National Park Service
U.S. Department of the Interior

Big South Fork National River and Recreation Area
Oneida, Tennessee

Environmental Assessment

For The
Fire Management Plan Update

February, 2019

U.S. Department of the Interior
National Park Service
Big South Fork National River and Recreation Area
Kentucky and Tennessee

EXPERIENCE YOUR AMERICA

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Chapter 1: PURPOSE and NEED

The Proposal

Big South Fork National River and Recreation Area, referred to hereafter as "BISO" proposes to update BISO's fire management plan in order to comply with current federal and National Park Service wildland fire policy. (NPS Reference Manual 18)

Need for the Proposal

BISO needs to update their existing fire management plan so that it reflects current federal and National Park Service wildland fire policy. An updated fire management plan will allow BISO to use current wildland fire management strategies and tools. The full suite of wildland fire management tools are: suppression strategies, singularly or in combination: monitoring, confine, contain or control, managed wildfire for multiple objectives, prescribed fire, including broadcast burning, underburning and pile burning; manual and mechanical fuels reduction by scattering fuels, slash piling or chipping of fuels. This full suite of available strategies and tools will help BISO safely manage wildfires, utilizing wildland fire, which includes wildfire and prescribed fire, to meet resource/fire management/other management objectives, reduce the increasing amount of vegetation (burnable fuels), known as *hazard fuels*, encroaching on historic structures and infra structure contained within park boundaries and threatening areas outside of park boundaries.

BISO is located in southern Kentucky and northern Tennessee as shown Figure 1, Big South Fork NRRA vicinity map*:*

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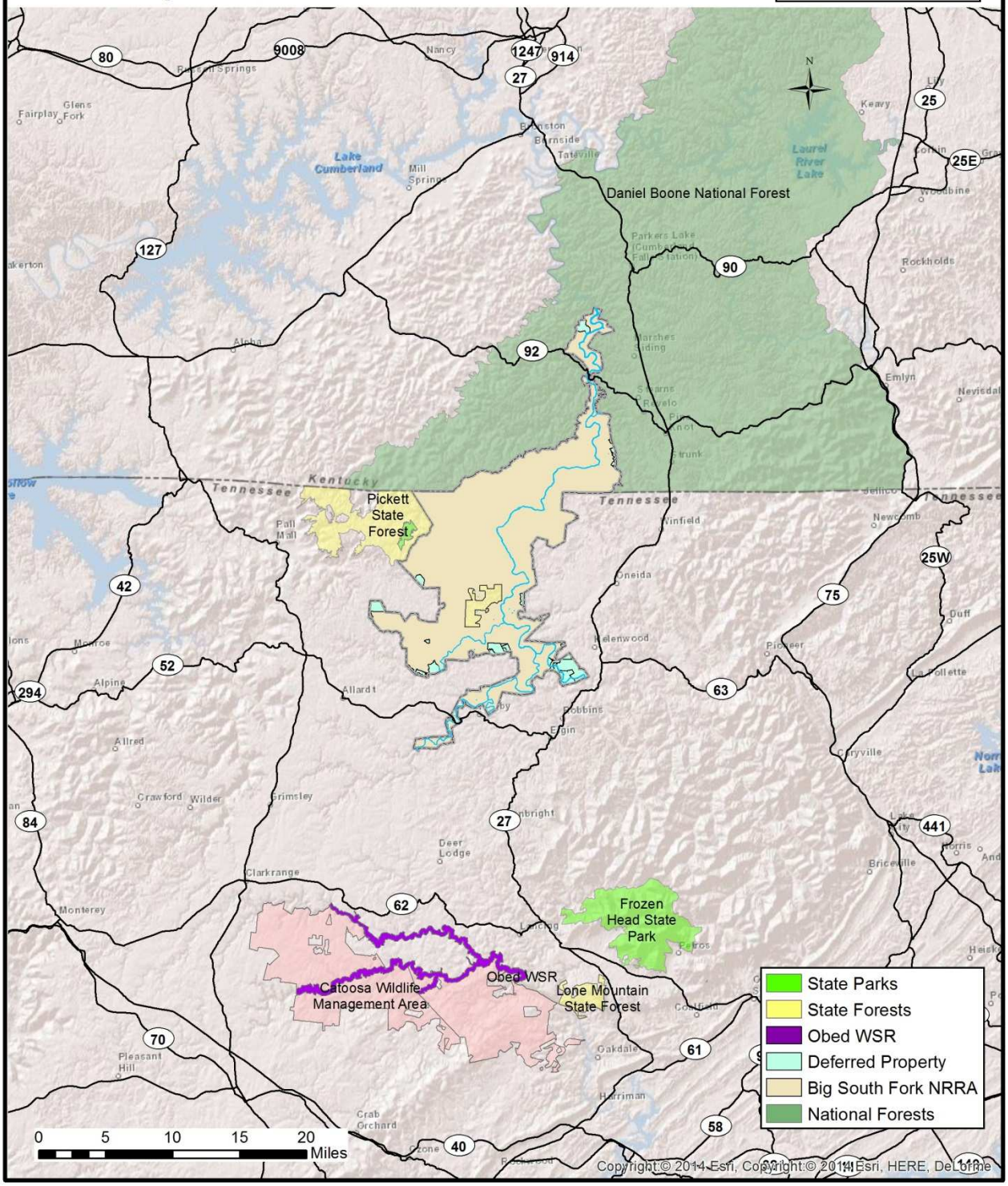
Vicinity Map

Figure 1



Chapter 2: ALTERNATIVES

Alternatives Analyzed in this Environmental Assessment

The following alternatives were developed for analysis in the *Big South Fork National River and Recreation Area Fire Management Plan Update Environmental Assessment*: Alternative A, *No Action* and Alternative B, *Managed Fire for Multiple Objectives*. The alternatives were developed through discussions among park staff and Southeast Region fire management staff. The alternatives cover the range of what is physically possible, acceptable by policy and feasible for local managers.

Management Direction Applied to All Alternatives

Special Resource Management Projects

Special projects may include vista clearing, cultural landscape maintenance, and endangered species habitat management. The Fire Management Plan Update EA does not develop specific objectives for restoring and maintaining vistas and cultural landscapes, or for managing special-status species and restoring habitat, but considers them as issues. When other plans indicate the need to employ fire as a tool and the scope of the effects of the proposed fire project have been covered in this EA, then a prescribed fire plan will be prepared consistent with the Fire Management Plan Update. If the scope of the effects has not been considered, additional NEPA documentation will be needed.

Suppression Chemicals

Under both alternatives: Fire retardants and Class A foams will be used in accordance with National Park Service, Department of Interior and Federal Wildland Fire Management policies. Ground application of Class A Foams is allowed in the park in areas more than 100 feet away from water. For aerial applications, Class A foam and fire retardants will not be used in BISO except in the following emergency situations and if needed aerial applications of retardant are restricted within 300 feet of waterways as long as it is safe for pilots:

1. potential loss of human life
2. potential destruction of park developments (headquarters complex, Bandy Creek complex, Station Camp Horse Camp, Bear Creek Horse Camp, Blue Heron complex)
3. potential consumption of structures associated with identified cultural landscapes (Lara Blevins, Litton-Slaven, Oscar Blevins, Charit Creek)
4. potential fire escape from NPS lands into areas of Wildland Urban Interface.

Determination of Projected Annual Work Under all alternatives the total of acres burned and mechanical fuel reduction work completed each year would be identified and approved in the annual Fire Management Plan review and would not exceed 10,0000 acres. The areas will include:

1. Areas (acres) of fuel reduction in wildland/urban interface (through prescribed fire and mechanical cutting).
2. Areas (acres) of ecological restoration and maintenance (through prescribed fire and managed wildfire for multiple objectives).
3. Acres burned by suppressed wildfire.

Because of variability in wildfire occurrence from year to year no precise estimate can be made about the number of acres that will burn annually by managed wildfire. Similarly, the actual acres of prescribed fire will vary as well; years with more active wildfires will tend to have fewer prescribed fires. It is expected, however, that the total number of acres treated from all three sources will be relatively consistent.

Alternative A: No Action

Alternative A would continue the use of the wildland fire management strategies and actions described in the *BISO 2004 Fire Management Plan* and is the baseline condition with which proposed activities are compared. Although this alternative would not allow the use of all of the fire management tools available under current National Wildland Fire Policy, it does not mean an absence of active management of fire and fuels. Under Alternative A, all unplanned ignitions (wildfires) would be suppressed and prescribed fire (planned ignitions) as well as mechanical/manual fuels reduction projects would be used to achieve resource and fire management objectives. Use of managed wildfire for other objectives would not be allowed. The fire management plan for BISO would continue to have the same designated 2004 fire management units. The fire management program would still need to follow current overall federal wildland fire management policy.

Wildfire Management under Alternative A

Wildfires would be managed using a strategic fire response limiting wildfire growth as quickly as possible while ensuring public and firefighter safety and protecting BISO's natural, cultural and historic resources, as well as private and other public property. Initial action and subsequent extended attack to wildfires would entail the deployment of firefighters with hand tools and engines, possible aviation resources such as helicopters with water buckets dipping from local water sources (lakes, ponds and rivers) or restrictive use of air tankers applying retardant drops or water to control the fire as quickly as possible.

Indirect attack, where suppression forces burn out fuel in advance of the fire, using existing roads and trails as control lines, would also be used.

In the event of the report of more than one fire, the highest priority would be given to wildfires that have potential to adversely affect human life or safety, or to spread onto private or other public lands outside the boundaries of BISO or threaten oil and gas wells or developed sites located within the boundaries of BISO. (See Figure 4: Oil & Gas Sites)

Prescribed Fire under Alternative A

It is important to note that prescribed fires are planned projects, reviewed by park staff with the appropriate consultation concerning issues related to Sec 7 (Endangered Species Act, 1973) and Sec 106 (National Historic Preservation Act, 1966) before the project is implemented. Prescribed fire (broadcast burning and pile burning) would be implemented to reduce the intensity of wildfires and maintain a fuel level that facilitates protection of life, property, cultural values and natural resources. Prescribed fire would also be used in support of resource management objectives. The amount of prescribed fire that would be planned and implemented for BISO is dependent upon funding and availability of prescribed fire resources. Operations associated with prescribed fire projects would be similar to those suppressing wildfires. Crews with digging, cutting and scraping tools, engines and other vehicles are routinely used to control a prescribed fire.

Mechanical/Manual Hazard Fuel Reduction under Alternative A

Mechanical/Manual hazard fuel reduction would be used on a limited basis (in fields, along park boundaries, and to protect structures) to achieve fire management protection objectives. Operations would include: chipping cut vegetation, cutting and piling vegetation and mastication.

Debris burning would be not allowed in this alternative.

Fire Management Units (FMUs) under Alternative A

Alternative A would continue utilizing two fire management units, 1. Unit One: ***Developed*** FMU and 2. Unit Two: ***Natural*** FMU.

Alternative B: Implement National Wildland Fire Policy (Preferred Alternative)

Alternative B would implement a wildland fire program utilizing all of the fire management strategies and tools available under current National Wildland Fire Policy 2009 found at the following link. https://www.doi.gov/wildlandfire/fire-policy. Alternative B would integrate wildfire suppression the same as described in Alternative A, would allow the use of managed wildfire for multiple objectives found in the BISO General Management Plan (2005), Foundation Document (2017) and the Fire Management Plan (2018), would utilize prescribed fire with the addition of debris burning, and nonfire fuel treatment activities the same as Alternative A to meet management objectives.

Alternative B, would be developed with four specific goals: 1) allow BISO to utilize all of the fire management tools available under current Federal Wildland Fire policy; 2) continue to reintroduce fire into areas of BISO that show adverse effects of fire suppression; 3) continue to maintain the historical fire regime in park ecosystems where vegetation is within its natural range of variability; and 4) continue to restore more natural levels of forest and fuel

characteristics near communities, roads, campgrounds, and park resource values (e.g., historic sites, cultural landscapes, cabins).

Wildfire Management under Alternative B

Wildfires under Alternative B would be managed with the same strategies as Alternative A: *monitor*, *confine*, *contain* and *control*. Unlike Alternative A, Alternative B would allow *managed wildfires for multiple objectives*. Objectives would be allowed to change as the wildfire moves across the landscape.

Use of fire retardants and foams in Alternative B would be the same as in Alternative A.

Indirect attack in Alternative B would be the same as Alternative A.

Priority of suppression for multiple fires occurring at the same time would be the same as Alternative A.

Prescribed Fire under Alternative B

Under Alternative B, prescribed fire would be the same as in Alternative A except Alternative B would allow debris burning.

Mechanical/Manual Hazard Fuel Reduction under Alternative B

Mechanical hazard fuel reduction would be the same as Alternative A.

Fire Management Units under Alternative B

Alternative B would establish three Fire Management Units (see Figure 2: Developed Areas within FMU: 1. *Developed*, 2. *Plateau* and 3. *Gorge*.

The *Developed* FMU would include most developed campsites and facilities, day use areas, trailheads, and administrative areas. The *Developed* FMU would receive the highest protection priority to protect development and minimize the chance of fire spreading out of the park and onto adjacent property or affecting private property assets in the park such as oil and gas wells.

The *Plateau* and *Gorge* FMUs would consist of the remainder of the park. These FMUs would maximize the area in which unplanned ignitions may be used as a management tool to perpetuate, restore and maintain fire adapted BISO ecosystems.

Figure 2: Developed Areas within FMU shows the proposed change in the Gorge FMU. In Alternative B the Gorge FMU (using the Gorge boundary as defined in BISO's enabling legislation) would extend throughout the BISO gorge. This would ensure that the gorge is managed consistently. In addition, the Developed Area FMU would be updated to show all of the developed areas to date, outside of the Gorge FMU.

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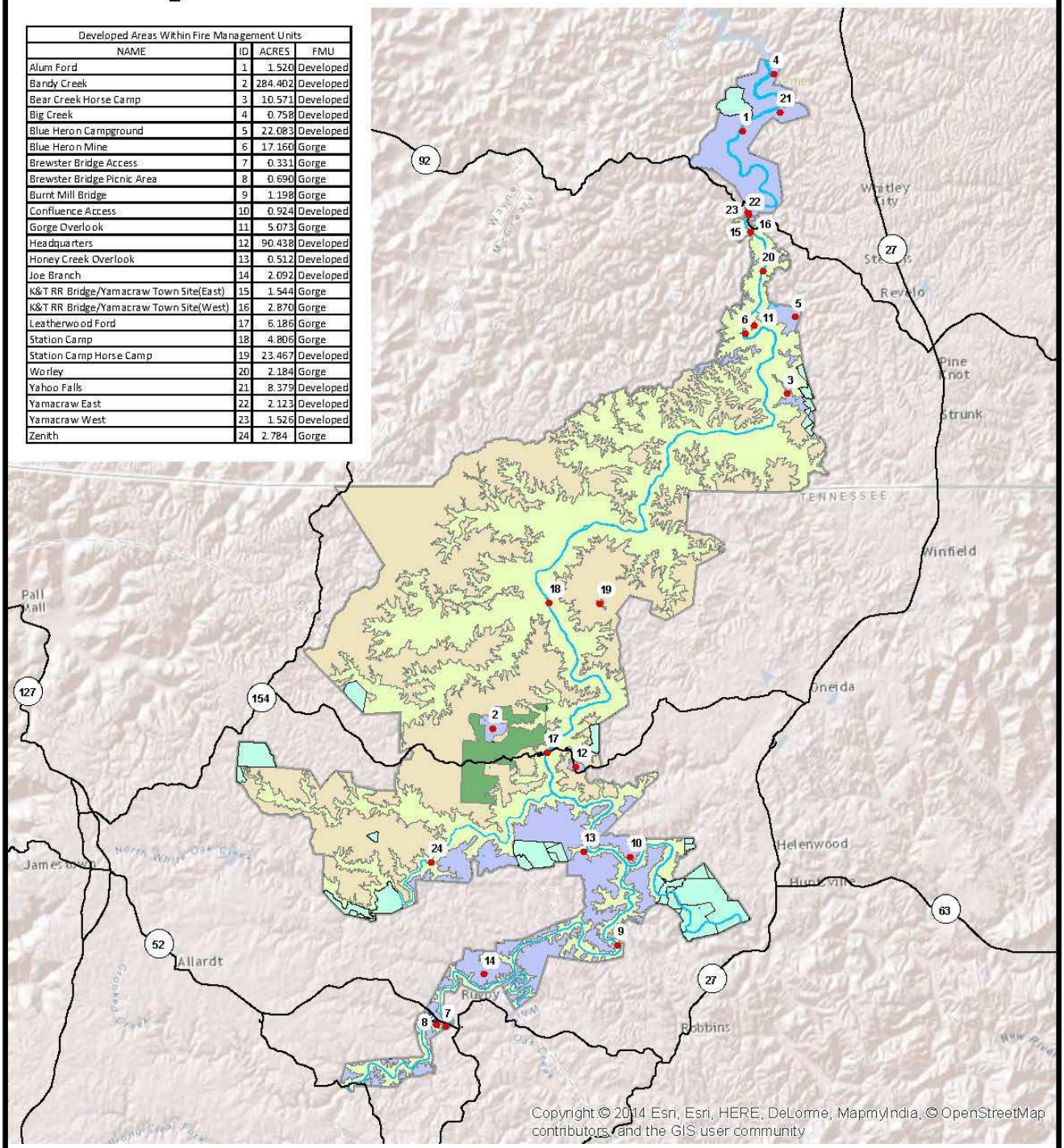
Developed Areas within FMU

Figure 2

Developed Areas Within Fire Management Units			
NAME	ID	ACRES	FMU
Alum Ford	1	1.520	Developed
Bandy Creek	2	284.402	Developed
Bear Creek Horse Camp	3	10.571	Developed
Big Creek	4	0.758	Developed
Blue Heron Campground	5	22.083	Developed
Blue Heron Mine	6	17.160	Gorge
Brewster Bridge Access	7	0.331	Gorge
Brewster Bridge Picnic Area	8	0.690	Gorge
Burnt Mill Bridge	9	1.198	Gorge
Confluence Access	10	0.924	Developed
Gorge Overlook	11	5.073	Gorge
Headquarters	12	90.438	Developed
Honey Creek Overlook	13	0.512	Developed
Joe Branch	14	2.092	Developed
K&T RR Bridge/Yamacraw Town Site(East)	15	1.544	Gorge
K&T RR Bridge/Yamacraw Town Site(West)	16	2.870	Gorge
Leatherwood Ford	17	6.186	Gorge
Station Camp	18	4.806	Gorge
Station Camp Horse Camp	19	23.467	Developed
Worley	20	2.184	Gorge
Yahoo Falls	21	8.379	Developed
Yamacraw East	22	2.123	Developed
Yamacraw West	23	1.526	Developed
Zenith	24	2.784	Gorge



Created by Big South Fork NRRA
GIS Office
NAD83 UTM Zone 16N

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Developments
Developed FMU
Gorge FMU
Plateau FMU
Scott State Forest
Deferred Property

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August, 2017

Prescribed fires would be used in the *Developed* and *Plateau* FMUs to accomplish resource/fire management objectives. Prescribed fires would be limited in the Gorge Fire Management Unit, which encompasses an area extending to the border of BISO and lies adjacent to recreation and wildland urban interface areas. Prescribed fire originating within Plateau and Developed FMUs would be allowed to burn down into the Gorge FMU, mimicking natural fire behavior.

