar locations in the area.

The basic framework addressing air pollutants is mandated by the 1970 Clean Air Act (CAA), as amended in 1990 and 1999. The CAA was developed to "protect and enhance" air quality. Section 160 of the CAA requires measures "to preserve, protect and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores and other areas of special national or regional natural, recreation, scenic, or historic value." Class I areas include Forest Service and Fish & Wildlife Service wilderness areas over 5,000 acres that were in existence before August 1977, and National Parks in excess of 6,000 acres as of August 1977. Designation as a Class I area allows only very small increments of new pollution above already existing air pollution levels. There is one Class I airshed (Mingo Wilderness, Mingo National Wildlife Refuge) approximately 54 air miles east of the project area.

Table 11. Smoke Sensitive Receptors in Fremont-Pineknot East Restoration Project Area

Smoke Sensitive Receptor	**Distance from Receptor to Prescribed Fire Burn Area**	**Cardinal Direction of Project to Receptor**
Van Buren (community) Winona (community)	10 5	Northeast Northwest
US Highway 60	Traverses center of project	North and South
Highway 19	Adjacent	West
Highway J	Adjacent	East

Prescription parameters are adjusted to minimize smoke impacts to downwind receptors such as highways, schools, and communities. Smoke from wildfires and both private and agency prescribed fires is common across the district and public complaints of nuisance smoke are rare. Most public interest related to smoke has been calls from the public that have seen smoke and reported it thinking it was a wildfire.

Smoke can have an impact on how far and how clearly we can see on a highway or in viewing scenery. Fine particles in the smoke are known to be able to scatter and absorb light, which can reduce visibility. There is some potential for short range (<1 mile) and short duration (<1 hour) visual impacts to adjacent roads related to prescribed fire implementation. These impacts are mitigated with burn day prescription parameters for meeting smoke management objectives and with onsite traffic control or law enforcement as necessary. Based on the location from the proposed project and prescribed wind directions for implementation of a prescribed fire, visibility would not likely be impacted at Mingo National Wildlife Refuge or Hercules Glades Wilderness Area due to the smoke management prescription parameters identified in, and implemented under, specific burn plans.

Carbon monoxide from a fire is rapidly diluted at short distances and therefore poses little or no health risk to the public. Firefighters are at the greatest health risk because they have longer exposures at higher concentrations. It is recommended that fireline personnel rotate away from the fireline periodically to decrease their exposure. By doing so, health impacts to firefighters could be mitigated. This would be implemented under Alternative 2, thus allowing the proposed activity to comply with NAAQS for carbon monoxide. Because the “No Action” alternative is defined as a wildfire situation, there are no specific recommended Standards and Guidelines and other mitigation measures identified. Each wildfire is unique and mitigation would be determined once the wildfire has been discovered and addressed by fire suppression resources.

There are a few activities such as prescribed fires that can produce some of the precursors to ozone. These include oxides of nitrogen and organic carbon. Levels for the proposed project burn units are estimated to be low enough that they would not contribute to development of ozone levels above the NAAQS.

ALTERNATIVE 1 – NO ACTION

This alternative may result in large wildland fires since there would be no management treatment to reduce increasing fuel accumulations within the project area. Many years of fire suppression actions have reduced the amount of acres burned naturally, thus increasing the amount of available fuels for a wildland fire.

Smoke from uncontrolled wildfires has potential to affect an area for several days. This situation may occur during multiple events (i.e. more than one uncontrolled wildland fire). An uncontrolled wildland fire also has potential to spread from or into areas outside of the analysis area, which may cause increased smoke impacts to smoke sensitive receptors. Because of actions identified in this alternative, only after a wildland fire is reported and determined that the associated smoke is or may cause health or safety concerns, can Standards and Guidelines and other mitigation measures be identified and implemented. The severity of these potential air quality impacts resulting from wildfires can be mitigated through the resource management activities (i.e. harvesting and understory removal) under Alternative 2.

ALTERNATIVE 2 – PROPOSED ACTION

Under Alternative 2 – Proposed Action, the prescribed fire treatments would be conducted on a two to five year rotational basis. The following effects are likely to occur over short periods of time (less than two days following treatment):

- Increases in particulate matter and carbon monoxide concentrations for short periods of time
- Chance of eye, nose and throat irritations
- Possibility of minor periods of decreased visibility along nearby travelways
- Possible odor/nuisance of smoke

Currently, the amount of ozone precursors produced by prescribed fire from these burns would not be significant enough to produce ozone levels that would exceed NAAQS (Sandberg & Dost, 1990). The decreased potential to exceed NAAQS would be applicable to Alternative 2. With Alternative 1, there would be an increased potential of exceeding NAAQS during a wildfire event, specifically PM-10 and PM 2.5, resulting from increasing fuel quantities being consumed under uncontrolled conditions. Removal of biomass material from understory removal operations would also reduce fuel-loading.

The NAAQS would not be exceeded under the prescribed fire prescriptions. Based on analysis, literature review, and implementation of the identified Forest plan Standards and Guidelines and other mitigation measures, all NAAQS would be met for the project. Based on the location from the proposed project and prescribed wind directions for implementation of a prescribed fire, visibility would not likely be impacted at Mingo and Hercules Glades Wilderness.

CUMULATIVE EFFECTS ON AIR QUALITY

The cumulative effects area is the Fremont-Pineknot East Restoration Project area. Cumulative effects on air quality can vary depending upon the quantity of other reasonable and foreseeable activities that hold potential to produce pollutants, conducted by other individuals or entities during the same timeframe that these proposed prescribed fire treatments may be implemented. This includes, but is not limited to activities such as operation of combustion engines (i.e. vehicles, lawn mowers, turbines, etc.), use of fireplaces, wood stoves, dust from un-surfaced roads, other fire activity (wildfire or prescribed), and industrial emissions. These emissions, coupled with prescribed fire, may have potential to exceed the NAAQS for ozone and PM 2.5. Based on potential of these other activities to produce pollutants, the project would be coordinated with private landowners and appropriate agencies to prevent contributing to levels that could cause NAAQS to be exceeded.

Past, Present and Foreseeable Actions: Any prescribed fire and all future fuel treatments are relevant federal actions that have a significant cause and effect relationship with the direct and

indirect effects of Alternative 2 – Proposed Action. The district routinely implements prescribed fires on National Forest System lands within the Eleven Point Ranger District outside of the Fremont-Pineknot East Restoration Project area. These prescribed fires are conducted on a rotational basis, generally at two to five year return intervals, to enhance and maintain natural community types. Foreseeable actions include an increase to the amount of acres the district would treat by prescribed fire over the next fifteen years, principally outside of the Fremont-Pineknot East Restoration Project area.

Other land management agencies near the analysis area, which include the Ozark National Scenic Riverway (ONSR), and the Missouri Department of Conservation (MDC), are currently conducting prescribed fires on a similar rotational basis and could possibly have combined effects to the analysis area with regard to smoke concentrations. OSNR has an annual prescribed fire target of approximately 4,000-5,000 acres. The foreseeable target acreage for prescribed fire on the Ozark National Scenic Riverway (ONSR) is planned to remain the same; however the Park Service may have years when they may choose to burn more or less than that burning target depending on resource management needs.

In addition, ONSR and the Poplar Bluff and Eleven Point Ranger districts are cooperators in fire management activities on Federal lands in the project vicinity. The three entities, ONSR and the two ranger districts, cooperatively address wildland fires in the area that involve Federal lands and coordinate and periodically share resources on prescribed fire activities. The two ranger districts combined treat an estimated 15,000 acres annually by prescribed fire. Collectively, ONSR and the Forest Service treat an estimated 20,000 acres annually.

Smoke impacts from these prescribed fires could possibly have a cumulative impact if they would occur during the same day. Factors that would contribute to the extent of these effects would include fire size, wind direction, atmospheric stability, and specific burn location. Communication and planning efforts between the aforementioned agencies to coordinate the timing of planned burns would be needed to minimize cumulative effects from smoke and is planned under Alternative 2 – Proposed Action.

MDC and Missouri Department of Natural Resources (MDNR) occasionally conduct prescribed fires on state and private lands. Burning activities on State-managed lands is generally of the same type conducted by the Forest Service. Collectively, the two state agencies are estimated to treat 1,900 to 2,700 acres each year in Carter and surrounding counties. Burning on private lands is typically confined to burning ditches, fencerows, brush piles, and small pastures and woodlots. Smoke generated from burning activities on private land is usually minimal since it involves small acreages and short durations. Smoke impacts from other federal agencies, state agencies and private landowners prescribed fires could possibly have a cumulative impact if they would occur during the same day as prescribed fires on Federal lands. Contributing factors that would contribute to the extent of these effects are the same. Communications between the aforementioned agencies serve to minimize cumulative effects from smoke to areas in proximity to the project area.

The Fremont-Pineknot East Restoration Project prescribed fire treatments, conducted according to burn plan prescription parameters and coordinated with other Federal and state agencies, would not produce smoke emissions to the extent or duration that serious public health threats would occur at identified smoke sensitive receptor sites.

WATERSHED

AFFECTED ENVIRONMENTS

Impaired Waters - 303(d) Listed Stream and Water bodies: The Clean Water Act requires the identification of water bodies that do not meet, or are not expected to meet, water quality standards or are considered impaired. The most current list available is 2012. The 2014 list is currently being reviewed developed by the Missouri Department of Natural Resources.

Within the watershed condition analysis area there are no streams or lakes on the 303(d) list. However, streams in the analysis area are a tributary to the Current River or the Eleven Point River. Both the Current and Eleven Point Rivers are on the 303(d) list for atmospheric deposition of mercury as by evidence from fish tissue samples.

Current Land Ownership:

The analysis area lies within a mix of forested landscape and urbanization (cities, towns, agricultural, and pasture land). Table 12 includes the amount of Mark Twain National Forest Lands and the total amount of public land ownership with each HUC-6 watershed. In watersheds Big Barren Creek, Headwaters Big Barren Creek, Little Pike Creek, Lower Pike Creek, and Middle Pike Creek the U.S. Forest Service owns the majority of the watershed acres. In watersheds Middle Pike Creek and Upper Pike Creek the majority of the ownership is public lands including both U.S. Forest Service and the Missouri Department of Conservation.

Table 12. Mark Twain National Forest Ownership and other Public Lands.

Watershed Name	Counties	Acres	Amount of Public Land Ownership
Big Barren Creek	Carter and Ripley	26,321	National Forest, 18,406 acres (70%)
Headwaters Big Barren Creek	Oregon and Ripley	20,777	Natioal Forest, 18,435 acres (89%)
Little Pike Creek	Shannon and Carter	19,450	National Forest, 12,298 acres (63%)
Lower Pike Creek	Carter	22,270	National Forest, 14,226 acres (64%) and Peck Ranch Conservation Area 206 acres (1%)
Middle Hurricane Creek	Shannon, Carter, and Oregon	28,956	National Forest, 24,000 acres (83%)
Middle Pike Creek	Shannon and Carter	22,231	National Forest, 9,874 acres (44%) and Peck Ranch Conservation Area 4,412 acres (20%)
Upper Hurricane Creek	Shannon	25,488	National Forest, 9,687 acres (38%)
Upper Pike Creek	Shannon	25,941	National Forest, 9,789 acres (38%); Rocky Creek Conservation Area 3,019 acres (12%) and Twin Pines Conservation Area, 462 acres (2%)

* Source: USDA Forest Service Cooporate Database and the Center of Applied Research and Environmental Systems (CARES) Missouri Watershed Tool

The average precipitation patterns are the result of weather systems moving across the region as well as interactions between topography and atmosphere. Yearly average precipitation ranges from 40-50 inches, and precipitation events occur throughout the calendar year. January through May precipitation events increase with April and May having the large amounts of total precipitation. The driest months tend to be November and December. Extreme precipitation events that cause flooding can happen any time of the year but occur most frequently in spring, summer, and fall. On average thunderstorms develop from 10-25 days during each of the seasons, and during the winter is usually fewer than 10 days. Storm can produce intense rain, wind, hail, and cause flash flooding. In the spring and summer tropical cyclones, hurricanes, tropical storms, and tropical depressions are responsible for many of the extreme precipitation events (USDA Forest Service, 1999a).

Weather extremes play a role in watershed condition. Numerous droughts have occurred in Missouri; four major droughts occurred between 1952-1957, 1962-1969, 1975-1982, and 1988 (northern part of state) (USDA Forest Service, 1999a) and the latest drought occurring in 2012. The most extreme drought was in the 1930's during the dust bowl. The opposite also occurs with years of flooding, such as the events in August 2013 causing a record flood on the Gasconade River. Additionally tornadoes occur within the analysis area, and cause damage to forested land. Between 1950 and 1994 Missouri reported 854 tornadoes, ranked 7th in the nation (USDA Forest Service, 1999a).

Climate change is affecting hydrology and the response of rivers and streams. Current trends show the central hardwoods region (US Forest Service ownership in Missouri, Illinois, and Indian) is receiving 12 to 17 percent more precipitation, particularly in the spring and fall. Also more rain has been falling as heavy precipitation events of 3 inches or greater over the past 30 years. In the Ozark Highlands discharge on the 2-year flood interval has increased 30% over the past 30 years (Foreman, 2014). Since the 1970's there has been a decrease in snow cover which has led to an increase in soil frost (Brandt, et al., 2014). Models have been used to predict how climate may change over the next century. The current prediction is precipitation will increase in winter and spring 2 to 5 inches for the two seasons combined, and in summer an increase up to 3 inches or and increase up to 8 inches. As a result hydrological model projections indicate that soil moisture, runoff, and stream flow may increase during the spring as precipitation increases. Models also indicate that snow cover and duration will continue to decrease (Brandt, et al., 2014). Vulnerabilities from climate change include: increase in heavy precipitation events may result in flood risk, and droughts will increase in duration or decrease depending on the model (Brandt, et al., 2014).

General Physiography, Hydrology, Geology, and Hillslope Characteristics: The majority of the Mark Twain National Forest lies within the Ozark Mountain Range, mostly in the Salem Plateau including the Eleven Point Ranger District (USDA Forest Service, 1999a). The Ozark physiographic province is an elongated domal structure extending across Missouri from the Mississippi River to Northern Arkansas to Northeastern Oklahoma (Romito, 1984). For the most part the surface contains Ordovician and Cambria rocks within rocks of later Paleozoic age (Romito, 1984). Within the watershed cumulative effects analysis area maximum elevations ranges from 1,002 to 1,999 feet with drainage valleys several hundreds of feet deep.

The analysis area is underlain predominantly by sedimentary rocks of lower Paleozoic age (Romito, 1984). Periodic uplifting in conjunction with continuous post-Paleozoic erosion brought

Upper Cambrian and Ordovician strata to the surface toward the center of the Ozark Dome with progressively younger rocks out-cropping along the flanks (Romito, 1984). Lithologic logs and other drill data indicate that the thickness of Paleozoic sedimentary strata down to the crystalline rock averages approximately 1,500 feet (Romito, 1984). The major structural feature is the Ozark Dome, and this uplift is asymmetric with its axis trending south-southwest (Romito, 1984). Dips on the southeast and east are much steeper than those in other directions (Romito, 1984). There has been a considerable amount of faulting and folding within the Mark Twain National Forest area (Romito, 1984).

The Salem Plateau landscape is characterized as karst topography. Karst landscapes are characterized by the presence of caves, springs, sinkholes, and losing streams, created as groundwater dissolves soluble rock such as limestone or dolomite. Within Missouri's karst topography groundwater recharge is considered to be discrete recharge (localized, concentrated movement of water from land surface into subsurface). Discrete recharge occurs where the dissolution of limestone and dolomite bedrock has occurred (Miller & Vandike, 1997). In karst terrain there is a strong interaction between surface water and ground water.

Sinkholes are depressions on the surface created by the subsurface removal of soil and rock. Sinkholes are created when slightly acidic groundwater has dissolved soluble bedrock and overtime the roof of the solution-enlarged cavities collapses (Miller & Vandike, 1997). Sinkholes are abundant in the Salem Plateau, and on the Eleven Point Ranger District. Sinkholes act as natural funnels, collecting and channeling underground the runoff that occurs with their catchment areas (Miller & Vandike, 1997).

In karst topography there are gaining and losing streams. Gaining streams are streams that maintain flow essentially year-around and have flows that are well-sustained or increase in a downstream direction (Miller & Vandike, 1997). The water table along gaining streams is generally at or above stream level and groundwater generally moves toward the stream. Losing streams lose a significant part of their flow to the groundwater, and are considered discrete recharge features that allow surface flow to rapidly enter the subsurface (Miller & Vandike, 1997). The water table along losing streams is below stream elevation. Unlike sinkholes, losing streams do not always direct all of the water into the subsurface. A stream in the Ozarks can have sections that are both gaining and losing. Also losing streams can become gaining for a short duration after a precipitation event that cause the groundwater table to rise to stream level. Most losing streams will carry some flow after a heavy prolonged precipitation event, but some are dry all of the time (Miller & Vandike, 1997). Missouri Code of State Regulations defines a losing stream as a stream which distributes thirty percent (30%) or more of its flow through natural processes such as through permeable geologic materials into a bedrock aquifer within two miles flow distance downstream of an existing or proposed discharge. Not all ephemeral channels at the beginning of the stream network in karst topography are considered a losing stream. There are ephemeral channels that flow only in response to a storm event and are not losing water to the subsurface.

Both sinkholes and losing streams are considered to be groundwater outlets. Springs are groundwater outlets and recharge gaining streams. Caves are considered to be a spring, when water still flows through the conduit. The spring/cave can either be completely within the water table or contain a gaining stream. If the cave is dry it is considered to be an old spring that represents the previous water table height. The volume of discrete recharge in Missouri is enormous, and most of the remains underground for only a short period of time, a few days or weeks (Miller & Vandike, 1997). Water tracing studies have shown that groundwater can move

more than a mile per day (Miller & Vandike, 1997). There are springs and caves located within the project area, and are protected by Best Management Practices through the implementation of the Forest Plan.

The total miles of streams (including known losing stream miles) and acres of lakes by HUC-6 are included in Table 13.

Table 13. Total Miles of Stream, Miles of Perennial Streams, Miles of Intermittent Streams, Known Number of Losing Streams, Acres of Lakes and Ponds, and Major Streams within each Watershed of the Watershed Condition Analysis Area.

Watershed Name	Total Miles of Streams	Miles of Perennial Streams	Miles of Intermittent Streams	Known Number and Miles of Losing	Acres of Lakes and Ponds	Major Streams within the Watershed
Big Barren Creek	101.5	0.4 (>1%)	101.1 (98%)	5 segments, 12.1 miles	0	Big Barren Creek, Cave Fork, Cedar Bluff Creek, Devils Run, and Fools Catch Creek
Headwaters Big Barren Creek	81.1	0	81.1 (100%)	9 segments, 18 miles	0	Big Barren Creek, Cedar Bluff Creek, East Prong Cedar Bluff Creek, North Prong Cedar Bluff Creek, and South Prong Cedar Bluff Creek
Little Pike Creek	77.5	0	77.5 (100%)	12 segments, 20.1 miles	0	Little Pike Creek and Pike Creek
Lower Pike Creek	93.7	0	93.7 (100%)	16 segments, 21.7 miles	15.5	Pike Creek and Wilburn Branch
Middle Hurricane Creek	153.7	12.3 (8%)	140.8 (92%)	10 segments, 20.0 miles	90.3	Dry Fork and Hurricane Creek
Middle Pike Creek	93.5	0.8 (1%)	92.2 (97%)	18 segments, 32.3 miles	0.6	Pike Creek, Sycamore Creek, and Windes Creek
Upper Hurricane Creek	102.3	2.3 (2%)	98.9 (97%)	16 segments 16.4 miles	21.9	Hurricane Creek, Little Hurricane Creek, and South Fork Hurricane Creek
Upper Pike Creek	113.9	4.0 (4%)	109.5 (96%)	7 segments, 3.5 miles	73.6	Pike Creek, Seaman Creek, and Sycamore Creek

***** Sources: Losing Stream – Missouri Spatial Data Service. Perennial and Intermittent Stream Information – Center of Applied Resarch and Environmental Systems (CARES) Missouri Watershed Tool. All other stream and lake information is from the National Hydrography Dataset Connection (NHD)

Watershed History of Disturbance: The following disturbances contribute to watershed health and stream condition: timber harvesting, pasture/hay crops, cultivated crops, and developed lands (urbanization) includes the land use and land cover information for each HUC-6 watershed within the watershed condition analysis area. The type of land cover and use of the landscape affect the overall watershed condition.

Currently all watersheds within the analysis area have a higher percentage of a forested land cover along with a high percentage of ownership of public land, mostly the Mark Twain National Forest. However, this has not always been in the case. Past land management activities affected the overall watershed condition, which still can be observed in the main stem stream channels today.

Roads: Roads and motorized trails affect watershed condition because more sediment is contributed to streams than any other land management activity in the Forest Service (U.S.D.A. Forest Service, 2011). Road construction and road use are the primary sources of nonpoint source pollution on forested lands, contributing up to 90 percent of the total sediment from forestry operations (U.S. Environmental Protection Agency, 2012). Roads and trails for motorized use modify drainage networks and accelerate erosion processes, resulting in the alteration of physical and biological processes in streams by directly affect water quality and aquatic habitat. Roads and motorized trail directly alter natural sediment and hydrological regimes by changing streamflow patterns and amounts, sediment loading, transport, and deposition, channel morphology and stability, water quality, stream temperatures, and riparian conditions within a watershed (USDA Forest Service, 2001; USDA Forest Service, 2010). These changes can be dramatic and long lasting and can degrade water quality and aquatic habitat (Hagans, Weaver, & Madej, 1986). Common hydrologic problems originating at roads and motorized trails include: rutting and road surface erosion; poorly placed or inadequate stream crossings and surface drains that may fail, divert drainage from its natural course or block passage for fish and other aquatic organisms; and over-steepened cut-and-fill slopes prone to erosion and mass wasting. Studies have indicated that as road and stream crossing densities increases, so do negative effects on aquatic habitat parameters and fish populations (USDA Forest Service, 2001).

Land Management - Timber Harvesting and Agriculture: Humans have been affecting Missouri landscape for the last 12,500 years. Native Americans occupied Missouri 12,500 years ago and altered the landscape with the use of fire, utilizing timber resources, localized agriculture in fertile valleys or along rivers, hunting of game, and village sites. European settlements led to substantial changes in the landscape. By the mid-19th century large-scale logging operations, commercial farming, livestock overgrazing, and fire suppression had begun in the state leading to landscape far different from the early 1800's. As a result, overall the majority of Missouri's native vegetation remains in a highly degraded condition and in return affecting the overall quality of watershed condition (Nelson P. W., 2010).

The land use changes have altered the morphology of the streams from natural conditions in the Ozark Plateau (United States Geological Survey, 1997). The effect of disturbances have been characterized by accelerated aggradation (increase) of gravel especially in former deep pools, accelerated channel migration and avulsion (rapid abandonment of a river channel and the formation of a new river channel), and growth of gravel point bars (United States Geological

Survey, 1997). The first major land cover change that effect stream morphology occurred from the early 1800's to approximately 1880 was the replacement of valley-bottom forest with cultivated fields and pastures causing a direct disturbance to stream channels (United States Geological Survey, 1997). During this same time period wildfire suppression in the uplands caused an increase of woodland with woody understory in grassland and oak savannahs causing decreased runoff and sediment yield from uplands (United States Geological Survey, 1997). Commercial timber companies began large operations starting in 1870 to 1880 to harvest shortleaf pin for sawlogs and oak railroad ties. The post Timber boom period (1920-1960) began a phase on annual burning of uplands and cut-over valley slopes, increased grazing, and increased use of land for cultivated crops (United States Geological Survey, 1997). The net effects of this complex land use changes are difficult to determine and separate from natural variability (United States Geological Survey, 1997). Natural conditions such as extreme flooding periods also affect stream morphology. However, these major land use activities have affected Ozark stream channels.

Today, most of the valley bottoms in the Pike Creek watersheds are in private land ownership and are still used for agriculture production (mostly cattle).

Currently on the Mark Twain National Forest Land timber harvest operations occur under the direction of the Forest Plan for proposes of restoration in the management area (MA 1.1) that this project falls within. These land disturbing activities contribute short-term adverse effects and long-term beneficial effects to overall Watershed Condition. See the "Environmental Consequence" section below for more information of the effects of current timber harvest operations.

Urbanization – Developed Lands: Housing developments and cites also affect watershed condition. The most significant effect is the creation of impermeable surfaces due to roads, driveways, and roofs. This causes increased runoff and alterations of the hydrological flow regime. It also increases the likelihood of pollutants (pesticides, oil, etc.) reaching the surface water and ground water. In the watershed condition analysis are smaller urban areas and homes are more dispersed across the landscape. However, development still contributes to the cumulative effects on watershed condition.

An additional adverse impact to watershed condition on Mark Twain National Forest Lands is trash dumping. There are numerous sinkholes and losing stream channels that are used as trash dumps. Due to the karst topography sinkholes and losing streams are direct connections to the groundwater and gaining streams. Contamination from the trash dumps directly enters the system and affects water quality, aquatic habitat, and groundwater dependent ecosystems. Efforts occur on annual bases to clean up trash on the Forest, however large and small dumpsites still occur and grow annually.

Observations of Current Stream Channel Condition and Affects from the History of Disturbance: As mentioned in the discussion on land management, in this area timber had been cleared in the 1800's and fire suppression occurred. This drastically altered the landscape and resulted in increased runoff and erosion of the land surface to rivers and streams. This had long lasting effects on overland flow and stream morphology and associated aquatic habitat, which still affect the landscape today. With the original vegetation stripped away, overland flow has been altered because less precipitation filters into the water table to supply aquifers and springs. This resulted in many springs going dry (Nelson P. W., 2010). A second denser growth flush of woody vegetation now covers the once open Ozark woodland and a flattened mat of accumulated leaf litter now replaces the lush cover of deep rooted, water absorbing forbs and grasses. This has

caused an alteration of the water holding capacity. As a result of the altered ecosystems the following observations have been made by resource specialists: modified spring flows and connected stream/river flows; precipitation infiltration on the uplands may be less in degraded, overgrown woodlands where the herbaceous ground layer is thinnest; and episodic rainfall events likely more rapid, irregular rises in Ozark stream and river volumes, and corresponding rapid lowering of water levels caused by the landscape's decreased ability to "sponge" water (Nelson P. W., 2010).

Climate change or climate variation also impacts the hydrology of the watersheds in the analysis area. As mentioned above there has been an increase in of 12 to 17 percent more precipitation and more rain has been falling as heavy precipitation events of 3 inches or greater during the past 30 years (Brandt, et al., 2014). An increase in precipitation and heavy precipitation events leads to more flooding events.

Upper, Middle, and Lower, and Little Pike Creek Watersheds:

Mark Twain National Forest ownership ranges from 38% to 64% in these watersheds and the ownership is in the uplands. Along Pike Creek it is all in private land. The majority of the land along Pike Creek is used for agriculture purposes, mainly cattle grazing. There are fish sampling records from 1988, including identification of a cave fish species. These pools where fish sampling occurred no longer exist. The stream only flows in response to precipitation events until you reach the lower end on the channel as it comes into the Current River. Personnel communications with a landowner located along Pike Creek describe a stream with perennial flow from springs, and a swimming hole that is now gone and filled in with gravel. Today Pike Creek has little to no riparian vegetation and landowners along the creek have been reshaping the channel or cutting it deeper through pasture land. These activities cause more sediment to erode from the banks and down cutting of the channel. As the channel continues to get deeper the channel acts as a funnel and the velocity of the flow increases, causing a continuation of increased erosion of the stream banks and increased gravel and sediment within Pike Creek and eventually into the Current River. Lack of connection to the floodplain and no riparian vegetation also causes an increase in velocity of the flow and reducing the system's ability to store water and have normal flow rates to to slowly discharge through the system and into the Current River. Due to the current and past land management activities, Pike Creek it appears to act more as an ephemeral channel or gully due to the history of land management activities, rather than karst geology creating a losing stream. Historically Pike Creek could have had sections of stream that were gaining. In addition to stream morphology changes, this has also resulted in a loss of aquatic habitat and creates long-term effects to the Current River aquatic habitat. For example, one of the threats to the Ozark Hellbender, a federally listed endangered species, is the loss of deep pool habitat from gravel loading in streams.

Roads also impact Pike Creek and tributaries to Pike Creek. Roads occur in former floodplain of Pike Creek and stream crossing are concrete slabs that acts as dams and create aquatic organism passage barriers. As mentioned above roads and motorized trail directly alter natural sediment and hydrological regimes by changing streamflow patterns and amounts, sediment loading, transport, and deposition, channel morphology and stability, water quality, stream temperatures and riparian conditions within a watershed (USDA Forest Service, 2001).

Headwaters Big Barren Creek and Big Barren Creek:

Mark Twain National Forest ownership in these watersheds is 89% in Headwaters Big Barren Creek and 70% in Big Barren Creek. Forest Service ownership is both in the uplands and along Big Barren Creek. Sections of Big Barren Creek have perennial flow, and other sections go dry.

In the Headwaters of Big Barren Creek Carter County Road 173 parallels the creek through a large section of the watershed. Through public comments a concern was brought forward about an area in this section that appears to be inputting additional rock and sediment into the creek off of National Forest Lands. The public is concerned that prescribed burning is consuming on the leaf matter, exposing bare soil and causing an increase in sediment to Big Barren Creek. On the hillslope side of the road is a cut slope into the hillside and on the other side of the road is Big Barren Creek. On the cut slope there is exposed soil, due to the way the road has been built and maintained. Roads modify drainage networks and accelerate erosion processes, resulting in the alteration of physical and biological processes in streams by directly affect water quality and aquatic habitat. Roads directly alter natural sediment and hydrological regimes by changing streamflow patterns and amounts, interception of groundwater flow, sediment loading, transport, and deposition, channel morphology and stability, water quality, stream temperatures and riparian conditions within a watershed (USDA Forest Service, 2001; USDA Forest Service, 2010). This road is in a poor location and causing the major impacts to the stream and riparian corridor in this location.

Above the cut slope of the road is a rocky, steep slope. This is normal diversity of soil types throughout the landscape, especially on steeper slopes. Effective ground cover includes vegetative litter and duff, fine and large woody debris, rock greater than ¾ inch thick, and live vegetation. When there is effective ground cover erosion occurs within natural variability. The rocky, steep slope contains rock greater than ¾ inch. Terrestrial communities and vegetation types occur on this type of terrain, and contribute to habitat diversity. Seen on this slope is vegetation still growing, including moss on the rocks and rocks greater than ¾ inch thick. If these rocks were rolling down hill, then moss would not be growing. Prescribed burning on this slope does not appear to impacting the stream. As mentioned County Road 173 is the major impact to increased sediment to Big Barren Creek in this area.

In Big Barren Creek watershed, a section of the stream has been designated as a State Natural Area, because of a relatively intact stream channel. This section is designated as a Natural Area due to exceptional diversity of aquatic habitat. This area is a gaining stream reach with deep, permanent spring-fed pools with a more intact bottomland forest within the riparian corridor. Most of the upper section of Big Barren Creek is in Mark Twain National Forest Service ownership. US Fish and Wildlife conducted a fish species survey in summer of 2012 and a mussel survey in summer of 2013. USFWS collected 45 species including state listed sensitive fish species Ozark shinner and pugnose minnow. USFWS also found 7 mussel species including four species on the state listed sensitive species list. This is an area where the stream morphology and the aquatic habitat has stayed intact, and is one of the few areas where this still occurs in the Ozarks.

Below the Natural Area Big Barren Creek watershed is mostly private ownership, until Twin Spring (known as Mabry Spring to residents in the area). From Mabry Spring to the confluence of the Current River, Big Barren Creek is all in Mark Twain National Forest. In the section of Big Barren Creek with mostly private ownership, the creek has similar issues to Pike Creek, but not as large of scale. Habitat connectivity below the natural area is poor due to nine stream crossings affecting stream morphology and causing aquatic organism barriers. Private land does have some agriculture uses, mainly cattle grazing, and riparian vegetation corridors have been removed. The majority of the current effects to the stream channel are from County Road C-10 that crosses the stream 9 times and each crossing is an aquatic organism barrier during low-flow conditions, and some are barriers during high flow conditions. These nine low-water stream crossings act as a dam and do not allow streambed material to move naturally through the system which raises the base level of the creek. Additionally the road has been graded down far enough to become the

active channel during flood flow, causing an additional input of gravel and sediment and causing aggradation and the creek to act widely. The impacts of past vegetation clearing and current impacts from the road and lack of a riparian corridor have caused the stream channel morphology to be altered. Today this section of the stream channel only flows during the winter and spring months and goes dry in the summer, except for isolated pools. The channel has no defined shape, aggraded from gravel, and the ability to support aquatic habitat is limited. During the dry period fish are trapped isolated in small pools in small sections between stream crossings.

Due to the multiple springs and the character of the stream through the natural area, the lower section of Barren Creek was possibly a gaining stream in historical times. Residents have mentioned the creek would be more wet than dry, and dry periods seen in the channel seem to be increasing. Many factors could contribute to the loss of surface flow, including the nature of karst topography, groundwater draw downs, land use alterations, and the road. Since this section of the stream channel is in poor condition and numerous aquatic organism passage barriers, there is no habitat connectivity below the natural area to the Current River. Additionally the increased amounts of precipitation in this area during climate change will continue to cause flooding problems and increased gravel movement to the Current River and associated aquatic habitat.

Watershed Condition Indicator and Measures: The Watershed Condition Classification (WCC) as part of the Watershed Condition Framework (WCF) is to determine watershed condition. WCC is in terms of discrete categories or classes that reflect the level of watershed health or integrity in the context of WCF. A watershed is considered to be functioning properly if the physical attributes are appropriate to maintain biological integrity. There are three classes to describe watershed condition. Class 1 or Functioning Properly: watersheds exhibit high geomorphic, hydrological, and biotic integrity relative to their natural potential condition. A functionally properly watershed has minimal undesirable human impact on natural, physical, or biological processes and is resilient and able to recover to the desired when or if disturbed by large natural disturbances or land management activities. Class 2 or Functioning at Risk: watersheds exhibit moderate geomorphic, hydrological, and biotic integrity relative to their natural potential condition. Class 3 or Impaired Function: watersheds exhibit low geomorphic, hydrological, and biotic integrity relative to their natural potential condition. An impaired function watershed occurs because a threshold has been exceeded and substantial changes to the factors that caused the degraded state are needed to set them on a trend of improving conditions that sustain physical, hydrological, and biological integrity.

There are 12 watershed condition indicators used to measure watershed condition on Mark Twain National Forest Lands. The indicators are split into four categories to measure overall watershed condition class 1, 2, and 3: aquatic physical, aquatic biological, terrestrial physical and terrestrial biological (U.S.D.A. Forest Service, 2011). The indicators and their attributes are surrogate variables representing the underlying ecological functions and processes that affect soil and hydrological function.

In 2010 the watershed condition scores were determined by Mark Twain National Forest staff, using the known information and professional expertise. Table 14 through Table 20 include the condition scores for overall watershed health of Mark Twain National Forest lands only and the scores of the each indicator and measure. In some case, if private land activities adjacent to or near Mark Twain National Forest affected a measure, then the effects to Mark Twain National Lands were factored into the condition scores.

Table 14. Existing Condition Overall Scores of Watershed Condition and Scores of Each Indicator on Mark Twain National Forest Lands

Watershed Name	Overall Score	Aquatic Physical	Aquatic Biological	Terrestrial Physical	Terrestrial Biological
Big Barren Creek	1	2	1	1	2
Headwaters Big Barren Creek	1	2	2	2	2
Little Pike Creek	1	2	1	1	2
Lower Pike Creek	2	2	2	1	2
Middle Hurricane Creek	1	2	1	1	1
Middle Pike Creek	1	2	1	1	2
Upper Hurricane Creek	2	2	2	1	1
Upper Pike Creek	2	2	2	1	2

Table 15. Existing Condition Scores for Aquatic Physical Indicator and Measures for Water Quality and Water Quantity on Mark Twain National Forest Lands Only within Analysis Area

Watershed Name	Impaired Watershed 303(d) Listed	Water Quality (Not Listed)	Water Quality Total Score	Flow Characteristics for Water Quantity Score
Big Barren Creek	1	2	1	2
Headwaters Big Barren Creek	1	2	1	2
Little Pike Creek	1	2	1	2
Lower Pike Creek	1	2	1	2
Middle Hurricane Creek	1	2	1	2
Middle Pike Creek	1	2	1	2
Upper Hurricane Creek	1	2	1	2
Upper Pike Creek	1	2	1	2

A score of Class 2 was given for water quality in all watersheds because there is a state wide fish consumption warning due to mercury in fish. Both the Current River and the Eleven Point River are on the 303(d) list for atmospheric deposition of mercury. However, currently the tributaries are not on the 303(d) list.

A score of Class 2 was given for flow characteristic in all these watersheds, because the hydrology of the stream network has been altered due to the historic land changes that were mentioned in above in this existing condition section.

Table 16. Existing Condition Scores for Aquatic Physical Indicator and Measures for Aquatic Habitat on Mark Twain National Forest Lands Only within the Analysis Area

Watershed Name	Habitat Fragmentation	Large Woody Debris	Channel Shape and Function	Aquatic Habitat Score
Big Barren Creek	2	3	2	3
Headwaters Big Barren Creek	3	3	2	3
Little Pike Creek	2	3	2	3
Lower Pike Creek	2	3	2	3
Middle Hurricane Creek	3	3	2	3
Middle Pike Creek	2	3	2	3
Upper Hurricane Creek	3	3	2	3
Upper Pike Creek	2	3	2	3

Habitat fragmentation scores were based on the number of aquatic organism passage barriers caused by road stream crossing. Data was collected in 2010 and 2012 within the Mark Twain National Forest Proclamation Boundary.

Current large woody debris in the stream channel is significantly less compared to the historic records. This is due to lack of riparian vegetation and roads.

A score of Class 2 was given for channel shape and function in all these watersheds, because the hydrology of the stream network has been altered due to the historic land changes that were mentioned in above in this existing condition section.

Table 17. Existing Condition Scores for Aquatic Biological Indicators and Measures on Mark Twain National Forest Lands Only within the Analysis Area

Watershed Name	Life Form Presence	Native Species	Exotic and or Aquatic Invasive Species	Aquatic Biota Total Score	Riparian/Wetland Vegetation for Vegetation Condition Score
Big Barren Creek	1	1	1	1	2
Headwaters Big Barren Creek	1	1	1	1	2
Little Pike Creek	1	1	1	1	2
Lower Pike Creek	1	1	1	1	3
Middle Hurricane Creek	1	1	1	1	1
Middle Pike Creek	1	1	1	1	2
Upper Hurricane Creek	1	1	1	1	3
Upper Pike Creek	1	1	1	1	3

Aquatic biological survey information varies in these watersheds and the expected species exist in locations that have been sampled, including sensitive species. Because of this the score for Aquatic Biota is Class1. This score has the potential to decrease because of the habitat condition.

Currently there are known aquatic invasive species in these watersheds.

A score of Class 2 was given to Riparian /Wetland Vegetation on Forest Service lands, because of clearing and/or roads. However due to the application of BMPs through the Forest Plan, the riparian/wetland areas are slowly recovering.

Table 18. Existing Condition Scores for Terrestrial Physical Indicators and Measures for Roads and Trails on Mark Twain National Forest Lands Only within the Analysis Area

Watershed Name	Open Road Density	Road and Trail Maintenance	Proximity to Water	Roads and Trails Total Score
Big Barren Creek	2	2	2	2
Headwaters Big Barren Creek	2	2	1	2
Little Pike Creek	1	2	1	2
Lower Pike Creek	2	2	2	2
Middle Hurricane Creek	2	2	2	2
Middle Pike Creek	2	2	1	2
Upper Hurricane Creek	2	2	2	2
Upper Pike Creek	2	2	2	2

Open Road Density and Proximity to Water are based on a calculation of miles of road with National Forest boundaries and roads locations within a 100 feet of a stream channel. This calculation was determined using GIS with the know information in the cooperate database.

A score of 2 was given in all watersheds for road and trail maintenance, because the level of maintenance on county roads varies, so the Forest Engineer wanted to select 2 as an overall score because within a watershed an individual road could have a score of 1 or a score of 3 depending on the county's funding, management style, and ability to keep roads maintained.

Table 19. Condition Scores for Terrestrial Physical Indicators and Measures for Soil on Mark Twain National Forest Lands Only within the Analysis Area

Watershed Name	Soil Productivity	Soil Erosion	Soil Contamination	Soil Total Score
Big Barren Creek	1	1	1	1
Headwaters Big Barren Creek	1	1	1	1
Little Pike Creek	1	1	1	1
Lower Pike Creek	1	1	1	1
Middle Hurricane Creek	1	1	1	1
Middle Pike Creek	1	2	1	1
Upper Hurricane Creek	1	1	1	1
Upper Pike Creek	1	1	1	1

Table 20. Existing Condition Scores for Biological Indicators and Measures on Mark Twain National Forest Lands Only within the Analysis Area

Watershed Name	Fire Regime Condition Class	Forest Cover	Rangeland Vegetation	Terrestrial Invasive Species	Insect and Disease	Ozone	Forest Health Total Score
Big Barren Creek	3	1	1	1	1	2	1
Headwaters Big Barren Creek	2	1	2	1	1	2	1
Little Pike Creek	3	1	2	1	1	2	1
Lower Pike Creek	3	1	2	1	1	2	1
Middle Hurricane Creek	2	1	2	1	1	2	1
Middle Pike Creek	3	1	2	1	1	2	1
Upper Hurricane Creek	2	1	2	1	1	2	1
Upper Pike Creek	3	1	2	1	1	2	1

Fire regime condition class was used to determine the score. The fire regime condition class is based on the degree of departure from reference conditions, possibly resulting in changes to key ecosystem components, such as vegetation characteristics, fuel composition, fire frequency, severity, and pattern, and other disturbances such as insect and disease mortality, grazing, and drought.

A score of 1 for Forest Cover was given to every watershed, because there is some form of vegetation or ground cover on Mark Twain National Forest Lands.

Rangeland Vegetation condition is displayed only to see how it factors in the overall score. This score was based on known information by the Forest Rangeland Program Manager.

The terrestrial invasive score was based on known survey information. A score of 1 does not mean there are non-native invasive species, but the occurrences are isolated and/or controlled.

Insect and disease was determined by the Forest Silvicultrists based on known information and studies in 2010.

Ozone information was given by the zone air quality specialists, which was based on known information and studies in 2010.

DIRECT AND INDIRECT EFFECTS ON WATERSHED

ALTERNATIVE 1 - NO ACTION

No ground disturbing activities would occur; therefore no adverse effects would occur.

However, the purpose and need of this project would not be met; therefore the restoration and enhancement activities for pine and pine-oak bluestem would not occur.

ALTERNATIVE 2 - PROPOSED ACTION

The purpose and need of the Proposed Action is to restore and enhance fire-adapted pine and pine-oak bluestem woodlands to their full range of historic vegetation composition and structural

conditions which occur under natural disturbance regimes (fire, drought). This project is needed because resiliency, integrity, and sustainability of these ecosystems on the Mark Twain National Forest could be compromised if current conditions, such as dense canopy cover, high tree densities, and lack of fire are allowed to continue. Treatments include mechanical vegetation thinning and planting, prescribed fire, road maintenance, construction, and decommissioning, and 1 mile of relocation of the Ozark Trail. These activities are described in detail in the Proposed Action located on file in the project record.

Under the proposed action there is the potential for direct and indirect effects to beneficial uses from vegetation treatments, prescribed burning, and all road activities.

Roads: As mentioned under the existing condition roads and motorized trails affect watershed condition because more sediment is contributed to streams than any other land management activity in the US Forest Service (USDA Forest Service, 2010). Road construction and road use are the primary sources of nonpoint source pollution on forested lands, contributing up to 90 percent of the total sediment from forestry operations (U.S. Environmental Protection Agency, 2012). Roads and trails for motorized use modify drainage networks and accelerate erosion processes, resulting in the alteration of physical and biological processes in streams by directly affect water quality and aquatic habitat. Roads and motorized trail directly alter natural sediment and hydrological regimes by changing streamflow patterns and amounts, sediment loading, transport, and deposition, channel morphology and stability, water quality, stream temperatures and riparian conditions within a watershed (USDA Forest Service, 2001; USDA Forest Service, 2010). These changes can be dramatic and long lasting and can degrade water quality and aquatic habitat (Hagans, Weaver, & Madej, 1986). Common hydrologic problems originating at roads and motorized trails include: rutting and road surface erosion; poorly placed or inadequate stream crossings and surface drains that may fail, divert drainage from its natural course or block passage for fish and other aquatic organisms; and over-steepened cut-and-fill slopes prone to erosion and mass wasting. Studies have indicated that as road and stream crossing densities increases, so do negative effects on aquatic habitat parameters and fish populations (USDA Forest Service, 2001).

Road construction and maintenance activities on Forest Service system roads are planned to reduce the effects of increased sediment to water quality and beneficial uses. Activities include improve road drainage by adding Best Management Practices. These activities can include re-shaping of slope, smoothing surface to remove ruts and rills, improving ditches, adding cross drains such as rolling dips or culverts, and adding rock to outlet of culverts to prevent/reducing gullying of the soil. These activities can cause a temporary increase in erosion and sediment to the creek, but overall these activities will reduce the amount of sediment from the system road network. As long as the road prism exist there still will be an effect, but it is not expected to degrade beneficial uses. See Appendix A for a complete list of applicable BMPs.

The Aquatic Cumulative Effects model can be used to individually look at the direct and indirect effects from roads that would occur in each watershed. In the watershed analysis area roads are contributing 25-36% of the total tons/year of sediment to the streams (Table 21. Tons/year of sediment from roads contributed by watershed.

Table 21. Tons/year of sediment from roads contributed by watershed.

Watershed	Total Sediment Tons/Year for Entire Watershed	Road Sediment Tons/Year Existing Condition	Additional Effects From Roads Under Alternative B	Percent of Sediment Roads Contribute to Stream
Big Barren Creek	3948.87	1354.42	20.50	35
Headwaters Big Barren Creek	3050.52	1132.12	1.90	37
Little Pike Creek	3419.13	1144.02	58.45	35
Lower Pike Creek	3264	1222.7	14.15	38
Middle Hurricane Creek	4341.55	1498.88	0.27	35
Middle Pike Creek	3464.79	1015.69	29.85	30
Upper Hurricane Creek	5760.52	1435.82	0	25
Upper Pike Creek	4956.53	1769.12	3.67	36

Road decommissioning non-system roads will improve the overall health of streams and beneficial uses. The effects from these roads will be removed.

Mechanical Vegetation Treatments: Vegetation treatment activities include creation and use of skid trails, landings, and temporary roads with mechanical ground-based equipment. These land management treatments have the potential to increase erosion potential and sediment to streams because effective soil ground cover (leaf litter, vegetation, woody debris etc.) would be removed in this area. Direct effects (sediment reaching the stream as result of activities in or next to channel) and indirect effects are reduced with the application of stream course protection zones as defined in the Forest Plan. These protections include the application of riparian management zone or water course protection zone. Increase in erosion rates resulting from direct and indirect effects are expected to be short term and within natural variability of the system with the use of BMPs. Typically sediment is reduced as forest floor vegetation recovers. See Appendix A for a complete list of applicable BMPs.

In the watershed analysis area mechanical vegetation treatments would contribute less than 1 percent up to 7 percent of the total tons/year of sediment reaching the streams throughout the watershed (Table 22. Tons/year of sediment from mechanical vegetation treatments by watershed.

Table 22. Tons/year of sediment from mechanical vegetation treatments by watershed.

Watershed	Total Sediment Tons/Year for Entire Watershed	Clearcut Tons/Year Sediment Reaching Streams	Heavy Thinning Tons/Year Sediment Reaching Streams	Seed Tree Tons/Year Sediment Reaching Streams	Shelterwood Tons/Year Sediment Reaching Streams	Percent of Sediment Treatments Contribute to Stream
Big Barren Creek	3948.87	0	58.57	0	0	1
Headwaters Big Barren Creek	3050.52	0	14.26	2.14	0	1

Watershed	Total Sediment Tons/Year for Entire Watershed	Clearcut Tons/Year Sediment Reaching Streams	Heavy Thinning Tons/Year Sediment Reaching Streams	Seed Tree Tons/Year Sediment Reaching Streams	Shelterwood Tons/Year Sediment Reaching Streams	Percent of Sediment Treatments Contribute to Stream
Little Pike Creek	3419.13	6.96	175.09	58.41	1.01	7
Lower Pike Creek	3264	0	15.78	2.62	1.33	1
Middle Hurricane Creek	4341.55	0	9.32	1.72	0	Less than 1
Middle Pike Creek	3464.79	1.41	105.10	18.02	0	4
Upper Hurricane Creek	5760.52	0	1.8	0	0	Less than 1
Upper Pike Creek	4956.53	0	14.29	3.76	0	Less than 1

Prescribed Fire: There are public concerns that prescribed fire causes increased erosion and sediment to the stream-network. Fire effects to watershed health have been well documented through studies conducted on western Forests (USDA Forest Service 2005), and soil movement and sedimentation to the stream network and waterbodies can occur. Effects depend on the temperature, consumption of vegetative material, soil type, slope, and climate. Prescribed burns occur during the winter season before spring vegetation. This keeps the burns cool and occurring during a wetter time of year. Typically Mark Twain National Forest prescribed fire techniques does not cause a hot enough burn to cause a major loss in soil cover (personnel communications with Paul Nelson). Fires that are hot enough to cause a major loss in soil cover have a vegetative regrowth. This observation was made in 2010 on a monitoring field trip from a hot prescribed fire on the Poplar Bluff Ranger District. During the short time period before vegetative re-growth increased sedimentation occurred, but no observable effect to the stream network could be seen. BMP evaluations during the summer of 2013 and 2014 in the CFLRP area include examining prescribed burn areas one year after treatment. No evidence of increased erosion could be observed in the area one year after the burn. The area was so dense with vegetation one could hardly walk through the woods. March 13, 2015 a site visit was conducted in the Handy Project Area burn units, burned February 17, 2015. The week before March 13 there was heavy snowfall and due to melting snow and the ground was over saturated. Rainfall started the night of March 12 and ended March 14 with a total rainfall of around 8 inches in Doniphan, MO. On March 13 all stream channels were following, including ephemeral channels at the top of the watershed in the Headwaters of Big Barren Creek. Observations of the conditions in the burned area included clear flowing streams with no suspended sediment, duff and leaf litter was still covering soil below the black area burned, and no evidence of massive soil erosion in the form of rills, ruts or gullies on the steep hillslopes. Based on observations made, sediment erosion reaching the streams from prescribed burning is minimal and short-term.

Over the long-term these treatments are expected to improve the hydrologic function with possible flow returning to lost springs. As mentioned under the existing condition in this area timber had been cleared in the 1800’s and fire suppression occurred. This drastically altered the landscape and resulted in increased runoff and erosion of the land surface to rivers and streams.

This has long lasting effects on overland flow and stream morphology and associated aquatic habitat. With the original vegetation stripped away, overland flow has been altered because less precipitation filters into the water table to supply aquifers and springs. This resulted in many springs going dry (Nelson P. W., 2010). A second denser growth flush of woody vegetation now covers the once open Ozark woodland and a flattened mat of accumulated leaf litter now replaces the lush cover of deep rooted, water absorbing forbs and grasses. This has caused on alteration of the water holding capacity. As a result of the altered ecosystems the following observations have been made by resource specialists: modified spring flows and connected stream/river flows; precipitation infiltration on the uplands may be less in degraded, overgrown woodlands where the herbaceous ground layer is thinnest; and episodic rainfall events likely more rapid, irregular rises in Ozark stream and river volumes, and corresponding rapid lowering of water levels caused by the landscape's decreased ability to "sponge" water (Nelson P. W., 2010). In order to restore and maintain the landscape woodlands require periodic fire. As forbes and grasses return, the hydrologic function of the soils will improve and impacts will be reduced. Therefore overland flow run enough will decrease as the vegetation is restored to a more natural condition.

The activities associated with prescribed burning have a greater risk of creating adverse direct and indirect effects. These activities include fireline construction (causes removal of vegetative soil cover), water sources for water trucks, and potential chemical spill from fueling operations (torch, ATVs, etc.). Forest Plan standards and guides were created to reduce the effects of fireline construction. See Appendix A for a complete list of applicable BMPs. During the 2014 BMP evaluations a rating of failure to properly implement BMPs occurred in a prescribed burn unit. This failure was due to the location of a fireline along an ephemeral channel, on a steep slope, and no water bars were constructed. The district will correct this action on future prescribed burn activities by revaluating fireline locations and constructing water bars using the Forest Plan standards and guides.

In the watershed analysis area prescribed fire treatments would contribute less than 1 percent up to 3 percent of the total tons/year of sediment reaching the streams throughout the watershed (Table 23). This is less than mechanical vegetation treatments.

Table 23. Tons/year of sediment for prescribed fire and fire lines by watershed.

Watershed	Total Sediment Tons/Year for Entire Watershed	Prescribed Burn Tons/Year Sediment Reaching Streams	Fire Line Tons/Year Sediment Reaching Streams	Percent of Sediment Treatments Contribute to Stream
Big Barren Creek	3948.87	40.03	9.30	1
Headwaters Big Barren Creek	3050.52	13.70	2.90	1
Little Pike Creek	3419.13	61.25	26.00	3
Lower Pike Creek	3264	19.91	5.82	1
Middle Hurricane Creek	4341.55	2.26	1.37	Less than 1%
Middle Pike Creek	3464.79	58.09	20.81	2
Upper Hurricane Creek	5760.52			Less than 1%
Upper Pike Creek	4956.53	4.33	6.01	Less than 1%

The Forest Plan did not include standards and guides for drainage channels outside of RMZs and WPZs. The Forest Plan does recognize these other drainage channels during timber harvest

operations. Drainage channels outside the designation of RMZs and WPZs are ephemeral channels with a V or U shape channel, but do not have a defined stream bank according to Forest Plan definitions. These ephemeral channels are the beginning of the stream network and are still considered under Missouri State as either as losing stream or all other waters. The general criteria for all Waters of the State include the following: "Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community." During the creation of dozer fire line, the dozer operator might push sediment and debris into an ephemeral drainage channel at a crossing, creating a debris dam that disconnects upstream from downstream. If this occurs, this action causes a long-term change in channel morphology and hydrological flow regime. To prevent increased sediment and debris from dozer line construction on other drainage channels stream crossing the following project design criteria is included:

- If it is determined necessary to cross a drainage channel not identified as an RMZ or WPZ, lift blade when crossing over the channel to prevent pushing sediment into the creek and creating a dam that would alter the morophogical and hydrological processes of these ephemeral channels.

Application of BMPs from all Activities: Overall for direct and indirect effects from all proposed activities, as mentioned the application of BMP's for all proposed activities would provide protection to the entire watershed from project related sediment delivery to the immediate channel and the channel network. The risk of adverse direct and indirect effect to beneficial uses is expected to be little to none and if an effect does occur it is expected to be short-term and within natural variability. The proposed activities are expected to have all long-term beneficial affect to beneficial uses. Impacts on water quality could occur under the following circumstances:

1. Failure to implement Best Management Practices (BMPs) through the implementation of Forest Plan Standards and Guides.

2. Extreme water yields resulting from abnormally high intensity, magnitude, duration of storm events, which could be increasing in frequency as a result of climate change.

Monitoring of BMPs through the nationwide BMP evaluation program will continue in these projects areas, especially in prescribed fire treatment areas.

CUMULATIVE EFFECTS ON WATERSHED

CUMULATIVE EFFECTS ANALYSIS FOR PROJECT ACTIVITIES

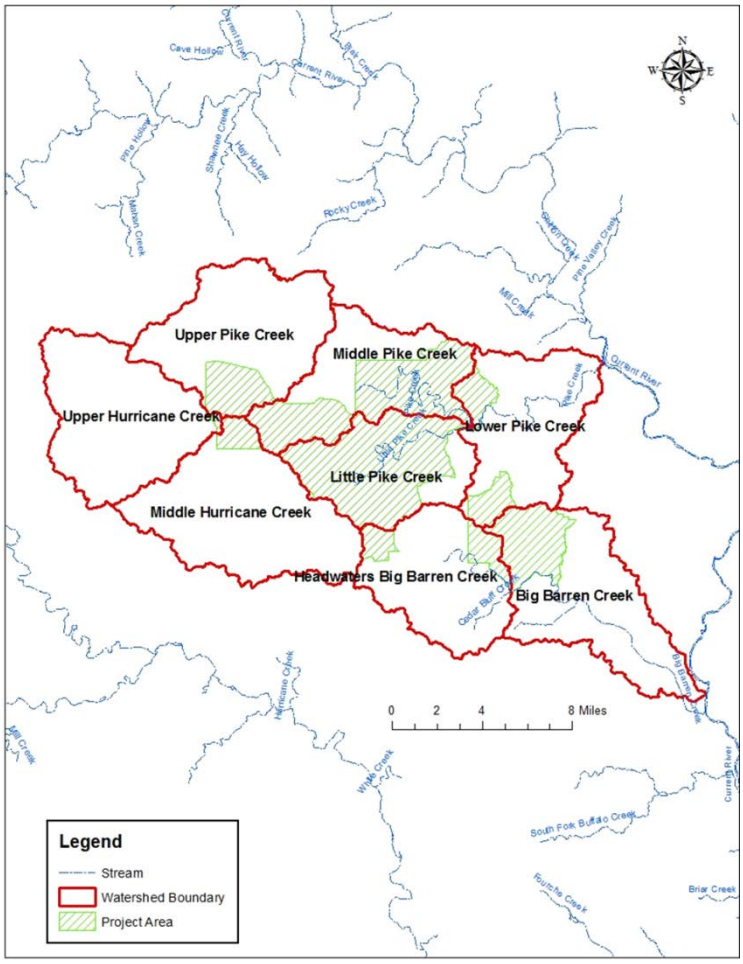
The scope of the cumulative effects analysis includes eight HUC-6 watersheds (Hydrologic Unit Code, 12 digits). The watersheds within the Current River Basin include Upper Pike Creek, Middle Pike Creek, Lower Pike Creek, Little Pike Creek, Headwaters Big Barren Creek, and Big Barren Creek. The watersheds within the Eleven Point River Basin include Upper Hurricane Creek and Middle Hurricane Creek. Figure 8 Watershed Analysis Area Location with Hydrological Units, 12th Level includes a watershed map in reference to the project boundary.

A timeframe of 3 years is used in for the aquatic cumulative effects model (Clingenpeel, Alan J, 2015). Local research has shown the effects of increased sediment as a result of timber harvests are notifiable for up to three years (Clingenpeel, Alan J, 2015). Proposed actions are constrained to a single year to model the worst case scenario.

An indefinite time frame for road reconstruction and maintenance and trail relocation will be used, since it will still occur on the landscape.

If effects were determined to be adverse, then project design mitigations (BMPs) were developed to reduce effects if it is not covered under the Forest Plan. (Appendix A).

Figure 8 Watershed Analysis Area Location with Hydrological Units, 12th Level



The Aquatic Cumulative Effects Model is used to estimate the cumulative risk to water quality and associated beneficial uses from silvicultural activities. Sediment is used as measure for effects determination on land management activities (Clingenpeel 2015). Sediment increases can adversely impact water quality and associated aquatic habitat (Clingenpeel 2015). This model estimates the current condition and the effects of various management alternatives, and compares to risk levels (or threshold) by watershed. A timeframe of 3 years is used in for the aquatic cumulative effects model because local studies show sediment as a result of timber harvest activities are seen for up to 3 years (Clingenpeel 2015). The model assumes all proposed activities will occur on the landscape in the same year. Project implementation does not occur this way. Typically the project is implemented over a 10 year time period. On average 15% of the proposed silvicultural treatments occur on an annual basis throughout the project area and prescribed fire treatments occur on a 3-5 year interval. Detailed information of all model inputs and results are on file in the project record.

Table 24. Aquatic Cumulative Effects Model, includes a summary from the aquatic cumulative effects model of all actions causing sediment to reach in the streams in each watershed with the analysis area. Land use describes the various activities in a watershed that generate sediment, including pasture, farmland, timber harvesting on private land, and urbanization. The sum of

alternative 2 includes all activities in the watershed from the proposed action and any future actions on Forest Service lands from previous decisions including Handy and Van Buren projects. Activities including mechanical vegetation treatments, prescribed burning, fire line construction, road reconstruction, road maintenance, and road decommissioning. In all watersheds the majority of the sediment reaching the stream is due land use activities outside of the proposed work on Mark Twain National Forest Lands.

Table 24. Aquatic Cumulative Effects Model Alternative Comparison

Watershed	Roads Sediment Tons/Yr	Percent of Sediment Roads Contribute to Stream	Land Use Sediment in Tons/Yr	Percent of Sediment Land Use Contribute to Stream	Alt B Sediment in Tons/Yr	Percent of Sediment Alt B Contribute to Stream	Total Sediment Tons/Year Alt B
Big Barren Creek	1354.42	34	2224.64	56	369.81	9	3948.87
Headwaters Big Barren Creek	1132.12	37	1883.88	62	34.52	1	3050.52
Little Pike Creek	1144.02	33	1409.16	41	865.98	25	3419.13
Lower Pike Creek	1222.7	37	1868.47	57	172.83	5	3264
Middle Hurricane Creek	1498.88	35	2789.58	64	53.09	1	4341.55
Middle Pike Creek	1015.69	29	1846.63	53	602.47	17	3464.79
Upper Hurricane Creek	1435.82	25	4256.33	74	68.37	1	5760.52
Upper Pike Creek	1769.12	36	3003.79	61	183.62	4	4956.53

The final results of the model outputs are included in Table 25 Aquatic Cumulative Effects Modeled Results, including a comparison to the Alternative 1 - No Action. Alternative 1 has sediment generated activities because of other decisions the Forest Service is implementing on the ground in 2015, 2016, and 2017 from the Handy and Van Buren decisions. Alternative 2 includes all activities occurring under previous decisions and the proposed activities under alternative B.

Final results of the aquatic cumulative effects model are defined by:

- Low Risk is 0 to 2567 tons of sediment
- Moderate Risk is 2818 to 5635 tons of sediment
- High Risk is greater than 5636 tons of sediment

A low risk level only requires that the project implementation include forest standards and guides and best management practices as defined in Appendix A. A moderate risk suggests that streams be monitored to determine the health of the aquatic biota. A high risk suggests that the project should consider reducing proposed activities or proposing additional improvement projects such as road and trail obliterations or closures.

All watersheds have a low risk rating under the proposed action alternative. This means that the implementation of the Forest Plan standards and guides and best management practices listed in Appendix A would protect watershed condition and beneficial uses with the implementation of the proposed action.

Table 25 Aquatic Cumulative Effects Modeled Results

Watershed Name	Proposed Tons of Sediment Alternative A	Proposed Tons of Sediment Alternative B	Risk Rating Alternative A	Risk Rating Alternative B
Big Barren Creek	42.01	369.81	Low	Low
Headwaters Big Barren Creek	12.63	34.52	Low	Low
Little Pike Creek	35.07	865.98	Low	Low
Lower Pike Creek	36.02	172.83	Low	Low
Middle Hurricane Creek	26.81	53.09	Low	Low
Middle Pike Creek	63.58	602.47	Low	Low
Upper Hurricane Creek	66.5	68.37	Low	Low
Upper Pike Creek	76.2	186.62	Low	Low

The Little Pike Creek watershed has the most proposed activities, and the largest amount of sediment reaching the streams predicted by the model. The model assumes all proposed activities will occur on the landscape in the same year, so this number is inflated compared to what actual conditions would be. To have a visual comparison of how much sediment this would be each day, the results are compared to how much soil a typical dump truck can hold. When filled to the top a typical dump truck can hold 30,880 pounds of soil or 154 tons. If this was spread out over the entire year this would be a total of 0.01 of a dump truck each day of the year. This is a minor amount of sediment compared to roads and other types of land use activities in the floodplain of the river.

CUMULATIVE EFFECTS ANALYSIS FOR WATERSHED CONDITION

There are 12 watershed condition indicators used to measure watershed condition on Mark Twain National Forest Lands. The indicators are split into four categories to measure overall Watershed Condition Classes 1, 2, and 3: aquatic physical, aquatic biological, terrestrial physical and terrestrial biological (USDA Forest Service 2011). The indicators and their attributes represent ecological functions and processes that affect soil and hydrological function. Each indicator will be analyzed for a change in condition class.

Aquatic Physical Indicators:

Water quality condition is measured by impaired waters on the 303(d) list and water quality concerns not on the 303(d) list. Currently under the existing condition all watersheds are considered have a score of Class 1 – Functioning Properly, since there are no streams on the 303(d) list. Land management activities under the proposed action are expected to have no cumulative effects that would cause an additional listing on the impaired waters 303(d) listed due to the application of BMPs (Appendix A). The major tributaries these watersheds are connected to streams on the 303(d) list for atmospheric deposition of mercury from coal mining. This listing is not the result of land management activities on the Mark Twain National Forest, and is not within the control of Forest to improve this listing since the cause is from coal mining not occurring on the Forest.

Water quantity condition is measured by assessing flow conditions. All watersheds in the project analysis area having a rating of Class 2 – Functioning at Risk on National Forest Service lands. This is existing condition is result of past land management activities in the watersheds and current management activities on nearby private land up or downstream of Forest Service lands. See the Existing Condition section for more information. This condition rating is expected to remain the same due to application of BMPs.

Aquatic Habitat Condition is measured by assessing habitat fragmentation, large woody debris in stream, and the channel shape and function. This is existing condition is result of past land management activities in the watersheds and current management activities on nearby private up or downstream of Forest Service lands. See the Existing Condition section for more information. This condition rating is expected to remain the same due to application of BMPs.

Terrestrial Physical Indicators:

Road and trail condition is measured assessing open road density, road and trail maintenance, and proximity to water. This indicator will remain the same, because there are no activities to decommission open system roads, maintenance of county roads has not changed, and there are no segments of roads proposed to be removed outside of the RMZ or WPZ. The cumulative effects from sediment on roads are expected to have a long-term reduction on Forest System roads with proposed road construction and maintenance. The effect of these roads will still occur on the landscape, but the current effects will be reduced under the proposed action.

Road decommissioning is only proposed on non-system roads which are not used in the indicator for open road density. Even though there will be no change in the indicator, road decommissioning with have a long-term beneficial effect on the landscape. Sediment from these non-system roads will no longer reach the stream-network.

Soil condition is measured assessing soil productivity, soil erosion, and soil contamination. This indicator was assessed in a separate report on file in the project record. This condition rating is expected to remain the same due to application of BMPs.

Terrestrial Biological Indicators:

Fire regime condition is assessed using the fire regime condition class (FRCC). The effects to this condition class were analyzed in a separate report on file in the project record. Prescribed fire will be a tool used for the vegetation restoration treatments. As described under the existing condition land management in the project area including clearing timber in the 1800's and fire suppression. This drastically altered the landscape and resulted in increased runoff and erosion of the land surface to rivers and streams. This has long lasting effects on overland flow and stream morphology and associated aquatic habitat. With the original vegetation stripped away, overland flow has been altered because less precipitation filters into the water table to supply aquifers and springs. This resulted in many springs going dry (Nelson P. W., 2010). A second denser growth flush of woody vegetation now covers the once open Ozark woodland and a flattened mat of accumulated leaf litter now replaces the lush cover of deep rooted, water absorbing forbs and grasses. This has caused on alteration of the water holding capacity. As a result of the altered ecosystems the following observations have been made by resource specialists: modified spring flows and connected stream/river flows; precipitation infiltration on the uplands may be less in degraded, overgrown woodlands where the herbaceous ground layer is thinnest; and episodic rainfall events likely more rapid, irregular rises in Ozark stream and river volumes, and corresponding rapid lowering of water levels caused by the landscape's decreased ability to

“sponge” water (Nelson P. W., 2010).To restore and maintain woodlands, prescribed burns on a regular interval is recommended (Nelson P. W., 2010). As forbes and grasses return, the hydrologic function of the soils will improve and impacts will be reduced.

Stream channels in the watershed analysis area have been drastically altered from past land management activities and current land management activities. Roads and loss of riparian vegetation continue to degrade the stream network and cause long-term cumulative effects. Potential short-term increase in sediment from prescribed fire activities are no expected to add additional long-term cumulative effects. Effects are expected to be short-term with the application of BMPs through the implementation of the Forest Plan. A long-term beneficial effect is expected as the herbaceous ground layer recovers and overland flow rates recover.

The proposed prescribed management will improve FRCC condition class. The long-term goal of the Missouri Pine-Oak Woodland Restoration Project (MoPWR) is to restore and improve woodlands. The projects proposed under the MoPWR, like Fremont and Pineknot East Restoration Projectwill improve the FRCC condition class, and the end goal is to have an FRCC of 1 which represents ecosystems with low (<33 percent) departure and that are still within the estimated historical range of variability during a specifically defined reference period. This would then give a rating of good or functioning properly as an indicator for watershed condition. It will take multiple treatments and projects across the landscape to change this rating for each watershed. The Fremont and Pineknot East Woodland Restoration project may not change the indicator of fire regime condition class in each watershed. The final rating will be determined post implementation of the whole MoPWR project.

Forest Cover is measured by assessing where trees provide 10% or greater canopy cover and are part of the dominant (uppermost) vegetation layer, including areas that have been planted to produce woody crops. Under the existing condition this is rated as Class 1 functioning properly within the watershed analysis area. For more information refer to the silviculturist report on file in the project record.

Vegetation treatments have the potential to cause increased sediment. Project induced sediment resulting in proposed treatments are expected to be short-term. On the Ouachita National Forest in Arkansas, sediment is used to measure cumulative effects from land management activities and studies indicate increased sediment as a result of timber harvests are identifiable for up to 3 years (Clingenpeel and Crump 2005). Therefore long-term cumulative effects are not expected as a result of proposed vegetation treatment.

Terrestrial Invasive Species. Non-Native Invasive Plant Species treatments were analyzed in a Forest-wide Environmental Impact Statement. On-going treatments are planned forest-wide and are expected to improve the condition class in the future. Since these treatments are part of a long-term treatment, a change in the condition class is not shown in this report.

Forest Health. This indicator addresses forest mortality impacts to hydrologic and soil function due to major invasive and native forest pest insect and disease outbreaks and air pollution. Measures include insects and disease and ozone. The measure was rated at Class 1 functioning properly in all watersheds within the analysis area. The vegetation restoration proposed activities will help this area continue to be resilient to pest insects and disease outbreaks. For more information refer to the silviculturist report on file in the project record.

VEGETATION

AFFECTED ENVIRONMENTS

Woodland Structure and Composition: The Fremont-Pineknot East Restoration Project area today is much different in character and vegetation dominance than it was before European settlement. Current vegetation within the area is the result of logging of the virgin shortleaf pine timber in the late 1800's, with its subsequent change in dominance to oak hardwoods brought about by decades of fire suppression and over-grazing (open range persisted until the 1960's), and forest management by the Forest Service favoring recovery of shortleaf pine. The entire project area is covered with dense growth of second, and in some cases, third growth hardwoods, oak-pine, and pine forest.

Shortleaf pine ecosystems are fire-adapted. Fires were started either by lightning or more commonly set by Native Americans. The absence of fire over the past 50 years has had a profound effect in changing and altering vegetation, and the distribution in patterns and abundance of associated wildlife, throughout the Ozarks. There has been a reduction of Missouri's once vast Ozark pine woodland communities. The associated non-woody plant species have been drastically reduced and some have been eliminated due to decades of open-range grazing, fire suppression, and subsequent accumulation of deep leaf debris in an overstocked stand of deciduous trees.