Nonfire mechanical/manual fuel treatment methods: chipping, slash piling and mastication, would be used to manage hazard fuels and to aid in accomplishing vegetation management objectives in areas where safe and effective prescribed fire treatment is difficult due to fuel conditions or is otherwise infeasible.

Wildfires in the Plateau and Developed Fire Management Units would be allowed to burn down into the Gorge Fire Management Unit, if they meet developed decision criteria, in order to permit natural ignitions to exert their historical influence upon park ecosystems at time(s) and place(s) that would be defined by the resource itself. All prescribed and wildfires, as well as nonfire treatment projects, would be subject to a cultural resource clearance pursuant to the guidelines established in the National Historic Preservation Act of 1966, and guidelines set forth by the Tennessee and Kentucky Historic Preservation Officers.

Table 1: Comparison of Alternatives with Regard to Key Changes

Management Category	Common to All Alternatives	Alternative A: *No Action*	Alternative B: *Managed Fire for Multiple Objectives*
Fire Management Units	Not Applicable	Retain Two Current Fire Management Units: *Developed* and *Natural*	Three Fire Management Units: *Developed*, *Plateau*, & *Gorge*
Fire Objectives	Not Applicable	Wildfire may only be managed for one objective (suppression).	Wildfire may be managed for multiple objectives are allowed based on vegetation composition, fuel types, and other resource values.
Wildfires	In the event of more than one fire, priority is given to fires with potential to adversely affect human life or safety, spread beyond park boundaries, or threaten oil/gas wells or development.	Full Suppression in a cost effective manner to limit the spread of a fire as quickly as possible.	Strategic Management Response. Every wildfire will be evaluated for suitability for resource or other benefits. Allows full range of tactical options to be considered under extended attack incidents.
Conversion of Prescribed Fires to Wildfires	Not Applicable	If escaped, prescribed fires will be converted to wildfires with a goal of full suppression.	Upon conversion, if fire is meeting resource or other management objectives, it may be managed for those objectives
Debris Burning	Not Applicable	Not allowed.	Natural debris may be burned.

Management Category	Common to All Alternatives	Alternative A: *No Action*	Alternative B: *Managed Fire for Multiple Objectives*
Prescribed Fire Planning	Prescribed fire used to reduce the intensity of unplanned wildfires, reduce accumulation of hazard fuels, and support ecosystem management. Annual burn plans developed & only implemented when prescriptive parameters are met. Section 7 consultation with USFWS completed as part of annual burn planning. Section 106 consultation with SHPO completed as part of annual burn planning Prescribed fire treatment areas not designated in areas with high potential for coal fires or fires that may adversely impact oil and gas facilities. Plans adapted to protect known T&E plants, habitat, potential habitat and HISTORIC STRUCTURES AND CULTURAL LANDSCAPE	Not Applicable	Periodic and Post-treatment fire effects monitoring of T&E species and habitats to allow for more careful analysis of treatment effects. Future management actions will be adapted to reflect the better understanding of fire effects through monitoring. Isolated cultural resources determined to be significant will be fire lined.

Alternatives Considered but Dismissed

Alternatives considered but not included in the alternatives for further evaluation include:

Prohibit Fire Suppression

The concept of an alternative geared towards taking no action when fires started was also considered but rejected. It is neither possible nor consistent with any NPS guidance or policy to allow fires to burn without any form of management or response.

Full Suppression only Program

A full suppression alternative was also considered. Under a full suppression alternative, all ignitions would be suppressed. No prescribed fires would be conducted. This alternative was dismissed for several reasons, including its inconsistency with National Park Service and federal wildland fire management policy. A return to the "suppress all wildfires" policy was dismissed because it would result in fuel accumulations and changes in forest structure that would increase (rather than reduce) the risk of uncontrollable, catastrophic wildfire and the potential for loss of life and property.

Use Mechanical Fuels Treatments Only

This alternative was dismissed because of its inability to meet park objectives and because it would conflict with National Park Service and other federal policies and mandates. This alternative was also dismissed from further consideration because thinning and other mechanical treatment would not further resource management objectives in most areas of the park.

Disallow the Use of Mechanical Fuels Treatment

This alternative was dismissed because of the need to retain options when developing strategies for the reduction of fuels and the risk of harmful wildfire along Wildland Urban Interface (WUI) areas.

Fire Management Mitigation Measures Common to All Alternatives

Fire management planning incorporates appropriate mitigation measures to reduce impacts to resources, both natural and social, into all fire management operations. General minimum impact strategy and tactics (*MIST)* apply to all operations in order to reduce suppression impacts to resources. In concert with *MIST* are mitigation measures specific to the resource. Some of the mitigation measures are developed through Sec 7 and Sec 106 consultations and other mitigation measures for specific resources are developed through experience and scientific study. A list of mitigation measures currently used at BISO is found in Appendix E: Fire Management Mitigation Measures. This is not a complete list as new mitigation measures are developed all the time and are added to the list as needed.

Chapter 3: AFFECTED ENVIRONMENT and ENVIRONMENTAL CONSEQUENCES

Introduction

Chapter 3 describes existing conditions and analysis of environmental impacts on chosen impact topics identified for further analysis in this EA. The natural resources that are addressed include the following *Physical Resources*: air quality, soils, water resources (surface and ground water), oil and gas, soundscapes, and *Biological Resources*: vegetation, wildlife and aquatic species, federally listed threatened and endangered species, which includes species of special concern. The cultural environments include *Cultural Resources*: archeological, historic structures, cultural landscapes and ethnographic resources and *Social Resources*: BISO visitor use.

Natural Resource Elements (Physical Resources)

Air Quality

BISO Air Quality Affected Environment

Air quality is important to BISO managers, both from a health standard and as a visibility standard. Air quality in BISO receives protection under several provisions of the Clean Air Act (CAA), including the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) Program. The area is considered to be in attainment of the NAAQS, the minimum standards for air quality throughout the country. Under this program, BISO is classified as a Class II area.

Despite this protection, air quality and visibility are affected by air pollution in the area. Visibility is often reduced by fine particulate pollution. In its 1993 report on visibility in national parks and wilderness areas, the National Research Council concluded that in most of the East, the average visual range is less than 20 miles (about 30 km), or about one fifth of the natural range (National Research Council 1993). The visual range in BISO is approximately 10 to 15 miles (17-25 km) (EPA 1998). BISO's goal is to protect the scenic vistas available to visitors.

The target for burned acres for all sources of fire management smoke is 10,000 acres. The distribution of these burned acres can be from wildfires, managed wildfires for multiple objectives and prescribed fires, including natural debris pile burning.

Effects of Fire on Air

Fire affects air quality through the introduction of volatile compounds and particulates into the airshed creating haze, which reduces visibility and introducing inhalable particulates that can cause human respiratory problems.

Air Quality: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to air quality were derived from park staff's observations of the effects of fire on air quality and from literature on managing fire impacts on air quality.

Air quality is of concern at BISO because protection of viewsheds is important for visitor enjoyment of BISO and protection of human health is very important.

Air Quality Impacts of Alternative A

Alternative A includes wildfire suppression, prescribed fire operations and mechanical/manual fuels reduction operations.

Under Alternative A, wildland fires (wildfires and prescribed fires) within BISO would continue to have negative short term impacts to human health and viewsheds through the presence of smoke in the air. The smoke from a wildland fire would have the greatest negative effect in the area adjacent to the scene of the fire for a short time, generally one to two days, depending on the size of the fire, the fuels, and the environmental conditions present. Emissions concentrations are greatest in the smoke column as it is forced into the air by the heat of the fire and diminishes in concentration as the smoke cools and moves back to the ground (EPA 2016). Human health standards (National Ambient Air Quality Standards for particulate matter size class of 10 microns in diameter and smaller and particulate matter of 2.5 microns in diameter and smaller) could be approached or exceeded for short periods (several hours to several days) in the area immediately adjacent to the fire or in areas where cooled smoke concentrates, again dependent upon fire intensity/duration, fuels and environmental conditions. Areas of concentrated smoke could cause people to have difficulty breathing and people with preexisting breathing difficulties could face serious health problems. Air quality on a regional scale would be negatively affected when many acres are burning on the same day, with the same health concerns.

Alternative A would have less short term negative health impacts on people than Alternative B as all wildfires would be suppressed at minimum size, often within the first burning period creating less uncontrolled smoke, which negatively impacts air quality and human health where ever transport winds move the smoke.

Prescribed fire smoke is essentially the same as wildfire smoke with one important difference. Prescribed fire is a planned event and therefore project planning documents would need to consider the health impacts of smoke on the surrounding population and state smoke implementation plans would regulate the timing of the burn. This is important in that fire managers would start a prescribed fire only under wind transport and smoke dispersion conditions that would move the smoke into downwind nonsensitive areas, thereby impacting less people. Prescribed fires are also planned as to ignition sequencing with the goal of igniting the burn unit in such as manner as to utilize the best smoke transport and dispersion conditions of the day thereby reducing the amount of smoke that could affect people's health. Lastly a

prescribed fire can be put out if smoke dispersion conditions are not favorable. These controls can effectively manage and lessen negative smoke impacts to people's health.

Alternative A due to the reduction in wildfire acres burned and the reduction in prescribed fire burned acres and mechanical/manual fuels treated would have the long term effect of creating larger more intense fires in BISO. Over time, with fewer acres treated within BISO, fuel loads would increase creating wildfires in the future that could be larger, more intense and last longer; all factors which lead to more uncontrolled smoke (pollutants) in the air for longer periods of time potentially negatively impacting people's health in any area downwind of the fire.

Air quality due to smoke and associated haze, would also decrease distances of viewsheds. Viewsheds are important to BISO in providing a more complete visitor experience. Negative smoke/haze impacts from wildland fires could reduce visibility for short periods of time in areas within BISO, especially the river gorge where smoke might settle and adjacent to BISO, persisting until transport winds move the smoke away.

As with human health concerns wildfires with uncontrolled smoke impact viewsheds whichever direction the wind blows, negatively impacting important downwind viewsheds in BISO and degrading the visitor experience. Another factor with wildfires is that they generally occur during high visitor use periods which means that negative smoke impacts important viewsheds for more visitors.

Alternative A: Air Quality Cumulative Impacts

Cumulative impacts to air quality would occur if planned or unplanned ignitions occur on lands outside the park at the same time BISO wildfires or prescribed burns occur on BISO lands. The duration of the cumulative impact would coincide with the duration of the concurrent fire events. Lack of control over atmospheric and drought conditions when unplanned wildfires begin increase their potential to contribute emissions to the local airshed. These impacts would be local and regional, short and long term, and adverse. The cumulative effects of the Alternative A to air quality would be sporadic and temporary. Alternative A would cumulatively contribute less BISO generated smoke pollutants to other smoke contributor's wildfire smoke due to BISO's wildfire full suppression strategy of controlling a wildfire at minimum acres. Alternative A would not allow the use of managed wildfire for multiple objectives, effectively minimizing BISO's contribution of wildfire smoke to other sources of air pollution in the short term, but ultimately creating fuel accumulations that create larger more intense wildfires in the long term. The result of fewer prescribed burns would make it easier for BISO managers to cooperatively schedule prescribed burns with other prescribed burning agencies, such as the Daniel Boone N.F. in Kentucky, as well as the State of Tennessee and Commonwealth of Kentucky, taking better advantage of optimum periods of smoke dispersal further reducing cumulative negative impacts. The application of the NWCG Smoke Management Guide (Hardy et al. 2001) would reduce the intensity and duration of those contributions. Currently there is

some coordination through park managers to routinely coordinate with other nearby state and federal fire managers.

Air Quality Impacts of the Alternative B

Alternative B has the same general effects on human health due to smoke degrading air quality as Alternative A. Alternative B would have the potential to have BISO's greatest over all negative short term impact on human health due to poor air quality caused by smoke. Alternative B allows for managed wildfire for multiple objectives. Wildfires burning under this provision may burn for several days to weeks under the right set of conditions whereas Alternative A puts out the fire at minimal acreage. Smoke reducing techniques available to BISO managers conducting prescribed burns, such as pretreating fuels with mechanical and manual fuel reduction projects prior to ignition or varying ignition patterns, often cannot be used to reduce emissions from wildfires (EPA 1998). However, operations involving managed wildfire for multiple objectives would be conducted following predetermined environmental conditions, which include favorable conditions that limit the impacts of smoke. If potential smoke impacts to human health are expected to exceed determined air quality thresholds the wildfire is suppressed.

Alternative B also includes provisions for more BISO acres being treated with prescribed fire, due to the addition of natural debris pile burning. Even though prescribed fire is burned under conditions that reduce direct negative human health impacts due to smoke more acres burned means more potential negative human health smoke degraded air quality impacts. Direct human health impacts to air quality from natural debris pile burning would be minimal as these operations are carried out under very favorable conditions for smoke transport, the area and duration of the burn is less and combustion is more complete in a pile burn creating less particulates than burning the same material in a broadcast burn.

Alternative B has the potential to more quickly lessen the indirect effect of larger BISO fires in the future. With a more aggressive BISO fuels treatment program and the addition of managing wildfires for multiple objectives more BISO acres will have less accumulation of fuels leading to smaller less intense smoke producing wildfires with the potential for less human health impacts from BISO wildfire smoke in the future. BISO managers put a high priority on protecting human health and maintain clean air benefits recreation users as well as surrounding communities.

General air quality impacts from smoke and haze affecting viewsheds from wildfires and prescribed fires for Alternative B is similar to Alternative A. Alternative B would potentially have more periods of smoke in the air as this alternative allows debris burning and wildfire managed for multiple objectives. Wildfires generally occur during higher visitor use periods and with the potential for longer duration wildfires under Alternative B impacted viewsheds degrading the visitor experience would be more likely. Wildfires managed for multiple objectives would be allowed to burn as long as important viewsheds were not impacted to a degree determined by managers.

Alternative B: Air Quality Cumulative Impacts

Alternative B cumulative human health impacts due to poor air quality caused by smoke are similar to Alternative A. Implementation of Alternative B would cumulatively add to local and regional air quality pollution due to additional smoke from managing wildfires for management objectives and increased prescribed and natural debris pile burning.

Managing wildfires for multiple objectives occurring in BISO would extend burning periods for those wildfires. The result is BISO smoke from those managed wildfires would be added to other regionally generated pollution such as power plants, other industrial facilities as well as prescribed burning private landowners and agencies for longer periods of time.

Regional air quality during prescribed fire operations can be affected by meteorology; existing air quality; the size, timing, and duration of the activity; and other activities occurring in the same air shed when many acres are burned on the same day. The increase in prescribed burning in Alternative B would include the addition of natural debris pile burning, not allowed in Alternative A. Natural debris pile burning would add to local and regional smoke from other natural debris pile burners potentially affecting human health. The advantage of the natural debris pile burn program is that the piles can be burned under wet off season excellent smoke dispersal conditions creating less smoke which would have less impact on human health. The smoke dispersal and transport conditions under which natural debris piles are burned make it easy to coordinate burn times with other burners reducing air quality degrading smoke overall making this a short term local and regional cumulative impact to human health.

Soils

BISO Soils Affected Environment

The Cumberland Plateau is underlain by roughly horizontal sedimentary rock strata, which is primarily sandstone, and shale (Campbell & Newton 1995). Most of the soils on the plateau are formed from these weathered materials. The depth of the soil to bedrock ranges from about one foot on steep hillsides to about four to five feet on broad, smooth interstream divides (Campbell & Newton 1995). Generally, the soils are well drained, silty clay loam. These types of soils are fairly resistant to fire unless they are exposed to high temperatures for long durations. (Forest Service, 2005) Although low in natural fertility, plants grown on these soils generally were higher in nutritive value than plants grown on other soils and had the best potential for supporting wildlife of any in the McCreary-Whitley County, Kentucky area (Byrne, et al. 1964).

Effects of Fire on Soil

Analyses of the potential intensity of impacts to soils were derived from available soils information (NRCS), park staff's observations of the effects on soils from fire, and literature on fire ecology and effects.

BISOs predominantly well drained sandy loam soils can withstand fairly high temperatures without damaging the structure of the soil.

Fire will volatilize a percentage of the organic nitrogen present in the soil layer, with the actual amount determined by the fuels present, the duration of heat and the existing moisture in the soil. However, larger amounts of mineralized nitrogen would become available on a short term basis for plant uptake due to fire caused mineralization of organic nitrogen and increased nitrogen fixation associated with micro site changes caused by fire use (Wade 1989, EPA 1999). When a fire changes a log or other woody material to ash, nutrients bound in chemical compounds are released and changed to a form that is more water soluble. In this soluble form, nutrients percolating into the soil are again usable in the growth of other plants (USDA Forest Service 1993).

Under normal circumstances, sufficient moisture would be present to prevent complete combustion of the duff and forest litter, providing a protective layer for the soil (Wade 1989). Soil erosion caused by wildland fire suppression/control activities would in all likelihood be confined to fireline constructed on steep slopes (slopes 25% or greater).

Removal of vegetation and the underlying forest floor (duff) by fire decreases the amount of rainfall that is absorbed by the soil, thereby increasing the potential for runoff (Tiedemann 1979). Erosional responses to burning are a function of several factors such as the degree of elimination of protective cover, steepness of slope, degree the affected soil sheds water, climatic characteristics, and how quickly the vegetation recovers (Tidemann 1979, Wade 1989). Few studies have been conducted in the eastern United States to assess fire effects on the soils. However, conventional wisdom has shown if the prescribed burn or wildfire is under a timber stand and some duff remains, soil movement will be minor on slopes up to 25 percent (Wade 1989).

Soils: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to soils were derived from park staff's observations of the effects of fire on soils and from literature on fire ecology and effects.

Soils are of concern at BISO because populations of eleven federally listed endangered mussels and two fish that exist in the main stem of the river and some of the major tributaries could be negatively impacted by soil erosion entering waterways and maintenance or enhancement of soils benefits BISO flora and fauna.

Soils Impacts of Alternative A

Alternative A would have the least direct negative impacts to BISO's silty-clay-loam soils in the short term. Wildfires are kept to minimal size thereby reducing areas of potential direct negative impacts to soils.