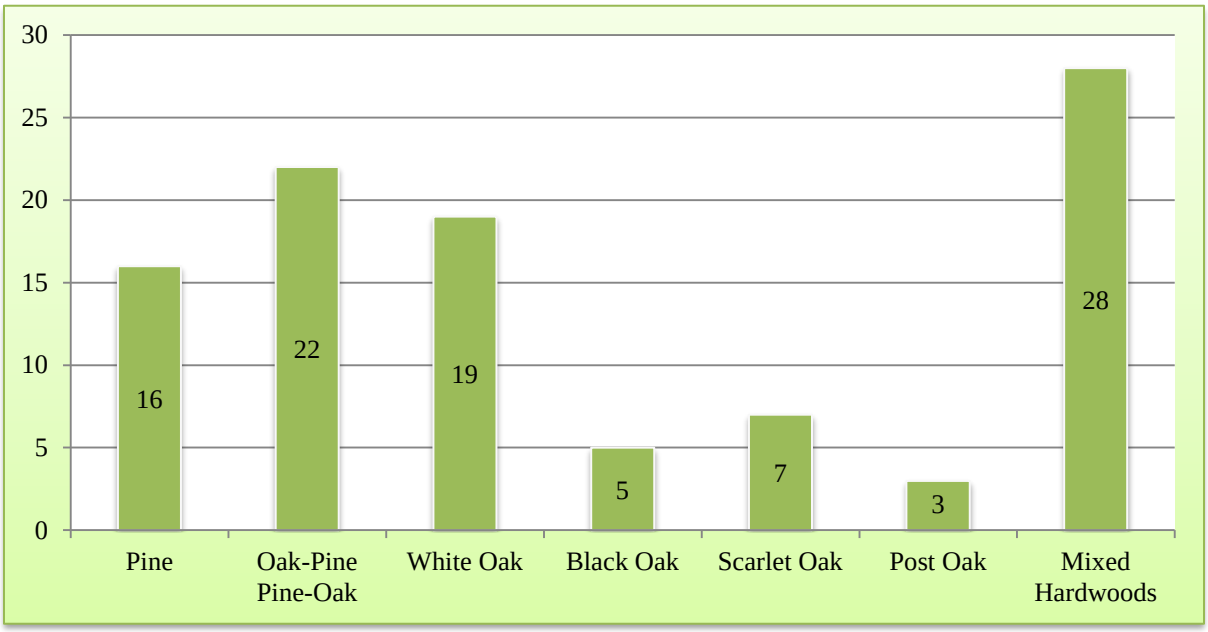
The majority of the project area is currently upland forest and closed woodland natural community complexes which are generally located on the ridges and side slopes. Within the project area, 91% of the area has a canopy closure greater than 50%, equivalent to closed woodland and forest community groups. The 2005 Forest Plan classifies Open Woodland canopy closures as less than 50%. Open Woodland natural community types are currently underrepresented within the Fremont-Pineknot East Restoration Project area. Closed tree canopies are inhibiting understory growth of forbs and grasses. A comparison of the historic natural communities of the early 1800's versus the existing condition based on the Fremont-Pineknot East Vegetation Survey is shown in Table 26.

Table 26. Natural Communities in the Fremont-Pineknot East Vegetation Survey

	Savanna	**Open woodland**	**Closed woodland**	**Forest**
Desired	6%	81%	12%	1%
Existing	2%	7%	65%	26%

The project area is dominated by tree cover with most stands lacking thriving populations of forbs or grasses. Inventory data for the project area reveals that stands vary in dominance by shortleaf pine, mixed pine and oak and oak hardwoods. Dominance of shortleaf pine by basal area is much reduced from presettlement condition. White oak, scarlet oak and black oak dominate north and east-facing slopes and ravines. Shortleaf pine dominates or co-dominates on upland ridges and southwest-facing slopes. The percentage of dominate forest types represented across the Fremont-Pineknot East Restoration Project Area is shown in Figure 9.

Figure 9. Current Forest Types in Project Area



The Eleven Point Ranger District is in the heart of the historic shortleaf pine range (Hanberry, Dey, & He, 2012). About 6.6 million acres of shortleaf pine forest historically occurred in the Missouri Ozark Highlands (Guyette & Dey, 1997). Pure shortleaf pine and shortleaf pine mixed with other species accounts for about 1% and 2% of current forest cover. In contrast to 23% and 31% of the historical forest in the Missouri Ozarks (Zhang, et al., 2009). Perhaps the best and most extensive pine-bearing lands exist on state and federal ownerships, where management over the past 75 years has favored the re-establishment or protection of pine (Cunningham, 2007). Shortleaf pine has become a co-dominant species in public land, whereas it has become a minor species in private land (Zhang, et al., 2009). High integrity shortleaf pine and mixed pine-oak natural communities are underrepresented on the Mark Twain national Forest according to conservation assessments. Restored high integrity natural communities (Nelson P. W., 2010) attract abundant wildlife with increases in grass/forb cover and diversity.

Management Direction: The Mark Twain National Forest 2005 Land and Resource Management Plan (USDA Forest Service: Mark Twain National Forest, 2005b) outlines environmentally sound management to achieve desired conditions on the land and produce goods and services in a way that maximizes long-term net public benefits. The 2005 Forest Plan emphasizes different desired conditions and goals for various parts of the Forest. It also provides an integrated, interdisciplinary, programmatic framework for environmentally sound management based on the best available scientific information. The Forest Plan provides programmatic management direction for selecting the appropriate silvicultural activities at the project level to achieve desired conditions on the landscape. Goals relate to general management direction, objectives represent more precise characterizations of general goals, and evaluation criteria are even more focused and specific with respect to desired outcomes (Long, Smith, & Roberts, 2009). The goals, objectives, and desired condition for Fremont-Pineknot East Project Area will be defined in three parts: the Forest Plan defined forest-wide goals and objectives; the Forest Plan defined goals and desired condition for management prescription 1.1; and individual stand desired condition and objectives. Evaluation criterions were defined to provide a reasonable expectation over both short and long term periods, depending on the objective. Appendix B

contains a discussion on the guiding silvicultural principles that are followed as restoration is implement across the project area.

Silviculture Objectives and Evaluation Criteria

1. Restore, enhance, and maintain the conditions of terrestrial natural communities.
    - Stimulate the ground surface vegetation by creating openings in the canopy to allow light to reach the ground surface.
    - Restore the ecological role of fire in natural communities.
    - Create early seral habitat within the context of historical variability.
    - Increase stands age class diversity.
2. Improve current forest health conditions.
    - Remove trees exhibiting signs of oak decline and reduce risk of oak decline.
    - Promote long lived species.
3. Address hazardous fuel conditions.
    - Reduce potential hazardous fuel loading and hazard trees.
4. Provide timber and wood products to the local economy.
    - Provide commercial wood products.
    - Employ workers in stand tending activities.

Non-Native and Invasive Species: An NNIP inventory was conducted within the project area in 2011 by Forest Service personnel. Of these species found; Spotted knapweed, Beef steak, Autumn olive, Princess tree and Winter creeper would be the highest priority species for treatment. Sericia lespedeza, Multiflora rose and Japanese Honeysuckle are wide spread invasive species throughout the southern Ozarks and would not be the highest priority for treatment even though treatments would occur. The proposed activities which could adversely affect existing infestations of NNIP species include: vegetation treatments, road maintenance and construction, and prescribed burning. Most impacts to NNIP species is based on the level of ground disturbance which promotes the spread of species into new locations. Table 27 lists proposed activities for this project and its potential to promote the spread of known infestations (R9 NNIS Best Management Practices).

Table 27. Activity type and potential for spread of NNIP species.

Activity Type	**Potential for NNIP spread**		
	Low	Moderate	High
Prescribed Burning	✓		
Road Construction			✓
Road Maintenance		✓	
Log landings			✓
Skid Trails		✓	
Commercial Thinning	✓		
Salvage Harvest			✓
Understory Removal	✓		
Plant and Release	✓		
Pre-commercial	✓		

Activity Type	Potential for NNIP spread		
Thinning			
Clear cutting			✓
Fire Control lines (dozer)		✓	

In February 2012, the Integrated Non-native Invasive Plant (NNIP) Control Project Record of Decision (ROD) was signed taking an integrated approach to the treatment of non-native invasive plants (USDA, Forest Service, Mark Twain National Forest, Final Environmental Impact Statement (FEIS), and Integrated Non-native Invasive Plant Control Project, Feb 2012). This integrated approach included the prevention, suppression, reduction and eradication of existing and future NNIP infestations on National Forest System lands within the Mark Twain National Forest.

Treatments of mapped NNIP infestation are on-going within the Fremont and Pineknot East Restoration Projectarea with the implementation of the Forest-wide Integrated Non-native Invasive Plant Control Project. A complete analysis of the NNIP for this project is located in the project file.

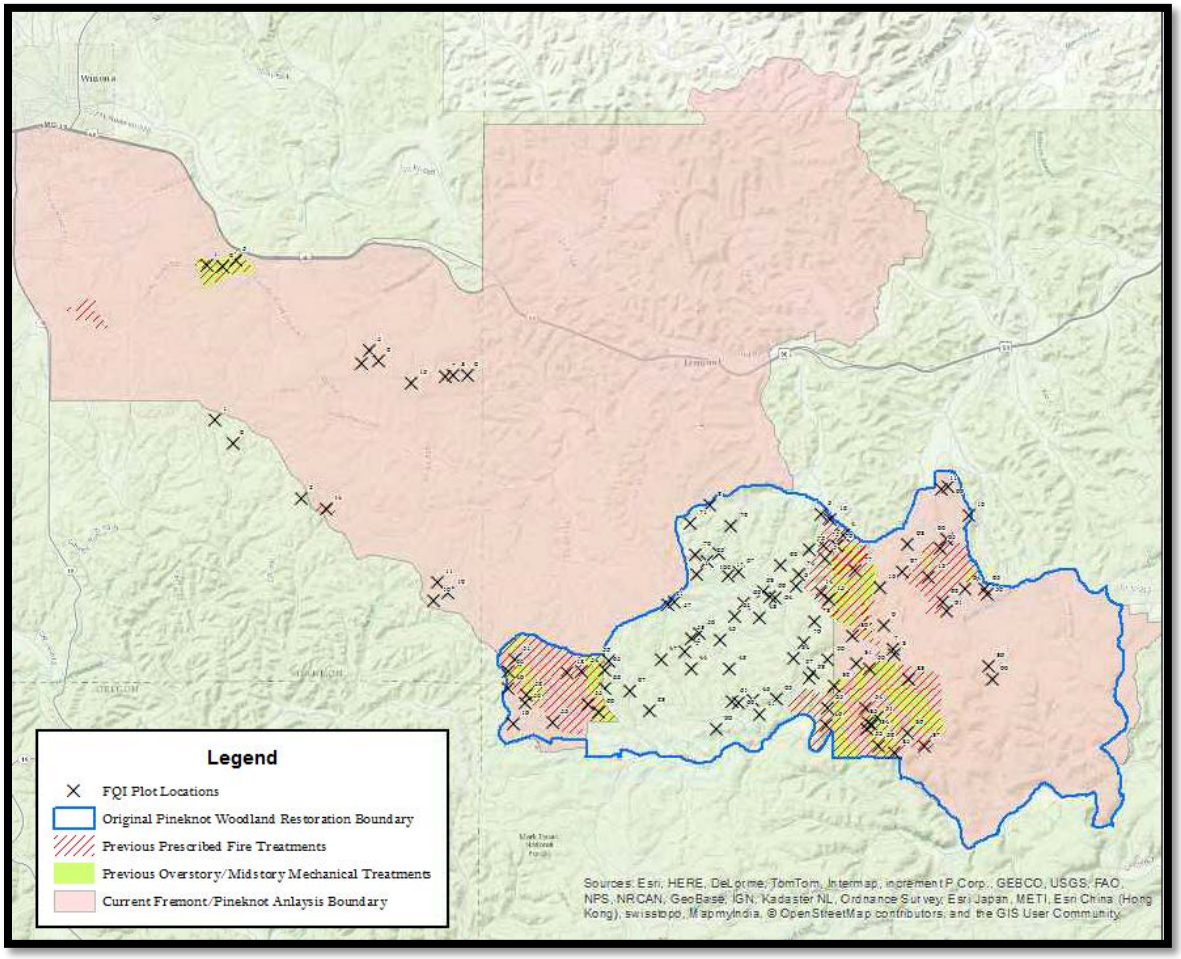
Herbaceous Understory and Floristic Quality Assessment: The Forest conducts intensive monitoring of most of its natural community restoration efforts located in Management areas 1.1 and 1.2 to assess the progress toward desired condition. The monitoring protocol is based on Floristic Quality Assessment (FQI or FQA) (Taft & et al, 1997; Wilhelm & Ladd, 1988) methodologies which were first initiated by The Nature Conservancy stating in 2000 with the Pineknot Woodland Restoration Decision (2002) to commence restoration of shortleaf pine woodlands. FQI uses the proportion of conservative plant species in a plant community to assess the degree of "naturalness" of an area. Conservative species are defined as being restricted to intact ecosystems where ecological processes, functions, composition, and structure have not been (or minimally so) degraded/modified by human stressors.

Species richness is expressed as an index (C value) based on numerical values (between 0 and 10) assigned to each native vascular plant species. This numerical index is an expression of the relative integrity of the ecosystem. Taft et al. (1997) provides a more in-depth explanation of assignments of C values to plant species. Additionally, the actual values assigned to plant species reflect the relative degree to which the species and collection of species are restricted to high quality ecosystems. The presence of “conservative” plant species assigned values greater than 5 often indicate good quality, least disturbed habitats. Likewise, species assigned values less than 5 often indicate poor quality habitats (old fields, lawns, overgrazed woodlands). For meeting the goals and objectives of Ecosystem Sustainability, the aggregate mean floristic quality index of the areas flora is an effective predictor of site potential for ecosystem recovery. Plot data from vegetation sampling serves as an effective means of assessing current condition since numerical values and indices will reflect the degree to which conservative plant species are distributed (as well as species at risk) within a given area.

The Floristic Quality Index is based on repeated sampling of vegetation in randomized plots (typically fifty 1/4 square meter quadrats) along permanent line transects. These transects are located in representative natural communities for which information on biotic trends and changes, particularly in relation to ongoing management activities, is needed. In some cases these data are augmented with supplementary sampling of larger plots to derive tree data relating to structure, composition and recruitment, or faunistic data such as breeding bird surveys. Collectively, these locations are referred to as plot settings. The rationale for this monitoring approach is explained in (Heummann, 2002).

In 2000 and 2001, the Forest established 100 FQI plot settings in the Pineknot Woodland Restoration Project area to monitor the effectiveness of the thinning and prescribed fire activities and to establish a baseline of quality of the understory flora. Eleven of these plots also fall within the current Fremont Project area and thirty-four of these are within the Pineknot East project area (Figure 10). In 2012, fourteen additional FQI plots were established in the Fremont project area to establish a baseline of quality of the understory flora. Thirty-six of these 59 FQI plots fall within previous prescribed fire units and thirteen have had overstory or midstory thinnings.

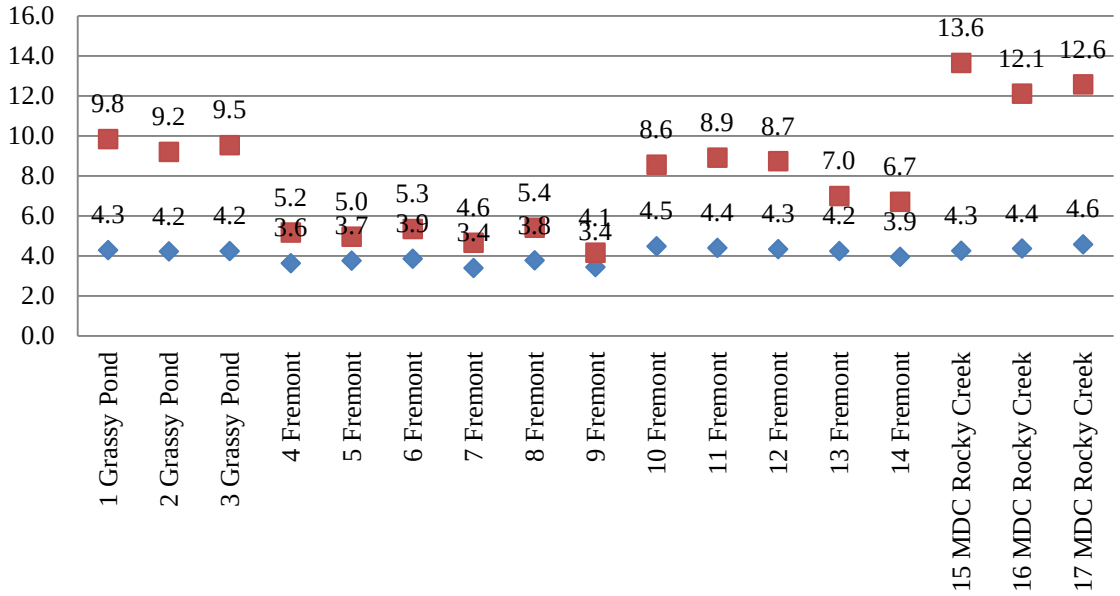
Figure 10. Locations of FQI settings in project area



Two main indices that the Forest looks at to measure the quality of response to restoration management activities are: 1) The average C-Value of all plants (Mean C); and 2) Mean C of all plants multiplied by the square-root of the number of all plants (FQI). Both the Mean C and FQI is an indication of native vegetative quality of a site.

Figure 11 displays the Mean C and FQI for all plot settings collected in Fremont in 2012. Some of these plots were established in area where restoration work has been conducted such as the Grassy Pond Savanna Burn (Plot Settings 1-3) and the Missouri Department of Conservation Pine Restoration Site on Rocky Creek Conservation Area (Plot Settings 15-17). These sites have undergone restoration thinning and repeated prescribed fire over the last 15 years. In those plots the FQI which is an indication of native vegetative quality for an area.

Figure 11. Mean C and FQI indices for 2012 Plot Settings in Fremont and Rocky Creek Conservation Area



DIRECT AND INDIRECT EFFECTS ON VEGETATION

ALTERNATIVE 1- NO ACTION

Alternative 1 would continue the trend of less light reaching the forest floor, and natural communities moving toward a closed forest natural community type, farther and farther away from the historic and desired conditions of open and closed woodland natural community types. Alternative 1 (No action) would continue to have a closed canopy over time. There would be gaps created as mortality of the red oak group occurred and there is a possibility that a significant occurrence of oak decline in the stand could open the canopy fairly quickly over a short time period. Shade intolerant and short-lived species such as scarlet oak and black oak would inexorably fall out of stands over the next ten years (Kabrick, 2008; Nowacki & Abrams, 2008).

Alternative 1 would not restore the ecological role of fire in natural communities. Without the introduction of prescribed burns or other vegetation treatments, heavy leaf and shrub litter will continue suppressing and smothering grasses and forbs to a point where seed production is limited and percent ground cover is reduced to less than 20%. Groundcover plant species richness will remain low or continue decreasing with increased fuel accumulation. Certain plants could be lost in a continual degraded condition.

Alternative 1 is unlikely to produce an environment that would recruit shortleaf pine instead of its hardwood competitors due to the lack of a good existing seed source or current shortleaf pine regeneration in many stands. Pine regeneration would not occur unless some natural event, such as a tornado opened up a large area with a pine seed source nearby. The pine component would gradually become less a part of the forest landscape.

Many stands of black oak and scarlet oak are past their rotation ages as defined by the 2005 Forest Plan (p. 2-28). Their current ages put them at high risk for oak decline (Dwyer, Kabrick, & Wetteroff, 2009). Alternative 1 would not address the issue of oak decline and mortality and could increase the susceptibility of the forest for attack by insects and disease in the future.

White oak would become the predominant overstory species. Shade tolerant species would become dominant in the understory because they are better able to thrive in lower light levels than oak and pine species. The open woodland and closed woodland natural communities would not be restored unless by random natural events. Stand age-class distribution would continue to be heavily skewed toward the older age groups.

Shade intolerant and short lived species such as scarlet oak and black oak would slowly fall out of stands in the project area and be replaced by more long lived, shade intermediate species such as white oak, post oak, and hickory. Some shade tolerant species would respond to this environment in the mid-story. Natural disturbances that would create small canopy gaps would most likely continue this trend; however, a large scale natural disturbance such as a tornado could reinitiate the predominance of red oak once again into the stand. Trees would mature and become less vigorous, and tree density would increase, thus increasing competition for nutrients. Species diversity would decrease, making the tree more susceptible to an attack from species-specific pathogens.

ALTERNATIVE 2 – PROPOSED ACTION

Alternative 2 (the Proposed Action) would move natural community types in the project area into closer compliance with the Desired Condition as generally described in the 2005 Forest Plan and Management Prescription 1.1.

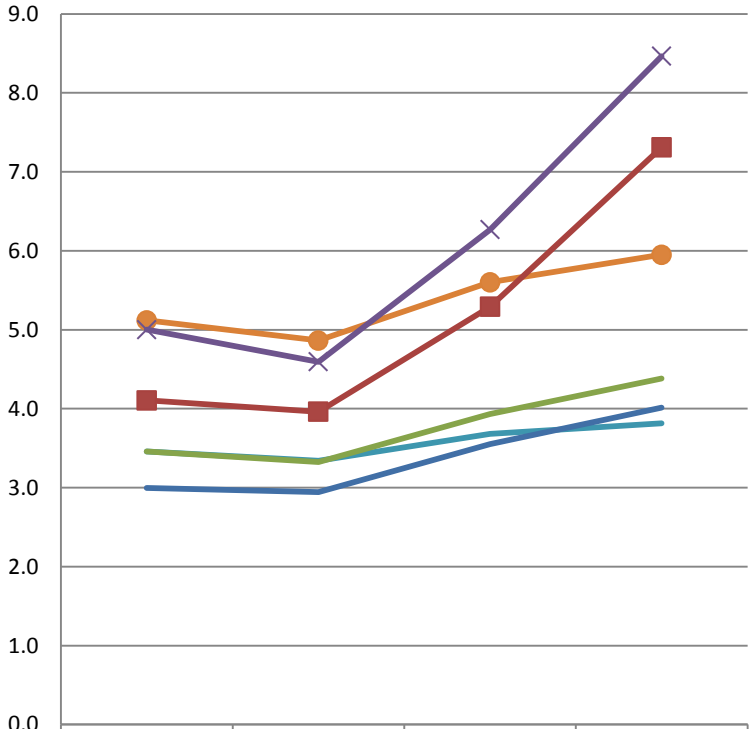
Open woodland would increase; closed woodland would decrease; and forest natural community types would be slightly reduced. Acreages and percentages, although not at historical levels, would be closer to the desired conditions than those that currently exist.

Enhancement of terrestrial natural communities in the project area revolves around allowing light to reach the forest floor to increase ground vegetative cover and diversity as well as increasing the pine regeneration potential in the project area. Timber harvest and non-commercial stand-tending measures in Alternative 2 would increase and maintain natural community types. The use of commercial (timber harvest) and non-commercial (TSI) activities would move vegetation towards the desired balance of natural communities. Results of Alternatives 2 create various sizes of canopy openings dependent upon prescribed individual treatments. No temporary opening created by even-aged regeneration harvest will be greater than 40 acres in size.

The logging of the virgin shortleaf pine, over grazing, and fire suppression efforts since 1940s, have decreased the abundance of shortleaf pine to 20-25% of its original occurrence through the accumulation of forest litter, inhibiting shortleaf pine regeneration in the Missouri Ozarks (Shifley & Brookshire, 2000). Without fire, woody vegetation will encroach into prairies, savannas and open woodlands. Both shade and accumulating deep leaf litter smother and reduce/eliminate otherwise sun-loving flora and associated fauna (McCarty & Hassien, 1984). Increases in native, plant diversity has been shown to increase through the use of restoration treatments. Kinkead et al (2013) found that compared to the control, percentage ground cover of woodland indicators was seven times greater in burned stands, six times greater in harvested stands, and 22 times greater in harvested and burned stands.

Figure 12 shows responses in the Mean C and FQI to past restoration activities (Grassy Pond and the 2003 Pineknot Woodland Restoration Project) that have occurred in the portions of the Pineknot and Fremont project areas.

Figure 12. 2001-2010 Treatment vs. No Treatment FQI and Mean C in Fremont and Pineknot



	2000	2001	2005	2010
No Treatment Avg Setting FQI	5.1	4.9	5.6	6.0
Mechanical/Fire Avg Setting FQI	4.1	4.0	5.3	7.3
Fire Only Avg Setting FQI	5.0	4.6	6.3	8.5
No Treatment Avg Mean C	3.5	3.3	3.7	3.8
Mechanical/Fire Avg Mean C	3.0	2.9	3.6	4.0
Fire Only Avg Mean C	3.5	3.3	3.9	4.4

The deliberate decision to prescribe burn on a landscape scale was adopted by the 2005 Forest Plan, and is a key element of restoration efforts. Prescribed burning will be implemented as part of landscape burns on a 2 to 5 year rotation during the initial stages of restoration. Prescribed burns will be conducted to reduce hardwood understories/midstories and reduce annual forest litter accumulation. Initial prescribed burning will likely top kill or significantly stress smaller diameter hardwood trees resulting in new hardwood sprouts. Repeated prescribed burns will continue to top kill or stress small diameter hardwood trees and keep them in a suppressed or significantly subordinate canopy position, but will not fully eliminate sprouting. On approximately 1,167 acres, midstory treatment would be directly followed by stump treatment with triclopyr and/or glyphosate herbicides to prevent re-sprouting. The actual area occupied by all the treated stumps would be less than one acre in size. By using the stump treatment method, it is anticipated that no non-targeted vegetation will be effected. Pine responses to prescribed burning also include top kill and sprouting of trees.

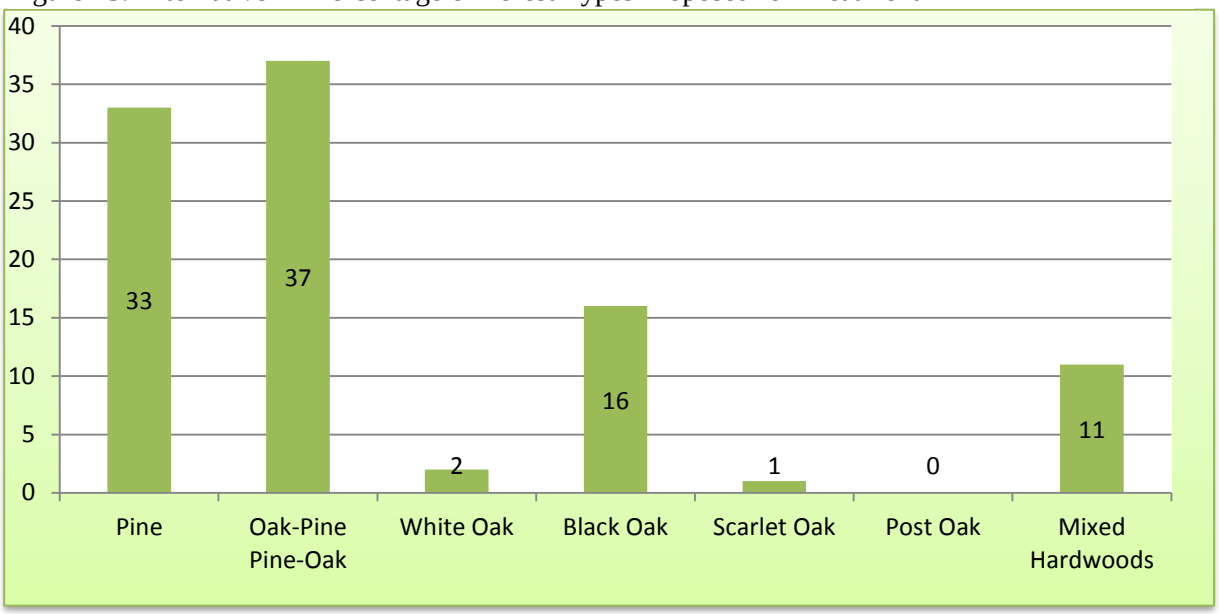
Low intensity prescribed fire has minimum effect on overstory (Dey & Fan, 2009; Hutchinson, Yaussy, Long, Rebbeck, & Sutherland, 2012). Although, prescribed fire can be an additional stressor in red oak stands that are already exhibiting signs of oak decline or have been recently regenerated. The use of prescribed fire and commercial harvest will be timed to reduce losses of

stands affected by oak decline. Value and volume losses due to fire damage have been found to be low. Value loss is very low if trees are harvested within approximately five years after fire damage, regardless of scar size (Marschall, Guyette, Stambaugh, & Stevenson, 2014).

The initial burns will likely be more intense due to accumulation of fuels from decades of fire suppression and the amount of fuel present from activity fuels. Initial burns will be accomplished during the dormant season to offset the effects of increased fuel loadings. Subsequent burns will likely be less intense as previous burns and as decomposition reduce activity fuels. Prescribed burning will also prepare sites for the establishment of pine and oak regeneration by removing or decreasing leaf and duff layers, thereby increasing the probability of seed contact with bare soil.

It must be realized that without the use of prescribed fire, only short term gains in species density and richness can be acquired. Any attempt to open the canopy will quickly be followed by an onset of hardwood regeneration in most of the treated areas. The hardwood regeneration will soon shade the desired understory plants. However, short term gains in many stands could favor the survival of seed sources of certain plants that are being lost in the currently degraded stand condition and could be lost in a continual degraded condition. It is also understood that establishment of shortleaf pine is most vulnerable at the seedling sapling stage. Studies conducted at Chilton Creek have shown that repeated burning killed two thirds of the shortleaf pine regeneration and roughly 26% of shortleaf pine stems were killed after a moderate intensity burn. Longer free intervals and lower fire intensities will be required to regenerate and sustain pine regeneration in a frequent burning regime (Fan, Ma, Dey, & Roberts, 2012).

Figure 13. Alternative 2 - Percentage of Forest Types Proposed for Treatment



A priority management objective of the Fremont-Pineknot East Restoration Project is the shift towards its historical shortleaf pine composition. As indicated in Figure 13, greater than 70% of the proposed treatment area currently has a significant shortleaf pine component. In Alternative 2, the shortleaf pine plantings in some salvage and regeneration harvests give an opportunity to establish the shortleaf pine composition and structure that is described in Appendix A in the 2005 Forest Plan. Existing shortleaf pine regeneration will respond to openings created by regeneration harvests. Even though the desired condition will not be entirely achieved for decades this will likely set the stage for future success. Large shortleaf pine and white oak would be favored as reserve trees in even-aged harvest systems and remain as the dominant species in salvage

treatments. Both shortleaf pine and white oak regenerate most successfully in full sunlight. Even-aged harvests followed by timber stand improvement treatments will promote young stands dominated by these desirable species (Johnson, Shifley, & Rogers, 2002).

Alternative 2 would remove individual trees within a stand that are at the highest risk of developing or currently exhibiting insect or disease infestations. Oak mortality is an immediate forest health concern for parts of the project area (Fan, Kabrick, Spretich, Shifley, & Jensen, 2009). Vegetation treatments implemented under Alternative 2 would improve forest health in the area by salvaging dead and dying black and scarlet oaks in danger of being killed by insects and/or disease or other factors.

Oak decline is not necessarily predictable due to its association with multiple environmental factors, but risk is associated with increased age. Dominant and co-dominant black and scarlet oak >12" have mortality rates of about 20 percent per decade and those mortality rates were roughly twice those of white oak and post oak (Kabrick, Shifley, Jensen, Fan, & Larsen, 2004). Many stands of black oak and scarlet oak are past rotation ages defined by the forest plan. Their current ages put them at risk of an occurrence of oak decline. Alternative 2 would not prevent all tree mortality. Before treatment and in vulnerable stands that were not selected for treatment unavoidable tree mortality will occur. In the affected area, 10-15% of vulnerable stands will remain unless the area presents an unacceptable risk to public health, or safety, or threatens forest health.

The promotion of longer lived species gives land managers more options in the management of stand vegetation in the future. Generally, longer lived species are less susceptible to injurious agents. They have a wider range of time before a need for final harvest. In situations where large landscapes are in a similar age class, more time is allowed to regulate the age classes. Vigorous trees of long lived species can enable long term retention and provide a variety of potential benefits. Alternative 2 emphasizes long lived species both in the short term and long term. The planting and release of shortleaf pine and any future thinning will enhance the dominance of this longer lived species. In a recent study on Shortleaf Pine Natural Community Restoration on Peck Ranch Conservation Area, very close proximity to this project, the results indicated that herbicide in combination with planting and natural tree regeneration is probably the best and most efficient way of regenerating shortleaf pine (Tuttle & Houf, 2007).

Alternative 2 would reduce the risk of catastrophic wildfire and the potential for large numbers of hazardous trees. Silvicultural activities would be used to balance fuel conditions over time and to reduce the potential for hazardous fuel-loading (Northeast Regional Strategy Committee of the National Cohesive Wildland Fire Management Strategy Committee, 2012, Part II-17). Alternative 2 would reduce heavy fuel accumulations, and help mitigate the potential for a significant number of hazard trees.

While temporary increases in activity fuels may be expected, once the small trees and large limbs decay, hazardous fuel conditions would be improved.

Timber sales are often an efficient, effective, and sometimes the only means to move toward the desired conditions for vegetation on the landscape. The sale of timber products is an appropriate use of National Forest lands as authorized by various federal laws including Multiple-Use Sustained Yield Act of 1960 and National Forest Management Act of 1976. Forest resources are very important in supporting the local economy and the forest industry. Alternative 2 treatments would provide wood products in the near future. Approximately 58 million board feet would be provided over the next 10 years.

CUMULATIVE EFFECTS ON VEGETATION

ALTERNATIVE 1 – NO ACTION

Alternative 1 would not likely produce an environment that would recruit young shortleaf pine, white oak, or black oak due to the lack of openings large enough to create full sunlight (Johnson, Shifley, & Rogers, 2002). The red oak group would gradually decline as these trees mature and die out of the overstory. Eventually shade tolerant species such as maple, elm, ash, black gum and sassafras, which are currently present in the understory, will fill in canopy gaps caused by the death of mature oaks in the overstory (Nowacki & Abrams, 2008). This will result in future stands moving away from the desired conditions described in the 2005 Forest Plan.

ALTERNATIVE 2 – PROPOSED ACTION

A cumulative effects spatial boundary of the Fremont-Pineknot East Restoration Project area was selected because effects of Alternative 2 (the Proposed Action) would be limited to the area receiving vegetative treatment. This spatial boundary was selected because this is the extent where the cumulative effects information would be measurable and meaningful and the effects would be relevant.

A cumulative effects temporal boundary of 10 years was selected because that is considered the life of the expected effects of the Fremont-Pineknot East activities. This temporal spatial boundary was selected because this is the extent where the cumulative effects information would be measurable and meaningful and the effects would be relevant.

Alternative 2 would improve forest health in the project area and move the area towards Desired Conditions as generally described in the 2005 Forest Plan. Open woodland would increase; closed woodland would decrease; and forest natural community types would be slightly reduced. Acreages and percentages would move closer to the desired conditions than those that currently exist. Alternative 2 would also reduce the risk of catastrophic wildfire and the potential for large numbers of hazardous trees.

WILDLIFE

AFFECTED ENVIRONMENTS

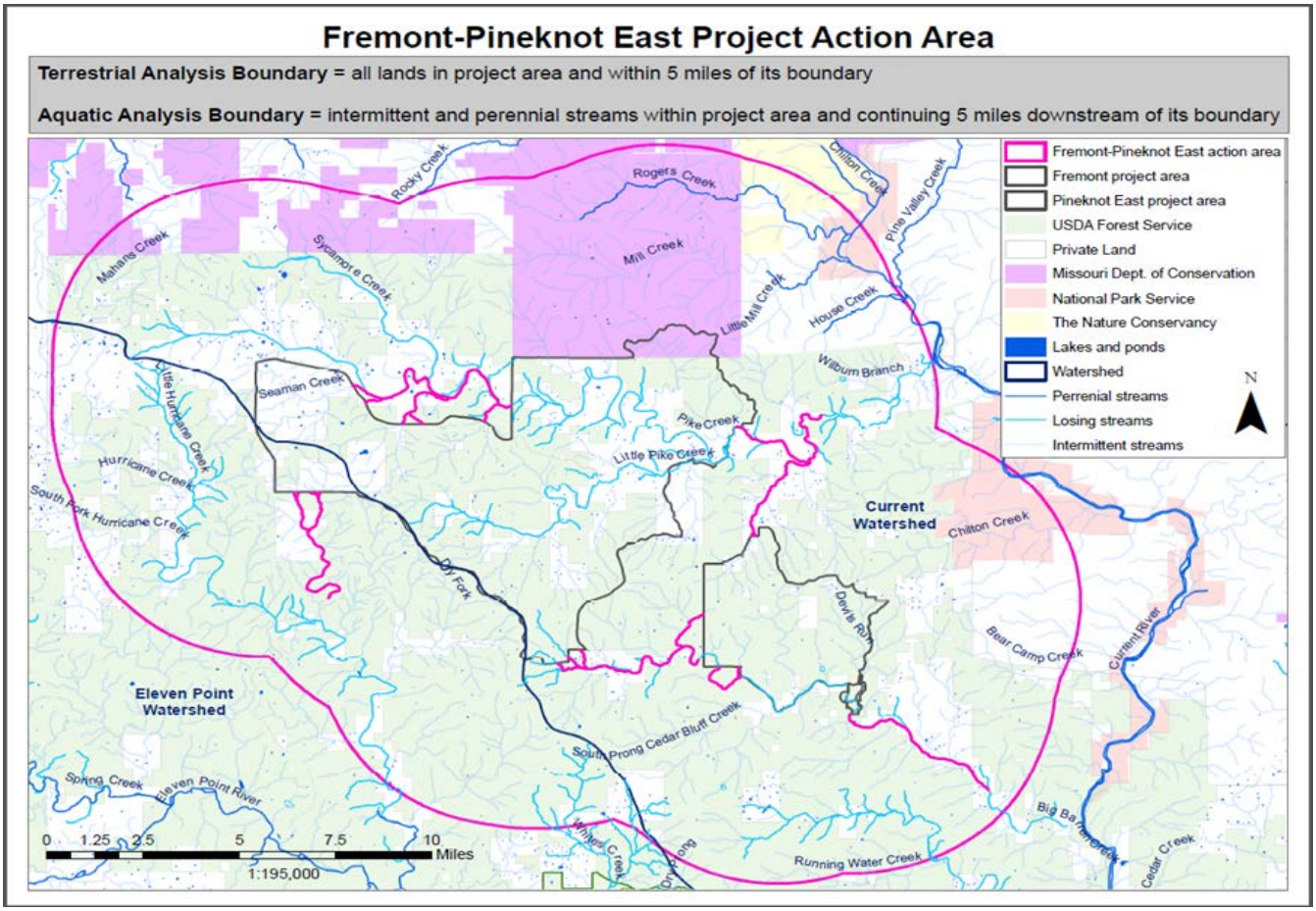
The Fremont-Pineknot East Project Area is comprised of two separate project areas located at the north end of the Eleven Point Ranger District. It encompasses almost 30,000 acres of national forest land. Activities are not proposed for every Forest Service stand, and some activities (mainly prescribed burns) are planned for Missouri Department of Conservation, L-A-D Foundation, and privately-owned lands in cooperation with these landowners. The existing conditions on these lands were determined using field survey reports from resource specialists, grid plot inventory data collected on Forest Service land (Fremont in 2009 and Pineknot in 2012) (Schanta, 2012a; Schanta, 2012b), floristic quality index plots on Forest Service land (Fremont in 2012, Pineknot in 2010), and records in the Mark Twain National Forest GIS database (U.S.D.A. Forest Service, 2014).

Much of the project area consists of strongly rolling to hilly lands and moderately dissected upland plains. Slopes are steep and ridges and valleys are narrow. Rocky soils, karst, springs, and losing streams are characteristic of this area (Nigh & Schroeder, 2002). Based on “field-call” grid plot canopy cover data, the majority of Forest Service land in the project area is currently upland forest (19,812 acres or 66%) and closed woodland (8,898 acres or 30%) (Schanta, 2012a; Schanta, 2012b). Fremont has about 12,950 acres (60%) of oak and mixed hardwood forest types and about 8,634 acres (40%) of pine and mixed oak-pine forest types (Schanta, 2012a). Pineknot

East has about 5,456 acres (66%) of oak and mixed hardwood forest types and about 2,829 acres (34%) of pine and mixed oak-pine forest types (Schanta, 2012b).

The Fremont-Pineknot East Project Area is almost entirely within the Current River watershed (Figure 14). The major streams that flow through the project area include Pike, Little Pike, and Big Barren creeks. These are losing streams, but each has several spring-fed permanent pools and reaches. Little Pike Creek joins Pike Creek within the Fremont Project Area, and water flows approximately 10 miles downstream to the Current River from where Pike Creek leaves the project boundary. The main channels of these two creeks are mostly on privately-owned lands, but much of their headwaters are on national forestland. Big Barren Creek and its headwaters flow through both project areas and then approximately 11 miles downstream to the Current

Figure 14. Fremont-Pineknot East Project action area for wildlife species and their habitats



River from the Pineknot East Project boundary. A relatively small area on the western side of Fremont is in the Eleven Point River watershed, and water drains approximately 17 miles from the project boundary to the Eleven Point River via Hurricane Creek.

According to records in the GIS database (U.S.D.A. Forest Service, 2014), there are 263 ponds scattered across the Fremont-Pineknot East Project Area. Of these, 67 ponds are on national forestland within the Fremont Project Area and 11 ponds are on in the Pineknot East Project Area.

Almost all of these are human-constructed ponds, but several are natural ponds. Beavers also construct dams in drainages to create temporary pools.

The project area was surveyed on numerous occasions between August 2009 and August 2013. During site visits, the general conditions of the project stands and specialized habitats were observed. Only two springs are documented in Fremont, but there are likely several in both project areas. There is only one known Ozark deep muck fen in Pineknot East, but beavers have flooded it in the past and woody vegetation is now encroaching on it. There are at least 30 sinkholes in the project area, and some of these sinkholes contain shrub swamps. Four of the larger shrub swamp sinkhole ponds (Fox, Grassy, Tan Bark, and Young Hollow) are designated Forest Special Areas. There are more than 20 limestone-dolomite glades in the project area and most have woody vegetation encroaching on them. Thirteen caves are known within the project boundary, and four of these are within Big Barren Creek Natural Area. This state designated natural area also features a rock shut-in and cliffs, a glade, a spring-fed stream and permanent pools, and bottomland forest. The Forest Plan (USDA Forest Service: Mark Twain National Forest, 2005b) has specific standards and guides to protect specialized habitats wherever they occur and immediately upon discovery.

WILDLIFE HABITAT

The 2005 Forest Plan sets goals and objectives for wildlife habitat. Forestwide Goal 1.4 (pp. 1-3) of the Forest Plan includes: (1) provide the range of natural habitats necessary to support populations of existing native plant and animal species and (2) restore and manage natural communities as the primary means of providing quality terrestrial, karst, and aquatic wildlife and rare plant habitat. Measurable objectives to promote the achievement of this goal include:

Objective 1.4a: Improve open woodland conditions on at least 10,500 acres to provide habitat for summer tanager, northern bobwhite, Bachman's sparrow, and eastern red bat.

Objective 1.4b: Increase the proportion of managed native grasslands to that of exotic cool season grasses from the current 46% native grass to 55% native grass to provide habitat for northern bobwhite.

Objective 1.4c: Maintain forest, closed woodland, or open woodland cover over 85% or greater of Mark Twain National Forest acres to provide habitat for worm-eating warbler.

Objective 1.4d: Treat at least 4,000 acres of glades to reduce woody vegetation to provide habitat for Bachman's sparrow.

The Fremont-Pineknot East Project Area is within a 1.1 Management Area. The goals of this prescription include: (1) restore, enhance, and maintain the structure, composition, and function of distinctive terrestrial and aquatic natural communities; and (2) restore the ecological role of fire in natural communities. The desired condition for the Fremont-Pineknot East Project Area includes:

- Plant species distributional patterns, abundance, and diversity increase following management activities. Natural communities exhibit the desired composition, patch size, canopy structure, understory, shrub layer, and ground cover characteristics.
- Prescribed fire emulates historical fire regimes, creating variable patterns of vegetation structure and abundance that meet habitat needs for associated wildlife.

MANAGEMENT INDICATORS

Management Indicators (MIs) provide a means of monitoring and evaluating the effects of actions on biotic resources, natural communities, habitats, and specific species (U.S.D.A. Forest Service: Mark Twain National Forest, 2005a). In Chapter 3, page 116 of the Final Environmental Impact Statement to accompany the 2005 Forest Plan (FEIS), it states that the Forest did not attempt to develop a list of management indicators representing the full range of natural communities or habitat types. Instead, species were selected to meet a limited objective for maintaining ecological conditions that contribute to long-term abundance and distribution of species associated with declining natural communities. The Forest Service has designated five animal species and three terrestrial communities as MIs (Table 28). Table 15 in the FEIS describes the MIs and associated conditions and species.

Table 28. Management indicator species and communities

Birds	Mammal	Terrestrial Community
Northern bobwhite	Red bat	Glades
Summer tanager		Open woodlands
Worm-eating warbler		Groundwater seepage
Bachman's sparrow		

DIRECT AND INDIRECT EFFECTS ON MANAGEMENT INDICATORS

NORTHERN BOBWHITE

This ground-nesting bird is usually found in brushy open lands, such as prairies and grasslands, near forest edges. They often nest in tall grass or brush piles in fields or along woodland edges. The primary nesting season for bobwhite is between March and September, but they occur in Missouri year-round. Approximately 316 acres (1%) of Forest Service land within the project area has 0-30% canopy cover (Schanta, 2012a; Schanta, 2012b), including utility and road corridors, savannas, glades, and an old 64-acre field. Approximately 947 acres (3%) of Forest Service land within the project area is open woodland with 30-50% canopy cover (Schanta, 2012a; Schanta, 2012b). Small openings generally occur within large tracts of upland forest and closed woodland. Results from the North American Breeding Bird Survey (BBS) indicate northern bobwhite populations have declined sharply on the Bennett route across the Eleven Point District (Sauer, et al., 2014, p. Table 15). The Bennett BBS route is about two miles south of the Fremont-Pineknot East Project boundary. Bobwhite population trends are also decreasing on other routes across the Forest and statewide most likely due to habitat loss and fragmentation associated with fire suppression and conversion of woodlands to fescue pasture (NatureServe, 2014). Northern bobwhites are not known to currently occupy Forest Service lands in the Fremont-Pineknot East Project Area.

ALTERNATIVE 1 – NO ACTION

There would be no vegetation management if this alternative is selected and no direct impacts to northern bobwhites or their habitats. Natural succession would proceed and open woodlands would become denser closed woodlands. Natural events, such as oak decline and windstorms, would create scattered openings within the project area. The old field and savannas would eventually become overgrown with woody vegetation. The No Action alternative would result in the loss of potential habitat for bobwhite quail and associated species.

ALTERNATIVE 2 – PROPOSED ACTION

Silvicultural treatments, prescribed fire management, and glade restoration activities would create, maintain, and improve open habitats. It is extremely unlikely that cutting and burning activities would destroy nests or harm individual bobwhites because they are not expected to occur in the project area. Timber harvest and prescribed burns would reduce tree densities, basal areas, and canopy closures as well as create more savannas, open woodland, and early successional habitats in regeneration openings. The increased sunlight would encourage the growth of herbaceous vegetation and increase insect prey diversity and abundance. Tree tops would be left on the ground and may provide cover and nest sites for bobwhites. The old field is within a burn unit and would be maintained in early successional habitats. It may eventually be planted in native grasses and forbs to improve the quality of this limited habitat type. Prescribed burns will encourage the establishment and spread of native plant species. The proposed activities and repeated treatments would eventually increase the amount of savanna and other areas with 0-30% canopy cover to almost 6%. Open woodlands would cover about 81% of Forest Service land in the project area when the desired condition is attained. Bobwhites may be drawn to this area as conditions improve.

Table 29. Trend analysis for BBS routes through Mark Twain National Forest and statewide.

MI Species	**11 Point *Bennett***	**Poplar Bluff *Williamsville***	**A/C/WS *Hilda***	**Salem *Centerville***	**Pot/Ftown *Cascade***	**Statewide Overall Trend**
Northern bobwhite	-38.91	-12.37	-3.43	-16.12	-6.98	-3.01
Summer tanager	3.36	2.80	3.65	-14.17	-0.91	1.45
Worm-eating warbler*	7.35	-2.50	0.00	18.69	3.11	2.81

* Data was collected on the first four routes from 1994-2011. The Cascade route has data from 1967-1970, 1973-1976, and 1978-2011. Statewide trends are based on data collected from 1967-2012 (Sauer, et al., 2014).
**Trends for worm-eating warbler may not be accurate because of low abundance and small sample sizes.

SUMMER TANAGER

This bird is often found at the top of trees in oak and oak-pine forests near streams and in dry, open woodland (Ehrlich, Dobkin, & Wheye, 1988). It forages on insects and fruits, and nests primarily from May to June. Summer tanagers are migratory species and leave Missouri during the winter months. Forest Service land in the Fremont-Pineknot East Project Area is currently 66% upland forest, 30% closed woodland, and 3% open woodland (Schanta, 2012a; Schanta, 2012b). Small openings generally occur within large tracts of upland forest and closed woodland. Results from the BBS indicate summer tanager populations are increasing along the Bennett route as well as statewide (Table 29). This species likely occurs in the project area.

ALTERNATIVE 1 – NO ACTION

There would be no vegetation management if this alternative is selected and no direct impacts to summer tanagers or their habitats. Natural succession would proceed and open woodlands would become denser closed woodlands. Small openings in closed woodlands and upland forests would also close. Natural events, such as oak decline and windstorms, would create scattered openings within the project area. The No Action alternative would result in the loss of potential habitat for summer tanagers and associated species.

ALTERNATIVE 2 – PROPOSED ACTION

Silvicultural treatments and prescribed fire management activities would mostly benefit species associated with open woodland habitats. Tree cutting may destroy nests and kill some individuals, particularly young that cannot fly. Adult birds could fly away and possibly re-nest. Timber harvest and prescribed burns would reduce tree densities, basal areas, and canopy closures and would create more open woodland. Open woodlands would cover about 81% of Forest Service land in the project area when the desired condition is attained. Clearcut, seedtree, shelterwood, and salvage harvests would create regeneration openings that provide short-term grass, forb, and shrub habitat distributed throughout the project area. Open woodlands and regeneration openings have greater solar exposure, which encourages the growth of herbaceous vegetation and fruiting shrubs and increases insect prey diversity and abundance. The Proposed Action would greatly increase the amount of open woodland and increase potential habitat for summer tanagers and associated species in the project area.

WORM-EATING WARBLER

This forest-interior species is closely associated with large tracts of upland deciduous forest and can be found on shaded hillsides and ravines (Jacobs, 2001). It is often seen walking on the ground on damp wooded slopes with dense undergrowth (Ehrlich, Dobkin, & Wheye, 1988). Worm-eating warblers do not eat worms, only insects and their larvae. It is a ground nester and the primary nesting season is June-August. Worm-eating warblers are very sensitive to fragmentation of their forested breeding habitat. They are migratory and leave Missouri during the winter months. Forest Service land in the Fremont-Pineknot East Project Area is currently 66% upland forest and 30% closed woodland on strongly rolling to hilly lands (Schanta, 2012a; Schanta, 2012b). Roads dissect the area and developed private lands are interspersed with national forest lands. Results from the BBS seem to indicate worm-eating warbler populations are increasing along the Bennett route as well as statewide (Table 29). The results may be misleading because worm-eating warblers were not detected on many routes throughout the state and/or very few were detected on these routes. This species likely occurs in the project area.

ALTERNATIVE 1 – NO ACTION

There would be no vegetation management if this alternative is selected and no direct impacts to worm-eating warblers or their habitats. Roads would not be decommissioned and would continue to fragment habitats. Natural succession would proceed and closed woodlands would become denser upland forests. Small openings in closed woodlands and upland forests would also close. Natural events, such as oak decline and windstorms, would create scattered openings within the project area. Potential habitat for worm-eating warblers and associated species would remain relatively unchanged under the No Action alternative.

ALTERNATIVE 2 – PROPOSED ACTION

Trees would be removed during silvicultural treatments and road, trail, and parking lot construction. These activities may destroy the ground nests of worm-eating warblers and kill some individuals, particularly young that cannot fly. Adult birds could fly away and possibly re-nest. Prescribed fire management activities would not directly impact worm-eating warbler nests because fireline preparation and burns are not conducted during their nesting season. Silvicultural treatments and prescribed burns would reduce tree densities, basal areas, and canopy closures. The amount of upland forest would be reduced and closed and open woodland habitats would increase in the project area. Some areas with very high basal areas and canopy closures are expected to remain upland forest even after treatments such as commercial and restoration thinning. Understory brush would be reduced in the short term, but the increased amount of sunlight on the forest floor would encourage the growth of herbaceous vegetation and shrubs and increase insect prey diversity and abundance. Of the approximately 29,893 acres of national forest in the project area, 13,372 acres have no proposed silvicultural activities. These areas would likely remain or succeed to upland forest, habitat preferred by worm-eating warblers.

The Fremont-Pineknot East Project Area includes large tracts of forestland, but it is also fragmented by utility corridors and numerous roads. The Proposed Action includes decommissioning 45 roads for a total of 19 miles. These closed roads would undergo natural succession and eventually be reforested. Worm-eating warbler is tolerant of many different management practices, and all regeneration and salvage harvests have standards that require retention of some overstory within the harvest units (U.S.D.A. Forest Service: Mark Twain National Forest, 2005a). The Proposed Action would maintain forest, closed woodland, or open woodland cover over 85% or greater of the project area to provide potential habitat for worm-eating warblers and associated species.

BACHMAN'S SPARROW

This species inhabits glades, early successional stage old fields, open pinewoods, and oak-hickory or shortleaf pine regeneration with canopy cover less than 30%, according to the Missouri Fish and Wildlife Information System (Missouri Department of Conservation, 2014a). Glade complexes are their primary habitat in Missouri, and bare ground and a well-developed herbaceous layer are also important. Bachman's sparrows spend most of their time on the ground where they nest and forage on insects, arachnids, and seeds. They nest from April to August and raise two broods. Bachman's sparrows are rare summer residents in Missouri and overwinter in the southern U.S. states.

The Fremont-Pineknot East Project Area contains about 23 glades covering approximately 17 acres on Forest Service and private lands. A few of the glades are completely open, but most have variously sized cedar trees and other woody vegetation encroaching on them. The project area also includes a 64-acre field recently purchased by the Forest Service. The field has been maintained by bush-hogging and vegetation is mainly grasses and small shrubs with scattered patches of trees, particularly along drainages. Forest Service land in the Fremont-Pineknot East Project Area is currently 66% upland forest and 30% closed woodland. Based on grid plot inventory data, only about 3% is open woodland (30-50% canopy cover) and 1% is glade, savanna, or other open habitats (0-30% canopy cover) (Schanta, 2012a; Schanta, 2012b).

The BBS does not track Bachman's sparrow populations in Missouri because it is too uncommon, but in the states that do track this species, populations have been declining (Sauer, et al., 2014). Bachman's sparrow has not been detected on the Bennett route across the Eleven Point District (C. Price, personal communication, 2009) or in the project area (Missouri Department of Conservation, 2014a). It is not expected to occur in the Fremont-Pineknot East Project Area.

ALTERNATIVE 1 – NO ACTION

There would be no vegetation management if this alternative is selected and no direct impacts to Bachman's sparrows or their habitats. Natural succession would proceed and open woodlands would become denser closed woodlands. Small openings in closed woodlands and upland forests would also close. Natural events, such as oak decline and windstorms, would create scattered openings within the project area. The glades and old field would eventually become overgrown with woody vegetation. The No Action alternative would result in the loss of potential habitat for Bachman's sparrow and associated species.

ALTERNATIVE 2 – PROPOSED ACTION

Silvicultural treatments, prescribed fire management, and glade restoration would mostly benefit species associated with open habitats. Tree cutting and associated activities may destroy nests and kill some individual birds, particularly young that cannot fly. Adult birds could fly away and possibly re-nest. Bachman's sparrows would not be harmed or killed because they are not expected to occur in the project area. Timber harvest and prescribed burns would reduce tree densities, basal areas, and canopy closures and would create or improve glades, savannas, open woodland, and early successional habitats in regeneration openings. The increased sunlight would encourage the growth of herbaceous vegetation and fruiting shrubs and increase insect prey diversity and abundance.

Restoration activities are proposed for 19 glades covering approximately 15 acres in the northeast portion of the Fremont Project Area. Eastern red cedar that is encroaching on the glades would be felled by chainsaws and left in place. These glades are within burn units and prescribed fire would be allowed to burn across them. Periodic burning would keep them open and encourage the germination of native glade plant species. The old field is also within a burn unit and would be maintained in early successional habitats. It may eventually be planted in native grasses and forbs to improve the quality of this limited habitat type. Prescribed burns would encourage the establishment and spread of native plant species. The proposed activities and repeated treatments would eventually increase the amount of glades, savannas, and other areas with 0-30% canopy cover to almost 6%. Open woodlands would cover about 81% of Forest Service land in the project area when the desired condition is attained. Bachman's sparrows are not anticipated to move into the project area immediately, but potential habitat for this and associated species would be more abundant and of better quality.

RED BAT

This bat species inhabits open woodlands, forest edge, fencerows, orchards, parks, and residential yards (Missouri Department of Conservation, 2014a). During the summer, solitary red bats roost in tree foliage with an open understory to allow easy entry and exit (NatureServe, 2014). They forage at night on flying insects, generally at or above the tree canopy in forested areas or along streams or lake margins. Red bats mate from August to October, have delayed fertilization, and usually give birth to two pups in May or June. The young can fly in about a month. Red bats in southern Missouri do not tend to migrate or enter hibernation. During the winter months, they may roost under tree bark or in hollow branches (NatureServe, 2014), but are often found in a state of torpor in the leaf litter (Missouri Department of Conservation, 2014a).

The Fremont-Pineknot East Project Area has very limited open woodland habitat, but forest edge is abundant. Much of the understory is dense. Private lands within the project boundary tend to be open residential yards, cattle pasture, and hay fields. Red bats occur throughout Missouri and are most common in the Ozark highlands, which includes the project area. Their populations are not

tracked in Missouri, but are likely stable. Red bats have not been impacted by white-nose syndrome and their global status is considered secure (NatureServe, 2014). Forest Service biologists conducted bat mist-net, harp trap, and acoustic surveys in or adjacent to the Fremont-Pineknot East Project Area during the summers of 2001-2003, 2008, 2009, and 2011-2013. Red bats were the most frequently captured species, representing 51.5% of all captures during the 2009-2013 surveys. Red bats are common in the Fremont-Pineknot East Project Area and can be found there year-round.

ALTERNATIVE 1 – NO ACTION

There would be no vegetation management if this alternative is selected and no direct impacts to red bats or their habitats. Roads would not be decommissioned and would continue to provide edge habitat. Natural succession would proceed and open woodlands would become denser closed woodlands. Small openings in closed woodlands and upland forests would also close. Natural events, such as oak decline and windstorms, would create scattered openings within the project area. Potential habitat for red bats and associated species would likely be reduced under the No Action alternative.

ALTERNATIVE 2 – PROPOSED ACTION

Silvicultural treatments and prescribed fire management activities would mostly benefit species associated with open woodland habitats. Timber harvest, fireline preparation, road and trail reconstruction, and parking lot construction may remove red bat roost trees. Adult bats would likely be able to fly away and not be harmed. Pups that are too large to be carried by their mothers, but are too young to fly are at the greatest risk of being harmed or killed if their roost trees are cut down. Pups can fly about a month after birth, so this heightened risk is relatively brief. Prescribed burns and heavy equipment use during timber, fire, roads, and recreation activities could impact red bats in leaf litter during the winter months. Red bats would likely sense approaching equipment and fire, and since all bats would be volant during this time, could fly away. Observations of red bats flying up out of the leaf litter during prescribed burns and move away from the smoke and flames. Many bat species have presumably evolved in fire-dependent ecosystems and developed roosting strategies that limit their vulnerability to fire.

More than 13,000 acres would not have any silvicultural treatments and relatively small units would be burned at one time in the project area. Potential red bat roost trees would remain abundant in treated and untreated stands. Leaf litter would remain thick in areas not proposed for prescribed fire and in unburned patches within burn units. Reducing tree densities, basal areas, canopy closures, and understory clutter through timber harvest and prescribed fire would increase the amount of open woodland and improve roosting habitat for red bats.

The Fremont-Pineknot East Project Area currently provides suitable foraging habitat as evidenced by the frequent captures of red bats during mist-net surveys. Timber harvests and prescribed burns would alter stand structure and composition, but the project area is expected to remain suitable for foraging red bats. The Proposed Action includes decommissioning 45 roads for a total of 19 miles. These closed roads would eventually revert to forest and some edge habitat would be lost. Roads are and would remain abundant in the project area and would continue to provide ample foraging habitat and corridors for red bats. Proposed road maintenance, reconstruction, and decommissioning should reduce soil erosion and potential stream sedimentation. Management activities would avoid or limit impacts to water quality and flying insect prey would remain abundant. The Proposed Action would increase the amount of open woodland habitat, reduce

understory clutter, and continue to provide forest edge habitat. Red bats and associated species are expected to benefit from implementing the Proposed Action.

GLADES

Glades are open, exposed bedrock areas dominated by drought-adapted herbs and grasses in an otherwise woodland or forest matrix (U.S.D.A. Forest Service: Mark Twain National Forest, 2005a). Hundreds of plant and animal species, including many that are threatened, endangered, or sensitive, are restricted to glade habitats. The Fremont-Pineknot East Project Area contains about 23 glades covering approximately 17 acres on Forest Service and private lands. A few of the glades are completely open, but most have variously sized cedar trees and other woody vegetation encroaching on them.

ALTERNATIVE 1 – NO ACTION

There would be no glade restoration activities if this alternative is selected. Woody vegetation would continue to encroach on the glades and grow larger within them. The woody vegetation would shade the ground and reduce or eliminate habitat for sun-loving, glade adapted species. The No Action alternative would likely result in the loss of glade species diversity, possibly including species at risk.

ALTERNATIVE 2 – PROPOSED ACTION

Restoration activities are proposed for 19 glades covering approximately 15 acres in the northeast portion of the Fremont Project Area. Eastern red cedar that is encroaching on the glades would be felled by chainsaws and left in place. These glades are within burn units and prescribed fire would be allowed to burn across them. Periodic burning would remove leaves and needles covering the ground and kill young cedar trees. Fire would stimulate native herbaceous glade flora to germinate. The glades would be protected during management activities. Forest Plan standards and guidelines prohibit mechanically constructed firelines within 100’ of glades. Firelines would be manually constructed (i.e., with rakes and leaf blowers) and all surface disturbing activities would be minimized on and within 100’ of these glades (USDA Forest Service: Mark Twain National Forest, 2005b). The proposed activities and repeated treatments would restore at least 15 acres of glades and likely increase the abundance and diversity of native plants and animals in these unique habitats. Eastern collared lizards, Missouri Species of Conservation Concern (Missouri Natural Heritage Program, 2014), may eventually disperse from nearby glades on Missouri Department of Conservation land and colonize the restored glades in the project area.

OPEN WOODLANDS

These communities are highly variable, but are characterized by an overstory tree canopy ranging from 30-100% closure, a sparse understory, and a dense ground flora of grasses, sedges, and forbs (Nelson P. W., 2010). The desired condition for open woodlands in 1.1 Management Areas is for overstory trees to have 30-50% canopy cover and 30-50 basal areas (USDA Forest Service: Mark Twain National Forest, 2005b). Only 3% (947 acres) of Forest Service land in the Fremont-Pineknot East Project Area is currently open woodland based on canopy cover data (Schanta, 2012a; Schanta, 2012b). These communities are likely of poor quality and probably lack diverse ground flora.

ALTERNATIVE 1 – NO ACTION

There would be no vegetation management if this alternative is selected. Canopy closures in existing open woodlands would increase and the understory would become denser. Ground flora would be reduced or eliminated by deep leaf litter. The No Action alternative would likely result in the loss of open woodland associated plant and animal species.

ALTERNATIVE 2 – PROPOSED ACTION

The Proposed Action includes silvicultural treatments and prescribed fire management that would alter the forest's structure and composition. Timber harvest and prescribed burns would reduce tree densities, basal areas, canopy closures, and understory clutter and would create areas with open woodland characteristics. More sunlight would reach the ground in these areas and stimulate the growth of herbaceous vegetation and shrubs. The proposed activities and repeated treatments would eventually create open woodland on approximately 81% of Forest Service land in the Fremont-Pineknot East Project Area when the desired condition is attained. The Proposed Action would restore historic habitat conditions and greatly benefit native plant and wildlife species associated with open woodland communities.

GROUNDWATER SEEPAGE

These wetland communities include fens and seeps that are characterized by a constant or near-constant supply of groundwater. Fens are distinguished from seeps when they are large enough to create gaps in tree canopies (Nelson P. W., 2010). Fens and seeps are small landscape components, but they contain a disproportionately high level of plant biodiversity. Many of these species are of regional or global concern (Nelson P. W., 2010). There are no documented seeps in the project area and only one known Ozark deep muck fen in the Pineknot East area. The Missouri Natural Heritage Database record for this site describes the fen as having good diversity and no signs of disturbance in 1986 (Missouri Department of Conservation, 2014b). Small-fruit seedbox (*Ludwigia microcarpa*), a Regional Forester Sensitive Species, was documented in this fen at that time (Missouri Department of Conservation, 2014b). By 1992 beaver impoundments had inundated over half of the fen and it was considered destroyed. The site was surveyed in November 2012 and no signs of recent beaver activity were observed. The dams were not maintained, but old beaver channels carved through the fen had flowing water and woody vegetation has encroached on it. The Heritage Database record suggests using prescribed fire to reduce woody vegetation and prevent it from shading out herbaceous species (Missouri Department of Conservation, 2014b).

ALTERNATIVE 1 – NO ACTION

There would be no management activities if this alternative is selected. Woody vegetation would continue to encroach on the fen and grow larger within it. The root systems of the woody vegetation would take up more water making it unavailable to native fen plant species and creating drier conditions at the site. Trees and shrubs would shade the ground and reduce or eliminate habitat for sun-loving, fen adapted species. The No Action alternative would likely result in the further loss of diversity and abundance of fen-associated species.

ALTERNATIVE 2 – PROPOSED ACTION

The Ozark deep muck fen would be protected from the proposed activities by a buffer zone of 300 feet on the lateral and downstream sides and 500 feet on the upstream side. Vehicle and heavy equipment use, equipment refueling, timber management activities, new road construction, and significant soil disturbance are prohibited within this buffer zone. Salvage and restoration

thinning are planned for a few stands near the fen, but outside the buffer zone. No herbicide treatments are planned for this area. A non-system road adjacent to the fen would be decommissioned and should reduce erosion and potential negative impacts to the fen and water quality. The fen is within a burn unit, but not near any hand or dozer line. Drip torch fuel would not enter the fen. Prescribed fire would be allowed to burn across the fen and extinguish naturally. Repeated burns should reduce woody vegetation growing in the fen and increase the amount of sunlight and water available to native fen species. We may remove the remnants of the beaver dams, but it would be extremely difficult to rehabilitate the channels and restore the original hydrological flow. A botanist will survey the fen in summer 2014 for small-fruit seedbox and other sensitive plants when they are flowering. The Proposed Action is expected to protect and improve the Ozark deep muck fen. Follow-up surveys would determine if our management activities are benefiting native plant and wildlife species associated with fen communities.

CUMULATIVE EFFECTS ON MANAGEMENT INDICATORS

The Council on Environmental Quality's regulations for implementing the National Environmental Policy Act defines cumulative effects as the impact on the environment that results from the incremental impact of the proposed actions when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).

The geographic boundary for cumulative effects analysis includes all lands in the Fremont-Pineknot East Project Area and within five miles of its boundary. It also includes all intermittent and perennial streams within the project area and continuing five miles downstream. This boundary includes known and potential habitat that may be directly or indirectly affected by the proposed activities. Bird species defend relatively small territories (usually < 100 acres) (Best, 1977; Cink, 2002; Oliarnyk & Robertson, 1996) and red bats usually forage within a half mile of their roosts (NatureServe, 2014). The terrestrial and aquatic boundaries were deemed appropriate because potential effects of the proposed activities would be insignificant or not occur outside this boundary. The temporal boundary for cumulative effects analysis is the past fifteen years, the present, and the next fifteen years. Most project activities would be implemented in the next few years and effects of these actions would be most evident during implementation and immediately upon completion. Project effects would be much less apparent after fifteen years.

There are approximately 268,263 acres of land and water within the Fremont-Pineknot East cumulative effects boundary. Ownership is approximately 73% Forest Service, 13% private, 11% MDC, 2% National Park Service (NPS), and 1% The Nature Conservancy (TNC). Past, present, and future actions within the cumulative effects boundary include activities by private individuals, state and federal agencies, and a conservation organization. The cumulative effects area is heavily dissected by state highways, county roads, and Forest system and non-system roads.

The majority of land within the cumulative effects boundary is the Mark Twain National Forest. Landscape scale vegetation management projects have occurred, are occurring, and will occur within the cumulative effects boundary on the Eleven Point Ranger District. These projects usually involve various timber harvest methods, firewood gathering, transportation system management, prescribed burning, open lands maintenance, and pond maintenance. These types of projects are analyzed under separate Environmental Analyses. The Pineknot, Northeast Corner, Possum Trot, and Camp 8 projects have been implemented, but minor management activities continue to occur in these areas. The Handy Project Decision Notice and Finding of No

Significant Impact was signed in 2009. About half of the scheduled timber harvests have been sold and are in various stages of completion. The remaining timber harvests and follow up activities will take place over the next several years. Many of the Handy Project burn units have been burned once and more are scheduled to be burned in spring 2014. The Van Buren Project Decision Notice and Finding of No Significant Impact were signed in 2011. A few timber sale units have been harvested and the remaining sale units have been marked. Timber harvest and follow up activities will take place over the next several years. The Open Lands Maintenance Project's Decision Memo was signed in 2012. The project encompasses approximately 818 acres in 12 existing fields scattered across the District. One of the fields, Windes Creek, is within the project area and six more fields are in the cumulative effects boundary. The fields will be maintained as early successional habitats for various wildlife species. Tree removal and mowing have already occurred at many of the fields and will continue into the future. The Briar and Sinking project areas may be evaluated for management following this project, but no decisions have been made for these areas.

Most privately owned lands within the cumulative effects boundary are centered around the communities of Winona, Fremont, and Van Buren. Private land ownership is also scattered around the smaller communities of Handy and Eastwood. Past, present, and future activities by private individuals include clearing upland and riparian forests for hay fields and grazing of cattle and horses. Some landowners harvest their timber and allow the forest to regenerate. Landowners burn their yards, brush piles, and fields, tear down old structures, and construct new residences and outbuildings. The population of Winona has increased over the past ten years and the trend is anticipated to continue in that city and surrounding communities. More land is being cleared of timber or converted from pasture to accommodate homes and businesses. Utilities have expanded to provide electric, water, and sewer services to the growing population. Some individuals set fire to federal and state forestland, and arson is expected to continue to impact all ownerships into the future.

Peck Ranch and Rocky Creek, MDC Conservation Areas, fall partly within the Fremont-Pineknot East cumulative effects boundary. Past, present, and future activities on the conservation areas are similar to activities on the Mark Twain National Forest. Timber harvest and prescribed burns are common activities, but they occur on a much smaller scale than on the Mark Twain National Forest. Conservation Area management includes eradicating invasive species, restoring historic natural communities, and conducting surveys for species of concern. The Missouri Conservation Commission approved an elk restoration plan on October 15, 2010. Elk were trapped and quarantined in Kentucky and brought to Peck Ranch for the first time in May 2011 and kept in holding pens for an additional quarantine and acclimation period. Elk were released in 2011, 2012, and 2013 into a 346 square mile "restoration zone" centered on Peck Ranch. The population was estimated at 107 individual elk in November 2013. All elk were microchipped and fitted with radio collars. If an individual elk becomes a nuisance, it can be re-located or removed. The Conservation Department will use hunting to maintain the elk herd at a manageable size. Elk are likely to eventually wander onto the Eleven Point District and the Fremont project area, but they are primarily grazers and this area of the Forest currently has limited forage for this species.

Much of the land adjacent to the Current River in the cumulative effects boundary is owned or managed by the NPS. The Ozark National Scenic Riverways manages the riparian corridor and activities on and along the river. They conduct prescribed burns to maintain and restore terrestrial natural communities, and they monitor and regulate activities within their ownership that could impair water quality. The water of the Current River is clear but polluted by atmospheric deposition of mercury, sediment from ground disturbing activities, and organic waste from cattle.