Under Alternative A because of the gradual buildup of fuels associated with this alternative, piled or windrowed debris or forest litter that burns when fuel and/or soil moisture conditions are extremely low, could elevate soil temperatures long enough to ignite organic matter in the soil and alter the structure of soil clays (Wade 1989). The indirect effect of removing the top organic matter and altering the structure of the silty-clay-loam soils is increased run off of rainwater, leading to more erosion, especially on slopes greater than 25%. Another indirect effect of Alternative A is a smaller amount of nutrients are being recycled and made available for use by plants due to the lower amount of burned acres associated with this alternative.

Prescribed burning as proposed in Alternative A would free nutrients and normally would cause little or no detectable change in the amount of organic matter in surface soils. In fact, slight increases in organic matter have been reported on some burned areas (Wade 1989). Low intensity surface fires under a timber overstory conducted under wetter conditions would not cause changes in the structure of mineral soil because the elevated temperatures are of brief duration and the burns would be conducted under controlled conditions favoring minimal soil duff removal.

In the long term, Alternative A could slow fuels decomposition as fuels develop deeper layers. Buildup of fuels has the potential to create more intense wildfires, which can lead to accelerated loss of soil structure, leading to less soil productivity and more erosion. Disturbed sites due to more intense wildfires could provide areas for undesirable plants to grow in place of native plants and create negative erosion sedimentation impacts into streams by altering stream channels causing more streamside erosion impacting mussels and clams.

Alternative A: Soils Cumulative Impacts

Cumulative impacts to soil could occur as a result of effects of implementation of Alternative A and other actions (e.g., development or prescribed burns conducted by local government and private entities, trail development in the park, new oil and gas developments and trail and road maintenance in the park). Associated soil disturbance may contribute short term adverse impacts to soils from construction, earthmoving, and repeated use (e.g., foot or equipment traffic) activities. Prescribed fire activities associated with other landowners and agencies, like the Daniel Boone National Forest who is increasing their use of prescribed fire, could result in temporary adverse impacts to soils, but may provide long term beneficial effects to soils through improved ecosystem functioning and improved resilience to wildfire. Cumulative impacts to soils under Alternative A are expected to be adverse in the short term and beneficial in the long term.

Soils Impacts of Alternative B

Alternative B would have the most short term direct negative impacts to BISO's silty-clay-loam-soils. Wildfires are larger in size as they are managed for multiple objectives, thereby increasing potential areas of bare soil prone to erosion until revegetated, generally within a year. The

prescribed fire program includes natural debris pile burning further increasing potential bare areas of soils.

Soils would be better protected from direct adverse effects of high intensity fires through the fuel management techniques proposed in *Alternative* B. The increase in low intensity prescribed fires proposed in Alternative B would decrease the acres of high natural fuel loads in BISO thereby reducing the intensity of wildfires occurring in those treated areas. Lower intensity wildfires would not create as much bare soil so the soil structure would mostly remain and there would be less erosion. Prescribed fires would be conducted under predetermined conditions that would insure that protective soil layers are not removed, exposing mineral soil to the effects of erosion.

Alternative B has the management option of managing wildfires for multiple objectives, including a prescribed burning program, coupled with mechanical/manual fuels reduction where needed. As with Alternative A, Alternative B has a cap of 10,000 total burned acres per year. The result is a fire management program that creates more acres burned under wetter more controlled conditions. The indirect result is larger areas of BISO will experience increasing site productivity. Site productivity is increased under Alternative B because these larger burned areas would accelerate the natural decomposition process over a larger area thereby releasing more nitrogen to stimulate plant growth. The increased plant growth would enhance organic soil layers thereby increasing site productivity. Another indirect effect of Alternative B is the potential for an increase in erosion. The areas of erosion would occur within the 10,000 acres of burned areas where fires were hot enough to remove the soil organic layer and modify soil structure, especially on slopes over 25% or from digging fire control lines to mineral soil around the perimeter wildfires or prescribed burns. The impact of removing the soil layer and changing the structure of the soil is that there would be more erosion from these sites. More erosion leads to the potential for invasive species colonization as well as more sedimentation in waterways causing channel changes leading to more erosion along stream banks. Stream sedimentation can negatively affect mussels and other water inhabitants.

Alternative B has the potential to have less intense wildfires in BISO. Wildfires that burn in areas previously burned would exhibit less intense fires, thereby reducing overall negative impacts to future soil productivity and positive impacts through decreases in erosion.

Alternative B: Soils Cumulative Impacts

Cumulative impacts to soils are the same as Alternative A.

Water Quality

BISO Water Quality Affected Environment

One of the primary reasons BISO was established was to preserve as a natural, free flowing stream, the Big South Fork of the Cumberland River for the benefit and enjoyment of present and future generations. BISO managers emphasize maintaining or enhancing the water quality within BISO boundaries as water quality is important for the visitor experience and the animal and vegetative habitat good water quality provides. The Big South Fork River is formed by the New River and the Clear Fork River, and drains the northern portion of the Cumberland Plateau in Tennessee (See Figure 3: Rivers & Streams). As the Big South Fork of the Cumberland River flows from south to north it is fed by a variety of sources ranging from perennial streams, such as North White Oak Creek, to many creeks that are intermittent in nature. Flooding is common during the winter months (December – March) when the soils are saturated, frozen or covered with snow; however, floods can occur during any time of year due to the steep terrain in the watershed. Springs and ponds can be found scattered throughout BISO. Preserving the water quality of the Big South Fork of the Cumberland River is an important BISO management concern.

The aquatic environment of BISO gorge and adjacent plateau supports a wide variety of plant and animal life which depends upon the aquatic systems for drinking, food, living space and cover (Corps of Engineers 1976). The river and its floodplain are habitat for eleven federally protected mussels (all endangered) in the BSF River and at least one federally protected fish (Duskytail/Tuxedo Darter – endangered). The Blackside Dace (threatened) only occurs in small headwater streams and is known from 4 small streams in the park. The palezone shiner was documented approximately one half mile upstream of the BISO boundary in the Rock Creek System in 2008. It is important to BISO that due care and caution be exercised while carrying out fire management operations to prevent impacting this special resource. A complete overview of the management of the water resources is contained in the Big South Fork Water Resources Management Plan (Hamilton & Turrini-Smith 1997) on file at the Headquarters Building.

The states of Kentucky and Tennessee have each declared their portions of the Big South Fork of the Cumberland River as an Outstanding National Resource Water (ONRW) (NPS 2005a). An ONRW is a river that is “of exceptional recreational or ecological significance,” per EPA water quality standards at 40 CFR 131.12. A majority of the Big South Fork of the Cumberland River is included in this designation as an Outstanding National Resource Water. Many waterways are located in BISO as shown in Figure3 Big South Fork Rivers and Streams.

Fire Effects on Water Quality

BISO water quality is impacted by wildland fire and fire management operations in several ways. Small fires and fires of low intensity are expected to have little direct impact on water quality. These types of fires do not create large areas of hydrophobic soil layers, do not burn all of the litter and duff layers and therefore have a minimal impact on the ability of soils to absorb rainfall. This means during rainfall events there could be minimal increases in run off and erosion potential. Generally, these types of fires will not kill all the shading vegetation along

waterways so vegetation continues to provide cooling shade to waterways. These minimal effects are considered normal and natural in fire adapted ecosystems and would be within the normal range of variability. These adverse impacts would be expected to last one or two vegetation growing seasons to allow the vegetation to become reestablished after the wildfire.

Fires that become large could have adverse and short to long term effects on water quality. Large intense wildfires can burn large portions of a watershed. Due to the high intensity of the fire and large area covered negative impacts could exceed the natural range of variability causing substantial adverse impacts, which could last longer than two growing seasons. A wildfire event that exceeds the natural range of variability could cause sediment loading that is higher than historic rates; thereby changing the transport capacity of the affected channels. These events could cause changes in hydrologic conditions, such as shifting channels that may require a substantial duration of time for recovery, due to increased ash and woody debris deposited into water bodies and their floodplains. This type of deposition could increase turbidity downstream from the fire. Loss of vegetation could lead to increased erosion and sediment loading in surface water resources in BISO. If the burned vegetation was shading a waterway there could be increases in water temperature as the indirect result of removal of shading vegetation. Removal of protective vegetation and organic layers can indirectly increase the amount of sediment that enters streams through erosion processes causing increased turbidity and chemical changes. Direct and indirect deposition of ash can increase the PH of affected waterways and possibly increase the amount of nitrogen present in waterways.

Effects on water quality from fire suppression strategies have the potential to be more severe than other fire management techniques depending on the intensity of the fire and the location of the fire in relation to perennial streams or riparian areas. These effects are related to maintenance of roads, construction of fire lines with hand tools or heavy equipment, installation of water tanks, installation of fire camps, trampling of soils by personnel and equipment at fire lines and camps. Operationally fireline construction has the biggest potential to indirectly add to sediment loads in streams due to erosion from firelines dug to mineral soil. This is a short term impact as fire managers use mitigation practices to reduce erosion, especially on slopes 25% or greater. Rehabilitation of firelines to minimize erosion at the end of operations is required. In summary fire suppression strategies effects on water quality are generally from runoff from erosion of soils disturbed by these activities.

Under all alternatives fire suppressant chemicals would be used on a limited basis, with restrictions on how close they can be used near waterways (not within 300 feet for aerial applied retardant and 100 feet for ground use of foams and fire retardant chemicals) to protect human life and property due to the potential to affect sensitive aquatic species including federally listed fish and mussels. Fire suppressant chemicals, when applied directly to waterways, have been demonstrated to adversely affect aquatic organisms (McDonald et al. 1995a, McDonald et al. 1995b, Minshall 2003, Minshall and Brock 1991, Norris and Webb 1989, Poulton 1996). Runoff from applications adjacent to aquatic habitat may also cause mortality in aquatic organisms (Norris and Webb 1989).

Water Quality: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to water quality were derived from park staff's observations of the effects of fire on water quality and from literature on fire ecology and effects.

Water quality is of great concern at BISO because of populations of eleven federally listed endangered mussels and two fish that exist in the main stem of the river and some of the major tributaries. Protecting water quality in BISO also insures that water leaving BISO is better for downstream users, both human, plant and wildlife. Water quality must be protected and enhanced to the maximum extent possible.

Water Quality Impacts of Alternative A

Alternative A includes wildfire and prescribed fire operations as well as mechanical fuels reduction operations. Fire affects water quality by introducing sediment into waterways and by removing shading vegetation along stream banks.

Fire affects the soil's ability to resist erosion by burning the organic layer exposing bare soil strata. Erosion affects water quality by increasing sediment loads carried in the water. Increasing sediment loads increase turbidity, the clarity of the water, as well as changing stream channels through creation of sandbars which push water to stream banks causing more erosion. Alternative A would have short term effects on water quality due to the potential to have the lowest wildfire burned acres, as wildfires would be suppressed at their smallest size. Wildfires can burn more intensely than prescribed fires creating more areas susceptible to erosion. The decrease in burned area directly decreases the total potential area for erosion a major source of fire impacts to waterways. Under Alternative A, prescribed fires would reduce the fire intensity of future prescribed burns or wildfires that occur in the treated area. Therefore, wildfires in the treated areas would burn less intensely, negatively impacting less soil thereby reducing soil erosion.

Alternative A, with reduced wildfire acreage in the short term, would minimize fire removal of shade producing vegetation along BISO waterways. Shaded producing vegetation protects waterways from direct sunlight creating a cooler water surface temperatures leading to minimal increases in total water temperature. Water temperature is important for organisms that live in the water because they generally have a range of water temperatures they can exist in before being stressed. A direct effect of Alternative A is the accumulation of unnatural fuel loadings within BISO as the proposed fire program would not be able to keep up with fuels accumulations. This unnatural fuel loading would lead to larger more intense wildfires removing more shade vegetation.

Alternative A with larger more intense wildfires over time could indirectly create substantial changes to streambeds as more sediment loads entering the streams modify stream channels. Firelines designed for control of wildfires and containment of prescribed burns and constructed on slopes greater than 25 percent have the potential to erode, indirectly adding to sediment

loads impacting water turbidity in nearby waterways. However, under all alternatives both prescribed burns and suppressed wildfires would use existing manmade and natural barriers when possible as control lines limiting disturbed soil and erosion reducing water quality turbidity impacts.

Under Alternative A, using a combination of mechanical treatments and prescribed fire, BISO staff would selectively reduce fuels under controlled conditions in those areas prone to high intensity fires. The proactive nature of this alternative would reduce the likelihood of large, high intensity fires in areas that appear to have the greatest potential for causing damage to water resources (Tiedemann 1979). The actual treated areas would be restricted to planned projects, as use of managed wildfire for multiple objectives is not allowed. This limits the positive impacts of the fire program by allowing nontreated areas to accumulate fuels over time that could lead to larger more intense wildfires causing more negative erosion impacts to water quality.

Long term impacts associated with currently available retardant and foam formulations is believed to be low because of the transient nature of the chemical plume in streams and biodegradation of major toxic components in the chemicals (Buhl 2000, Norris and Webb 1989). Additionally, adsorption and binding of surfactants to solids and dissolved organic matter likely reduces the bioavailability of anionic surfactants (Buhl 2000). Protection of water quality, especially turbidity, temperature and the introduction of potentially harmful fire retardants and foams is important to BISO managers because BISO's waterways provide refuge for many listed species of mussels and a couple of fish. Potential impacts are minimal since aerial retardants are limited within the gorge boundary described in the original FMP from North White Oak in the south to the Bear Creek confluence in the north and only during emergency situations that involve potential loss of human life or to prevent destruction of park developments or cultural structures and landscapes. In order to provide protection to mussels and other organisms in the water prescribed burning would not occur in the vicinity of waterways creating a buffer of vegetative and organic layer for chemical absorption, aerial application of fire retardants would not be used within 300 feet of a waterway nor would ground based foams be used within 100 feet of waterways. Therefore, the effects of retardant and foam use has a low likelihood of impacting water based species based on limits on where chemicals can be used and protective vegetative and undisturbed soil buffers.

Alternative A: Water Quality Cumulative Impacts

Other past, present, and foreseeable actions that may affect water quality are federal, state and private operations that disturb soils near upstream waterways, increasing sediment to streams or removing shading vegetation from upstream waterway banks or introduce chemicals into waterways. Water quality is impacted by a mixture of land development, strip mining, oil and gas sites, timber harvesting, prescribed burning, and more intense wildfires (more likely associated with Alternative A) in a common drainage. Cumulatively these actions could increase the possibility of increased turbidity and elevated temperatures in a particular watershed causing stress to water based organisms. Under Alternative A the potential for

negative long term impacts increase due to large more intense wildfires over time. Large intense wildfires can cover large areas of a watershed which due to high fire intensities can increase sediment loads to streams and remove shading vegetation from stream banks elevating water temperatures and increasing sediment loads causing stress to water based organisms inside and downstream of BISO. Due to the presence of endangered mussels and fish in BISO waterways, a few of which are only found in this area, any reduction of water quality that stresses these species is important to BISO. This could result in adverse cumulative impacts to water quality.

Water Quality Impacts of Alternative B

Fire and fire management operations impacts on water quality for Alternative B are the same as Alternative A. A difference is Alternative B would allow use of managed wildfire for multiple objectives. This means that wildfires are allowed to burn as long as they meet predetermined criteria. The result is that the increased acres burned by wildfires can directly increase run off from burned areas increasing turbidity and negatively affecting water quality. Water temperatures could also rise as shade vegetation is removed from stream banks allowing more direct sunlight leading to increases in water temperatures. Due to the criteria developed for managing a wildfire for multiple objectives it is expected that the fire effects will be within the range of natural variability. Under Alternative B, prescribed fires can include natural debris burning which can reduce later intensities of wildfires and prescribed fires leading to less turbidity and loss of shading vegetation in and along nearby waterways.

Under Alternative B firelines would be constructed and managed the same as in Alternative A. The increase in potential wildfire acreage due to managed wildfire for resource and other benefits does not mean an increase in fire line construction as fire managers would be allowed to let wildfires burn to natural or manmade barriers. The result is that Alternative B would allow more burned acres reducing unnatural fuel loads. Reduction of these fuel loadings would have the positive effect of having later wildfires in these areas exhibit less fire intensity, protecting vegetative shading along waterways and soil

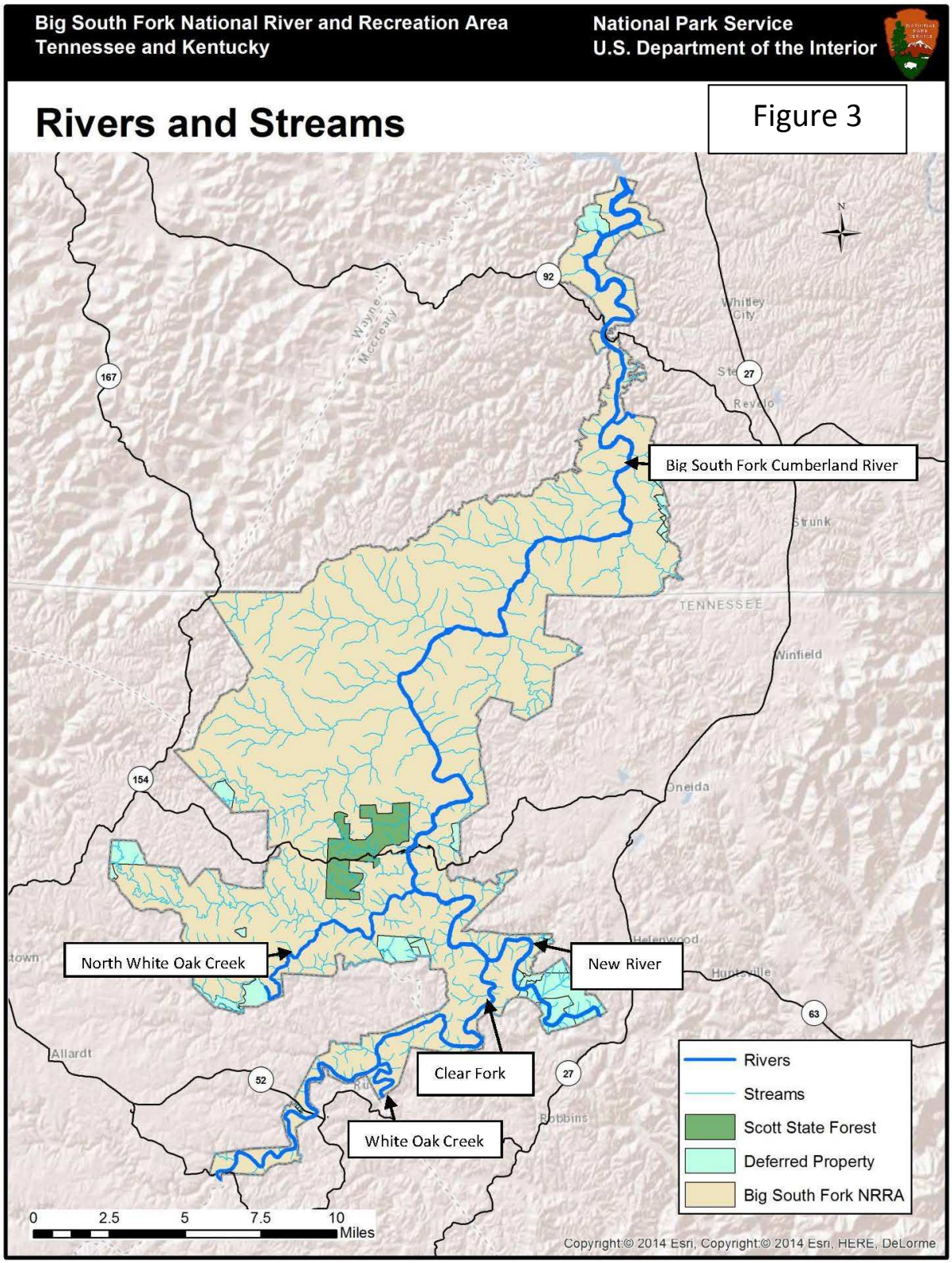
Under Alternative B the impacts on water quality caused by the use of chemicals in firefighting would be the same due to similar use restrictions used in Alternative A.