The Alma Peterson Azalea Memorial Preserve, owned by the TNC, is partly within the Fremont-Pineknot East Project's cumulative effects boundary. The preserve was donated to TNC decades ago, but they had not conducted any major management activities on that area (Neal Humke, personnel communication, January 28, 2011). Mr. Humke believes a floristic survey was conducted at least 10-15 years ago and results indicated the area did not rank very high in diversity. There are no trails or interpretive sites at the Peterson Preserve and vegetative succession is progressing naturally. Thirteen elk were released onto the Preserve in June 2012 since it is near Peck Ranch and within the restoration zone. Some habitat improvements have been made in recent years and will likely continue to make the area more suitable for elk.

Global shifts in climate may contribute to changes in Central Hardwoods ecosystems, which includes the Fremont-Pineknot East Project Area. Temperatures, precipitation in winter and spring, and runoff and streamflow during spring are projected to increase while snow cover and duration are projected to decrease over the next century (Brandt, et al., 2014). Changes in climate are not expected to have a dramatic effect on many common tree species in the region, such as white oak and eastern red cedar. Habitat suitability for northern tree species is expected to decrease, but it is projected to increase for southern species, such as shortleaf pine. Upland forests, open and closed woodlands, savannas, and glades; natural communities that provide habitat for native species from worm-eating warblers to Bachman's sparrows; are anticipated to have low or low-moderate vulnerability to climate change over the next 100 years (Brandt, et al., 2014). Open woodlands and savannas tend to be drought tolerant, so future conditions are expected to be favorable to these communities, particularly if they can shift across the landscape. Fens are strongly tied to specific hydrologic and geologic features and may not persist with rising temperatures and altered precipitation. Restored, healthy natural communities have greater resiliency and capacity to adapt to projected climate changes.

Forest management activities would likely need to be adjusted in response to climate change. Heavier and more frequent precipitation may require additional investments in erosion control measures for all ground-disturbing activities. Wet ground conditions would delay work more often and for longer time periods. The seasonal timing of prescribed burns may be shifted or shortened. Wildfires may occur more frequently and grow larger. More resources would likely be dedicated to controlling non-native invasive species. Climate change is expected to influence the flowering of plants and breeding, nesting, and migration behaviors of wildlife. The impacts of Forest management activities on species would likely change in duration and intensity. Seasonal restrictions on activities such as cutting down hazard trees, burning fens, or working in streams may be extended or mandatory. Many potential impacts remain unknown, but as the distribution and amount of habitat changes, some species will benefit and some will be harmed (Brandt, et al., 2014). Forest activities in the Fremont-Pineknot East Project action area would improve plant communities to reflect naturally occurring historic habitat conditions that meet the needs of native plants and wildlife. These natural communities are expected to be more resilient to a changing climate and ecological conditions would be monitored and evaluated through the Management Indicators.

ALTERNATIVE 1 – NO ACTION

The Fremont-Pineknot East Project would not occur if the No Action alternative is selected. There would be no silvicultural treatments, firewood gathering, prescribed fire management, glade restoration, pond maintenance or reconstruction, transportation system activities, or recreation improvements. Combining the lack of management proposed in this alternative with other past, present, and reasonably foreseeable future actions on all ownerships would have no immediate impacts on management indicator species or communities. Activities on private lands

are likely to create or maintain very open lands (pasture, housing) or very dense conditions (unmanaged woodlots). Actions on public lands tend to create or maintain a mosaic of habitat conditions from mature, upland forest needed by worm-eating warblers to open woodlands preferred by red bats.

Species requiring mature, dense forest would likely benefit from a lack of management. An abundance of habitat for these species currently exists and would increase in the future. The amount of open woodlands and glades would probably continue to decrease. Species that use open woodlands, such as summer tanager, are likely to decrease in number of individuals. Populations of certain species that depend on glades or wetlands may eventually be lost from the action area as woody vegetation encroaches and dominates these habitats. Glade and groundwater seepage communities on the Mark Twain National Forest would continue to be protected from mechanical disturbances by Forest Plan standards and guides. They are not likely to receive special consideration on private property. Natural succession, arson, and illegal motorized recreation on any ownership may affect the quality of all of these habitats. The structure and composition of the existing vegetative communities in the action area are mostly out of balance with historic habitat conditions and are expected to be less resilient to climate change. The cumulative effect of the No Action alternative and other past, present, and future activities is not likely to contribute to the long-term abundance and distribution of management indicator species or natural communities.

ALTERNATIVE 2 - PROPOSED ACTION

Combining these activities with other past, present, and reasonably foreseeable future actions on all ownerships is expected to mostly benefit management indicator species and communities in the cumulative effects area. Silvicultural treatments and prescribed burns would create or maintain open woodlands and increase habitat availability for summer tanagers, red bats, and associated species in the area. Maintaining old fields would provide potential habitat for northern bobwhite and other grassland species. Glade restoration in the cumulative effects boundary may not benefit Bachman’s sparrow within the next fifteen years, but as other glade complexes are restored across the region, this species may eventually find suitable habitat in this area. Removing woody vegetation and burning would directly benefit other glade associated species. Groundwater seepage communities would also benefit from prescribed fire as it would reduce woody vegetation and increase the amount of sunlight and water available to native herbaceous species. Activities on private lands are not likely to create or maintain habitats with the structure, composition, and function of historic natural communities that would benefit native plants and animals.

The amount of upland forest would decrease within the cumulative effects boundary if the Proposed Action is implemented. It is currently abundant and would remain so in untreated and lightly managed stands. Decommissioning many miles of roads would reduce fragmentation of mature forest. Worm-eating warblers and other forest interior species may have smaller populations, but each species is expected to continue to occur in the cumulative effects area. Glade and groundwater seepage communities on the Mark Twain National Forest would be buffered from mechanical disturbances according to Forest Plan standards and guides. They are not likely to receive special consideration on private property. Road maintenance and decommissioning would reduce erosion and potential sedimentation of fens and seeps. Arson and illegal motorized recreation on any ownership may affect the quality of all habitats. The Proposed Action seeks to restore and enhance communities to their full range of historic vegetation composition and structural conditions which occurred under natural disturbance regimes. These natural communities would have greater resiliency and capacity to adapt to projected climate changes. The cumulative effect of the Fremont-Pineknot East Project and other past, present, and future activities is likely to contribute to the long-term abundance and distribution of management

indicator species or natural communities, particularly those associated with more open conditions. Mature forest species and communities may be reduced, but they would remain present in the action area.

MIGRATORY BIRDS

Under the National Forest Management Act (NFMA), the Forest Service is directed to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives. . . ." (16 U.S.C. § 1604(g)(3)(B)). The USDA Forest Service Landbird Strategic Plan (U.S.D.A. Forest Service, 2000), US Shorebird Conservation Plan (Brown et al., 2001), Executive Order 13186 (2001), Partners in Flight (PIF) Bird Conservation Plans for specific habitats, and PIF North American Landbird Conservation Plan (Rich, et al., 2004) all reference goals and objectives for integrating bird conservation into forest management and planning.

In late 2008, a Memorandum of Understanding between the USDA Forest Service and the US Fish and Wildlife Service (USFWS) to Promote the Conservation of Migratory Birds was signed (U.S.D.A. Forest Service, 2008). The intent of the MOU is to strengthen migratory bird conservation through enhanced collaboration and cooperation between the Forest Service and the Fish and Wildlife Service as well as other federal, state, tribal, and local governments. These and other documents concerning migratory bird conservation were considered in the development of this analysis. Within the National Forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for land management activities. Consideration of the effects on bird habitat, both long and short term, was a key part of this analysis.

Partners in Flight formed in 1990 to conserve neotropical migrant landbirds through voluntary partnerships. Neotropical migratory birds include birds that spend the breeding season in North America, but overwinter in the southern United States and Central and South America. Various bird surveys, including the North American Breeding Bird Survey, have documented drastic declines in populations of some once-common species over the past several decades (Rich, et al., 2004). Partners in Flight seeks solutions to threats, including loss of habitat (change in structure and species composition or permanent removal), fragmentation and degradation of remaining habitat, failure to identify and protect or manage migration and winter habitats, and widespread increases in dispersed mortality factors not directly related to habitat (e.g., communication towers, wind turbines, and feral cats) (Rich, et al., 2004). The US Forest Service is a partner and participates in protecting and managing habitat for neotropical migratory birds. The Mark Twain National Forest falls within PIF's Ozark/Ouachita Plateau physiographic area, which has 36 priority bird species that require immediate conservation efforts to ensure their viability (Fitzgerald & Pashley, 2000). Thirty-two species that may occur in the Fremont-Pineknot East Project Area are identified in by their preferred breeding habitat.

Table 30. PIF's Ozark/Ouachita physiographic area priority species.

Species	**Preferred Habitat**
Kentucky warbler, Prairie warbler, Whip-poor-will, Field sparrow, Orchard oriole, Northern bobwhite, Brown thrasher, Chuck-will's-widow, Blue-winged warbler, Painted bunting, Loggerhead shrike, Bewick's wren, Short-eared owl	Forest edge, young sapling/pole-timber forest, scrub-shrub, fields, or openlands, often intermixed with mature forest.
Swainson's warbler, Cerulean warbler, Bell's vireo,	Mature riparian forests, often with some

Acadian flycatcher, Prothonotary warbler, Louisiana waterthrush, Yellow-throated warbler, Rusty blackbird	midstory and shrub development.
Worm-eating warbler, Great-crested flycatcher, Ovenbird, Pileated woodpecker, Carolina chickadee, Yellow-billed cuckoo, Yellow-throated warbler, Summer tanager, Wood thrush, Red-headed woodpecker, Purple finch	Mature forest with semi-open canopies and relatively open midstory and some shrub development.

The majority of Forest Service land in the Fremont-Pineknot East Project Area is currently upland forest (19,812 acres or 66%) and closed woodland (8,898 acres or 30%) (Schanta 2012a, Schanta, 2012b). Only about 947 acres (3%) are currently considered open woodland and approximately 316 acres (1%) are in an open condition (e.g., savannas, glades, old fields, and road corridors). Fremont has about 12,950 acres (60%) of oak and mixed hardwood forest types and about 8,634 acres (40%) of pine and mixed oak-pine forest types (Schanta, 2012a). Pineknot East has about 5,456 acres (66%) of oak and mixed hardwood forest types and about 2,829 acres (34%) of pine and mixed oak-pine forest types (Schanta, 2012b).

The major streams that flow through the project area include Pike, Little Pike, and Big Barren creeks. These are losing streams, but each has several spring-fed permanent pools and reaches. The main channels of Pike and Little Pike creeks are mostly on privately-owned lands, but much of their headwaters are on national forestland in the Fremont project area. Big Barren Creek and its headwaters flow through both project areas on Forest Service and privately-owned lands. Pike, Little Pike, and Big Barren creeks drain into the Current River, which is located about five miles east of the Fremont-Pineknot East Project boundary.

A bird monitoring project was implemented on the Mark Twain National Forest within CFLRP areas between May 19 and July 5, 2013. Survey plots were located in and near the Fremont-Pineknot East Project Area. The bird monitoring project was designed to 1) determine changes in abundance in response to restoration activities; and 2) determine relationships between bird abundance and vegetation structure and composition. Observers used point counts to survey abundance of 17 focal species. The total number of bird detections by species (but not location) was documented in a brief report by the primary researchers (Thompson et al., 2013). Results from objective 1 will require bird surveys spaced over the duration of the project, but initial results from objective 2 will be available after 3 years based on the current variation in structure and management that has already taken place. In 2014, researchers will also conduct nocturnal surveys for chuck-will's-widow and whip-poor-will and monitor nesting success of focal species on the Mark Twain National Forest.

DIRECT AND INDIRECT EFFECTS ON MIGRATORY BIRDS

ALTERNATIVE 1 – NO ACTION

The Fremont-Pineknot East Project would not be implemented if the No Action alternative is selected. There would be no silvicultural treatments, firewood gathering, prescribed fire management, glade restoration, pond maintenance or reconstruction, transportation system activities, or recreation improvements. Natural succession would proceed and open woodlands would become denser closed woodlands and closed woodlands would become upland forests. Small openings in closed woodlands and upland forests would also close. Forest interior species, such as the ovenbird and wood thrush, would likely benefit from maintaining and increasing the amount of mature forest. Ground flora would be reduced or eliminated by deep leaf litter and lack of sunlight reaching the forest floor. Many neotropical migratory birds prefer large tracts of

mature forest, but these conditions may not be suitable for some species because the midstory may be too closed and shrubs may be lacking.

Natural events, such as oak decline and windstorms, would create scattered forest openings within the project area. These openings would provide areas of early seral stage habitat and forest edge habitat. Roads would not be decommissioned and would also continue to provide edge habitat. Grasses, forbs, and shrubs may develop within the forest openings, but these areas would likely be small, temporary, and lack floristic diversity. Forest openings and edges created or maintained by natural events and current management practices would provide very limited habitat for some species of neotropical migrants.

Woody vegetation would continue to encroach on the glades and old field in the project area and grow larger within these early seral habitat types. The woody vegetation would shade the ground and eliminate habitat for many grass and forb species. Vegetative structure would change and species diversity would be reduced as natural succession progressed. The glades and old field would provide potential habitat for some migratory bird species for not more than ten years. Early seral stage habitats are extremely limited on Forest Service land within the Fremont-Pineknot East Project Area. Species associated with these habitats would be expected to decline if the No Action alternative is implemented.

ALTERNATIVE 2 – PROPOSED ACTION

The Proposed Action, including silvicultural treatments, firewood gathering, prescribed fire management, glade restoration, pond maintenance and reconstruction, transportation system activities, and recreation improvements, would be implemented if this alternative is selected. Direct impacts to some individual birds would likely occur when management activities are conducted during the breeding season. Loud equipment noise may drown out singing males and affect their ability to mate and defend territories. Repeated disturbances may force birds to move out of the immediate area and find new territories. Management actions would likely remove trees with bird nests or destroy ground nests. Adults could fly away and possibly re-nest, but non-volant young may be killed. Some individual neotropical migratory birds are likely to be harmed or killed as a direct result of implementing the Proposed Action, but the entire population of a species is not expected to be eliminated from the project area.

Silvicultural treatments and prescribed burns would reduce tree densities, basal areas, and canopy closures. The amount of upland forest would be reduced and closed and open woodland habitats would increase in the project area. Some areas with very high basal areas and canopy closures are expected to remain upland forest even after treatments such as commercial and restoration thinning. Understory brush would be reduced in the short term, but the increased amount of sunlight on the forest floor would encourage the growth of herbaceous vegetation and shrubs and increase insect prey diversity and abundance. Of the approximately 29,893 acres of national forest in the project area, 13,372 acres have no proposed silvicultural activities and would likely remain or succeed to upland forest. Many Forest management activities are prohibited or restricted within Riparian Management Zone buffers, so mature riparian forest should remain intact and protected from most potential impacts and disturbances. Large tracts of interior forest would remain abundant in the Fremont-Pineknot East Project Area and are expected to continue to provide suitable habitat for species such as ovenbirds and wood thrushes.

The proposed silvicultural treatments and prescribed fire management activities would greatly benefit bird species associated with more open habitat conditions. Open woodlands would cover about 81% of Forest Service land in the project area when the desired condition is attained.

Clearcut, seedtree, shelterwood, and salvage harvests would create regeneration openings that provide temporary early successional habitat distributed throughout the project area. Nineteen glades would be restored and a 64-acre old field would be maintained as open lands with repeated prescribed burning. The field may eventually be planted in native grasses and forbs to improve the quality of this limited habitat type. Fire would stimulate native herbaceous flora to germinate and reduce competition from non-native plant species. Open woodlands, regeneration openings, glades, and fields receive large amounts of sunlight at ground level, which encourages the growth of herbaceous vegetation and fruiting shrubs and increases insect prey abundance and diversity. The Proposed Action would greatly increase the amount of open woodland and early seral stage habitats in the project area and is expected to increase the abundance and diversity of bird species associated with these habitats.

Habitat fragmentation and nest predation are often cited as major contributors to the decline of neotropical migratory bird populations. Habitats can be fragmented by highways, powerlines, and land management activities. Forests are fragmented when they become separated by farms, subdivisions, and some silvicultural treatments, such as large clearcuts. Fragmentation results in reduced amounts of original habitat and increased amounts of edge. Edge habitat supports many common bird species, but can be detrimental to rare and sensitive migratory bird species. Brood parasitism by brown-headed cowbirds and nest predation increase with fragmentation. The Shawnee National Forest was described by Faaborg (2002) as "…cowbird heaven, because it is a heterogeneous mix of pastures, feedlots, and forests, with lots of forest edge for nest searching." The Mark Twain National Forest, and more specifically, the Eleven Point Ranger District does not fall into this category. Faaborg (2002) states "...in a huge forest area such as the Missouri Ozarks, nests are nearly immune from cowbird parasitism." The Fremont-Pineknot East Project Area does have large tracts of forest, but it also has some edge habitat. Cowbird parasitism is likely occurring, but is not believed to be a major contributor to the decline of neotropical migratory bird populations in this area. The Proposed Action would potentially reduce fragmentation or edge effects by decommissioning 45 roads for a total of 19 miles. These closed roads would undergo natural succession and eventually be reforested. Only five dispersed stands for a total of 78 acres are proposed to be clearcut. All regeneration and salvage harvests have are required to retain reserve trees or reserve tree groups within the harvest units (USFS 2005b).

Within the Ozark/Ouachita Plateau, upland forest bird species have high rates of reproductive success. Species that have exhibited population declines are associated with grass-shrub, early successional forest, and bottomland forest habitats (Fitzgerald & Pashley, 2000). The Proposed Action would continue to provide habitat for mature forest species. It would also create early successional forest and maintain grass-shrub habitat in the glades, old field, and the understory of open and closed woodlands. It is not anticipated to impact bottomland forest species. The Proposed Action would eventually restore historic habitat conditions and is expected to increase the diversity of native neotropical migratory birds in the Fremont-Pineknot East Project Area.

CUMULATIVE EFFECTS ON MIGRATORY BIRDS

The geographic boundary for cumulative effects analysis includes all lands in the Fremont-Pineknot East Project Area and within five miles of its boundary. It also includes all intermittent and perennial streams within the project area and continuing five miles downstream. This boundary includes known and potential habitat that may be directly or indirectly affected by the proposed activities. Bird species defend relatively small territories (usually < 100 acres) (Best, 1977; Cink, 2002; Oliarnyk & Robertson, 1996). The terrestrial and aquatic boundaries were deemed appropriate because potential effects of the proposed activities would be insignificant or not occur outside this boundary. The temporal boundary for cumulative effects analysis is the past

fifteen years, the present, and the next fifteen years. Most project activities would be implemented in the next few years and effects of these actions would be most evident during implementation and immediately upon completion. Project effects would be much less apparent after fifteen years. Past, present, and reasonably foreseeable future actions on all ownerships within the cumulative effects boundary are described in the Management Indicators section and are not repeated here.

ALTERNATIVE 1 – NO ACTION

The Fremont-Pineknot East Project would not occur if the No Action alternative is selected. There would be no silvicultural treatments, firewood gathering, prescribed fire management, glade restoration, pond maintenance or reconstruction, transportation system activities, or recreation improvements. Combining the lack of management proposed in this alternative with other past, present, and reasonably foreseeable future actions on all ownerships would have no immediate impacts on neotropical migratory birds. Activities on private lands are likely to create or maintain very open lands (pasture, housing) or very dense conditions (unmanaged woodlots). Actions on public lands tend to create or maintain a mosaic of habitat conditions from mature open and closed forests to glades and shrubby fields.

Bird species requiring mature, dense forest would likely benefit from a lack of management. An abundance of habitat for these species currently exists and would increase in the future. The amount of open woodlands, glades, and brushy fields would probably continue to decrease. Species that use open woodlands are likely to decrease in number of individuals. Populations of certain bird species that depend on glades or native grass-shrub habitats may eventually be lost from the action area as vegetative succession proceeds and changes the structure and composition of these habitats. Glades and riparian forests on the Mark Twain National Forest would continue to be protected from mechanical disturbances by Forest Plan standards and guides. They are not likely to receive special consideration on private property. Natural succession, arson, and illegal motorized recreation on any ownership may affect the quality of all of these habitats. The structure and composition of the existing vegetative communities in the action area are mostly out of balance with historic habitat conditions and are expected to be less resilient to climate change. The No Action alternative would not contribute to negative edge effects within the cumulative effects boundary, but it does not create or maintain habitat that is most lacking for migratory bird species that are in decline in this area.

ALTERNATIVE 2 – PROPOSED ACTION

The Proposed Action, including silvicultural treatments, firewood gathering, prescribed fire management, glade restoration, pond maintenance and reconstruction, transportation system activities, and recreation improvements, would be implemented if this alternative is selected. Combining these activities with other past, present, and reasonably foreseeable future actions on all ownerships is expected to have an overall positive impact on neotropical migratory bird populations in the cumulative effects area. Silvicultural treatments, prescribed burns, glade restoration, and old field maintenance activities on public lands would create or maintain open woodlands, early successional forest, glades, and brushy fields and increase habitat availability for bird species that are in decline. Activities on private lands are not likely to create or maintain optimal conditions for neotropical migrants. Open land on private property tends to be hay fields or pasture. Fescue contains a potentially toxic fungus and provides low-quality short-grass habitat. Fescue fields have extremely low structural and species diversity and are unsuitable for most native, migratory bird species.

The Proposed Action, along with other federal, state, and TNC actions within the cumulative effects area, would create or maintain a mosaic of habitat conditions from mature open and closed forests to glades and shrubby fields. Fragmentation and its associated impacts on bird populations would be minimal. A primarily wooded landscape would be maintained and no conversion of National Forest lands to permanent agriculture or other non-forest uses would occur. Species requiring open woodlands and early successional habitat are likely to increase in number in the cumulative effects area. Additional bird species may eventually be detected in the area as rare habitats are restored. Neotropical migrants requiring mature, dense forest may decrease in number, but species would not be lost from the area. An abundance of habitat for these bird species would continue to exist in the cumulative effects area. These species are generally over-represented because current habitat conditions do not reflect the open woodlands that historically existed in this region. The Proposed Action seeks to restore and enhance communities to their full range of historic vegetation composition and structural conditions which occurred under natural disturbance regimes. These natural communities would have greater resiliency and capacity to adapt to projected climate changes. The cumulative impact of the Fremont-Pineknot East Project and other past, present, and future activities would likely be an increase in the abundance and diversity of neotropical migratory birds in this area.

FEDERALLY THREATENED AND ENDANGERED SPECIES

Fifteen federally threatened and endangered species and one proposed endangered species that may be affected by activities on the Forest are considered in the Fremont-Pineknot East Restoration Project Federal Biological Evaluation (BE). These federal species are identified in Table 31. Thirteen of these species are not known to occur or have potential habitat in the action area or would not be impacted by the proposed activities. Indiana bat, northern bat, and gray bat are known to occur or have potential habitat in the Fremont-Pineknot East Project action area. The action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR § 402.02). The terrestrial analysis boundary includes all lands in the Fremont-Pineknot East Project Area and within five miles of its boundary. The aquatic analysis boundary includes intermittent and perennial streams within the project area and continuing five miles downstream of its boundary (**Error! Reference source not found.**). Potential direct, indirect, and reasonably foreseeable cumulative effects to Indiana, northern, and gray bats as a result of the No Action and Proposed Action alternatives were evaluated in depth in the Federal BE. That analysis is summarized in this document.

Table 31. Mark Twain National Forest list of federally threatened, endangered, and proposed species.

Species	Designation	Habitat
Mammals		
Indiana bat (*Myotis sodalis)*	Endangered, Critical Habitat	Forest wide; caves, forested areas Critical Habitat is hibernacula not on National Forest
Northern bat (*Myotis septentrionalis*)	Proposed Endangered	Forest wide; caves, forested areas
Gray bat (*Myotis grisescens)*	Endangered	Forest wide; caves, riparian areas near caves
Insects		
Hine's emerald dragonfly (*Somatochlora hineana)*	Endangered, Critical Habitat	Range includes most of Mark Twain National Forest, including EPRD; Calcareous or limestone/dolomite wetlands and shallow, spring-fed steams draining into wet meadows and cattail marshes; Critical Habitat on National Forest

Snails		
Tumbling Creek cavesnail (*Antrobia culveri)*	Endangered, Critical Habitat	Cave aquatic systems, Ava RD Critical Habitat on private landowner
Amphibians		
Ozark hellbender (*Cryptobranchus alleganiensis bishopi)*	Endangered	Large river drainages, Willow Springs Unit, EPRD; Eleven Point, Current, and North Fork White rivers
Mussels		
Pink mucket pearlymussel (*Lampsilis abrupta)*	Endangered	Large river drainages with gravelly bottoms; lower Big, Meramec, Osage, Black, Little Black, St. Francis
Curtis pearlymussel *(Epioblasma florentina curtisii)*	Endangered	Medium to large rivers in riffles, stable substrate, Black, Castor, Little Black rivers, Cane Creek
Scaleshell mussel (*Leptodea leptodon)*	Endangered	Large rivers in mud, Houston-Rolla RD; Big, Gasconade, Meramec rivers
Snuffbox mussel (*Epioblasma triquetra*)	Endangered	Small to med creeks with swift current; sand, gravel, cobble substrates; Meramec, Bourbeuse, Castor, St. Francis, Black, L. Blk
Sheepnose mussel (*Plethobasus cyphyus)*	Endangered	Large rivers , gravel bottom with swift to moderate current, Sal/Pot, Meramec River basin, primarily in the Meramec itself
Spectaclecase mussel (*Cumberlandia monodonta)*	Endangered	Medium to large rivers with cobble, gravel, sand, with good water quality and strong currents, Hou/Rol RD, Lower Osage, Gasconade, Big Piney, Sac, Meramec
Rabbitsfoot mussel (*Quadrula cylindrica cylindrica)*	Threatened, Proposed Critical Habitat	Small to medium rivers with moderate to swift current, sand and gravel, Fredtown Unit, Spring, Black, St. Francis rivers, Shoal Creek; Proposed Critical Habitat along Spring and St. Francis rivers
Plants		
Running buffalo clover (*Trifolium stoloniferum)*	Endangered	Forest wide introduced; Open woods along streams
Mead's milkweed (*Asclepias meadii)*	Threatened	Igneous, chert glades; prairies, Potosi-Fredtown Ranger District, Bell Mt. wilderness
Virginia sneezeweed (*Helenium virginicum)*	Threatened	Open sinkhole ponds or man-made ponds with fluctuating water levels, WS Unit on private

DETERMINATIONS AND RATIONALE FOR INDIANA BAT

ALTERNATIVE 1: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT

The No Action alternative is not anticipated to result in direct impacts to Indiana bats. Hibernacula and hibernating bats are not expected to be affected. Potential roost trees would remain abundant as snags continue to be lost and created by natural and human activities. The lack of active forest management and natural vegetative succession would result in increased canopy covers, basal areas, and clutter over time. Suitability of foraging habitat and roost trees for Indiana bats would further decline as forests and woodlands became denser. Water sources would be lost over time as ponds dry up, but new ponds would likely be constructed and sources of drinking water and aquatic insect prey are expected to remain plentiful in the action area. Water quality would likely remain unchanged or decline slightly. The No Action alternative is not likely to adversely affect Indiana bats.

ALTERNATIVE 2: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT

The Proposed Action includes silvicultural and prescribed fire management activities to mimic historic disturbance regimes and restore the natural vegetation composition and structural conditions previously found in this area. The eventual restoration of historic habitat conditions is expected to benefit Indiana bats in the long term. Indiana bats are not likely to be adversely affected by the activities proposed in Fremont-Pineknot East Project.

All known Indiana bat hibernacula and the 150-acre buffer around each of them are outside the Fremont-Pineknot East Project Area boundary. Occupied bat caves are considered smoke-sensitive areas, so prescribed fires would be planned to avoid or minimize smoke impacts to the two hibernacula in the action area. Monitoring has indicated that smoke is unlikely to enter hibernacula, which tend to trap colder air in the winter. Hibernating bats have not appeared to be disturbed by light smoke. Fires were a frequent occurrence in this area throughout history and bats have likely adapted to low levels of smoke in their environment.

The Proposed Action would create forest and woodland habitats with diverse structure and composition and provide roosting and foraging habitat of varying suitability. There would be no permanent land conversion to non-forest habitats with this project. Dead and dying trees would remain abundant in the action area and are continually being created through natural events and human actions. Project activities would remove potential Indiana bat roosts, but Indiana bats have never been captured on the Eleven Point District during summer surveys. If Indiana bats are migrating through the project area, the chances of removing an occupied roost tree would be extremely low because of the relatively small number of Indiana bats hibernating on the District (<100), the numerous possible migration corridors, and the brief amount of time bats are expected to spend in any one location during migration. According to Forest Plan standards and guides, trees with characteristics of suitable roosts (i.e., dead or dying with exfoliating bark or large living trees with flaking bark) are retained wherever possible. Hazard trees are removed between November 1 and April 1 as much as possible. Three additional mitigation measures would be implemented to further reduce the possibility of impacts to potential roost trees and roosting Indiana bats.

W1—Timber. Do not remove trees with characteristics of suitable roosts (i.e., dead, dying, or living trees with cavities, crevices, or loose, flaking bark) within one mile of the hibernaculum from September 15 to November 1.

W2—Fire. Do not remove trees with characteristics of suitable roosts (i.e., dead, dying, or living trees with cavities, crevices, or loose, flaking bark) within one mile of the hibernaculum between April 1 and November 1.

W3—Ponds. Tree removal associated with pond maintenance and reconstruction will occur between November 1 and April 1.

Silvicultural treatments and prescribed fire would reduce tree basal area, canopy closure, and understory clutter over much of the Fremont-Pineknot East Project Area. Suitable Indiana bat foraging habitat on Forest Service land within the project area would increase from 33% to 93% when the desired condition is attained. Areas proposed for commercial harvests that reduce canopy closure below 30% may provide potential foraging habitat in the future as the forest regenerates. There are numerous water sources in the action area available to Indiana bats for drinking water and obtaining aquatic insect prey. Project activities would slightly increase the number of suitable ponds and improve or decommission roads that may be contributing sediment

to waterways. Water sources would be protected by buffers and the Proposed Action would not impair water quality.

All applicable 2005 Forest Plan standards and guidelines would be implemented to minimize or prevent adverse effects to Indiana bats. It is extremely unlikely that roosting Indiana bats would be negatively impacted. The Proposed Action is expected to greatly increase Indiana bat foraging habitat suitability in an area with an abundance of potential roost trees and water sources. There would be no decrease in the survival, fitness, or reproductive success of Indiana bats within the action area as a result of implementing the proposed activities. Any adverse impacts to Indiana bats or their habitat would be reported to USFWS at once, and activities determined to have caused the impact would be suspended immediately.

DETERMINATIONS AND RATIONALE FOR NORTHERN BAT

ALTERNATIVE 1: NOT LIKELY TO ADVERSELY AFFECT

The No Action alternative is not anticipated to result in direct impacts to northern bats. Hibernacula and hibernating bats are not expected to be affected. Potential roost trees would remain abundant as snags continue to be lost and created by natural and human activities. The lack of active forest management and natural vegetative succession would result in increased basal area, canopy cover, and understory clutter over time. Suitability of foraging habitat and roost trees for northern bats may decline as forests and woodlands became denser. Water sources would be lost over time as ponds dry up, but new ponds would likely be constructed and sources of drinking water and aquatic insect prey are expected to remain plentiful in the action area. Water quality would likely remain unchanged or decline slightly. The No Action alternative is not likely to adversely affect northern bats.

ALTERNATIVE 2: LIKELY TO ADVERSELY AFFECT, NOT LIKELY TO RESULT IN JEOPARDY

The Proposed Action includes silvicultural and prescribed fire management activities to mimic historic disturbance regimes and restore the natural vegetation composition and structural conditions previously found in this area. The Project Area is within the northern bat’s historic range, so the restoration of habitat conditions is expected to support northern bat populations. The proposed activities may impact a few individual northern bats, but would not jeopardize the continued existence of the species.

All known northern bat hibernacula and the 150-acre buffer around each of them are outside the Fremont-Pineknot East Project Area boundary. Occupied bat caves are considered smoke-sensitive areas, so prescribed fires would be planned to avoid or minimize smoke impacts to the two hibernacula in the action area. Monitoring has indicated that smoke is unlikely to enter hibernacula, which tend to trap colder air in the winter. Hibernating bats have not appeared to be disturbed by light smoke. Fires were a frequent occurrence in this area throughout history and bats have likely adapted to low levels of smoke in their environment.

The Proposed Action would create forest and woodland habitats with diverse structure and composition and the project area would provide roosting and foraging habitat of varying suitability. There would be no permanent land conversion to non-forest habitats with this project. Project activities would remove suitable northern bat roosts, but dead and dying trees would remain abundant in the action area during and after project implementation. The probability of removing an unknown occupied roost trees is small because there is an extremely large number of potential roost trees in the project area and a relatively small percentage of them would be

removed. If an occupied roost tree was cut down, it would most likely have had an individual male or non-reproductively active female since they use a wider range of potential roosts. These individual northern bats would likely arouse before the tree fell and escape unharmed to an alternate roost. It is very unlikely that an occupied maternity tree would be cut down since maternity colonies tend to roost in trees that are specifically targeted for protection by Forest Plan standards and guides. If an occupied maternity tree was cut down, most of the adults and juveniles would likely escape unharmed to an alternate roost, but some may be injured or killed (U.S. Fish and Wildlife Service, 2005). It is very unlikely that northern bats would be adversely affected during swarming/staging periods since all bats would be volant (capable of flying) and are expected to roost singly or in very small numbers. Migrating northern bats are also unlikely to be impacted because there are numerous potential travel corridors across the District and the amount of time spent in one location is expected to be brief.

According to Forest Plan standards and guides, trees with characteristics of suitable roosts (i.e., dead or dying with exfoliating bark or large living trees with flaking bark) are retained wherever possible. Hazard trees are removed between November 1 and April 1 as much as possible. Three additional mitigation measures would be implemented to further reduce the possibility of impacts to potential roost trees and roosting northern bats.

W1—Timber. Do not remove trees with characteristics of suitable roosts (i.e., dead, dying, or living trees with cavities, crevices, or loose, flaking bark) within one mile of the hibernaculum from September 15 to November 1.

W2—Fire. Do not remove trees with characteristics of suitable roosts (i.e., dead, dying, or living trees with cavities, crevices, or loose, flaking bark) within one mile of the hibernaculum between April 1 and November 1.

W3—Ponds. Tree removal associated with pond maintenance and reconstruction will occur between November 1 and April 1.

Silvicultural treatments and prescribed fire would reduce tree basal area, canopy closure, and understory clutter over much of the Fremont-Pineknot East Project Area and potentially improve foraging suitability for northern bats. Upland mature forest would remain widely available in unmanaged and lightly managed areas and provide northern bats an abundance of suitable foraging habitat. Water sources would remain abundant in the project area and continue to provide northern bats with suitable drinking water, foraging sites, and an abundance of aquatic insect prey. Project activities would slightly increase the number of suitable ponds and improve or decommission roads that may be contributing sediment to waterways. Water sources would be protected by buffers and the Proposed Action would not impair water quality.

All applicable 2005 Forest Plan standards and guidelines, including newly proposed standards and guides, would be implemented to minimize or prevent negative impacts to northern bats. The Proposed Action is likely to adversely affect a few roosting northern bats, but would not jeopardize the continued existence of the species. Implementing the proposed activities would not reduce the likelihood of survival or recovery of northern bats within the action area. Any adverse impacts to northern bats or their habitat would be reported to USFWS at once, and activities determined to have caused the impact would be suspended immediately. No designated critical habitat has been proposed for northern bat at this time (U.S. Fish and Wildlife Service, 2014).

DETERMINATIONS AND RATIONALE FOR GRAY BAT

ALTERNATIVE 1: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT

The No Action alternative is extremely unlikely to adversely affect gray bats. There would be no effect to hibernacula or maternity caves. Habitat around the transient caves and along foraging corridors on Forest Service land is expected to remain forested. Smoke from wildfires is unlikely to enter caves. Some water sources may be lost over time as ponds dry up, and water quality may decline slightly if roads are not maintained or decommissioned. Gray bat aquatic insect prey is expected to remain abundant in the action area.

ALTERNATIVE 2: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT

The Proposed Action is not likely to adversely affect gray bats. There would be no effect to hibernacula or maternity caves. Forest Service management activities are limited or prohibited around caves and surrounding habitat would remain forested. The transient caves are not expected to be occupied when prescribed burns are conducted, but burns would be planned to avoid or minimize smoke impacts to the caves. Forest Service management activities are also limited or prohibited within perennial and intermittent stream buffers, so gray bat foraging corridors on national forest land would remain forested. The Fremont-Pineknot East Project Area would continue to provide woodland and forest habitats with diverse structures and species compositions. There are numerous water sources in the project area and the proposed action would ensure at least twelve ponds would support the development of gray bat aquatic insect prey. Stream buffers and road maintenance and decommissioning would reduce sedimentation of waterways. The Proposed Action would not impair water quality and aquatic insect prey would remain abundant. All applicable 2005 Forest Plan standards and guidelines would be implemented to minimize or prevent adverse effects to gray bats. Gray bat populations were stable or increasing across their range and were proposed for downlisting to threatened prior to the discovery of WNS. There will be no decrease in the survival, fitness, or reproductive success of gray bats within the action area as a result of implementing the proposed activities. Any adverse impacts to gray bats or their habitats would be reported to USFWS at once, and activities determined to have caused the impact would be suspended immediately.

REGIONAL FORESTER SENSITIVE SPECIES & STATE ENDANGERED SPECIES

Regional Forester Sensitive Species (RFSS) and Missouri State Endangered Species (SES) that may be affected by activities on the Forest are considered in the Fremont-Pineknot East Restoration Project RFSS & SES Biological Evaluation (Project Record).

The Missouri Fish and Wildlife Information System (Missouri Department of Conservation, 2014a) and the Missouri Natural Heritage Database (Missouri Department of Conservation, 2014b) were consulted to determine which RFSS and SES may occur in the project's action area based on species habitat requirements and known and potential locations across the Forest. Field surveys by district personnel also contributed to knowledge of habitat availability and likelihood of a species presence. According to these database searches and field surveys, 60 RFSS or SES have potential habitat in the action area and are listed in the tables below. (The 28 species that have been documented in the action area are in bolded text.) Potential direct, indirect, and reasonably foreseeable cumulative effects to the 60 RFSS or SES as a result of the No Action and Proposed Action alternatives were evaluated in depth in the RFSS & SES BE by habitat type. Species that utilize several habitat types were evaluated for each habitat. The effects analysis is summarized in this document.

Table 32. Grasslands, Praries, Glades, Open Woods, Openings

Common Name	Scientific Name	Group	Habitat
Eastern small-footed bat	*Myotis leibii*	Mammal	Glades, upland forest, caves
Little brown bat	*Myotis lucifugus*	Mammal	Forest margins, caves
Tri-colored bat	*Perimyotis subflavus*	Mammal	Forest margins, caves
Eastern spotted skunk	*Spilogale putorius*	Mammal	Grasslands, openings, edge
Northern harrier	*Circus cyaneus*	Bird	Grassland, fields
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	Bird	Grasslands, old fields
Bachman's sparrow	*Peucaea aestivalis*	Bird	Glades, open woods, old field
Westfall's snaketail dragonfly	*Ophiogomphus westfalli*	Insect	Open woods, fields (adults)
Forked liverwort	*Metzgeria furcata*	N-V. Plant	Glades, bluffs, rocks
Purple false foxglove	*Agalinis skinneriana (purpurea)*	V. Plant	Open woods, prairies, glades
Ofer Hollow reedgrass	*Calamagrostis porteri insperata*	V. Plant	Rock ledges, bluffs, open woods
Pretty sedge	*Carex woodii*	V. Plant	Woodlands, dry or mesic
Ozark chinquapin	*Castanea pumila var. ozarkensis*	V. Plant	Rocky outcrops, dry woods
Wavy-leaf purple coneflower	*Echinacea simulata*	V. Plant	Glades, savannas, roadsides
Nieuwland's blazing star	*Liatris scariosa var. nieuwlandii*	V. Plant	Glades, old fields, roadsides
Baldwin's milkvine	*Matelea baldwyniana*	V. Plant	Glades, open rocky woods
Narrowleaf evening primrose	*Oenothera fruiticosa*	V. Plant	Rocky banks, roadsides, glades
Bush's skullcap	*Scutellaria bushii*	V. Plant	Glades, bald knobs
Royal catchfly	*Silene regia*	V. Plant	Glade edges, open woods
Gattinger's goldenrod	*Solidago gattingerii*	V. Plant	Glades, bald knobs
Softleaf arrow-wood	*Viburnum molle*	V. Plant	Glades, ledges, bluffs

Table 33. Upland Forest

Common Name	Scientific Name	Group	Habitat
Eastern small-footed bat	*Myotis leibii*	Mammal	Caves, glades, upland forest
Little brown bat	*Myotis lucifugus*	Mammal	Forest margins, caves
Tri-colored bat	*Perimyotis subflavus*	Mammal	Forest margins, caves
Eastern spotted skunk	*Spilogale putorius*	Mammal	Grasslands, openings, edge
Large whorled pogonia	*Isotria verticillata*	V. Plant	Upland forest
Crippled cranefly orchid	*Tipularia discolor*	V. Plant	Upland forest, riparian
Ozark trillium	*Trillium pusillum* var. *ozarkanum*	V. Plant	Upland forest

Table 34. Caves, Cliffs, Bluffs, Rock Outcrops

Common Name	Scientific Name	Group	Habitat
Eastern small-footed bat	*Myotis leibii*	Mammal	Caves, glades, upland forest

Little brown bat	*Myotis lucifugus*	Mammal	Caves, forest margins
Tri-colored bat	*Perimyotis subflavus*	Mammal	Caves, forest margins
A springtail	*Pseudosinella espana*	Insect	Caves
Forked liverwort	*Metzgeria furcata*	N-V. Plant	Glades, bluffs, rocks
Ofer Hollow reedgrass	*Calamagrostis porteri insperata*	V. Plant	Rock ledges, bluffs, open woods
Ozark chinquapin	*Castanea pumila* var. *ozarkensis*	V. Plant	Rocky outcrops, dry woods
A leatherwood	*Dirca decipiens*	V. Plant	Bluffs
Orange coneflower	*Rudbeckia fulgida var. speciosa*	V. Plant	Wetlands, ledges
Softleaf arrow-wood	*Viburnum molle*	V. Plant	Glades, ledges, bluffs

Table 35. Wetlands, Riparian

Common Name	Scientific Name	Group	Habitat
Bald eagle	*Haliaeetus leucocephalus*	Bird	Riparian
Swainson's warbler	*Limnothlypis swainsonii*	Bird	Riparian
Cerulean warbler	*Setophaga cerulean*	Bird	Riparian
A heptageniid mayfly	*Maccaffertium bednariki*	Insect	Riparian (adults)
Dichelyma moss	*Dichelyma capillaceum*	N-V. Plant	Wetlands, riparian
Water sedge	*Carex aquatilis var. aquatilis*	V. Plant	Riparian
Epiphytic sedge	*Carex decomposita*	V. Plant	Wetlands, sinkhole ponds
Large sedge	*Carex gigantean*	V. Plant	Wetlands, sinkhole ponds
Dioecious sedge	*Carex sterilis*	V. Plant	Wetlands, fens
Straw sedge	*Carex straminea*	V. Plant	Wetlands, sinkhole ponds
Tussock sedge	*Carex stricta*	V. Plant	Wetlands, fens
Hairyfruit sedge	*Carex trichocarpa*	V. Plant	Wetlands, fens
Log fern	*Dryopteris celsa*	V. Plant	Wetlands, sinkholes
Daggerleaf spikerush	*Eleocharis lanceolata*	V. Plant	Wetlands, riparian, gravel bar
Featherfoil	*Hottonia inflata*	V. Plant	Wetlands, sinkhole ponds
Butternut	*Juglans cinerea*	V. Plant	Riparian, base of slopes
Weak rush	*Juncus debilis*	V. Plant	Riparian
Small-fruit seedbox	*Ludwigia microcarpa*	V. Plant	Wetlands
Baldwin's milkvine	*Matelea baldwyniana*	V. Plant	Glades, open woods, riparian
American ginseng	*Panax quinquefolius*	V. Plant	Riparian, mesic forest
Carolina phlox	*Phlox carolina ssp. carolina*	V. Plant	Riparian
Spotted phlox	*Phlox maculata ssp. pyramidalis*	V. Plant	Wetlands, fens
Yellow-fringed orchid	*Platanthera ciliaris*	V. Plant	Wetlands
Small green woodland orchid	*Platanthera clavellata*	V. Plant	Wetlands
Southern rein orchid	*Platanthera flava var. flava*	V. Plant	Riparian
Orange coneflower	*Rudbeckia fulgida var. speciosa*	V. Plant	Wetlands, ledges
Gibbous panic grass	*Sacciolepis striata*	V. Plant	Wetlands, sinkhole ponds
Canby bulrush	*Schoenoplectus*	V. Plant	Wetlands, sinkhole ponds

	etuberculatus		
Tradescant aster	*Symphyotrichum dumosum var. strictior*	V. Plant	Wetlands
Crippled cranefly orchid	*Tipularia discolor*	V. Plant	Upland forest, riparian
Fernald's false (or pale) manna grass	*Torreyochloa pallida var. fernaldi*	V. Plant	Wetlands
Lesser marsh St. Johns wort	*Triadenum tubulosum*	V. Plant	Wetlands, riparian
Northern arrow-wood	*Viburnum recognitum*	V. Plant	Riparian

Table 36. Creeks, Small and Large Rivers

Common Name	Scientific Name	Group	Habitat
Ozark shiner	*Notropis ozarcanus*	Fish	Rivers, Creeks
Ouachita kidneyshell	*Ptychobranchus occidentalis*	Mollusk	Rivers, Creeks
Purple lilliput	*Toxolasma lividum*	Mollusk	Rivers, Creeks
A heptageniid mayfly	*Maccaffertium bednariki*	Insect	Rivers (larvae)
Westfall's snaketail dragonfly	*Ophiogomphus westfalli*	Insect	Rivers (larvae)

DETERMINATIONS OF EFFECT AND RATIONALE

ALTERNATIVE 1 – NO ACTION

This alternative would have **"no impact"** on RFSS or SES associated with upland forests, caves, cliffs, bluffs, rock outcrops, or perennial streams. Upland forest habitat would remain abundant, caves and rocky areas would not be impacted by ground-disturbing activities or smoke, and water quality is expected to remain unchanged from current conditions.

The No Action alternative **"may impact individuals, but it is not likely to contribute to a loss of viability or a trend toward federal listing"** of RFSS or SES associated with grasslands, glades, open woods, forest openings, wetlands, and riparian areas. Natural succession would proceed and woody vegetation would continue to encroach on fields, fens, and glades. Tree densities, basal areas, and canopy closures would also increase resulting in more closed, dense forests. There would be an overall loss of potential habitat for species preferring open conditions. Roads would not be maintained or decommissioned and may continue to erode and possibly contribute sediment and other pollutants to wetlands or riparian areas.

ALTERNATIVE 2 – PROPOSED ACTION

The Fremont-Pineknot East Restoration Project **"may impact individuals, but it is not likely to contribute to a loss of viability or a trend toward federal listing"** of any RFSS or SES. Proposed activities would involve tree removal, ground disturbance, noise, fire, and smoke, but Forest Plan standards and guidelines would remove or minimize potential impacts to RFSS and SES and their habitats. Most management activities are prohibited or limited within the RMZ and 100 feet of glades, caves, cliffs, bluffs, rock outcrops, and wetlands. All ground-disturbing activities must prevent or minimize rutting, erosion, compaction, rapid runoff, disruption of water movement, and loss of water and soil quality. Large live trees, snags, and trees with cavities and crevices are left standing whenever possible to provide potential roost and den trees. All habitat types would remain available in the project area, but the amount and distribution of some habitats and their associated species would change.

The Proposed Action is also expected to have a **"beneficial impact"** on RFSS and SES associated with grasslands, glades, open woods, forest openings, wetlands, and riparian areas. The proposed activities would reduce woody encroachment on fields, glades, and fens. Silvicultural treatments and prescribed fire would reduce leaf litter, understory clutter, tree density, basal area, and canopy closure over much of the Fremont-Pineknot East Project Area. More sunlight would reach the ground and encourage the growth of herbaceous vegetation. Prescribed burns are expected to stimulate native flora to germinate and produce seed. The Proposed Action would increase the amount and quality of open habitats in the project area and benefit RFSS and SES that depend on these habitats. The proposed road maintenance and decommissioning activities should reduce erosion and potential impacts to wetlands and riparian habitats from sediment and other pollutants.

RECREATION

AFFECTED ENVIRONMENTS

The Fremont-Pineknot East Restoration Project area is classified as a General Forest Area and consists of undeveloped forested land with some gravel roads present. Water features are limited within the project area to a few ephemeral and intermittent streams, small wildlife ponds (e.g., 15-30 feet across), and springs. These water features do not support most water-based recreation activities such as fishing. Due to the lack of water features, water-based recreation is not analyzed or considered. Similarly, there are no developed recreation areas or sites in the project area.

The major recreation features in the project area include segments of the Ozark National Recreation Trail and the Big Barren Creek State Natural Area. The Ozark National Recreation Trail's *Current River Section* crosses through the northeast corner of the Fremont area. The *Between the Rivers Section* crosses a portion of the southeast corner of Pineknot East. The nearest trailheads are located on Peck Ranch Road, Highway 60, and the Sinking Creek Lookout Tower.

The *Current River Section* of the Ozark National Recreation Trail enters the Fremont project area from the Peck Ranch Conservation Area through Midco Hollow. The trail travels approximately 2.0 miles generally south and southeast until it exits the project area. Vertical elevation changes along this section within the project area range from approximately 700-950 feet elevation above sea level. Blown down trees cover the area containing the proposed 1.4 mile trail reroute. That section of the trail also traverses a ridge making water control difficult. Equestrian use is not allowed on this section of the Ozark National Recreation Trail.

Approximately 3.5 miles of the Ozark National Recreation Trail in the *Between the Rivers Section* crosses the southeast corner of Pineknot East. The segment follows Devil's Run, crosses Hog Hollow, and parallels a portion of Fools Catch Creek. Vertical elevation changes along this section within the project area range from approximately 570-930 feet elevation above sea level. Foot travel and equestrian travel is allowed on the *Between the Rivers Section*.

The Big Barren Creek Natural Area has the potential to be a substantial draw factor as a natural feature of interest to recreational visitors. The Big Barren Creek State Natural Area features 232 acres of lush mesic bottomland forest along Big Barren Creek, a high-quality Ozark stream (Missouri Department of Conservation, n.d.). The Big Barren Creek State Natural Area currently does not provide any visitor amenities. The Big Barren Creek State Natural Area presents an opportunity to provide basic amenities to support public use, recreation, and nature study.

Areas along U.S. Highway 60 provide opportunities for sightseeing and scenic views. The highway traverses a valley along Little Pike Creek in the vicinity of Fremont and a series of rolling hills east of Winona. Points of interest include the Fremont Lookout Tower about 4.0 miles west of Fremont.

The Windes Creek Fields (T. 27 N, R. 3 W, sec. 35, 36) is located along U.S. Highway 60 approximately 0.5 mile west of the Fremont Tower. The Windes Creek Fields are approximately 64 acres in size and features creeks and small ponds.

Most of the project area along forest roads in the project area consists of dense forest. The area primarily exhibits a wall of green with limited visual penetration and few open areas. In many cases throughout the project area, a straight-line wall of green vegetation exists within 6 feet of the road, and on Forest Service spur roads, in several cases, vegetation grows into the travelway.

Visual penetration along main forest roads within the project area provides a typical maximum depth of 50 or so yards into the forest interior during the leaf-on period. However, in thick areas, especially in very dense new growth areas with small diameter trees, visual penetration is often limited to 20 yards. In numerous cases, little visual penetration exists. Visual penetration and views may be somewhat better during the fall leaf-off period, but, is still limited.

Sightseeing and wildlife viewing opportunities are very limited across much of the project area due to the dense vegetation, vegetation growing up to the edge of the road, lack of open areas, and lack of interesting visual features. The area lacks unique natural features such as vistas, rock features, or substantial water features across most of the project area. Few open areas exist along or near roads across the project area with the exception of small areas resulting from blown down trees and open areas along the roads that have been used for dispersed deer camps. Due to the dense vegetation and lack of openings, opportunities to view wildlife are limited.

Dense vegetation with very limited views would likely be associated with low visual interest and potential negative perceptions and reactions from many general forest visitors. Forest visitors do not prefer areas with dense ‘eye-level’ vegetation or undergrowth with dense sapling stands or forest understories (Tlusty & Bacon, 1989). People often perceive such areas as appearing boring, unsafe, fearsome, and lacking in views and way finding indicators (Kaplan, Kaplan, & Ryan, 1989). Most people prefer savannah-like landscapes of fairly open areas with low ground cover, a water source or green or flowering plants apparent, and scattered clumps of trees and shrubs (Hill & Daniel, 2007). People prefer open or sparse undergrowth and a park-like appearance and openings that provide views (e.g., Hill & Daniel, 2007; Tlusty & Bacon, 1989).

Some roads within the project area need maintenance to be brought up to Forest Service standards. Of particular note, some spur roads and other roads have so much limb growth in and across the road that many limbs are at approximately 6 feet in height potentially endangering vehicles, horseback riders and some other users that may use these routes.

Trash dumps and illegal user-created ATV trails are evident in several areas along forest roads in the project area, and other trails likely exist. Illegal use of forest lands by motorized recreationists on user-created or non-System roads and trails damages resources, disrupts wildlife, and degrades the recreational experiences of other user groups (Hammitt & Cole, 1998) (Hammitt & Cole, 1998; Hunt et al., 2009; Manning, 1999; Moore & Driver, 2005). The presence of illegal trails and roads and trash dumps serve as a releaser cue which promotes these and other depreciative and or illegal behaviors (Manning, 1999; Moore & Driver, 2005). Further, illegal user-created trails are often used for poaching, illegal drug activity, and arson (Hunt et al., 2009).

Recreation opportunities primarily support dispersed recreation attracting visitors that seek backcountry-type experiences. As General Forest, Roaded Natural ROS, forest visitors can engage in most any dispersed recreation activity unless it is specifically prohibited. Few activities are prohibited, with the exception of riding off-highway vehicles (OHVs) and All-Terrain Vehicles (ATVs) on routes that are not designated as National Forest System Roads.

PHYSICAL SETTING – TRANSPORTATION SYSTEMS AND ACCESS

Considerable public use occurs across the national forest as individuals travel through the project area for purposes other than recreation. The best available estimates of public transportation use near the project area are provided by the Missouri Department of Transportation, Transportation Planning (2011). The Missouri Department of Transportation provides estimates of traffic volume reported as average annual daily trips (AADTs), not adjusted for seasonality.

The main traffic corridor through the project area is U.S. Highway 60, which runs east-west. Travel along U.S. Highway 60 in the project area varies from 4,533 AADTs at the intersection with State Route C, to 5,132 AADTs at Fremont, to 5,301 AADTs at Winona. These reported intersection traffic counts yield a mean of 4,989 AADTs across the U.S. Highway 60 travel corridor within the project area.

North-South travel corridors near the project area include State Routes 19, J, and C. State Route 19 at Winona hosts 732 AADTs, and at its southern terminus with U.S. Highway 160, 2,126 AADTs. State Route J has 148 AADTs at Fremont, and 190 AADTs at its southern terminus with U.S. Highway 160. State Route C has 402 AADTs at its intersection with U.S. Highway 60, and 176 AADTs at its southern terminus with U.S. Highway 160. These travelers represent potential recreation demand as they pass through the project area and learn about project actions that would create new recreation opportunities.

The Forest Service does not collect or maintain data on traffic counts and road use of National Forest System roads. Few travelers are likely present on interior forest roads through the week and during the period when project activities such as timber treatments or prescribed fire would occur.

MANAGERIAL SETTING – MANAGEMENT PRESCRIPTIONS AND RECREATION OPPORTUNITY SPECTRUMS IN THE PROJECT AREA

The Mark Twain National Forest 2005 Land and Resource Management Plan classifies components of the project area into Management Prescriptions 1.2, 2.1, and 8.1. The project area is primarily located within Management Prescription 1.1.

Management Prescription 1.1 emphasizes restoration of natural communities while providing a roaded natural recreation experience. This area is classified as Natural Community Restoration, Roaded Natural Recreation Opportunity. The recreation setting is natural appearing, and treatments to vegetation are evident but in harmony with the natural setting (USDA Forest Service, Mark Twain National Forest, 2005b, p. 3-3).

Both Management Prescriptions 1.1 and 1.2 are classified as Roaded Natural Recreation Opportunity Spectrum. The 2005 Forest Plan specifies the carrying capacity for these roaded natural areas as 4.2 recreation visitor days/acre/year for dispersed recreation (USDA Forest Service, Mark Twain National Forest, 2005b, p 2-22).

An area along the eastside of the project area falls within Management Prescription 2.1. Management Prescription 2.1 is managed for multiple use including dispersed recreation and visual quality among other resource. This area is classified as General Forest, Roaded Natural Recreation Opportunity Spectrum (USDA Forest Service, Mark Twain National Forest, 2005b, p. 3-11). The recreation setting is natural appearing, and treatments to vegetation are evident but in harmony with the natural setting (USDA Forest Service, Mark Twain National Forest, 2005b, p. F-4). MP 2.1 emphasizes multiple use resource objectives while allowing for the enhancement of natural communities, improvement of forest health conditions, and roaded natural recreation

experiences; multiple use resource objectives provide developed and dispersed recreation opportunities.

The Big Barren Creek State Designated Natural Area is classified as Management Prescription 8.1, Designated "Special Areas" other than wilderness. Designated special areas exist to protect unusual environmental, recreational, cultural, or historical resources, and for scientific or educational studies (USDA Forest Service, Mark Twain National Forest, 2005b p. 3-49). These areas provide low to moderate use for recreation with a variety of recreation opportunities, and production of other resources, when compatible with the special area designation. Consistent with the 2005 Forest Plan, unless otherwise stated, Management Prescription 8.1 areas are managed under the Roaded Natural Recreation Opportunity Spectrum (USDA Forest Service, Mark Twain National Forest, 2005b, p. 3-52).

The Recreation Opportunity Spectrum guides how the Forest Service provides recreational settings and opportunities for forest visitors, and ranges from primitive to highly developed settings. These recreational settings may be classified as *Primitive, Semi-Primitive Non-Motorized, Semi-Primitive Motorized, Roaded Natural, Rural,* or *Urban*. Each type of setting is then managed in terms of *physical, social,* and *managerial components* as the Forest Service provides a recreation opportunity at a given site for visitors to pursue their desired recreation experience compatible with the respective Recreation Opportunity Spectrum class.

The *physical setting* involves the theme of management, the actual characteristics of the environment, infrastructure, and vegetation). The *managerial setting* is composed of the degree of Forest Service staff presence, regulations, and or other management indicators. The *social setting* refers to the presence of other users, the group size, and so on.

Under the Roaded Natural Recreation Opportunity Spectrum (USDA Forest Service, Mark Twain National Forest, 2005b, p. F-4), the physical setting is natural appearing with nodes and corridors of development such as campgrounds, trailheads, boat launches, and rustic, small-scale resorts, with the setting located within ½ mile of improved roads. For access, all road surfaces are present, though system roads are usually aggregate. The roads fall within the Classified Road System for all types of vehicle use. Fishing sites may be present such as rivers, lakes, and reservoirs with some facilities potentially present. Camp/picnic sites may be present with identified dispersed and developed sites. If present, sanitation facilities consist of developed outhouses that blend with the setting. A water supply may be present and developed.

Signing may be provided and range from signs that appear rustic with natural materials to more refined signs using a variety of materials such as fiberglass or metal. Interpretive signs may also be present as simple roadside signs and or some interpretive displays. Any water crossings consist of bridges constructed of natural materials. Changes (treatments) to the natural vegetation patterns are evident but in harmony with the natural setting. The managerial setting provides recreation visitors an opportunity to be with other users in developed sites. Some obvious signage (information and regulations) may be present and there is a low to moderate likelihood of meeting Forest Service staff. The social setting includes moderate evidence of human sights and sounds, moderate concentration of users at campsites, and little challenge or risk.

The proposed activities are consistent with the 2005 Forest Plan for the management prescriptions of the proposed areas to be treated as well as their designated Recreation Opportunity Spectrum classification and physical, managerial, and social settings.

SOCIAL SETTING – ESTIMATES OF VISITOR USE

The Mark Twain National Forest hosts 874,000 total estimated site visits per year across the entire forest according to National Visitor Use Monitoring data (U.S.D.A. Forest Service, Natural

Resource Manager, 2012). Of these site visits, an estimated 591,000 visits are to General Forest Areas spread across the nearly 1.5 million acre forest.

Most of the recreation use on the Eleven Point Ranger District likely occurs as water-based recreation on the district's rivers and around developed recreation campgrounds and areas. Estimates of visits to the proposed project's General Forest Area are needed, but National Visitor Use Monitoring data and estimates are not available at the project-level.

The Fair Share Approach may serve as a reasonable approach to estimating the number of visits within the project area. The Fair Share Approach seeks to use data from the whole forest to estimate values for a smaller area. National Visitor Use Monitoring data is the best available data from which to estimate recreation visitation in the project area, with the recognition that issues of reliability exist when adapting this data for use other than at the forest-scale.

As of September, 2012, the Mark Twain National Forest included 1,493,565 acres of federal land (J. Fraley, personal communication, November 19, 2013). The number of acres of federal land often changes by small marginal amount as land is acquired or exchanged. As compared to the total acres of federal land across the entire national forest, the project area of an estimated 29,893 acres represents 1/49.96370387 of the total national forest federal land. Using the Fair Share Approach, the 591,000 visits to General Forest Areas across the entire national forest were divided by 49.96370387 which yielded 11,829 expected visits to the project area.

Forest-wide National Visitor Use Monitoring data (U.S.D.A. Forest Service: National Visitor Use Monitoring Program, 2012), suggests that the main recreation activities most likely to occur in the project area include viewing natural features, hiking/walking, relaxing, hunting, viewing wildlife, OHV use, nature study, driving for pleasure, horseback riding, bicycling, gathering forest products, backpacking, and primitive camping. Estimates of visitor use to the project area were made based on these activities only. Activities associated with developed recreation such as campgrounds with facilities, water-based recreation, motorized trails, skiing, etc., are not included in estimates as such infrastructure or setting characteristics are not present on national forest land in the project area.

National Visitor Use Monitoring percentages for "Participation by Main Activity" for activities relevant to the project area were multiplied by the 591,000 visits to General Forest Areas to estimate the number of visits by relevant activity across the forest. As an example, of the 591,000 visits to General Forest Areas, National Visitor Use Monitoring data indicate that 20.8% of people across the forest engaged in Viewing Natural Features as their main activity. Forestwide, it is estimated that 122,928 visits occurred for Viewing Natural Features.

The forestwide values were divided by 49.96370387 to estimate the number of unweighted visits to the project area. As an example, for "Viewing Natural Features," dividing the 122,928 estimated forest-wide visits by 49.96370387 yielded 2,460 as the unweighted expected number of visits to the project area. It should be noted that the relevant unweighted visits do not sum to the expected 11,829 visits.

At the suggestion of Dr. Don English (personal communication, January 7, 2013), USDA Forest Service National Visitor Use Monitoring Manager, the unweighted estimated visits were "normalized" to reflect the expected 11,829 visits via the use of a normalization factor. The normalization factor was obtained by dividing the 591,000 visits across the forest by the 398,334 relevant visit activities which yielded a factor of 1.48368. The normalization factor was then applied to each unweighted expected number of visits to yield the estimated number of visits to the project area.

Table 37 displays data on Mark Twain National Forest Visits and Estimated Fair Share Visits for the project area. This table reflects data on relevant recreational activities that are likely to occur

in the project area. The Fair Share Approach suggests that the project area likely receives 11,829 recreation visits per year.

Table 37. Visits to the Mark Twain National Forest and estimated visits for the Fremont Pineknot East Project Area.

NVUM Main Activity	Part. % as Main Activity	Mark Twain National Forest Visits	Unweighted Proportional Share Expected	Estimated Project Area Visits via Fair Share with Normalization
Viewing Natural Features	20.8%	122,928	2,460	3,650
Relaxing	6.9%	40,779	816	1,211
Hiking / Walking	12.5%	73,875	1,479	2,194
Viewing Wildlife	3.7%	21,867	438	649
Other Non-Motorized	6.5%	38,415	769	1,141
Picnicking	1.4%	8,274	166	246
Driving for Pleasure	1.4%	8,274	166	246
OHV Use	2.2%	13,002	260	386
Hunting	4.6%	27,186	544	807
Nature Study	1.8%	10,638	213	316
Gathering Forest Products	0.7%	4,137	83	123
Primitive Camping	*0.2%	1,182	24	35
Backpacking	0.6%	3,546	71	105
Horseback Riding	1.3%	7,683	154	228
Bicycling	0.2%	1,182	24	35
No Activity Reported	1.7%	10,047	201	298
Some Other Activity	0.9%	5,319	106	158
Total		**398,334**	**7,972**	**11,829**

*NVUM data indicated that 0% of visitors reported primitive camping as their main activity. Staff visits with visitors at hunter camps indicate that numerous relatives or friends engage in primitive camping to be with family or others. For this segment of visitors their main activity is primitive camping, so 0.2% was identified as a reasonable estimate for use in this project.

Estimates may be high in some cases due to the characteristics of the project area. As examples, few natural features such as rock outcrops, water resources, and so on exist in the project. Viewing natural features would likely be most associated with visits to view trees and vegetation during the spring bloom, and again as leaves change colors in the fall.

Wildlife viewing opportunities are limited in the project area due to the lack of openings in the forest, and thick forest areas that limit visual penetration into the forest interior during leaf-on seasons. Similarly, picnicking opportunities are limited due to the lack of forest and absence of picnic tables. OHV and other motorized uses are limited as use is restricted to designated National Forest System roads as allowed by state and local laws.

With the exception of rifle deer hunting season, few recreation visitors are likely present in the project area during weekdays. It is likely that 32 visits or less would occur in the project area on any given day such as a weekday. This visitor estimate reflects the estimated 11,829 visits per year divided by 365 days which yields approximately 32 visits per day. In reality, during much of

the year, there would likely be few or no visitors present in the project area which is particularly true on weekdays when most proposed project activities would occur.

Most recreation visits likely occur during the spring and fall shoulder seasons on weekends and holidays. Most recreation occurs during spring and fall peak periods, such as during hunting seasons or leaf change periods and during moderate weather conditions. Little activity is known to occur during the intense heat of the summer season, or during the cold months of winter. The most readily observed recreation participation in the project area occurs during rifle deer hunting season. During deer season, numerous visitors engage in hunting, primitive camping, riding ATVs on forest roads, relaxing, and so on.

SOCIAL SETTING – ESTIMATES OF ECONOMIC IMPACTS FROM RECREATION

Estimates of visitor spending vary by group and are available at the forest-level for numerous categories such as overnight versus day users, local versus nonlocal users, type of activity, and so on (e.g., Stynes & White, 2005; USDA Forest Service, 2012). Direct visitor spending includes expenditures on items such as fuel, food, lodging, souvenirs, guide fees, equipment rentals and so on associated with the national forest visit. National Visitor Use Monitoring (USDA Forest Service, National Visitor Use Monitoring Program, 2012) visitation and economic data is the best available data from which to estimate visitor spending within the project area. It is recognized that issues of reliability exist when adapting this data for use other than at the forest-scale.

According to the USDA Forest Service National Visitor Use Monitoring (NVUM) Program (U.S.D.A. Forest Service: National Visitor Use Monitoring Program, 2012), most visits to the Mark Twain National Forest were from local visitors, with 57% of visits for day use (these visitors spent $34 per group per trip), 7% as overnight visits on the forest (these visitors spent $167 per group per trip), and 1% as overnight visitors staying off the forest (these visitors spent $172 per group per trip). Non-local visitors (from over 50 miles from home) accounted for 8% of day use (spending $58 per group per trip), 13% of overnight visits on the forest (spending $167 per group per trip), and 3% of overnight visits while staying off the forest (spending $308 per group per trip). The remaining 11% visited the national forest as a non-primary stop as they travelled to their primary destination (spending $219 per group per trip). The average total trip spending per party was $110, and nearly three-quarters of visitors stayed in national forest campgrounds, cabins, or engaged in undeveloped camping on the national forest, with the remainder using other lodging. The average group size was 2.4 people.

Using the previously described data, and presuming visitation of 11,829 visits to the project area with an average group size of 2.4 suggests a direct economic impact of $455,761.51 per year for spending associated with recreation visits to the project area. This estimate may serve as an upper bound of direct economic expenditures for recreation visits to the national forest. This estimate may be high as forest-wide data includes visits to higher-cost areas and activities as compared to the rural project area and dispersed recreation opportunities.

Based on National Visitor Use Data and input from Eric White (personal communication, January 24, 2013), it may be appropriate to assume that 75% of visits is local day use, 11% is not local day use, and 14% is not primary, and per person spending with some day and some overnight users ranges from $10.21-$49.67, with an average of $21.60. Presuming 11,829 visits and the conservative estimate of $21.60 per visit suggests a direct economic impact of $255,506.40 per year from spending for recreation visits to the project area. This conservative estimate may serve as a lower bound of direct economic expenditures associated with national forest visits.

Given the variation between the upper and lower bound estimates, the average of these estimates may serve as a better midrange estimate. The average between the upper and lower bound

estimates is $355,633.96 and serves as a midrange estimate of direct economic expenditures for recreation visits to the national forest project area.

Outdoor recreation generates economic impacts in local economies and has a multiplier effect (Kebede, Schelhas, & Haslerig, 2008). Induced and multiplier effects occur as the newly spent money from recreation circulates through the local economy creating indirect and secondary economic benefits. As an example, each dollar spent on hunting/wildlife viewing in Alabama was found to generate $2.047 in economic benefits, which was reported as being comparable to similar studies (Kebede, Schelhas, & Haslerig, 2008).

For Missouri, economic multipliers for recreation on national forest lands have been reported as 1.95 for hunting and 2.06 for wildlife viewing (American Sportfishing Association, 2007). As a midrange value, it is presumed that each dollar of direct outdoor recreation spending in the project area likely generates $2.00 in economic benefits. A multiplier of 2.00 would suggest that the $355,633.96 in direct economic expenditures from recreation visits to the national forest project area would result in approximately $711,267.91 in total economic benefits.

Participation in outdoor recreation and ecosystems services benefits generates additional benefits and fulfills visitor motivations such as to be outdoors, experience nature, fulfill spiritual benefits, spend time alone or with others, experience challenge, be self-reliant, improve skills, relax or get away from demands, exercise, view wildlife, achieve health benefits, etc. (e.g., Green, Schuster, Graefe, & Cordell, 2012; Lee & Driver, 1999; Moore & Driver, 2005). While not readily quantifiable, many of these benefits or motivations result in economic benefits such as improved health, lower medical expenses, improved quality of life, and so on. These ecosystems services benefits from outdoor recreation have economic value at both the individual and societal levels.

PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS THAT MAY AFFECT RECREATION

PAST ACTIONS WITH RELEVANCE TO RECREATION

Past national forest actions likely have relevance to recreation and the proposed project. Landscape scale vegetation management projects have occurred, and minor management activities continue to occur, in the Van Buren, Handy, Eastwood and Pineknot Project Areas, and other forest areas. These projects involve or have involved various timber harvest methods, firewood gathering, transportation system management, prescribed burning, and other activities similar to the actions proposed in this project. These projects likely have had similar effects on recreation as those described in this analysis.

Potentially affected or displaced recreation users from past projects potentially sought and or seek recreation opportunities in different locations of the same project area or other project areas creating new impacts to those areas such as increased demand, increased number of users, increased environmental impacts, and impacts to the recreational experiences of other users and conflict.

PRESENT ACTIONS WITH RELEVANCE TO RECREATION

Elk are being released in the Peck Ranch Conservation Area, which is near portions of the project area. The Missouri Department of Conservation (MDC) estimates that there will likely be a population of 500 elk sometime between years 2016-2019, at which time elk hunting will begin to be allowed.

The Ozark National Scenic Riverways (National Park Service, 2010) has been engaged in the planning process for its general management plan. The National Park Service is also conducting a wilderness study of an area near Big Spring for potential U.S. Congress designation as Wilderness. Most recently, the National Park Service proposed to develop the Current River Trail

for foot-traffic from the Current River State Park to the Brushy Creek Area. The Ozark National Scenic Riverways is east of the project area.