Under Alternative B more acreage would have lower fuel loads than would exist under Alternative A. The result is that fires are more likely to be less intense leading to less erosion induced turbidity in waterways and less removal of shading vegetation reducing waterway temperatures.

Alternative B: Water Quality Cumulative Impacts

Cumulative impacts to water quality under Alternative B are similar to Alternative A. The difference is in Alternative B the fire management program accelerates returning fire in BISO to

a more natural range of variability over time with the expectation that negative cumulative impacts to water turbidity and temperature due to wildfires will decrease.


Big South Fork National River and Recreation Area
Tennessee and Kentucky
National Park Service
U.S. Department of the Interior
Rivers and Streams
Figure 3
Big South Fork Cumberland River
North White Oak Creek
New River
Clear Fork
White Oak Creek
TENNESSEE
Winfield
Oneida
Whitley City
Rivers
Streams
Scott State Forest
Deferred Property
Big South Fork NRRA
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Oil and Gas

BISO Oil and Gas Affected Environment

Oil and gas fields are located adjacent to and extend into the boundary of Big South Fork NRRA, primarily in the southern portions of the park unit. According to the Big South Fork NRRA GMP, in 1994, 82% of Tennessee's total oil production, and 60% of its total gas production, came from counties within the watershed of the Big South Fork River (Scott, Fentress, Pickett, and Morgan counties) (NPS 2005a). In 2006, 50% of Tennessee's total oil production and 99% of its gas production came from the watershed counties. In 1992, there were 788 actively producing oil wells and 529 actively producing gas wells in this watershed (NPS 2005a). By 2006, there were 829 producing oil wells and 810 producing gas wells in this area (Spradlin, pers. comm., 2007).

The enabling legislation for the Big South Fork NRRA prohibits oil and gas extraction and development within the designated gorge area, but allows for development in the adjacent areas outside the gorge. Currently, there are more than 300 oil and gas sites within the Big South Fork NRRA. The status of these wells has been classified in the BISO Oil and Gas Management Plan, 2012 into one of five categories, as follows:

1. *Active*—Actively producing wells. This includes wells that are mechanically capable of being produced and have documented production in the past 12 months.
2. *Inactive wells*—Wells that have no documented production in the past 12 months, including wells that have been shut in.
3. *Plugged*—Wells that have been permanently closed by placement of cement plugs. Includes abandoned wells.
4. *Unknown*—Wells for which the NPS does not have sufficient information to verify the location or status.
5. *Orphaned*—Wells that do not have a responsible party.

The 12 month timeframe for describing actively producing or inactive wells makes use of the State of Tennessee's requirement for operators to file annual production reports.

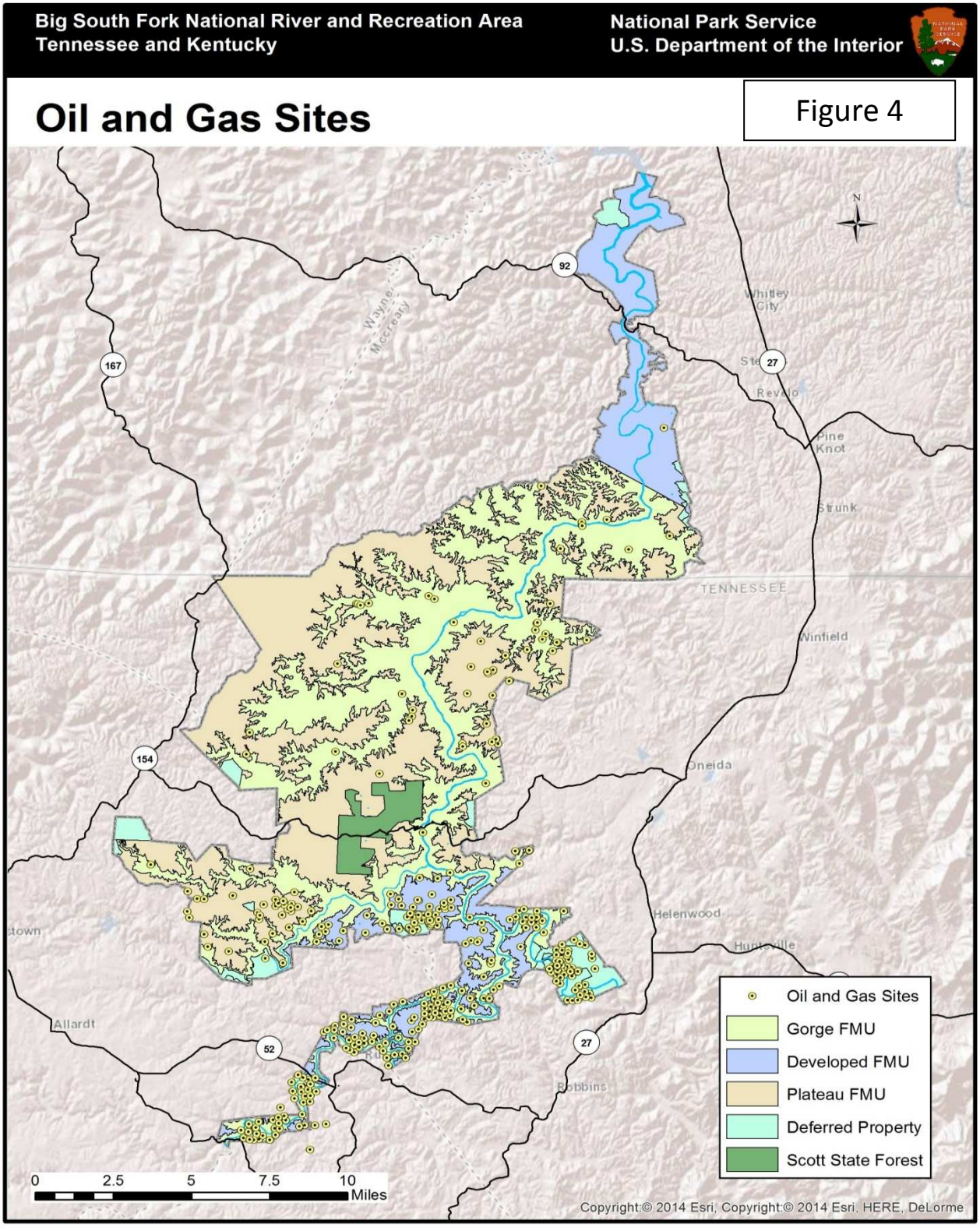
No new wells have been drilled in the Big South Fork NRRA since about 1990. Active oil and gas production at Big South Fork NRRA occur primarily in the south end of the unit, on both deferred properties (fee simple private property within the legislative boundary), as well as on property owned by the United States government. This includes a large, underground natural gas storage operation located in the New River drainage, within one of the largest oil and gas fields in Tennessee (NPS 2005a). Wells with an "inactive" status are candidates to become either actively producing wells or plugged and abandoned wells. Approximately 50 to 60 inactive wells occur on lands owned by the U.S. government. To date, 56 inactive wells have been plugged. An additional 11 orphaned wells are scheduled to be plugged in 2019.

Some instances of land acquisition at Big South Fork NRRA have resulted in the NPS managing oil and gas wells on lands where both the surface and mineral estate are federally owned but where the petroleum is produced according to an outstanding private lease right. The Bureau of Land Management (BLM) and the Bureau of Ocean Energy Management, Regulation and Enforcement, formerly known as the Minerals Management Service, are responsible for collecting any royalties due to the federal government, but are not authorized to issue new federal oil and gas leases. Protection of these wells from wildfire and BISO fire management activities is very important to BISO managers.

Fire Effects on Oil and Gas Resources

Wildland fire managers view oil and gas resource extraction and storage sites with particular concern. These sites represent added dangers to wildland firefighters generally not equipped for fighting oil and gas fires. Wildfire and prescribed fires can negatively affect oil and gas sites by setting them on fire. Direct flame contact and or burning embers from a wildland fire could ignite combustible oil or gas pumping or storage sites. Crews working in and around these sites could impact storage, pumping facilities and/or underground product gathering lines with heavy equipment causing damage to the sites or potentially ignition of oil or gas. These negative impacts could be short term to long term depending if the how much the storage site or well is impacted. Storage sites could be rebuilt with only a loss of stored oil or gas. An impacted well could lead to long –term repair and reconstruction of well head equipment and underground gathering lines.

Oil and gas sites are shown in Figure 4.


Big South Fork National River and Recreation Area
Tennessee and Kentucky
National Park Service
U.S. Department of the Interior
Oil and Gas Sites
Figure 4
N
92
167
27
154
52
TENNESSEE
Whitley City
Pine Knot
Strunk
Winfield
Oneida
Helenwood
Huntsville
Allardt
Robbins
Wayne
McCreary
Oil and Gas Sites
Gorge FMU
Developed FMU
Plateau FMU
Deferred Property
Scott State Forest
0 2.5 5 7.5 10
Miles
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Oil and Gas: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to oil and gas were derived from park staff's observations of the effects of fire on oil and gas operations.

Oil and Gas Sites Impacts of Alternative A

Alternative A wildland fire impacts to gas and oil sites are related to management of fuels in and around the sites. Fire from burning fuels can ignite gas wells or destroy above ground equipment. Fire managers in the Alternative A would continue emphasis of hazard fuel reduction surrounding the sites in order to reduce the intensities of any wildfire burning in treated areas making it easier to suppress the fire, thereby protecting the site from burning.

Alternative A proposes full suppression of all wildfires occurring in BISO. In the short term this has a positive direct effect on protecting oil and gas sites as wildfires are kept to minimum size reducing the risk of changing environmental conditions allowing the fire to grow faster. Prescribed burning as a method of reducing hazard fuels in the vicinity of oil and gas sites could have a short to long term negative effect on oil and gas sites if protection measures designed for the site during prescribed burn operations fail and the site catches fire. Mechanical/manual fuels reduction operations have minimal effect on impacts to oil and gas sites. These operations are monitored closely and occur during times of lower potential for wildfire starts. Alternative A does not include natural debris pile burning as an option so this operation has no effect on oil and gas sites.

Alternative A would also propose prescribed burning as a way to reduce hazard fuels. Prescribed fire can be used positively to indirectly protect oil and gas sites by reducing hazard fuels around the site so that a wildfire burning in the treated area would be less intense and therefore easier to suppress saving the site from burning.

Alternative A does not allow managed wildfire for multiple objectives. The direct result is a long term buildup of hazard fuels within BISO over time. The accumulation of fuels would occur outside the immediate vicinity of the oil and gas sites as these sites would have fuel reduction projects surrounding them. The unnatural accumulation of hazard fuels will allow wildfires to be larger and more intense making it more difficult for suppression crews to halt the spread of the wildfire from burning oil and gas sites.

Alternative A: Oil and Gas Sites Cumulative Impacts

Other past, present, and reasonably foreseeable actions that may affect oil and gas sites are market conditions that determine if a site is active, or inactive. Increasing accumulation of hazard fuels in BISO under Alternative A could adversely affect oil and gas wells in BISO as well as surrounding areas, especially if hazard fuels are allowed to accumulate on neighbors properties by making them more susceptible to burning.

Oil and Gas Sites Impacts of Alternative B

Alternative B has similar impacts to gas and an oil site as Alternative A. Alternative B also includes two fire management options not available in Alternative A. These are wildfire managed for multiple objectives and natural debris pile burning. The result is that BISO has the potential to have active burning in the park for a longer period of time which could allow wildfires to enter gas and oil sites.

Alternative B with the addition of managed wildfire for multiple objectives could have more fire occurring annually than Alternative A. It is not expected that managed wildfire for multiple objectives would directly impact oil and gas sites. Management constraints on where these events will take place would not allow this management option in the vicinity of the oil and gas sites. The direct effect is the reduction of hazard fuels over a larger area of the park than would occur under Alternative A making wildfires that start in these areas less intense and easier to suppress thereby protecting BISO oil and gas sites.

Prescribed fire impacts for Alternative B are the same as Alternative A.

Natural debris pile burning indirectly affects oil and gas sites by using this operation to quickly and more safely reduce hazard fuels around the sites. The expected result is that a wildfire starting or entering the treated areas will be easier to suppress. Piled debris can be burned under conditions that will not allow fire to spread further protecting these sites from operational ignition sources. Therefore, under Alternative B use of debris pile burning would further protect oil and gas sites

Alternative B with a more aggressive hazard fuels reduction program, the addition of managed wildfire for multiple objectives and natural debris pile burning will change more of BISO to a wildfire scenario approaching the natural range of variability, more closely aligned with historical fire. This will have a positive long term effect on protection of oil and gas sites as wildland fires will be less intense and easier to suppress or control.

Alternative B: Oil and Gas Sites Cumulative Impacts

Alternative B has similar cumulative effects on oil and gas sites as Alternative A. Under Alternative B it is expected, with BISO's emphasis of reducing the unnatural fuel build up in areas adjacent to oil and gas sites of, there will be less chance of wildfires exiting BISO onto other ownerships. Therefore it is expected that Alternative B will positively affect oil and gas sites in and around BISO.

Natural Resource Elements (Biological Resources)

Vegetation

BISO Vegetation Affected Environment

BISO lies within the Cumberland Plateau physiographic province which is one of the most biologically rich temperate regions in the world (Braun 1950, Hinkle et al. 1993, Shaw and Wafford 2003). BISO supports an enormous diversity of vegetation, with over 95 percent of BISO being forested. In terms of woody plants, BISO has more native families (52) than any other park unit in the National Park system. The current number of known vascular plant species for BISO is 1,108, which includes 996 native plant species and 112 nonnative species (NPS Appalachian Highlands I&M search results October, 2018). Among the native flora, there are 4 federally listed species, and a total of 114 state listed species (vulnerable to critically imperiled) in Tennessee and Kentucky combined. State- listed species for both Tennessee and Kentucky appear in Appendix D: State Listed Vascular Plants in Big South Fork National River and Recreation Area.

Though diversity remains high, the composition of forest types in BISO has been continually altered by nearly a century of land use. Timber harvesting, pine plantings, agriculture, coal mining, oil and gas extraction, fire, grazing, recreational activities, exotic forest diseases, and introduction of nonnative invasive plants have all shaped or continue to shape the plant communities within BISO. The most recent substantial impact to forest composition in BISO was the widespread damage caused by Southern pine beetles between 2000 and 2002. Dead; standing and fallen trees remain virtually everywhere in BISO where shortleaf pine (*Pinus echinata*) and Virginia pine (*Pinus virginanus*) stands existed prior to the infestation (NatureServe 2011).

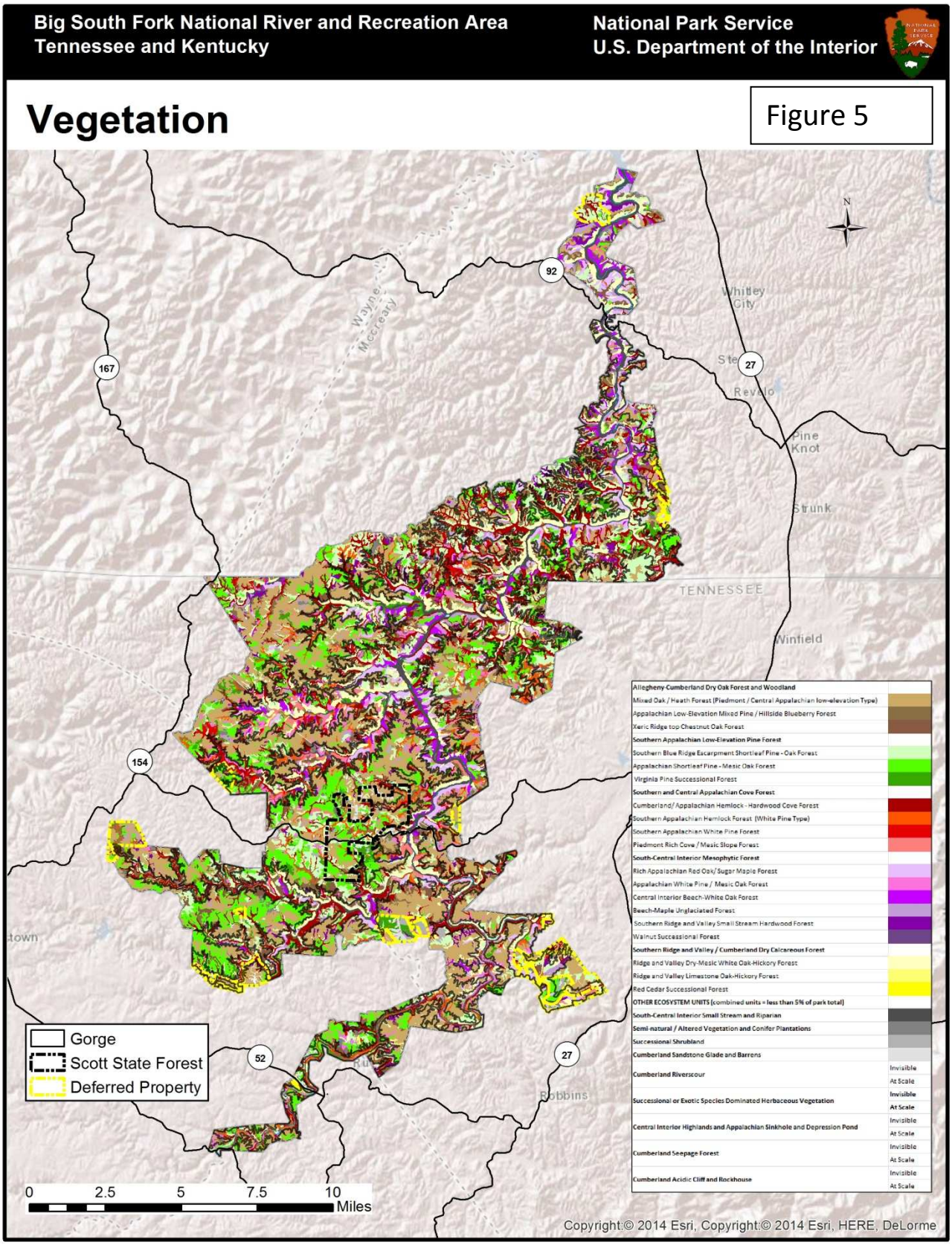
Classification of plant communities in BISO, completed by NatureServe (2011), identified 47 distinct community associations as defined by *The National Vegetation Classification System: list of types* (NVCS) (Anderson et al. 1998). Thirty six community associations were considered natural, while the remaining 11 were considered human modified, successional or exotic species dominated. Twelve of the natural community associations were too small to be captured by NatureServe plot data; however, they were previously documented in BISO. Communities were grouped into 14 broader NVCS Ecological Systems categories (NatureServe 2011). The top five Ecosystem Units include communities that account for over 95% of the total vegetation cover in BISO. The characteristics of these five Ecosystem Units and the communities they include are briefly discussed below. Figure 5 shows the vegetation type locations at BISO.