The project area likely helps meet needs identified in the *Missouri 2008-2012 Revised Statewide Comprehensive Outdoor Recreation Plan* (SCORP) (Missouri Department of Natural Resources, 2008). The Missouri 2008-2012 SCORP reported high regional needs for outdoor recreation facilities, provisions for special user groups, trails, better access roads and transportation systems, and environmental protection of water, soil, and fish and wildlife habitat. Further, the plan reported relevant community recreation needs that included walking trails, bicycle trails, equestrian trails, nature trails, and multipurpose trails, and campsites.

Beyond activities by other agencies in the local area and area needs, technology has created new challenges in outdoor recreation management. ATVs and other motorized and mechanized transportation (e.g., mountain bikes) enable visitors to travel deeper into the forest, often where no routes exist (e.g., Moore & Driver, 2005). These means of transportation promote user-created trails, environmental impacts and conflicts with other recreation visitors seeking remote experiences (e.g., Moore & Driver, 2005).

Inventions such as cell phones, GPS, and personal locator beacons encourage visitors to venture into remote areas (e.g., Moore & Driver, 2005). Many of these visitors lack outdoor knowledge, skills, and gear which can result in increased emergency incidents requiring agency response. Impacts from the development and use of new technology are likely to continue to evolve as visitors acquire new devices and begin to recreate in new ways.

FUTURE ACTIONS WITH RELEVANCE TO RECREATION

Landscape-scale projects will likely continue in the future and have similar impacts as the current and past projects. Substantial demand and participation in outdoor recreation may emerge on this national forest as people learn about recreation opportunities on national forest lands.

There will likely be increased demand for resources and outdoor recreation participation in the future. Forest Service research (U.S.D.A. Forest Service Southern Research Station, 2006) indicates that substantial demand for outdoor recreation exists within 75 miles of the Mark Twain National Forest. Recreation demand by activity category for the area near the Mark Twain National Forest ranges from 350,000-3,000,000 people (U.S.D.A. Forest Service Southern Research Station, 2006). This demand includes the activity categories of: viewing and photographing scenery, wildlife, and vegetation, etc.; sightseeing; gathering non-timber forest products such as mushrooms, berries, etc.; visiting a primitive area; day hiking; driving off-road; hunting; mountain biking; primitive camping; horseback riding; and backpacking.

According to the *Missouri Statewide Comprehensive Outdoor Recreation Plan 2013-2017* (Missouri Department of Natural Resources, Missouri State Parks, & Synergy/PRI/JPA, 2013), more than half of Missourians expect to increase their participation in outdoor recreation over the next five years. Missourians expect to increase their participation in bicycling, fishing, wildlife/outdoor photography, hiking, horseback riding, walking, target shooting, hunting, wildlife observation/birding, backpacking, driving for sightseeing, picnicking, and ATV/off-road riding. Missouri Parks and Recreation Professionals expect a significant increase in demand for trails, and increased needs for picnic areas, nature parks, camping sites, hunting sites, and target shooting sites (Missouri Department of Natural Resources, Missouri State Parks, & Synergy/PRI/JPA, 2013).

As the region's population grows, and demand for outdoor recreation increases, there would be likely be increased visitor use on the national forest along with increased environmental impacts and user conflict. Studies show that increasing visitation generates larger groups, increased crowding, decreased solitude, more competing uses, increased conflict among recreation users,

and increased environmental impacts (e.g., Hammitt & Cole, 1998; Manning, 1999; Moore & Driver, 2005).

EFFECTS OF CLIMATE CHANGE ON RECREATION

Climate change is likely to result in effects on outdoor recreation on the Mark Twain National Forest. The length of recreation seasons are likely to extend and participation increase for several activities including bird watching, camping, hiking, horseback riding, motorcycle riding, mountain bike riding, off-road vehicle use, picnicking, and sightseeing (Alig, 2011; Brandt et al., 2014; Irland et al., 2001; Nicholls, 2012). In contrast, fall leaf color changes may become less vivid, dimmer, change later in the season, and change in an uncoordinated display (Bloomfield et al., 1997) which would likely impact visitation to view leaf color change.

Elevated temperatures would be associated with changes in species, increased pests, pathogen outbreaks, increased tree mortality, and fires (Bloomfield et al., 1997; Sasidharan, 2000; Wildlife Management Institute, 2008). Changes to the distribution and composition of natural resources would likely make forests less attractive and degrade the outdoor experience for activities such as viewing, photographing, fishing, and hunting (Bloomfield et al., 1997; Nicholls, 2012; Wildlife Management Institute, 2008). As an example, forage for big game is expected to be of lower quality, less nourishing and less digestible (Wildlife Management Institute, 2008). Changes in habitat, species, and decreased wildlife populations would likely result in the displacement of recreationists (Sasidharan, 2000).

Increased heat and humidity, precipitation, and insects and pests may decrease human comfort and reduce demand (Bloomfield et al., 1997; Brandt et al., 2014; Irland et al., 2001; Nicholls, 2012; Osman-Elasha et al., 2009; Sasidharan, 2000; Wildlife Management Institute, 2008). Frequent and or severe storm precipitation events during the spring could create unpleasant conditions, increase risks for flash flooding, and threaten recreationists, campsites and trails (Bloomfield et al., 1997; Brandt et al., 2014; Nicholls, 2012; Osman-Elasha et al., 2009; Sasidharan, 2000). Extreme climate conditions may make participation in some outdoor activities dangerous (Brandt et al., 2014).

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions, Present Actions of Relevance,* and *Reasonably Foreseeable Actions of Relevance.*

DIRECT AND INDIRECT EFFECTS ON RECREATION

The proposed project area is located on national forest lands classified under the 2005 Forest Plan as *General Forest Areas*. Visitors to General Forest Areas engage in various recreation activities including hiking/walking, relaxing, hunting, viewing wildlife, OHV use, nature study, driving for pleasure, horseback riding, bicycling, gathering forest products, backpacking, and primitive camping as indicated by National Visitor Use Monitoring data (U.S.D.A. Forest Service, Natural Resource Manager, 2012).

The effects of the proposed activities will vary by type of recreational user group and what they do on the forest. Some recreational user groups will be affected positively while others will be affected negatively by timber harvest, clearing, road activities and other activities (Harshaw & Sheppard, 2003; Levine & Langenau, 1979).

Visitors that travel into the interior of General Forest Areas may experience similar effects as visitors who engage in trail-based activities for many recreation activities. Therefore, *Trail-Based Recreation and General Forest Recreation* will be considered together.

Trail-based recreation activities typically include hiking/walking, horseback riding, bicycling, and backpacking. Trail-based recreation occurs on portions of the *Ozark National Recreation Trail*

that traverses a portion of the project area. Recreation visitors may walk, hike, backpack, or horseback ride on the *Between the Rivers Section*, and hike or backpack only on the *Current River Section*. These trail-based activities are somewhat related and include user groups that may experience similar effects from the proposed action. As such, these trail-based activities are analyzed as a group.

Postings on the *Ozark Trail Association's* (n.d.) OT Forum Web bulletin boards include hiker comments about downed trees on the trail, overgrown areas, issues with trail signs and markers, smoke from prescribed fire, and burned areas. Although the comments are a few years old and address the trail as a whole or sections outside the project area, they do illustrate concerns of trail users that are considered and addressed in the proposed action.

The term General Forest Recreation will be used for recreation by visitors to General Forest Areas. General Forest Recreation is typically similar to activities that visitors engage in while enjoying trail-based recreation. General Forest Recreation activities may include activities such as hiking/walking, relaxing, viewing wildlife, nature study, horseback riding, gathering forest products, and primitive camping. As such, visitors to General Forest Areas for General Forest Recreation are considered in conjunction with trail-based activities.

Many visitors to the project area engage in hunting as their primary activity, as such, *Hunting* will be considered on its own. Deer hunting likely accounts for a majority of recreation use within the project area, with high use occurring during both archery and firearm seasons. The project area also accommodates turkey and small game hunting.

The public use of roads is considered in response to public concerns expressed during Scoping. Public use is presumed to mean the public use of public roads through the project area and National Forest System Roads. The public use of roads is of concern for the public, and many visitors engage in driving for pleasure as a primary recreation activity. The *Public Use of Roads and Driving for Pleasure* are similar and will be considered together.

ALTERNATIVE 1 – NO ACTION

Under Alternative 1, the No Action Alternative, existing resource and setting conditions would continue to degrade within the project area. Red oak decline would continue creating dead and dying oak trees. Areas of dense growth would continue as well. The forest area would continue to grow dense until a natural event such as a windstorm develops openings. The dense growth of vegetation would continue degrading views, develop ladder fuels, and create hazard trees and hazardous fuel conditions. This growth would continue in the absence of resource management actions. Hazardous fuel buildup may lead to conditions for catastrophic wildfire, imperil recreationists, and endanger forest resources.

Under Alternative 1, visual penetration and the ability to see wildlife and sightsee would likely continue to degrade. Few open areas exist in the project area or along the Ozark National Recreation Trail and vegetation would likely grow denser. As openings and canopies close, visitation would likely decline as areas begin to look like a 'forest' (Englin, Loomis, & González-Cabán, 2001, p. 1843).

Limited views, low visual penetration, and a lack of unique natural features and wayfinding indicators would likely further degrade. These degraded conditions are often associated with low levels of psychological interest and perceptions of discomfort, boredom, fear, and lack of safety (e.g., Appleton, 1975; Gobster, 2001; Hill & Daniel, 2007; Kaplan et al., 1998; Tlusty & Bacon, 1989). Over time, some visitors may displace and substitute activities, locations, or use times (e.g., Hall & Cole 2007; Manning, 1999; Schneider, 2007).

Roads would continue to degrade and create environmental impacts. Deteriorating roads may reduce access, increase wear and tear on vehicles, and generate concerns about safety. Further, the existence of trash dumps would likely expand and encourage additional dumping of trash.

Illegal roads and trails would continue to exist and likely expand. Impacts to natural resources, wildlife and the public would likely increase. The existence of illegal roads and trails would encourage more illegal use worsening the scale and extent of these illegal travelways. These user-created trails would increase damage to resources, disruption of wildlife, and degradation of the recreational experiences of other user groups (e.g., Hammitt & Cole, 1998; Hunt et al., 2009). They would also be likely to be used for poaching, illegal drug activity, arson and other illegal behaviors (e.g., Hunt et al., 2009; Manning, 1999; Moore & Driver, 2005).

Effects of the No Action Alternative on Trail-Based Recreation and General Forest Recreation: Areas along the proposed re-route of 1.4 miles of the Ozark National Recreation Trail contain numerous dead and dying red oak trees. The area contains hazard trees and downed timber that presents hazards to hikers and other trail users. Resource conditions would continue to deteriorate and negatively impact visitor access, safety, and satisfaction. As examples, trees and limbs grow into or over the trail blocking trail travel and or creating safety problems. Hazard trees also develop that could fall and block trails and or endanger recreation visitors. This segment of the trail is also located along the top of the ridge which does not support proper water management and trail impacts from water will worsen over time (W. Scott, personal communication, July 31, 2013).

Effects of the No Action Alternative on Hunting: Under Alternative 1, the forest would continue growing under successional processes to climax conditions reducing hunting opportunities for several species such as deer and turkey. Climax forests are associated with lower populations of deer and certain other game animals. These lower populations are due to having less suitable habitat available. Hunter harvest opportunities would be expected to decrease for deer and some other species as the forest moves toward climax conditions. Squirrel and other late-successional stage or climax forest-associated species would benefit, and present hunting opportunities for those species.

Effects of the No Action Alternative on the Public Use of Roads and Driving for Pleasure: Opportunities to sightsee and view wildlife would likely continue to degrade with ongoing forest growth. In addition, roads would continue to deteriorate likely reducing access. Forest visitors may experience increased wear and tear on vehicles when travelling deteriorated roads.

ALTERNATIVE 2 – PROPOSED ACTION

RECREATIONAL IMPROVEMENTS AND AMENITIES

Trail users of the Ozark National Recreation Trail would benefit from the reroute of the trail. The trail reroute would avoid an area of dead and dying trees that may endanger visitors and detract from the recreation setting. Both trail users and the environment would benefit from relocating the trail segment to an area that allows proper water management (Hammitt & Cole, 1998).

There would likely be minimal disruptions associated with these recreation amenities. Activities may involve the removal of some trees with chainsaws. The use of specialized light equipment and hand tools may be used in the reroute of the Ozark National Recreation Trail. Trucks and light tractors may be used to transport and place gravel as needed. Project activities may have effects similar to light road construction with temporary delays at the sites and dust. These activities would likely occur during weekdays, be of short duration, and have limited visual or audible effects.

Project activities associated with recreational amenities would provide positive benefits to the public. The project effects are short-term and limited in scope with low potential for significant cumulative effects. The proposed actions would enhance recreational access and the recreation setting and opportunities.

Effects of Recreational Improvements and Amenities on Trail-Based Recreation and General Forest Recreation: The 1.4 mile long reroute of the Ozark National Recreation Trail would benefit trail users.

Effects of Recreational Improvements and Amenities on Hunting: Activities associated with the Ozark National Recreation Trail would likely have minimal effect on hunters. Activities would not likely occur during hunting season. Further, the effects of the activities would not likely extend beyond the specific sites where activities were conducted.

EFFECTS OF RECREATIONAL IMPROVEMENTS AND AMENITIES ON THE PUBLIC USE OF ROADS AND DRIVING FOR PLEASURE: FOREST VISITORS WHO TRAVEL THROUGH THE PROJECT AREA WOULD BENEFIT FROM THE PRESENCE OF SIGNS WITH INTERPRETIVE INFORMATION ABOUT PROJECT ACTIONS.

SILVICULTURAL TREATMENTS

Silvicultural treatments have the potential to enhance opportunities to view scenery, wildlife, wildflowers, and trees. Timber harvest creates forest openings, generates edge habitat around the perimeters of openings, and provides conditions to generate a diversity of new habitat and browse within the harvest area. Creating openings in the forest canopy promotes forbs, grasses, and shrub that support wildlife and wildlife viewing opportunities. Shade intolerant vegetation and wildflowers move into the open areas and species richness and diversity increases. Increased opportunities would likely develop to view wild flowers, natural features, and wildlife, and visitor satisfaction would likely increase.

Silivicultural treatments would increase visual penetration into the forest. Vegetation management and increased visual penetration would likely increase perceptions of visual interest, comfort, and safety (e.g., Appleton, 1975; Gobster, 2001; Hill & Daniel, 2007; Kaplan et al., 1998). These actions would likely improve the recreational setting, recreational experience, and visitor satisfaction. As visitor satisfaction increases and the public learns about improved views and recreation opportunities, visitation may likely increase.

In Alternative 2, conducting silviculture treatments would increase recreational opportunities for dispersed camping, nature viewing, photography, and wildlife viewing and hunting opportunities. Wildlife-oriented recreationists (e.g., hunters, wildlife photographers, and birders) seek wildlife habitat and understand that removing vegetation increases wildlife visibility (Gobster, 2001; Hunt, Lemelin, et al 2009; Levine & Langenau 1979). Many wildlife species would migrate into the open areas and increase population as new browse emerges and they are drawn to “edge” areas where vegetation types and densities merge (Bolen & Robinson, 2003; Gobster, 2001). Early successional habitat becomes wildlife habitat for many species and “recreation habitat” for visitors (Gobster, 2001, p. 478).

Visitors to General Forest Areas would benefit from silvicultural treatments through increased recreational access and greater opportunities to view wildlife and natural features. New entry areas, temporary roads, log landings, and trails increase recreational access and use, increase visual penetration, and make it easier to observe wildlife and harvest game (Hunt, Lemelin, et al., 2009; Hunt, Twyanam, et al., 2000). These travelways provide easier access than walking through dense forest (e.g., Hunt, et al., 2000; Hunt, et al., 2009). Hikers, bikers, horseback riders, and other recreational visitors often use new openings to travel into the forest interior.

Under Alternative 2, recreation visitors would experience some temporary negative impacts during, or as a result of, implementation. Some forest areas used for outdoor recreation may be temporarily unavailable or closed during proposed resource management actions. These temporary delays or closures may be necessary for visitor safety and resource work. Such actions may occur during the creation of temporary logging roads and landings, silvicultural treatments, site preparation, and transporting timber to the mill.

Timber harvest operations occur as part of silvicultural treatments. The project would likely include 22-24 sale areas that would have harvests initiated over the next 10 years. Harvests would likely be distributed across a ten year period. The typical harvest area is approximately 200-300 acres in size and yields about 1 MMBF (million board feet). There is typically 2-4 timber harvest areas sold per year, and typically in different parts of the project area. As such there may be 2-4 timber harvest sites active at any one time, but in most cases they will likely be separated 2-6 miles apart.

Causal analysis of proposed project activities and timber harvests from a recreation perspective suggests effects to recreation resulting from the build-up of existing roads, creation of temporary roads, creation of openings for log landings, timber harvest, dust and smoke from harvest activities, transporting timber to the mill, and audible and visual effects from timber operations and openings in the harvest area.

Prior to timber harvest, forest roads are inspected and may be built-up to current Forest Service engineering standards to support the heavy equipment and trucks used in timber operations. Potential build-up of existing roads may involve trucks and heavy equipment used in road improvement. This road build-up may involve making some areas temporarily unavailable for recreation visitors or closing areas as construction is conducted. Visitors may observe trucks and heavy equipment; hear sounds from the construction, and experience dust resulting from construction activities.

During the creation of temporary roads, openings for landings and timber harvest activities, visitors may experience temporarily unavailable areas or closures, timber harvest traffic, and the sights and sounds of heavy equipment such as bulldozers and chainsaws. Temporary roads are created into the forest area where timber harvest will occur, often with the aid of bulldozers and chainsaws. Openings within the forest area to be treated are created for log landings with bulldozers and chainsaws as locations to which logs are transported and as areas in which booms or loaders load logs onto semi-trailer truck log transports. Some landings and openings may support future recreational use as parking areas and camp areas (DeByle, 1985).

Timber is cut in the respective treatment area with chainsaws and typically transported to the log landing via a tractor, bulldozer, or skidder. Trucks then transport the harvested logs to the mill over the temporary roads and existing Forest Service roads. During the transport of logs to the mill, visitors may encounter large semi-trailer trucks from the harvest site(s) across Forest Service and public roads as trucks transport logs to the mill. Harvest activities typically occur on weekdays.

The normal operating season on the Mark Twain Nation Forest is from April 1 to November 30. The normal operating season is a contract term used to determine contract adjustment days and extension opportunities if or when they are needed. Contractors may be allowed to operate outside of the normal operating season, but only with permission and when the ground is frozen or dry. Such cases could occur in an unusually dry winter, dry periods of winter, or if the ground is frozen. Many times, operators will work during the mornings throughout the winter, until the ground begins its daily thaw.

Some locations within the project area would be subject to recurring vegetation management activities. Beyond the initial timber harvest, 2,379 acres of timber designated for salvage sanitation harvest and timber stand improvement would be subject to additional mechanical and/or hand tool treatments over the next 15 years. These post-harvest treatments may negatively impact various recreation user groups as these follow-up activities are conducted using chainsaws, tractors, and other equipment that generates sights and sounds associated with timber management activities.

Most of the resource management activities would use equipment similar to that used for construction and have similar impacts to recreation users. During timber harvest and other project activities, visitors may observe and hear heavy equipment. These various activities would generate dust, smoke from some equipment, and audible and visual effects. People tend to view the sights and sounds of logging and logging vehicles and industrial vehicles as undesirable (Hunt, Twynam et al., 2000).

The California State Board of Forestry and Fire Protection (2008) analyzed the effects of sounds from timber harvest in its Final Environmental Impact Report [EIR] for the Jackson Demonstration State Forest Plan. (See the link entitled "Noise," under Part VII - Resource Specific Analysis of the Web page.) That analysis included a variety of D7 and D8 Bulldozers, Caterpillar 325 loaders, and chainsaws, during active timber harvest operations. The California State Board of Forestry and Fire Protection EIR reported sound levels of between 68 and 83 decibels dBA Leq at a distance of 50 feet. The EIR (Page VII 12-6) reported comparable sounds as including: Auto (60 mph) at 100 feet—65 dBA; Vacuum cleaner at 10 feet—70 dBA; Electric Lawn Mower at 3 feet—85 dBA; and Food blender at 3 feet—90 dBA.

The EIR notes that sounds have the potential to affect sensitive receptors and recreation areas (i.e., recreational users, trails, scenic vistas, camping areas, habitat, and rural residents near timber harvest or road maintenance activities). There may also be certain times in which specific user groups are more sensitive to sounds from project activities. As examples, when hunters are afield during deer and turkey seasons, they are likely to be sensitive to sounds from project activities. However, many logging operations shut down in this region during key hunting seasons, such as during deer season. The EIR notes that the sound level is reduced by one-half with a doubling of distance between the source and the receptor.

Sounds may be generated by chainsaws, dozers, loaders, skidders, logging trucks, and other vehicles during timber operations. Sounds associated with project activities, while potentially substantial in the immediate vicinity of timber activities, would typically be separated by time and space from recreation visitors. Project activities would primarily occur during the week, and most recreational use occurs on weekends. Further, these sounds would likely be attenuated by surrounding trees, soft earth, and topographical surfaces (California State Board of Forestry and Fire Protection, 2008). The impact of sounds to recreational users should be minimal and have only short-term impacts.

Some campers may experience negative impacts from timber harvest. It is estimated that 1-2 dispersed camp sites may be affected per active timber sale area. These campsites may be unavailable during the life of the sale and or silvicultural treatments. Further, the recreation setting in harvest and or treatment areas would be physically and visually different following timber harvest.

Some visitors may view silvicultural treatment areas negatively. People tend to view logged settings as undesirable when seeing evidence of logging, being in a logged area or recently clearcut forest, hearing sounds of logging and vehicles, and encountering industrial vehicles (Hunt, Twynam et al., 2000). Many recreation users typically prefer large mature trees with a lush

understory and open midstory with good visual penetration (Gobster, 2001). Clearcuts and slash debris on the ground generates negative visual impacts (Gobster, 2001).

Timber slash and debris that remains on the ground has the potential to negatively affect hikers, horseback riders, and other recreation visitors who travel into the forest interior. Recreation visitors often travel into the forest interior to camp, use the restroom or for similar purposes. The presence of slash and debris may affect visitors' visual perceptions, but more importantly, affect visitor movement. While some recreation visitors may find slash as a negative impact, others may perceive it as a positive impact as cover and habitat for wildlife. From a management perspective, slash and debris at some locations can restrict illegal and unauthorized motorized use. Also, slash and debris can be used to restrict user-created trails.

The amount and type of debris and or slash that remains at treatment sites vary by timber harvest treatment as do the potential effects (S. Robinson, personal communication, October 30, 2013). Thinning would not likely impact users the next day, while many visitors would not want to traverse an area for at least five years following regeneration harvests and clearcuts (S. Robinson, personal communication, October 30, 2013). Large diameter materials may impacts some users for 10-15 years when left on the ground (S. Robinson, personal communication, October 30, 2013).

Some recreation visitors may perceive certain harvest treatment areas as visually unacceptable in the years and decades following timber harvest (e.g., Bolen & Robinson, 2003; Gobster, 2001; Tlusty & Bacon, 1989). As an example, a study in British Columbia, Canada, found that in that geographic area and vegetation type, it would take 28 years for effective green-up to the point at which restoration efforts were visually acceptable to visitors and major aesthetic signs of timber harvest activity would be less evident (Harshaw & Sheppard, 2003).

Studies have shown visual acceptability of green-up and vegetation for most visitors within 15-30 years following treatment (e.g., Gobster, 2001; Harshaw & Sheppard, 2003; Pâquet & Bélanger, 1997). As an example, Pâquet and Bélanger (1997), in a study in Quebec, found that landscapes became acceptable for most groups when the vegetation reached a height of 4-7 meters which required 15 years for balsam fir/white birch. They also found landscapes as being acceptable to all users when the vegetation reached a height of 7-12 meters or taller. Similarly, Gobster (2001) notes that ratings of aesthetic preference rise quickly in two decades after cutting.

According to district foresters, for this geographical area and vegetation types, recreation visitors would likely find regrowth and green-up visually acceptable within 15-20 years following silvicultural treatment at specific areas (S. Maijala, personal communication, October 30, 2013; S. Robinson, personal communication, October 30, 2013). In their view, signs of harvest degrade relatively quickly in this geographic area.

During this project, timber harvest would likely be initiated over the next 10 years, with harvests being distributed across the ten year period. Visual impacts associated with the first specific sale area(s) could begin as early as the first year of project initiation and may last through project years 15-20 but not likely later than year 30 following completion of the first timber harvest(s). Visual impacts associated with the last sale area(s) with harvest that could occur as late as year 10 may last through project years 25-30 but not likely later than year 40 following completion of the last timber harvest(s). Implementation of other sale area harvests and visual effects would occur within this bounded time range.

The Mark Twain National Forest 2005 Land and Resource Management Plan (USDA Forest Service, Mark Twain National Forest, 2005b) specifies management direction for slash and debris in General Forest Areas. Slash and debris may exist at heights of 24 inches within the "near foreground" at distances of 0 to 300 feet of trails, and 30 inches or more at longer distances from

the trail and in other forest areas. The *Visual Resources* section describes visual mitigation practices, such as the management of timber slash and residual debris along forest roads.

During implementation of project activities, the Forest Service typically applies mitigation measures that minimize the visual impacts of timber harvest. Feathering, thinning, selective tree harvest, or no harvest is often used to reduce impacts as harvests approach campsite areas and other sensitive areas (DeByle, 1985; Pâquet & Bélanger, 1997). Such actions help preserve the character of the campsites and reduce impacts associated with high place attachment (Hammitt & Cole, 1998; Krueger & Williams, 2007; Manning, 1999; Schroeder, 2007).

The extent of visual effects would reflect topographical conditions of the harvest sites and surrounding viewshed(s). Visual effects would be confined to the specific harvest sites for areas located in relatively flat terrain surrounded by mature forest. For harvest sites surrounded by higher elevations such as ridges and hills, the harvested sites may be visible at a distance and from various viewpoints. Similarly, harvest sites on elevated areas such as ridges and hilltops may be visible at a distance across the viewshed.

Recreation visitors who camp or engage in other recreation activities at a perceived “special spot” may experience negative emotional impacts from changes to the site and or access. These emotional impacts are associated with “place attachment” to the site or area (Hammitt & Cole, 1998; Krueger & Williams, 2007; Manning, 1999; Schroeder, 2007). Changes to forest areas and sites perceived as special may negatively affect visitor satisfaction, past memories, emotional bonds to the site, and their relationship with the agency.

Due to changes at particular sites, some recreation visitors may seek substitute activities, alternate use times, engage in coping strategies, and or displace to other locations (Hall & Cole, 2007; Manning, 1999; Schneider, 2007). Some visitors may substitute different activities and or locations or simply forego the desired or similar recreation activity due to displacement (Hall & Cole, 2007; Manning, 1999; Schneider, 2007). As examples, sightseers, mountain bikers, hikers, horseback riders, multi-day backpackers, and members of environmental or outdoor clubs often seek undisturbed areas, have low tolerance for timber harvest and are displaced (Hunt, Twynam, Haider, & Robinson, 2000; Langenau, O'Quin, & Duvendeck, 1980).

Displacement may occur as some recreation users shift use from one site to another, or to sites outside the project area. Displacement in recreational use to other locations may negatively affect users at the new site generating user conflict. User conflict occurs between recreation user groups with incompatible goals, social values, activities, or impacts; users in the same group vying for the same space at the same time; and with increased recreational use and impacts to natural resources (Cordell & Tarrant, 2002; Hammitt & Cole, 1998; Hunt, Lemelin, & Saunders, 2009; Manning, 1999).

Displacement from the project area would likely be minimal, as would the associated impacts to other public lands or users in the area. Few areas would be treated at the same time. Areas would likely recover within 15 years following treatment. Hunters likely represent the largest group of visitor that would travel into the forest area, and most would perceive these treated areas as improving habitat and increasing opportunities to view wildlife. Many other wildlife-oriented visitors would likely have similar perceptions. For those visitors that due displace, they would have expansive area within the project area that would offer similar recreation settings and opportunities.

Most project effects are short-term and limited in scope with low potential for significant cumulative effects. The proposed actions would enhance recreational access, the recreation setting and opportunities, and would ultimately be likely to increase outdoor recreation demand and participation within the project area.

EFFECTS OF SILVICULTURAL TREATMENTS ON TRAIL-BASED RECREATION AND GENERAL FOREST RECREATION

Trail users of the Ozark National Recreation Trail would benefit from the implementation of silvicultural activities in that area. Silvicultural treatments would remove dead and dying trees that may endanger visitors and detract from the recreation setting.

Forest visitors pursuing General Forest Recreation would benefit from silvicultural treatments. Hikers, mountain bikers, horseback riders, and those engaged in viewing would benefit from decommissioned roads as new routes that they could use to access the forest interior. These visitors as well as those engaged in photography, gathering, and similar dispersed recreation would benefit.

General Forest Areas that receive silvicultural treatments may support future primitive campsites. Screening and hiding cover that is retained in these areas enhance user sites in semi-primitive, roaded natural or rural settings (Tlusty & Bacon, 1989). Treatments along roads and trails may benefit some visitors as trail users tend to prefer heterogeneous landscapes with some early successional habitat and mature forest (Gobster, 2001).

Silvicultural treatments and early successional habitat would increase visual penetration and opportunities for sightseeing and wildlife viewing. Visitors would likely experience increased visitor interest, satisfaction, and perceived safety and comfort. Silvicultural treatments and early successional habitat would enhance the recreation setting, recreation experience, and visitor satisfaction for General Forest Recreation.

EFFECTS OF SILVICULTURAL TREATMENTS ON HUNTING

Conducting silvicultural treatments and creating open areas would increase the number of game wildlife and opportunities to view and or hunt wildlife. New entry areas, temporary roads, log landings, and trails increase recreational access and use, increase visual penetration, increase wildlife habitat, and make it easier to observe and harvest game (e.g., Gobster, 2001; Hunt, Lemelin, et al., 2009; Twynam, et al., 2000; Langenau, et al., 1980; Levine & Langenau, 1979).

The creation of openings promotes forbs, grasses, and shrubs that serve as deer browse and supports other wildlife. During years 1-10 following timber harvest, early seral stage habitat of forbs, grasses, and shrub are beneficial to deer, turkey, and other game (DeByle, 1985). Nutritious forage may be available and of benefit for up to 20 years following timber harvest (e.g., Bolen & Robinson, 2003; DeByle, 1985; deCalesta & Stout, 1997; Gobster, 2001; Langenau et al., 1980). Wildlife viewing and hunting opportunities would likely match the period of optimal habitat and game populations.

Timber harvesting and thinning increases deer forage and relative deer densities (deCalesta & Stout, 1997). Silviculture treatments and resource management activities that produce mixed forest communities, herbaceous and shrubby understory, and grasslands in patches of 10-40 acres typically serve as desirable deer habitat while patches of 25-60 acres serve as desirable elk habitat (DeByle, 1985).

Wood debris and slash that remains on the ground can impede travel, but many hunters would view the slash as cover and habitat for deer and other game. Many deer hunters would likely seek these edge habitat areas and openings as desirable hunting locations.

Many hunters engage in dispersed camping in openings in forest areas that were formerly used as logging areas, skidding areas, or as remnant open areas that remain from temporary roads that were decommissioned. Hunting camps often also include non-hunters as family and friends who participate in camping for social or family reasons. Hunting camps are often used for prolonged

periods of time during the hunting season, and typically for 2 weeks or more at the site. Hunting camps typically involve the use of travel trailers, campers, and tents.

During actual timber harvest, it is estimated that 1-2 dispersed camp sites used by deer hunters, with possibly 6-8 hunters per camp, may be affected per active timber sale area. Presuming that the project will include 22-24 sale areas, it is estimated that a bounded range of 132-384 hunters may be affected during the various harvests over the life of the project. Many hunters associated with the harvested sites would likely return in the season(s) following harvest as herbaceous and shrubby understory, forbs, and grasses emerge and attract deer.

EFFECTS OF SILVICULTURAL TREATMENTS ON THE PUBLIC USE OF ROADS AND DRIVING FOR PLEASURE

Alternative 2, the Proposed Action, would increase opportunities for sightseeing and wildlife viewing which is often associated with the use of roads and driving for pleasure. Vegetation management and increased visual penetration would increase perceptions of visual interest, comfort, and safety (e.g., Appleton, 1975; Gobster, 2001; Hill & Daniel, 2007; Kaplan et al., 1998). Visitor satisfaction would likely increase as visual opportunities increase.

Some travelers and recreation visitors may have potential concerns regarding the effects of transportation impacts of proposed resource management activities. The California State Board of Forestry and Fire Protection (2008) analyzed the effects of transportation and traffic from timber harvest in its Final Environmental Impact Report [EIR] for the Jackson Demonstration State Forest Plan. (See the link entitled “Transportation and Traffic,” under Part VII - Resource Specific Analysis of the Web page.)

The EIR found that most logging traffic volume occurred in the morning hours and concentrated before 8 AM as trucks leave the harvest site with timber harvested the day before. After that peak, truck travel was then spread throughout the day with 1-2 trucks departing per hour, with volume based on season and market conditions. The EIR analysis was conducted for a 2 MMBF (million board feet) level, with an average log truckload of 4-5 MBF (thousand board feet), and 400-500 trips per year, spread over a typical season of 150 days between April and October, and 3 log truck trips per day.

It is anticipated that 2-4 timber harvest sites would be active for this project at any one time, with each site likely yielding 1 MMBF (million board feet). Each harvest site may be expected to generate at least 1-2 truckloads of timber per day, and project area-wide a total of up to 8 log truckloads per day. In practice, sales are typically conducted on opposite sides of the project area.

During the week, recreation visitors may encounter 1-3 semi-trailer trucks on forest roads leading from a specific harvest site to the mill. Logging trucks primarily operate during the week and most recreation use occurs on weekends. The level of traffic generated by logging trucks would not likely be significant, either individually or cumulatively, as the trips are spread out over the day and on different travel routes from other harvest areas.

Conflict would be minimized and mitigated via signage. Timber sale contracts specify safety and mitigation methods that require traffic control warning signs at road intersections of the affected county and state roads during the life of the sale. The signs notify and inform other road travelers and recreation users of timber harvest activity to promote public safety.

Potential conflict among travelers or recreation users and silvicultural activities and log trucks is likely to be low. Recreation and timber traffic trips would likely be separated in time and space. Timber traffic would most likely occur during the mornings and early afternoons on weekdays. In contrast, weekday recreation visitors would likely travel in the late afternoon and evening after work or school. Further, most recreation use will occur on weekends versus timber harvest

activities that typically occur during the week. Also, project activities would be spread out over the course of weeks, months, and years. Many activities would be conducted during short periods of time which would likely minimize project effects during specific time periods.

CHEMICAL SITE PREPARATION

Up to 1,219 acres could receive chemical stump treatment for pine planting and natural pine regeneration. This treatment would include the application of Triclopyr (e.g., Garlon™ 3A, Garlon™ 4) directly to cut stumps and foliar application to small wood oak sprouts to increase. This chemical application would likely increase the success of pine planting and pine regeneration.

Timber stands and areas treated with herbicide would likely be temporarily unavailable to forest visitors and recreationists until the herbicide dries or breaks down. Visitors would likely have to delay entry into the specific treated areas, or select a substitute location. " . . . Areas that have been treated with chemicals will be closed to visitors during and immediately after the treatment, in accordance with standard re-entry times for those chemicals" (USDA Forest Service, 2012, p. 142).

"There is very little risk that the public may unknowingly come into direct contact with treated vegetation" (USDA Forest Service, 2012, p. 160). "All sites and areas that are treated with herbicide would be posted to inform forest visitors what herbicide was used, when it was applied and how long the herbicide would persist in the area before breaking down" (USDA Forest Service, 2012, p. 137). Following treatment, odors from chemical herbicides may persist at spray sites for several days, but would likely dissipate prior to the entry of forest visitors. "Dead vegetation would be noticeable for several days to several weeks . . . ." (p. 137). Treatments that occur during the fall would not be visually noticeable, and treatments that occur during other seasons would likely be noticeable for one growing season or less.

The use of Triclopyr and other herbicides were analyzed in the Mark Twain National Forest's *Final Environmental Impact Statement: Integrated Non-native Invasive Plant Control* (USDA Forest Service, 2012). That document reported that "risk assessments showed no indications of risk to the general public" (USDA Forest Service, 2012, p. 159). Herbicides are 'considered safe when used in accordance with label direction" (pp. 155-156).

Potential health effects from exposure to Garlon® 4 Ultra Herbicide include slight eye irritation, moderate skin irritation, drying and flaking, but prolonged skin contact is unlikely to result in absorption of harmful amounts (Dow AgroSciences, 2007, p. 1). Triclopyr can cause eye irritation and skin irritation, has been found to have marginal evidence of carcinogenity, and does not produce reproductive or developmental effects within typical application (USDA Forest Service, 2012, p. 159). Non-accidental acute exposure via contact with vegetation does not generate doses at levels of concern (Durkin, 2011).

Forest visitors would not likely enter areas that received recent treatments due to signing. Conducting treatment during the week, mowing or trimming consumables (if present), avoiding spraying consumables, and limiting access to the site would help ensure public safety. Compliance with label directions, project design criteria, and restrictions on entry into an area following treatment would reduce potential risks of exposure (USDA Forest Service, 2012).

There would likely be no negative effects from Chemical Site Preparation on recreation if all manufacturer and label directions are followed and applications are conducted in accordance with the Mark Twain National Forest's *Final Environmental Impact Statement: Integrated Non-native Invasive Plant Control* (USDA Forest Service, 2012).

EFFECTS OF CHEMICAL SITE PREPARATION ON TRAIL-BASED RECREATION AND GENERAL FOREST RECREATION

Treated areas would be subject to delayed entries by humans. Some dead vegetation may be visible. There would likely be no negative effects from Chemical Site Preparation on General Forest Recreation.

EFFECTS OF CHEMICAL SITE PREPARATION ON HUNTING

Treated areas would be subject to delayed entries by humans. Some dead vegetation may be visible. There would likely be no negative effects from Chemical Site Preparation on Hunting.

EFFECTS OF CHEMICAL SITE PREPARATION ON THE PUBLIC USE OF ROADS AND DRIVING FOR PLEASURE

Forest visitors who travel near the treated sites may view some dead vegetation. There would likely be no negative effects from Chemical Site Preparation on the Public Use of Roads and Driving for Pleasure.

PRESCRIBED FIRE

Prescribed fire and the burning of vegetation may result in both positive and negative impacts to various groups of recreation visitors. The use of fire opens dense understory vegetation, opens views into the forest, and eventually results in increased herbaceous ground cover. During the season(s) following prescribed fire, forest visitors would benefit from the emergence of native vegetative species and increased diversity of vegetation. Increases in vegetative diversity and native species would provide greater natural scenery viewing opportunities. Increased herbaceous ground cover and vegetative diversity following fire would benefit wildlife, wildlife viewing, and hunting (Gobster, 2001).

Trail users and those who travel into the forest interior would benefit from the removal of low vegetation with prescribed fire. Prescribed fire removes briars and other thick ground vegetation making travel easier and increasing visual penetration. Benefits from prescribed fire with reduced ground vegetation would likely last 1-3 years and be improved by the return of prescribed fire, or continue to degrade in the absence of fire (A. Davis, personal communication, October 22, 2013). The removal of ground vegetation and brush with prescribed fire has also been found to reduce populations of ticks from one to several years following prescribed fire (Adams, Edmondson, Willis, & Carter, 2013).

According to a Forest Service fact sheet and reports (Esposito , 2006a; Ryan, 2005; Taylor, 1990), the impacts of prescribed fire on visual quality vary widely depending upon how and when treated and when visual quality is assessed. Light prescribed fire with low intensity burns and little or no tree mortality can improve scenic and recreational values in some forests (Daniel, 1990; Dawson & Grecko, 1994; Ryan, 2005; Taylor, 1990). Low-severity fires have been found to increase scenic beauty ratings, especially 1-2 years after fire (Esposito, 2006a; Ryan, 2005; Taylor, 1990).

Studies also predominantly indicate that visitation will likely increase 1-2 years following prescribed fire (Dawson & Grecko, 1994; Ryan, 2005; Taylor, 1990; Daniel, 1990). As an example, Englin et al. (2001) found an increase in visitation, especially in years 1 and 2 following a fire. Similarly, Hesseln, Loomis, Gonzáles-Cabán and Aleander (2003) found that prescribed fire in Colorado slightly increased the value per trip for hikers. As explanation of the positive impacts of fire on recreation, Englin et al. (2001) concluded that the increase in flowers and animals following fire attract people as recreationists. Consistently, Brown, Rosenberger, Kline, and Needham (2008) found that annual values for hiking increased following prescribed fire in Colorado.

Light fire has been found to have little impact on picnicking, hiking and backpacking, and a slightly positive impact on nature study, while camping is sensitive to even light prescribed fire (Taylor, 1990; Taylor & Daniel, 1984).

Scenic beauty and aesthetic research suggests benefits from prescribed fire for many forest visitors (Ryan, 2005). Landscapes with uniform or monotonous vegetation or dense vegetation are less visually appealing than mosaics. Increased variability and mosaics and landscape types increase visual preference. Prescribed fire can be used to help create mosaic vegetation patterns.

People prefer open structure that allows visual access or visual penetration through the understory (Ryan, 2005). Openings within an enclosed forest are typically reported as being more visually pleasing, and many people prefer the forest edge near small openings (Ryan, 2005). Removing understory vegetation can open and frame views along recreation trails and increase their scenic value. Prescribed fire can be used to enhance visual penetration into the forest.

Forest visitors would benefit from greater visual penetration into the forest which increases visual comfort. Increased visual penetration enhances views into the forest and increases the ability to view unique natural features and wayfinding indicators and is typically associated with higher levels of psychological interest and perceptions of comfort and safety (e.g., Appleton, 1975; Gobster, 2001; Hill & Daniel, 2007; Kaplan et al., 1998).

The most preferred scenes consist of a mixed-age stand with good visual penetration. Areas of dense, small trees are less preferred than areas with large trees and greater visual access or visual penetration. Larger numbers of herbaceous plants on the ground are more preferred. Prescribed fire can also increase wildlife habitat via creating early successional habitat which benefits wildlife and recreational viewing. Prescribed fire can be used to help create or maintain these desirable conditions.

Prescribed fires would likely impact few forest visitors directly. Most prescribed fire operations occur during the week and in the early to middle part of the day, while most recreation visits occur on weekends. Forest visitors may experience delays in travel, reroutes, and frustration due to temporary road and area closures during prescribed fire operations. Some visitors may also perceive concerns about safety while being in the vicinity of a prescribed fire. The Forest Service would keep the public away from the prescribed fire to ensure public safety.

If present during prescribed fire operations, some visitors may experience negative effects during and or after the use of prescribed fire. Short-term negative effects of prescribed fire include direct effects that impact recreation decisions such as area closures and the impacts of smoke from fire on outdoor recreation in the area (Taylor, 1990).

Visitors would need to delay entering the project area near burn units until prescribed fire operations are complete and no remnants of fire and heat remain. Visitors could also choose to re-route around the project area. During and soon after the use of prescribed fire, some visitors may displace and recreate elsewhere, while others may be attracted to burned areas to examine the effects of fire (Brown et al., 2008).

Closures to recreation areas or recreating in blackened areas are examples of short-term effects that subside soon after the fire and typically of concern to few people (Taylor, 1990). Even for the most sensitive area, wilderness, research has found that over half of forest visitors accept the use of prescribed fire (Knotek, Watson, Borrie, Whitmore, & Turner, 2008).

The Forest Service implements Best Management Practices and mitigation measures to protect the public that may be traveling on National Forest System Roads and other travelways during prescribed fire operations. The Forest Service announces upcoming prescribed fires in advance of their implementation on the Mark Twain National Forest Web page, local newspapers, and other

media. Signs are posted near the boundaries of prescribed fire areas informing the public of fire operations. Prior to a prescribed fire, staff clear the area of visitors, close roads, and place staff at potential road entries to keep visitors out of areas during prescribed fire operations.

Vehicles traveling roads potentially affected by prescribed fire would be stopped prior to entering the area of fire operations. Drivers would be asked to take another route, or wait at the location until the fire is over and smoke subsides, as would forest visitors seeking to recreate. Once the area is safe for the public, forest visitors and vehicles would be allowed to enter or pass through the area that underwent prescribed fire.

Forest visitors may experience a temporary increase of Forest Service vehicles and traffic along forest roads as fire personnel engage in prescribed fire operations. Such traffic is likely during preparation for the fire, during fire operations, and following the fire as staff monitor area conditions. In addition to the presence of Forest Service vehicles and traffic, travelers may experience sights and sounds of fire vehicles, trucks with trailers, ATVs/UTVs, heavy equipment, chainsaws, and aerial support from helicopters during fire operations.

Sounds from prescribed fire operations may be similar to, or likely less than, that associated with timber harvest activities. An analysis of sounds from D7 and D8 Bulldozers, Caterpillar 325 loaders, and chainsaws, during timber harvest reported sound levels between 68 and 83 decibels dBA Leq at a distance of 50 feet (California State Board of Forestry and Fire Protection, 2008, Page VII 12-6). These sound levels were reported as being similar to that of a vacuum cleaner or electric lawn mower.

It is unlikely that forest visitors would ever be in close enough vicinity of fire operations to hear sounds from equipment directly engaged in implementing the prescribed fire. It is possible that some visitors may hear sounds from helicopter overflight that may occur in support of fire operations, but these sounds would likely be at a distance and of short duration. Sounds associated with fire operations would likely not have significant impacts to visitors, either individually or cumulatively.

Forest visitors in the vicinity of prescribed fire area may experience degraded views and visibility within viewsheds and forest areas during prescribed fire and smoke events. Visual impacts of smoke could affect driving and other activities in the area of the prescribed fire. The visual effects of smoke would likely be greatest during the actual fire. Under some climatic conditions, smoke may linger and settle in low areas and remain there through much of the evening. Visibility would likely be back to normal by mid-morning of the following day.

Forest Service guidance on prescribed fire implementation (Esposito, 2006b; Ryan, 2005) suggests avoiding the use of fire in visually sensitive areas such as near roads, trails, and ridgelines. This guidance suggests protecting large trees and clearing around their base, cleaning the edges of burns adjacent to roads, minimizing woody debris and slash, timing burns for fast revegetation, and enhancing revegetation along roads, fire breaks, and staging areas by seeding and fertilizing. Implementation guidance also advances providing interpretation about fuels management.

Fuels management that uses natural boundaries and blends with undisturbed areas promote perceptions of scenic beauty and acceptance as does screened fire breaks and roads (Dawson & Grecko, 1994; Ryan, 2005). The inclusion of small-scale burns, random burn contrasts, retention of select understory vegetation, variation with future burn unit boundaries, and fires crossing roads and trails in some areas, provide visual diversity (Dawson & Grecko, 1994). Streams, drainages, ridges, old firelines, meadows, and rock outcrops have been advanced as natural boundaries (Dawson & Grecko, 1994). The use of natural boundaries and new fire line provide variation as compared to the use of roads and hiking trails as boundaries. Variation in the spatial

and temporal return of fire and variation in boundaries used also provide visual diversity (Dawson & Grecko, 1994).

The Mark Twain National Forest implements many components of this guidance for visual quality. Public involvement is conducted to identify issues and concerns that the public has regarding the proposed action and prescribed fire and visually sensitive areas. Areas proposed for prescribed fire are analyzed to identify visually sensitive areas and special recreation area concerns. Adjustments are made to the proposal as needed to maintain visual quality and minimize impacts to recreation users.

Due to the time of year of the prescribed fires, there would likely be few visitors present in the project area. Prescribed fire treatments typically occur around February-March before vegetative blooming and leaf green-up. Few trail users and general forest visitors are typically in the area at that time. Further, few visitors would likely be present on weekdays when prescribed fire is typically conducted.

Following a prescribed fire, visitors to prescribed fire areas may view blackened areas and remnants of burned vegetation and perceive lower scenic beauty. Short-term negative impacts to scenic beauty have been found to occur from wildfire with fire scars, scorched trees, charred trunks, dead wood, blackened and burned remnants on the ground, blackened areas of vegetation, and scorched earth (Daniel, 1990; Dawson & Grecko, 1994; Ryan, 2005). Visual evidence of such effects in the project area would be minimal due to the nature of a low, cool prescribed burn.

Visible remnants from fire are perceived negatively, but typically recover quickly and are rated as scenic after one growing season (Daniel, 1990; Esposito, 2006a; Ryan, 2005; Taylor, 1990). Residual visual effects on vegetation from the proposed prescribed fire would likely last one season or less. Visual effects would likely be minimal and subside with the spring bloom of various types of vegetation. After one growing season and the areas have greened-up, areas treated with prescribed fire have been rated as more scenic than areas that were not burned. Prescribed burning of slash can also increase scenic beauty by removing woody debris.

Prescribed fire and fuels treatments where people live or recreate heighten sensitivity and scrutiny (Ryan, 2005). Sensitive areas include travelways such as roads, trails, and waterways, and primary use recreation areas such as campgrounds, and special areas such as wilderness. Camping and picnicking activities are very sensitive to such management. Areas near homes, natural areas which people hold as special and areas that are familiar are particularly sensitive and associated with opposition to treatment.

A Forest Service fact sheet and report provides guidance for the use of prescribed fire and maintaining visual quality (Esposito, 2006b; Ryan, 2005). Guidance on planning focuses on multidisciplinary planning, conducting public involvement and using visual assessment tools to determine how visually sensitive areas are. The guidance on planning suggests avoiding the use of fire in visually sensitive areas such as near homes, scenic roads, and ridgelines.

Many people mistakenly equate prescribed fire with wildfire. It is true that extremely hot uncontrolled wildfire in western states with steep slopes and fragile soils often exhibit long-term negative effects such as fire scars that affect scenic quality or recreation acceptability (Taylor, 1990). Wildfires that leave fire scars, scorched trees, charred trunks, dead wood, partly burned wood debris and tree stumps lower scenic beauty ratings, often up to 15 years (Daniel, 1990; Dawson & Grecko, 1994; Esposito 2006a; Ryan, 2005). Research has also identified other impacts from wildfire to the outdoor recreation environment (Chavez & McCollum, 2004) such as falling snags, hazard trees, soil impacts, erosion, flooding, degraded water quality, and damage to infrastructure, among others.

It is highly unlikely that any of the previously described effects associated with western wildfire could occur with the use of prescribed fire in the project area. The environmental conditions in Southern Missouri, the cool, low intensity nature of prescribed fire, and use of the Best Management Practices, mitigations, and use of fire within planned prescriptions would not result in significant impacts or long-term impacts.

Most of the impacts to recreation from prescribed fire would be short-term in nature that impact recreation decisions such as area closures and the impacts of smoke on outdoor recreation (Taylor, 1990). Further, prescribed fire is not perceived to be a major concern with air quality or air pollution in outdoor recreation areas (Taylor, 1990). Prescribed fires typically occur as a short-term impulse event such that large areas are burned quickly in one day or at most over a few days to minimize negative impacts. There would not likely be any long-term negative effects from the use of the cool, low intensity prescribed fires that would be conducted in this proposed project.

The project effects are short-term and limited in scope with low potential for significant cumulative effects. The proposed actions would enhance recreational access, the recreation setting and opportunities, and would ultimately be likely to increase outdoor recreation demand and participation within the project area.

EFFECTS OF PRESCRIBED FIRE ON TRAIL-BASED RECREATION AND GENERAL FOREST RECREATION

The effects of prescribed fire would be similar for recreation visitors to General Forest Areas as well as hikers and backpackers along the Ozark National Recreation Trail.

Prescribed fire would not likely have any significant negative effects on Trail-Based Recreation or General Forest Recreation within General Forest Areas. Areas along roads and the Ozark National Recreation Trail are considered in prescribed fire planning. These and other components of visual quality and aesthetics are considered within the *Visual Quality* section of the environmental assessment.

Trail segments within the project area may be temporarily unavailable for public safety reasons during the use of prescribed fire. Similarly, some General Forest Areas may be closed to the public during prescribed fire activities. While visitors are in the vicinity of a current or recent fire, the odor of smoke could bond to recreational clothing and outdoor gear. People that walk through the prescribed burn area soon after the fire could get fire residue such as soot on their recreational clothing and outdoor gear. These impacts would be readily corrected by washing the affected outdoor clothing and gear.

During the seasons following prescribed fire, visitors would benefit from the emergence of native vegetative species and increased diversity of vegetation. Increases in vegetative diversity and native species would improve wildlife habitat and wildlife viewing opportunities. The use of fire opens dense understory vegetation, opens views into the forest, and eventually results in increased herbaceous ground cover. Early seral stage habitat and increased herbaceous plants and forbs benefit deer, turkey, quail, rabbits, birds, and many other wildlife species following treatment (Bolen & Robinson, 2003; DeByle, 1985; deCalesta & Stout, 1997; Gobster, 2001; Langenau et al., 1980). Increased early seral stage habitat would improve wildlife viewing opportunities.

Research suggests that the use of low intensity prescribed fire improves scenic and recreational values (Daniel, 1990; Dawson & Grecko, 1994; Ryan, 2005; Taylor, 1990) and that visitation will likely increase 1-2 years following prescribed fire (Englin et al., 2001; Hesseln et al., 2003). The use of prescribed fire would likely have net positive benefits that improve visual penetration into the forest, improve ease of movement through the forest, and may increase visitation in the

following season and next 1-2 years. These benefits would be renewed after each use of prescribed fire.

EFFECTS OF PRESCRIBED FIRE ON HUNTING

Hunting would not likely be affected by the use of prescribed fire. Most hunting use occurs during rifle deer season, during November, with some hunting occurring during archery deer season, squirrel season, and the spring and fall turkey seasons. Prescribed fire treatments typically occur around February-March before vegetative blooming and leaf green-up.

Hunters would not likely be present during prescribed fire operations, nor enter the prescribed fire areas until well after the burns. Residual visual effects on vegetation would likely last one season or less. Visual effects would likely be minimal and subside with the spring bloom of various types of vegetation. Spring turkey hunters would likely view little evidence remaining from the prescribed fire during the season in mid-April, and there would be even less evidence of fire as time progresses through other hunting seasons.

Hunters would benefit from the removal of low vegetation with prescribed fire. Prescribed fire removes briars and other thick ground vegetation making travel easier. Importantly, hunters would have greater visual penetration into the forest to view and hunt wildlife.

During the seasons following prescribed fire, hunters would benefit from the emergence of native vegetative species and increased diversity of vegetation. Increases in vegetative diversity and native species would improve wildlife habitat and provide greater wildlife viewing and hunting opportunities. The use of fire opens dense understory vegetation, opens views into the forest, and eventually results in increased herbaceous ground cover. Increased herbaceous plants and forbs benefit turkey, quail, rabbits, birds, and many other wildlife species. Early seral stage habitat with herbaceous and shrubby understory, forbs, and grasses benefits deer, turkey, and other species following treatment (Bolen & Robinson, 2003; DeByle, 1985; deCalesta & Stout, 1997; Gobster, 2001; Langenau et al., 1980).

Prescribed fire would not likely have any significant negative effects on hunting. In fact, the use of prescribed fire would benefit many wildlife species that are hunted, as well as hunters. The recreational demand for hunting and associated expenditures would likely increase following prescribed fire.

EFFECTS OF PRESCRIBED FIRE ON THE PUBLIC USE OF ROADS AND DRIVING FOR PLEASURE

It is anticipated that few travelers would likely be on interior National Forest System Roads on weekdays and during the implementation of prescribed fire(s). Also, it is unlikely that prescribed fire would impact travel on U.S. Highway 60, U.S. Highway 160, or State Routes 19, J, and C which are closer to the prescribed fire areas and convey traffic daily. For prescribed fire activities near public highways, burn prescriptions would be strictly followed and prescribed fire not conducted unless conditions were within the prescriptions and smoke from fire would move aloft into transport winds. The Forest Service also notifies law enforcement agencies of planned burns and works with those agencies to ensure public safety on public roads.

Following a prescribed fire, travelers that drive through burned areas may view blackened areas and remnants of burned vegetation and perceive lower scenic beauty until the spring bloom and leaf green-up. However, most vehicle travelers on forest roads drive at relatively quick speeds that reduce visual impacts to vehicle drivers and passengers as compared to slow travel speeds such as when walking, biking, or riding a horse. Further, few people likely engage in driving for pleasure before the spring bloom and leaf green-up period. Once the spring bloom occurs, few drivers and passengers would likely perceive much visual impact such as blackened areas.

Travelers and people driving for pleasure in seasons following the spring bloom and green-up would likely experience greater satisfaction as compared to travel prior to the prescribed fire. Visual penetration into the forested interior would likely be greater through the reduction of ground vegetation. Opportunities to view wildlife would likely be increased due to increased visual penetration and the emergence of new growth and herbaceous plants that would attract wildlife.

Travelers would likely perceive increased scenic beauty. Variable and mosaic landscapes, open structure, visual access and visual penetration through the understory, openings, and views result in increased scenic value, visual preference, and visual appeal (Esposito, 2006a; Ryan, 2005; Taylor, 1990).

ROAD ACTIVITIES

Alternative 2, the Proposed Action, would improve and maintain National Forest System Roads. Reconstructing roads and conducting road maintenance would improve recreational access and benefit all forest visitors.

Well-maintained roads provide forest access and safe transportation routes into the forest. Designated and maintained System Roads enhance public safety, provide for resource management, and provide reasonable recreation access. Motorized travelers and recreation visitors would be able to legally use System Roads consistent with state and local laws.

Perceptions of safety and satisfaction would increase as the Forest Service removes evidence of depreciative actions by cleaning-up trash dumps and closes illegal user-created ATV trails. These various actions would improve the recreation setting, recreational experience, and visitor satisfaction.

Decommissioning old unimproved dirt roads and non-System roads would benefit forest resources, general forest visitors, and recreation visitors who travel into the forest interior. Hikers, bicyclists, horseback riders, hunters, and those engaged in viewing, photography, gathering, and or other non-motorized activities can use these areas in the same manner as any other General Forest Area. Recreational visitors would benefit from recreation settings that are not subject to illegal motorized use that negatively impacts their recreation experience, disrupts wildlife, and damages resources.

The decommissioned roads would be allowed to naturally regenerate vegetation. Closed roads and regenerated vegetation would reduce illegal motorized use and its associated resource damage.

Some forest roads may be temporarily unavailable or closed during road activities. These temporary delays or closures may be necessary for visitor safety and resource work. Such actions may occur during road reconstruction and maintenance and other road activities.

Road reconstruction would consist of clearing roadside vegetation, installing drainage features, and placing aggregate surface material. In some cases, realignment of the road may be necessary to safely accommodate vehicles. Road maintenance may include surface blading, replacement of surface material, mowing and limbing roadside vegetation, cleaning and restoring drainage features, and replacing road signs.

All non-System roads would be decommissioned unless under special use permit or easement. These roads would be decommissioned using a barrier of rock and/or earth berms or vegetative slash. Some decommissioned roads may be obliterated and planted with native species appropriate to the site.

The various road activities would typically include the use of bulldozers, trucks, chainsaws, tractors, and or mowing equipment. These activities would create sights and sounds that in many

cases are similar to that of construction and or timber harvest operations. During project activities, visitors may observe and hear heavy equipment. These various activities would generate dust, smoke from some equipment, and audible and visual effects. People tend to view the sights and sounds of logging and logging vehicles and industrial vehicles as undesirable (Hunt, Twynam et al., 2000).

Construction sounds and sounds from timber harvest are similar (California State Board of Forestry and Fire Protection, 2008). An analysis of sounds from timber harvest operations similar to the proposed project was found to range from 68 to 83 decibels dBA Leq at a distance of 50 feet, which was similar to an electric lawn mower at 3 feet (California State Board of Forestry and Fire Protection, 2008).

Proposed road activities are consistent with 2005 Forest Plan standards (bold face and require compliance) and guidelines including:

> **Goal 2.8 – Recreation Opportunities**
>
> **Decommission user-defined trails that are causing resource damage.** (USDA Forest Service, Mark Twain National Forest, 2005b, p. 2-23)
>
> **Off-road vehicles that comply with State and local laws are allowed on all National Forest System roads that are open and have a National Forest System road number.** (USDA Forest Service, Mark Twain National Forest, 2005b, p. 2-24)
>
> **Other use of off-road vehicles on National Forest System lands is prohibited unless on designated off-road vehicle trails . . . . Show motorized trails in the Transportation Atlas.** (USDA Forest Service, Mark Twain National Forest, 2005b, p. 2-24)

Some motorized users may feel that they are also losing access to de-commissioned non-system roads and illegal, unauthorized, user-created roads and trails. Use of these illegal and unauthorized roads and trails has been prohibited and continues to be illegal and subject to law enforcement actions. These roads and other illegal user-created trails are prohibited from use for motorized recreation by Executive Order (E.O.) 11644 (1972), ‘‘Use of Off-Road Vehicles on the Public Lands,’’ as amended by E.O. 11989 (1977) and most recently the USDA Forest Service *Travel Management Directives* (2009).

While demand exists for driving off-road, many recreationists would likely enjoy driving on approved National Forest System Roads within the project area. SUVs, ATVs, OHVs, and other modes of transportation are allowed on Designated Forest Service Roads consistent with state and local laws.

Most travelers on public and National Forest System Roads would be separated in time and space from road activities. Road activities would occur during weekdays. Most recreation traffic likely occurs during the late afternoon and on weekends. Road activities would be short-term and limited in scope with low potential for significant effects or cumulative effects to the Public Use of Roads and Driving for Pleasure. The proposed actions would enhance recreational access, the recreation setting and opportunities, and would ultimately be likely to increase outdoor recreation demand and participation within the project area.

EFFECTS OF ROAD ACTIVITIES ON TRAIL-BASED RECREATION AND GENERAL FOREST RECREATION

Forest visitors would benefit from improved road conditions and safe access. The closure of illegal user-created trails and removal of trash dumps would likely enhance the recreation setting, aesthetics, and perceptions of safety.

EFFECTS OF ROAD ACTIVITIES ON HUNTING

Road activities would benefit hunters by providing improved road conditions and safe access. Hunters would also benefit from the closure of illegal user-created trails that would prevent illegal motorized recreation that disrupts and stresses wildlife and detracts from the recreation setting and experience.

When hunters are afield they are likely to be sensitive to sounds from road activities. However, most road activities would likely occur during weekdays with little work performed during early morning or late afternoon hours. Road work would not likely occur on weekends, and typically not occur during gun deer hunting season.

EFFECTS OF ROAD ACTIVITIES ON THE PUBLIC USE OF ROADS AND DRIVING FOR PLEASURE

Forest visitors would benefit from improved road conditions and safe access. The closure of illegal user-created trails and removal of trash dumps would likely enhance the recreation setting, aesthetics, and perceptions of safety.

CUMULATIVE EFFECTS ON RECREATION

Spatial Boundary: The project area is the unit of spatial analysis for the recreation analysis. The geographic boundary for cumulative effects analysis includes all area within the project area boundary. Dispersed recreation occurs throughout the project area. This boundary is appropriate because potential effects of the proposed activities would likely be insignificant or not occur outside this boundary.

Temporal Boundary: The temporal boundary for cumulative effects analysis is the past 15 years, the present, and the next 40 years. Effects considered include those that are short-term (e.g., within 1–10 years), and long-term, up to 40 years, as these are most appropriate time frames for analyzing recreational impacts under the proposed action. As one example, prescribed fire would be used as a repeating treatment on 3-5 year cycles and have recurring effects on recreation throughout the duration of the project and for some time thereafter. As another example, timber harvests that occur as late as year 10 of project implementation may be associated with slash and visual impacts up to 20 years or more following harvest. In addition, timber stand improvement activities would occur for approximately 15 years and may have continuing slash and visual impacts for some time thereafter.

ALTERNATIVE 1 – NO ACTION

The No Action Alternative would allow project area conditions to continue to degrade and may eventually generate potentially dangerous conditions. These conditions would result from successional processes, oak decline, and weather that create hazard trees and hazardous fuel buildup. Vegetation is likely to grow denser until a natural process such as insects, disease, or high winds occur blowing down trees and vegetation. Over time, degraded conditions with hazard trees and hazardous fuels may endanger recreation visitors and forest resources.

Under Alternative 1, the No Action alternative, no management actions would be taken and conditions within the project area would continue to decline. As the recreation setting and opportunities decline, so would visitor satisfaction. These declines would likely result in reduced demand and outdoor recreation participation within the project area. Further, recreation users may substitute different activities and or locations or simply forego the desired or similar recreation activity due to displacement (e.g., Hall & Cole, 2007; Manning, 1999; Schneider, 2007).

ALTERNATIVE 2 – PROPOSED ACTION

CUMULATIVE EFFECTS OF RECREATIONAL IMPROVEMENTS AND AMENITIES

There would be no cumulative negative effects associated with recreation improvements and amenities.

CUMULATIVE EFFECTS OF SILVICULTURAL TREATMENTS ON RECREATION

Given the current levels and types of recreation participation within the project area, the proposed management actions, their temporary nature, application of 2005 Forest Plan Standards and Guidelines, and Best Management Practices, potential cumulative negative impacts from silvicultural treatments would likely be negligible and limited.

Conducting silvicultural treatments and rerouting a section of the Ozark National Recreation Trail would likely have positive impacts on recreation resulting in a beneficial cumulative effect. Conducting silvicultural treatments would likely have positive impacts on General Forest Recreation, Hunting, and the Public Use of Roads and Driving for Pleasure and result in some beneficial cumulative effects through the creation of variation in the landscape for greater visual interest, greater visual penetration, and greater opportunity to view landform features and wildlife.

MITIGATION OF EFFECTS OF SILVICULTURAL TREATMENTS ON RECREATION

Standards in the 2005 Forest Plan (USDA Forest Service: Mark Twain National Forest, 2005b) serve as mitigation for timber activities and specify that for the Ozark National Recreation Trail, logging will be restricted to leaf-off periods within the near foreground, vehicles will be prohibited on the trail except at approved trail crossings (p. 2-30), and log-decking areas will be located so that they are not visible from the national recreation trail (p. 2-32).

Standards in the 2005 Forest Plan for recreation trails (which apply to the Ozark National Recreation Trail) specify that not more than 10 chains (660 feet) of temporary opening may occur along any 40 chains (0.5 miles) of a hiker or horse trail during a decade, that log landings are prohibited within 100 feet of a recreational trail (p. 2-32) , timber harvesters are not to use recreation trails as skid trails or temporary logging roads , and that where skidding across a recreation trail is unavoidable, it shall be at a right angle and at designated locations (p. 2-31).

Guidelines in the 2005 Forest Plan also state that the Forest Service should provide at least 600 feet between skid trails crossing national recreation trails, except where topography requires occasional approval of closer trails (p. 2-31), leave flowering and colorful vegetation species within the near foreground zone of national recreation trails whenever feasible, and for all recreation trails, where feasible, place paint marks used for identification of project work on the side of the tree away from the trail so marks are not visible from the trail (p. 2-30).

During implementation of project activities, the Forest Service typically applies additional mitigation measures that minimize the visual impacts of timber harvest. Feathering, thinning, selective tree harvest, or no harvest is often used to reduce impacts as harvests approach campsite areas and other sensitive areas (DeByle, 1985; Pâquet & Bélanger, 1997). Such actions help preserve the character of the campsites and reduce impacts associated with high place attachment (Hammitt & Cole, 1998; Krueger & Williams, 2007; Manning, 1999; Schroeder, 2007).

Feathering vegetation and minimizing the size of openings near trails and roads reduces visual impacts to recreational visitors. Avoiding spanning ridgelines, reducing the size of harvest areas, modifying harvest areas to reflect topography and natural patch shape, and leaving standing trees along harvest edges also reduces visual impacts. Incorporating slash abatement within the Near

Foreground and within 50 feet of the trail further reduces visual impacts. Some of these methods are described in the *Visual Resources* section.

Incorporating aesthetic and visual mitigations can reduce the visual impacts of silvicultural treatments. Avoiding or limiting the size of timber harvest areas and clearcuts would increase visual acceptance by sightseers (Langenau et al., 1980). In addition, the use of irregular tree lines with curves, insets, and pockets setback along roads and other areas are more visually interesting than continuous straight tree lines along the travelway (Bolen & Robinson, 2003). Irregular treeline borders increase the amount of "edge" and benefit sightseers and wildlife (Bolen & Robinson, 2003).

The use of roads, trails, and landings that flow with the landforms and that are treated as operations are completed reduce visual impacts of clearcuts (Pâquet & Bélanger, 1997). Further, cutting during the dormant season and removing debris also reduces visual impacts (Pâquet & Bélanger, 1997). The use of small cuts (e.g., 10-50 ha) in which less than 25% of the landscape is harvested is visually acceptable to most groups (Pâquet & Bélanger, 1997).

Uneven-aged harvests are more visually acceptable that even-aged harvests (Bolen & Robinson, 2003). Limiting the amount of cut area visible from one point, retaining mosaics of forested stands in the midground, and delaying harvest of adjacent stands until cut stands have reestablished minimizes visual impacts (DeByle, 1985). The use of small, irregularly shaped harvest areas and the use of feathered thinning along edges would further minimize visual impacts (DeByle, 1985).

Known dispersed campsites that have been historically used for hunting and other recreation may warrant conservative timber harvest techniques such as thinning, selective tree harvest, or no harvest near the sites. Conducting harvests away from the actual campsites and or using feathering as the harvest approaches camps may help preserve the character of the campsites and reduce impacts to visitors that have high levels of place attachment. Relatedly, screenings and hiding cover are of major importance for user sites in semi-primitive, roaded natural or rural settings (Tlusty & Bacon, 1989).

Information and education efforts may help manage visitor expectations and reactions (e.g., reduce their level of negative reaction) through messages with strong arguments via the central route of persuasion (e.g., Petty & Cacioppo, 1986; Moore & Driver, 2005).

CUMULATIVE EFFECTS OF CHEMICAL SITE PREPARATION ON RECREATION

There would be no cumulative negative effects for Chemical Site Preparation if all manufacturer and label directions are followed and applications are conducted in accordance with the Mark Twain National Forest's *Final Environmental Impact Statement: Integrated Non-native Invasive Plant Control* (USDA Forest Service, 2012). There would be no cumulative effects on recreation, barring repeated ingestion of triclopyr or triclopyr-contaminated fruit or vegetation (Durkin, 2011). No reported cases of long-term health effects in humans due to triclopyr or its formulations are known to exist (USDA Forest Service, Pacific Northwest Region, 1996).

CUMULATIVE EFFECTS OF PRESCRIBED FIRE ON RECREATION

Given the current levels and types of recreation participation within the project area, the proposed management actions, their temporary nature, application of 2005 Forest Plan Standards and Guidelines, and Best Management Practices, potential cumulative negative impacts from prescribed fire would likely be negligible.

The implementation of recurring prescribed fire may have positive impacts on recreation resulting in a beneficial cumulative effect. The use of prescribed fire would likely have positive impacts on recreational access into General Forest Areas, the recreation setting, and recreation opportunities.

The use of prescribed fire would create variation in the landscape for greater visual interest, greater visual penetration, and greater opportunity to view landform features and sightsee. Prescribed fire would also increase plant diversity and early successional habitat, and improve opportunities for wildlife viewing.

CUMULATIVE EFFECTS OF ROAD ACTIVITIES ON RECREATION

Given the current levels and types of recreation participation within the project area, the proposed management actions, their temporary nature, application of 2005 Forest Plan Standards and Guidelines, and Best Management Practices, potential cumulative negative impacts from road activities would likely be negligible.

The implementation of the proposed road activities would likely have positive impacts on recreation resulting in a beneficial cumulative effect. Road activities would benefit all recreational visitors by providing forest access and safe transportation routes into the forest, as well as protect sensitive resource areas. Improved access and roads would increase visitor satisfaction and may increase recreational demand as travelers learn about project actions that would create new recreation opportunities within the area and the improved transportation system.

UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts to recreation predominantly involve temporarily unavailable areas and or closures. Treatments in or near some visitors “special areas” may result in negative reactions from some visitors due to changes to the site(s). Visual and aesthetic impacts would likely occur for some visitors due to their visual perceptions of the treated area(s) following prescribed fire and or harvest. Slash and remnants on the ground would have differential impacts depending upon the user group that encounters the materials. Unavoidable adverse impacts would decline over time, with activities or results having little impact after one growing season such as after prescribed fire, which other activities such as timber harvest and treatments may have impacts up to 20 years or more following treatment(s).