Allegheny Cumberland Dry Oak Forest & Woodland Ecosystem Unit

In BISO, these dry hardwood forests on predominately acidic substrates are the most widespread (37% total cover), typically dominated by white oak (*Quercus alba*), chestnut oak (*Quercus prinus*), scarlet oak (*Quercus coccinea*) and black oak (*Quercus velutina*), with lesser amounts of red maple (*Acer rubrum*), sand hickory (*Carya pallida*) and mockernut hickory (*Carya alba*) and scattered Virginia and shortleaf pines. White pine (*Pinus strobus*) may become prominent in the absence of fire (NatureServe 2011). Four community types were classified into this system, including the Mixed Oak Heath Forest which is the most common community in BISO, covering nearly a quarter of the total area. All four communities are tolerant of and/or maintained by occasional fire.

Southern Appalachian Low Elevation Pine Forest Ecosystem Unit

This system (26% total cover) consists of shortleaf pine and Virginia pine dominated forests in BISO. Forests in this type generally occur on ridgetops, upper slopes and midslopes and are dominated by Virginia pine, shortleaf pine with occasional occurrences of pitch pine (Pinus rigida). Hardwoods are sometimes abundant and may include dry site oaks such as chestnut, Southern red (Quercus falcata), post (Quercus stellata) and scarlet oaks and other species such as red maple or pignut hickory (Carya glabra) (NatureServe 2011). Three community types were classified into this system, including the second and third most abundant types in BISO, the Southern Blue Ridge Escarpment Shortleaf Pine – Oak Forest (12% cover) and the Appalachian Shortleaf Pine-Mesic Oak Forest (11% cover). All three communities are tolerant of and/or maintained by occasional fire in BISO


Big South Fork National River and Recreation Area
Tennessee and Kentucky
National Park Service
U.S. Department of the Interior
Vegetation
Figure 5
92
167
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154
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TENNESSEE
Whitley City
Pine Knot
Winfield
Robbins
Gorge
Scott State Forest
Deferred Property
0 2.5 5 7.5 10 Miles
Allegheny-Cumberland Dry Oak Forest and Woodland
Mixed Oak / Heath Forest (Piedmont / Central Appalachian low-elevation Type)
Appalachian Low-Elevation Mixed Pine / Hillside Blueberry Forest
Xeric Ridge top Chestnut Oak Forest
Southern Appalachian Low-Elevation Pine Forest
Southern Blue Ridge Escarpment Shortleaf Pine - Oak Forest
Appalachian Shortleaf Pine - Mesic Oak Forest
Virginia Pine Successional Forest
Southern and Central Appalachian Cove Forest
Cumberland/ Appalachian Hemlock - Hardwood Cove Forest
Southern Appalachian Hemlock Forest (White Pine Type)
Southern Appalachian White Pine Forest
Piedmont Rich Cove / Mesic Slope Forest
South-Central Interior Mesophytic Forest
Rich Appalachian Red Oak/ Sugar Maple Forest
Appalachian White Pine / Mesic Oak Forest
Central Interior Beech-White Oak Forest
Beech-Maple Unglaciated Forest
Southern Ridge and Valley Small Stream Hardwood Forest
Walnut Successional Forest
Southern Ridge and Valley / Cumberland Dry Calcareous Forest
Ridge and Valley Dry-Mesic White Oak-Hickory Forest
Ridge and Valley Limestone Oak-Hickory Forest
Red Cedar Successional Forest
OTHER ECOSYSTEM UNITS (combined units = less than 5% of park total)
South-Central Interior Small Stream and Riparian
Semi-natural / Altered Vegetation and Conifer Plantations
Successional Shrubland
Cumberland Sandstone Glade and Barrens
Cumberland Riverscour
Invisible
At Scale
Successional or Exotic Species Dominated Herbaceous Vegetation
Invisible
At Scale
Central Interior Highlands and Appalachian Sinkhole and Depression Pond
Invisible
At Scale
Cumberland Seepage Forest
Invisible
At Scale
Cumberland Acidic Cliff and Rockhouse
Invisible
At Scale
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Southern & Central Appalachian Cove Forest Ecosystem Unit

This system (16% total cover) consists of mesophytic hardwood or hemlock-hardwood forests of sheltered topographic positions, such as concave slopes, draws and well protected north facing slopes. Characteristic species in the canopy include Eastern hemlock (*Tsuga canadensis*), American beech (*Fagus grandifolia*), tulip poplar (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), American basswood (*Tilia americana*) and magnolias (*Magnolia* spp.) (NatureServe 2011). Four community types were classified into this system, including Cumberland/Appalachian Hemlock – Hardwood Cove Forest, the fourth largest community type in BISO (nearly 11% cover). These community types occur in cool, moist sites in which fire is not typical. The majority of species in these types are not tolerant of fire.

South Central Interior Mesophytic Forest Ecosystem Unit

Forests in this system (12% total cover) are highly diverse occur on deep and enriched soils in nonmontane settings and usually in somewhat protected landscape positions such as coves or lower slopes. Many examples may be bisected by small streams. Dominant species are primarily deciduous and typically include American Beech, tulip poplar, American basswood, sugar maple (*Acer saccharum*), red oak (*Quercus rubra*) and cucumber magnolia (*Magnolia acuminata*) and, sometimes, black walnut (*Juglans nigra*). Eastern hemlock may be a component in some stands. The herb layer is typically rich, often supporting abundant spring ephermerals (NatureServe 2011). Six community types were classified into this system, all of which occur in cool, moist sites in which fire is not typical. The majority of species in these types are not tolerant of fire.

Southern Ridge & Valley / Cumberland Dry Calcareous Forest Ecosystem Unit

Three community types were classified into this system; however, the Ridge and Valley Dry Mesic White Oak – Hickory community is the only type with significant cover (6%) in BISO. This dry mesic forest typically occurs on slopes with southerly aspects and well drained upland soils. In BISO, soils were rapidly to well-drained, dry to mesic sandy loams. Community cover is moderate to very dense and is dominated by white oak, black oak (*Quercus velutina*), chestnut oak and mockernut hickory. Other species may include white ash, tulip poplar, umbrella magnolia (*Magnolia tripetala*) and red maple.

Other Ecosystem Units in BISO Communities in the remaining 9 Ecosystem Units account for less than 5% of the total vegetation cover in BISO. Three systems, Successional Shrubland, Cumberland Sandstone Glade and Barrens and Successional or Exotic Species Dominated Herbaceous Vegetation, contain fire tolerant/fire maintained communities. The remaining systems contain vegetation which primarily occurs in cool, moist or wet sites in which fire is not typical. Though small in size, two of these systems, Cumberland River Scour and Cumberland Acidic Cliff and Rockhouse, contain both globally rare community types and support numerous state and federally listed rare plant species, and therefore warrant special management attention.

Former Vegetation

An excellent overview of the vegetation present when BISO was created, and the interrelationships of the flora with fauna can be found in the following document: *Final Environmental Impact Statement: Establishment, Administration and Maintenance of Big South Fork National River and National Area, Tennessee and Kentucky* (Corps of Engineers 1976). This document is on file at BISO Headquarters.

Effects of Fire on Vegetation

Although fire ecology on the Cumberland Plateau is not completely understood, there are fire adapted and fire dependent plants and plant communities where fire does play a role in these natural ecosystems, and (Campbell 2001). The highest concentration of fire intolerant sensitive plant species in BISO occur in floodplains, seeps, and similar wet environments in which the historical role of fire is minor. Several rare plant species are associated with very dry/xeric rocky areas such as sandstone glades and cliff top barrens. Fire helps maintain these communities by releasing nutrients and by discouraging the encroachment of later successional vegetation.

Fire may injure or kill part of a plant or the entire plant, depending on how intensely the fire burns and how long the plant is exposed to high temperatures (Wade 1989). Plants that are not fire adapted are more susceptible to damage from fire. Small trees of any species suffer a higher rate of mortality.

Historical fire occurrence in BISO is approximately 2 fires per year burning an average of 94 park administered acres, with a total of 112 acres when including all ownerships. Analyses of the potential intensity of impacts to vegetation were derived from park staff's observations of the effects of fire on vegetation and from literature on fire ecology and vegetation effects.

Both alternatives may lead to the establishment of exotic plant species in highly disturbed areas and forested areas, and fire scars may make certain tree species susceptible to disease (Wade 1989).

Vegetation: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to vegetation were derived from park staff's observations of the effects of fire on vegetation and from literature on fire impacts on vegetation.

Vegetation is of concern at BISO because protection and enhancement of vegetation is important for maintaining plant species diversity and as habitat and food sources for BISO animals.

Vegetation Impacts of Alternative A

Under Alternative A, the direct top-killing of small trees, shrubs and forbs within a burn area would continue to occur and if the fire burned into the soil potentially killing the plant. In the short term wildfire burned areas, with associated impacts of killing vegetation, would be minimal, averaging approximately 94 acres per year, of which not all of the burned area would sustain a fire intensity that would completely kill the vegetation, as Alternative A stresses keeping all wildfires to minimum size. Prescribed fire under Alternative A is expected to have an overall beneficial effect on fire adapted ecosystems in BISO as prescribed burns would be carried out in fire adapted ecosystems under environmental conditions that are favorable to fire adapted vegetation.

Wildfire suppression activities under Alternative A would have adverse impacts on vegetation. Removal of vegetation along fire lines and fuel breaks would result in the direct loss of individual plants; however, impacts are not expected to rise to population level effects. Some trampling of vegetation could occur during suppression activities from firefighters and equipment, and vehicles could crush or remove vegetation in localized areas. Adverse impacts of suppression actions on vegetation are expected to last only during the duration of the wildfire or for one to two growing seasons post fire. High intensity wildfires have the potential to create widespread and long lasting impacts to vegetation, due to removal of large areas of vegetation with adverse impacts to seed banks, soils, and hydrology. Prescribed burning reduces fuel buildup. When a wildfire occurs under reduced fuel conditions, there would be fewer fuels to support a high intensity fire, making wildfire suppression easier, requiring fewer damaging suppression tactics. The likelihood of direct consumption of organic matter is reduced in lower intensity fires protecting seed banks and roots of top killed plants. Suppression activities associated with lower intensity wildfires would result in short term adverse impacts, but post treatment impacts as a result of avoiding large scale, intense wildfire would be beneficial.

Prescribed fire may require that areas of denser vegetation be removed reducing fuel loads prior to prescribed fire activities, resulting in a direct loss of individual plants and potential negative impacts to species populations on a localized level. The use of prescribed fire would result in short term short term adverse effects to vegetation, via removal of individuals or local populations, and in long term beneficial impacts to fire adapted vegetation communities through maintaining ecological function and supporting native species.

Prescribed fire improves soil nutrient cycling indirectly promoting plant productivity (Neary et al. 1999). Prescribed fire helps thin encroaching scrub/shrub components, thereby reducing competition for limited resources, indirectly restoring fire adapted native vegetation structure and composition. Prescribed fire does have potential to indirectly contribute to the spread of invasive nonnative species by creating openings near invasive nonnative plant seed sources or through transport on firefighting apparatuses. Mitigation practices, such as washing and inspecting all apparatuses prior to a prescribed fire, would be implemented to avoid and mitigate this threat.

Overall, prescribed fire could result in the loss of individual plants; however, broader impacts to the plant population and community composition would be long term and beneficial due to beneficial impacts on nutrient cycling, plant productivity, and improved resilience to unplanned ignitions. The use of prescribed fire, when used in conjunction with other management tools, could assist with controlling nonnative plant species.

Fire has been instrumental in shaping plant communities in the southern Appalachians. In particular, stands of southern yellow pine on xeric ridges and south and west facing slopes have historically been established and maintained by periodic fire (Van Lear and Waldrop 1989, Vose et al. 1999). The long term absence of fire will favor more shade tolerant, less fire tolerant species, and succession will proceed toward a climax community rather than a fire maintained subclimax type (Van Lear 1989, Olson 1998). For example, xeric Virginia pine (*Pinus virginiana*) sites will be succeeded by hardwoods if fire is not introduced to the system at an appropriate frequency. On the Cumberland Plateau, current increases in red maple (*Acer rubrum*) and eastern white pine (*Pinus strobus*) density in ridge top communities suggests a shift in species composition from fire adapted species to species adapted to longer fire free intervals (Blankenship and Arthur 1999). Widespread damage caused by an epidemic of southern pine beetle (*Dendroctonous frontalis*), between 2000 to 2002, has accelerated the loss of shortleaf and Virginia pine on xeric and old-field sites on the Cumberland Plateau. Reestablishment and continued maintenance of xeric pine species on affected sites will be largely dependent on the reintroduction of fire. Under Alternative A, less fire in fire maintained ecosystems would continue the successional trend away from fire adapted species to a forest of fire intolerant species. Subsequent large scale, high intensity wildfire could result in a higher rate of mortality.

Alternative A: BISO Vegetation Cumulative Effects

Cumulative impacts to vegetation could occur as a result of Alternative A and other actions (e.g., land development or prescribed burns conducted by the states of Kentucky and Tennessee plus the Daniel Boone National Forest Service and private entities, new trail or recreation site development at BISO, trail and road maintenance in BISO). The cumulative effects of removing individual plants are not expected to rise to population level effects. While prescribed fire associated with other landowners and agencies could temporarily impact vegetation, such activities are expected to provide long term benefits through improved ecosystem functioning, restoration to historic vegetative conditions, and improved resilience to intense wildfire effects across a broader area. Alternative A would minimally contribute to short term adverse effects to vegetation in the region as the area burned at BISO is small when compared to potential regional impacts and cumulative long term beneficial impacts to fire adapted vegetation in the region would also be minimal for the same reason.

Vegetation Impacts of Alternative B

Initially under Alternative B, accumulations of fuel may actually increase during the restoration of fire to the landscape phase due to the top- killing of smaller trees and shrubs by prescribed fire and natural debris removal and burning resulting from mechanical/manual fuel reduction operations. Alternative B allows managed wildfire for multiple objectives which would increase

wildfire acreage with top killed vegetation falling to the ground over time adding to fuel loads. Alternative B would have the greatest short term negative effect of killing vegetation, with the quickest beneficial effect of creating a larger area of favorable site conditions post burn for fire adapted vegetation in BISO.

Impacts resulting from mechanical treatment, prescribed fire, and wildland fire suppression would be similar to those described under the Alternative A: short term, adverse and long term, beneficial. The difference between Alternative A and Alternative B is Alternative B's use of wildfire for multiple objectives, which would allow the park to manage unplanned ignitions without immediate full suppression. Therefore, it is possible for more acres of vegetation to be killed or top killed by fire management activities under Alternative B when compared to Alternative A but the implementation of managed wildfire for multiple benefits would allow fire managers to use natural and manmade barriers to fire spread actually decreasing the need for constructed firelines that kill vegetation. Impacts to vegetation would be the same as described under the Alternative A, with both adverse and beneficial impacts occurring on more acreage under Alternative B.

The use of managed wildfire for multiple objectives would promote a naturally functioning ecosystem which is a goal of BISO. Direct impacts to vegetation would occur from the wildfire burning and top killing or completely killing vegetation and suppression control operations removal of vegetation. Removal of vegetation through the use of wildfire for multiple objectives would have short term, minor effects on vegetation due to top killing. Top killed plants would be expected to regrow within one or two growing seasons before the vegetation recovers after the wildfire event. It is important to BISO that fire adapted ecosystems as other present ecosystems are maintained or enhanced. Fire adapted species would be expected to benefit over time due to less intense wildfires moving across a landscape with more normal fuel loadings.

Use of wildfire for multiple objectives can enhance the cycle of nutrients by releasing nutrients bound in dead plant material, making them available for new plant growth. While fire encourages new growth of many plant species, it can also alter plant community composition. Fire can be used to clear residual plants from a landscape and, when used in conjunction with other management tools, to negatively impact nonnative plants or other invasive species that dominate certain habitats to the extent that habitat quality is compromised. Perpetuating a natural fire regime would have long term, direct, beneficial effects on vegetation.

Wildfire managed for multiple objectives and prescribed fire as proposed under Alternative B would be introduced to appropriate fire adapted community types to reverse the trend of nonfire adapted species occupying sites were natural fire kept those species out.

Under both alternatives, desired species such as warm season grasses would be stimulated, thereby promoting and possibly allowing them to out compete nonnative cool season grasses. The reduction of heavy fuel adjacent to homes and other structures, public use facilities, and oil

and gas sites would make fires easier to manage and control. Van Lear and Waldrop (1989) observed that the role of prescribed fire in reducing the hazards of disastrous wildfires was realized after major fires in the South during the droughty 1930s and 1950s. Alternatives B would more quickly reverse the trend perpetuated by full suppression by opening the forest floor, protecting the overstory, and favoring fire adapted species. Prescribed fire has also been successfully used under very exacting fuel and weather conditions to control cone insects such as the white pine cone beetle (*Conophthorus coniperda*) while the pest is over wintering in cones on the ground (Wade 1989). Prescribed fire would tend to promote a more natural forest composition and structure, increasing tree vigor and spacing to combat pine beetle infestations. Prescribed burning generally costs much less than traditional chemical methods used to control forest pests.

Mechanical/manual treatments will remove or damage a limited amount of vegetation. Use of equipment can impact small localized areas of vegetation, creating openings through erosion or compaction. Due to erosion control and compaction mitigation practices it is expected that adverse impacts that kill vegetation will be minimal and short term.