RELATIONSHIP OF SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The proposed project activities and recreation activities and uses would not negatively impact long-term productivity. Closure of illegal user-created trails would reduce negative resource impacts and enhance long-term productivity. Other than illegal motorized-use, the existing recreation activities and current levels of use have not exhibited impacts to a threshold that could reduce long-term productivity.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

None of the alternatives would have an irreversible or irretrievable commitment on the recreation resource in the project area.

SUMMARY OF EFFECTS ON RECREATION

The No Action Alternative, Alternative 1, would allow project area conditions to continue to degrade and may generate potentially dangerous conditions. Vegetation would likely grow denser until a natural process such as insects, disease, or high winds occur blowing down trees and vegetation. These conditions would result from successional processes, oak decline, and weather that create hazard trees and hazardous fuel buildup. Conditions for wildlife viewing and hunting would continue to degrade for many big game species such as deer and turkey.

Trash dumps would remain in the area and likely increase in number. Illegal, unauthorized user-created trails would remain and likely increase in number and have expanding negative impacts

on natural resources, wildlife, and forest visitors. Further, the condition of roads would continue to degrade and environmental impacts would likely increase.

As the recreation setting and opportunities decline, so would visitor and recreational user satisfaction. These declines would likely result in reduced recreation demand and participation within the project area.

With the implementation of Alternative 2, the Proposed Action, project activities would enhance recreational access and opportunities. Project activities would have effects on some visitors that vary by the type of recreation activity.

Project activities would likely enhance recreational access and opportunities, visual interest, perceptions of safety, wildlife habitat for certain species, and opportunities for wildlife viewing and hunting. A diversity of new habitat and browse would emerge benefiting a variety of wildlife including big game for up to possibly 20 years following silvicultural treatment. Project activities would benefit a multitude of recreation activities such as sightseeing, wildlife viewing and hunting. As viewing and recreational opportunities increase, recreation demand and participation may increase.

Roads would be maintained and illegal unauthorized user-created trails would be closed reducing impacts to natural resources, wildlife, and forest visitors. In addition, trash dumps would be removed. Visitor satisfaction would likely increase following project activities. As the public learns about improved views and recreation opportunities, visitation may increase.

The various project impacts to recreation would be limited, and of short duration. There would be no significant negative long-term cumulative effects on recreation. Conducting the proposed management actions should have positive net impacts on recreation access, the recreation setting and opportunities, and public use resulting in a beneficial cumulative effect.

OTHER RELEVANT DISCLOSURES

The proposed project complies with the *Federal Land Policy Management Act*, *Forest and Rangeland Renewable Resources Planning Act* (commonly referred to as RPA), the *Multiple-Use Sustained-Yield Act*, and *National Forest Management Act*, by considering multiple uses and outdoor recreation in this land management planning processes. Further, this recreation analysis complies with requirements of the *Federal Land Policy Management Act*, which specifically states that land use plans coordinate with the statewide [comprehensive] outdoor recreation plan (SCORP). The recreation analysis considered the *Missouri 2008-2012 Revised Statewide Comprehensive Outdoor Recreation Plan (SCORP)* (Missouri Department of Natural Resources, 2008) and the *Missouri Revised Statewide Comprehensive Outdoor Recreation Plan 2013-2017* (Missouri Department of Natural Resources, Missouri State Parks, & Synergy/PRI/JPA, 2013).

The proposed project is also compatible with the USDA Forest Service's "Connecting people with America's Great Outdoors: A Framework for Sustainable Recreation" (U.S.D.A. Forest Service, 2010). The framework's guiding principles, as related to this project, include connecting people with their natural and cultural environment, recreational activity in the outdoors, sustainability, community engagement, national forests are part of a larger landscape, and recreation is integrated into the agency mission.

VISUALS

AFFECTED ENVIRONMENTS

The Fremont-Pineknot East Pine-Oak Woodland Restoration project area contains lands administered under 2005 Forest Plan Management Prescriptions (MP) 1.1 - Natural Community Restoration, Roaded Natural Recreational Opportunity Spectrum (ROS) (Forest Plan 3-3), MP 2.1

- General Forest, Roaded Natural Recreation Opportunity Spectrum and MP 8.1 - Designated "Special Areas" Other Than Wilderness.

The Visual Quality Objective (VQO) is determined for a specific area by referring to the visual quality matrix found in the standards and guidelines for each management prescription. Each district has the variety classes and sensitivity levels mapped and the criteria for determining variety class and sensitivity level are documented in the 2005 Forest Plan, Appendix G. They may be changed based on field conditions.

The Fremont-Pineknot East Pine-Oak Woodland Restoration project area falls into primarily Variety Class A (Distinctive) and Variety Class B (Typical). This area includes segments of the Ozark National Recreation Trail and the Big Barren Creek State Natural Area. The Ozark National Recreation Trail's Current River Section crosses through the northeast corner of the Fremont area. The Between the Rivers Section crosses a portion of the southeast corner of Pineknot East. The nearest trailheads are located on Peck Ranch Road, Highway 60, and the Sinking Creek Lookout Tower.

The Sensitivity Level 1 travelways located in the project area are: Highway 60 which traverses east and west through the project, Highway J goes south from Hwy 60 into the project area, Hwy 19 goes south from Hwy 60 along the western boundary and Hwy C heads south from Hwy 60 and briefly touches a portion of the eastern project boundary. In addition to those highways, the National Recreation Trails are rated as Sensitivity level 1 travelways (Most Sensitive). Sensitivity Level 2 level travelways are Hwy P, Y, DD and FS roads 3169 and 3253. All remaining travelways are a Sensitivity Level 3 (Least sensitive).

The Visual Quality Objective (VQO) in MP 2.1 in Variety Class A along the Level 1 travelways is Retention (R) for the foreground and Partial Retention (PR) for the middleground and background. The VQO along the Level 2 travelways is Partial Retention for the foreground and Modification for the middleground and background.

The VQO in MP 2.1 in Variety Class B along the Level 1 travelways is Partial Retention for the foreground and Modification for the middleground and background. The VQO along the Level 2 travelways is Partial Retention for the foreground, Modification for the middleground and Maximum Modification (MM) for the background. (Table 3-2, pg. 3-12 LRMP)

The Visual Quality Objective (VQO) in MP 1.1 in Variety Class A along the Level 1 travelways is Retention (R) for the foreground and Partial Retention (PR) for the middleground and background. The VQO along the Level 2 travelways is Partial Retention for the foreground and Modification for the middleground and background.

The VQO in MP 1.1 in Variety Class B along the Level 1 travelways is Partial Retention for the foreground and Modification for the middleground and background. The VQO along the Level 2 travelways is Partial Retention for the foreground, Modification for the middleground and Maximum Modification (MM) for the background. (Table 3-3, pg. 3-9 LRMP)

The Visual Quality Objective (VQO) in MP 8.1 is Retention for the State Natural Areas and for the Nationally Designated Ozark National Recreation Trail. (pg. 3-49 LRMP)

(See VQO map in project file)

The existing road surfaces other than the blacktop state highways are gravel or native surface with an average low travel speed and little or no shoulder.

The Variety/Scenic attractiveness classifications are:

1) Class A- Distinctive
2) Class B-Typical

3) Class C-Indistinctive

Class A – Distinctive: Areas where landform, vegetation patterns, water characteristics, and cultural features combine to provide unusual, unique, or outstanding scenic quality. These landscapes have strong positive attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

Class B – Typical: Areas where landform, vegetation patterns, water characteristics, and cultural features use combine to provide ordinary or common scenic quality. These landscapes have generally positive, yet common, attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern and balance. Normally they would form the basic matrix within the ecological unit.

Class C- Indistinctive: Areas where landform, vegetation patterns, water characteristics, and cultural land use have low scenic quality. Often water and rockform of any consequence are missing in class C landscapes. These landscapes have weak or missing attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

The sensitivity levels for the travelways were developed by user related concerns and expectations. Landscape visibility is subject to many essential, interconnected considerations. These include:

- context and experiences of viewers
- expected images
- position of observer in the landscape
- number of people and
- viewer scrutiny of the landscape caused by duration of view, viewing distance, air clarity, and visual magnitude."

The Fremont-Pineknot East Pine-Oak Woodland Restoration project area shows visual variety through naturally appearing areas along the travelways with occasional encounters of small rural communities. These travelways have conifer and a variety of hardwood trees that make a continuous tunnel effect on one or both sides of the roads or waterways, opening up to ridgetops with views over valleys covering long distances and open landscapes. Within the project area, there are pastoral and agricultural landscapes and small areas where you encounter a local clustering of residences. The visitor would see hay being grown and harvested (private property) and cattle grazed. Due to the changes in elevation of the terrain and the vegetation, it is not common to see most of the roadways from other areas, especially during the time of year when deciduous trees have their leaves.

The existing landscape character is one that has evolved naturally over time without glaciation. The terrain has areas of changes in elevation that are several hundred feet. There are creeks and springs that provides interesting sights and sounds that change with the volume and speed of the water. The viewer would encounter rock outcroppings of interesting shapes that look different during different times of day or year or depending on the weather. There are mixed vegetative species that provide seasonal color and texture in all vertical levels of the forest from the little mayapples that sprout and bloom in the spring to the large oak trees turning colors in the fall. The roadways are primarily narrow gravel surfaces that are winding and climb up and down hill. Many bird and animal species can be seen and heard throughout the year.

The existing Scenic Integrity for the majority of the project area ranges from Retention-R (appears unaltered) to Modification-M (altered). "The frame of reference for measuring achievement of scenic integrity levels is the valued attributes of the "EXISTING" landscape

character "BEING VIEWED". In Natural or Natural appearing character this is limited to natural or natural appearing vegetative patterns and features, water, rock and landforms. Direct human alterations may be included if they have become accepted over time as positive landscape character attributes."

A general discussion of visual management and effects of the different types of management activities can be found in the Landscape Aesthetics "A Handbook for Scenery Management"- Forest Service-US Department of Agriculture-Agriculture Handbook Number 701, December 1995" incorporated here by reference.

The Visual Quality Objective (VQO) requires that we meet scenic integrity levels. As stated on page 2-5 of Agriculture Handbook 701, "In general, a specific integrity level can be achieved by decreasing the visual contrast of the deviation being viewed." Several approaches may meet integrity levels:

The following are those pertaining to this project area:

1. "Usually the most effective way is to repeat form, line, color, texture, pattern and scale common to the valued landscape character being viewed."…"If repetition is accurate and well designed the deviation may blend so well the change is not evident (HIGH). It may only borrow well enough to be noticeable but visually subordinate (MODERATE)."
2. "Another approach is to borrow form, line, color, texture, pattern and scale from similar but different valued landscapes outside that being viewed."…"Because these are introduced elements from landscape character outside the one being viewed these are usually evident (MODERATE) if not dominant (LOW)."
3. "An approach used for the VERY LOW level is to shape and blend only with the landforms. Harvest unit boundaries, for example, would follow draws where low branched trees and brush exist over ridge or hill tops to avoid dominance of unnatural appearing edges. Roads and landings would conform to folds and ridge lines in the landscape to avoid dominance. Harvest boundaries would normally utilize all breaks in topography to avoid excessive unit size."

Forest Plan Standards and Guidelines for Visual Management

The 2005 Forest Plan (page 2-24) provides the following required standards:

- **Resource management activities must meet or exceed the established VQO.**
- **Allow a short-term reduction, the equivalent of one VQO, for central hardwood regeneration or similarly impacting activities.**
- **Foreground sensitivity level 1 (fg1) or foreground sensitivity level 2 (fg2) areas must not be reduced below modification.**
- **Retain the original VQO for adjusted areas, and meet it within 20 years after initial entry into the corridor or viewshed.**
- **Residue treatment requirements must meet those specified for the original VQO.**

Within fg1 and fg2 areas with a VQO of retention or partial retention:

- Mitigate negative visual impacts concurrently with or immediately after each phase or activity;
- Complete mitigating measures for each cutting unit or project area before beginning activities in the next sequential block or project area in the same corridor or viewshed; and

- Complete obligations specified by a contract or a project prescription within one year from initiation of activities for any single cutting unit or project area. Emphasize completing all work within these areas in a systematic manner within the shortest practical time.

Within fg1 and fg2 areas with a VQO of modification, the standards are the same as above except the total lapsed time from initiation of activities to completion of obligations specified by a contract or a project prescription shall not exceed two years for any sale block or project area.

Table 38. Maximum residue treatment heights (above ground surface) for designated travelways and use areas by sensitivity levels (USDA Forest Service: Mark Twain National Forest, 2005b, p. 2-26))

Visual Quality Objective - VQO	Distance Zone	Travel Speed MPH	Sensitivity Level 1 (Mandatory)	Sensitivity Level 2 (Mandatory)	Sensitivity Level 3 (Optional)
Retention – (R)	Nfg (0-300')	0-10 11-35 36-55	18 inches 24 inches 30 inches	N.A.	N.A.
	Secondary Zones (up to 600')	0-10 11-35 36-55	6 feet 8 feet 8 feet		
Partial Retention – (PR)	Nfg (0-300')	0-10 11-35 36-55	18 inches 24 inches 30 inches	30 inches 30 inches 36 inches	36 inches 36 inches 48 inches
	Secondary Zones (up to 600')	0-10 11-35 36-55	8 feet 8 feet 12 feet	10 feet 10 feet 12 feet	12 feet 12 feet 12 feet
Modification (M)	Nfg (0-300')	0-10 11-35 36-55	N.A.	36 inches 48 inches 48 inches	48 inches 48 inches 48 inches
	Secondary Zones (up to 600')	All Speeds	N.A.	12 feet	N.A.
Maximum Modification (MM)	Nfg (0-300')	All Speeds	N.A.	N.A.	48 inches
	Secondary Zones (up to 600')	All Speeds	N.A.	N.A.	N.A.

DIRECT AND INDIRECT EFFECTS ON VISUAL RESOURCES

This section describes the area of analysis for direct and indirect effects and the area evaluated for cumulative effects. The scope of the analysis will include the scenic resources within the Fremont-Pineknot East Pine-Oak Woodland Restoration project area and potential visual quality effects from the travelways within and adjacent to the area. Because the Forest provides a wide range of recreation opportunities and scenic landscapes, there are no scenery resources or recreation activities limited or specific to the Fremont-Pineknot East Pine-Oak Woodland

Restoration project area. Therefore, any analysis beyond that described above will not be necessary.

ALTERNATIVE 1: NO ACTION

No sudden changes from the existing condition would be expected to occur. Barring natural disturbance, it is anticipated that the existing visual condition of the project area would slowly change. The project area as a whole would appear as a natural mature or old growth forest in the future with continued degradation of the stream channels and fields.

Illegal vehicle access damage, dumping and erosion are not keeping the area within the prescribed VQO. By leaving the diseased and damaged timber and doing no burning, the forest visitor would not be able to see as far into stands for either wildlife viewing, seasonal viewing or hunting.

The oak decline would continue to kill mature oak trees in the project area decreasing the inherent scenic attractiveness of these oak stands and the continued encroachment of cedar in the midstory and pastures reduces the visual variety.

Scenery may retain a large tree look over the area with landscapes containing high numbers of Shortleaf Pine trees or patches of dead trees and less variety. Over time there would be less visual variety than exists now in all aspects of the project area.

ALTERNATIVE 2: PROPOSED ACTION

This alternative would have some management activity visible from a few portions of the Sensitivity Level 1 and Sensitivity Level 2 roads as well as the trails and along some of the Sensitivity Level 3 roads. By harvesting the dead and declining oak species, thinning out dense canopies of numerous pine stands and providing an opportunity for new growth, the area would continue to have added visual variety. Immediately after timber management activity, it would appear more open and the slash disposal would be visible for a short period of time. The prescribed burn areas may appear black until spring green up.

Scenery would show young thick stands of trees (many of which would be thinned in this alternative) and older, larger stands with an open understory giving a more park like appearance. It would allow the visitor to see further into some of the areas allowing an opportunity to view wildlife and differing vegetation such as the service berry, redbud and dogwood blooming in the spring or the oak trees turning colors in the fall. Keeping the deciduous trees healthy in an area very heavy in pine would give a seasonal variety experience to the forest visitor.

The removal of illegal trash dumps and improvement of water sources (for wildlife) give the area a more natural feel and may present a more pleasant experience for those viewing wildlife and scenery in the Fremont-Pineknot East Pine-Oak Woodland Restoration project area.

The rerouting and maintenance of any trails will be visible during the time of construction and activity and will only be visible for the time it takes for the vegetation to regrow in the areas of decommissioning.

The planned activities of firewood sales (in all areas with a harvest prescription) also help minimize the visual quality concerns of tops and unusable logs being left behind. This utilization would occur only after the sale has been closed so some degradation of the visual experience may happen for a short time. Additionally, the use of prescribed fire on a 2-5 year cycle would also reduce the visual quality for a short period as tops and unusable logs left behind from the timber harvest become more visible.

CUMULATIVE EFFECTS ON VISUAL RESOURCE

A one mile corridor around the Fremont-Pineknot East Pine-Oak Woodland Restoration project area was selected as the visual resource cumulative effects boundary. This area was used because it will adequately address any effects related to vegetative management on the scenery resources. See the Visual resource cumulative effects spatial boundary map in the Fremont-Pineknot East Pine-Oak Woodland Restoration Project File.

The temporal boundary was set to analyze 10 years prior to this decision, plus 10 years following this decision. The boundary was selected because 10 years is the normal management cycle and this is the extent the effects are measurable and meaningful.

Past and present activities that may have an effect on the Visual resource: On Federal and private lands activities includes: wildfire suppression, prescribed fire, fireline construction, timber harvest, timber stand improvement, road maintenance, reconstruction and decommissioning, wildlife habitat improvements, opening maintenance, pond maintenance, pond construction, illegal dump removal, power-line installation, utilities installation, herbicide use, insect and disease occurrences (such as the oak borer), the influences from Highways 60, J, 19, C, DD, Y and P along with numerous Forest Service and County roads. Any effects to the Visual resource have since diminished.

Vegetation and ground disturbing activities such as road maintenance, and temporary road building, would be necessary to implement the action alternative. These activities would result in short-term increases of sediment and slash on the ground. Various items such as the standards and guides in this environmental assessment and other items found in the forest plan, and timber sale contract provisions would be implemented to minimize any short-term impacts.

There would be no long term negative impacts on any of the visual quality for this area. In fact, over time, the proposed activities would improve the quality and quantity for most visual and recreational activities such as driving for pleasure, wildflower and wildlife viewing, hunting and hiking.

It is important to consider the overall end result desired while at the same time maintaining the current Forest Plan direction. Harvests would cause a reduction in number of trees per acre, additional slash on the ground, and possibly temporary roads or landings visible from the county or Forest Service roads. The negative effects of harvest activity on visual values adjacent to these roads would be minor because the vegetation that is removed in the near foreground would be mitigated with the required slash disposal height, while opening up the understory allowing the visitor to see further into the forest and creating variation in both the size of the trees and appearance of the timber stands to a more park like appearance with open understory.

The continued presence of open areas with a carpet of native grasses and wildflowers along some roadsides would provide a break from the wooded corridor. The cut areas would be laid out on the ground in a manner that would reflect natural lines and be visually subordinate to the characteristic landscape.

The visual effects of these proposed harvesting activities would be more noticeable to residents, hunters and other visitors using the local forest roads and trails, especially as pedestrians or other low speed travel. Visual effects may be more noticeable from a few places on private lands within the area, but views would primarily be of thinned areas.

Past and present actions on private and National Forest lands were considered in forming the affected environment of the area as described above. No anticipated future actions are known that would be inconsistent with the visual quality objectives for the analysis area which are primarily partial retention and modification.

Under all the alternatives, there would continue to be open woods due to natural low soil fertility, natural disturbance (windstorm, insect & disease, etc.) or wildfire. Most existing roads would continue to be maintained. The cumulative effect for the action alternative should meet the VQO for all levels.

Thinning of overcrowded stands and harvest of declining trees reduces natural mortality, decreasing the fire fuel load and reducing the threat of stand replacing wildfire. These activities also decrease the threat of insect and disease epidemics and enhance the ecosystem. The oak decline would continue to kill mature oak trees in the Fremont-Pineknot East Pine-Oak Woodland Restoration project area. The prescribed burning has short term negative visual effects to achieve a long term desired Visual Quality Objective.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT ON RESOURCES

None of the alternatives would have an irreversible or irretrievable commitment on this resource in the proposed Fremont-Pineknot East Pine-Oak Woodland Restoration project area.

Visual resource summary: There would be no significant cumulative effects of any kind on the Visual resource because of the limited nature and extent of the cumulative effects discussed above. This conclusion was reached after analyzing all of the above information regarding the past, present and reasonably foreseeable future activities on all ownerships within the specified spatial and temporal boundaries.

TRAVEL MANAGEMENT

AFFECTED ENVIRONMENTS

The Fremont-Pineknot East Project Area is located just south and east of Winona. The project area is primarily within 1.1 and 2.1 management areas, the former emphasizes multiple resource objectives while providing a roaded natural recreation experience and the latter is for restoration of natural communities. A small portion of the project area is within 8.1 management areas, which are designated special areas with unusual environmental, recreational, cultural, or historical resources, and for scientific or educational studies.

Roads under state jurisdiction normally move people from one major point to another within the state and traverse a large part of the state. State highways are paved to handle large amounts of commercial truck traffic and high volumes of passenger car traffic.

County and Mark Twain National Forest system roads provide localized access within the project area. The county roads have an aggregate surface, whereas Forest Service roads have an aggregate or native surface. County and Forest Service roads are used by passenger and high clearance vehicles, and carry considerably less traffic than state highways. Anyone traveling to the project area is likely to drive upon a combination of state, county, and Forest Service roads.

Privately owned land is scattered throughout the project area and is accessed mainly by State and county roads. Forest Service roads access several private in-holdings. Several non-system roads are managed under special use permits.

The project area contains 35 National Forest System roads, with a combined length of 38.4 miles. These roads vary in length from 0.2 miles to over 3 miles. These roads are single lane and dead-end within the National Forest. National Forest System roads are marked with brown, vertical posts showing the road’s number and length.

In September 2013, the Mark Twain National Forest updated the motor vehicle use map (MVUM) for the Eleven Point Ranger District in which the project area is located. This map identifies those Forest Service system roads designated for public motorized vehicle use.

Motorized use is limited to those vehicles and operators that comply with all federal, state, and local traffic laws and regulations. The map also shows which designated roads have seasonal restrictions. Public motorized access is prohibited on any Forest Service road not shown on the MVUM. This black and white map is free to the public and will be updated annually. All-terrain (ATV) and utility vehicle (UTV) operators with a valid Carter or Shannon County ATV or UTV permit may use those county roads and any Forest Service system roads shown on the MVUM within that particular county. Mixed-use of the roads by licensed trucks and cars and permitted ATVs is a common occurrence.

National Forest system roads are developed and maintained for long-term access and as such provide primary access into the project area for recreation, administration, and commodity production. System roads within the project area are generally located on ridge tops, have been constructed to Forest Service engineering standards, are maintained and signed in accordance with their objective maintenance level, and are considered adequate for use under normal operating conditions. Any management activity, which increases use or considerably alters normal road conditions or traffic patterns, may be mitigated with appropriate warning and precautionary signing. Additional road maintenance may be required to safely accommodate heavier volumes of traffic. Roads may also require reconstruction in order to allow commercial vehicle access for resource management activities.

In addition to system roads, there are approximately 29 miles of non-system roads on National Forest land in the project area. Non-system roads are roads on Forest Service managed land that are generally not needed for long-term access. Many have been in place since the early 1900's when the area was first harvested for timber. However, they generally aren’t needed to accomplish Forest management activities. The condition of these roads is usually fair to poor because little or no improvements or maintenance work has ever been done. Those located on ridge tops are relatively stable, except for areas that become soft when wet. Those located on side slopes or riparian areas are less stable and may become entrenched, rutted, or washed out. These roads have continued to be used for recreational activities, timber harvesting, and other resource management activities. Some of the non-system roads have been decommissioned by the District or have become inaccessible due to natural vegetation growth, but many have remained open because of continued recreational vehicle use. Motorized use on non-system roads is prohibited, unless written authorization is granted.

Some non-system roads access private property and are under a special use permit (SUP). A special use permit authorizes the permit holder to use a non-system road for access to private property. The road is still under the jurisdiction of the Forest Service, but the permit holder is solely responsible for performing any necessary road maintenance. The condition of SUP roads vary. Those SUP roads that access a primary residence are more likely to be maintained for low-clearance vehicles (passenger cars), while those used to reach property primarily used for agricultural or recreational purposes are generally maintained for use by high-clearance vehicles (trucks and SUVs). Currently, there are several non-system roads under special use permit within the project area.

All open roads, including both system and non-system, receive some degree of vehicular traffic. Use occurs primarily on weekends for recreational driving, hunting, firewood gathering, and other recreational pursuits. Evidence of hunter camps can be seen along several of the roads. A majority of non-system roads within the project area are used frequently by unauthorized high clearance vehicles and ATVs. As stated previously, the MVUM prohibits motorized vehicles on non-system roads, without written authorization. However, non-motorized travel, such as hiking, biking, or horseback riding is allowed.

DIRECT AND INDIRECT EFFECTS ON TRAVEL MANAGEMENT

- A majority of system roads needed for resource management activities and public access are already in place. The need for road maintenance, reconstruction, or decommissioning activities is based on management area objectives, proposed management activities, and the need for resource protection. National Forest system roads are meant to provide safe and efficient access for both the public and agency employees and its contractors.
- The intent of road construction or reconstruction is to provide long-term access into an area with the least amount of disturbance possible. Part of the "least disturbance" objective is to ensure resource damage does not occur after a road has been constructed or reconstructed. Proper construction or reconstruction would minimize disturbance to the area. Road construction or reconstruction increases the degree of soil and vegetative disturbance in the short term, while providing long-term load bearing strength and stabilization of the surrounding soil and vegetation. Roads are constructed or reconstructed to provide a minimum standard of road necessary for management area objectives. Road reconstruction would reduce seasonal access restrictions due to wet weather. Road reconstruction consists of clearing vegetation from the roadway, installing drainage features, and adding aggregate to harden the driving surface of the road. In some cases, realignment of the road may be necessary.
- Road maintenance is the ongoing upkeep of a road necessary to retain or restore it to its approved road management objective. Road maintenance activities are preventive measures, used to stabilize the road, protect road investments, and minimize disturbance to surrounding resources. Activities associated with road maintenance and improvement may include surface blading, replacement of driving surface material, mowing and limbing of roadside vegetation, cleaning and restoring drainage features, and replacing signs.
- Roads identified for decommissioning are not needed for long-term resource management and in many cases are poorly located on the landscape, within or very close to streams and drainages, or on extremely steep slopes that are highly erosive. Road decommissioning eliminates motorized vehicular travel and returns the roadway back to a natural state. The result of road decommissioning is restored hydrology, a reduction in soil erosion and sedimentation, and the growth of new vegetation where the road once existed. Road decommissioning may involve one or more of the following treatments: blocking access with earthen berms, rock berms, boulders, or slash piles; restoration of natural drainage features by removing culverts and re-contouring the area; scarification to remove the roadbed; re-vegetation by seeding, planting, or fertilizing; and signing to discourage motorized use of the road. Priority roads for decommissioning are those causing the greatest resource damage, such as erosion, and/or constituting a risk to public safety.
- All road miles in the following analysis are estimates and are based on current data in the Mark Twain National Forest's Geographical Information System (GIS) and INFRA database. Some adjustment of estimated miles may occur in order to protect resources, reconcile GIS and INFRA mileage differences, and provide for the application of sound engineering judgment when implementing proposed road projects on the ground.

ALTERNATIVE 1 – NO ACTION

- No changes would be made to the existing 38.4 miles of National Forest System roads within the project area. Routine maintenance on approximately 25.6 miles of system road would continue. These maintained roads would continue to provide access for both Forest Service management activities and public enjoyment of the area.

- No reconstruction of system roads would occur. Without reconstruction, these roads would continue to deteriorate and become less safe to travel upon. Travel would be impeded due to rutting and vegetation growing within or next to the roadway. Without aggregate surfacing, the roads would continue to be a source of soil erosion and sedimentation into nearby streams. Lack of surfacing material would exacerbate rutting and mud holes when vehicles are driven on saturated soils within the road. Excessive rutting and large mud holes would force drivers to maneuver around them, which could result in the vehicle leaving the roadway or even dragging or hitting the bottom of the vehicle, and thus make driving more hazardous. In addition, trees, bushes, and grasses growing along or within the road would limit sight distance, scratch the sides of vehicles that brush against them, and smack windshields.
- No unneeded roads would be decommissioned within the project area. These roads would likely continue to receive unauthorized motorized traffic, diminishing the ability of the roads to revegetate naturally and return the area to a natural appearing environment.
- This alternative would not foreclose authorization of the current 0.8 mile of special use permits or future potential special use permits for non-system roads used to access private property within the project area.

ALTERNATIVE 2 – PROPOSED ACTION

- This alternative would address the purpose and need of providing a safe and efficient transportation system at a level that meets the need for resource management and public access. Routine maintenance of approximately 25.6 miles of system road would continue. The effects of road maintenance would be the same as in Alternative 1.
- In addition, approximately 12.5 miles of system road would be reconstructed. Road reconstruction would improve motorized access into the Fremont-Pineknot East project area. High-clearance and/or commercial vehicles could safely use reconstructed roads, as drivers would not encounter large mud holes, ruts, or tree limbs whacking their vehicles. Sight distances would also be improved. Upon completion of road reconstruction, drivers could travel much more safely and efficiently. Due to their hardened driving surface, reconstructed roads would have less erosion, and thus less sedimentation into nearby streams. The area's recreational experiences would be enhanced by improved driving conditions on the reconstructed roads.
- Approximately 20.7 miles of non-system and 0.3 miles of system road would be decommissioned. Motorized access on these unneeded roads would be eliminated. Decommissioning would help ensure that drivers are not using unsafe roads. Decommissioning would return the land back into suitable areas for natural resource production (wood products, wildlife habitat, forage, etc). These unneeded roads would no longer be a source of soil erosion and sedimentation into nearby streams, springs, seeps, or fens.
- Several non-system roads are currently managed under special use permit for access to private land. Additional non-system roads may need to be managed under special use permit for access to private property. If it is determined that access is not necessary or no longer needed for any of these roads, they would also be decommissioned.

Table 39. Alternative 2 Road Management Activities

Alternative 2 - Proposed Activities	**Measures (Estimated)**
System road maintenance: 3253 (2.65 mi); 3254L (0.5 mi); 3261 (2.75 mi); 3261C (1.3 mi); 3261F (1.1 mi); 3270 (0.1 mi); 3274 (1.2 mi) ;4006 (0.8 mi); 4045 (2.4	25.6 miles

Alternative 2 - Proposed Activities	**Measures (Estimated)**
mi); 4072A (1.0 mi); 4088 (1.1 mi); 4097 (2.7 mi); 4248 (0.9 mi); 4261 (0.7 mi); 4719 (1.5 mi); 4981 (0.9 mi); 4249 (1.4 mi); 3169Q (1.4 mi); 4113 (1.2 mi).	
System road reconstruction: - 3165 (1.0 mi); 3253 (0.15 mi); 3254F (0.4 mi); 3254G (0.6 mi); 3254L (1.0 mi); 3261 (0.75 mi); 4072A (0.4 mi); 4088 (0.5 mi); 4097B (0.4 mi); 4101 (0.5 mi); 4102 (0.7 mi); 4728 (0.4 mi); 4737 (1.3 mi); 3169E (1.3 mi); 3253A (0.5 mi); 3278 (1.0 mi); 4036 (0.4 mi); 4097A (0.3 mi); 3145A (0.4 mi); 4100 (0.5 mi).	12.5 miles
Non-system road converted to system road with reconstruction	0 miles
Decommission system roads: 3262A (0.2 mi); 3270 (0.1 mi).	0.3 miles
Decommission non-system roads not under special use permit.	20.7 miles

Table 40. Comparison of Road Management Activities by Alternative

Road Management Activities	**Alt. 1**	**Alt. 2**
Total miles of system roads	38.4	38.1
Miles of system road to maintain	25.6	25.6
Miles of system road to reconstruct	0	12.5
Miles of system road to decommission	0	0.3
Miles of non-system road to convert to system road and reconstruct	0	0
Miles of non-system road to decommission	0	20.7
Miles of non-system road potentially managed under special use permits	8.3	8.3

Install gates: Install gate on FR 3261 at approximately mile post 3.0, to limit access to Fremont Tower site.

CUMULATIVE EFFECTS ON TRAVEL MANAGEMENT

The Fremont-Pineknot East Project Area is the cumulative effects boundary for transportation. Cumulative effects for roads will be analyzed for the next 5 years because government (federal, state, and local) transportation planning is normally limited to a five-year period. Government road-related budgets are also difficult to predict beyond a couple of years.

The Fremont-Pineknot East travel analysis evaluated both system and non-system roads within the project area. These are the types of roads more readily impacted by project actions. The travel analysis evaluated which roads should be maintained, reconstructed, constructed, or decommissioned. The analysis did not identify any new opportunities for motorized trails or areas within the project area. The Fremont-Pineknot East Project Area was selected as the appropriate analysis boundary to give the Responsible Official the site-specific context dealing with roads to determine the ultimate effects of the Fremont-Pineknot East Project actions.

The Forest Plan calls for decommissioning unneeded roads, with priority given to those roads that pose the greatest risk to public safety or where use is causing unacceptable resource damage, such as soil erosion. This would be applicable to Alternative 2 as discussed above. When needed, an existing non-system road may be used to temporarily access project activities, but would then be decommissioned when such activities are done. This would reduce the amount of new road

construction needed and associated sediment movement. Unauthorized use of non-system roads would be reduced or eliminated after roads are decommissioned. Non-system roads have been identified as current or potential candidates for special use permits. If it is determined that any of these roads provide primary access to private property, then they would not be decommissioned, and would be managed as special use permit roads. The private individual who is issued the special use permit would be responsible for any necessary road maintenance.

The mitigation measures currently employed and found in the Forest Plan Standards and Guidelines, such as constructing roads with less than a 10% grade or installing drainage features at appropriate intervals, ensure the integrity of the roads is maintained. Roads, which were used in the past, will likely be used again. Current Forest Service annual road maintenance budgets have only been adequate for Maintenance Level 3 and 4 roads, and a small percentage of Maintenance Level 2 roads. Maintenance Level 3 and 4 roads are the most heavily traveled roads on the Forest. In addition to the annual road budget, road maintenance deposits collected through commercial activities (such as timber harvesting) have been used for surface blading and roadside mowing and limbing. In some cases, commercial users of roads have performed road maintenance activities themselves, such as; surface blading, removal of roadside vegetation, or replacement of road surfacing materials, primarily on Maintenance Level 2 roads. Periodic road maintenance activities would provide a safe and efficient transportation system within the Fremont-Pineknot East project area. Without regular maintenance, future road reconstruction would likely be needed on system roads within 10-20 years.

The Forest Plan requires an assessment of the types and amounts of traffic found on Forest Service roads. Where public traffic on these roads is primarily due to non-Forest activities, the appropriate county should be contacted to determine their maintenance responsibility. However, all Forest Service roads within the Fremont-Pineknot East project area appear to serve mainly Forest Service-related travel activities.

According to the State Transportation Improvement Plan for 2013-2017, no state highways or routes within the analysis area are scheduled for improvement. Routine maintenance of state highways is expected to continue within the project area. The Safe and Sound Bridge Improvement Project lists no bridges inside the project area. Routine maintenance of state highway bridges is expected to continue within the project area.

It is expected that the vast majority of road activities by Carter and Shannon Counties would consist of routine maintenance, such as surface blading, culvert cleaning, and roadside mowing and limbing.

Access to the project area should be safer and more efficient for motorized travel as a result of Forest Service road reconstruction (as identified in Alternative 2) and maintenance of state, county, and Forest Service roads.

The paved surfaces of state highways eliminate surface erosion, but present impacts from winter salt and petroleum product residues from the road surface. Residues come from the paving material itself (asphalt) and leaks from automobiles, trucks, farm machinery and other gas-powered vehicles.

Aggregate roads, in particular Forest Service and county roads, will continue to be sources of sediment that may migrate to area streams. National Forest system roads and county roads represent the same potential source of fine material via erosion that affects water resources as sediment. Aggregate roads are perpetual sources of fine materials (dust and small particles), with potential to become sediment in nearby streams. However, with routine maintenance, the amount of sediment eroding from roads surfaces would be reduced. An aggregate road would produce a minimum amount of sediment when the road is used infrequently during wet periods, heavy truck

traffic is limited, maintenance is performed on a routine basis, or any type of off-road use that disturbs the road is prohibited.

Since Forest Service system roads are normally built and maintained to a higher standard than most private roads (with the possible exception of private roads that directly access homes and are driven by low-clearance passenger vehicles), private roads would be expected to have a greater impact on stream sedimentation from erosion of their road surface materials.

Past transportation system activities, current proposed actions, and reasonably foreseeable future activities do not pose any appreciable cumulative effects on motorized access to or use of the project area or its vicinity for all alternatives.

The preceding analysis was based on the following resources: 1) GIS spatial data and maps; 2) Tabular road data in INFRA; 3) Missouri State Transportation Improvement Plan 2013-2017; 4) Missouri State Safe and Sound Bridge Improvement Project; and 5) Monitoring by personal observation. Information was also borrowed from the soils analysis using the Water Erosion Prediction Model (FSWEPP; Elloit et al 2000).

HERITAGE RESOURCES

AFFECTED ENVIRONMENTS

A total of the 12,945 acres were surveyed for cultural resources in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area. A majority of the project area, 10,397 acres, were inventoried using a “complete coverage” standard used by C Dimension of Plano, Texas, Effigy Archeological Services of Overland Park, Kansas and by Mark Twain heritage staff. In addition to the broad scale cultural resources inventory surveys, the heritage resource management personnel implemented a prescribed burn survey on 2,548 acres of private land using the Mark Twain National Forest “Revised Rx Burn” methodology adopted in February, 2013 (Missouri SHPO Log No. 025-MLT-13). Such public/private partnerships are authorized at private landowner’s request under the Wyden Amendment (Public Law 105-277, Section 323 as amended by Public Law 109-54, Section 434). Please see Cultural Resource Surveys and Testing, below, as well as maps in Attachment B for more detailed descriptions of the surveys undertaken in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area. Additional information is available in the project record (Cooper et al., 2012; Gannon & Moerbe, 2013; Lakey, 2013; MacNeill, 2014).

A total of 85 archaeological sites, 282 historic features, and 43 isolated finds were recorded in the Fremont CFLRP project. The Mark Twain National Forest believes that, following the application of appropriate mitigation measures, proposed management activities will result in either no effect or no adverse effect, to historic properties within the analysis area. The following are brief descriptions of the currently identified cultural resources within the project area as well as the Mark Twain National Forest’s evaluation (pursuant to 36 CFR 800.5) of potential cumulative effects on historic properties.

Prehistoric archaeological sites/site occupations investigated to date in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area indicate that the regions saw moderately widespread and occasionally intensive use by peoples throughout prehistory. Sites occur on a variety of landforms including broad ridges, ridge tops, toes of ridges, saddles, knolls, bluff tops, terraces, benches, floodplains, as well as springs and sinkholes. The occupations range in size and complexity from small ephemeral sites to more extensive seasonal sites. Temporally diagnostic prehistoric artifacts from sites within the project area indicate that the area was utilized from the Late Paleo-Indian/Early Archaic to Early Mississippian periods. Descriptions of the diagnostics recovered within the project area can be found in the report and site recordation forms generated

in support of this undertaking and are available in the project record (Cooper et al. 2012; Gannon & Moerbe, 2013; Lakey 2013; MacNeill, 2014).

Archaeological investigations in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area as well as archival sources have provided information about the Euro-American agrarian land use and settlement that dates from the mid-nineteenth to the mid-twentieth centuries. The settlement period within the project area is bounded on the terminal end by the U. S. government's acquisition of privately owned tracts of land in the 1930s to the 1960s. Site types observed within the project area include rural farmsteads/homesteads, abandoned agricultural fields, rural school house locations, logging trams, artifact/trash scatters, a cemetery, and historic rock features. Rock features included structural foundations, rock walls, and field clearing activities, piles/alignments, and check dams. Descriptions of the sites and associated features recorded within the project area can be found in the reports and site recordation forms generated in support of this undertaking and are available in the project record (Cooper et al., 2012; Gannon & Moerbe, 2013; Lakey, 2013; MacNeill, 2014).

The Mark Twain National Forest has evaluated 85 archaeological sites with respect to the National Register of Historic Places (NRHP) Significance Criteria, as found in 36CFR 60.4. The Forest has determined that 65 (76.5%) of the sites found in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area are considered "not eligible" or a "noncontributing element "for inclusion to the National Register. The remaining 20 (23.5%) sites are being managed as "unevaluated" properties that have the potential to meet Criteria A and D of the NRHP.

Criteria A – Properties associated with events that have made a significant contribution to the broad pattern of our history.

Criteria B – Properties that have yielded, or my likely to yield, information important in prehistory or history.

Sites are generally considered "unevaluated" as a result of a resource manager's conclusion that additional levels of investigations are warranted prior to issuance of final NRHP site eligibility determinations. Although "unevaluated" sites do not fall within a formal National Register site eligibility category under 36 CFR 800.4(c)(2), such sites are afforded the same level of consideration regarding assessment of adverse effects under 36 CFR 800.5 as sites determined to be "eligible" for the National Register. For additional information on archaeological sites, historic features, and isolated finds recently recorded within the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area. The reader is referred to the project record and cultural resource survey reports that were produced in support of this undertaking (Cooper et al., 2012; Gannon & Moerbe, 2013; Lakey, 2013; MacNeill, 2014).

Twenty of the 85 archaeological sites identified in the Fremont Project Area (23.5%) have been determined to be "unevaluated" with respect to their eligibility for listing on the National Register of Historic Places. These sites include 12 historic sites, 7 prehistoric sites, and 1 multiple occupation sites.

Sixty-five of the 85 archaeological sites identified within the Fremont Project Area (76.5%) have been determined to be "not eligible" or a "noncontributing element" for inclusion to the National Register of Historic Places. A portion of an unevaluated or eligible site can be determined a noncontributing element if alterations and disturbances to the site have caused it to lose its historical integrity or capacity to yield significant information about a historical property. Often the data producing potential of a noncontributing element can be exhausted through the initial investigations of the site or historic property. These 64 archaeological sites include 32 historic sites, 30 prehistoric sites, and 3 multiple occupation sites.

As summarized above, 282 historic features and 43 isolated finds have been recorded within the project area. Isolated finds and historic features are generally not considered significant so they are not considered "eligible" for the National Register of Historic Places. These isolated finds and historic features are not generally protected during the implementation of the project.

Regulatory consultation with the Missouri State Historic Preservation Officer (SHPO) has been carried out for the activities proposed in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area. Consultation is required under the National Historic Preservation Act, as Amended, and the accompanying regulations found at 36 CFR 800.

A letter of concurrence was received from the Missouri State Historic Preservation Officer dated February 26, 2014. The State Historic Preservation Officer concurred with the site eligibility determinations and recommendation that there would be "no adverse effect," with regard to project effects on historic properties if 2005 Forest Plan standards and guidelines and other mitigation measures as described in the Determination of Eligibility and Effect report are implemented (Project Record, Letter of Concurrence from Mark Miles, State Historic Preservation Officer RE: Determination of Eligibility and Effect for the Fremont I, Fremont II, and Fremont and Pine Knot East RX Burn Dozer Lines Survey, Eleven Point Ranger District, Mark Twain National Forest, Shannon and Crater Counties Missouri, FS Report No. R2014090523408 , by William L. MacNeill). A list of mitigation measures are provided in Chapter 2 of this environmental assessment. During implementation, applicable 2005 Forest Plan standards and guidelines would be followed to protect sites.

Tribal consultation with recognized Native American tribes has been completed. In the event that human remains are unintentionally discovered during project activities, the Forest Service, as consistent with the 2005 Forest Plan, would follow provisions specified in the Native American Graves Protection and Repatriation Act and Chapter 214, Cemeteries, and Chapter 194, Unmarked Human Burials, Revised Statutes of Missouri.

DIRECT AND INDIRECT EFFECTS ON HERITAGE RESOURCES

ALTERNATIVE 1 – NO ACTION

Under the No Action Alternative, the proposed Fremont Project would not occur and therefore the project would have no effect on cultural resources in the survey area.

However, if the No Action Alternative is selected, the project area could potentially suffer from the adverse effects of hazardous fuels built up over time and the potential effects of unmanaged forest decline on surface and subsurface archaeological site integrity. These potential adverse effects include increased tree mortality, resultant tree-tips, and wildfire intensity. Fires occurring within areas of dense concentrations of combustible materials have the potential to burn with greater than normal intensity and duration, thereby altering the physical integrity and/or research value of archaeological sites or site components. Resulting denudation can lead to a sharp increase in soil erosion, thus disturbing or leading to a loss of archaeological soil deposits and/or site components.

With no change in current management activities and direction, archaeological sites in the Fremont Project Area could potentially suffer from the effects of the No Action Alternative.

ALTERNATIVE 2 – PROPOSED ACTION

Activities that have the potential to directly affect the archaeological site in the Fremont Project Area are listed above (Definition of Effects and Area of Potential Effects), and included commercial timber harvesting; prescribed burns; dozer constructed fire lines; maintenance of Forest Service roads where ground disturbance takes place outside existing road rights-of-way and ditches; road decommissioning using ground disturbance methods, such as pit and berm, re-

contouring, or ripping and seeding; and issuance of Special Use Permits for use of existing roads where ground disturbance is authorized outside existing road corridors/ROWs.

The Mark Twain National Forest believes that potential adverse effects to cultural resources resulting from the Fremont CFLRP Project activities can be mitigated provided that appropriate mitigation measure are properly applied and followed. In that instance, project activities are not expected to adversely affect archaeological sites and the effects on cultural resources of project activities will be as follows:

1) In those project areas where no historic properties are present, the proposed project activities will have "no effect" on historic properties.
2) In those project areas in which proposed ground disturbing or other related activities that have the potential to adversely impact historic properties, mitigation measures CR 1, CR 2, CR 3, and CR 4 will be implemented to avoid adverse effects to historic properties. The proposed project activities are expected to have "no adverse effect" [36 CFR 800.4(d)(1)] on historic properties.
3) The proposed activities are expected to have "no effect" on "non-eligible" sites whose data producing potential have been exhausted through investigations prior to the project implementation and in project areas where no historic properties are present.
4) "Unevaluated" sites in project areas where no activity is proposed, project implementation is expected to have "no effect" on cultural resources.
5) The proposed activities are expected to have "no adverse effect" [36 CFR 800.4(d)(1)] on archaeological site, 09-05-26-633/23CT1651. A portion of the site, located in the project area on Forest Service land, has been determined to be a "non-contributing element" of the site. The data producing potential of the "non-contributing element" of the site located on Forest land has been exhausted through two separate investigations (Moerbe, 2013; Lakey, 2013). The undocumented portion of the site located outside of the project area, on private land, is considered unevaluated for the National Register of Historic Places and will not be affected by the proposed activities on federal lands. The portion of archaeological site, 09-05-26-633/23CT1651, located on Forest Service land is released from management.
6) Archaeological sites that occur along routes of access and where operating restrictions and/or site avoidance (CR 1) is not feasible, Mitigation Measure CR 4 will be applied with the expectation that a mitigation plan can be developed to result in a finding of "no adverse effect" [36 CFR 800.4(d)(1)].

In the case of the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area, increased site vulnerability is expected to be the principal indirect effect to cultural resources resulting from activities included in the Proposed Alternative as listed in the Definition of Effects and Areas of Potential Effect section. With application of appropriate mitigation measures, it is not expected that the proposed project activities in any of the alternatives would increase visitor use in those areas in which archaeological sites are located. Therefore, it is not expected that implementation of the proposed activities would have indirect effects on the cultural resources.

Because it is expected that implementation of project activities would result in findings of either No Effect or No Adverse Effect, there is expected to be little change over the existing condition with respect to the archaeological sites.

CUMULATIVE EFFECTS ON HERITAGE RESOURCES

Spatial Boundary: The spatial boundary for the analysis is the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area.

Temporal Boundary: The temporal boundary for the analysis included historic and prehistoric sites and features.

Project activities in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area have the potential to affect cultural resources. Cultural resources surveys have not necessarily been completed for temporary roads, skid trails, and landings; forest road activities; and trash dump cleanup. As locations of these activities become known, they will be surveyed, and Section 106 consultation will be completed prior to project implementation.

Section 106 Consultation: The necessary consultation with the Missouri State Historic Preservation Officer (SHPO) as outlined in the National Historic Preservation Act (as amended, 2000), and the accompanying regulations found at 36 CFR 800, will be carried out with respect to all Areas of Potential Effect and historic and unevaluated properties prior to project implementation. Such consultation will offer the Missouri State Historic Preservation Officer the opportunity to comment on the forest's efforts to identify historic properties, the determination of National Register eligibility of the archaeological sites in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area and on the forest's determination of effect for the project actions with respect to the eligible and unevaluated sites. MacNeill (2014) provided documentation to the Missouri State Historic Preservation Officer to date as the basis for the regulatory consultation. The letter of concurrence from the Missouri State Historic Preservation Officer is contained within the project record (Project Record, Letter of Concurrence from Mark Miles, State Historic Preservation Officer RE: Determination of Eligibility and Effect for the Fremont I, Fremont II, and Fremont and Pine Knot East RX Burn Dozer Lines Survey, Eleven Point Ranger District, Mark Twain National Forest, Shannon and Crater Counties Missouri, FS Report No. R2014090523408 , by William L. MacNeill), February 26, 2014). As noted previously, regulatory consultation will be carried out as required for the remaining project areas as surveys of those areas are completed.

Irretrievable and Irreversible Effects

Irretrievable and irreversible effects from the Fremont CFLRP Project are unlikely as long as locations of activities are surveyed, Section 106 consultation occurs, and 2005 Forest Plan standards and guidelines and specified cultural mitigation measures are applied. Failure to provide for adequate cultural surveys and resource protection could result in irretrievable and irreversible damage to historic and prehistoric sites that may have met National Register of Historic Places significance criteria.

SUMMARY OF PROJECT EFFECTS ON HERITAGE RESOURCES

Numerous historic and prehistoric sites and features have been identified within the Area of Potential Effect for the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area. Limited investigations have been conducted in the area. Of those sites investigated, the investigations were insufficient to fully evaluate them against the National Register of Historic Places significance criteria, and these sites are being managed as unevaluated properties. The unevaluated sites are afforded protection from project activities that may harm the sites.

Project activities in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area have the potential to affect cultural resources. Cultural resources inventory surveys in the Fremont and Pineknot East Pine-Oak Woodland Restoration Project Area have focused on locations and areas in which proposed activities have the potential to affect archaeological sites. Areas where known ground-disturbance is proposed to occur have had complete cultural survey coverage. Activities that occur in areas that have been surveyed will not be re-surveyed. Cultural resources surveys have not necessarily been completed for temporary roads, skid trails, and landings; forest road activities; and trash dump cleanup. However, as locations of these activities

become known, they will be surveyed, and Section 106 consultation will be completed prior to project implementation.

SOCIAL ECONOMICS

AFFECTED ENVIRONMENTS

Missouri forests and the forest products industries contribute significantly to Missouri's economy (Missouri Department of Conservation & USDA Forest Service, 2010). Forestry and forest products industries contribute $7.3 Billion to Missouri's economy annually and employ 41,200 people (Missouri Forest Products Association, 2012). These industries provide $1.9 billion in payroll, $610 million in taxes and $77 million in state sales tax (Missouri Forest Products Association, 2012).

Forestry and forest products industries provide direct, indirect and induced economic benefits (Missouri Forest Products Association, 2012). Direct economic impacts are generated by jobs in the primary wood processing industry such as logging and sawmills. Indirect impacts arise from the secondary wood products industries such as flooring and furniture producers. Induced impacts occur as these employees buy fuel, groceries, and so on.

For the State of Missouri, the vast majority of timberland is located on private lands, with only a small percentage of timberland located on the Mark Twain National Forest. According to 2009 data, as reported by the Missouri Forest Products Association (2013), Missouri has 14,711,046 acres of timberland (p. 7), of which 85% is located on private lands (p. 4, p. 7, p. 15). Tabular data indicates that approximately 9.8% of Missouri's timberland is located on the Mark Twain National Forest, with the remaining 4.7% located on state land.

Most of Missouri's saw timber harvest comes from private lands, with only a small percentage of the saw timber harvested on the Mark Twain National Forest. According to the Missouri Forest Products Association (2013), approximately 93% of Missouri's annual saw timber harvest comes from privately owned timberland (p. 15). (Table data indicate 90.8%). Tabular data indicates that approximately 5.4% of the annual timber harvest comes from the Mark Twain National Forest, and 3.7% comes from state lands.

The Mark Twain National Forest provides substantial economic contributions to local, regional, and state economies (FSWeb: U.S. Forest Service Intranet, 2014). Economic contributions associated with the national forest are provided through *Timber Products, Forest Service Resource Management Investments, Recreation Visitor Use, Payments to States and Counties, Livestock Grazing,* and *Minerals and Energy Production.* The Fremont-Pineknot East Project would include economic contributions through *Timber Products, Forest Service Resource Management Investments, Recreation Visitor Use,* and *Payments to States and Counties.*

In 2010, forest-wide, Mark Twain National Forest *Timber Products* generated 817 average annual jobs, $27,595,191 in employee compensation, $40,391,639 in labor income, a total income of $55,090,194, and $60,535,900 in gross regional product (FSWeb: U.S. Forest Service Intranet, 2014). National forest *Timber Products* generated 337 direct jobs, and 480 jobs in secondary employment. Employee compensation per Job was $32,429 per direct job, and $34,719 per secondary job.

Mark Twain National Forest *Resource Management Investments* include all non-salary expenditures such as for ecosystem restoration, infrastructure maintenance, etc., and employee salaries and benefits. During 2010, Mark Twain National Forest Resource Management Investments generated 309 average annual jobs, $17,254,004 in employee compensation, $18,036,174 in labor income, a total income of $22,616,450, and $23,527,564 in gross regional

product (FSWeb: U.S. Forest Service Intranet, 2014). The employee compensation per job was $17,254.

Mark Twain National Forest's *Recreation Visitor Use* in 2010, generated 229 average annual jobs, $5,151,878 in employee compensation, $5,813,719 in labor income, a total income of $8,702,487, and $10,288,000 in gross regional product (FSWeb: U.S. Forest Service Intranet, 2014).

During 2010, Mark Twain National Forest's *Payments to States and Counties* generated 48 average annual jobs, $1,832,937 in employee compensation, $2,037,608 in labor income, a total income of $2,589,018, and $2,696,610 in gross regional product (FSWeb: U.S. Forest Service Intranet, 2014). The Employee Compensation per job was $43,168 per direct job, and $25,573 per secondary job.

Federal "Payments in Lieu of Taxes" are disbursed to local governments to offset lost property taxes due to the presence of nontaxable federal lands (U.S. Department of Interior, n.d.a). These payments are made as consistent with Public Law 94-565 and Chapter 69, Title 31 of the United States Code.

In 2013, Payments in Lieu of Taxes (U.S. Department of Interior, n.d.b) for federal lands located within the county boundary were as follows: Carter County - $120,500, Oregon County - $91,926, Ripley County - $95,263, and Shannon County - $145,525. Payments in Lieu of Taxes are used for local government services such as public safety, the environment, housing, social services, transportation, and government administration.

The Secure Rural School and Community Self-Determination Act, Public Law 110-34, was enacted to provide financial assistance to rural communities that depend upon national forests (U.S.D.A. Forest Service, 2013). The Secure Rural School and Community Self-Determination Act was recently reauthorized for one year (U.S.D.A. Forest Service, 2013). Funding via the Secure Rural School and Community Self Determination Act is awarded to the state and distributed to the counties, subject to various options and provisions. In Fiscal Year 2012, $3,352,723.39 was paid to the state and distributed across counties according to Payment Report ASR 10-1 FY2012 (USDA Forest Service, n.d.).

In Fiscal Year 2012, under the Secure Rural School and Community Self-Determination Act (USDA Forest Service, n.d.), payments were made as follows: Carter County - $228,053.17, Oregon County - $289,057.85, Ripley County - $248,517.10, and Shannon County - $290,447.39. (See reports for ASR 18-1 FY2012, ASR 18-2 FY2012.)

The proposed project is located within Carter and Shannon counties, both of which are mostly covered with forest. Land coverage was analyzed using the Economic Profile System-Human Dimensions Toolkit (Headwaters Economics, 2014). A socioeconomic profile for land use indicated that in 2006, of the 325,773 acres in Carter County, 257,361 acres (79% of the county) had forested land cover. Of the 642,402 acres in Shannon County, 507,498 acres (79% of the county) was forested.

According to the Missouri Department of Conservation (2012), approximately 100 wood processors are listed as operating and or purchasing products within Carter, Oregon, Ripley, and Shannon counties. Mill products include barrels/stocks, blocking, cabin logs, cants, charcoal, excelsior/bedding, fuel wood, handle/blanks, lumber, mine supports, pallet lumber, poles, posts, ties, veneer, and other. Missouri's forest products also include furniture, cabinets, flooring, shavings, and other wood products (Missouri Department of Conservation & USDA Forest Service, 2010). Missouri is also a leader in generating forest products such as walnut nutmeats, shell products, and red cedar gifts.

Forestry and the wood products industries provide substantial economic benefits to surrounding areas and counties. In 2012, the *Wood Product Manufacturing* industry (Missouri Economic Research and Information Center, n.d.a) contributed the following wages to local counties: Carter County - $1,952,474, Oregon County - $4,555,200, Ripley County - $2,279,427, and Shannon County - $3,056,806. During that same year, *Forestry and Logging* (Missouri Economic Research and Information Center, n.d.a) contributed $73,154 in wages to Oregon County, and $167,118 in wages to Shannon County. Data for *Forestry and Logging* were not available for Carter and Ripley counties.

For the 12 county area in the South Central Region in which the project is proposed, *Wood Product Manufacturing* contributed $13,512,360 in wages during the 4th Quarter of 2012 (Missouri Economic Research and Information Center, n.d.b). *Agriculture, Forestry, Fishing, and Hunting* contributed an additional $3,784,560 in wages during that same quarter.

Missouri Economic Research and Information Center (n.d.a) *Wood Product Manufacturing* employment data for 2012 reports the following average employment: Carter County – 95, Oregon County – 196, Ripley County – 127, and Shannon County - 155. Employment data for *Forestry and Logging* in 2012 reported 3 employees in Oregon County, and 9 employees in Shannon County.

Within the South Central Region, 2,204 people were employed within the *Wood Product Manufacturing* industry (Missouri Economic Research and Information Center, n.d.b). An additional 411 were employed in *Agriculture, Forestry, Fishing, and Hunting.* Reported data related to forestry does not likely reflect the impacts to other employment sectors such as transportation, which also likely benefit from transport of products from the wood products industries.

Travel and tourism to the local communities and areas provide additional economic benefits, some of which is likely attributable to the forest. Industries that include travel and tourism near the project area were analyzed using the Economic Profile System-Human Dimensions Toolkit (Headwaters Economics, 2014). According to 2011 data, there were 158 travel and tourism related jobs in Carter County, and 95 such jobs in Shannon County. The average annual wages for these jobs were $9,805 in Carter County, and $9,404 in Shannon County.

Past and present action that may affect economics: Historically, forest management focused on timber production. In the 1960's, forest management began to move toward multiple-use management. The *Multiple-Use Sustained-Yield Act* directed that public lands be managed for multiple-uses that included timber, range, watershed, fish and wildlife and outdoor recreation purposes. The Act also directed that lands be managed for sustained yields and benefits over time.

In recent decades, public values have shifted demanding more from forests than strictly timber and economic values. Forests provide innumerable and invaluable social and environmental benefits that cannot always be tied to direct economic benefits. Examples of these benefits include ecosystem services benefits such as clean water, wildlife habitat, outdoor recreation, landscape stabilization, environmental stability, and carbon storage to name a few. Trees also improve air quality, reduce the heat island effect of warmer temperatures near hard-surfaced areas, decrease energy demands, and much more (Missouri Department of Conservation & USDA Forest Service, 2010).

Public participation in gathering and collecting forest products has emerged for personal interest, personal consumption and economic benefits (Hembram & Hoover, 2008; Missouri Department of Conservation & USDA Forest Service, 2010). Demand exists for medicinal products, herbs, mushrooms, nuts, fruits, and decorative products among numerous other forest products and

ecosystem services. As an example, according to Krieger (2001, p. 20), “1.3 million pounds of seven medicinal plants were harvested . . . in 1993” from the Mark Twain National Forest.

Subsistence harvest of non-timber and non-wood forest products are important to the rural poor and contribute to their domestic energy, food- and health-security, provide income, and serve as an important ‘safety net’ (Osman-Elasha et al., 2009). As an example, a study of people gathering nontimber forest products near the Daniel Boone National Forest showed that 43 plant species were sold commercially and 120 were used in local households (Hembram & Hoover, 2008). The study indicates that people who gathered and collected these products earned $200-$15,000 annually, with most full-time harvesters earning $3,000 per year. While most of this activity was conducted without a Forest Service permit, the findings do demonstrate that such activity occurs on national forests and contributes to household use and incomes.

The last decade has had divergent effects on the timber industry. Timber markets reflect the economy, popularity of type of wood at the time, and volume being sold in the area (Missouri Department of Conservation & USDA Forest Service, 2010). Softwood timber demand has declined as has the housing market and declines in new home building starts. At the same time, private land owners have dealt with increasing property values and taxes on timber and inheritances (Missouri Department of Conservation & USDA Forest Service, 2010).

Local and Regional Considerations: The demand for softwood lumber for housing continues to be down, and a trend may emerge toward smaller homes with less hardwood and millwork (Missouri Department of Conservation & USDA Forest Service, 2010). The depressed economy will likely continue to affect the logging and forest products industries.

Potential overharvest has been identified as a concern for the Missouri Ozarks and nearby region in southeast Missouri (Missouri Department of Conservation & USDA Forest Service, 2010). Many communities in the region are dependent upon the forest products industry. A major decline in available harvests would likely cause forest-dependent communities to continue to suffer.

The *Missouri’s Forest Resource Assessment and Strategy: Seeking a Sustainable Future for Missouri’s Forest Resourc*es (Missouri Department of Conservation & USDA Forest Service, 2010) identifies numerous factors that may impact forest production and economics. Most of Missouri’s forest land is in private ownership, and most of these owners are now elderly. The rate of land ownership turnover will likely increase in upcoming years.

Private lands and forests are threatened by conversion of land to other uses, fragmentation, and parcelization (dividing into smaller land areas) (Missouri Department of Conservation & USDA Forest Service, 2010). Forest conversion reduces wildlife habitat, natural communities, water quality, carbon storage, and the production of forest products. Collectively, conversion, fragmentation, and parcelization may reduce timber production on private lands which would impact the timber industry and markets.

Parcelization results in higher management costs, such as for logging areas of 25 acres or less in size (Missouri Department of Conservation & USDA Forest Service, 2010). As land size diminishes, forest thinning, timber stand improvement and wildlife habitat practices become more expensive. At some point, such management actions become impractical.

In the future, the total consumption of wood is expected to increase due to population increases and emerging markets for biofuels (Missouri Department of Conservation & USDA Forest Service, 2010). New markets for woody biomass may develop for combustion heat, to generate electricity, and as bio-oil and ethanol (Missouri Department of Conservation & USDA Forest Service, 2010). This niche area would support the removal of poor quality trees from crowded forests, which currently have little current or future economic value.

Climate change impacts on forests and timber was analyzed in *The 2005 RPA Timber Assessment Update* (Haynes et al., 2007). Key findings include the following:

- "In the 'climate + CO_2' scenario, climate and elevated CO_2 act to augment growth in all regions. Both softwood and hardwood growth on private lands expand steadily . . . . " (p. 111).
- "In the 'climate only' scenario, some regions continue to realize increases in timber growth (e.g., SE), while growth in other regions declines (e.g., SC)"(p. 111).
- "For the United States as a whole, however, both scenarios lead to overall increases in both softwood and hardwood inventories on private lands" (p. 111).
- " . . . Average private softwood inventory over the 2010–2050 period rises by 9.3 percent and hardwood inventory by 5.6 percent in the 'climate + CO_2' scenario but by only 2.3 percent and 1.2 percent, respectively, in the 'climate only' scenario" (p. 111).
- ". . . Prices of softwood lumber, hardwood lumber and OSB rise slowly (annual compound rated of 0.2 percent, 0.3 percent, and 0.1 percent, respectively) while prices of plywood, paper, and paperboard remain stable or fall" (p. 45).
- "Because the inventory changes are gradual, their impacts on private timber harvest, timber prices, and ultimately on product markets and prices in both scenarios are relatively small and expand over the projection" (p. 111).

More recently, the USDA Forest Service Southern Research Station examined climate scenarios for the northern region, including Missouri, as published in the *Forecasts of Forest Conditions in Regions of the United States Under Future Scenarios: A Technical Document Supporting the Forest Service 2012 RPA Assessment* (Wear, Huggett, Li, Perryman, & Liu, 2013). Major consistent findings across the climate models indicated that hardwood oak-hickory will decline between 2010 and 2060, while white-red-jack pine area increases. A leveling of standing biomass will occur due to the aging of forests and fairly constant timber harvest, and growing stock will peak around 2020-2030. The report notes that changes in forest management practices, increased planting, shifts in tree species, and shifts in land use from agriculture to forest may occur in response to market demand.

Consistently, Irland et al. (2001) report that the timber–products sector would benefit under climate change, but prices would generally be lower (except for softwood pulpwood) as inventories and timber harvests increase. Irland et al. advance that potential negative effects of climate change will be offset by markets such that producers, consumers and mill owners would gain. As examples, adaptations would occur with reduced price, the salvage of dead and dying timber, and planting species adapted to the new climate. Other adaptation strategies may include alternative species in manufacturing, changing the use or location of capital and machinery, adoption of new technologies, recycling, and increased efficiency.

Markets are emerging for carbon storage, and protection of water, wetlands, and biodiversity that value ecosystem services and reduce the effects of climate change (Alig, 2011; Deal, Cochran, & LaRocco, 2012; Deal, Raymond, Peterson, & Glick, 2010). Markets would provide incentives to private forester landowners to manage forests for ecosystem services such as carbon sequestration. Forest carbon stocks would sequester carbon in standing forest, wood products, and the use of wood as a substitute for fuel-consuming products.

These markets seek to keep or increase the amount of forest sequestered carbon through extended rotations (e.g., 100 years) or increased growth rates through carbon trading or forestry credits (Adams, Aliq, Latta, & White, 2011; Alig R. , 2011; Deal, Raymond, Peterson, & Glick, 2010). Such markets would encourage afforestation and reforestation of land and adaptations that plant species adapted to climate change and at lower densities to reduce completion for water (Adams, Aliq, Latta, & White, 2011; Alig R. , 2011; Deal, Raymond, Peterson, & Glick, 2010).

Using forests to store carbon and mitigate climate change would impact timber supply, forest product markets, trade, and the local, regional, and national economy (Alig, 2011; Alig & Bair, 2006; Nepal, Ince, Skog, & Chang, 2013a, 2013b). Studies suggest that these markets would increase the forestry land base, inventory of standing stock, reduce inventory available for harvests, increase the price of logs and products, and reduce timber production and consumption (Adams, Aliq, Latta, & White, 2011; Nepal, Ince, Skog, & Chang, Forest carbon benefits, costs and leakage effects of carbon reserve scenarios in the United States, 2013; Nepal, Ince, Skog, & Chang, Project U.S. timber and primary forest product market impacts of climate change mitigation through timber set-asides, 2013).

DIRECT AND INDIRECT EFFECTS ON SOCIAL ECONOMICS

ALTERNATIVE 1 – NO ACTION

Under Alternative 1, no actions would be taken. Timber harvests would not be conducted. The forest and forest products industries would not have access to project timber and wood products. Foregoing harvests would mean no Forest Service project-related jobs and expenditures associated with forest management.

Mature trees would be allowed to decline, die, and rot. The economic value of the affected timber would be lost. At broad scales, substantial losses of trees that would have otherwise been harvested reduce the inventory of timber for the market, increase prices and may force some businesses out of the market (Prestemon & Holmes, 2008).

Allowing these trees to die would likely increase fuel loadings and wildfire severity. Resulting wildfires may occur and generate substantial costs for firefighting. Such wildfires may also result in additional economic losses as other forest lands, and possibly private homes, are consumed or damaged by fire.

Natural community restoration would be hindered without the use of prescribed fire. Mechanical vegetation management alone would not create enough widespread disturbances to allow natural seed sources of ground flora species to thrive. The existing vegetation types would be susceptible to the effects of climate change, such as drought, extreme heat, invasive species, pests, etc., that could increase timber losses.

The proposed trail relocation would not occur on segments of the Ozark National Recreation Trail within the project area. This portion of the trail would continue to degrade. Degraded trail conditions would likely reduce trail use and local recreational expenditures. Degraded trail conditions could endanger trail users and result in injuries and medical costs.

Deteriorating roads would negatively impact travelers who cross forest roads for jobs and other economic purposes. Travelers may be endangered by deteriorating roads which could cause damage to vehicles, accidents, and result in repair costs and medical expenses. Failure to maintain roads would result in deferred maintenance that would increase environmental degradation and total costs required to repair roads later.

Failure to close and decommission non-System roads and illegal trails would result in increased damages to forest resources and lost economic value. Illegal use of these roads and trails typically results in ongoing damage to resources, harassment of wildlife, and is often associated with arson, poaching, and other illegal activities (Hunt et al., 2009). These activities generate costs due to loss of resources, and response and enforcement requirements. Continued use by illegal users may endanger trespassers on non-System roads and trails and forest visitors, and result in medical expenses.

Continued use of non-System roads and trails negatively affects the recreation setting, forest visitors, and may lead to displacement of recreational visitors (e.g., Hall & Cole, 2007; Manning,

1999; Schneider, 2007). Displacement of recreational visitors may result in decreased or lost recreational expenditures in the local area.

Recreational visitors may displace to other locations at increased personal and social costs. Alternately, they may forego their desired recreation setting and experience all together. Altered or ceased recreational activity could reduce or prevent social and health benefits and increase individual and societal costs due to decreased mental and physical health and fitness.

A parking area would not be constructed at the Big Barren Creek State Natural Area nor signage provided. Recreational visitors would continue to lack designated and hardened parking access. The lack of access likely dissuades visitors from use of the area. Visitors who do visit the natural area park anywhere, including on private property, and create environmental impacts.

Open areas along roads and illegal, user-created trails would be susceptible to increased risk of invasive species and pests with climate change. Invasive species would not be monitored and treated. Invasive species follow roads, any openings, and can be transported by vehicles, equipment, and humans. Failure to monitor and treat invasive species could promote their spread and increase eventual treatment costs. The spread of invasive species also typically outcompete native species and can result in the loss of native species which could generate social and or economic losses.

Wildlife habitat and vegetation management activities would not be conducted. Rehabilitation and maintenance activities would not be performed on ponds and glades, and forest conditions would decline. Decline would occur due to existing conditions and lack of management activities and the rate of decline may increase with climate change. Wildlife habitat conditions would continue to degrade. Some species populations would decline or no longer be present.

Declining wildlife populations (or their absence) may reduce wildlife viewing, recreation, and hunting opportunities. Decreases in wildlife viewing, recreation, and hunting opportunities would reduce or eliminate the associated recreational uses and financial expenditures in the local area. Such changes would also incur individual and or costs to social values via displacement or cessation of the recreation opportunities.

Failure to remove trash dumps from the area has the potential to create several negative effects and costs. Trash dumps would likely continue to increase in size and quantity increasing future costs for removal. The existence of trash dumps may also release harmful contaminants into the environment that could result in health hazards and increased costs for environmental clean-up.

Trash dumps decrease aesthetics, the recreational setting and experience, and may result in displacement of forest visitors and reduced recreation expenditures. Trash dumps near private property may also decrease private property values. Trash dumps often attract rodents that can cause diseases, and snakes in search of rodents. Trash dumps may also contain materials that pose dangers to forest visitors and or forest employees. Such materials could be harmful and result in illness, injuries and medical expenses.

Areas with trash dumps also imply a lack of agency stewardship and law enforcement (e.g., Moore & Driver, 2005). The presence of trash dumps suggests that the agency is not caring for the land and adequately monitoring the area and or providing adequate law enforcement. The presence of trash dumps promotes illegal activity and perceived threats to forest visitors from criminal acts. Such conditions may decrease forest visitation and expenditures in the local area.

ALTERNATIVE 2 – PROPOSED ACTION

Under Alternative 2, the Proposed Action, timber harvests and other vegetative treatments would be conducted. Vegetation management activities would generate timber sales receipts for the forest. Logging operations would directly employ log harvest crews and equipment operators in

timber harvest operations and hauling materials to sawmills. These actions would benefit primary wood products industries. Once the raw materials are processed, they would then flow to secondary wood products industries for use in furniture and so on.

Participating forest product industries would produce direct and indirect economic benefits from wages, income taxes, product sales, and sales taxes. Induced economic benefits would occur as employees of forest and wood products industries spend money within the local economies. Local economies would also benefit as products are “exported” into other markets. As a result of exports, new outside money would be “imported” into the local economy. Induced economic benefits and import of new money would likely generate enhanced economic benefits through ""multiplier effects".

Sustainable forest management would assure a sustainable supply of logs of desired species, size and quality within sustainable harvest rates and balanced with other forest values (Missouri Department of Conservation & USDA Forest Service, 2010). Sustainable forest management would allow periodic harvests of sustainable timber volumes and income streams without overharvesting or flooding the market. Sustainable forestry would benefit the forest products industry and local economy. Importantly, sustainable forest management would provide these benefits while increasing forest health and providing ecosystem services, benefits for wildlife habitat, clean water, clean air, and so on.

The project’s timber harvest and sales would be spaced over time and planned to minimize potential negative impacts to the timber market. Harvests would be planned to include multiple timber sales of various sizes over the next 8-10 years. Such action would avoid inputting a large supply of timber into the market and causing timber prices to decline during the harvest and sale period (Prestemon & Holmes, 2008; Prestemon et al., 2001). Maintaining stable prices may extend the rotation lengths of timber inventories and enhance land values in the market area benefiting the private sector (Prestemon et al., 2001). Conducting harvests over time would reduce effects on timber markets, nontimber values and ecosystem services and benefits.

Restoring natural communities and species that are more resistant and resilient to climate change and extreme events would enhance the long-term sustainability of the forest. Proposed timber stand improvement, non-commercial thinning, and understory control would improve species composition, ground flora diversity, and overall forest health and productivity, for the next 100 years or so. These activities would improve the health and sustainability of forest products in the project area. These treatments would also likely result in contract opportunities and additional revenues for local contractors. These contractors would pay wages that would benefit the employees and the local economy.

Forest treatments that create forest openings and or early successional habitat would create wildlife habitat for wildlife dependent upon early seral habitat. Openings and early successional habitat would increase opportunities for wildlife viewing and some types of recreation and hunting. These increased opportunities for wildlife viewing, recreation, and hunting would likely generate increased local financial expenditures as visitor use increases. These expenditures would occur as visitors purchase fuel, food, and so on in the local area.

Prescribed burning would move the project area closer to the desired conditions of natural communities, reduce long term hazardous fuel loadings, and increase ground flora diversity. Fuel loads and wildfire severity would be reduced. A reduction in wildfire severity would mitigate soil erosion, forest product degradation and habitat loss. In concert with vegetation management activities, natural community enhancement would also likely improve overall forest health and resiliency to climate change.

Construction of a parking area and signage at the Big Barren Creek State Natural Area would provide visitor access to the area. The provision of access would enhance recreation opportunities and promote visitor use and recreation expenditures. The provision of accesses would also decrease environmental impacts from uncontrolled parking. Designated parking would also reduce unauthorized parking on nearby private property.

Trail relocation and periodic maintenance and signing on segments of the Ozark National Recreation Trail would benefit trail users. The trail relocation would improve visitor safety, the recreation setting, mitigate hazard trees, and address environmental impacts. Periodic maintenance and signing would support sustained and increased use of the trail, maintain or improve visitor satisfaction, and promote visitor expenditures associated with trail use.

Invasive species would be monitored and treated. Monitoring and treating invasive species would reduce their spread, competition with native species, and environmental impacts.

Rehabilitation and maintenance activities would be performed on ponds and glades. The presence of numerous small ponds and glades benefit a variety of wildlife species. These areas attract and support plants and wildlife, and may become even more important under climate change and extreme temperatures, droughts, etc. Some of these sites likely support wildlife viewing and wildlife-based recreation. Improved settings may increase recreational visits and local expenditures.

Improved wildlife habitat would benefit wildlife and may increase wildlife viewing, recreation, and hunting. Increased wildlife viewing, recreation, and hunting would likely generate increased local financial expenditures as visitor use increases.

Road maintenance and reconstruction activities would improve the quality of roads. Improved roads would decrease costs associated with vehicle wear and tear and damage to vehicles. Improved road conditions may also reduce the potential for accidents and the associated vehicle repair expenses and medical expenses.

Decommissioning non-System roads and illegal user-created trails would reduce both perceived and potential dangers to trespassers and forest visitors, potential medical expenses, and negative effects to the recreation setting. Importantly, decommissioning non-System roads and illegal user-created trails would likely reduce illegal access, damages to forest resources, and loss of economic value (e.g., Hunt et al., 2009; Manning, 1999; Moore & Driver, 2005).

Decommissioning non-System roads and illegal user-created trails would reduce harassment of wildlife, and help prevent arson, poaching, and other illegal activities (Hunt et al., 2009). Closing illegal, user-created trails would reduce the loss of resources and their economic value. Closures of these areas would reduce the likelihood of infestation of invasive species and pests (which are expected to increase with climate change) and mitigate expenditures that would be needed for treatment. The closure of illegal user-created trails would also reduce agency costs for responding to arson fires that often occur in these areas. Further, closing these areas would reduce agency costs required for law enforcement and response activities in these areas.

Maintaining a desirable recreation setting would likely prevent or reduce displacement of recreational visitors and ultimately increase visitation. Preventing or reducing displacement of recreational visitors may increase recreational expenditures in the local area. Preventing or reducing displacement would also reduce personal economic and social costs associated with displacement.

Preventing or reducing displacement would increase visitor satisfaction, length of stay, and desired recreational benefits. Recreational visitors would likely benefit from recreational experiences that increase mental and physical fitness and health and that reduce health care costs.

Improved recreations settings would likely be associated with increased recreational visitation and economic expenditures.

The removal of trash dumps has the potential to create several positive effects. The early removal of trash dumps prevent them from increasing in size and quantity. This action avoids the increased cost of removal of a larger and more hazardous dump that grows over time. The early removal of trash dumps also reduces or prevents the release of harmful contaminants. The potential release of contaminants could require substantial expenditure for environmental clean-up.

Removing trash dumps removes materials that may endanger forest visitors and cause injury or illness. Removing trash dumps reduces the potential for illness and injuries and associated medical expenses. The removal of trash dumps also eliminate sites that often attract rodents that can cause diseases and draw snakes searching for rodents.

Removing trash dumps improves area aesthetics and the recreational setting and experience. The removal of trash dumps may increase recreation visitation and expenditures in the area. Likewise, removing trash dumps near private property may increase property value(s). The removal of trash dumps also shows Forest Service presence and activity. Evidence of Forest Service stewardship may reduce potential criminal activity and impact to forest visitors.

CUMULATIVE EFFECTS ON SOCIAL ECONOMICS

ALTERNATIVE 1 – NO ACTION

Under Alternative 1, vegetative conditions would continue to decline and degrade. Opportunity costs would occur due to the foregone economic benefits that would not be generated from timber that would not be harvested. Fuel loadings would likely increase over time and increase the risks of wildfire that could generate additional economic losses. Wildlife habitat conditions would continue to degrade and some species populations would decline.

Vegetative conditions would likely worsen more rapidly over time due to the effects of climate change and increased temperatures, droughts, pests, and so on. "Changes in disturbance regimes such as changes in forest fire outbreaks, severe storm and wind damage, disease outbreaks, or insect infestations that lead to large areas of dead, dying and decaying trees-can have more immediate effects on markets that changes in forest yields" (Osman-Elasha et al., 2009, p.104).

The illegal use of roads and trails would likely expand and increase impacts to natural resources and recreation settings and would increase future costs for restoration. Recreation participation would likely decline due to degraded conditions and reduced opportunities for wildlife related recreation, and likely result in decreased recreation expenditures.

The number and volume of trash dumps would expand, increase risks of contaminants to humans and the environment, and increase future costs for removal.

The No Action alternative would result in individual and collective conditions that could have (a) significant negative cumulative effect(s) on economics.

ALTERNATIVE 2 – PROPOSED ACTION

Project activities would enhance resource conditions, vegetation, and wildlife habitat and move the area toward restoration and desired conditions. Forest vegetation and habitat would be more resilient to climate change and providing future ecosystems services benefits such as biodiversity, wildlife habitat, clean water, and settings to support multiple-uses. These and other ecosystems services benefits would likely be of greater social and economic value in the future.

The project would generate economic benefits to local counties and the region. Economic benefits would accrue from the timber industry, recreation, and secondary and induced economic effects. Forest restoration would facilitate future forest conditions later in the century that would allow sustainable forests, sustainable harvests, income streams, and economic benefits.

The proposed project would likely result in positive cumulative effects over the future as the project area becomes more capable of withstanding climate change effects, providing ecosystems services benefits, and yielding sustainable forest products and economic benefits.

ECONOMIC ANALYSIS

REQUIREMENTS FOR CONSIDERATION OF ENVIRONMENTAL, ECONOMIC AND TECHNICAL CONSIDERATIONS

The National Environmental Policy Act requires that project-level analysis consider environmental amenities and values along with economic and technical considerations. Externalized costs and benefits of ecosystem services are to be analyzed, however, there is no presumption that these values must be reduced to dollar amounts, and it is presumed that many of these values cannot be quantified. Implementing Regulations at 40 Code of Federal Regulation Part 1502.23 specifically states that ". . . the weighting of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations" (Council on Environmental Quality, n.d.).

The proposed project activities would restore or enhance natural communities, improve forest health and wildlife habitats, and move forest conditions to be more resilient to climate change. In addition, the project would produce a myriad of environmental, economic and social benefits, many of which cannot be quantified. As examples, how would the social, economic, and environmental benefits of forest health, clean air, clean water, carbon sequestration, scenic beauty, and so on, be quantified at the project-level?

While numerous project costs can be estimated, the resulting social and economic benefits are often unquantifiable. The cost of removing trash dumps can be calculated, but the economic benefits of cleaner water and improved aesthetics is not quantifiable in this project. The costs of road maintenance can be estimated, but it is not feasible to quantify the economic benefits of use of forest roads for travel to work, business activities, or for travel to pursue recreational activities that benefit personal physical and mental health and reduce medical costs.

While direct project costs or benefits to the Forest Service can be estimated, total economic benefits that result from harvest, transportation, processing, distribution, and disposition of finished forest products is not readily quantifiable. While timber harvests would produce such benefits, the timber treatments would move the forest closer to natural conditions and improved forest health to provide sustainable future environmental and economic benefits which are not readily quantifiable.

Timber harvests would open forest areas and create early successional habitat that would benefit certain wildlife species and increase opportunities for wildlife viewing and hunting, but the economic and social benefits of these open areas are not readily quantifiable. The project would likely benefit numerous wildlife species, including federally-listed species, management indicator species, and species of state concern, however, these benefits are unquantifiable.

These various qualitative comparisons, suggest that qualitatively, the project would provide substantial benefits that cannot be readily quantified. Forest Service projects consider various values, benefits, and economics, but decisions are not required to be made primarily for the greatest dollar return or unit output.

ECOSYSTEMS SERVICES AMENITIES AND VALUES

The national forest provides numerous "ecosystem services" that serve as our life support system and as natural capital (Collins & Larry, 2007). The term *ecosystem services* refer to the ". . . benefits people obtain from ecosystems" (Millennium Ecosystem Assessment, 2005a, pp. 49-53). "Ecosystem services underpin human well-being" (Millennium Ecosystem Assessment, 2005b, p. 50). Ecosystem services support human well-being by providing *Basic Material for Good Life* (e.g., food, shelter, energy, and water) and *Security* (e.g., security from disaster), supporting *Health* (e.g., clean air and water), and facilitating *Good Social Relations* (e.g., social cohesion) (Millennium Ecosystem Assessment, 2005b).

Ecosystem services include *Provisioning, Regulating, Cultural and Supporting services* that affect human well-being (Millennium Ecosystem Assessment, 2005a), 2005b; Ranganathan et al., 2008). Forests provide P*rovisioning Services* and products that include fresh water, fuel wood, fiber, natural medicines and biochemicals, genetic resources, and ornaments such as flowers. Provisioning Services are economically valued in markets and typically receive focal economic consideration in decisions for timber value. Non-timber forest products such as medicinal plants, mushrooms and edible plants and fish and wildlife also often generate income or subsistence resources that benefit the rural poor (Krieger, 2001; Osman-Elasha et al., 2009).

The national forest provides *Regulating Services* that maintain air quality, influence local climate such as temperature and precipitation, support waste treatment, affect water filtration and transport and storage, retain soils, provide pollination, and influence natural hazards such as flash flooding and wildfire, among other regulating services. These services, though often unrecognized are critical to our health, security, and very survival.

The national forest provides *Cultural Services* through scenic beauty and aesthetic vistas and scenes, natural connections for inspiration and spiritual and religious enrichment, historically and or culturally important areas, a sense of place, outdoor recreation opportunities, and sites that support tourism. Forest visitors directly benefit from these services. Further, many people ascribe *existence value* to forests in knowing that the forests and cultural resources exist and will continue to exist in the future (Krieger, 2001) even though they may never experience these features.

Forests also provide *Supporting Services* such as oxygen, soils, nutrient cycling, water purification and cycling, and habitat. Supporting services maintain the conditions of life (Millennium Ecosystem Assessment, 2005a). Many of these services are often taken for granted, but are often important to our health, security, and survival.

CHALLENGES IN ESTIMATING THE VALUE OF ECOSYSTEMS SERVICES

The values of non-market ecosystem services are often overlooked in decisions which are typically based on measurable economic benefits (Krieger, 2001; Millennium Ecosystem Assessment, 2005b; Ranganathan et al., 2008). *Regulating, Supporting* and *Cultural Services* are often not adequately considered in decisions as many are intangible, lack assigned monetary values, and or are hard to measure (Millennium Ecosystem Assessment, 2005a)(Collins & Larry, 2007; Krieger, 2001; Ninan, & Inoue, 2013). Many ecosystem services are also *public goods* in that they are available to everyone at no charge (e.g., scenic beauty or clean air) (Collins & Larry, 2007; Krieger, 2001; Millennium Ecosystem Assessment, 2005b).

Sustainable management of ecosystems requires consideration of non-market values as well as economic impacts of decisions (de Groot et al., 2012; Krieger, 2001; Millennium Ecosystem Assessment, 2005b; Ranganathan et al., 2008). Costs of ecosystem services often involve trade-offs resulting in opportunity costs, degradation that requires enhancement, and or loss that requires replacement (de Groot et al., 2012; Krieger, 2001; Millennium Ecosystem Assessment,

2005b; Ranganathan et al., 2008). Costs of ecosystems services are borne by large groups of people and future generations while economic benefits typically accrue to a small number of people and the current generation (Krieger, 2001).

". . . Nonmarketed benefits are often high and sometimes more valuable than the marketed ones" (Millennium Ecosystem Assessment, 2005b, p. 6). Importantly, de Groot et al. (2012) notes that values of some ecosystem services may be undervalued as the values of some service are not yet recognized. These authors note that the value of carbon sequestration was only recently recognized and is of high value.

Reported values of ecosystem services vary widely based on location, type of biome, type of service, local context and social conditions, study methods, and so on (de Groot et al., 2012; Krieger, 2001; Ninan & Inoue, 2013). Some existing studies have been criticized based on design, lack of detail, price and year of value, lack of value standardization, etc. (de Groot et al., 2012; Ninan & Inoue, 2013). However, Krieger (2001) notes that ". . . the reported values [of ecosystem services] can serve as a basis for estimates relevant to specific regions or ecosystems" (p. 7).

Available data suggests that the total value of ecosystem services exceed the value of timber as a raw material at least 3-25 times. The Millennium Ecosystem Assessment (2005b) indicates that non-timber products account for “. . . between 25% and 96% of the total economic value of the forests” (p. 6). The Millennium Ecosystem Assessment (2005b, p. 9) also reported that “. . . the market values of ecosystem services associated with timber and fuelwood products are less than one-third of the total economic value including nonmarket values such as carbon sequestration, watershed protection, and recreation”.

At the low end, separate meta-analyses indicate that raw materials from global temperate forests account for 6.01% (de Groot et al., 2012, p. 55) and 7.94% (Ninan & Inoue, 2013, p. 147) of their total ecosystem service value. Consistently, other analyses reports that raw materials from global temperate forests account for 8.26% (Krieger, 2001, p.8) to 8.35% (Ninan & Inoue’s, 2013, p. 138) of their total ecosystem services value. Similarly, a study of U.S. Forests by Krieger (2001) indicates that timber accounts for approximately 8.33% of their total ecosystem services value.

Some studies report estimated financial values for various ecosystem services. As an example, Krieger’s (2001) study indicates a value per acre of U.S. forests at $122.31 per acre in 1994 dollars (with several missing values), which would be worth an estimated real price of $192 per acre in today’s dollars. More recently, Esposito, Phillips, Boumans, Moulaert, and Boggs' (2011) study suggest a value of $355.26 per acre across U.S. public lands. In contrast, de Groot et al. (2012) reported a value of $3,013 per hectare for temperate forests in 2007 dollars which would be worth an estimate real price of $8,376.69 per acre in today’s dollars. Estimated values in terms of land area appear to vary widely across studies, biomes, metrics, and methods of calculations.

Importantly, the value of ecosystem services will likely increase substantially in the future (Millennium Ecosystem Assessment, 2005a)(Adams et al., 2011; Alig, 2011; Collins & Larry, 2007; de Groot et al., 2012; Millennium Ecosystem Assessment 2005b; Ranganathan et al., 2008). The importance and “human use of ecosystem services increases substantially . . . during the next 50 and will be adversely affected by climate change” (Millennium Ecosystem Assessment, 2005b, p. 80). Consistently, managers need to make decisions that will enable future landscapes to continue providing ecosystem services (Collins & Larry, 2007; Millennium Ecosystem Assessment, 2005b; Ranganathan et al., 2008).

ECONOMIC ANALYSIS BACKGROUND AND ASSUMPTIONS

Economic analyses were conducted for the project. Known and quantifiable benefits and costs were estimated. These values were based on respective resource management specialists' input that reflected data from similar projects. Project planning and analysis investments such as

silviculture and cultural resources analysis were excluded from analysis consistent with Office of Management and Budget (1992) Circular A-94 Revised.

Recreation visitor use and expenditures were considered the same across both alternatives. While recreation visitor use and expenditures would likely increase under Alternative 2, data is not available to predict the magnitude of likely differences across alternatives.

Alternative 1, the No Action Alternative, would incur “opportunity costs” due to actions that would be foregone. Financial losses would occur as a result of timber mortality from oak decline and not conducting timber harvest. It is estimated that timber mortality for timber would occur at a rate of 20% per decade (Kabrick et al., 2004). This value was included in the analysis as an opportunity cost of not performing harvest activities and is consistent with direction in Office of Management and Budget (1992) Circular A-94 Revised. This mortality loss was distributed as 2% mortality per year for the estimated duration of the project and was assigned the same value and volume estimates as the estimated hardwood volume proposed for harvest in the proposed action.

Alternative 2 Proposed Action costs analyzed included timber and vegetative treatments, road activities (e.g., reconstruction, maintenance, decommissioning), prescribed fire, treatment of invasive species, pond maintenance, glade maintenance, reroute of the Ozark National Recreation Trail, trail maintenance and signing, and construction of a parking area at the Big Barren Creek State Natural Area. Some activity costs within Alternative 2 would be covered within timber sales such as temporary roads, some road maintenance, road closure, etc., and were not included in the analysis to avoid “double counting”. Some expenditure items would be captured as part of road maintenance and timber sales such as trash dump removal.

Alternative 2 benefits considered included timber revenues, the purchase of firewood permits, and recreation expenditures that benefit the local economy.

Data on project activities and their associated costs and benefits were entered into Quick-Silver 6.0, a Forest Service program for financial analysis of resource management projects (USDA Forest Service: Planning and Analysis Group, 2012). Assumptions for economic analysis included use of a 4% Discount Rate and 0% Inflation Rate.

As emphasized in Office of Management and Budget (1992) Circular A-94 Revised, estimates of benefits and costs typically include uncertainty because of the underlying data and modeling assumptions. Uncertainty also exists for this project with the potential effects of climate change and forest disturbance events, actual forest outputs, and actual future market values of prices and economic perturbations in local and regional economies.

ECONOMIC ANALYSIS RESULTS

Results of the economic analysis are provided in Table 41 and reflect 2009 dollars.

Table 41. Economic Analysis Result.

Economic Criterion	Alternative 1 (No Action Alternative)	Alternative 2 (Proposed Action)
Benefit/Cost Ratio	0.00	2.50
Composite Rate of Return (%)	NA	10.54
Investment Length (Years)	15	15
Net Annual Equivalent ($)	-$11,569	$500,540
Present Net Value	-$128,624	$5,565,204
Present Value Benefits	$0	$9,286,093
Present Value Costs	-$128,624	-$3,720,888

The *Benefit/Cost Ratio* equals the sum of the discounted benefits divided by the sum of the discounted costs. Projects with a Benefit/Cost Ratio above 1.0 are economically desirable as the value of the benefits exceed the costs. Benefit/Cost Ratios can often be used to rank similar projects with the higher ratio being desirable and excepted. The Benefit/Cost Ratio indicates that Alternative 2 is desirable, as it is above 1.0, and it is above that of Alternative 1. This ratio indicates that the benefits in Alternative 2 exceed the costs 2.5 times. In contrast, the costs of Alternative 1 exceed the benefits which yield a ratio below 1.0.

The *Composite Rate of Return* assumes that early revenues are reinvested at the discount rate. A return of 10.54% in Alternative 2 is more desirable than a loss in Alternative 1.

The *Investment Length* indicates the number of years from the first investment period to the year when the last cost or benefit occurs. The investment length evaluated was 15 years for each alternative.

The *Net Annual Equivalent* is a measure of annual profit from the investment. Alternative 2 yields a Net Annual Equivalent of nearly $500,540 as compared to an annual net loss of $11,569 incurred by Alternative 1.

Present Net Values reflect the sum of future benefits or costs, or their net value discounted to today's value. The Present Net Value of Alternative 2 is $5,565,204, as compared to Alternative 1, which would be equivalent to a net loss of $128,624. When converted from 2009 dollars to 2013 dollars adjusted for the Consumer Price Index, the real price benefit would be $6,040,000.

Economic criterion and Benefit/Cost analysis and data indicate that Alternative 2 (Proposed Action) is more beneficial than Alternative 1 (No Action Alternative). From an economic perspective, Alternative 2 is more beneficial than Alternative 1 (No Action Alternative).

Total economic impacts of the proposed project would actually be greater than the simple direct effects of receipts from timber sales and local expenditures that occur in conjunction with forest visits. Project revenues and economic activity such as labor wages and income would also generate induced secondary and multiplier effects. As an example, economic multipliers for Missouri (American Sportfishing Association & USDA Forest Service, 2007) suggests that the estimated annual $355,633.96 in direct economic expenditures associated with visits to the national forest project area would result in approximately $711,267.91 in total economic benefits through multiplier effects.

Year 2010 economic contribution reports for the Mark Twain National Forest Timber Products (FSWeb: U.S. Forest Service Intranet, 2014) indicate that:

- Each $1 of Direct Gross Regional Product for Timber Products generates approximately $2.69 in Secondary Gross Regional Product.
- Each $1 of Direct Employee Compensation in Timber Products generates approximately $1.52 in Secondary Employee Compensation.
- Each $1 of Direct Total Income from Timber Products generates approximately $2.50 in Total Secondary Income.
- One (1) job is created per $74,095 of Gross Regional Product.
- For each job created in Direct Employment in Timber Products, approximately 1.4 jobs are generated in Secondary employment.

Projected expenditures for Timber Products during the project yield a present value of approximately $6,897,150. This value equates to an average annual expenditure of $689,000 for Timber Products across the 10 years of timber activities. Employment multipliers derived from data FSWeb: U.S. Forest Service Intranet, 2014) suggests that Timber Products would generate

approximately 9.3 total average annual jobs across the 10-years of timber activities, 3.8 of which would be in direct employment, and 5.5 of which would be in secondary employment.
It should be noted that the estimated number of jobs throughout this section is likely conservative. All estimates of jobs are based on direct expenditures or investments within the project area and local area. Economic analysis conducted by an economist at a regional scale would consider not only local financial expenditures and impacts but secondary and induced economic impacts and multiplier effects of expenditures, incomes, and so on at multiple scales that would sum to yield the gross regional product. Thus, a complete economic analysis by an economist may yield higher numbers for employment that reflects multiple scales.

A review of year 2010 economic contribution reports for Mark Twain National Forest Recreation Visitor Use (FSWeb: U.S. Forest Service Intranet, 2014) indicates that:

- Each $1 of Direct Gross Regional Product from Recreation Visitor Use generates approximately 45¢ in Secondary Gross Regional Product.
- Each $1 of Direct Employee Compensation in Recreation Visitor Use generates approximately 34¢ in Secondary Employee Compensation.
- Each $1 of Direct Total Income from Recreation Visitor Use generates approximately 49 in Total Secondary Income.
- One (1) job is created per $44,926 of Gross Regional Product.
- For every 10 jobs created in Direct Employment associated with Recreation Visitor Use, approximately 3 jobs were created in Secondary Employment.

Projected expenditures for Recreation Visitor Use during the project yields a present value of approximately $3,801,997 in 2009 dollars. The Recreation Visitor Use benefits would be worth approximately $4,130,000 when adjusted for the real price of 2013 dollars based on the Consumer Price Index. This value equates to an average annual expenditure of $275,333 for Recreation Visitor Use. Employment multipliers derived from data FSWeb: U.S. Forest Service Intranet (2014) suggests that Recreation Visitor Use would generate approximately 6.1 total average annual jobs across the 15-year project life, 4.7 of which would be in direct employment, and 1.4 of which would be in secondary employment.

Year 2010 economic contribution reports for the Mark Twain National Forest Resource Management Investments (FSWeb: U.S. Forest Service Intranet, 2014) indicate that:

- Each $1 of Direct Gross Regional Product for Forest Service Resource Management Investments generates approximately 39¢ in Secondary Gross Regional Product.
- Each $1 of Direct Employee Compensation in Forest Service Resource Management Investments generates approximately 19¢ in Secondary Employee Compensation.
- Each $1 of Direct Total Income from Forest Service Resource Management Investments generates approximately 35¢ in Total Secondary Income.
- One (1) job is created per $76,141 of Gross Regional Product.

Substantial Forest Service Resource Management Investments will be made over the life of the project. These investments include a parking area at the Big Barren Creek State Natural Area ($1,233), invasive species treatment ($93,410), prescribed fire treatments ($351,183), road maintenance and activities ($146,408), trail activities ($6,346), timber management activities such as planting and thinning ($2,583,752), and wildlife and natural area activities ($13,254), and various business operations for project implementation ($525,302). The present value of Forest Service Resource Management Investments over the life of the project is estimated to be approximately $3,720,888.

Employment multipliers derived from FSWeb: U.S. Forest Service Intranet (2014) data suggests that Forest Service Resource Management Investments would generate approximately 48.9 average annual jobs during resource management investment activities. Of these jobs, approximately 31.5 would be in direct employment and 17.4 would be in secondary employment.

It may be reasonable to presume that Payments in Lieu of Taxes to Carter and Shannon Counties in 2014 would be similar to that in 2013 of $120,500 and $145,525 respectively. A review of FSWeb: U.S. Forest Service Intranet (2014) data suggests that 1 job is created per $56,179.37 of gross regional product associated with Payments in Lieu of Taxes. Payments in Lieu of Taxes would produce 4.7 jobs across both counties. Of these jobs, approximately 3.3 would be in direct employment and 1.4 would be in secondary employment. The Payments in Lieu of Taxes will likely continue.

Funding under the Secure Rural School and Community Self-Determination Act has been reauthorized for one year. In Fiscal Year 2012, Carter County received $228,053.17 and Shannon County received $290,447.39. If funding continues at this level, approximately 9.2 jobs may be created, of which 6.5 would likely be in direct employment, and 2.7 would be in secondary employment.

The economic analysis does not consider economic benefits that are not readily quantifiable or qualitative benefits such as ecosystems services benefits such as those associated with a clean environment, clean water, aesthetic beauty, quality of life, and so on. As advanced by Krieger (2001), reported values of ecosystems services can serve as a basis for estimates of ecosystem services.

Available data suggests that the total value of ecosystems services benefits within the Fremont-Pineknot East Restoration Project area may fall within a bounded range of $10.5-$249 Million Dollars. Total ecosystem services values of temperate forest have been found to exceed the value of timber as a raw material at least 3-25 times (e.g., de Groot et al., 2012; Krieger, 2001; Ninan & Inoue, 2013; The Millennium Ecosystem Assessment, 2005b). Given the estimated present value of timber sales receipts of $6,897,150 as raw material from the project, suggests an estimated bounded range value of total ecosystem services of $20,691,450 to $247,428,750.

Given Esposito, Phillips, Boumans, Moulaert, and Boggs' (2011) use of conservative values and overall value of $355.26 per acre times the 29,767 acres in the project area would suggest that a total ecosystem services value of $10,575,024.42. In contrast, de Groot et al.'s (2012) value of $3,013 per hectare for temperate forests in 2007 dollars would be worth an estimated real price of $3,390 in 2013 dollars, and when converted to acres, yields a value of $8,376.69 per acre, or $249,348,931 for the entire project area.

Importantly, the values of some ecosystem services may be undervalued or unknown (de Groot et al., 2012), and the values of ecosystem services will increase in the future (Millennium Ecosystem Assessment, 2005a)(Adams et al., 2011; Alig, 2011; Collins & Larry, 2007; de Groot et al., 2012; Millennium Ecosystem Assessment 2005b; Ranganathan et al., 2008). The proposed project would improve forest health and enhance the area's capability to adapt to climate change and provide sustainable ecosystems services benefits over the next 100 years.

SUMMARY OF EFFECTS ON ECONOMICS

The project would produce a myriad of environmental, economic and social benefits, many of which cannot be quantified. From a qualitative perspective, Alternative 2 (Proposed Action) best meets the project's purpose to benefit forest health and wildlife. These and other environmental benefits are unquantifiable. From an economic perspective, Alternative 2 is more beneficial than Alternative 1 (No Action Alternative), and will likely generate over $6 Million Dollars (in 2013 dollars) of net economic benefits over the project life.

The project would increase the future productivity and economic value of forest products in the project area and generate sustainable ecosystem services benefits over time. Project activities would enhance the quality of the environment and recreation setting, create wildlife habitat, and increase opportunities for wildlife viewing, recreation, and hunting. Enhanced environmental conditions and recreation settings also have the potential to generate increased social and economic benefits to the geographic area.

Implementation of Alternative 2, the Proposed Action, would make the landscape more capable of withstanding climate change effects and providing sustained ecosystems services benefits. Total ecosystems services benefits for the project area may range from $10.5-$249 Million Dollars. While not readily quantifiable, it is likely that the importance of ecosystem services will increase substantially in the future as the project area provides sustainable social and economic benefits through the next century.

The cumulative effects spatial boundary includes Carter and Shannon counties. Timber harvests conducted on the forest may involve several harvest crews from these and or other area counties. Once logs are processed, many of these products would likely be purchased by secondary wood industries located across the local counties and other counties in the region. The finished products may then be sold to consumers within the region or beyond. Similarly, Recreation Visitor Use would generate effects positive economic effects in the geographic area.

Project effects may last up to 15 years, or longer. Most commercial logging operations would likely last up to 10-12 years following the decision. Harvested trees would be processed and the resulting products would be distributed to secondary product markets and to consumers. Many of the products generated from this project would serve various purposes for an extended period of time beyond that (e.g., railroad cross ties, fence posts, cooperage products, etc.). Timber stand improvement activities and other physical activities would likely occur during years 5-15. These activities would likely produce employment and revenue streams throughout the life of the project and beyond the implementation time of project activities.

This project would not likely result in unavoidable adverse impacts as harvests and market inputs would be conducted in a sustainable manner over time to avoid adverse impacts to the environment and local markets and the economy.

The proposed project activities would not negatively impact long-term productivity. Proposed actions would provide for periodic harvests and economic benefits which would not degrade long-term productivity.

Neither of the alternatives would have an irreversible or irretrievable commitment as related to economics.

The proposed project complies with the Federal Land Policy Management Act of 1976 (2001), Forest and Rangeland Renewable Resources Planning Act of 1974 (1974), the Multiple Use Sustained Yield Act, and National Forest Management Act of 1960 (1960), by considering multiple uses in this land management planning processes. The project complies with the National Environmental Policy Act of 1969 (1970) and Council on Environmental Quality (n.d.) regulations as it analyzes and considers environmental amenities and values along with economic and technical considerations.

ENVIRONMENTAL JUSTICE

AFFECTED ENVIRONMENTS

Demographic profiles of relevant population centers were generated with the Economic Profile System-Human Dimensions Toolkit (EPS-HDT) (Headwaters Economics, 2014) and are

summarized within this section. These communities and towns included Fremont (identified as a Census Designated Place in EPS-HDT), Van Buren (identified as a town in EPS-HDT), and Winona (identified as a city in EPS-HDT).

The project area is located in a rural area in the vicinity of the unincorporated community of Fremont, Missouri (population: 132). The nearest sizeable towns include Van Buren (population: 858) and Winona (population: 1,414). Since 2000, Van Buren grew 1.5% and Winona grew 9.6%. The Median Ages in 2012 were 54.6 years for Van Buren and 35.4 years for Winona, which is considerably older as compared to the Median Age of 37.9 for the State of Missouri.

These areas are very similar in racial make-up and predominantly classified as White with Fremont being 100% White, Van Buren being 98.3% White, and Winona being 96.1% White. Other races present include 0.8% Black or African American in Van Buren and 1.9% Black or African American in Winona. As compared to the racial composition of the State of Missouri's 83.1% White, these local areas have approximately 13%-15% higher percentages of Whites. As compared to specific categories of other races, the State of Missouri as well as the local towns is made up of less than 2% by each respective minority category.

Across these towns, employment primarily occurs in the category of Education, Health Care, & Social Assistance, and includes approximately 22%-31% of employment by town. Approximately 16%-18% of people are employed in Retail Trade across these towns. Approximately 14%-16% of the work force is employed in Manufacturing in Van Buren and Winona. Employment is spread across a variety of other industry segments. Of note, employment within the category of Agriculture, Forestry, Fishing & Hunting, Mining is 4.1% for Van Buren and 8.3% for Winona. Data was not available for employment for Fremont.

The Median Household Incomes were $25,958 for Van Buren and $23,051 for Winona, as compared to $47,333 for the State of Missouri. As compared to the Median Household Income for the State of Missouri, the Median Household Income for Van Buren is approximately 45% lower, and Winona is approximately 51% lower. The Per Capita Income was $18,541 for Van Buren and $12,571 for Winona as compared to $25,546 for the State of Missouri. As compared to the Per Capita Income for the State of Missouri, the Per Capita Income for Van Buren is approximately 27% lower, and Winona is approximately 51% lower.

Approximately 92% of the people in Fremont, 13% of people in Van Buren, and 37% of people in Winona are below the Poverty Level. The Poverty Level for Van Buren is nearly comparable to the 15% for the State of Missouri. The Poverty Level for Winona is nearly 2.5 times higher than the Poverty Level for the State of Missouri.

Less than 29% of the population 25 years or older in Fremont are High School Graduates, and data indicate that no one has a Bachelor's Degree or Higher. For Van Buren, approximately 85% of the population 25 years or older have completed a High School Degree, and 11% have completed a Bachelor's Degree or Higher. In Winona, approximately 73% have completed a High School Degree, and approximately 4% have completed a Bachelor's Degree or Higher. For the State of Missouri, approximately 83% of people 25 years or older have completed a High School Degree, and nearly 26% have completed a Bachelor's Degree or Higher.

LOCAL UNEMPLOYMENT

Local Area Unemployment Statistics (Missouri Economic Research and Information Center, n.d.c) for 2013 were as follows: Carter County - 7.5%, Oregon County – 6.6%, Ripley County – 6.9%, Shannon County - 8.6%, and the State of Missouri – 6.5%. As compared to unemployment

rates in 2012, each has improved 0.2%-0.5%, with the exception of Shannon County which has improved 2.0%.

According to the Missouri Economic Research and Information Center (n.d.d) Industry Employment Projections for 2012-2014 reports *Forestry and Logging* (Industry Code 113000) as a Declining Industry with a loss of 9 jobs and a decline of 4.76%. *Support Activities for Agriculture and Forestry* (Industry Code 115000) is similarly listed as a Declining Industry with a loss of 24 jobs and a decline of 1.04%. In contrast, *Wood Product Manufacturing* (Industry Code 331000) is identified among the Industries with Largest Growth for 2012-2014 with 271 new jobs and 3.66% growth.

The Missouri Economic Research and Information Center (n.d.e) Industry Employment Projections for 2010-2020 indicates an increase of 4 jobs with 2.4% growth for *Logging* (Industry Code 113300). *Support Activities for Forestry* (Industry Code 115300) are expected to grow by 8 jobs or 20%. *Logging* and *Support Activities* are listed among the Industries with the projected Fastest Growth for 2010-2020 and Industries with the Largest Growth for 2010-2020.

The proposed project would provide employment opportunities in forestry and support activities and facilitate the wood product manufacturing industry in the local communities and counties in the regional area.

ENVIRONMENTAL JUSTICE BACKGROUND

This section on environmental justice analyzes and considers the effects of the proposed action on low-income and minority populations. Executive Order Number 12898 (1994), “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” directs that:

> . . . each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States . . . . (Exec. Order No. 12898 1994, Section 1-101.)

Environmental justice is defined “. . . as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (U.S. Environmental Protection Agency, 2010, p. 3). According to the U.S. Environmental Protection Agency (2010), fair treatment considers activities in term of how burdens and benefits (such as environmental effects) are distributed across all populations.

The U.S. Environmental Protection Agency defines fair treatment as:

Fair Treatment means that no group of people should bear a disproportionate burden of environmental harms and risks, including those resulting from the negative environmental consequences of industrial, governmental, and commercial operations or programs and policies. (U.S. Environmental Protection Agency, 2010, p. 3)

Meaningful involvement is defined as:

> Meaningful Involvement means that: 1) potentially affected community members have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; 2) the public’s contribution can influence the regulatory agency’s decision; 3) the concerns of all participants involved will be considered in the

> decision-making process; and 4) the decision-makers seek out and facilitate the involvement of those potentially affected. (U.S. Environmental Protection Agency, 2010, p. 3)

During implementation of environmental justice, special attention is given to ". . . populations that have historically borne a disproportionate share of environmental harms and risk . . . ." (U.S. Environmental Protection Agency, 2010, p. 3). But, agencies are ". . . also encouraged to look at the distribution of the positive environmental and health consequences from . . . activities" (U.S. Environmental Protection Agency, 2010, p. 3).

CONSIDERATION OF ENVIRONMENTAL JUSTICE

According to the U.S. Environmental Protection Agency (2010), agency environmental justice processes should be able to answer the following questions:

1. How did your public participation process provide transparency and meaningful participation for minority, low-income, and indigenous populations, and tribes?

2. How did you identify and address existing and new disproportionate environmental and public health impacts on minority, low-income, and indigenous populations?

3. How did actions taken under #1 and #2 impact the outcome or final decision?

(Adapted from U.S. Environmental Protection Agency, 2010, p. 26.)

TRANSPARENCY AND MEANINGFUL PARTICIPATION

Public involvement activities have sought to contact and involve all populations. As detailed in the Public Involvement section, mailings were conducted to recognized Native American Tribes. Public service announcements were submitted to local newspapers and legal notices were published. These announcements and legal notices were conducted to notify the public of the proposed action and to seek their input and involvement in this decision making process. In addition, the proposed action and documents were posted on the Mark Twain National Forest Web page.

Outreach letters and notices have stated that all project documents can be mailed to individuals who request such materials. This offer was made to mitigate potential environmental justice concerns that may exist as related to individuals that may lack Internet access, appropriate technology, or technical skills. In addition, outreach letters and notices have stated that individuals can submit written or oral comments to the Forest Service. Accepting written or oral comments may help mitigate potential concerns related to individuals that lack Internet access, appropriate technology, technical skills, or communication skills.

Outreach materials have incorporated tailored messages (U.S. Environmental Protection Agency, 2010) that have sought to be concise, understandable, and readily accessible. These materials included simple messages in public service announcements, legal notices, and letters. These materials included or directed the reader to summary overviews of the project. Instructions were also provided as to how individuals could access full project reports and detailed maps and documents of the proposed actions.

Public comments, including those that may have been submitted from tribes, minorities, and or low-income groups, and that may relate to environmental justice were fully considered. Such comments and consideration are described in the Public Involvement section of this document.

IDENTIFICATION OF MINORITY, LOW INCOME, AND INDIGENOUS POPULATIONS

This environmental justice analysis serves to identify and address existing and new disproportionate environmental and public health impacts on minority, low-income, and indigenous populations. Available demographic and socio-economic resources such as those provided by the U.S. Census Bureau have been reviewed and analyzed to characterize populations in the geographic area that are likely to be most affected by the proposed action. The analysis examines and considers indicators that may suggest potential environmental justice concerns.

IMPACTS ON OUTCOME OR DECISION

The entirety of the *Environmental Justice* section examines the environmental justice implications of the project and which will be considered in the project decision.

ENVIRONMENTAL JUSTICE ANALYSIS METHODS USED

The Environmental Protection Agency (EPA) has been developing new criteria for environmental justice analysis with the release of *Plan EJ 2014* (U.S. Environmental Protection Agency, 2011). A new Web-based Environmental Justice analysis tool will likely be available from EPA in the Fall of 2014 (B. Corazzin, December 4, 2013, and March 14, 2014). In the interim, guidance from EPA is that federal agencies should use the current Web tool *EJ View* (U.S. Environmental Protection Agency, n.d.a.). It should be noted that the existing EJ View tool uses American Community Survey data 2006-2010.

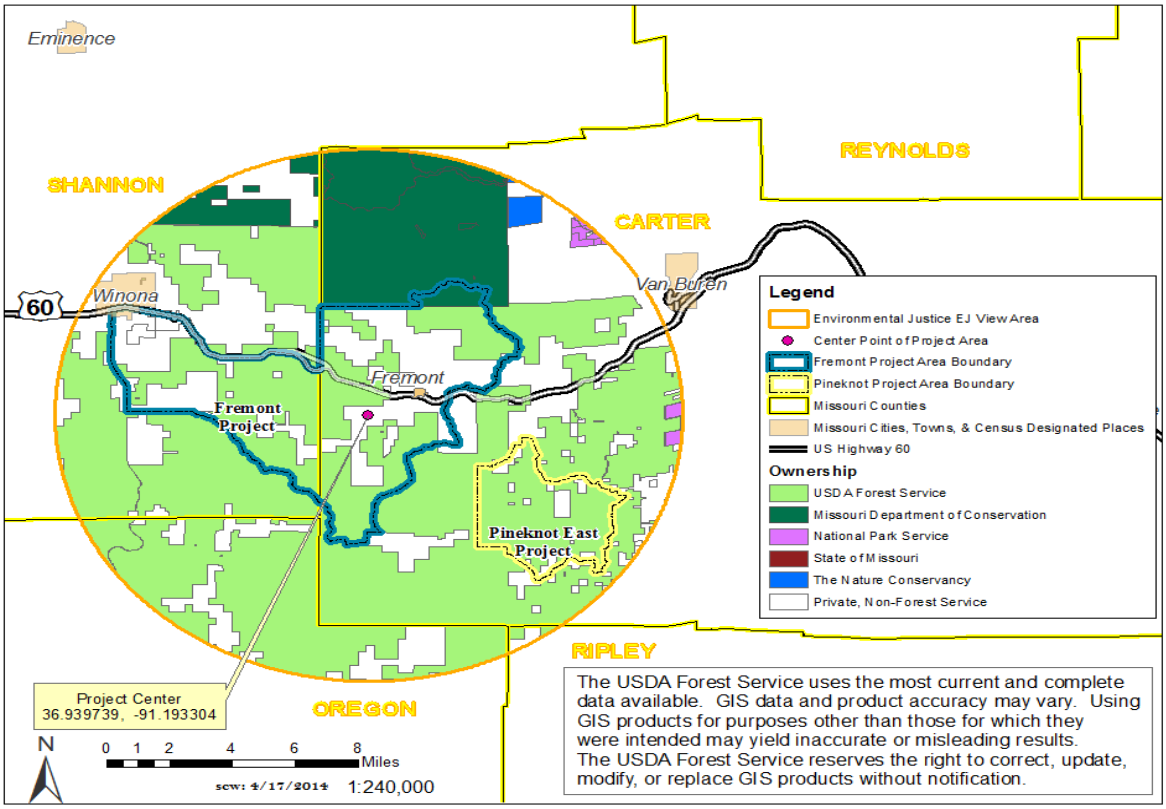
According to Brendan Corazzin, EPA Region 7 Program Management Analyst (personal communication, December 4, 2013; personal communcation, March 21, 2014), EPA Region 7 is using state level data to assist in the identification of potential environmental justice communities until *Plan EJ 2014* (U.S. Environmental Protection Agency, 2011) and new criteria are publically available. For the State of Missouri, the poverty level is 14% as indicated by the number of households with an income at or below $14,999. The minority population in Missouri represents 17.2% of the total population. EPA Region 7 considers a community to have the potential for environmental justice concerns when demographic indicators exceed state averages and the community is disproportionately exposed to environmental hazards.

An EJ View Area (U.S. Environmental Protection Agency, n.d.a. n.d.b.) was established as a 10-mile radius around the project area's center (Latitude 36.939, Longitude -91.192). This area was selected as containing local populations that have the highest potential to experience project impacts. Such impacts may include traffic associated with logging and resource management, views of smoke from prescribed fire, economic impacts, and so on. For more information on potential project impacts from activities to humans from traffic, smoke, impacts to settings, and other impacts, see the *Recreation* section within *Chapter 3 Environmental Consequences*. For information on potential economic impacts, see the *Economics* section.

Figure 16 depicts the Environmental Justice Study Area. The EJ View area is contained within the depicted circle which includes a 10-mile radius around the project area's approximate center.

A small portion of the EJ View Area includes Fremont, Winona, and scattered parcels of private lands shown as white blocks. Most of the lands within the circle are public lands which include

Figure 15. Environmental justice study area based on EPA's EJ View



those managed by the Missouri Department of Conservation, National Park Service, State of Missouri, The Nature Conservancy, and the USDA Forest Service (which includes the Fremont and Pineknot East Project areas). Van Buren is located very close to the EJ View Area. Portions of the EJ View Area fall within Carter, Oregon, Ripley, and Shannon counties.

The Forest Service Zone Geographic Information Systems Specialist analyzed the size of the land area and ownership within the EJ View Area using the forest's Geographical Information System (GIS). Forest GIS analysis indicates that the EJ View Area is approximately 314 square miles in size as compared to that reported in EJ View (U.S. Environmental Protection Agency, n.d.b.) as 268 square miles. GIS indicates that Forest Service lands occupy approximately 183 square miles, or 117,133 acres. Approximately 39 square miles, or 25,209 acres, of land are managed by the Missouri Department of Conservation, National Park Service, The Nature Conservancy, and State of Missouri. GIS shows that approximately 92 square miles, or roughly 58,656 acres, are private lands upon which local residents may reside.

The reported population of 3,512 people within the EJ View Area (U.S. Environmental Protection Agency, n.d.b.) may be high. The population density within the EJ View Area (U.S. Environmental Protection Agency, n.d.b.) is reported as 13 people per square mile, which would suggest a population of 1,196 people living on private lands within the EJ View Area.

ENVIRONMENTAL JUSTICE STATUS VIA ENVIRONMENTAL PROTECTION AGENCY METHODS

Table 42 displays demographic data for the Environmental Justice analysis area. This data is based on a Summary Report from the U.S. Environmental Protection Agency's (n.d.b) EJ View and U.S. Census Bureau (n.d.a; n.d.b; n.d.c; n.d.d; n.d.e; n.d.f; n.d.g; n.d.h; n.d.i; n.d.j) data. U.S. Census Bureau data was extracted for Carter, Oregon, Ripley, and Shannon counties and the State of Missouri for comparison with EJ View data.

U.S. Census data for 2007-2011 was extracted as it contained the most recent and comparable data at the time of analysis. Data for 2008-2012 was reviewed but lacked some report components such as Median Household Income which would detract from comparisons.

Table 42. Environmental justice study area demographic data.

Demographic Characteristics	**EJ View Area @ 10 Mi. Radius**	**Carter County**	**Oregon County**	**Ripley County**	**Shannon County**	**Missouri**
Population [a, b]	3,512	6,208	10,810	14,080	8,428	5,955,802
Gender [a, b]						
Male	50%	48.4%	49.8%	49.3%	50.0%	48.9%
Female	50%	51.6%	50.2%	50.7%	50.0%	51.1%
Race/Ethnicity [a, b]						
White	94%	96.6%	96.3%	99.0%	96.3%	83.2%
Black	1.0%	0.6%	0.2%	0.2%	0.5%	11.5%
American Indian	1.0%	0.6%	1.6%	0.3%	1.0%	0.4%
Asian	0.0%	0.0%	0.3%	0.1%	0.9%	1.6%
Hispanic	1.0%	1.2%	1.2%	1.1%	1.6%	3.5%
Persons Reporting Two or More Races	4.0%	2.0%	1.5%	0.4%	1.3%	2.2%
Age [a, b]						
Under 5 Years	8.0%	7.5%	5.7%	6%	6.2%	6.5%
Under 18 Years	32.0%	24.4%	22.6%	23.6%	23.5%	23.9%
65 Years & Over	9.0%	16.6%	19.4%	18.5%	16.9%	13.9%
Median Household Income [a, c]	Not Available	$26,689	$27,885	$30,198	$31,748	$47,202
Per Capita Income [a, c]	$14,892	$15,597	$15,396	$14,966	$16,095	$25,371
Persons Below Poverty Level [a, c]	Not Available	21.8%	25.2%	25.6%	23.3%	14.3%
Households with Income $14,999 or Less [a, c]	23.0%	14.5%	27.1%	18.3%	13.8%	6.7%

Notes. Data adapted from: [a]U.S. Environmental Protection Agency's (n.d.b) EJ View Summary Report (all data was reported in whole numbers); and [b]U.S. Census Bureau (n.d.a; n.d.b; n.d.c; n.d.d; n.d.e) DP05 reports for Carter, Oregon, Ripley and Shannon Counties, and the State of Missouri. [c]Data adapted from U.S. Census Bureau (n.d.f; n.d.g; n.d.h; n.d.i; n.d.j) DP03 reports for Carter, Oregon, Ripley and Shannon Counties, and the State of Missouri.

Statistics for these areas can be compared to provide insights related to population and income. Visual comparison of data shows that the gender ratios for the EJ View Area and the counties are similar to the state. However, statistics for race/ethnicity, age, median household income, persons

below the poverty level, and households with incomes of $14,999 or less and show some substantial differences that warrant further consideration.

The following sections provide additional details on race/ethnicity, age, income, and education as related to potential environmental justice concerns.

MINORITY POPULATION

Minority populations within the EJ View Area and area counties are well below the state average of 16.8% and do not indicate significant concern.

LOW-INCOME POPULATION

The United States Department of Agriculture's Economic Research Service (2008) has identified Carter, Oregon, Ripley, and Shannon counties, Missouri, as persistent poverty counties and as persistent child poverty counties. The Economic Research Service has defined persistent poverty counties as those counties with poverty rates of 20% or more in each census in the decades from 1970 through 2000. The persistent child poverty county indicator applies to children under 18 years of age and was added in 2009.

Analysis of the Table 42 demographic characteristics of the EJ View Area shows that the percentage of Households with Income of $14,999 or less is 3.4 times greater than that for the State of Missouri. The percentage of Households with Income of $14,999 or less in the EJ View Area is approximately 1.59 times greater than that of Carter County, is 1.25 times that of Ripley County, and 1.67 times that of Shannon County. The percentage of Households with Income of $14,999 or less in Oregon County is 1.2 times that of the EJ View Area.

The EJ View Area, as well as Carter, Oregon, and Ripley counties have percentages of Households with Income of $14,999 or less that exceeds the 14% threshold and may indicate low income environmental justice populations of concern.

The U.S. Environmental Protection Agency's (n.d.b) EJ View Summary Report did not provide data on the Median Household Income or Persons Below Poverty Level for the EJ View Area. Comparisons cannot be made for these demographic variables. As compared to the State of Missouri, the Median Household Incomes of the local counties are 32.74% - 43.46% lower. The percentages of Persons Below Poverty Level for the local counties are 1.52 - 1.79 times higher than that for the State of Missouri.

The Per Capita Income for the EJ View Area is approximately 41.30% less than that for the State of Missouri. The Per Capita Income for the EJ View Area is roughly 4.52% less than that of Carter County, 3.27% less than that of Oregon County, nearly equal to that of Ripley County, and 7.47% less than that for Shannon County.

ENVIRONMENTAL JUSTICE ANALYSIS VIA NEW FOREST SERVICE GUIDELINES

The Forest Service released guidance on environmental justice to field units just prior to the release of this environmental assessment (P. Whitworth, personal communication, March 31, 2014). Forest Service guidance on environmental justice (Grinspoon et al., 2014, p. 7) notes that federal agencies are to "analyze environmental effects, including human health, economic, and social effects on minority populations, low-income populations, and Indian tribes . . . ."

Forest Service guidance on environmental justice (Grinspoon et al., 2014, p. 8; Periman & Grinspoon, 2014, p. 5) recommends use of the Council on Environmental Quality's definition of a minority population which specified that "A minority population may be an identifiable group that has a meaningfully greater minority population than the adjacent geographic areas, or may

also be a geographically dispersed/transient set of individuals such as migrant workers or Native Americans."

Forest Service guidance states that: "Identifying meaningfully greater means making efforts to measure the study area in relation to the general population. A difference of more than 5 percent between the study area and the surrounding geographic area may indicate a minority population" (Grinspoon et al., 2014, p. 8). Guidance indicates that units use the recommended 5 percent threshold or set a different threshold for meaningfully greater differences based on local conditions.

Geographical units of analysis analyzed for this project under the new Forest Service methods include Fremont, Van Buren, Winona, Carter County, Shannon County, and the State of Missouri. Winona's demographics allow for comparison with those of Shannon County as the reference geographic area. Demographics for Fremont and Van Buren allows for comparison with those of Carter County as the reference geographic area. Demographics for counties can be compared with the State of Missouri as the reference geographic area. If the demographics for a minority population for the local area (e.g., Fremont) geographic unit of analysis exceed those of the higher unit reference geographic area by more than 5%, then an environmental justice population would be found to exist in the geographic unit of analysis area.

Table 43 provides key demographic data from the Economic Profile System-Human Dimensions Toolkit (Headwaters Economics, 2014) for Fremont, Van Buren, Winona, Carter and Shannon Counties, and the State of Missouri. Demographics from the Economic Profile System-Human Dimensions Toolkit (Headwaters Economics, 2014) served as the foundation for environmental justice analysis using the new Forest Service guidelines.

Table 43. Key Demographic Data from Economic Profile System-Human Dimensions Toolkit (Headwater Economics 2014)

Demographic Variable	Fremont	Van Buren	Winona	Carter County	Oregon County	Ripley County	Shannon County	Missouri
Total Population	132	858	1,414	6,225	10,885	14,070	8,407	5,982,413
Race as Percent of Total								
White Alone	100.0%	98.3%	96.1%	96.1%	96.1%	96.9%	96.5%	83.1%
Black or African American Alone	0.0%	0.8%	1.9%	0.7%	0.1%	0.5%	0.6%	11.5%
American Indian Alone	0.0%	0.0%	0.0%	0.5%	1.2%	0.6%	1.3%	0.4%
Asian Alone	0.0%	0.0%	0.0%	0.0%	0.3%	0.2%	0.0%	1.6%
Native Hawaiian & Other Pacific Is. alone	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Some Other Race Alone	0.0%	0.0%	0.0%	0.1%	0.3%	0.1%	0.0%	1.0%
Two or More Races	0.0%	0.9%	2.0%	2.6%	2.0%	1.7%	1.7%	2.2%
People and Families Below Poverty Level								
People	132	820	1,414	6,187	10,705	13,961	8,314	5,802,726
Families	27	166	323	1,571	2,815	3,984	2,411	1,543,528
People Below Poverty Level	121	107	527	1,681	2,789	3,797	1,776	869,036
Families Below Poverty	27	4	75	299	505	833	366	165,242
Poverty as Percent of Total								
People Below Poverty	91.7%	13.0%	37.3%	27.2%	26.1%	27.2%	21.4%	14.9%
Families Below Poverty	100.0%	2.4%	23.2%	19.0%	17.9%	20.9%	15.2%	10.9%
Income								
Per Capita Income	Not Available	$18,541	$12,571	$17,283	$15,956	$15,367	$16,749	$25,546
Median Household Income	Not Available	$25,958	$23,051	$27,209	$26,926	$31,141	$33,091	$47,333

MINORITY POPULATION

Reported percentages of minority populations for Fremont and Van Buren are not 5% greater than that of Shannon County. Similarly, the minority population of Winona is not 5% greater than that of Carter County. Carter, Oregon, Ripley, and Shannon counties do not have minority populations 5% greater than that of the State of Missouri. Therefore, there is no meaningfully greater minority population or environmental justice populations associated with the project area. Minority populations do not constitute an environmental justice population across these geographical units.

LOW-INCOME POPULATION

Forest Service documents on environmental justice (Grinspoon et al., 2014, p. 9; Periman & Grinspoon, 2014, p. 6) note U.S. Department of Agriculture regulations that state that "low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Census Bureau's annual current population reports (Series-P-60) on income and poverty." Further, the documents report that: "In 2013, the poverty guidelines for the 48 contiguous states . . . are $11,490 for a one-person household and $23,550 for a four-person household" (Grinspoon et al., 2014, p. 10; Periman & Grinspoon, 2014, pp. 6-7).

The Economic Profile System-Human Dimensions Toolkit (Headwaters Economics, 2014) provided poverty data from 2012. The poverty thresholds for 2012 were $11,720 for a one-person household and $23,492 for a four-person household (U.S. Census Bureau, 2014). The median household income of Winona falls below the poverty threshold which indicates a low-income environmental justice population.

The Economic Profile System-Human Dimensions Toolkit (Headwaters Economics, 2014) demographics report indicates that nearly all people and families within Fremont were below poverty level. Over 1/3rd of people and nearly 1/4th of families in Winona were below the poverty level. The poverty levels for people were above 20% in each of the local counties, and nearly as high for families. Indicators of poverty and poverty thresholds may suggest that environmental justice populations and low-income populations exist in the EJ View area and surrounding counties.

PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS OF RELEVANCE

Past Forest Service actions in the geographic region have included timber harvest, fire suppression, road activities, and timber stand improvement thinning. These activities have been conducted under the Mark Twain National Forest 2005 Land and Resource Management Plan (USDA Forest Service, Mark Twain National Forest, 2005b). These activities have not resulted in long-term negative effects to forested character of the project area nor negative impacts to local populations of concern.

Foreseeable Forest Service actions in the vicinity of the project area would likely involve timber harvest, fire suppression, road activities, and timber stand improvement thinning. These activities would likely continue into the future under the 2005 Forest Plan.

Reported percentages of minority populations for Fremont and Van Buren are not 5% greater than that of Shannon County. Similarly, the minority population of Winona is not 5% greater than that of Carter County. Carter, Oregon, Ripley, and Shannon counties do not have minority populations 5% greater than that of the State of Missouri. Therefore, there is no meaningfully greater minority population or environmental justice populations associated with the project area. Minority populations do not constitute an environmental justice population across these geographical units.

Future climate change may have considerable impacts for the rural poor near the project area due to their vulnerability. A substantial portion of the rural poor's income is spent on basic needs such as energy and food, and the rural poor are sensitive to changes in resources and employment with climate change (Jensen, 2009). Rural areas have less adaptive capacity to cope with climate change than urban areas due to lack of resources and many rural areas exhibit persistent poverty (Alig R. , 2011; Jensen, 2009; Lal, Alavalapati, & Mercer, 2011).

A 'climate gap" (Jensen, 2009, p. 4) exists for rural areas as they have high percentages of climate-vulnerable populations and fewer resources as compared to urban areas. Rural climate-vulnerable populations include high percentages of seniors, the poor, and people employed in climate-sensitive sectors (Alig R. , 2011; Jensen, 2009; Lal, Alavalapati, & Mercer, 2011; Lynn, MacKendrick, & Donoghue, 2011). Rural communities have higher percentages of people that are very young or very old as compared to urban areas, and higher rates of mortality, disability, and chronic disease. Many rural people depend on natural resources such as forests and agriculture which make them vulnerable to climate change (Alig R. , 2011; Jensen, 2009; Lal, Alavalapati, & Mercer, 2011; Lynn, MacKendrick, & Donoghue, 2011).

Direct impacts to the rural poor and outdoor workers from climate change may include exposure to extreme temperatures and weather events, increased pests and pathogens, and changes to hunting and fishing as habitat changes and species shifts (Alig R. , 2011; Lal, Alavalapati, & Mercer, 2011; Lynn, MacKendrick, & Donoghue, 2011; Osman-Elasha, et al., 2009). Increased temperature and precipitation are expected to have direct effects on recreation and tourism which would impact participation and expenditures. If climate change reduces or shifts jobs associated with recreation, most of the impacts would be felt by local rural communities.

Climate change may reduce the capacity of forests to provide resources and essential non-wood forest products needed to meet the basic needs of forest-dependent people (Osman-Elasha, et al., 2009). It is likely that many poor rural residents will continue to seek forest products and resources for their consumption, personal needs, and economic benefits (Hembram & Hoover, 2008; Missouri Department of Conservation & USDA Forest Service, 2010; Osman-Elasha, et al., 2009). The collection and gathering of non-timber and non-wood forest products may become more common with climate change due to crop failures (Osman-Elasha, et al., 2009).

DIRECT AND INDIRECT EFFECTS ON ENVIRONMENTAL JUSTICE

ALTERNATIVE 1 – NO ACTION

No project activities would occur, so there would be no project impacts, nor increased opportunities or benefits, to low-income residents or minority populations. Opportunity costs may be incurred by these populations due to the foregone jobs that may have been available during project-related actions and the economic benefits to communities that would not occur.

Under Alternative 1, roads would continue to degrade. Unmaintained roads may result in damage to vehicles and or danger to those travelling roads. Deteriorated roads may result in reduced opportunities for recreation, hunting, and gathering and collecting non-timber forest products such as fruits, mushrooms, and so on. The gathering and collection of forest products has been found to be important for household use and for sale by low income populations (Hembram & Hoover, 2008).

Under Alternative 1, no vegetation management practices would occur. Lack of treatments would prevent the creation of forest openings and early seral habitat. Opportunity costs to populations of concern would include foregone recreational opportunities for activities such as wildlife viewing or hunting in early seral habit. As the forest continues to move toward climax conditions, game populations for certain species such as deer would continue to decline. Reduced populations of game such as deer would reduce opportunities for recreation as well as hunting and obtaining game as food which may impact some individuals' subsistence.

Existing vegetation would likely continue to degrade due to the age class structure of trees, red oak decline, and other environmental characteristics and influences. Red oak decline, as well, as other factors would likely continue the buildup of fuels on the ground. Eventually, hazardous fuel conditions may exist that could increase the threat of wildfire that could impact the forest, local populations, and populations of concern.

ALTERNATIVE 2 – PROPOSED ACTION

Proposed activities would result in silvicultural operations that are likely to produce positive economic benefits to the local area. Silvicultural activities would provide direct economic benefits through employment of people engaged in logging, equipment operations, trucking of materials, and saw mill operations. Connected actions for timber stand improvement would involve some employment and potentially the sale of some small roundwood and firewood. The sale of small roundwood and firewood generates some economic benefit. More importantly, the availability of low cost roundwood and firewood would benefit low income populations that use wood for home heating.

Secondary wood product industries that manufacture wood products would benefit from the availability of raw materials. The sale of finished products would benefit local and regional communities. Indirect benefits from the project may include new jobs in local and regional wood processing and manufacturing industries.

These various management activities and timber harvests would generate local revenue from direct expenditures and taxes for purchases of fuel, oil, food, and so on. Management activities and timber harvest would likely add tax revenues from employment incomes and local expenditures by companies. Employees of forest and wood product industries would likely spend money in the local economy for personal goods and services. The local area may also benefit from potential multiplier effects of infusing money into the local area from outside sources.

Project activities have the potential to provide economic benefits to low-income populations, minorities, and other demographic groups within the project area. These economic benefits may include potential jobs and or stewardship service opportunities. Local industry expenditures and tax revenues would benefit the local communities and residents.

Project benefits to low income populations would include increased recreation and hunting opportunities. Project activities would provide more habitat diversity such as early successional habitat and variation in age classes of vegetation. These landscape changes would likely provide openings for new recreation activities such as wildlife viewing, and draw game animals to areas with early successional habitat.

Road improvements would benefit everyone including populations of concern. Traffic counts indicate that state and county roads in or near the project area carry from 162 to 1,682 vehicles per day (Missouri Department of Transportation, Transportation Planning, 2011). Conducting

maintenance on the roads would likely reduce potential wear, tear, and damage to vehicles that travel forest roads. This maintenance would also reduce road hazards and potential danger to those travelling forest roads.

Conducting maintenance on forest roads would keep them usable by all people including focal populations of concern. Usable roads support transportation for employment, travel to obtain food and medical care, and other vital purposes. These roads also provide access to forest areas for recreation, hunting, and gathering and collecting non-timber forest products such as fruits, mushrooms, and so on. The gathering and collection of forest products is important for household use and as supplemental income for low income populations (Hembram & Hoover, 2008; Missouri Department of Conservation & USDA Forest Service, 2010).

Negative project impacts should be limited and temporary in nature. Negative externalities such as noise and dust from logging operations would have little effect beyond the specific site(s) where operations are being conducted. Most of these effects would possibly extend up to a few hundred yards beyond the specific site(s). Effects should rarely extend beyond the national forest boundary, except for sites located near boundary lines and private lands. Local residents may encounter some logging trucks and or other equipment and traffic as part of project activities.

CUMULATIVE EFFECTS ON ENVIRONMENTAL JUSTICE

The focal cumulative effects area (spatial boundary) consists of the 10-mile radius around the project center. Consideration of effects was expanded to include Carter, Oregon, Ripley, and Shannon Counties. Most direct effects (such as sound and dust) would be limited to the specific action site, or within a few hundred yards, and within the national forest boundary. Associated impacts such as project-related traffic would most likely to be noticed by the public within 10 miles of the project center. Primary and secondary wood processing impacts would likely generate employment and economic benefits to the local communities and counties within the nearby region.

Project temporal effects may last up to 15 years, or longer. Most commercial logging operations would likely last up to 10-12 years following the decision. Harvested trees would be processed and the resulting products would be distributed to secondary product markets and to consumers. Many of the products generated from this project would serve various purposes for an extended period of time beyond that (e.g., railroad cross ties, fence posts, cooperage products, etc.). Timber stand improvement activities and other physical activities would likely occur during years 5-15. These activities would likely produce employment and revenue streams throughout the life of the project and beyond the implementation time of project activities.

ALTERNATIVE 1 – NO ACTION

The No Action Alternative would result in continued oak decline. No timber harvests would be conducted and no sales receipts and economic benefits would accrue to local communities. Project area conditions would continue to degrade and may generate potentially dangerous conditions via hazard trees and fuel buildup. Degraded conditions would reduce wildlife habitat for some species. Populations of certain species such as deer would likely decline reducing opportunities for recreation and game harvest which could negatively impact low-income residents that rely on game as part of their subsistence. Individually and collectively, various degraded conditions and loss of resources could result in negative cumulative impacts to local populations of concern.

ALTERNATIVE 2 – PROPOSED ACTION

This project is likely to have some positive cumulative economic benefits to low-income and minority populations, but would have no negative cumulative impacts.

The proposed project would provide sustained benefits to residents in the area. These benefits would include potential jobs and economic benefits during the life of the project. Importantly, the project would provide forest resources that are more resilient to climate change and sustained ecosystems services and benefits over the next 100 years or so.

Using the U.S. Environmental Protection Agency's (2010, pp. 20-21) environmental justice question screening process, there does not appear to be environmental justice concerns. This action is not likely to be of particular interest to or have particular impact upon minority, low-income, or indigenous populations, or tribes. The action is unlikely to impact the health of these populations. The action is also unlikely to negatively impact the environment of these populations.

There would be no disproportionately high and adverse impacts on minority and/or low income populations associated with the proposed action. The effects of the project should be similar across populations. It is likely that the project would generate positive economic benefits that impact local communities and counties including populations of concern.

The action is unlikely to present an opportunity to address an existing disproportionate impact on these populations. The action is unlikely to result in the collection of information or data that could be used to assess potential impacts on their health or environmental conditions. The action is unlikely to affect the availability of information to these populations or tribes.

The project is unlikely to have any negative cumulative effects on low-income and minority populations. The project may have some positive cumulative economic impacts to numerous local residents, including low-income and minority populations, associated with employment and revenues that may flow into the local community or communities over the life of the project.

EFFECTS ON CONSUMERS, CIVIL RIGHTS, MINORITY, GROUPS, AND WOMEN

Any contract work would include specific clauses protecting civil rights. This project would have limited direct, indirect, or cumulative effects on low-income populations and minorities. The proposed actions do not pose disproportionately high or adverse environmental, human health, economic, or social effects to residents in the project area or Carter or Shannon Counties.

CONSULTATION WITH THE ENVIRONMENTAL PROTECTION AGENCY

Informal consultation occurred with the U.S. Environmental Protection Agency due to its changes to methods of Environmental Justice analysis, criteria, and evaluation of potential environmental justice concerns. Brendan Corazzin, EPA Region 7 Program and Management Analyst in the Environmental Justice Program, consulted on and reviewed the methods, analysis, findings, and conclusions for this Environmental Justice Analysis (B. Corazzin, personal communication, March 21, 2014).

Mr. Corazzin agreed with the Forest Service finding that there would be no significant negative cumulative effects on Environmental Justice, and that the project would likely generate positive cumulative effects to local communities and counties within the region. Mr. Corazzin stated that

"there may be low-income populations of concern, but the environmental impacts appear to be minimal and inconsequential, thus they would not exacerbate or result in any disproportionate environmental/human health impacts". He also commented that any potential negative impacts "are far outweighed by the potential for positive economic outcomes if the action is taken".

UNAVOIDABLE ADVERSE IMPACTS

There should be no unavoidable adverse impacts to environmental justice. Minor impacts to area residents may result from project implementation. These minor inconveniences would be greatly overshadowed by the positive impacts that the project would produce for the local communities and counties.

RELATIONSHIP OF SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The proposed project activities would not negatively impact long-term productivity nor environmental justice.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Neither alternative would have an irreversible or irretrievable commitment of resources as related to environmental justice in the project area.

OTHER RELEVANT DISCLOSURES

The project complies with Executive Order 12898 (1994) as it examines and considers impacts to minority and low-income populations, U.S. Environmental Protection Agency (2010; 2011) direction and thresholds, and USDA Forest Service (Grinspoon et al., 2014; Periman & Grinspoon, 2014) guidance. The project complies with the National Environmental Policy Act of 1969 (1970) and Council on Environmental Quality (n.d.) regulations as it analyzes and considers environmental amenities and values along with economic and technical considerations.

SUMMARY OF EFFECTS ON ENVIRONMENTAL JUSTICE

There would be no significant negative cumulative effects environmental effects, including human health, economic, and social effects on minority populations, low-income populations, and Indian tribes. It is likely that the project would generate positive cumulative effects via economic benefits that impact local communities and counties within the region that contain populations of concern. There would be no disproportionately high and adverse impacts on minority and/or low income populations associated with the proposed action. These conclusions are based on information that was analyzed and considered in this section and the identified spatial and temporal boundaries.