Alternative B: Cumulative Effects on BISO Vegetation

Cumulative effects of Alternative B are the similar as Alternative A. Due to overall positive fire effects Alternative B continues to promote positive impacts on fire dependent vegetation as more fire intolerant species are removed from areas previously occupied by fire tolerant species. Areas that historically contained intolerant fire species would receive more protection over time as more of the landscape fuel loadings decrease and less intense wildfires occur they will not be able to move into wetter areas or areas of sparse fuels where fire intolerant species reside naturally.

Wildlife & Aquatic Species

Wildlife and Aquatic Species Affected Environment

The terrestrial vegetation types described in the "Vegetation" section of this chapter combine with the terrain and aquatic environments at BISO to provide diverse habitats for fish and wildlife. Many studies of specific habitat types and wildlife groups, such as inventories of mammals, mussels, fish and aquatic life, bats, and vegetation have been performed at BISO over the past century, with many in the last decade. Appendix H describes selected animal species common to BISO.

***Mammals*:** A total of 67 mammals have been documented as being "present in the park," (Appalachian Highlands Monitoring Network "APHN" Data). The most common native large mammal found at the park unit is the white tailed deer (*Odocoileus virginianus*). Although nonnative, a stable or increasing population of feral hogs (*Sus scrofa*) is also found at Big South

Fork NRRA. Black bear (*Ursus americanus*) and elk (*Cervus elaphus*) were released in Tennessee relatively recently (1996/1997 and early 2000s, respectively), and although the programs are considered a success, these species are less common than other large mammals. Although there is a stable bear population, there are no current population estimates available for BISO. There is currently no population of elk within the park unit.

***Birds*:** Breeding bird surveys have been conducted annually at BISO from 1994 to 2006 (Stedman n.d.). Approximately 259 species of birds (APHN data) occur within BISO, and are dominated by those found in the forest interior. Edge species also find some habitat to suit their needs, but birds of open country are largely excluded from the park, and the degree of exclusion increases each year as park forests mature and their open areas diminish (Stedman 2006). Based on survey data, the red eyed vireo (*Vireo olivaceus*) is the most common species reported annually at Big South Fork NRRA. Other common species include American crow (*Corvus brachyrhynchos*), ovenbird (*Seiurus aurocapillus*), indigo bunting (*Passerina cyanea*), and hooded warbler (*Wilsonia citrina*) (Stedman n.d.).

***Reptiles and Amphibians*:** A total of 28 reptiles (16 snakes, 6 turtles, and 6 lizards/skinks) and 28 amphibians (16 salamanders, 8 frogs, 2 toads, 1 mudpuppy, and 1 newt) have been documented as present at Big South Fork NRRA (Stephens et al. 2008).

***Fish*:** One of the world's richest assemblages of temperate freshwater fish once inhabited the Cumberland River into which the Big South Fork flows. However, impoundment and coal mining related impacts have made the Cumberland River one of the nation's most severely altered river systems. The Big South Fork of the Cumberland River encompasses over 138 miles of fishing streams and is home to 79 species of fish considered present in the park, 15 of which are classified as game fish (Scott 2007; NPS 2006g).

***Mussels*:** Mussel species are the most jeopardized and rapidly declining faunal group in the United States: 12 of the nation's 300 species are now extinct and over 67% are listed as endangered, threatened, or special concern, or are being considered for listing (NPS 2006h). Of the nearly 300 recorded species of freshwater mussels in the United States, approximately 130 are or were known to occur within the political boundaries of Tennessee. BISO currently has 52 documented species, 11 of which are federally listed as endangered and discussed in the "Federally Listed Threatened and Endangered Species" section of this chapter. In the Southeast, only the Duck, Clinch, and Green Rivers contain this level of diversity, and only two other NPS units in the country have greater diversity (NPS 2006h).

***Crayfish*:** The Big South Fork Crayfish is one of nine crayfish species listed endangered by the Tennessee Wildlife Resources Commission. This species inhabits freshwater creeks of moderate gradient. This species is restricted to a single stream system, with approximately 10 occurrences in an occupied area of less than 100 square kilometers. The Big South Fork Crayfish is considered extremely vulnerable to extirpation due primarily to a limited distribution. Individuals are found among vegetation in heavily silted pools and among boulders as well as being found in streams

with no vegetation or boulders. Threats to habitat quality exist from urbanization and acid mine runoff (NatureServe 2009; Williams, Bivens, and Carter 2002).

Bats: The forests of Big South Fork National River and BISOs provide roosting and foraging habitat for 12 species of bats including three federally listed species and several sensitive species. Active forest management activities in BISO consist primarily of fire management such as prescribed fire, fire suppression, and mechanical fuels suppression. Results of a 2017 study on the impacts of fire management activities on bats discovered the following.

Bats were active on the landscape throughout the dormant period but activity in both burned and unburned forested sites was low throughout the fall, winter, and spring period. Results of this study suggest that prescribed fire has created good foraging and commuting habitat for bats in BISO during the summer maternity period. However, because *Myotis* spp. and tri-colored bats use declined in higher severity burn sites compared to low severity sites, our results suggest that maintaining a mosaic of burn sites of low to high severity may provide foraging habitat for the entire bat community. Activity of highly sensitive species such as *Myotis* spp. and tri-colored bats was low during winter and concentrated near pond sites. Thus, our results suggest that conducting prescribed fires during the dormant season should not have a significant impact on these species or their behavior. In contrast, species such as red bats, evening bats, big brown bats, and silver haired bats were active throughout the dormant season, particularly on nights when temperatures were above 10°C. High activity on warmer nights suggests that red bats, silver haired bats, and evening bats which often roost under the litter or in low bushes or crevices during winter, may be able to arouse more quickly and escape fire if prescribed fires are set when temperature are ≥ 10°C. High activity of bats at ponds sites compared to forested sites during winter suggests that drinking may be an important function of winter activity.

Effects of Fire on Wildlife

Fire negatively affects wildlife through direct mortality and removal of habitat and food sources. Fire can also benefit wildlife by creating suitable habitat and more palatable food sources all of which is very dependent upon the wildlife species.

Wildlife*: Impact Analysis of Alternatives*

Analyses of the potential intensity of impacts to wildlife were derived from park staff's observations of the effects of fire on wildlife and from literature on fire impacts on wildlife.

Wildlife are of concern at BISO because protection and enhancement of wildlife is important for maintaining wildlife species diversity. Wildlife viewing is also an important part of the visitor experience at BISO.

Wildlife and Aquatic Species Impacts of Alternative A

Analyses of the potential intensity of impacts to wildlife and aquatic species were derived from park staff's observations of the effects of fire on wildlife and aquatic species and from literature on fire ecology and wildfire effects.

Alternative A would benefit established species in the short term because it would preserve the *status quo* (minimal wildfire burned acreage plus prescribed burns). Wildfires ignited by lightning often occur primarily during the summer months. Under Alternative A there would be short term negative effects from wildfire. It is expected that effects would not threaten populations and that the most directly affected individuals of a species would be those that cannot move out of the way of the flames or the young. These individual animals would likely die or be injured in a fire. Wildfire suppression operations could have short term displacement of animals due to noise from mechanical suppression equipment or human presence, during which it is expected that mobile species would move into adjacent nondisturbed areas. Periods of disruption would cease soon after suppression operations end and it is suspected that wildlife would utilize unburned areas adjacent to burned areas and move back into the burned area when conditions return to favorable habitat. Slow moving species or very young may be killed or hurt by fire suppression equipment, but it is expected that this would not affect the species population.

Wildfire and prescribed fire generally will not impact aquatic species. A very large intense wildfire that burns major portions of a watershed could indirectly negatively affect aquatic species by lowering the water quality resulting in stress on aquatic species. Prescribed fires, due to their lower fire intensities and effective minimum impact strategy and tactics operations in concert with mitigation measures are expected to have minimal water quality impacts to aquatic species. Aquatic species of concern will have approved mitigation practices put in place for all wildland fire events.

Bats can and will fly away from the smoke (Perry 2011). There can be loss of habitat, cover and forage areas (Perry 2011). Some bats can utilize burned areas better than others. Direct mortality of resident bats is very dependent upon what areas of the forest they utilize: trees, snags or forest litter, how severe the fire, the duration of the fire and depending on the species if the fire occurs during the dormant season or not (Jodice et.al. 2017).

Prescribed fire and associated operations would have similar effects on animals as wildfire operations. The major difference is that prescribed fires are planned so there can be operational controls put in place as to timing, fuel moistures, soil moistures, ambient air temperature and other mitigation practices that minimize impacts to selected species of concern.

Wildfire and prescribed fire effects on fauna as an outcome of Alternative A would result from changes in the environment and habitat structure, with ensuing differences in food and cover having a positive indirect effect on a species population. The creation of a diversified patchy mosaic across the BISO landscape provides a variety of food for different species. Generally,

areas of burned vegetation provide more nutritious food due to nutrients released in fires. Also, areas of early successional vegetation benefit due to increased light and nutrient recycling benefiting wildlife that utilize those areas. (Shortess, 1986).

Although Alternative *A* would be beneficial in the short term for wildlife species dependent upon fire intolerant plant species, generally, wildlife species dependent upon fire tolerant plant species and a varied vegetation mosaic across the BISO landscape are expected to be more impacted over the long term as a result of a full suppression policy. Full suppression would result in a decline in habitat diversity and an increase in the probability of high intensity, stand altering fires, which, by extension, would limit the numbers and types of species that would frequent BISO.

The lack of fire has unintended ecological effects, leading to the loss of habitat for rare species dependent upon fire and the decline of fire dependent ecosystems (EPA 1998). Many plant and animal species are on the decline because they exist in fire dependent habitats that haven't burned in decades (EPA 1998). Through the use of prescribed fire projects, alternative A would help create a diversity of habitat types.

Wild turkeys and ruffed grouse would also benefit from open areas created by prescribed burning and wildfires. Studies have shown that following a fire, populations of small mammals drop in number but recover quickly, and increase in the following two to three years (Lyons et al. 1978, Masters et al. 1998). An increase in small mammals would benefit those animal and bird species that rely on them for food. Little is known about the reptile and amphibian populations that inhabit BISO and the effect fire or the absence of fire will have on them on a long term basis. Data indicate they generally inhabit moist or protected sites, and very few individuals are killed during fires (Means 1981).

Periodic fire tends to favor understory species that require more open habitat. Deer and turkey are game species that benefit from fire (Lyon et al. 1978, Wade 1989). Wildlife benefits from burning are substantial. For example, fruit and seed production is stimulated in some species. Yield and quality increases occur in some herbs, legumes, and hardwood sprouts. Openings are created for feeding, travel, and dusting (Wade 1989). Conversely, Lyon et al. (1978) noted that fire in old growth forest create habit for cavity nesting birds, while at the same time destroying snags that may be favored by the same species. The loss of a specific post fire or post logging successional stage may correlate with the decline of those species dependent on the particular vegetation represented. The maintenance of all successional stages through positive management should insure at least minimal levels of all potential species in an area (Lyon et al. 1978).

Under Alternative A, there may be short term negative effects from wildfire to a wide variety of wildlife such as limited mortality, loss of food sources, and the loss of protective cover (Lyon et al. 1978).

Alternative A: Wildlife and Aquatic Species Cumulative Impacts

The prescribed burning program which is currently being implemented in the Daniel Boone National Forest and state and private forests would interact with burning in Alternative A to create a positive cumulative benefit to wildlife in the region.

Methods to Reduce Impacts: Due care would be taken to avoid impacts to ground nesting birds and other wildlife during sensitive periods. Additional protection would be afforded listed species (see Threatened and Endangered Species).

Wildlife and Aquatic Species Impacts of Alternative B

Alternative B would have the same direct impacts to wildlife species as Alternative A. Alternative B with the addition of managed fire for multiple benefits and natural debris pile burning has the potential to have a larger negative impact on individual animals due to injury or killing or displacement, but is not expected to impact populations. Displacement is expected to be short term, 1 to 2 growing seasons but positive benefits in the long term as animals move into areas of more nutritious vegetation caused by the intake of released nutrients in the burned area.

Operational impacts, displacement, potential injury and killing of animals would be the same for wildfire suppression and prescribed fire preparation and control.

Alternative B impacts to aquatic species would be the same as Alternative A.

Alternative B would include natural debris piling and burning. Operations to cut and pile natural fuels into burnable piles have minimal injury or loss of life to wildlife and especially aquatic species. Wildlife would move out of areas of operations during operational periods of activity and no operations would happen in waterways. These are planned operations that would take place during periods of time with minimal impacts to species of concern. Locations and timing of these projects are part of the mitigation practices that would be used to effectively minimize negative impacts. Noise from operations would last approximately 8 hours per day, cease before dusk and terminate completely upon completion of the project, generally 1 to 2 weeks. Negative effects would be short term with potential positive long term effects when new more nutritious vegetation regrowth occurs.

The most notable wildfire and prescribed fire effects on fauna as an outcome of Alternative B are the increases in resulting changes in the environment and habitat structure, with ensuing differences in food and cover being the greatest indirect effect on a species population than what occurs under Alternative A (Shortess 1986). As described in Alternative A different species of bat utilize burned areas of different intensities and Alternative B would create more diverse openings across the BISO landscape benefitting not only different bat species but other species dependent upon forest edge areas and open areas themselves.

Alternative B has the same long term benefits as Alternative A. Under Alternative B, generally, wildlife species would be expected to benefit positively over the long term as a result of a fire management program that accelerates reintroduction of fire across the landscape of BISO. Managed wildfire for multiple objectives, prescribed fire and natural fuel pile burning would result in an increase in habitat diversity and a decrease in the probability of high intensity; stand altering fires, which, by extension, would positively benefit the numbers and types of species that would frequent BISO.

Alternative B: BISO Wildlife and Aquatic Species Cumulative Effects

The cumulative effects of Alternative B are the same as Alternative A. It is expected that the reintroduction of fire across the landscape at a faster rate in conjunction with prescribed burning on the Daniel Boone N.F. will bring long term cumulative benefits to a diversity of wildlife and aquatic species.

Species of Management Concern: Federally Listed Threatened and Endangered Species and Federal and State Species of Concern

Species of Management Concern

Federally Listed and Endangered Species Affected Environment.

Under the *Endangered Species Act* (ESA) of 1973, the NPS has the responsibility to address impacts to federally listed threatened, endangered, and species proposed for listing and are encouraged to manage cooperatively species of concern. Federal agencies are directed by federal wildland fire management policy to use fire to regulate fuels and maintain healthy ecosystems while at the same time manage fires to protect life, property, and resources. BISO has 21 federal listed species of which BISO protects 14 federally listed aquatic species (12 freshwater mussels and 2 fish) four listed plants, and two listed bat species. A previous completed a Biological Assessment covering 17 of the federal threatened and endangered species has been completed.

Section 4.4.2.3 of the NPS *Management Policies 2006* (Management of Threatened or Endangered Plants and Animals), moreover, directs the agency to consider federally listed threatened, endangered, and candidate species proposed for listing, as well as state listed species, to the extent practical in its decision making. (Appendix C identifies current state (Kentucky and Tennessee) listed animal species found in BISO and Appendix D identifies current state (Kentucky and Tennessee) listed vascular plant species)

Threatened and endangered species in BISO include mammals, mussels, fish, and plants. Currently BISO contains 15 endangered species that are listed in current USFWS reports. There are 5 possible threatened species. See Table 2, Federal T&E Species at BISO.

Table 2: BISO Federal T&E Species (as of 11/15/2018)

*Table created by Rebecca Schapansky, Natural Resource Specialist, OBRI/BISO

Common Name	Scientific Name	Federal Status
Mammals	NA	NA
Indiana Bat	*Myotis sodalist*	Endangered
Gray Bat	*Myotis grisescens*	Endangered
Northern Long-eared Bat	*Myotis septentrionalis*	Threatened
Fish	NA	NA
Tuxedo (formerly Duskytail) Darter	*Etheostoma lemniscatum*	Endangered
Palezone Shiner	*Notropis albizonatus*	Endangered
Blackside Dace	*Phoxinus cumberlandensis*	Threatened
Freshwater Mussels	NA	NA
Cumberland Elktoe	*Alasmidonta atropurpurea*	Endangered
Spectaclecase	*Margaritifera monodonta*	Endangered
Dromedary Pearlymussel	*Dromus dromus*	Endangered
Cumberlandian Combshell	*Epioblasma brevidens*	Endangered
Oyster Mussel	*Epioblasma capsaeformis*	Endangered
Tan Riffleshell	*Epioblasma walkeri*	Endangered
Pink Mucket	*Lampsilis abrupta*	Endangered
Littlewing Pearlymussel	*Pegias fabula*	Endangered
Clubshell	*Pleurobema clava*	Endangered
Fluted Kidneyshell	*Ptychobranchus subtentus*	Endangered
Cumberland Bean	*Venustaconcha troostensis*	Endangered
Plants	NA	NA
Cumberland rosemary	*Conradina verticillata*	Threatened
Cumberland sandwort	*Minuartia cumberlandensis*	Endangered
Virginia spiraea	*Spiraea virginiana*	Threatened
White-fringeless Orchid	*Platanthera integrilabia*	Threatened

Critical Habitat. Critical habitat rules were finalized in the Federal Register, August 31, 2004, 50 CFR 17. New River, Clear Fork and North White Oak, along with other tributaries and the main stem Big South Fork in BISO are listed as designated Critical Habitat and should be afforded the protection under the ruling, as applied by the USFWS. Within BISO, critical habitat is designated for four federally listed mussels including the Cumberland elktoe mussel, oyster mussel, fluted Kidneyshell and the Cumberlandian combshell mussel. The primary constituent elements of critical habitat for all mussel species consist of:

1. Permanent, flowing stream reaches with a flow regime (i.e., the magnitude, frequency, duration, and seasonality of discharge over time) necessary for normal behavior, growth, and survival of all life stages of the five mussels and their host fish;
2. Geomorphically stable stream and river channels and banks (structurally stable stream cross section);
3. Stable substrates, consisting of mud, sand, gravel, and/or cobble/boulder, with low amounts of fine sediments or attached filamentous algae;
4. Water quality (including temperature, turbidity, oxygen content, and other characteristics) necessary for the normal, behavior, growth, and survival of all life stages of the mussels and their host fish; and
5. Fish hosts with adequate living, foraging, and spawning areas for them.

For additional discussion of the potential impacts of the proposed actions on T&E species and the suggested measures to mitigate those impacts, see the attached Biological Assessment of the *Fire Management Plan Update*. Consideration of T&E Species is important to BISO as a few of the species are very limited and contain critical habitat found in BISO. Wildland fire operations may have impacts on T&E species which will be addressed in both planned operations, i.e. prescribed fire as well as manual and mechanical hazard fuel reduction projects, and unplanned wildfire suppression operations. Wildfire operations will assess strategies to suppression actions based on the extent of the emergency and values at risk.

Effects of Fire on Species of Management Concern

Fire effects species of management concern through direct mortality or causing stress through changes of habitat or food sources. Effects can be positive or negative depending on the species of management concern.