CLIMATE CHANGE

Two aspects of climate change are discussed below: 1) climate change effects on project area resources, and 2) project effects on climate change via changes in carbon storage. The scope of the analysis for direct and indirect effects of climate change on the project is the project area over the next 85 years. The timeframe was chosen because it aligns with a recent climate change vulnerability assessment for the Missouri Ozarks and it also aligns with the average lifespan of trees in the area. The scope of the direct, indirect, and cumulative effects of the project on climate change is at a larger spatial scale because greenhouse gas emissions are thoroughly mixed in the atmosphere and statistical confidence in carbon data is more robust at scales beyond the project level. While the most appropriate boundary would be the globe, we discuss carbon emissions

within the context of the Mark Twain National Forest and the state of Missouri for context. As with impacts of climate change, we discuss carbon dynamics over the lifespan of the stands in in the project area. Note: Some of the material in this section is adapted from (quoted) and referenced by the Cherokee National Forest Big Creek Environmental Assessment (U.S.D.A. Forest Service, 2010).

CURRENT CONDITION

The current climate of the Missouri Ozarks is generally characterized as a humid continental climate, with cool winters and long, hot summers. Average annual temperatures are 55.6 °F (13.1 °C) in the Missouri Ozarks (Brandt, et al., 2014). Annual average precipitation is 43.9 inches (Brandt, et al., 2014). Between 1901 and 2011, mean annual temperatures fluctuated from year to year by several degrees across the Missouri Ozarks, with no clear increasing or decreasing trend (Brandt, et al., 2014). Temperatures were warmer than the long-term average during the “Dust Bowl” era of the 1930s. That period had many of the warmest and driest years on record, and summers were particularly hot and dry. By contrast, temperatures were cooler during the 1970s and early 1980s. Temperatures have been on the rise in the area in the most recent decades, but not as high as they were earlier in the 20th century (Brandt, et al., 2014). Trends in precipitation over the past century have been more pronounced, with decreases in the area during the summer and increases in other parts of the year, particularly the fall (Brandt, et al., 2014). Heavy rain events of three inches or greater have also been increasing in Missouri in recent decades (Saunders, Findlay, Easley, & Spencer, 2012).

DIRECT AND INDIRECT CLIMATE CHANGE EFFECTS ON PROJECT AREA RESOURCES

A climate change vulnerability assessment for the Central Hardwoods Region, including the project area, was recently published (Brandt, et al., 2014). The assessment examined regional trends in climate and projected climate change impacts using peer-reviewed literature and statistically-downscaled climate projections (Dalton & Jones, 2010; Hayhoe & Stoner, 2013; Stoner, Hayhoe, Yang, & Wuebbles, 2012). To examine future changes in climate, two model-scenario combinations were chosen to bracket a range of plausible futures over the next century: GFDL A1FI, which projects a greater amount of warming and hot, dry summers throughout the region; and PCM B1, which projects a lesser amount of warming and wetter summers with modest temperature increases in summer. All global climate models project that temperatures will increase in the Central Hardwoods Region over the next century (Kunkel, et al., 2013; IPCC, 2013). The downscaled climate projections examined in the vulnerability assessment suggest an increase in temperature over the next century across all seasons by 2 to 7 °F in the Missouri Ozarks. Precipitation is projected to increase in winter and spring by 2 to 5 inches for the two seasons combined by the end of the century. There is a difference in model projections for later in the growing season, but evidence seems to indicate there may be a decrease in precipitation in either summer or fall, depending on scenario. Even if the total annual amount of precipitation does not change substantially, some models suggest it may occur as heavier rain events interspersed among relatively drier periods (Kunkel, et al., 2013). More winter precipitation and more intense rain events are projected to lead to increased streamflow and increased risk for severe flooding in Missouri by mid-century (Qiao, Pan, Herrmann, & Hong, 2013). The projected changes in precipitation and temperature are projected to increase the probability of wildfire in the region by the end of the century (Liu, Stanturf, & Goodrick, 2010; Moritz, et al., 2012).

The vulnerability assessment summarized projected climate-induced impacts over the next century on selected tree species or species groups based on three forest impact models: Tree Atlas

(Iverson, Prasad, Matthews, & Peters, 2008; Landscape Change Research Group, 2014), Linkages v. 2.2 (Wullschleger, Gunderson, Tharp, Post, & West, 2003), and Landis Pro (Wang, et al., 2013). All models used the same two downscaled model-scenario combinations as climate inputs. Under both climate change scenarios, all three forest impact models used in the assessment project an increase in habitat suitability and establishment probability for shortleaf pine in the Missouri Ozarks over the next century. Projections for oak species are more mixed. For example, the Tree Atlas model projects decreases in habitat suitability for scarlet oak under both scenarios, and a decrease in habitat suitability for black oak under the warmer, drier scenario. The other two models project a decrease in red oak group species under the drier, warmer scenario and an increase under the wetter scenario. All models suggest that eastern redcedar is projected to be largely unaffected by climate change in the area. Model results for some species are available from the Tree Atlas model only. Suitable habitat for woody understory species such as eastern redbud and dogwood is projected to remain stable under the range of climate scenarios examined. As with oaks, projections for hickory species are also mixed, with suitable habitat for some species projected to remain stable, some increase, and some decline in habitat suitability.

The assessment also examined the vulnerability of different natural community types to climate change, based on the impacts of climate change on dominant species, stressors, and system drivers and the capacity of those systems to adapt to these changes. Of nine community types assessed, mesic upland forests were considered to be the most vulnerable due to negative impacts on dominant species and a limited capacity to adapt to disturbances such as fire, flooding, and drought. Dry-mesic forests were considered moderately vulnerable, but were expected to be more vulnerable at the western extent of their range where conditions are drier. Fire-adapted communities such as woodlands, savannas, and glades were considered less vulnerable because they have more drought and heat-adapted species and are better able to withstand large-scale disturbances. Bottomland forests had slightly higher vulnerability due to the possibility of shifts in flood dynamics. These determinations of vulnerability are general across the entire Central Hardwoods region, and will be influenced by local conditions, forest management, and land use.

The vulnerability assessment did not focus specifically on associated wildlife, but other studies have examined the impacts of climate change on wildlife in the area. Habitat suitability for maternity colonies of Indiana bat is projected to decline over the next century across the Missouri Ozarks and much of the western part of their current range due to rising temperatures and precipitation changes (Loeb & Winters, 2013). Note that changes in vegetation were not examined in the Loeb and Winters study. Changes in habitat suitability for many bird species of interest in the project area have also been modeled under a range of climate change scenarios (Matthews, Iverson, Prasad, & Peters, 2011). A few species, Bachman's sparrow and brown-headed nuthatch, are projected to benefit from projected changes in climate in the area. Suitable habitat for most bird species examined is not projected to be affected greatly by changes in climate, including the blue-gray gnatcatcher, Chuck-Will's widow, field sparrow, pine warbler, yellow-breasted chat, prairie warbler, white-eyed vireo, and northern bobwhite. A few species were projected to have negative climate change impacts on suitable habitat: red-headed woodpecker, blue-winged warbler, summer tanager, eastern wood-pewee, orchard oriole, eastern towhee. There are no published studies on climate change impacts on reptiles and amphibians in the area.

To account for these projected changes in climate and associated impacts, staff on Mark Twain National Forest used the Adaptation Workbook in Forest adaptation resources: Climate change tools and approaches for land managers (Swanston & Janowiak , 2012) to consider how climate change would affect resources in the project area and the ability to meet project objectives

(workbook sheets are in the project record). Staff also evaluated natural community types in the project area for climate change vulnerability. Upland forest was considered to be the most vulnerable community type in the area because it was dominated by a number of species projected by the models to decline and had a limited capacity to adapt to future change because of lower species diversity, reduced ability for future-adapted species to regenerate, and a reduced understory herbaceous layer that could help with moisture retention during dry periods. Other community types had low to moderate vulnerability because of a higher shortleaf pine component (a species projected to do well), better conditions for regeneration of future-adapted species, and a more developed herbaceous understory. Staff evaluated both challenges and opportunities related to meeting management objectives given climate change projections. In general, opportunities were perceived to outweigh the challenges, and it was considered feasible to meet management objectives.

Mark Twain staff considered a peer-reviewed menu of climate change adaptation strategies and approaches in the Forest Adaptation Resources document to help overcome climate change-related challenges and capitalize on opportunities. A number of adaptation strategies were selected from the menu that would help reduce vulnerability to climate change in the area while capitalizing on opportunities:

- Restore fire to fire-adapted systems
- Alter forest structure or composition to reduce risk or severity of wildfire
- Maintain or improve ability of forests to resist pests and pathogens
- Favor or restore native species that are expected to be better adapted to future conditions
- Prevent the introduction and establishment of invasive plant species.
- Emphasize drought- and heat- tolerant species and populations.
- Retain biological legacies.
- Anticipate and respond to species decline.

The proposed action would incorporate tactics to carry out this climate change adaptation strategies. In particular, it would convert the amount of area that is currently vulnerable (upland forest) to less vulnerable community types (open woodland, savanna). It would also favor future-adapted species (primarily shortleaf pine) while reducing less-adapted species that are already in decline (black and scarlet oak).

The No Action Alternative would leave much of the project area as upland forest, which was considered to be more vulnerable to climate change because of lower diversity, more maladapted species, a less developed understory herbaceous layer, and greater susceptibility to severe wildfire.

DIRECT AND INDIRECT EFFECTS OF PROJECT ON CLIMATE CHANGE

The proposed action would remove biomass as a result of harvesting, thinning, and burning. This would temporarily reduce the amount of carbon stored in the treated stands. A portion of the carbon removed via harvest would remain stored for a period of time in wood products. The harvest of live trees and burning of vegetation, combined with the increase in down dead wood, would temporarily convert stands from a carbon sink that removes more carbon from the atmosphere than it emits, to a carbon source that emits more carbon through respiration than it

absorbs. These stands would remain a source of carbon to the atmosphere until carbon uptake by new trees and other vegetation exceeds the emissions from decomposing dead organic material. The stands would likely remain a carbon source for several years depending on the amount of dead biomass left onsite and new trees' growth rates once reestablished. As the stands continue to develop, the carbon source would change to a carbon sink. The strength of the carbon sink would increase until peaking at approximately 85 years of age (Mckinley, et al., 2011) and then would gradually decline but remain positive.

Recent scientific literature confirms this general pattern of changes in net ecosystem productivity (NEP) and carbon stocks over the period of forest stand development. (The Net ecosystem productivity, or NEP, is defined as gross primary productivity (GPP) minus ecosystem respiration (ER) (Chapin, et al., 2006). It reflects the balance between (1) absorbing CO2 from the atmosphere through photosynthesis (GPP) and (2) the release of carbon into the atmosphere through respiration by live plants, decomposition of dead organic matter, and burning of biomass (ER). When NEP is positive, carbon accumulates in biomass. Ecosystems with a positive NEP are referred to as a carbon sink. When NEP is negative, ecosystems emit more carbon than they absorb. Ecosystems with a negative NEP are referred to as a carbon source. Pregitzer & Euskirchen (2004) synthesized results from 120 separate studies of carbon stocks and carbon fluxes for boreal, temperate, and tropical biomes. They found that in temperate forests NEP is lowest, and most variable, in young stands (0-30 years), highest in stands 31-70 years, and declines thereafter as stands age. These studies also reveal a general pattern of total carbon stocks declining after disturbance and then increasing, rapidly during intermediate years and then at a declining rate, over time until another significant disturbance (timber harvest or tree mortality resulting from drought, fire, insects, disease or other causes) kills large numbers of trees and again converts the stands to a carbon source where carbon emissions from decay of dead biomass exceed that amount of carbon removed from the atmosphere by photosynthesis within the stand.

The impacts of the proposed action on global carbon sequestration and atmospheric concentrations of CO2 are very small. However, the forests of the United States significantly reduce atmospheric concentrations of CO2 resulting from fossil fuel emissions. The forest and wood products of the United States currently sequester approximately 200 teragrams (200 teragrams, or Tg, equals 196,841,306 US tons) of carbon per year (Heath & Smith, 2004). This rate of carbon sequestration offsets approximately 10% of CO2 emissions from burning fossil fuels (Birdsey, Pregitzer, & Lucier, 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 US forests is a result of past land use changes, including the re-growth of forests on large areas of the eastern U.S. harvest in the 19-20th century, and 20th century fire suppression in the western U.S. (Birdsey, Pregitzer, & Lucier, 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 (Canadell, et al., 2007; Pacala, et al., 2007). Management actions –such as those proposed – that improve the resilience of forest to climate-induced increases in fire frequency, 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, Jenkins, Johnston, & Huber-Sannwald, 2007).

Current available data on forest carbon is imprecise and statistically nonviable at the project level. What follows is an exercise to provide context for the magnitude of carbon impacts project to

illustrate why the project is too small to warrant a more formal quantitative analysis. The Mark Twain National Forest stores about 0.000151 Tg C/ha (Heath, Smith, Woodall, Azuma, & Waddell, 2011). About half of the total carbon stored on the forest is aboveground in live and dead trees and herbaceous vegetation, while the remaining is stored belowground in soil and roots (Heath, Smith, Woodall, Azuma, & Waddell, 2011). At 612,000 ha total, that means about 92.6 Tg C are stored on the Forest both above and belowground. The project area for the proposed action is 19,465 ha (including other ownerships). Assuming that the carbon density across ownerships is similar and that the carbon density in the project area is similar to the Mark Twain National Forest as a whole, then about 2.9 Tg C are stored in the project area, or about 3 percent of the total carbon stored on the Mark Twain National Forest. Forest Inventory and Analysis (FIA) data, upon which these carbon estimates are based, is not available at a fine enough scale to assess (with statistical confidence) differences in carbon density or carbon sequestration rate among specific community types and management within the project area. However, FIA data from across the Central Hardwoods vulnerability assessment area indicate that shortleaf pine, oak-pine, and oak-hickory forest types have similar carbon densities (Brandt, et al., 2014). Thus, it is expected that long-term effects of the proposed action on carbon storage and sequestration would be minimal.

The no-action alternative would not result in an immediate release of carbon from prescribed burning or harvest. However, it would retain declining black and scarlet oak, which would put the area at risk for future carbon losses from decay or wildfire as they die and dead wood accumulates.

CUMULATIVE EFFECTS ON CLIMATE CHANGE

When combined, the carbon emissions from this and past projects in the analysis area are expected to have a minimal cumulative effect. Since greenhouse gas emissions are thoroughly mixed in the atmosphere, the appropriate cumulative effects boundary would be the globe. However, to provide context, we examine the emissions at the scale of the state of Missouri. In 2011, the state of Missouri released the equivalent of 37 Tg C from fossil fuel emissions (U.S. Environmental Protection Agency, 2013). If all of the carbon currently stored aboveground in the project area was lost in one year, this would be equivalent to roughly 4 percent of total fossil fuel emissions in the state. However, project activities are expected to take place over the course of 15-20 years and most of the management treatments proposed will retain a large proportion of aboveground biomass, thus any emissions from this project in a given year are expected to be equivalent to less than one percent of the fossil fuel emissions released from the state of Missouri in one year. In addition, as new trees and vegetation regenerate and grow in the project area, it will begin sequestering carbon and return to being a carbon sink over the long-term. In addition, under current management, national forests in the US Forest Service Eastern Region (the smallest unit for which sequestration data are available) sequester an average of 4.74 Tg C per year (Heath, Smith, Woodall, Azuma, & Waddell, 2011). Given the magnitude of the activities that occur at the project level would be insufficient to tip regional sequestration from a carbon sink to a carbon source

MONITORING

Forest Plan Monitoring

Effective Forest Plan monitoring and evaluation fosters improved management and more informed planning decisions. Monitoring and evaluation are learning tools that form the backbone of adaptive management. With these tools, information is collected and compiled to serve as reference points for the future; new scientific understanding and technology, changes in law and

policy and resource conditions, growing concerns, trends and changing societal values are incorporated into forest planning; and the scientific validity and appropriateness of assumptions used in the development of the forest plan is evaluated.

Several kinds of activities can be referred to as "monitoring." Project implementation monitoring monitors compliance with LRMP standards and guidelines. Effectiveness monitoring evaluates how effective our management actions are at achieving desired outcomes.

A Monitoring and Evaluation ID Team (M&E IDT) and the Ranger Districts conduct annual monitoring to review the minimum legally required monitoring items and the monitoring questions as outlined in the 2005 Land and Resource Management Plan Monitoring Guide.

The Forest will be completing administrative changes to the current 2005 Forest Plan monitoring section (2005 Forest Plan, Chapter 4, Monitoring and Evaluation) by May 2016 to conform to the new 2012 Planning rule (36 CFR 219) monitoring requirements. This new monitoring program must contain one or more monitoring question and associated indicators addressing each of the following as identified in 36 CFR 219.12(a)(5).

> (i) The status of select watershed conditions.
>
> (ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
>
> (iii) The status of focal species to assess the ecological conditions required under § 219.9.
>
> (iv) The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.
>
> (v) The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
>
> (vi) Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.
>
> (vii) Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.
>
> (viii) The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)) (36 CFR 219.12(a)

Social, economic and cultural sustainability would also be addressed in the monitoring program.

Effectiveness and Implementation Monitoring

The following are the current and planned monitoring being conducted in and adjacent to the project area.

Ecosystem Restoration

Monitoring Question: Are restoration activities increasing plant species richness for woodlands, glades and forests? Are we moving toward desired condition for groundcover and natural community type structural characteristics?

Driver: 36 CFR 219.12 (a) (5). Forest Plan Goal 1.1, Objective 1.1c and 1.1b

Methods: In 2012, 17 vegetation monitoring plots were established as a baseline to track changes for floristic composition and dominance patterns (C-values and mean diversity among 50 0.25 m2 square quadrats) placed in a designated number of stratified macroplot settings in the Fremont Project Area. These plots in addition to the 100 vegetation monitoring plots established in Pineknot established in 2000 will be used for comparisons and to indicate significant improvements in floristic metrics within restoration treatment areas where thinning and prescribed fire have been implemented.

The project grid inventory will be used to assess changes in woodland structure and species composition. FSVeg plots were installed for Fremont (191 plots) in 2009 and Pineknot (82 plots) in 2012. The design is to have 1 plot (24 foot Fixed Radius Plot with Brown Fuel Transect) for each 100 acres set up on a spaced grid. The plot center is monumented and GPS location collected for re-measurement purposes. Plot re-measurement depends on when the activities will be completed. Main focus of this monitoring is treatment effectiveness and will evaluate species composition change, basal area objectives, canopy closure and tree mortality. Plots will be re-measured and compared to the initial plot data. Results will be reviewed and compared to the objectives outlines in the NEPA document for that project area.

Monitoring Report Data Source: Field Survey, Specialists Report

Frequency of Monitoring: 5 to 10 years

Frequency of Evaluation: 5 to 10 years

Type of Monitoring: Effectiveness, Implementation

Data Storage Method and Location: Field Sampled Vegetation (FSVeg)

Soil Productivity

Monitoring Question: Are the effects of forest management, particularly timber harvesting and prescribed fire, resulting in significant changes to productivity of the land? (To what extent have the desired physical, chemical and biological soil processes and functions on the Forests been provided to maintain and/or improve soil productivity?)

Driver: NFMA, Forest Plan Goal 1.3

Methods: For the Fremont and Pineknot East project area establish a minimum of 30 fixed monitoring points stratified by treatment (timber harvest and/or prescribed fire) and no treatment areas using the National Soil Disturbance Monitoring Protocol. Evaluation will compare results to Regional threshold values for detrimental soil disturbance and assess the implementation and effectiveness of soils guidelines and mitigation measures.

Monitoring Report Data Source: Monitoring Field Trip

Frequency of Monitoring: Annual – Based on activities implemented

Frequency of Evaluation: 5 years

Type of Monitoring: Effectiveness

Data Storage Method Location: Natural Resource Manager (NRM) and/or Monitoring Database maintained by Forest Soil Scientist

Watershed Condition

Monitoring Question: To what extent is Forest management affecting water quality, quantity, and the physical features of aquatic, karst, riparian, or wetland ecosystems?

Driver: USDA National Best Management Practices for water quality management on National Forest System Lands, Forest Plan Goal 1.3

Methods: For selected prescribed fire, ground based timber harvest and mechanical site treatments, conduct a monitoring assessments according to National BMP protocols.

Monitoring Report Data Source: Monitoring Field Trip

Frequency of Monitoring: Annual – Based on activities implemented.

Frequency of Evaluation: 5 years

Type of Monitoring: Effectiveness, Validation.

Data Storage Method Location: NRM - Watershed Improvement Tracking (WIT)

Responsibility: Forest Hydrologist

Air Quality

Monitoring Question: To what extent is the Forest management contributing or responding to air quality effects on ecosystems, human health, or human enjoyment?

Driver: Smoke Management S&G, Prescribed Burn Plan

Methods: Air quality (smoke) effects on human health and human enjoyment will be monitored by air quality monitors (Portable E-sampler) placed in designated sensitive areas as identified in burn plans to monitor smoke concentrations (micrograms per cubic meter). These monitoring devices will to tabulate what levels of smoke pollutants are being produced with real-time measurements of fine particulate matter concentrations (PM2.5), air flow, air temperature, relatively humidity, barometric pressure, wind speed, and wind direction. Use these kits to monitor fine particulate matter emissions from wildfires and prescribed burns.

Monitoring Report Data Source: Field Survey, Specialists Report

Frequency of Monitoring: Annual – Based on activities implemented

Frequency of Evaluation: Annual – Based on activities implemented

Type of Monitoring: Implementation, Effectiveness

Data Storage Method and Location: Stored with Fuels Accomplishment Reporting or with national prescribed fire emissions database.

Responsibility: Air Quality Specialist, Fire Management Officer

Fuels

Monitoring Question: How do fuel loadings change in amount and arrangement over time and how does that affect fire behavior and fire effects on residual vegetation?

Driver: Interim Directive 5140-2012-1, FSM 5140 Hazardous Fuel Management and Prescribed Fire

Methods: Establish photo monitoring points and Browns fuel transects within select treatment units.

Frequency of Monitoring: Annual – Based on activities implemented

Frequency of Evaluation: Annual – Based on activities implemented

Type of Monitoring: Implementation, Effectiveness

Data Storage Method and Location: FACTS and Fuels Effectiveness Database

Responsibility: Zone Fire Management Officer.

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APPENDIX A – FOREST PLAN STANDARDS AND GUIDELINES, BEST MANAGEMENT PRACTICES AND PROJECT DEVELOPED MITIGATION MEASURES.

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Plan-1 Forest and Grassland Planning	Use the land management planning and decision making processes to incorporate direction for water quality management consistent with laws, regulation, and policy into land management plans.	13	FSM 1900 and 1920 FSH 1909.12 and 2511	Goal 1.3	1-3	
Plan-2 Project Planning and Analysis	Use the project, environmental analysis, and decision making processes to incorporate water quality management BMPs into project design and implementation	14	FSM 1950 and 2524 FSH 1909.15			Completed in assessments at the project level
Plan -3 Aquatic Management Zone Planning	To maintain and improve the condition of land around and adjacent to waterbodies in the context of the environment in which they are located, recognizing their unique values and importance to water quality while implementing land and resource management activities.	17	FSM 2526	Defined as Riparian Management Zone (RMZ) and Watercourse Protection Zone (WPZ)	2-3 to 2-5	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
AqEco-1 Aquatic Ecosystem Improvement and Restoration Planning	Re-establish and retain ecological resilience of aquatic ecosystems and associated resources to achieve sustainability and provide a broad range of ecosystems services	19	FSM 2020	Goal 1.3 and 1.4	1-3 to 1-4	
AqEco-2 Operations in Aquatic Ecosystems	Avoid, minimize, or mitigate adverse impacts to water quality when working in aquatic ecosystems	21	none	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, and 2-13 to 2-14	
AqEco-3 Ponds and Wetlands	Design and implement pond and wetland projects in a manner that increases the potential for success in meeting project objectives and avoids, minimizes, or mitigates adverse effects to soil, water quality, and riparian resources	23	none	Standards and Guides for RMZ, WPZ, Soil Productivity, Water Management, Aquatic Habitat Management and Constructed Waterholes and Wildlife Ponds	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, and 2-14	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
AqEco-4 Stream Channels and Shorelines	Design and implement stream channel and lake shoreline projects in a manner that increases the potential for success in meeting objectives and avoids, minimizes, or mitigates adverse effects to soil, water quality, and riparian resources.	26	none	Standards and Guides for RMZ, WPZ, Soil Productivity, and Water Management	2-3 to 2-5	
Chem-1 Chemical Use Planning	Use the planning process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources from chemical use on NF lands	30	FSM 2153 FSH 2109.14, Chapter 10	Standards and Guides for RMZ, WPZ, Springs, Seeps, Fens, Sinkholes, and Shrub Swamps, Pesticide Use, and Rangeland Management	2-3 to 2-5, 2-13 to 2-14, 2-19 to 2-21	
Chem-2 Follow Label Directions	Avoid or minimize the risk of soil and surface water or groundwater contamination by complying with all label instructions and restrictions required for legal use.	32	FSH 2109.14, Chapter 50	Standards and Guides for Pesticide Use	2-19 to 2-20	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Chem-3 Chemical Use Near Waterbodies	Avoid or minimize the risk of chemical delivery to surface water or groundwater when treating areas near waterbodies	32	FSH 2109.14, Chapter 10 and 50	Standards and Guides for RMZ, WPZ, Springs, Seeps, Fens, Sinkholes, and Shrub Swamps, Pesticide Use, and Rangeland Management	2-3 to 2-5, 2-13 to 2-14, 2-19 to 2-21	
Chem-4 Chemical Use in Waterbodies	Avoid, minimize, or mitigate unintended adverse effects to water quality from chemical treatments applied directly to waterbodies	34	FSH 2109.14	Standards and Guides for RMZ, WPZ, Springs, Seeps, Fens, Sinkholes, and Shrub Swamps, Pesticide Use, and Rangeland Management	2-3 to 2-5, 2-13 to 2-14, 2-19 to 2-21	
Chem -5 Chemical Handling and Disposal	Avoid or minimize water and soil contamination when transporting, storing, preparing, and mixing chemicals; cleaning application equipment; and cleaning or disposing chemical containers.	35	FSH 2109.14 Chapter 40	Standards and Guides for Pesticide Use	2-19 to 2-20	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Chem-6 Chemical Application Monitoring and Evaluation	1. Determine whether chemicals have been applied safely, have been restricted to intended targets, and have not resulted in unexpected nontarget effects. 2. Document and provide early warning of possible hazardous conditions resulting from potential contamination of water or other nontarget resources or areas by chemicals	36	FSH 2150.1 and 2109.14 Chapter 50			NNIP EIS or in other assessments at the project level
Fac-1 Facilities and Nonrecreation Special Uses Planning	Use the applicable special use authorization and administrative facilities planning process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during construction and operation of facilities and nonrecreation special uses activities	40	FSH 7309.11 Chapter 20, 7409.11 Chapter 10, and 2709.11 Chapter 50	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Special Uses	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-32 to 2-33	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Fac-2 Facility Construction and Stormwater Control	Avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources by controlling erosion and managing stormwater discharge originating from ground disturbance during construction or developed sites.	41	none	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, and 2-13 to 2-14	
Fac-6 Hazardous Materials	Avoid or minimize short - and long-term adverse effects to soil and water resources by preventing releases of hazardous materials.	45	40 CFR 112 FSM 2160 FSH 2109.14 Chapter 60	Standards and Guides for Hzardous Materials	2-19	
Fac-7 Vehicle and Equipment Wash Water	Avoid or minimize contamination of surface water and groundwater by vehicle or equipment wash water that may contain oil, greasem phosphates, soaps, road salts, other chemicals, suspended solids, and invasive species	46	none	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, and 2-13 to 2-14	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Fire-1 Wildland Fire Management Planning	Use the fire management planning process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during wildland fire management activities.	52	FSM 5120 5150 and FSH 5109.19	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Prescribed, Fire, Fuels, and Wildland Fire Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-15 to 2-19	
Fire-2 Use of Prescribed Fire	Avoid, minimize, or mitigate adverse effects of prescribed fire and associated activities on soil, water quality, and riparian resources that may result from excessive soil disturbances as well as inputs of ash, sediment, nutrients, and debris	54	FSM 5140	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Prescribed, Fire, Fuels, and Wildland Fire Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-15 to 2-19	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Fire-3 Wildland Fire Control and Suppression	Avoid or minimize adverse effects to soil, water quality, and riparian resources during fire control and suppression efforts	57	FSM 5130	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Prescribed, Fire, Fuels, and Wildland Fire Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-15 to 2-19	
Fire -4 Wildland Fire Suppression Damage Rehabilitation	Rehabilitate watershed features and functions damaged by wildland fire control and suppression related activities to avoid, minimize, or mitigate long-term adverse effects to soil, water quality, and riparian resources	58	FSM 2523.4	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Prescribed, Fire, Fuels, and Wildland Fire Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-15 to 2-19	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Road-1 Travel Management Planning and Analysis	Use the travel management planning and analysis process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during road management activities	105	FSM 7710 and FSH 7709.55 and FSH 7709.59 chapter 10	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	
Road-2 Road Location and Design	Locate and design roads to minimize adverse effects to soil, water quality, and riparian resources.	107	FSM 7720 and FSH 7709.56	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Road-3 Road Construction and Reconstruction	Avoid or minimize adverse effects to soil, water quality, and riparian resources from erosion, sediment, and other pollutant delivery during road construction or reconstruction.	110	FSM 7720 and FSH 7709.56 and 7709.57	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	
Road-4 Road Operations and Maintenance	Avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources by controlling road use and operations and providing adequate and appropriate maintenance to minimize sediment production and other pollutants during the useful life of the road.	111	FSM 7732 and FSH 7709.59, chapter 60	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Road-5 Temporary Roads	Avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources from the construction and use of temporary roads.	114	None known	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	
Road-6 Road Storage and Decommissioning	Avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources by storing closed roads not needed for at least 1 year (Intermittent Stored Roads) and decommissioning unneeded roads in a hydrologically stable manner to eliminate hydrologic connectivity, restore natural flow patterns, and minimize soil erosion.	115	FSH 7709.59 Chapter 60 and FSM 7734	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Road-7 Stream Crossings	Avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources when constructing, reconstructing, or maintaining temporary and permanent waterbody crossings.	117	FSM 7722 and FSH 7709.56b	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	
Road-8 Snow Removal and Storage	Avoid or minimize erosion, sedimentation, and chemical pollution that may result from snow removal and storage activities.	120	FSM 7700-41 and FSH 7709.59, Chapter 24.11	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Road 9 Parking and Staging Areas	Avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources when constructing and maintaining parking and staging areas.	122	FSM 7710, 7720, and 7730	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	
Road 10 Equipment Refueling and Servicing	Avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources from fuels, lubricants, cleaners, and other harmful materials discharching into nearby surface waters or infiltrating through soils to contaminate groundwater resources during equipment refueling and servicing activities.	123	FSM 2160 and FSH 7109.19, Chapter 40	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Road-11 Road Storm-Damage Surveys	Monitor road conditions following storm events to detect road failures; assess damage or potential damage to waterbodies, riparian resources, and watershed functions; determine the causes of the failures; and identify potential remedial actions at the damaged sites and preventative actions at similar sites.	124	FSM 7730 and 2350	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Transportation System	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	
Veg-1 Vegetation Management Planning	Use the applicable vegetation management planning process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during mechanical vegetation treatment activities.	128	FSM 1921.12	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Timber Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Veg-2 Erosion Prevention and Control	Avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources by implementing measures to control surface erosion, gully formation, mass slope failure, and resulting sediment movement before, during, and after mechanical vegetation treatments	131	FSH 2409.15	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Timber Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	
Veg-3 Aquatic Management Zones	Avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources when conducting mechanical vegetation treatment activities in the AMZ.	132	FSM 2526 and 2527	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Timber Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Veg-4 Ground Based Skidding and Yarding Operations	Avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during ground-based skidding and yarding operations by minimizing site disturbance and controlling the introduction of sediment, nutrients, and chemical pollutants to waterbodies.	134	FSH 2409.15	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Timber Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	
Veg-6 Landings	Avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources from the construction and use of log landings.	136	FSH 2409.15	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Timber Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

BMP	Objective	Page Number	Manual or Handbook Reference	Forest Plan Direction	Page Number	Other
Veg-8 Mechanical Site Treatment	Avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources by controlling the introduction of sediment, nutrients, chemical, or other pollutants to waterbodies during mechanical site treatment.	138	None known	Standards and Guides for RMZ, WPZ, Water Management, Aquatic Habitat Management, and Springs, Seeps, Fens, Sinkholes, and Shrub Swaps, and Timber Management	2-3 to 2-5, 2-6, 2-8, 2-10 to 2-11, 2-13 to 2-14, and 2-39 to 2-42	

APPENDIX B – GUIDING PRINCIPLES FOR RESTORING AND MANAGING PINE-OAK AND OAK WOODLANDS

BACKGROUND

The restoration and management of woodlands can be conceptualized as occurring in three different phases: the restoration phase, the maintenance and tending phase, and the recruitment phase. The restoration phase applies when initiating management in woodlands where the tree and shrub density is high or the encroachment of shade-tolerant tree species and loss of shade-intolerant tree species has occurred because of fire exclusion, poor logging practices, or exotic insects or disease. The maintenance and tending phase occurs where woodland structure and composition have been restored and prescribed fire treatments and periodic harvest removals occur as needed to temporarily remove woody reproduction and to enhance the cover and diversity of the ground flora. The recruitment phase occurs where it has been determined that the regeneration and recruitment of new trees into the woodland is desirable. These three phases are described in greater detail below.

RESTORATION PHASE

The focus during this phase is to restore woodland structure and composition to the extent possible given the contemporary site conditions. Thinning and/or prescribed fire treatments are applied to reduce understory and midstory density and reduce the accumulation of leaf litter that has accumulated in high-density unmanaged woodlands. These treatments will stimulate the germination of woodland seeds stored in the soil and increase the amount of sunlight reaching the ground vegetation. This phase is intended to change stand density and composition from Fire Regime Condition Class (FRCC) III or II to FRCC ID.

Fire Frequency, Intensity, and Seasonality: In general, longer burn intervals favor the establishment of woody plants and shrubs and shorter burn intervals favor the establishment of herbaceous vegetation (Nelson 2010). During the restoration phase, prescribed fire may be applied frequently to more rapidly reduce stand density, remove some of the tree seedlings and seedling sprouts, and to help reestablish grasses, sedges, and forbs from seeds stored in the soil and from other propagules. Prescribed fire may be applied a short intervals (1 to 3 years) during this phase but is more typically applied every other year or every three years to protect the mineral soil from exposure to reduce the risk of erosion and to minimize the loss of soil organic matter needed for maintaining favorable physical properties for infiltration and plant growth. Low intensity prescribed fires will remove much of the leaf litter and top kill seedlings and seedling sprouts but will have little effect on understory and midstory trees. In appropriate area where residual stand timber would not be impacted, high intensity prescribed burns conducted on warmer, less humid days will remove more or all of the leaf litter and severely wound or top kill trees up to 4 inches diameter at breast height (d.b.h.) thereby reducing overall stand density by thinning from below. Growing-season burns are much more lethal to woody vegetation than dormant-season burns although high humidity and moist or green fuels can reduce the rate of spread or leave large areas unburned and are more difficult to conduct.

Thinning: During this phase the stocking level can be monitored to determine if target stand density levels are being achieved. Here stocking charts (Appendix I) are valuable tools for managing density. For closed-canopy woodlands, an overall stocking rate of 70 percent or less is desirable. However, achieving this stocking level make take 10 to 20 years if prescribed fire is the only tool being applied. Mechanical (commercial timber sale and non-commercial thinning) or chemical thinning from below to remove the midstory trees will accelerate stand density reduction. Chemical thinning has an advantage over mechanical thinning in that there will be fewer sprouts produced by its application. Even though thinning allows stand density to be

reduced more rapidly than with fire alone, it is more desirable to maintain higher stocking levels (57 to 70 percent) by not opening the canopy during the restoration phase until the density of woody sprouts has been decreased with prescribed fire.

Duration: The duration of the Restoration Phase is somewhat arbitrary and cannot be determined without some level of monitoring to assess stand density and ground flora response. In general the application of three to five prescribed fires over a 10-year period has been shown to cause substantial changes in the stand structure and ground flora composition although the full effects of burning and thinning treatments will take 20 years or longer to be realized.

TENDING PHASE

Once it has been determined through monitoring of the stand structure and of the ground flora that the restoration goal has been achieved, the management shifts to the tending phase. The tending phase occurs when the Fire Regime Condition Class approaches FRCC I. During the tending phase, the emphasis is to maintain the desirable structure and composition using prescribed fire and periodic thinning. The desirable stocking level for closed woodlands ranges from 50 to 70 percent and for open woodlands ranges from 30 to 50 percent. The stocking charts in Appendix I can be used to convert stocking levels to a basal-area basis for managements units of a given average diameter.

Prescribed Burning Frequency and Intensity: During the tending phase, prescribed fire can be applied as needed to enhance the ground flora or to reduce the density of seedlings and other woody plants and vines in the understory. Monitoring of the vegetation is helpful for regulating and application of prescribed fire. The intensity of the prescribed fire needs to be matched carefully to the age and average size of the trees in the woodlands. Low intensity fires are more suitable for younger woodlands with smaller-diameter overstory trees. Management units with younger and smaller trees are more susceptible to losses in commercial value when fire scarred years prior to commercial harvests because of the longer period for decay to occur to damaged cambium.

Thinning: The stocking level can be reduced through commercial harvesting if there is sufficient merchantable material to warrant a sale. Otherwise, non-commercial thinning from below can be done to meet desired stocking levels. If higher levels of stocking are acceptable, then only prescribed fire needs to be applied to thin the stands. As a rule of thumb, stocking will increase by about 1.3 percent per year when reduced to below the B level. On good sites this may be as much as 3 percent and on poor sites as low as 1 percent (Dale and Hilt 1989). This means that woodlands thinned to 30 percent stocking can be expected to reach canopy closure, or B-level stocking, in about 20 years. Maintaining variation in the stocking throughout the woodland is desirable and can adjusted to different levels depending on the local soil conditions and slope position.

Duration: There is considerable flexibility to adjust the duration of the tending phase. It can begin as soon as an acceptable number of trees (about 30 to 50 in oak woodlands and 50 to 70 in pine woodlands) in the management unit are sufficiently large to escape being top killed or damaged by prescribed fire and can be extended until the acceptable growing stock reach their biological maturity. However, when managed with area regulation, the end of the tending phase occurs when the management unit reaches rotation age. At that time, the management unit should be managed for recruitment.

RECRUITMENT PHASE

The goal of the recruitment phase is to recruit into the overstory a new cohort of trees. During this phase, the overall stocking needs to be reduced to allow for the recruitment of reproduction that has accumulated during the tending phase. The overall stocking needs to be reduced to about 10

to 30 percent at the stand level. The distribution of residual trees and therefore the stocking level can be quite variable within stands such that there are locations within the stand with large openings and other locations where trees remain and the stocking is much greater. The trees that remain should be large-crowned pines and oaks that provide habitat for wildlife and are considered character trees for the woodland.

Thinning: Thinning from below is recommended for adjusting the stocking levels during the recruitment phase. Where economically viable, commercial timber harvests should be conducted. Retaining a residual overstory at the 10 to 30 percent stocking range is essential for providing habitat and retaining "character" trees. Additionally, the partial shade provided by some of the retained trees will reduce the woody regrowth surrounding the residual trees and allow some of the ground flora to be partially retained.

Prescribed Fire, Frequency and Intensity: During the recruitment phase, prescribed fire should be excluded until a portion of the reproduction cohort is sufficiently large to escape being top-killed by fire's reintroduction. Here it is important to recognize that in mature woodlands there will only be about 30 to 40 canopy dominant or codominant trees per acre in oak woodlands and 50 to 70 trees per acre in pine-dominated woodlands. Thus, managing trees in woodlands is analogous to the silvicultural practice of crop-tree management in which a small number of trees are selected at an early age as the "crop" trees and are carefully cultured while the vast majority of trees in the stand are left unmanaged.

Duration: According to Arthur and others (2012), the fire-free interval in oak woodlands should be from 10 to 30 years to allow a sufficient number of trees to become large enough to not be top killed by fire (> 6 inches d.b.h.) so that they can recruit into the overstory. A shorter duration may be used in pine woodlands because shortleaf pine trees are less susceptible to fire damage than are many of the oak species. If producing marketable oak timber is also an objective, the fire-free interval may need to be 30 years or longer to allow a critical number of trees to become large enough to not be severely damaged by prescribed fire. For areas where managing for natural communities with a high level of floristic quality and integrity much shorter period would only be needed for regeneration. These trees are to be treated as the future timber crop so that they can be eventually harvested to offset some of the costs of implementing woodland management treatments. For example, it is reasonable to assume that as trees approach sawlog size they become less vulnerable to large losses in value caused by fire scarring of their bark. This is because the damaged outer portion of the sawlogs cut from these trees will be removed with the slab wood during milling operations.

Once a sufficient number of trees has been recruited and are no longer susceptible to topkill or excessive damage by prescribed fire, the woodland has reached the tending phase.

MANAGEMENT UNITS AND SPATIAL CONSIDERATIONS

With area regulation, specific land units of the woodland are selected for restoration, tending, or recruitment. For land units selected for the recruitment phase, prescribed fire can be excluded protect the seedlings and allow them to grow into the overstory. After a sufficient number of trees have recruited and are no longer in danger of being top killed or severely damaged, fire can be reintroduced along with other tending methods. Although the traditional land unit used in silviculture is the stand, the land unit to be used in this project is the burn unit. This is because fire lines surrounding the burn units allow each to be burned independently. Variation in the age structure at the landscape scale can be created by regulating the age classes of the different burn units within compartments.

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APPENDIX C - RESULTS OF 30-DAY COMMENT PERIOD AND FOREST SERVICE RESPONSE TO COMMENTS

INTRODUCTION

Public comments assist the Forest Service in understanding issues or concerns that the public may have with a proposed action. The Responsible Official and the Interdisciplinary Team read and consider public comments. Public comments play a key role in planning, environmental analysis, and decision making. The Responsible Official considers these public comments when making project decisions.

Public comments were submitted during the 30-Day Comment Period as letters, e-mails, and public comment forms. Comments were received from individuals, organizations, and agencies. All public comment responses were analyzed and considered. Every comment has the same value, whether expressed by many, or by one respondent, by an agency, organization, or other entity. Analyzing comments is not a vote-counting process.

Public comments do not necessarily represent the views of the public as a whole. The analysis of public comments and public concerns attempts to provide fair representation of the wide range of views submitted.

CONTENT ANALYSIS

All responses were analyzed using a process called content analysis. Content analysis is a systematic process that analyzes both qualitative and quantitative information. The process is designed to track all responses and identify individual comments by subject. The process also evaluates similar comments from different responses and summarizes like-comments into specific public concerns.

The term "concern" in this context does not imply a negative or positive meaning. The term concern is simply used to note an issue that the Forest Service can consider and potentially act upon. A Public Concern summarizes a specific issue or concern, whether only one comment or numerous similar comments were submitted.

Comments received were developed into Public Concern statements. Each Public Concern statement is accompanied by one or more sample public comments. These sample public comments provide the commenter's specific perspectives (what the agency should or should not do) and rationale (why) regarding that concern. Public Concerns provide a topical review of comments in a format that aids in careful consideration and agency response.

The Responsible Official and an Interdisciplinary Team of Forest Service staff reviews the Public Concerns, sample statements, comments, and or responses to consider the public's views as related to the project. Public concerns can often bring new issues and concern to the agency's attention or point to management actions or alternatives that should be considered in the project. These Public Concerns and public comments are considered during planning, environmental analysis, and decision making. A Forest Service response is developed for each public concern indicating how that concern has been or will be considered in the decision process.

Public Concerns have been organized into similar sections that relate to a natural resource management category, such as land management. The remainder of this section presents these natural resource management categories, Public Concerns within that category, examples of relevant public comments, and the Forest Service response. Note that the acronym PC will be used throughout the remainder of this document instead of continual use of the terms Public Concern. Each PC represents one or many public comments that point to the same management action of what the Forest Service should or should not do, but often differ in terms of the reasons or values given. To facilitate understanding of respondents' reasons or values given, sample statements that are similar in nature regarding reasons or values given have been grouped together into themes.

PUBLIC CONCERNS IDENTIFIED IN PUBLIC COMMENTS

GENERAL – PROPOSED ACTION

PC 1: The Forest Service should implement the proposed project.

PC 1 - A Themes	• To Restore Shortleaf Pine Across the Landscape • Because Shortleaf Pine Once Covered the Landscape Across 6 Million Acres • Because a Fraction of Shortleaf Pine Remain • Because Restoration Will Involve a Small Area of the National Forest • To Benefit a Diverse Wildlife Community

Sample Statements: The proposed actions of the Project on the National Forest area located within the Current River Hill subsection of the Ozark Highlands. The Current River Hills are known for their wide variety of forest habitat types with varying age classes, densities, and structures. The upland oak-hickory forests of this subsection have a vital role as the largest contiguous block of forest not only in the Ozarks, but also in the Midwest. Forests of Oak, shortleaf pine, and mixed deciduous species cover most of the area, along with open oak-pine woodlands that are found on the more exposed sites. This area is within the historic range of shortleaf pine, which once covered up to an estimated six million acres yet now has been significantly reduced across the landscape. The Department [Missouri Department of Conservation] supports efforts to increase the amount of shortleaf pine across the landscape in various woodland and forest types, in addition to the benefits of supporting the diverse wildlife community that relies on the forest interior habitats and oak-pine woodlands. (C6-1)

As pointed out in the project plan, the project area was part of a once extensive shortleaf pine system. These pine systems have been obliterated, and pineries are the only matrix-scale natural community with no functional examples remaining in the Missouri Ozarks[1]. . . . [1] The Nature Conservancy, Ozarks Ecoregional Assessment Team. 2003. Ozarks Ecoregional Conservation Assessment. Minneapolis, MN: The Nature Conservancy Midwestern Resource Office. 48 pp. + 5 appendices. (C11-3)

We . . . support the effort to restore portions of the important shortleaf pine and pine-oak woodlands which once was prevalent in southern Missouri. Today only a fraction of that

forest type remains, and it is logical and prudent to recover a meaningful representation. (C3-1)

Missouri's current timber economy is primarily focused on hardwoods, and we are sensitive to the concerns raised by some members of the forest products industry regarding the emphasis on pine and use of prescribed fire in the project area. However, this project and the broader CFLRP [Collaborative Forest Landscape Restoration Program] area comprise a minority of the Mark Twain lands, which themselves are a minority of Missouri's forest products output. (C11-8)

I do not understand the concern regarding any purported economic effects of restoring shortleaf pine natural communities. Some simple math will demonstrate that the percentage of proposed and existing land area in the CFLRP [Collaborative Forest Landscape Restoration Program] shortleaf pine landscape pales in comparison to the majority of the Mark Twain not subject to ecosystem restoration of shortleaf pine under the Forest Plan. (C9-6)

Please consider this as written permission to proceed, and as encouragement to go forward with this important work to bring a native Missouri landscape back to our state. (C3-3)

PC 1 - B Themes	• Because the Project Area Provides the Best Location In Missouri for Shortleaf Pine Woodland Restoration • Because the Project Area Has the Best Mix of Stands, Open Canopies, Age Classes and Pine Dominance

Sample Statements: During drafting of the 2005 Forest Plan, the Fremont and Pineknot East units on the Mark Twain National Forest Eleven Point Ranger District were chosen by The Nature Conservancy (TNC) as the best locations for pine woodland restoration in Missouri. To date, TNC has dedicated significant effort and funding to the vegetation monitoring program on these units as a means of tracking species richness, ground flora recovery, and tree plot data.

These two units provide a great opportunity for ecosystem restoration efforts because the project area has the best mix of diverse stands with already open canopies and age classes along with pine dominance. (C12-2)

The Fremont-Pineknot East Restoration Project is perhaps Missouri's best opportunity to demonstrate restoration of a globally threatened shortleaf pine landscape, inclusive of its distinctive plant and animal diversity. The Collaborative Forest Landscape Restoration Project gives the Mark Twain National Forest a great opportunity to achieve this effort and assure the viability of this diversity. (C9-14)

On the Mark Twain National Forest, the Fremont and Pineknot East project is the greatest opportunity for doing this work in Missouri. (C3-2)

PC 1 - C Themes	• Because the Project Area Lies in Conservation Opportunity Areas identified by the Missouri Department of Conservation • Because Conservation Opportunity Areas Enable All Wildlife Conservation

Sample Statements: Conservation Opportunity Areas (COAs): The majority of the project area lies within four COAs; Pineknot Dissected Plains, Pineknot Hills, Eleven Point and Chilton Creek. Conservation Opportunity Areas were initiated by the Missouri Department of Conservation and are priority places that identify the best places where partners can combine technology, expertise and resources for 'all wildlife conservation' (http://mdc.mo.gov/nathis/cws/coa/). (C12-17)

PC 1 - D Themes	• To Restore a Diverse and Biologically Unique System • To Benefit Sensitive Species • To Restore Bird Species of Conservation Concern • To Benefit Many Wildlife Species • To Benefit Native Wildflowers and Pollinator Species • To Benefit Amphibians and Reptiles

Sample Statements: An emphasis on shortleaf pine system restoration and management in the project area is appropriate and will provide enduring benefits for a globally unique resource, including: . . . restoration of a diverse and biologically unique system, with associated benefits to sensitive species restricted to or modal in pineland environments. (C11-6)

The CHJV [Central Hardwoods Joint Venture] has been supportive of the Mark Twain's Collaborative Forest Landscape Restoration Project (CFLRP) since its inception and continues to support the effort to this day. This is the only opportunity that we are aware of in the entire Central Hardwoods BCR [Bird Conservation Region] that would restore enough of a shortleaf pine-bluestem community to come close to meeting the JV's [Joint Venture's] habitat goal of the roughly 130,000 acres needed to help restore several bird species of continental conservation concern (i.e. chuck-will's-widow, eastern whip-poor-will, red-headed woodpecker, Bachman's sparrow, and prairie warbler) to desired population sizes within the region (see: http://www.stateofthebirds.org/extinctions/watchlist.pdf.) (C1-1)

The proposed actions to restore shortleaf pine and pine-oak-bluestem woodlands will benefit populations of many wildlife species in the area, including some that are species of conservation concern and some that are harvested as game. Research on pine savanna and woodland restoration projects in the Southeast United States have shown positive responses from wild turkey and Northern bobwhite quail. Research in Missouri has indicated that positive population increases will result for a number of songbird species from woodland restoration efforts similar to those proposed in the Project. Many of these songbird species are considered to be priority species by the Central Hardwoods Joint Venture and Partners in Flight initiatives. Woodland restoration also benefits the abundance and flowering rates of native wildflowers that are required by pollinator species such as bees and butterflies. There are also a variety of other types of animals, including amphibians and reptiles, which may show favorable responses to the proposed actions. (C6-2)

PC 1 - E Themes	• To Integrate Ecosystem Restoration into Planning • To Achieve Ecosystem Restoration Goals and Objectives of the 2005 Forest Plan

- To Achieve Collaborative Forest Landscape Restoration Program Objectives
- To Assure a Diversity of Benefits and Values to the Public

Sample Statements: It is clear that the future direction of the US Forest Service [USFS] is to assure a greater diversity of benefits and values to the public, including species and ecosystem viability. Not every acre of the Eleven Point Ranger District (as forestwide) should be first timber worthy. As is the intent of the 2012 Planning Rule, the USFS has elevated the significance of integrating ecosystem restoration into the planning framework. (C9-12)

I strongly support the development of a proposed action that will help complete and achieve the ecosystem restoration goals and objectives of the 2005 Forest Plan, and the objectives of the CFLRP [Collaborative Forest Landscape Restoration Program] project. Such an action should maximize the reasonable–operational extent of carrying out prescribed burns and thinning that will assure connectivity of this and other surrounding project areas to achieve landscape-scale restoration of shortleaf pine communities. (C9-1)

PC 1 - F Themes

- Because it Presents a Significant Natural Community Management Model
- Because it is Consistent with the 2005 Forest Plan
- Because the Missouri Department of Natural Resources Participated in Planning
- Because Results at Hawn State Park Model Desired Conditions for the Project

Sample Statements: The department [Missouri Department of Natural Resources] considers this project a very significant natural community management model and restoration project that is consistent with the 2005 Forest Plan for the Mark Twain National Forest. Department staff have participated in the planning group on the Collaborative Forest Landscape Restoration Program (CFLRP). Results from the department's restoration and monitoring at Hawn State Park have been used to model the desired condition for the Fremont/Pine Knot projects. (C12-1)

PC 1 - G Theme

- Because Many Conservation Organizations and Individuals Support Restoration

Sample Statements: Many conservation organizations and individuals supported the ecosystem restoration framework of the 2005 Forest Plan. (C9-2)

It is reasonable and prudent that the Mark Twain National Forest should proceed to the maximum extent feasible to fulfill its restoration goals as supported by so many partners in the CFLR [Collaborative Forest Landscape Restoration Program] project. (C9-7)

We commend the Forest Service for its collaborative approach in involving a robust spectrum of stakeholders, and look forward to working with you for long term project success. (C11-22)

PC 1 - H Themes

- Because Initial Project Phases Demonstrate Achievement of

Desired Outcomes

- Because it Achieves the Multiple-Use Mandate

Sample Statements: The initial phases of the Missouri Pine-Oak Woodlands Collaborative Restoration Project have demonstrated the project's ability to generate forest products and the resultant job opportunities while simultaneously improving forest health and resiliency, wildlife habitat, and natural community diversity and synecological integrity, including increased habitat for sensitive species. We feel that this project exemplifies an integrated conceptual approach to achieving the multiple use mandate required by the Forest Service's mission. (C11-1)

The initial phases of the plan have demonstrated the ability to produce forest products in a context of ecological restoration. While we are not advocating this management approach for most of the Mark Twain National Forest, it would similarly be short-sighted, and contrary to Federal requirements, to mandate that all Mark Twain lands be used solely to maximize current timber production without regard to ecological benefits, other resource issues, or long-term sustainability or forest resiliency. (C11-9)

I recently drove Highway J through Pineknot and was extremely pleased with the appearance and health of the shortleaf pine woodlands having obviously been thinned and prescribed burn. This very scenic drive demonstrates what is desired for the future of the Fremont area. (C9-15)

PC 1 - I Theme

- To Model Integration of Economic, Cultural, and Conservation Issues into Holistic Land Management

Sample Statements: The Nature Conservancy feels that this project has the potential to serve as a model for integrating economic, cultural, and conservation issues into a holistic land management concept. (C11-21)

PC 1 - J Theme

- Because Restoration Success, Benefits, and Positive Results Exceed Negative Effects

Sample Statements: Land managers have made adaptive adjustments in restoration approaches based on such information, and understand that some degree of effect will happen when working in previously damaged and out of character landscapes. The question becomes to what degree those effects are balanced against the benefit and success of achieving restoration goals. From my experience I believe the effects are quite minimal as compared to the positive results. Monitoring is essential to answering this question. (C9-3)

PC 1 - K Theme

- To Restore Healthy Ecosystems and Increase Their Resilience to Climate Change

Sample Statements: On the matter of climate change effects I helped plan two consecutive year workshops at the Missouri Natural Resources Conference. Discussions at those sessions concluded that Missouri should strive to restore healthy ecosystems to assure their resilience to the effects of climate change. (C9-4)

An emphasis on shortleaf pine system restoration and management in the project area is appropriate and will provide enduring benefits for a globally unique resource, including: . . . increased resiliency in the face of predicted changes. Contemporary models for future conditions in the Ozarks indicate that pine will be more suitable in many areas than oaks, particularly on historical pine sites. Focusing on biologically appropriate habitats and species makes sense from both ecological and economic perspectives, as it increases resiliency and diversification on both fronts. (C11-4)

PC 1 - L Theme

- To Increase Cover and Ground Layer Vegetation Diversity
- To Benefit Wildlife, Sensitive Species, Soils, and Hydrology

Sample Statements: An emphasis on shortleaf pine system restoration and management in the project area is appropriate and will provide enduring benefits for a globally unique resource, including: . . . increased cover and diversity of ground layer vegetation, providing multiple benefits to wildlife, sensitive species, soil quantity and quality, hydrological function and groundwater infiltration. (C11-5)

PC 1 - M Themes

- Because Funding Will Generate Employment
- To Explore Markets for Shortleaf Pine Products

Sample Statements: I would have to believe that the sizeable funding provided by CFLRP [Collaborative Forest Landscape Restoration Program] appropriations would provide both a great deal more employment for local communities as well as the continued exploration of future markets for shortleaf pine products. (C9-8)

PC 1 - N Themes

- Because the Standing Red Oak Far Exceeds Demand
- Because the Increase in Shortleaf Pine Would Not Eliminate Markets for Red Oak
- Because a Healthy Timber Industry Should Have a Diversity of Forest Products

Sample Statements: Surely the amount of red oak material still standing across the Missouri Ozarks far exceeds the demand. It seems it would take decades for shortleaf pine to even reach marketable size, and even then I'm skeptical that this increase would ever eliminate markets for red oak. I am one that believes that a healthy timber industry should include a diverse array of forest products consistent with meeting Forest Plan objectives across a diverse set of management zones. (C9-9)

Forest Service Response to PC 1

The proposed activities in Alternative 2 for the Fremont-Pineknot East Restoration Project are consistent with the goals and objectives of the Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan) (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, pp. 1-1 to 1-7). Hereafter, the Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan) will simply be referred to as the 2005 Forest Plan.

The Mark Twain National Forest's *Record of Decision for 2005 Land and Resource Management Plan (2005 Forest Plan)* (United States Department of Agriculture, Forest

Service, Mark Twain National Forest, 2005b), in selecting Alternative 3, specified the following rationale:

> I recognize that there is strong support for the restoration of natural communities. I also recognize there are some concerns about this new focus on restoration. In recognition of these different viewpoints and concerns, my decision balances the allocation of land so that about 29% will be managed with an emphasis on restoration on natural communities and about 45% of the Forest will be managed with multiple use resource objectives as an emphasis. The remaining 36% will be managed with an emphasis on recreation, Wilderness, or other special area designation. The 29% selected for a restoration emphasis are those lands that are the best examples of some of the rarest natural communities in Missouri. (pp. ROD-9 to ROD-10)

The purpose and need for this project is consistent with 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) Management Prescription 1.1 guidance to:

- Focus restoration efforts in areas that collectively represent irreplaceable concentrations of distinctive biota, and that represent the highest quality natural communities in Missouri.
- Restore, enhance and maintain the structure, composition and function of distinctive terrestrial and aquatic natural communities.
- Restore the ecological role of fire in natural communities.
- Provide a variety of uses, products and values by managing in support of desired ecological conditions. (pp. 3-3 to 3-5):

The activities identified in the proposed action assist in moving the project area from the existing condition to the desired condition described in the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) and achieving the purpose and need for the project (EA, pp. 2 to 7). The proposed action and its effects were analyzed in the environmental assessment (pp. 24 to 204).

PC 2: The Forest Service should manage the project area to maintain appropriate heterogeneity.

PC 2 Themes	• To Achieve Silvicultural and Ecological Goals • To Maintain Organismal Diversity and Natural Community Quality

Sample Statements: Long term management of the project area should ensure appropriate management condition heterogeneity to achieve silvicultural and ecological goals and maintain organismal diversity and natural community quality. (C11-19)

Forest Service Response to PC 2

The project area is out of character for the plant species distribution, abundance and diversity needed for a healthy, resilient ecosystem as addressed in the purpose and need and environmental assessment (pp. 2 to 7). For this project area, management emphasis is

placed on maintaining, enhancing and restoring a shortleaf pine woodland natural community type. The project is needed to change the existing high basal area, oak-pine forest type to a desired lowered basal area, pine-oak woodland type that was historically present as described in the environmental assessment (pp. 2 to 7).

PC 3: The Forest Service should not implement the proposed project.

PC 3 - A Theme

- Because of Environmental, Economic, and Social Concerns

Sample Statements: The Fremont Project should not go forward due to environmental, economic, and social concerns. (C2-2)

PC 3 - B Themes

- Because the Project May Irreparably Harm the Ecosystem, Economy and People
- Because the Potential for Irreversible Harm Exists

Sample Statements: I am fully aware that the 2005 forest plan calls for the restoration of the shortleaf pine natural community, so I will not debate the merits of that strategy. However, it is very important to discuss the tools that are being used to reach the restoration goal, and whether or not those tools are causing irreparable harm to other components of the ecosystem. Furthermore, I also believe it is very important to determine if implementation of the proposed strategy has the potential to harm the people in the area by impacting the economic climate in which they live. I believe the potential for irreversible harm exists in both these areas. (C7-10)

PC 3 - C Theme

- Because Future Timber Sales Will Not Be Economically Viable

Sample Statements: I . . . question the economic viability of conducting future timber sales within the restoration area after the initial basal area reduction. (C7-2)

My observation of existing restoration efforts in the area make me seriously question the economic viability of a timber sale based on available volume per acre alone. A minimum of 1500 feet per acre of decent sawtimber will be necessary to attract bidders to a proposed timber sale. (C7-4)

PC 3 - D Themes

- Because Impacts Have Not Been Analyzed
- Because Mitigation Plans Are Not in Place

Sample Statements: The short, medium and long-term impacts of the Fremont-Pineknot East Restoration Project have not been sufficiently analyzed and appropriate mitigation plans are not in place, as required by NEPA [National Environmental Policy Act]. (C2-14)

PC 3 - E Themes

- Because the Project is Too Large
- Because the Project Exceeds the Forest’s Ability to Evaluate

Sample Statements: The magnitude of the project is too large to implement a strategy that does not have known results. The intent of the proposed action is to try and create a habitat that was present in the distant past. Although I am opposed to this objective, I

understand that it is a part of the 2005 plan. Since theMark Twain National Forest received Cooperative Forest Land Restoration Project (CFLRP) funds to implement the 2005 plan objectives for restoration, I feel that basal area reduction and burning is far exceeding the Forest Service ability to properly evaluate the consequences of those actions. (C7-6)

PC 3 - F Theme

- Because Oak-Hickory Forest Benefits Wildlife and Forest Industry

Sample Statements: The current forest cover (primarily oak-hickory with a lesser component of shortleaf pine) supplies mast for wildlife and hardwood logs for the forest products industry. Its removal does a disservice to both wildlife and people. (C2-13)

Restoring Pineknot East is pretty, but wildlife will not survive on pine forest. (C5-2)

Forest Service Response to PC 3

The environmental assessment analyzes the environmental and social concerns and effects determined for analysis by the responsible official. The environmental and social effects are detailed in Chapter 3 of the environmental assessment.

An analysis of *Social/Economic* effects is addressed in the environmental assessment (pp. 162 - 180). Social concerns were examined partially through the National Environmental Policy Act process of public involvement. The responsible official reviews public comments and determines issues or alternatives that are analyzed in the environmental assessment. The Forest Service sought, considered, and responded to public comments during project Scoping and the 30-Day Comment Period.

Commenters are concerned the "Project May Irreparably Harm the Ecosystem, Economy and People". The project need and desired conditions provide information regarding the existing and desired conditions for this important and rare ecosystem. The purpose of the project is to restore and enhance fire-adapted pine and pine-oak bluestem woodlands to their historic vegetation composition and structural conditions. There is a need to improve the resiliency, integrity, and sustainability of ecosystem conditions within the project area. These ecosystem conditions could be compromised if the dense canopy cover, high tree densities, and absence of fire are not treated as discussed in the environmental assessment (p. 2).

Under Alternative 2, project activities would restore a shortleaf pine woodland natural community as consistent with the project need and 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, pp. 3-3 to 3-5) management direction. The benefits of this restoration include providing critical wildlife and plant habitat for species dependent on this natural community as described in the environmental assessment (pp. 83 to 112).

An economic analysis was conducted for the project and is provided in the environmental assessment (pp. 162 to 180). Results of the economic analysis indicate that project would generate an estimated present value of more than $9 million dollars in economic benefits and approximately 60 jobs. This project would generate employment and economic

benefits through timber products removal, resource management investments, recreation visitor use, and secondary processing and benefits.

In addition to the economic analysis, ecosystems services benefits were analyzed in the environmental assessment (pp. 173 to 175). The Forest Service has a responsibility for managing resources for multiple-use benefits and ecosystems services benefits. The forest provides numerous ecosystems services benefits such as species habitat diversity, clean air and water, recreation opportunities, and scenic values, among many others. Many ecosystems services are critical to public health, security and survival. The total value of ecosystem services likely exceeds the value of timber by up to 25 times.

The comment about impact to "people" is very broad and cannot be sufficiently evaluated. Numerous comments held that the project should be implemented while others commented that the project should not be implemented. The environmental assessment analyzed both the no action alternative and the proposed action. The analysis takes into consideration the issues, opportunities and concerns developed from public comments. The environmental assessment also analyzed the environmental justice effects of these alternatives (pp. 180 to 194).

Some comments raise concerns that future timber sales may not be viable. The need for action provides vegetative activities that would improve ecosystem health while also providing wood products through commercial timber sales. The 2005 Forest Plan's (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) Management Prescription 1.1 guides the forest to restore distinctive terrestrial and aquatic natural communities and provide a variety of uses, products and values. While the project will not maximize timber production as some desire, timber products and services would be available over the long-term as described in the environmental assessment (pp. 73 to 83, 162 to 180).

The environmental assessment analyzed the project's environmental, economic and social effects (EA, pp 162 to 180). The scale of the project was analyzed and is consistent with other Management Prescription 1.1 projects on the forest.

PC 4: The Forest Service should determine whether a shortleaf pine and bluestem ecosystem is adaptable to climate change.

PC 4 - A Themes	• Because Climate Change Will Create a New Environment • Because Restoration of Shortleaf Pine May Be Impractical • Because Climate Change May Promote the Pine Beetle

Sample Statements: We are in the middle of a significant climate change event. NOAA [National Oceanic and Atmospheric Administration] predicts that the average annual temperatures in the Midwest will rise by more than 4º F, and that average annual rainfall will increase by more than 15 percent. Within that annual rainfall prediction, NOAA further predicts that wet periods could be as much as 30% wetter, and dry periods could be 15% drier. Before proceeding further with burning, scientists need to determine whether a shortleaf pine and bluestem based ecosystem is even adaptable to this new environment. Consider also that climate change is believed partly responsible for

proliferation of the pine beetle in the Western pine forest; the effect of that creature on pine and spruce forests is devastating. It could be that climate change makes restoration of a shortleaf pine forest in the Ozarks impractical as well. (C2-8)

PC 4 - B Themes	• Because the Ecology Has Been Changed • Because of Species Competition • Because of Uncertainty of Project Outcomes

Sample Statements: Restoration of native ecosystems in the Ozark highlands is difficult because the ecology of the area has been change by man and introduction of non-native species (both flora and fauna). When the hardwood trees are removed, shortleaf pine and bluestem may, or may not, return because of competition from both hardwood species and "weeds" (including aggressive and undesirable non-natives). No one can say with certainty that this experiment will turn out as intended—rather, as with most experiment, it will be different. (C2-9)

Forest Service Response to PC 4

The effects of climate change on shortleaf pine and bluestem were analyzed by an interdisciplinary team during a Climate Change Workshop (Brandt, 2014). This workshop was led by the Regional Climate Change Specialist and resulted in an Adaption Workbook of staff findings (USDA Forest Service Mark Twain National Forest, 2014). Information about the forest's consideration of climate change and effects on shortleaf pine, scarlet and black oak were posted to the Climate Change Response Framework webpage (USDA Forest Service, Northern Research Station, Northern Institute of Applied Science, 2014).

The *Climate Change* section of the environmental assessment (pp. 193 to 198) addresses climate change, shortleaf pine, staff findings from the workshop, and climate change research.

Climate change issues involving the Mark Twain National Forest are addressed within the *Central Hardwoods Ecosystem Vulnerability Assessment and Synthesis: A Report from the Central Hardwoods Climate Change Response Framework Project* (Brandt et al., 2014) publication. Shortleaf pine is addressed throughout that report. Bluestem is considered on pages 204-208. The southern pine beetle is considered on pages 41, 96, 116, 117, 121, 128, 138, 140, and 142.

As a summary, these various sources consider future climate scenarios and environmental conditions as well as threats. Multiple climate change models agree that shortleaf pine will be a future-adapted species and that its habitat suitability and establishment probability is expected to increase under a range of future climate scenarios. Shortleaf pine would fare better than species less favored to future climate conditions such as black and scarlet oak. Further, more open conditions would reduce susceptibility to the southern pine beetle.

PC 5: The Forest Service should restore pine only on sites that were historically pine, and as they originally existed.

PC 5 Theme	• To Manage for Pine Oaks

Sample Statements: Pine should only be a management focus on sites that were historically pine, as demonstrated by General Land Office data, and only to the extent that pine was originally in the system (i.e., pine oak sites should be managed for pine oak, and not for pine or oak alone). (C11-7)

Forest Service Response to PC 5

For Management Prescription 1.1, the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, p. 1-1) directs the district to move natural communities toward restoration and appropriate vegetation composition and structural conditions.

Much of the historic range of shortleaf pine, white oak, and post oak has shifted toward black oak, scarlet oak, and red cedar. Six million acres of shortleaf pine woodland once covered the Missouri Ozarks (Liming, 1946). Shortleaf pine decreased from 54% to 15% in the Current River Hills subsection of the Ozarks as evidenced by comparing species composition data from General Land Office surveys conducted between 1815 and 1850 and contemporary data from USDA Forest Service Forest Inventory and Analysis (FIA) (Hanberry, Dey, & He, 2012).

The project proposes to move toward a healthier balance of shortleaf pine and white oak in many areas; it does not propose to eliminate oaks, clearcut all species, or replant only with shortleaf pine. The Mark Twain National Forest does not manage for pure pine plantations (as occurred in the 1930's-1950's). The forest re-seeds or plants seedlings only on sites where shortleaf pine historically occurred, and in mixtures of oak or hickory hardwoods.

This project would restore viable portions of the forest to shortleaf pine-oak woodland, which is now rare as a natural community type. Consistent with historic land survey records and land type associations, we envision that many project sites would contain mixtures of oak hardwoods and shortleaf pine as they historically occurred. Our estimates are that few sites contained pure shortleaf pine stands; these sites mostly occurred on upland ridges, plains and southwest-facing slopes.

PC 6: The Forest Service should minimize soil disruption, impacts to native vegetation, and monitor and prevent invasive species establishment when conducting pine planting.

PC 6 Themes	• To Minimize Soil Disruption and Impacts to Native Vegetation • To Minimize Invasive Species Establishment

Sample Statements: Pine planting, if necessary, should be conducted so as to minimize soil disruption and impacts to existing native vegetation (i.e., no ripping or similar site preparation), with attention to minimizing opportunities for invasive species establishment. Post planting actions should include monitoring and treatment as necessary to prevent invasive species problems. (C11-11)

Forest Service Response to PC 6

Pine planting is completed by hand. This type of planting has a low potential for contributing to the expansion of existing invasive species infestations. There are no expected negative consequences to soils or native vegetation which would contribute to increases of invasive species. See the Forest Service Response to PC 31 for more information on invasive species management.

PC 7: The Forest Service should use local genotype materials in pine plantings.

PC 7 Theme	• To Maintain Ecological and Fitness Perspectives

Sample Statements: The plan calls for replanting of shortleaf pine in some treatment areas. From both ecological and fitness perspectives, we urge the Forest Service to develop and use local genotype plant materials, ideally generated from seed trees within the project area. Planted pines should be at the very least Missouri Ozark genotype, and not improved silvicultural strains or material sourced from sites remote from the region. (C11-10)

Forest Service Response to PC 7

The seed that would be used was developed from native trees on the Mark Twain National Forest. Candidate native trees were located and evaluated for superior qualities, such as straightness and form, insect and disease resistance, and other quality characteristics. The top candidates were chosen as part of a tree-improvement breeding program to provide quality seed for reforestation as consistent with the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, p. 2-29).

PC 8: The Forest Service should conduct post planting invasive species treatment and monitoring.

PC 8 Theme	• To Prevent Invasive Species

Sample Statements: Post planting actions should include monitoring and treatment as necessary to prevent invasive species problems. (C 11-12)

Forest Service Response to PC 8

The Forest Service is currently treating existing invasive species within the project area. The level of ground disturbing activity with hand planting has very low potential for infestation by invasives. Hand planted seedlings would be monitored for establishment (survival) as well as for invasive species during project implementation. See the Forest Service Response to PC 31 for more information on invasive species management.