Species of Management Concern: Federally Listed Threatened and Endangered Species and Federal and State Species of Concern: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to species of management concern were derived from park staff's observations of the effects of fire on individual species of management concern and from literature on fire impacts on individual species of management concern.

Wildlife are of concern at BISO because protection and enhancement of wildlife is important for maintaining wildlife species diversity. Wildlife viewing is also an important part of the visitor experience at BISO.
For this analysis "Species of Management Concern" will be used to indicate Federal listed species as well as state listed species. Because there is similarity in habitat the potential effects of the proposed alternative's actions will be presented as a group rather than for each species.

Effects of Fire on Aquatic Species of Management Concern
Fire effects aquatic species of management concern through mortality or stress caused by changing water quality, either due to increased turbidity and sediment deposition, which caused by sediment entering waterways from soil erosion occurring in severely burned areas or causing water temperatures to rise through fire killing shading vegetation along waterways.

Aquatic Species of Management Concern: Impact Analysis of Alternatives
Analyses of the potential intensity of impacts to aquatic species of management concern were derived from park staff's observations of the effects of fire on individual aquatic species of management concern and from literature on fire impacts on individual aquatic species of management concern.

Aquatic Species of Management Concern Impacts of Alternative A
Fire management activities associated with Alternative A are wildfire, wildfire suppression, prescribed fire and operations. Alternative A does not have natural debris burning with associated mechanical fuels reduction operations. BISO contains the most T&E species within the Big South Fork River from the mouth of Station Camp Creek in Tennessee downstream to the mouth of Bear C
reek in Kentucky. There are five locations in this stretch of river that contain the majority of BISO's freshwater mussels and an endangered fish population.
Effects of fire under Alternative A would be expected to not cause stress or harm to aquatic species. Fire effects on aquatic species depend on fire severity and area burned, stream size and gradient, precipitation and run off, vegetative cover, geology and soil type. It is expected that wildfire will not impact species due to flame contact directly, as water cover would prevent that from happening. All wildfires under Alternative A would be suppressed at minimum size reducing the potential for large fire growth in all but extreme fire weather conditions.

Wildfire suppression operations that might negatively impact aquatic species include fire line construction and the potential use of fire suppressant chemicals (foams and retardants). If fireline constructing equipment were to enter a waterway direct mortality or injury could occur to aquatic species. Misapplication of foams and chemical fire retardants into waterways could directly negatively stress or kill aquatic species at the drop site and downstream until the chemical plume dissipates. These actions are considered unlikely to happen to aquatic species due to effective operations, restrictions on fireline construction locations, and BISO's restrictive mitigation measures for application of ground applied foams and aerial retardants.

Prescribed Fire has the same effects on aquatic species as wildfire. Prescribed fire is expected to have mostly negligible effects of stress or harm to aquatic species due to the planned nature of prescribed fire operations. Prescribed fires are designed to burn "cooler" than wildfires. Prescribed fires are planned, with effective mitigation practices incorporated into the burn plan and will not be implemented unless a successful outcome is expected. Prescribed fire operations impacts on aquatic species are also negligible for the same reasons as prescribed fires.

Alternative A generally, aquatic managed species of concern are expected to be more impacted over the long term as a result of a full suppression policy. Full suppression would result in an increase in the probability of high intensity, stand altering fires due to increases in fuel loading across the landscape, which, by extension, would decrease water quality (higher water temperatures and increased turbidity) indirectly having more negative effects of stress or harm to aquatic managed species of concern.

Alternative A: Aquatic Species of Concern Cumulative Impacts

Wildfire and prescribed fire with associated operations is not likely to have negative cumulative effects on aquatic managed species of concern if the aquatic system they reside in is healthy and productive. If the aquatic system is not healthy and productive, the cumulative effects of the wildland fire program may be cause for concern (Minshall 2003). Due to previous and ongoing pollution inputs into the Big South Fork watershed from other federal, state, municipal and private entities, the added inputs from fire and fire management operations must be mitigated.

Aquatic Managed Species of Concern Impacts of Alternative B

Alternative B includes wildfire, wildfire suppression operations, prescribed fire and operations and mechanical fuels reduction operations and associated natural debris pile burning.

Alternative B would have the same direct impacts to managed aquatic species of concern as impacts of wildfire listed in Alternative A. In addition, Alternative B would have the option of managed fire for multiple benefits and natural debris pile and burning with associated mechanical/manual fuels reduction operations it is expected that the results will be the same.

Under Alternative B operational impacts to aquatic species of concern would be the same for wildfire suppression and prescribed fire preparation and control as discussed in Alternative A and unlikely to harm aquatic species due to mechanical fuels reduction operations and associated natural debris pile burning. Mechanical fuels reduction operations are not carried out in streambeds and natural debris pile burning is accomplished under conditions with no fire spread potential with burned areas slightly larger than the pile perimeter, with no effect on water quality, which means no effect on aquatic managed species of concern.

Alternative B has the same long term benefits as Alternative A.

Alternative B: Aquatic Species of Concern Cumulative Impacts

The cumulative effects of Alternative B are the same as Alternative A. It is expected that the reintroduction of fire across the landscape at a faster rate in conjunction with prescribed burning on the Daniel Boone N.F. will speed up long term cumulative benefits.

Mammal Species of Management Concern (Bats) Affected Environment

The federally endangered Indiana bat, Gray bat and federally threatened northern long-eared bat occur at BISO. There currently are no other threatened and endangered mammals in BISO. Indiana bats hibernate in cave and cave like structures (mines, tunnels, etc.) with specific temperature and humidity requirements (USFWS 2006). Indiana bats hibernate in large clusters, sometimes of several thousand bats to a group (USFWS 2007) and prefer limestone caves with pools. The winter bat populations are monitored by the NPS Inventory and Monitoring Program. Indiana bats tend to arrive at hibernacula from mid-August through October and emerge from hibernacula from mid-April through May, after approximately 190 days of hibernation (Menzel et al. 2001). After hibernation, Indiana bats migrate an average of 296 miles and as far as 357 miles between a hibernaculum and summer maternity grounds (Winhold and Kurta 2006). After leaving hibernacula, Indiana bats migrate to suitable summer habitat, which consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed nonforested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures. This includes forests and woodlots containing potential roosts. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet (305 meters) of other forested/woodland habitat (USFWS 2014a).

Reproductively mature females form maternity colonies with as many as 500 individuals as a life history strategy to improve reproductive success, while males and nonreproductive females typically roost singly or in small groups (USFWS 2007). Maternity colonies generally occupy distinct home ranges generally no more than 5 miles in diameter (USFWS 2014a). Indiana bat maternity colonies typically occupy one to a few primary roost trees and may use as many as 20 additional secondary roosts during the summer maternity season (Callahan et al. 1997; Kurta et al. 2002).

Indiana bats are likely to roost and forage in surrounding forested habitat during summer. Indiana bats are sensitive to flooding, pesticide poisoning, loss of summer habitat, white-nose syndrome, and human caused disturbance. The Commonwealth of Virginia Department of Conservation and Recreation recommends adherence to Indiana bat protection guidelines and

coordination with the USFWS and Virginia Department of Game and Inland Fisheries to ensure compliance with protected species legislation.

Like the Indiana bat, northern long-eared bats hibernate in caves and mines, and distribute across the landscape during summer months. Northern long-eared bats tend to arrive at hibernacula, where they hibernate singularly versus in clusters, from mid-August through November and emerge from hibernacula from early April through May (USFWS 2014b). The species migrates from hibernacula to suitable summer habitat, which the USFWS considers generally similar to Indiana bats and includes a wide variety of forested/wooded habitats where northern long-eared bats roost, forage, and travel. Summer habitat also may include adjacent and interspersed nonforested habitats such as emergent wetlands, adjacent edges of agricultural fields, old fields, and pastures (USFWS 2014b). The northern long-eared bat is one of the species of bats most impacted by the disease white-nose syndrome.

Gray bats, with rare exceptions, live year round in caves. During winter, the species hibernates in deep, vertical caves. In summer, gray bats roost in caves scattered along rivers. Gray bats forage along rivers and lakes where they prey on a variety of flying aquatic and terrestrial insects. Nearly all gray bats are hibernating by early October. Pregnant and other females hibernate first then males as the males need to replenish fat reserves to carry them through 6 to 7 months of hibernation. Adult females emerge in late march or early April, followed by juveniles and males between mid-April to mid-May. (Tuttle 1976a).

Effects of Fire on Mammal (Bats) Species of Management Concern

Fire effects bat species of management concern through direct mortality or stress caused by changing habitat, removal of useful snags and vegetation that draws insect food sources. Depending on the species fire can also be beneficial as areas for foraging.

Mammal (Bats) Species of Aquatic Management Concern: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to bat species of management concern were derived from park staff's observations of the effects of fire on individual bat species of management concern and from literature on fire impacts on individual bat species of management concern.

Mammal Species of Management Concern (Bats) Impacts of Alternative A

Alternative A includes wildfire suppression and prescribed fire with associated operations as well as mechanical fuels reduction operations.

Wildfire and prescribed fire can impact Indiana bats and long-eared bats by burning the snags that they use. These would impact summer roosting sites. Snags could be felled during suppression and prescribed fire operations for safety reasons; with the potential of displacing

bats or killing individual bats. Roosting sites, snags, trees and caves, could be abandoned due to smoke and potential juvenile or adult mortality due to smoke and fire.

Wildfires and prescribed fires that negatively impact water quality could reduce the amount of insect hatches that bats feed on, thereby indirectly negatively impacting bats. This is especially true for gray bats that feed on or near waterways. This is not likely to harm the bat population as bats are mobile and will move to other areas not impacted by fire. As mentioned earlier bats prefer to feed in less intensely burned areas, over waterways and in unburned areas depending on the season and bat.

Ninety nine percent of BISO is forested and may contain suitable habitat for bats. Wildfire will be suppressed at minimal acreage under Alternative A, which would become increasingly more difficult as hazard fuels build up over time. The expected result is larger more intense wildfires in the future that are more difficult to put out. Prescribed fire will have negligible effects on bats because they are planned events and would have effective operational mitigation practices in place for the duration of the project.

Alternative A: Mammal Species of Management Concern (Bats) Cumulative Effects

If there are water quality issues that are caused by other federal, state, municipal or private actions and fire management activities add to water quality issues there could a reduction in waterborne insects that bats feed on leading to long term harm to bat populations. The increase in white-nosed syndrome across the east coast also has harmful effects on bat populations. Fire management mitigation practices working in conjunction with other agency actions would have a beneficial long term effect on bat populations as would maintaining and where desired increasing the amount of open areas with wildland fire to promote beneficial insect populations which make good feeding areas for bats.

Mammal Species of Management Concern (Bats) Impacts of Alternative B

Fire management activities associated with Alternative B are wildfire, wildfire suppression, prescribed fire and natural fuel pile and burning operations with associated mechanical/manual fuels reduction operations.

Fire effects of wildfire and prescribed fire under Alternative B are similar to Alternative A. There is an elevated potential for harm to bats because Alternative B would allow managed fire for multiple objectives. Wildfires managed for multiple objectives could spread into areas of bat use without the knowledge of fire managers before they have time to change the fire strategy and suppress the wildfire. It is unlikely tis would occur because part of the decision to manage a wildfire for multiple objectives would be the potential impacts to threatened and endangered bats. Fires managed for multiple objectives would include consultation with FWS and negative impacts to T&E species would require full suppression actions.

Alternative B also includes planned natural debris pile burning as well as mechanical/manual fuels reduction operations. It is expected that these operations would be unlikely to cause direct harm to bats as effective mitigation practices and ongoing consultation with USFWS will take place concerning location and timing of these projects to minimize harm to bats.

It is expected that Alternative B with a more robust use of wildfire, prescribed fire and hazard fuels reduction projects will reduce the intensity of wildfires over time and continuing to consult with FWS on T&E species will create positive long term benefits to bats.

Alternative B: Mammal Species of Management Concern (Bats) Cumulative Effects

Cumulative impacts are similar to Alternative A. Alternative B with an enhanced fire program moving fire to a more natural role in BISO and implementing USFWS approved mitigation practices is expected to have cumulative beneficial benefits to bats in the region.

Plant Species of Management Concern Affected Environment

There are four known T&E plant species of concern: Virginia spiraea, Cumberland rosemary and white fringeless orchid (Listed Threatened) and Cumberland Sandwort (Listed Endangered) that occupy sites in BISO.

Virginia spiraea occurs along creek edges with areas of exposed rock, piled debris, bars of gravel and/or boulders. It grows in alluvial filled cracks, containing light to no fuels. Due to where it grows only the most intense fires may have an effect on this plant.

Cumberland rosemary is endemic to the Cumberland Plateau and is restricted to flood-scoured cobble and boulder bars within the annual floodplain. Due to regular flooding events and its position within the floodplain, habitat for this species lacks sufficient fuel to carry fire. It is expected that wildfire and prescribed fire would have negligible effects on this species. Suppression and prescribed fire operations are also expected to have minimal negative effects as these operations are not carried out in streambeds.

Cumberland sandwort is endemic to rock shelters in the Cumberland Plateau. Immediate habitat is usually moist and consists of very few woody species. Fire would not likely carry into the habitat; however, during long periods of drought, fire could open the canopy immediately adjacent to the habitat. Reduction of nearby canopy may cause alterations in the microclimate of the habitat.

The white fringeless orchid inhabits wet, flat, boggy areas at the head of streams or seepage slopes. Sites are typically moist, but during long periods of drought, could be susceptible as they are small (ranging from 0.5 to 3 acres in the park) and are typically surrounded by forests with burnable fuels.

All of these species occupy sites that are wet, lacking in burnable fuels and somewhat protected from all but the most intense fires, therefore they will all be analyzed together.

Effects of Fire on Plant Species of Management Concern

Fire effects plant species of management concern through mortality or stress caused by changing soil profiles, removal of shading overstory or changes of micro climates.

Plant Species of Management Concern: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to plant species of management concern were derived from park staff's observations of the effects of fire on individual plant species of management concern and from literature on fire impacts on individual plant species of management concern.

Plant Species of Management Concern Impacts of Alternative A

Direct effects of wildfire and prescribed fire under Alternative A are unlikely to cause harm to these plants. Each of these species occupies areas that do not regularly burn at BISO. Fire management operations would have effective mitigation measures developed in consultation with USFWS in place to avoid areas containing these plants.

Indirect impacts for these species are caused by canopy closure and competition with other species. Removal of the canopy allowing more light to hit the ground would allow other species more adapted to greater light to take over and displace species such as the Cumberland sandwort. Canopy removal could impact Cumberland sandwort; however, mitigation measures in place could minimize this possible impact

It is expected that Alternative A with a less use of wildfire, prescribed fire and hazard fuels reduction projects will increase the intensity of wildfires over time, possibly harming or eliminating populations of these plants by removing large areas of canopy cover over the site. The presence of shade eliminates other plants from occupying these usually small dispersed sites to the advantage of these T&E plant species.

Alternative A: Plant Species of Management Concern Cumulative Impacts

Cumulative impacts of Alternative A are considered to be positive for the listed plants. Efforts by other agencies and land managers to protect the species plus the positive effects of the program at BISO will enhance future populations.

Plant Species of Management Concern Impacts of Alternative B

Alternative B includes wildfire, wildfire suppression operations, prescribed fire and associated operations, and natural debris pile burning with associated mechanical fuels treatment operations.

Direct effects of wildfire and prescribed fire under Alternative B are the same as Alternative A. Alternative B has managed wildfire for multiple benefits which has the same potential as wildfire and prescribed fire for negative effects. Consultation with USFWS would take place yearly with emergency consultation for wildfires, including wildfires managed for multiple objectives, as needed. During the decision process to manage a wildfire for multiple objectives emergency consultation would take place with USFWS and potential negative impacts to T&E species are reason to suppress a managed wildfire or multiple objectives. Prescribed fires have consultation with the USFWS during the planning stage and prior to ignition if needed.

Alternative B also includes planned natural debris pile burning as well as planned mechanical/manual fuels reduction operations. It is expected that these operations would unlikely harm any of the listed plants as effective mitigation practices derived from USFWS consultation for negligible or no impacts to these plant T&E species are designed into the operations.

It is expected that Alternative B with a more robust use of wildfire, prescribed fire and hazard fuels reduction projects will reduce the intensity of wildfires over time and continuing to consult with USFWS on T&E species will create positive long term benefits to these plants.

Alternative B: Plant Species of Management Concern Cumulative Impacts

Cumulative impacts are similar to Alternative A. Alternative B with an enhanced fire program moving fire to a more natural role in BISO and implementing USFWS approved mitigation practices is expected to have cumulative beneficial benefits to these plants in the region. Other impacts are potential sedimentation coming into BISO from outside sources burying cobble habitat. Invasive plants from outside seed sources taking over suitable habitat for these T&E plant species. Currently BISO actively manages nonnative species in areas of species concern. Construction projects outside BISO on private land as well as logging and oil and gas development outside the park can remove habitat.

Cultural Environments

Cultural Environments is a broad category further divided into Cultural Resources and Social Resources. Cultural Resources include the following: archeological resources, cultural landscapes, ethnographic resources, historic landscapes and cemeteries. Social Resources include: visitor use.

Cultural Resources

Cultural Resources Affected Environment

Archeological Resources

Archeological resources consist of "any material or physical evidence of past human life or activities which are of archeological interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research" (NPS 2006c). BISO is considered by some to be the most important archeological location in the Southeast Region of the NPS. BISO contains approximately 1,800 documented archeological sites, which may possibly represent only 40% of the estimated total for the park unit. Archeological resources at BISO consist of locations chosen by prehistoric hunter gatherers and include limited use and seasonal hunting camps, rock shelters, semi sedentary open campsites, and small hunting camps. Archeological sites created by historic occupations include 19th century farms and communities, moonshine still operation sites, niter mined rock shelter sites, salt manufacturing locations, coal mines and "coal camps," timber production sites, and contemporary farms (NPS 2009e). (See Figure 6: Cultural Landscapes) Due to the importance of the documented and undocumented sites found within the borders of BISO fire management operations will incorporate protection of this resource into operational planning.

Cultural Landscapes

Cultural landscapes are defined as "a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values" (NPS 2006c). Beginning in 1997, the cultural landscape team from the NPS Southeast Regional Office in Atlanta, GA, began documenting the many cultural landscape features of BISO for a Level I cultural landscape inventory. Features at the park include cemeteries that are both actively tended and others long abandoned. Industrial remnants at the park include the Blue Heron Tipple and Tram, the Yamacraw and Roaring Paunch Railroad bridges, the mine and town ruins at Worley, the K and T Railroad bed and the site of the Beatty Oil Well. Transportation features, such as a stone lined footbridge at No Business Creek, remain in place as do several other cut stone culverts and the evidence of farming in the form of remnant fields, farmhouse ruins, and fences (Brown et al. 2001).