PC 9: The Forest Service should conduct robust monitoring.

PC 9 Themes	• To Ensure Diversity and Natural Community Integrity • To Provide Direct Feedback to Guide Management Decisions • To Ensure That Vulnerable System Components Are Retained

Sample Statements: We support most of the goals, desired conditions, and management actions outlined in the project plan and recommend that they be accompanied by sufficiently robust ecological monitoring to ensure organismal diversity and natural community integrity are sustained. (C11-2)

We recommend that the Forest Service maintain the robust ecological monitoring program that has been developed to date in order to provide direct feedback to guide management decisions and ensure the most vulnerable components of the system will be retained through time. (C11-18)

Forest Service Response to PC 9

The Forest Service conducts monitoring to ensure the project is accomplishing its goals, and to make any necessary adjustments. Several kinds of activities can be referred to as "monitoring." Project implementation monitoring monitors compliance with Forest Plan standards and guidelines. Effectiveness monitoring evaluates how effective our management actions are at achieving desired outcomes.

In addition, the Fremont and Pineknot East Restoration Projectis part of a larger collaborative landscape restoration project known as the Missouri Pine-Oak Woodland Restoration Project. This is part of a national program referred to as the Collaborative Forest Landscape Restoration Program designed to encourage the collaborative, science-based ecosystem restoration of priority forest landscapes.

Title IV of the Omnibus Public Land Management Act of 2009 which established the CFLRP requires a multiparty monitoring to assess the positive or negative ecological, social, and economic effects.

The multiparty monitoring for the Missouri Pine-Oak Woodland Restoration Project is a collaborative effort lead by Central Hardwood Joint Ventures (CHJV) and includes direct participation from the American Bird Conservancy, Forest Service Northern Research Station, University of Missouri and the Nature Conservancy. The Forest has also reached out to the National Wild Turkey Federation, Missouri Department of Conservation, Oak Woodlands and Forest Fire Consortium, U.S. Fish and Wildlife Service and the Department of Natural Resources for technical opinions on inventory and monitoring needs.

The following monitoring is currently being implemented within the Fremont and Pineknot East Restoration Projectand CFLRP project area.

Floristic Quality Assessments (FQI): In 2012, 17 vegetation monitoring plots were established in Fremont project area as a baseline to track changes for floristic composition and dominance patterns (C-values and mean diversity among 50 0.25 m2 square quadrats) placed in a designated number of stratified macroplot settings in the Fremont Project Area. These plots in addition to the 100 vegetation monitoring plots established in Pineknot established in 2000 will be used for comparisons and to indicate significant improvements in floristic metrics with in restoration treatment areas were thinning and prescribed fire has been implemented. The Forest currently has a total of 151 permanent FQI plots across the CFLRP area. In 2014, The Nature Conservancy partnered with the Mark Twain National Forest to obtain canopy image data from all 100

vegetation monitoring plots within the Pineknot project. These images are currently being analyzed to determine canopy cover for each plot. These data can then be analyzed to reveal canopy effects by treatment, and also serve as a valuable reference against which to assess change over time as management actions precede. The methodology also allows direct comparison with similar projects on other Ozark sites. One concern with the current state of Ozark woodland systems is the paucity of herbaceous ground cover vegetation, in terms of abundance, diversity, and mean conservatism. Data from similar projects elsewhere in the Ozarks and Midwest suggest a strong correlation between ambient light levels and ground layer abundance, diversity, and quality, and that under a fire regime these are strongly linked to canopy cover. Thus, canopy cover monitoring serves as an efficient, valuable tool to provide direct feedback informing management actions.

Bird Monitoring: The Northern Research Station, U.S. Fish and Wildlife Service, American Bird Conservancy, and others have developed an avian survey protocol and began conducting surveys in May 2013. The objective of the surveys will: 1) determine change in abundance in response to restoration activities, and 2) determine relationships between bird abundance and vegetation structure and composition. Objective 1 will require bird surveys spaced over the duration of the project. However, initial results from objective 2 will be available after 3 years based on the current variation in structure and management that has already taken place. Data has been collected at the FQI plot and Grid plot locations in the 2013 and 2014. Given the various stages of restoration available, this initial round of surveys should accomplish the linkage objective as well as provide data to test and refine predicted responses of CHJV priority species to restoration. Surveys will be repeated in the last two years of funding (2018-2019) to determine change over time.

The Forest, Northern Research Station, and CHJV will correlate data from the grid inventory and the vegetative plots to bird monitoring that began in fiscal year 2012. Data will be stratified between treatment and non-treatment areas to determine changes in bird species and population in responses to restoration activities that result in significant changes in vegetative structure and composition. These plots are scheduled to be re-measured from 2016 to 2018.

Grid Inventory: The Forest has invested, for several years, in the establishment of a grid inventory for all vegetation management projects. The CFLRP project area consists of 981 plots where data has been collected. These plots are similar to Forest Inventory and Analysis plots and include tree data, scorch height by tree, canopy closure percent and fuels data. The project grid inventory will be used to assess changes in woodland structure and species composition. FSVeg plots were installed for Fremont (191 plots) in 2009 and Pineknot (82 plots) in 2012. The design has 1 plot (24 foot Fixed Radius Plot with Brown Fuel Transect) for each 100 acres set up on a spaced grid. The plot center is monumented and GPS location collected for re-measurement purposes. Plot re-measurement depends on when the activities will be completed. Main focus of this monitoring is treatment effectiveness and will evaluate species composition change, basal area objectives, canopy closure and tree mortality. Plots will be re-measured and compared to the initial plot data. Results will be reviewed and compared to the objectives outlines in the NEPA document for that project area.

IMPLAN Analysis: The Forest began collaboration in 2014 with the Northern Research Station and the University of Missouri to conduct and IMPLAN Analysis to evaluate the economic impacts that CFLRP is having in those counties affected by pine woodland restoration efforts on the Forest. In July of 2014, the University of Missouri replicated the baseline information for the CFLRP project and collaborated with Susan Winter on the FS approach utilizing the TREAT tool. The University is currently in the process of updating and compiling the most recent economic data within the CFLRP to utilize in the IMPLAN analysis. In early 2015 a preliminary economic impact analysis will be available for stakeholders (industry, local governments, and the collaborative) regarding the potential economic impact of restoration activities of the CFLRP. A final report containing a comparison of multiplies effects of CFLRP expenditures and any expected loss in economic activities is scheduled for release in winter 2016.

Watershed Monitoring: The Forest, in partnership with the Nature Conservancy is currently in the process of designing a monitoring program to assess the soil, water, and sediment impacts from restoration activities to conduct a geomorphic analysis of downstream impacts.

PC 10: The Forest Service should change the project scope and timing of actions.

PC 10 - A Themes

- To Balance Forest Management and Disturbance Practices
- To Meet Expectations of Residents and Forest Industry

Sample Statements: The forest products industry is important for the residents and communities of southern Missouri. The forest products industry, and the related recreation and tourism activities in the area, are all based upon the quality and availability of the diverse forests, woodlands, streams, caves and springs of the area. The Department encourages changes in the proposed Project scope and the timing of actions to achieve a better balance between forest management, air quality impacts to local citizens, and the use of disturbance practices like prescribed fire that mimic natural disturbance processes. The Department suggests that Project actions be adjusted to better balance the long-term sustainability of the management approach with the expectations of local residents and the forest products industry. (C6-3)

PC 10 - B Themes

- To Study Project Consequences
- To Avoid Unintended Consequences

Sample Statements: I strongly suggest that the size and magnitude of the project area be scaled back so that the consequences of the management strategies can be studied to determine that the goal of the 2005 objective can be met without realizing unintended consequences. (C7-11)

Forest Service Response to PC 10

The Forest Service agrees that the forest products industry and recreation are important for the residents and communities of southern Missouri. The proposed action would provide commercial timber sale opportunities and a variety of goods, products and values for desired ecological purposes consistent with the 2005 Forest Plan (United States

Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, p. 3-3). The Forest Service also recognizes the importance of other values (ecosystems services) associated with natural resources management. The Forest Service must serve numerous values and environmental laws that meet the needs of forest health, resiliency, and threatened and endangered species to name a few.

Management Prescription 1.1 within the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, pp. 3-3 through 3-5) emphasizes the restoration of natural communities. The responsible official addressed that distinction in the *Record of Decision for 2005 Land and Resource Management Plan (2005 Forest Plan)* (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005b), when he stated:

> I recognize that there is strong support for the restoration of natural communities. I also recognize there are some concerns about this new focus on restoration. In recognition of these different viewpoints and concerns, my decision balances the allocation of land so that about 29% will be managed with an emphasis on restoration on natural communities and about 45% of the Forest will be managed with multiple use resource objectives as an emphasis. The remaining 36% will be managed with an emphasis on recreation, Wilderness, or other special area designation. The 29% selected for a restoration emphasis are those lands that are the best examples of some of the rarest natural communities in Missouri. (pp. ROD-9 to ROD-10)

The need for action, existing conditions, and proposed activities are consistent with this direction as addressed in the environmental assessment (pp. 1 to 13). The environmental assessment analyzed public concerns such as project scale, timing of project implementation, air quality, and numerous other resource issues. The project scale has been determined to be appropriate for this particular management prescription. The project will likely take approximately 10 years to implement the project activities under Alternative 2.

The Forest Service complies with the Clean Air Act and air quality standards. In addition, smoke is monitored during and after prescribed fire to ensure public safety as described in the environmental assessment (pp. 44 to 49).

Suggested adjustments on project scale, and sustainability for local residents and the timber industry are considered in the environmental assessment. The issues of scale, timing, and sustainability will be under continued consideration during the public involvement process and decision making process.

The purpose and need describes the irreplaceable concentrations of distinctive biota in the project area, shortleaf pine natural community, that is are out of character with its historic conditions. Existing ecosystem conditions are aligned to further decrease and degrade this community. Change is needed at the landscape-scale to restore conditions that suit this community type and wildlife and plant species that depend on this habitat type.

PC 11: The Forest Service should reduce the size of the project area to 500 acres or less.

PC 11 - A Themes	• To Evaluate the Results of Basal Area Reduction and Fire • To Compare Desired to Actual Results • To Determine Whether or Not to Move Forward

Sample Statements: Drastically reduce the size of the proposed action to less than 500 acres and scientifically evaluate the results of basal area reduction and fire to achieve the shortleaf pine natural community. The desired results, which need to be identified and made public, should be compared to the actual results which are gathered through a scientifically credible process and then a determination should be made whether or not to move forward. (C7-7)

PC 11 - B Themes	• To Study the Results of Prescribed Fire • To Project Economic Impacts to the Local Community • To Project Future Commercial Timber Harvests

Sample Statements: Drastically reduce the size of the proposed action to 500 acres or less and implement the management strategies and study the results. Engage scientists that are trained to statistically design a project will yield credible results. Model the anticipated results of this action and make projections regarding the economic impact on the local community. Places currently exist in the areas that have received burning that can be evaluated to project the potential for future commercial timber harvests. (C7-5)

PC 11 - C Theme	• To Assess Erosion Following Prescribed Fires

Sample Statements: Drastically reduce the size of the proposed action to less than 500 acres and implement monitoring projects to assess the potential of erosion following prescribed burning. (C7-9)

Forest Service Response to PC 11

The commenter's suggestion to establish a 500-acre study area would not meet the purpose and need for the project, nor be consistent with the 2005 Forest Plan.

The Forest Service has a long history of implementing landscape-level projects as well as research on the role of fire and its effects, basal area reduction, the application of silviculture and prescribed fire toward achieving desired conditions, and effects of activities on erosion as described in the *Fremont and Pineknot East Woodland Restoration Project: available for 30-day comment* document (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2014, September, pp. 9-12). All of the commenter's concerns were analyzed in the environmental assessment.

The existing and desired conditions for the project area were fully disclosed to the public throughout this planning process and included details on the historically present, shortleaf pine natural community and 2005 Forest Plan direction for natural community restoration.

The desired conditions for the project were first fully disclosed to the public in 2013 during Scoping in the *Scoping Report: Fremont-Pineknot East Restoration Project*

(United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2013, April, pp. 2-7). The desired conditions were again disclosed in 2014 during the 30-Day Comment Period in the document entitled *Fremont and Pineknot East Woodland Restoration Project: Available for 30-Day Comment* (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2014, September, pp. 5-9). The existing and desired conditions are again disclosed in the environmental assessment (pp. 2 to 7).

The *Fremont and Pineknot East Woodland Restoration Project: available for 30-day comment* document (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2014, September, pp. 9-12) disclosed monitoring data collected in 2000, 2001, 2005 and 2010 on 100 plots in Pineknot EIS Project area, a similar restoration project. Since 2003, the Pineknot EIS Project area has received mechanical thinning, timber harvest, and prescribed fire at regular intervals (e.g., every 2-5 years). Monitoring data show increases in the number of ground-layer plant species and species richness as movement toward the desired conditions. The environmental assessment (pp. 7 – 11, 76 - 80) summarizes these monitoring results.

Consistent the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) Goal 2.4 (p. 1-5) and Management Prescription 1.1 (p. 3-3) timber management would be used to restore natural communities, desired ecological conditions, sustain healthy and productive forests, and reduce hazardous fuels. The project would provide a variety of uses, products and values. Commercial timber harvest would occur during the project, and wood products would be available throughout the project, but maximizing timber outputs is not a project purpose.

The purpose of this project is to restore and enhance fire-adapted pine and pine-oak bluestem woodlands to their historic vegetation composition and structural conditions as consistent with the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, pp. 1-1 to 1-7).

An economic analysis was conducted on all project activities, including commercial timber harvest as part of the environmental assessment (pp. 162 to 180). In summary, the economic analysis indicates that economic benefits would accrue to local communities through resource management investments (e.g., road work), revenues from recreation and tourism, timber harvest, and federal payments to states and counties. The project has an estimated present value of over $9 million dollars in economic benefits and would create approximately 60 jobs.

The project would also yield a multitude of invaluable ecosystems services benefits as described in the environmental assessment (pp. 173 to 175). The project would provide numerous ecosystems services benefits such as forest health, species diversity, clean air and water, recreation opportunities, scenic values, and many more. Many of these ecosystems services benefits are important to public health, security and survival. The total value of ecosystem services likely exceeds the value of timber by up to 25 times.

Forest watersheds, soils, and water quality are protected through the use of buffer zones and by implementing the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) and *FS-990a National Best*

Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide (USDA Forest Service, 2012).

Importantly, restoring the fire-adapted pine and pine-oak bluestem woodlands at the landscape-scale would result in a more sustainable and resilient ecosystem. Under future climate change, shortleaf pine will be a future-adapted species and is expected to increase on the Mark Twain National Forest while oaks are expected to decline (Brandt, 2014; USDA Forest Service Mark Twain National Forest, 2014, 2015; USDA Forest Service, Northern Research Station, Northern Institute of Applied Science, 2014).

See the Forest Service Responses to PCs 24, 25, 26, 27, and 28 for additional information about prescribed fire issues.

PC 12: The Forest Service should communicate the project's benefits of wildlife habitat outcomes.

PC 12 Theme	• To Enhance Understanding of Project Benefits to Wildlife

Sample Statements: Communication efforts could be included in the Project actions to enhance understanding of the benefits of the proposed wildlife habitat outcomes of the project. (C6-4)

Forest Service Response to PC 12

The U.S. Forest Service held a Fremont-Pineknot East Restoration Project Open House in Van Buren, Missouri, on October 2, 2014, to meet with the public. Visitors had the opportunity to discuss specific issues such as concerns about wildlife habitat with resource specialists including the district wildlife biologist.

The project would include an auto tour to explain woodland restoration activities. Approximately 10 pull-offs with interpretive signs would be established to describe native wildlife species expected to thrive with habitat restoration (Trombley, 2014, August 20, p. 11; United States Whitworth, 2014, p. 31, 47, 54).

The environmental assessment (pp. 83 to 112) describes wildlife habitat improvements and species that would benefit from restoration activities. The restoration of open woodlands, glades and other habitats would benefit the Northern bobwhite (a Management Indicator Species), Bachman's sparrow, (a Management Indicator, Regional Forester Sensitive Species, and State Endangered Species), Blue-winged warbler, whip-poor-will, Eastern collared lizards (a Missouri Species of Conservation Concern), and the federally and state endangered Indiana bat, among other species.

VEGETATION MANAGEMENT

PC 13: The Forest Service should thin to the desired condition.

PC 13 Themes	• Because Thinning Rarely Achieves the Desired Basal Area and Canopy Openness • Because Openness is Important to Stimulate Ground Flora Recovery • Because Basal Area and Shading Quickly Increase

Sample Statements: The amount of thinning rarely seems to reach or even exceed the desired minimal basal area and canopy openness so important in stimulating the recovery of ground cover flora. Perhaps this is an education matter of assuring timber markers mark enough trees. If the overstory trees left after thinning are greater than 30 to 50 BA for open woodland then conditions will likely not be better as basal area and shading increase from that point, including periodic fire. (C9-10)

Forest Service Response to PC 13

Enhancement of terrestrial natural communities would allow light to reach the forest floor, increase ground vegetative cover and diversity, and increase the pine regeneration potential. Timber harvest and non-commercial stand-tending measures would increase and maintain natural community types. The use of commercial (timber harvest) and non-commercial (timber stand improvement) activities would move vegetation towards desired natural communities. Project activities would create various sizes of canopy openings based on prescribed treatments (pp. 73-83).

Project activities would improve forest health and move the area towards desired conditions as consistent with the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a). Open woodland would increase; closed woodland would decrease; and forest natural community types would be slightly reduced. Acreages and percentages would move closer to the desired conditions (EA, pp. 73-83).

Examples of current silviculture treatments can be observed in project areas at Handy on the Eleven Point Ranger District and at Cane Ridge on the Poplar Bluff Ranger District.

PC 14: The Forest Service should conduct single entry thinning that thins to the desired condition.

PC 14 Theme

- Because Basal Area Would Quickly Increase

Sample Statements: I do not agree with the two entry approach of first thinning to a basal area [BA] about (60-80) to make trees "windfirm" in such a large proposed acreage. This 60-80 BA especially in open woodland will quickly become 80 and greater for decades to come before additional entries occur. It would be better to just thin to what is desired and not worry about the windfirming issue in MA [Management Area] 1.1 and 1.2. (C9-11)

Forest Service Response to PC 14

Thinning was analyzed in the environmental assessment (pp. 73 to 83). Thinning in proposed stands would reduce competition in pine sawtimber and pole stands with basal areas greater than 130. This treatment would improve growth, wind firmness of residual trees, and canopy openness, and begin development of ground flora (grasses and forbs). Approximately 60-80 basal area of overstory trees would be retained.

A portion of the stands would undergo hardwood understory control after thinning to further reduce canopy cover. The reduction in canopy cover would increase the amount

of light reaching the forest floor, stimulate development of ground flora, and enhance the pine component. Multiple commercial entries may be required to obtain desired results.

Moving towards the desired condition may take 15-25 years for ground cover and more than 100 years for the composition and structure of canopy characteristic (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, Appendix A1). Areas we are treating took decades to reach their current condition, and it may take decades more to reach the desired conditions.

PRESCRIBED FIRE

PC 15: The Forest Service should conduct prescribed fire and thinning.

PC 15 - A Themes

- Because the Desired Conditions of Pine-Bluestem Woodlands Can Only Be Achieved with Methods as Proposed
- Because the Use of Prescribed Fire Protects Biodiversity

Sample Statements: The importance of frequent prescribed fire intervals to reach desired condition of pine-bluestem woodlands as defined in the 2005 Forest Plan can only be achieved with the methods as outlined in the CFLRP proposal and scoping document. The plan for woodland restoration at Fremont and Pineknot is coincident with the ecosystem-based 2005 Forest Plan that the department supported for the emphasis it places on the protection of biodiversity through the use of prescribed fire. (C12-3)

PC 15 - B Themes

- For Shortleaf Pine Bluestem Restoration
- Because Bird Species of Conservation Concern Would Rebound

Sample Statements: The Forest Service has proposed thinning and burning treatments within project areas to attain desired stand and landscape characteristics which are very much in keeping with the prescriptions community ecologists across the Interior Highlands described as needed to reach desired future conditions for pine-bluestem restoration. The proposed thinning and prescribed burning treatments are within that larger geography, and are similar to the management that has been implemented on the Ouachita National Forest, a national "crown jewel" of shortleaf pine-bluestem restoration to date. Populations of the aforementioned bird species of conservation concern in the CHBCR [Central Hardwoods Bird Conservation Region] have rebounded significantly in response to those efforts on the Ouachita National Forest, and give us reason to believe that the same success will be achieved on the Mark Twain as a result of the CFLRP [Collaborative Forest Restoration Program]. (C1-2)

PC 15 - C Themes

- Because Missouri Landscapes are Fire-Mediated
- Because Smoke Releases Carbon Which is Sequestered into Vegetation and Soil

Sample Statements: Restoration must include fire management because the majority of Missouri's 86 primary natural communities are fire-mediated. Further, as in history, fire was an integral part of the carbon cycle where smoke released carbon which was then sequestered back into vegetation and soil. Studies in healthy ecosystems and in restoration of shortleaf pine woodlands show that the use of prescribed burning will build

more carbon into soil through time as deep-rooted perennial grasses and forbs are restored. (C9-5)

PC 15 - D Themes	• Because Hawn State Park's Restoration Program Models the Desired Condition • Because Missouri State Parks Worked with the Forest Service on the Proposal • Because Vegetation and Bird Data from Hawn State Park Guided Proposal Development

Sample Statements: The ecosystem restoration program at Hawn State Park that includes the frequent prescribed fire to restore the flashy fuel models to support pine recruitment has been used as a model to achieve the future desired condition of the project area. The Resource Management Section of the department's Missouri State Parks has worked closely with the Mark Twain National Forest on developing the CFLRP [Collaborative Forest Restoration Program] proposal that involves treatment through thinning and prescribed fire in the project area. Vegetation monitoring data and bird occurrence records from Hawn State Park have been used to help guide the early stages of development of the CFLRP proposal for this area. (C12-4)

PC 15 - E Theme	• To Help Wildlife

Sample Statements: We welcome anything that would help wildlife in the area. We support controlled burning. (C4-1)

Forest Service Response to PC 15

Fire historically shaped the shortleaf pine natural community and vegetation composition of the area as addressed in the environmental. The project area is currently at Fire Regime Condition Class 3. Prescribed fire with mechanical vegetative treatments would be used to restore fire into the natural communities and move toward Fire Regime Condition Class 1.

The project would use prescribed fire to emulate historical fire regimes and create variable patterns of vegetation structure and abundance as consistent with the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, p. 3-3). The effects of prescribed fire were analyzed in the environmental assessment (pp. 34 to 49).

PC 16: The Forest Service should restore all lands that show high departure from the natural fire regime, Fire Regime Condition Class 3.

PC 16 Theme	• Because This Should Be A Key Goal

Sample Statements: A key goal should be to restore all project lands showing high departures from the natural fire regime (Fire Regime Condition Class 3). (C11-20)

Forest Service Response to PC 16

The need for action and project activities are designed to move the existing conditions toward the desired conditions. Prescribed fire is needed to move the Fire Regime Condition Class from 3 to 1 as addressed in the environmental assessment pp. 35 to 45). The use of prescribed fire is consistent with 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, p. 3-3) Management Prescription 1.1 direction which specifies that prescribed fire emulate historical fire regimes and create variable patterns of vegetation structure and abundance.

PC 17: The Forest Service should implement prescribed fire regimes that emulate the fire regimes under which the system evolved.

PC 17 Theme

- Because Organisms Are Genetically Attuned to These Processes

Sample Statements: Fire management should attempt to emulate as closely as possible the fire regimes under which the system evolved as a post-glacial entity. These are the processes to which the component organisms are genetically attuned. (C11-16)

Forest Service Response to PC 17

See the Forest Service Response to PC 16 for more information about management for fire regimes.

PC 18: The Forest Service should educate the public that fire management is intended to maintain conditions to which the ecosystem is attuned.

PC 18 Theme

- To Maximize Native Diversity, Quality, and Resilience

Sample Statements: Public outreach efforts should dispel the myth that the project and its associated fire management is aimed at recreating some static past system, but instead is designed to maintain the conditions to which the system is attuned, thus maximizing the system's native diversity, quality, and resiliency. (C11-17)

Forest Service Response to PC 18

Consistent with the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, pp. 3 - 3 to 3-5), prescribed fire would be used in this fire-adapted ecosystem to benefit distinctive terrestrial and aquatic natural communities. The use of prescribed fire in a fire-adapted ecosystem and restoration were analyzed in the environmental assessment (pp. 34 to 44).

PC 19: The Forest Service should conduct prescribed fire that includes various fire intensities and some tree mortality.

PC 19 Themes

- To Benefit Birds of Conservation Concern
- To Benefit Wildlife and Ground Flora
- To Achieve Desired Canopy and Tree Spacing Conditions

Sample Statements: The descriptions under Management Areas 1.1 and 1.2 in the 2005 Forest Plan and appended FEIS make it clear that fire effects on the overstory can and should include some mortality or other burn effects. The USFS [US Forest Service] nationwide is in fact making an effort to restore fire-adapted natural communities, which should on an ecological basis include the effects of various fire intensities. This diversity provides structural variation for many birds of conservation concern, other wildlife and ground cover flora. Such effects also are an integral and effective tool for achieving canopy and tree spacing desired conditions. (C9-2)

Forest Service Response to PC 19

The Forest Service analyzed the effects of prescribed fire in the environmental assessment (pp. 35 to 45). Low to moderate intensity prescribed fire would target small-diameter trees and shrubs and stimulate ground flora species. As addressed in the environmental assessment, some minor overstory mortality would likely occur due to the mosaic nature of fire. The environmental assessment analyzes prescribed fire and mechanical vegetation treatments in creating the desired canopy and tree spacing. These treatments would create conditions needed to restore the desired ground flora. The treatments would benefit wildlife and plant species that depend on shortleaf pine woodland natural communities.

PC 20: The Forest Service should test and implement the use of more frequent and reduced intensity fire.

PC 20 Themes	• Because the Proposed Fire-Free Intervals May Be Too Long • Because Frequent, Low Intensity Fires Reduce Hardwood Scaring

Sample Statements: The proposed fire-free intervals for pine establishment in regenerating and planted stands may be too long, and consideration should be given to testing shorter intervals in conjunction with low intensity fires. While the project plan includes valuable data regarding fire frequencies based on dendrochronological studies, these must be interpreted as a minimum fire frequency, as more frequent, low intensity fires do not always produce cambial scaring detectable in these analyses. More frequent fires could allow burns with reduced intensity and residence times, reducing hardwood scarring. (C11-13)

Forest Service Response to PC 20

The effects of prescribed fire, fire intensity, and frequency were analyzed in the environmental assessment (pp. 34 to 44). Additional field evaluations would be completed to determine the best time to apply prescribed fire after pine plantings and natural pine recruitment. The Forest Service would use available data and studies as well as a variety of firing methods to ensure the protection of recruited and planted pine stands. There are a myriad of variables which are taken into consideration when determining the appropriate resumption of prescribed fire.

PC 21: The Forest Service should conduct prescribed fire during growing season only sparingly and in conjunction with monitoring.

PC 21 Themes	• Because There is Limited Historic Precedent for Growing Season

Fires
- Because Concerns Exist for Impacts to Pollinator Cohorts and Individual Plant Species

Sample Statements: Although growing season fires may be necessary for specific restoration goals, they should be used sparingly, and accompanied by ecological monitoring. There is limited historical precedent for growing season fires in the genesis and perpetuation of regional post-glacial systems, and concerns exist regarding their impacts on some pollinator cohorts and individual plant species. (C11-15)

Forest Service Response to PC 21

Prescribed fire typically occurs in the fall, winter and early spring months, prior to vegetation green-up, to provide low cool fire and prevent damage to overstory vegetation. This project will not use growing season burns during the recovery stage.

Fixed vegetation monitoring plots (PC 9) have been established in throughout the project area to monitor vegetative response to prescribed fire and silvicultural management.

PC 22: The Forest Service should conduct prescribed fire in conjunction with cooperating landowners.

PC 22 Theme
- To Improve Forest Service Access to Forest Land and Control of the Burn

Sample Statements: The . . . [Forest Service] has access to our land to control the burn. Two years ago they worked on our road to help their access. (C4-2)

Forest Service Response to PC 22

The Forest Service conducts prescribed fire treatments with cooperating landowners as authorized under the Wyden Amendment (United States Department of Agriculture, Forest Service, 2013). Over 20 landowners in the project area have expressed interest in having cooperative prescribed fire treatments conducted across their lands.

PC 23: The Forest Service should deploy storm water control practices during prescribed fire.

PC 23 Theme
- To Mitigate Runoff and Pollution

Sample Statements: The USFS [United States Forest Service] should also deploy storm water runoff control practices to mitigate for the additional runoff and pollution from prescribed fire activities. (C2-7)

Forest Service Response to PC 23

The Forest Service does perform water control practices when conducting prescribed fires. These practices include incorporation of *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1*

National Core BMP Technical Guide (USDA Forest Service, 2012, April) as well as adhering to 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) standards and guidelines. The use of the best management practices and 2005 Forest Plan standards and guidelines control and reduce water movement. These practices are fully compliant with the Clean Water Act and U.S. Environmental Protection Agency regulations.

The effects of prescribed fire were analyzed in the environmental assessment (pp. 34 to 44). The use of cool, low-intensity fire has little effect on surface fuels and large woody fuels. Root systems and decayed organic matter remain in place to absorb and slow runoff. Leaf litter and smaller fuels, such as limbs on the ground less than 3" in diameter, would be consumed.

Prescribed fires conducted during the cool dormant season would be expected to result in some water movement and short-term impacts. The removal of leaf litter and small ground debris may contribute some minor increase in water movement until vegetation green-up occurs. Once green-up occurs, there would likely be little water movement. In the long-term, as grasses and forbs return and the desired vegetation composition develops, the hydrologic function of soils would improve, water holding capacity would increase, overland flow would decrease, and water quality would improve (Eberly, 2014; EA, pp. 56, 66).

This project would use Wyden Amendment (United States Department of Agriculture, Forest Service, 2013) agreements with landowners to substantially reduce the amount of dozed fire control line. Wyden agreements would allow the Forest Service to use existing roads, trails, streams, and fence lines on private lands as fire control lines reducing the need for new dozer line. Monitoring has shown that dozer lines are at great risk for affecting soil movement and hydrologic function. The use of existing control line features reduces soil and water impacts.

Prescribed fire incorporates drainage features as specified in the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, Table 2.2, p. 2-16) standards and guidelines. Water bars, water dips and water turnout structures would be implemented on dozer-constructed fire control lines to reduce runoff and erosion. Dozer lines would also be seeded with a sterile ground cover within a month following prescribed fire.

This project would restore the ecosystem to a shortleaf pine ecosystem that would be more resilient to environmental impacts such as climate change and extreme weather events. Over time, the restored ecosystem would increase roots in the soil, enhance soil formation, and better able resist the effects of storm runoff.

The Eleven Point Ranger District proposes to prescribe burn approximately 25,616 acres in burn units of various sizes on a 2-5 year rotation. With inclusion of the Fremont-Pineknot East project, the total percentage of acres under prescribed burning across the entire district would be 19%. On an annual basis this would equate to about 4.4% of the district receiving prescribed fire treatments. The average total acres burned over the past 5 years (2010 to 2014) results in an average of 9,746 acres. On average, prescribed fire operations are conducted over approximately 10 days each year.

PC 24: The Forest Service should not conduct prescribed fire.

PC 24 - A Themes

- Because it Will Increase Runoff
- Because it Will Increase Pollution
- Because it Will Impair Water Quality
- Because the Fremont Area is Unique and Fragile
- Because Endangered Species Reside in the Waters

Sample Statements: A basic premise of hydrology is that runoff increases when vegetation is removed. Water interception and uptake by vegetation is the dominant water removal mechanism in the Missouri Ozarks. During the "restoration" process (which would occur over decades), runoff from the burned areas will increase. The result of the increase in runoff will be an increase in pollution, as pollution from atmospheric deposition (mercury from coal fired power plants, and sediment for example) is carried into waterways with the runoff. The organic matter covering the forest floor and in the soil acts like a sponge and helps absorb pollution. When removed by burning, this pollution could be mobilized, and studies show that relatively small changes in watershed surface cover (even as little as 2%-3% of the watershed) can cause significant downstream water quality impairment. The Fremont area is part of one of the most unique and fragile aquatic environments in the world, and endangered species live in the waters that this runoff will flow into. (C2-5)

PC 24 - B Theme

- Because it Will Increase Erosion, Runoff, and Flooding

Sample Statements: The proposed project has the potential to increase erosion and runoff from the impacted sites and the entire watershed. I believe the proposed project, by exposing bare mineral soil, on thousands of acres, will increase flooding causing potential harm to people living in the rural community. Anecdotal evidence from hiking burned areas in the region of the proposed project, suggests that there is significant potential for erosion. (C7-8)

PC 24 - C Theme

- Because of Visual Impacts

Sample Statements: As a neighbor to the USFS, I do not want to see the damage and destruction that results from prescribed fires as evidenced by burned areas of Pine Knot East. It will be decades before the Fremont Project's 19,018 burned acres look anything like you desire. In the meantime, the sight of blackened trees, exposed rocky hillsides and dead snags will not be viewed favorably by either local citizens or the many tourists who come every year to view these Ozark highlands. (C2-12)

PC 24 - D Theme

- Because of Human Health Impacts

Sample Statements: I disagree. Controlled burns are hazardous to my health and that of my grandchildren. The smoke makes us have headaches. (C10-1)

PC 24 - E Themes	• Because the Impact to Timber is Unknown • To Consider the Economic Wellbeing of the Area

Sample Statements: The long term impact of repeated burning on the residual timber stand is unknown and that is a very important factor to consider for the long term economic wellbeing of the area. (C7-1)

PC 24 - F Themes	• Because of Tree Mortality and Reduced Log Quality • Because of Reduced Forest Industry Interest in Timber Sales

Sample Statements: I believe the MTNF [Mark Twain National Forest] is underestimating the potential mortality of residual standing timber that is repeatedly exposed to fire. Furthermore, repeated fire will reduce log quality over time, reducing the interest of the forest products industry to participate in future sale operations within the fire zone. (C7-3)

PC 24 - G Theme	• Because of Impacts to the Greenland Ice Sheet

Sample Statements: Forest fires, whether wild or prescribed, have far reaching detrimental environmental impacts. Forest fires in the northern hemisphere are causing problems for the ice sheet in Greenland, according to a new study by Professor Jason Box from the Geological Survey of Denmark and Greenland. This darkens the top layer of the ice which means the heat from the sun is absorbed instead of being reflected causing the ice to melt even faster. Another recent study by Professor Ian Baker from Dartmouth College, USA, concluded there is a clear correlation between forest fires and the melting of the ice sheet. See http://www.realclearscience.com/articles/2014/10/06/us_forest_fires_melting_greenland_ice_10885.html (C2-11)

Forest Service Response to PC 24

The environmental assessment (pp. 2 to 7) details the need for prescribed fire. The project reflects ecological needs, scientific evidence, monitoring, and 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) direction. The use of prescribed fire, and its scale and intensity, were analyzed in the environmental assessment (pp. 34 to 44, 73 to 82).

PC 24 - A Themes—Additional Response to Erosion Runoff, Pollution and Flooding. Hydrological concerns were addressed in the watershed analysis of the environmental assessment (pp. 50 to 72). Historically, the local area was subjected to industrial logging, agriculture, grazing, and fire suppression that drastically altered the landscape prior to Forest Service acquisition. Historic land use altered the land, ecosystem characteristics, and stream morphology.

Due to the historically altered ecosystems, less water infiltrates into uplands soils, and more rapid, irregular rises in stream volumes occur. Historic alterations to the ecosystem have resulted in increases in overland flow, runoff and erosion today.

The use of prescribed fire has been analyzed in the environmental assessment. Runoff, water levels, erosion and other effects to soils are discussed in the environmental

assessment (pp. 24 to 36). As noted in the soils analysis of the environmental assessment effects on soil and water would be minimal. Further, the amount of land and soils impacted would be insignificant.

Prescribed fire may result in some short-term impacts to soil and water resources with limited soil movement at some specific sites. Prescribed fire would remove vegetation at the ground layer which is now primarily leaf litter. Some minimal impacts to water holding capacity and water quality could occur between the time of ground-layer vegetation removal and vegetative re-growth about 6 weeks later. The use of low to moderate fire intensity would not remove the duff layer where water holding capacity is greatest.

As grasses, forbes, and shrubs replace leaf litter, water holding capacity would increase. In the long-term, water holding capacity and water quality would return to baseline conditions consistent with the ecological land type and forest growth. In the long-term, continued forest growth would result in improved soil productivity, water quality and water infiltration (EA, pp. 24 to 34, 50 to 72).

Post-fire monitoring has shown little evidence of soil movement and no wide-scale soil erosion or erosion runoff (Eberly, 2014; United States Department of Agriculture, Forest Service, Mark Twain National Forest, Eleven Point Ranger District, 2014a, 2014b, 2014c). A few instances of small-scale soil erosion have occurred on steep fire control lines constructed with a bulldozer (Eberly, 2014; United States Department of Agriculture, Forest Service, Mark Twain National Forest, Eleven Point Ranger District, 2014a, 2014b, 2014c). Actions were identified to address these few instances of site-specific erosion which included the establishment of more water protection features, water control structures, and moving line location.

The Forest Service works with cooperating landowners under Wyden Amendment (United States Department of Agriculture, Forest Service, 2013) authority to use existing private roads, trails and fence lines as fire control lines to reduce the amount of dozer line.

Typically, prescribed fires conducted on the Mark Twain National Forest do not burn at hot enough temperatures to negatively affect soils (P. Nelson, personal communication). However during the short time before vegetative re-growth occurs, increased sedimentation can occur, but no observable effect to the stream network was observed.

Field evaluations examined the effects of prescribed fire areas in the Collaborative Forest Landscape Restoration Program area one year after treatment during the summers of 2013 and 2014. No evidence of erosion was present, and the area was dense with vegetation. Any soil movement was likely short-term with minimal or no impact to streams. Over the long-term, treatments are expected to improve the hydrologic function of soils, and possibly return flow to lost springs as described in the environmental assessment (EA, pp. 66).

During prescribed fire, the Forest Service implements 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) standards and guidelines including water control practices (pp. 2-15 through 2-16). The Forest Service also implements *FS-990a National Best Management Practices for Water*

Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide (USDA Forest Service, 2012, April).

PC 24 - A Themes—Additional Response on Impairment of Water Quality. See Forest Service Responses to PCs 23, 24 and 28.

PC 24 - A Themes—Additional Response on Resident Endangered Species in Water. Project activities and effects on biological resources were analyzed in the environmental assessment (pp. 26 to 204). The Federal Biological Evaluation (Trombley, 2014, August 20) notes that the project area is at least 10 miles upstream of the Current River and at least 17 miles upstream of the Eleven Point River. The biological evaluation found that proposed activities would have no direct, indirect, or cumulative effects on Ozark hellbender or its habitat (p. 17). Further, the seven federally threatened and endangered mussel species that the forest evaluates for potential impacts do not occur in area rivers, so the proposed activities would not affect them.

The Federal Biological Evaluation (Trombley, 2014, August 20) and Regional Forest Sensitive Species and State Endangered Species Biological Evaluation (Trombley, 2014, May 10) describe 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) standards and guidelines, including those for prescribed fire, that protect riparian corridors, riparian management zones, soil productivity, and water quality.

The Regional Forester Sensitive Species and State Endangered Species Biological Evaluation (Trombley, 2014, May 10) notes that project activities, roads and parking areas likely contribute small amounts of sediment or pollutants to streams but are not anticipated to impair water quality. This biological evaluation concludes that activities "may impact individuals, but it is not likely to contribute to a loss of viability or a trend toward federal listing" of any aquatic species (p. 10).

PC 24 - C Themes—Additional Response to Visual Impacts. The environmental assessment (pp.145 to151) analyzed effects of prescribed fire on a variety of recreation opportunities and visual quality.

As reported in the environmental assessment (page 136), impacts to recreation from prescribed fire would be short-term in nature. Recreational visitors may view blackened areas, remnants of burned vegetation, and perceive lower scenic beauty until spring bloom and leaf green-up. Once the spring bloom occurs, few visitors would likely perceive residual visual impacts.

Recreational visitors would likely report higher levels of scenic beauty and visitor satisfaction in seasons following the prescribed fire. During the following seasons, visitors would encounter greater diversity in views including forest openings, increased visual penetration into the forest, new vegetative growth, wildflowers, increased opportunities to view wildlife, and increased recreational access.

Visual quality was analyzed in the environmental assessment for this project. Travelers through prescribed fire areas after the burn may view some black areas that are visible for a few weeks until spring green-up. Some management activities may visible from Sensitivity Levels 1 travelways (Most Sensitive) which includes Highways 60, J, 19, C, and the Ozark National Recreation Trail; Sensitivity Level 2 travelways which include

Highways P, Y, and DD and Forest Service Roads 3169 and 3253; and all remaining Sensitivity Level 3 (Least Sensitive) travelways. This project would adhere to 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) standards and guidelines for Visual Quality.

PC 24 - D Themes—Additional Response to Human Health Impacts. Prescribed fire would be conducted following the *2015 Fire Management Plan, Mark Twain National Forest* and the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, p. 2-19) direction for smoke management to minimize adverse effects to the public. Prescribed fire would be conducted under specific prescriptions to generate smoke high into the atmosphere and away from communities, schools and highways. Public notification would be implemented to avoid impacts to humans and smoke monitoring would be conducted.

The effects of prescribed fire and smoke were analyzed in the environmental assessment (EA, pp. 36 - 51). Predicted smoke effects were evaluated using the Simple Approach Smoke Estimation Model (SASEM) and the First Order Fire Effects Model (FOFEM). Model results indicate that the use of prescribed fire would not exceed National Ambient Air Quality Standards (NAAQS). Activities that result in air pollutants below NAAQS would not result in detrimental effects to public health or welfare.

PC 24 - E and PC 24 - F Themes—Additional Response to Impacts to Timber, Economic Wellbeing, Tree Mortality, Log Quality, and Industry Interest. Area ecosystems could be compromised if existing conditions such as dense canopy cover, high tree densities, and lack of fire are not treated as described in the environmental assessment (pp. 34 to 44 and 73 to 83).

The goal of the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, p. 1-1) is to restore native natural communities to their vegetation composition and structural conditions and promote ecosystem health and sustainability. The purpose of this project is to restore fire-adapted pine and pine-oak bluestem woodlands to their historic vegetation conditions.

Consistent with the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a), prescribed fire would be used to alter understory and ground vegetation species composition and density. The environmental assessment (EA, pp. 34 to 44 and 73 to 83) discloses the effects of prescribed fire on trees and timber.

Fire intensity and effects on timber has been analyzed in the environmental assessment (EA, pp. 73 - 84). The environmental assessment overviews relevant research. Low intensity prescribed fire has minimum effect on overstory (Dey & Fan, 2009; Hutchinson, Yaussy, Long, Rebbeck, & Sutherland, 2012). However, prescribed fire can be an additional stressor in red oak stands that are already exhibiting signs of oak decline or have been recently regenerated.

The use of prescribed fire and commercial harvest will be timed to reduce losses of stands affected by oak decline. Value and volume losses due to fire damage have been found to be low. Value loss is very low if trees are harvested within approximately five

years after fire damage, regardless of scar size (Marschall, Guyette, Stambaugh, & Stevenson, 2014).

The restoration and species conversion process would occur slowly and avoid measurable impacts to timber industries and mills that depend on red oak. Restoration would occur on approximately 13,942 acres of national forest lands over 15-20 years while providing hardwood and pine timber products. Approximately 3,500 acres of hardwood-dominated stands would provide hardwood forest products.

The social and economic sections of the environmental assessment (EA, pp. 162 to 180) discloses the direct and indirect effects of activities associated with this project. These sections also overview goals and objectives of the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a). This project would provide both social and economic benefits under Alternative 2.

PC 24 - G Themes—Additional Response to Impacts to the Greenland Ice Sheet. The respondent's comments and source referring to Jason Box leads to non-peer-reviewed web articles (Sjogren, 2014, Oct. 6, Oct. 3) on fire effects from North America. Box's (n.d.) biographical information does not appear to list a published study specific to forest fire and effects on Greenland's ice sheet. An article on the website *Slate* (Holthaus, 2014) claims that Jason Box developed findings on the effects of fire on Greenland's ice sheets specifically for Slate. The Slate article appears to be the source of information for Sjogren's (2014, Oct. 6, Oct. 3) articles.

The Slate (Holthaus, 2014) article on Box refers to fires that occurred in Canada and the Artic and sub-Artic fires in boreal forests. Box notes that the challenge is to determine what fraction of soot on Greenland's ice sheet is from forest fires, factories and other sources. Articles about Box by Holthaus (2014) and Sjogren (2014, October 3, October 6), state that dark ice is also associated with infrequent summer snow storms, pollution, wind-blown dirt and dust, microbial activity, and pollen.

The commenter also points to a study by Ian Baker which is noted in Sjogren's article (2014, October 3). A link within Sjogren's article launches a study authored by Keegan, Albert, McConnell, and Baker (2014). The Keegan et al. (2014) study indicates that boreal forest fires in the Northern Hemisphere during abnormally warm summers contribute to black carbon deposits on Greenland's ice sheet. The study reports a moderate correlation; a low to moderate correlation is not the same as causation.

Keegan et al. (2014) note that they did not fingerprint the geographic source of fire other than as from boreal forests. (Boreal forest occurs at extreme northern latitudes near the Artic.) Keegan et al. offer that air mass back-trajectories suggest boreal forest fire smoke sources ranging from Siberia to North America during June and July, 2012.

While not explicitly defined in the Keegan et al. study, the summer timing and high temperature conditions were associated with extremely large "wildfires" in Siberia and Canada, not the use of prescribed fire. NASA (2012) cites the Sukachev Institute of Forest in the Russian Academy of Sciences as reporting that more than 17,000 wildfires burned more than 30 million hectares [74 million acres] across Siberia through August, 2012. Similarly, the Canadian Interagency Fire Centre Inc. (2013) reported that there

were 7,907 wildfires in 2012 (p. 17) that burned 1,960,742 hectares [4,845,099 acres] (p. 18).

Keegan et al. (2014) report that exceptionally warm summer temperatures combined with black carbon sediments from Northern Hemisphere forest fires reduced albedo (reflectance) and caused ice melting in 1889 and 2012. Keegan et al.'s findings could point to the benefit of prescribed fire to prevent extremely large wildfires with large inputs of soot. (Consistently, Wiedinmyer and Hurteau (2010) report that prescribed fire can reduce CO_2 and other emissions by 18%-25% in the western U.S. and up to 60% in specific forests.) Further, Keegan et al.'s study also suggests that fire that occurs other than during the hot season has less effect as there is less heat energy to melt ice.

The commenter inappropriately generalizes the cited findings from large wild fires in boreal forest in Siberia and extreme North America beyond their scope. The cited reports on effects of large-scale wildfires at extreme northern latitudes in boreal forests near the Artic do not examine the impacts of small-scale prescribed fire in the temperate broadleaf forest region of Missouri.

As compared to total worldwide inputs to of black carbon from industry, pollution, wildfires, and other sources, the potential input or effects of small-scale prescribed fire with this project would likely be minute in comparison. Also, given the near mid-latitude position of Missouri, transport winds that carry smoke from the project area would not likely be related to transport wind patterns at extreme northern latitudes that impact Greenland. In addition, the use of prescribed fire in this project would likely occur during cool seasons (e.g., April to March) and low temperatures, versus during abnormally warm summer temperatures. Small-scale prescribed fire would likely be associated with limited input of particulates that would fall out of the atmosphere with rain or snow and or over the ocean, but not likely travel to or impact the Greenland ice sheet.

The comment and cited reports are found to be beyond the scope of the proposed project and will not be analyzed further.

PC 25: The Forest Service should conduct studies on the impacts of prescribed fire.

PC 25 Themes	• To Determine the Impacts to Hydrology and Pollutants • To Determine the Impacts to Mast Species • To Determine the Impact to Sensitive Wildlife and Plant Species

Sample Statements: The USFS [United States Forest Service] should conduct extensive studies to determine the impact these burn projects are having on local hydrology, fate transport of pollutants, understory soft mast species, such as Serviceberry and Dogwood, and sensitive wildlife and plant species, before proceeding further. (C2-6)

Forest Service Response to PC 25

Surveys have been and would continue to be conducted within the Fremont-Pineknot East Restoration Project area to collect biotic and abiotic data as described in the monitoring section of environmental assessment (EA, 201 to 204). A point grid was developed and each inventory plot represented approximately 100 acres. Tree and down woody material data were collected from 284 plots in the project area. Understory woody and herbaceous

plant data were collected from 59 separate plots to determine floristic quality indices (FQI) within the project area (Trombley, 2014, August 20, pp. 14-15).

Some grid and FQI plots are in areas proposed for prescribed fire treatment. Repeated sampling at these plots would monitor vegetation, including soft mast and sensitive plant species, and response to prescribed fire treatments as described in the environmental assessment (EA, pp. 201-204).

Lyda, Hellgren, and Leslie (2007) demonstrated that prescribed fire reduces ground litter accumulation that can inhibit the growth of herbaceous and soft-mast producing vegetation.

The use of prescribed fire with and without other treatment methods in the adjacent Pineknot Project have shown progress in restoring diverse, native understory vegetation as described in the environmental assessment (EA, 8 to 11, 76 - 78). Plot data collected in 2000, 2001, 2005, and 2010 show an increase in floristic quality and number of native species recruited into the understory.

Similar vegetative responses to prescribed fire are occurring at Cane Ridge, Grassy Pond, The Nature Conservancy Chilton Creek Research and Demonstration Area, Rocky Creek Conservation Area, Hawn State Park, and other areas across the Central Ozarks as overviewed in the environmental assessment (pp. 8 to 11, 76 to 78).

Numerous wildlife surveys are conducted on or near the national forest on an annual basis (Trombley, 2014, August 20, p. 14). The surveys are conducted in burned and unburned areas by Forest Service employees or in partnership with other agencies, organizations, contractors, and universities. Examples of these surveys include bat surveys, the Missouri Black Bear Project, Mid-winter bald eagle counts and nest surveys, Missouri Breeding Bird Survey routes, Nightjar survey routes, Cave Research Foundation biological inventories, and the North American Amphibian Monitoring Program. These surveys evaluate the presence of sensitive wildlife species and population trends in response to landscape-level activities.

Prescribed fire and timber management activities are expected to restore natural communities and provide habitat for sensitive wildlife species as described in the environmental assessment.

See the Forest Service Responses to PCs 23, 24 and 28 for information on hydrological issues.

PC 26: The Forest Service should not conduct large-scale prescribed fires.

PC 26 - A Themes	• Because Study is Needed of Past Fire Impacts • To Save Millions in Tax Dollars

Sample Statements: The USFS [United States Forest Service] should suspend planned expansion of the Fremont-Pineknot East Restoration Project and begin a careful study of the landscape level impacts of the fires they have set in the recent past. Stopping this project and changing forest management policy will also save millions in tax dollars. (C2-15)

PC 26 - B Theme	• Because of Environmental and Economic Concerns

Sample Statements: The use of large scale forest burns (a primary method in this project) can be environmentally and economically damaging. (C2-1)

PC 26 - C Theme	• Because It Causes Flooding

Sample Statements: Burning too many acres too often causes too much flooding and too much gravel in the valley creek downstream from Pineknot East. (C5-1)

I think you are burning too often and too much. The flooding is also an issue. We are having severe floods after the intense burning. (C10-2)

PC 26 - D Themes	• Because of Impacts to Human Health • Because of Air Pollution

Sample Statements: A tremendous plume of smoke arises from a large forest fire, whether it is wild or set by the USFS [United States Forest Service] and the pall lingers for hours, perhaps days depending on the winds. The smoke is a known carcinogen, and burning the forest, regardless of good intentions, increases air pollution and creates a serious health risk for local residents. Air quality rules prohibit this level of air pollution in or near our cities, and those of us who live near USFS managed land deserve that same protection from harmful air pollution. (C2-10)

Forest Service Response to PC 26

Prescribed fire is needed to meet the project's purpose and need and move toward restoration of fire-adapted pine, pine-oak bluestem, and shortleaf pine woodland natural communities as addressed in the environmental assessment (pp. 36 to 46, 73 to 83). Prescribed fire would move the ecosystem toward desired conditions similar to that which occurred under natural disturbance regimes (e.g., fire and drought). The proposed activities are consistent with 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) goals and objectives (pp. 1-1 to 1-7) and Management Prescription 1.1 direction (pp. 3-3 through 3-5) to restore the ecological role of fire in natural communities and restore natural communities.

The environmental assessment analyzes the role of fire in restoring the shortleaf pine woodland natural community. Forest Service monitoring of prescribed fire effects shows an improvement in desired ground cover species (pp. 8 to 13, 76 to 78)

Prescribed fire is needed at the landscape-scale as the area was a historically fire-adapted ecosystem. Fire is needed to convert conditions, and landscape-scale treatments are necessary to make restoration feasible. The use of prescribed fire at the landscape-scale sets the trajectory of the restoration project. The use of small-scale prescribed fire would alter conditions too slowly to enable feasible and achievable restoration at a landscape-scale.

The use of landscape-scale fire provides a mosaic burn pattern. Prescribed fire at landscape-scales increases floristic diversity and species richness while providing variation in habitat conditions.

The use of prescribed fire at landscape-scales over 1-2 days reduces inconvenience to the public and undesired smoke effects. Implementing prescribed fire at the landscape-scale typically results in a single smoke impulse under optimal weather and transport wind conditions. One or a small number of prescribed fires minimizes disruption to the public, smoke impacts, potential economic impacts, and is more economical.

The commenter's proposed use of multitudes of small-scale fires would significantly impact the public. The public would be subjected to an extensive number of fire days (e.g., 100X more) each year with disrupted traffic patterns, reduced access, frequent smoke events, etc. The use of multitudes of small-scale fires would likely result in numerous instances of inappropriate transport winds and undesirable smoke impacts to the public.

Landscape-scale fires do not burn hotter or cooler than smaller fires such as 500-acre blocks. Size of the area burned is irrelevant. While topography, wind, and other conditions can have adverse effects on fire behavior, the adverse effects would change fire behavior on a small prescribed fire just as it would on a landscape-scale prescribed fire.

PC 26 - B Themes—Additional Response to Economic Concerns. An economic analysis was conducted for the project and disclosed in the environmental assessment (pp. 126 - 173). The economic analysis projects present value benefits of over $9 million dollars and approximately 60 jobs created. Economic benefits would occur with resource management investments such as road work, recreation and tourism expenditures, timber harvest, and federal payments to states and counties.

The project would yield invaluable ecosystem services benefits through plant health and diversity, clean air and water, recreation opportunities, wood fiber and forest products, soils improvements, nutrient cycling, scenic values, and many more. These ecosystems services benefits are critical to public health, security and survival. The total value of ecosystem services likely exceeds the value of timber as a raw material by up to 25 times.

PC 26 - C Themes—Additional Response to Flooding. See Forest Service Responses to PCs 22, 24, 28 for flooding and hydrological responses.

PC 26 - D Themes—Additional Response to Human Health Impacts and Air Pollution. See the Forest Service Response to PC 23 for human health and air pollution issues.

PC 27: The Forest Service should not conduct prescribed fire in the Pike Creek Watershed.

PC 27 Themes	• Because of Impacts to Water Quality • Because of Soil Erosion • Because of Impacts to Threatened and Rare Aquatic Species

Sample Statements: Big Pike Creek is a tributary to the Current River. Burning the forest in the Pike Creek watershed will harm water quality when heavy rainfall comes and soil and nutrient runoff increases into pristine waters. Soil erosion will increase due to loss of natural litter on the forest floor and soil disturbance from building fire lines and

roads around your fires. Threatened and rare aquatic species, such as the Ozark Hellbender, may be placed at even greater risk that they are now. (The same can be said for the thousands of acres you plan to burn at numerous other large tracts identified on both the Big and Little Pike Creek watersheds.) (C2-4)

Forest Service Response to PC 27

See the Forest Service Responses to PCs 23, 24 and 28.

PC 28: The Forest Service should not conduct prescribed fire in the Turley 3 and Turley 5 burn units.

PC 28 Themes	• Because Fire Will Increase Runoff and Flooding • Because The Units Are Near My Home • Because of Increased Flooding on Downstream Properties

Sample Statements: I object to the use of prescribed fire on the 572-acre tract identified as "Turley 5" and on the 549-acre tract identified as "Turley 3." Introducing this practice to the Big Pike Creek Drainage will increase the rate of runoff and severity of flooding. (Recent major flood dates: June 29, 2014, October 30, 2009, March 18, 2008). The "Turley 5" tract joins my property and is very near my home. It is also near the Big Pike Creek channel, with substantial slope down to that channel, and upstream of where that channel passes by my home. "Turley 3" is also near my property and near the Big Pike Creek channel. The creek is subject to large floods, and removing the cover and detritus from the forest floor by burning will result in more and faster runoff of rain water, exacerbating the flooding problem for me and other property owners downstream of these tracts. (C2-3)

Forest Service Response to PC 28

The Forest Service understands the commenter's concerns and works with adjacent landowners to address specific concerns about their property adjoining National Forest System lands.

The scale and intensity of prescribed fire has been analyzed in the environmental assessment (pp. 42). Fire would remove leaf litter and some ground vegetation. Some short-term impacts to water holding capacity and water quality could occur between the time of leaf litter removal and vegetative re-growth about 6 weeks later. The use of low to moderate fire intensity would not likely impact the duff layer where water holding capacity is greatest. Over the long-term, through the replacement of leaf litter with grasses, forbes and shrubs at the ground layer, the Forest Service expects to improve the area's water holding capacity.

The environmental assessment (pp. 24 – 34, 50 - 72) acknowledged that some short-term impacts to soil and water resources would occur. The impacts to soil and water would be minimal with application of the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) standards and guidelines and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012, April).

As described in the environmental assessment, the current watershed conditions are a result of historic industrial logging, agriculture, grazing, burning, and changes in land use that occurred prior to Forest Service acquisition. The Pike Creek watersheds is classified as functioning at-risk along the entire drainage and both public and private lands.

Project activities are expected to improve many watershed condition indicators for the Big Pike Creek. Maintaining roads, decommissioning user-created roads, moving the Fire Regime Condition Class from 3 to 1, improving forest cover, increasing resilient species composition, treating invasive species, and improving forest health would improve watershed conditions. Improvements in watershed conditions would improve water quality in the project area (EA, pp. 50 to 72). While watershed conditions on national forest lands are expected to improve, the overall condition class for the entire Big Pike Creek may not change due to the historic landscape condition and conditions outside of national forest lands.

The Forest Service does not agree that prescribed fire would have a significant impact on soil and water in a specific drainage such as Big Pike Creek. The use of low to moderate prescribed fire would not impact the duff layer and have minimal impacts to soil and water. Vegetative recovery on these sites would likely occur within approximately 6 to 8 weeks.

WILDLIFE MANAGEMENT

PC 29: The Forest Service should clear land and create food plots for wildlife.

PC 29 Theme	• To Meet Wildlife Needs

Sample Statements: Clear land and seed food plots to meet wildlife needs. (C5-3)

Forest Service Response to PC 29

The 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a, pp. 3-4 and 3-8) prohibits the creation of new food plots in Management Prescription 1.1 and 1.2 areas, and existing food plots are to be closed and rehabilitated. Management Prescription 1.1 areas concentrate on natural community ecosystems. Grassland habitats for this project would concentrate on glades, native prairies, and seeded or planted native grass on appropriate sites.

PC 30: The Forest Service should not involve people from outside the area.

PC 30 Theme	• Because People from Outside Should Not Tell Us How to Manage Our Forest

Sample Statements: I don't like people not from here coming in and telling us how to manage our property and forest. (C10-3)

Forest Service Response to PC 30

This comment is not site-specific to the actions associated with this project and is considered outside the scope of this project.

TRANSPORTATION MANAGEMENT

PC 31: The Forest Service should adhere to Environmentally Sensitive Maintenance techniques developed by the Penn State University's Center for Dirt and Gravel Road studies when conducting road activities.

PC 31 Theme

- Because Roads Are Known for Sediment Generation and Invasive Species Establishment

Sample Statements: The project calls for activities on 24 miles of roads, which are known vectors for sediment generation and invasive species establishment. The Conservancy encourages the Forest Service to adhere completely to the Environmentally Sensitive Maintenance techniques developed by the Penn State University Center for Dirt and Gravel Road studies, which are designed to minimize impacts, decrease sediments, and reduce long term maintenance needs[2]. . . . [2]Penn State University's Center for Dirt and Gravel Road Studies. http://www.dirtandgravel.psu.edu/index.html; the Forest Service partnered with the Center to publish a field guide of their techniques: http://www.fs.fed.us/eng/php/library_card.php?p_num=1177%201802P

Forest Service Response to PC 31

The Forest Service analyzed the effects of road construction, road maintenance and road decommissioning on soils and invasive species as detailed in the environmental assessment (pp. 75 – 76, 151 - 157). There would be some short-term soil and water effects associated with road activities. Improving and maintaining existing roads and decommissioning unneeded and user-created roads would reduce sedimentation within the watershed.

During implementation of road activities, the Forest Service would follow 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) standards and guidelines and incorporate *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012) to protect soil and water resources. The Forest Service would also incorporate practices from the *Environmentally Sensitive Maintenance Practices for Dirt and Gravel Roads, 7700-Transportation Management 1177 1802—SDTC (*Bloser, Creamer, Napper, Scheetz, & Ziegler, 2012).

An invasive species inventory was conducted for the project area (Bond, 2014). Eight species were identified in the project area for a total of 221 acres of infestation. Non-native invasive species objectives were set for each Forest Service road and included objectives for invasive species eradication, control, and reduction. Areas of known infestations along project area roads are currently being treated.

Invasive species are managed and treated consistent with the Mark Twain National Forest's *Final Environmental Impact Statement: Integrated Non-native Invasive Plant Control* (Unites States Department of Agriculture, Forest Service, Mark Twain National Forest, 2012). In addition, the Mark Twain National Forest follows *Non-native Invasive Species Best Management Practices: Guidance for the U.S. Forest Service Eastern Region* (United States Department of Agriculture, Forest Service, 2012, August).

HYDROLOGY—PROTECTING WATERSHEDS, WATERWAYS, KARST FEATURES, WETLANDS, AND WATER QUALITY

PC 32: The Forest Service should protect watersheds and consider the USDA Natural Resources Conservation Services Rapid Watershed Assessments.

PC 32 Theme
- Because the Reports and Data Could Provide Valuable Knowledge

Sample Statements: Ecological Drainage Unit: The proposed project lies entirely within the Ozark/Black/Current Ecological Drainage Unit.

Watersheds: There are many watersheds within the project area. Should specifics be required, please consult the department's geospatial data at http://msdis.missouri.edu/.

Rapid Watershed Assessment: The U .S. Department of Agriculture's Natural Resources Conservation Service has assessed several watersheds across the country. The reports and data for various watersheds in the state could provide valuable knowledge. Watershed resource information can be found at http://www.mo.nrcs.usda.gov/technical/RWAs.html. (C12-5)

Forest Service Response to PC 32

The Forest Service protects watersheds by implementing the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012, April).

PC 33: The Forest Service should protect all classified streams in or near the project area.

PC 33 Theme
- To Meet Water Quality Criteria

Sample Statements: Classified Streams: Many classified streams exist near or within the proposed project. All classified streams have at a minimum the designated beneficial uses of protection of warm water aquatic life and human health fish consumption, livestock and wildlife watering, and whole body contact recreation-Category B. Classified streams, through their designated beneficial uses, are protected by numeric water quality criteria contained in 10 CSR 20-7.031(5) and Table A. Please contact the department's Water Protection Program at (573) 751-1300 for more information. (C12-6)

Forest Service Response to PC 33

The Forest Service protects classified streams by implementing the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012).

PC 34: The Forest Service should protect all unclassified streams through Best Management Practices, re-establishing vegetation, and avoiding having heavy equipment in the water.

PC 34 Theme	• To Meet Water Quality Criteria

Sample Statements: Unclassified Streams: The proposed project area contains unclassified streams. Unclassified streams are protected by the general water quality criteria outlined in 10 CSR 20-7.031(4). Project planners should ensure proper Best Management Practices are in place to protect the stream's chemical, physical and biological characteristics, especially when a stream is crossed by equipment. Re-establish vegetation as soon as possible on any stream banks and riparian corridors denuded of vegetation. Heavy equipment must stay out of the water as much as possible. (C12-7)

Forest Service Response to PC 34

The Forest Service protects unclassified streams by implementing the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012, April).

PC 35: The Forest Service should examine data for losing streams, and implement additional precautions and Best Management Practices.

PC 35 Themes	• Because Numerous Losing Streams Exist in or Near the Project Area • To Protect the Area's Sensitive Water Quality and Ecology • Because Losing Streams Are Protected By Effluent Regulations

Sample Statements: Karst Topography-Losing Streams: According to existing data, there are numerous losing streams in or near the proposed project area. Project planners should check with the department's Missouri Geological Survey at (573) 368-2100 or geology@dnr.mo.gov to determine if they have more recent data and potentially additional sites. Should losing streams be found, additional precautions and Best Management Practices should be put in place to protect the area's sensitive water quality and ecology at all times. Losing streams are protected by stringent effluent regulations [10 CSR 20-7.015(1)(B)3 and (4)] and Water Quality Standards [10 CSR 20-7.031(1)(N), (5)(C) and (13)]. (C12-8)

Forest Service Response to PC 35

The Forest Service protects losing streams by implementing the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012).

PC 36: The Forest Service should protect karst topography, springs, sinkholes, and caves and implement additional precautions.

PC 36 Themes	• Because Numerous Losing Streams Exist in or Near the Project Area • Because Many Springs, Caves, and Sinkholes Exist In or Near the Project Area • To Protect Water Quality • Because Karst Features Provide Direct Access to Sensitive Species and Groundwater • Because Groundwater Supplies Private and Public Drinking Water

Sample Statements: Karst Topography - Springs, Sinkholes and Caves: According to existing data, there are many springs, caves and sinkholes in or near the proposed study area. Project planners should be vigilant that activities near these resources do not adversely impact water quality, as Karst features can provide a more direct access to sensitive species and groundwater which supplies private and public drinking water. Should the construction impact these areas, extra precautions may be necessary to protect these sensitive resources. (C12-9)

Forest Service Response to PC 36

The Forest Service protects karst topography, springs, sinkholes, and caves through the use of buffer zones and by implementing the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012, April).

PC 37: The Forest Service should protect the Current River, not increase pollutants, nor re-suspend pollutants.

PC 37 Themes	• Because it is an Outstanding National Resource Water • Because it flows Near the Project Area

Sample Statements: Other Sensitive Waters: The Current River is listed as an outstanding national resource water and flows near the eastern edge of the project area.

Impaired Waters: The Current River (Water Body Identification Number 2636), which flows near the eastern edge of the project area, is listed as impaired for high levels of Mercury in fish tissue. Project planners should be sure that any activities related to the project do not increase the amount of pollutants impairing the river nor re-suspend any pollutants that might be bound to sediment. The project is not expected to worsen the named impairment stated above. (C12-10)

Forest Service Response to PC 37

The Forest Service protects riverine and waterway systems by implementing the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain

National Forest, 2005a) and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012).

PC 38: The Forest Service should obtain a stormwater permit for land disturbing activities.

PC 38 Theme	• Because Land Disturbance Requires a Permit

Sample Statements: Land Disturbance Permits: Land disturbance activities disturbing one or more acres of total area for the entire project require a stormwater permit. Instructions on how to apply for and receive the on-line land disturbance permit are located at http://www.dnr.mo.gov/env/wpp/epermit/help.htm. Questions regarding permit requirements may be directed to the department's Southeast Regional Office at (573) 840-9750. (C12-11)

Forest Service Response to PC 38

The US Environmental Protection Agency ruled in the *Revisions to Stormwater Regulations To Clarify That an NPDES Permit Is Not Required for Stormwater Discharges From Logging Roads* (2013) that stormwater discharges from logging roads do not constitute stormwater discharges associated with industrial activity and that a National Pollutant Discharge Elimination System (NPDES) permit is not required. See: http://www.gpo.gov/fdsys/granule/FR-2012-12-07/2012-29688/content-detail.html

The Forest Service implements the 2005 Forest Plan (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005a) and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012, April) to protect soil and water resources.

PC 39: The Forest Service should protect wetlands and avoid and minimize impacts.

PC 39 Themes	• Because the Potential Exists to Affect Wetlands • To Protect Water Quality, Especially from Sedimentation

Sample Statements: National Wetland Inventory: A potential exists for the project to affect wetlands, particularly at stream crossings and within floodplains, depending on the exact location of the cable construction within the state highway right-of-way utility corridors. When wetlands exist, project planners should take care to avoid and then minimize any impacts through alternatives analyses before compensatory mitigation is considered. If wetlands are not directly impacted but are near any land disturbance, project planners should take care to protect the water quality, especially due to sedimentation. (C12-12)

Forest Service Response to PC 39

The project does not involve cable construction nor state highways. No wetlands would be impacted by this project. Wetlands would be protected through the use of buffer zones and by implementing the 2005 Forest Plan (United States Department of Agriculture,

Forest Service, Mark Twain National Forest, 2005a) and *FS-990a National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 National Core BMP Technical Guide* (USDA Forest Service, 2012). No compensatory mitigation would be needed.

PC 40: The Forest Service should protect wells located in or near the project area, and contact the Public Drinking Water Branch if additional wells are found, or any wells are to be impacted.

PC 40 Theme	• Because Numerous Wells Exist In or Near the Project Area

Sample Statements: Certified Wells: There are numerous wells located in or near the project area. These wells have various uses. Please contact the department's Public Drinking Water Branch at (573) 751-5331 for additional information should the sponsor find additional wells or determine that the project will impact any wells. (C12-13)

Forest Service Response to PC 40

There are no known wells within National Forest System land within the project area.

PC 41: The Forest Service should protect Public Drinking Water Protection Areas.

PC 41 Theme	• Because Several Public Drinking Water Well 20-Year Travel Time Zones Exist In or Near the Project Area

Sample Statements: Public Drinking Water Protection Areas: There are several public drinking water well 20 year travel time zones located in or near the projected areas. If additional information is needed, please contact Mr. Ken Tomlin of the department's Water Protection Program's Public Drinking Water Branch at (573) 526-0269 for more information. (C12-14)

Forest Service Response to PC 41

There are no known public water systems on National Forest System land within the project area. Proposed activities for the project are predicted to occur within the natural range of variability for water quality and water quantity.

PC 42: The Forest Service should examine water quality data collected near USGS Gauging Stations, if needed.

PC 42 Themes	• Because Numerous Gaging Stations Exist Near the Project Area • Water Quality Information May Be Available For these Sites

Sample Statements: U.S. Geological Survey Gaging Stations: Numerous gaging stations exist near the project area. These sites may provide background water quality information if needed. (C12-15)

Forest Service Response to PC 42

The Forest Service is aware of the gaging stations and utilizes available water data.

PC 43: The Forest Service should obtain a Clean Water Act Section 404 Permit and Section 401 Water Quality Certification for actions that would impact the jurisdictional waters of the United States.

PC 43 Theme
- To Comply with the Clean Water Act

Sample Statements: Water Quality Certification: A Clean Water Act Section 404 Department of the Army Permit and the department's Clean Water Act Section 401 Water Quality Certification are needed when placing dredged or fill material into the jurisdictional waters of the United States. Examples are culverts under road crossings, riprap along streambanks and stormwater outfall pipes. The term jurisdictional waters refer to large lakes, rivers, streams and wetlands, including those that don't always contain water. Should any jurisdictional waters be impacted, please contact the U.S. Army Corps of Engineers' Regulatory Branch in the Little Rock District at (501) 324-5295 and the department's 401 Certification Unit at (573) 751-1300 for more information. (C12-16)

Forest Service Response to PC 43

The project does not propose any activities that would occur in or impact the jurisdictional waters of the United States. As a matter of practice, the Eleven Point Ranger District sends all project proposals to the U.S. Army Corps of Engineers for their review and determination as to potential activities that may need a permit. In the event that a 404 Permit is required, the Forest Service works with the State of Missouri's 401 Certification Unit.

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