Some features are very remote and are the only remaining part of a formerly intact cultural landscape. However, several farmsteads were found to retain enough integrity to warrant listing on the National Register of Historic Places. More attention was focused on these farmsteads, such as the Oscar Blevins, Lora Blevins, Litton-Slaven, and Parch Corn Creek sites, which are now regarded as component landscapes within an overall "Rural Historic District" nomination (Des Jean, pers. comm., 2009). In addition, when Congress created BISO, the Charit Creek Lodge Complex was to maintain in its historic appearance. Therefore, it is treated as an "administrative landscape" (Des Jean, pers. comm., 2009). In addition to those cultural landscapes previously identified, the 2016 Historic Resource Study identified several other landscapes that contain sufficient integrity for listing in the National Register of Historic Places. These include the Blue Heron Mine Complex, the Yahoo Falls Scenic Area, and the Kentucky and Tennessee Railroad Line (Sargent et al 2016:286). The Historic resource study also identifies several cultural

landscapes of interest including Worley, Salttown/Salienville (Beatty Saltworks No. 1), the No Business Creek Community, the Ranse Boyatt Farmstead, the Parch Corn Creek community, and the Station Camp Creek Community (Sargent et al 2016:286).

Ethnographic Resources

Ethnographic resources are defined as "cultural and natural features of a park that are of traditional significance to traditionally associated peoples. These peoples are the contemporary park neighbors and ethnic or occupational communities that have been associated with a park for two or more generations (40 years), and whose interests in the park's resources began before the park's establishment" (NPS 2006c).

The Shawnee and Cherokee tribes have been historically associated with BISO. Under a series of treaties and agreements, including the 1785 Treaty of Hopewell, the 1790 Butler and Walton Treaty of Tellico, and the 1805 Treaty of Tellico, Cherokee tribal rights and land ownership was ceded to the U.S. government (NPS 2007a). The Shawnee claim association with the area; however, there are no identified sites attributed to the Shawnee. Both tribes most likely used the upland areas for supplementary subsistence hunting and gathering (Des Jean, pers. comm., 2009).

Historic Structures and Resources

The NPS defines historic structures as "a constructed work, usually immovable by nature or design, consciously created to serve some human activity." Examples are buildings of various kinds, monuments, dams, roads, railroad tracks, canals, millraces, bridges, tunnels, locomotives, nautical vessels, stockades, forts and associated earthworks, ruins, fences, retaining walls, and outdoor sculpture. In the national register context of BISO, a historic structure is any structure constructed by or utilized by humans during the post contact era.

Early settlers, Cumberland farmsteads, and a brief boom of the Industrial Revolution left a variety of historic structures at BISO. These buildings and engineering structures have survived relatively intact and are important examples of the historic human use of this area through time. Figure 6 shows historic landscapes in BISO. (See Appendix C: List of Historic Structures).

Currently, there are 13 "Cumberland" style farm structures that have been assessed as eligible for inclusion in the national register (NRHP 2009; Sargent et al., 2016). Additionally, three abandoned railroad bridges, a vehicular low water timber bridge, and a large steel coal mine tipple have also been identified as eligible for inclusion into the national register (NPS 1996).

Cemeteries

A total of 58 cemeteries are located within the boundaries of BISO. All of these cemeteries existed prior to the establishment of BISO. These cemeteries include several types including isolated grave sites, single, and multifamily cemeteries. Of the 58 cemeteries, 33 are owned by the U. S. Government and were purchased through 'fee simple' land purchases. Twenty five

cemeteries remain in private ownership and several of these are still actively being used for new burials. Figure 7 shows the locations of cemeteries in BISO.

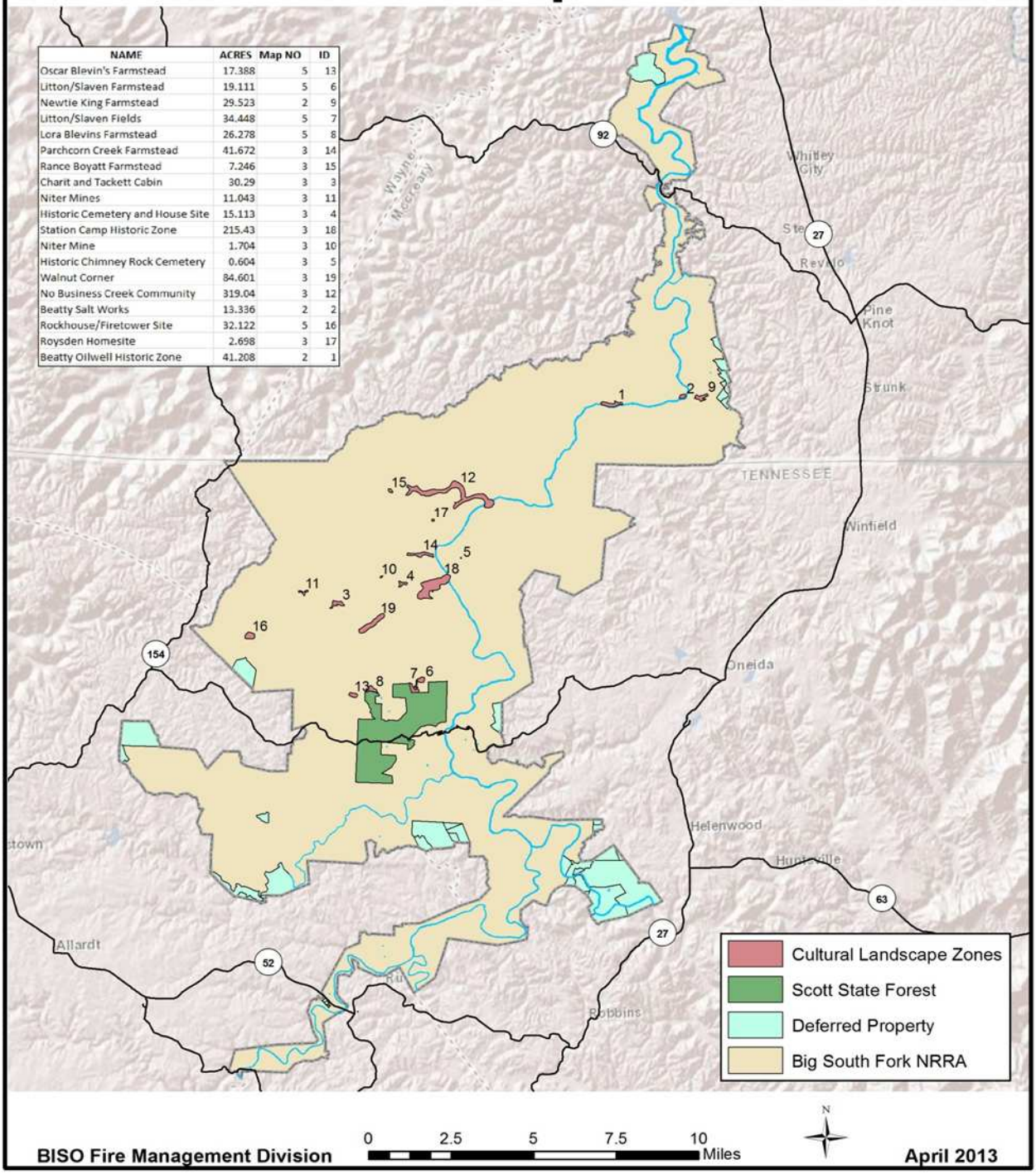
Big South Fork National River and Recreation Area
Tennessee and Kentucky

National Park Service
U.S. Department of the Interior

Cultural Landscapes

Figure 6

NAME	ACRES	Map NO	ID
Oscar Blevin's Farmstead	17.388	5	13
Litton/Slaven Farmstead	19.111	5	6
Newtie King Farmstead	29.523	2	9
Litton/Slaven Fields	34.448	5	7
Lora Blevins Farmstead	26.278	5	8
Parchcorn Creek Farmstead	41.672	3	14
Rance Boyatt Farmstead	7.246	3	15
Charit and Tackett Cabin	30.29	3	3
Niter Mines	11.043	3	11
Historic Cemetery and House Site	15.113	3	4
Station Camp Historic Zone	215.43	3	18
Niter Mine	1.704	3	10
Historic Chimney Rock Cemetery	0.604	3	5
Walnut Corner	84.601	3	19
No Business Creek Community	319.04	3	12
Beatty Salt Works	13.336	2	2
Rockhouse/Firetower Site	32.122	5	16
Roysden Homesite	2.698	3	17
Beatty Oilwell Historic Zone	41.208	2	1

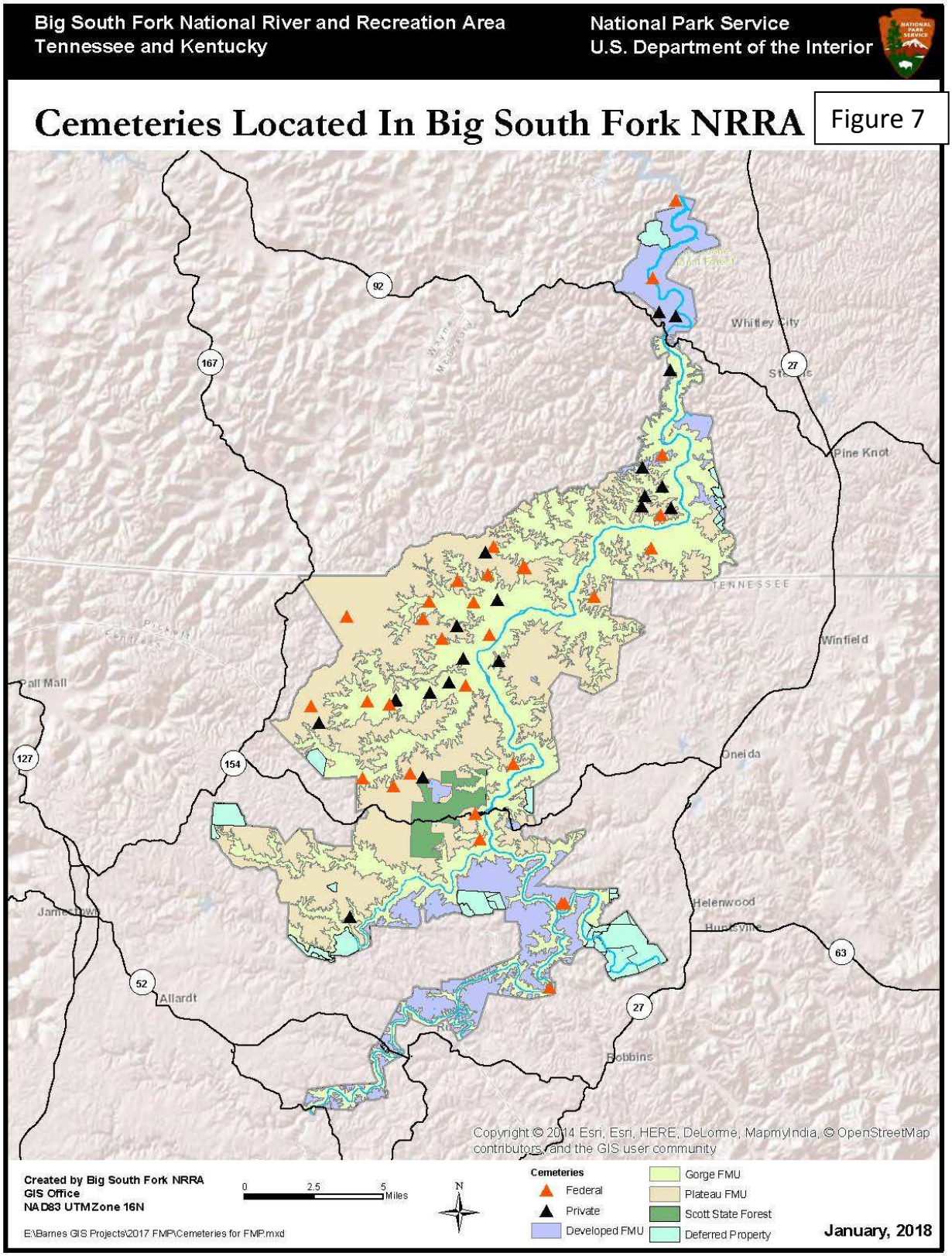


BISO Fire Management Division

0 2.5 5 7.5 10 Miles

N

April 2013


Big South Fork National River and Recreation Area
Tennessee and Kentucky
National Park Service
U.S. Department of the Interior
Cemeteries Located In Big South Fork NRRA
Figure 7
92
167
27
Whitley City
Pine Knot
TENNESSEE
Winfield
Pall Mall
127
154
Oneida
Helenwood
63
52
Allardt
27
Bobbins
Copyright © 2014 Esri, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Created by Big South Fork NRRA
GIS Office
NAD83 UTM Zone 16N
0 2.5 5 Miles
N
Cemeteries
Federal
Private
Developed FMU
Gorge FMU
Plateau FMU
Scott State Forest
Deferred Property
E:\Barnes GIS Projects\2017 FMP\Cemeteries for FMP.mxd
January, 2018

Effects of Fire on Cultural Resources

Fire negatively effects cultural resources by various degrees of burning, from complete consumption of the cultural resource to charring the surface. The degree of impact is associated with the proximity of the fire and duration that the cultural resource is impacted by the heat.

Cultural Resources: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to cultural resources were derived from park staff's observations of the effects of fire on cultural resources and from literature on fire impacts on cultural resources.

Cultural Resources: Impact Analysis of Alternatives

In order for an archeological resource, a historic structure, cemetery, or cultural landscape to be eligible for the National Register of Historic Places it must meet one or more of the following criteria of significance: A) associated with events that have made a significant contribution to the broad patterns of our history; B) associated with the lives of persons significant in our past; C) embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; D) have yielded, or may be likely to yield, information important in prehistory or history. An archeological resource, a historic structure, cemetery or a cultural landscape must also possess integrity of location, design, setting, materials, workmanship, feeling, association (*National Register Bulletins: Guidelines for Evaluating and Registering Archeological Properties; How to Apply the National Register Criteria for Evaluation*).

Cultural Resources Impacts of Alternative A

Impacts on cultural resources would occur from wildfires, wildfire suppression operations as well as prescribed fire operations and mechanical/manual fuels reduction operations.

Cultural resources would be at risk from wildfires, wildfire suppression operations as well as prescribed fire operations. Wildfires can burn up flammable BISO cultural resources such as wooden crosses located in cemeteries, wooden historic cabins, outbuildings, fences, historic orchards and other wooden structures. This would be a direct negative long term impact to these resources as they might not be replaceable. Fire can also scorch or damage both flammable and nonflammable cultural resource items. These could be short or long term negative impacts as the resource might be repairable.

BISO averages about two wildfires per year, burning an average of 98 acres. Wildfire suppression operations can damage cultural resources, especially if heavy equipment is used. Wildfire suppression techniques, such as the construction of fire lines and burnout operations, may cause direct negative impacts to buried artifacts due to soil disturbance and compaction, which could cause crushing or cracking artifacts beneath the soil. Under the existing FMP, fire

suppression is performed using MIST guidelines. By using these mitigation measures and cultural resource advisors in fire management decisions and operations, wildfire suppression activities would avoid impacts to known cultural resources and mitigate negative impacts to discovered cultural resources found during operations.

Prescribed fire has the same potential impacts as wildfire. Prescribed burning has the advantage of being a planned operation and prescribed fire plans include mitigation practices designed to protect known cultural resources and include established procedures to deal with newly discovered cultural resources. It is expected that prescribed fire operations would have minor impacts to cultural resources.

Mechanical/manual fuels reduction operations would have the potential for negative impacts on cultural resources by trampling or crushing cultural resources. Impacts to known cultural resources would be negligible as operations plans would include mitigation practices designed to protect a known resource. Unknown cultural resources could be crushed or broken by machinery used to cut and pile natural debris. It is expected that these negative impacts would be unlikely due to project area cultural resource presurveys, planned designed operations to minimize impacts to cultural resources and use of cultural resource specialists for monitoring

The use of prescribed fire to reduce hazard fuels would indirectly help protect BISO cultural resources by decreasing fuels around known cultural resource sites. An unplanned wildfire occurring in treated areas would burn with the less intensity of a wildfire in untreated areas. A less intense fire could have less of an impact on cultural resources due to less duration of heat impacting the cultural resource. Less intense wildfires would be easier and faster to suppress reducing the amount of time a cultural resource may be at risk.

Under Alternative A, cemeteries, houses, outbuildings, fences, historic orchards, and other structures and improvements at cultural sites scattered throughout BISO would be placed at greater risk as accumulations of fuels continue to increase and encroach on a site or structure. High intensity wildfires occurring near the BISO boundary would increase the need for the use of a tractor plow and other heavy equipment to halt the spread of fire. The use of such equipment could damage previously unknown archeological resources located below the surface. In the event a wildfire was to burn heavy accumulations of vegetation in or near cemeteries, headstones or other grave markers could be damaged or lost. Cultural landscapes, such as old fields, fences, historic ornamental plants, orchards, pens and pasturelands may be lost due to the encroachment of woody species an indirect result of the lack of fire across the landscape of BISO.

Alternative A: Cultural Resources Cumulative Impacts

Impacts to cultural resources are generally negative and long term because there is a finite inventory of cultural resources. Fire management program negative impacts to cultural resources can add to negative impacts from other BISO operations such as road and trail building, new facilities construction and many maintenance operations. Additionally, other

federal, state, county and private operations have a potential to damage or destroy cultural resources of the region. It is expected that the BISO fire management program and the completion of compliance with Sec 106 NHPA consultations, the use of cultural resource advisors and implementation of mitigation practices designed to protect cultural resources that cumulative impacts will be minor to cultural resources in the area.

Cultural Resources Impacts of Alternative B

Impacts on cultural resources would occur from wildfires, wildfires managed for multiple objectives, wildfire suppression operations, prescribed fire operations as well as natural fuels debris burning through mechanical/manual fuels reduction operations.

Direct impacts of wildfire and wildfire operations would be the same as Alternative A. Alternative B also includes wildfires managed for multiple objectives. The result is that more acres could burn under this alternative. Known BISO cultural sites under a wildfire managed for multiple objectives would unlikely be harmed due to preplanning needed to manage a wildfire for multiple objectives. Due to the unplanned nature of a wildfire unknown sites could be negatively impacted. The degree of harm to the site is dependent upon the material being burned, the duration of the burn and whether information contained at the site is retrievable or not.

Prescribed fire impacts would be similar to Alternative A.

Mechanical/manual fuels reduction would have similar direct impacts as Alternative A. The addition of natural debris pile burning under Alternative B could impact unknown cultural resources below ground under the area of the burned pile. Presurveys associated with planned projects such as mechanical/manual fuels reduction treatments and natural debris pile burning would help minimize potential destruction or damage of previously unknown cultural resources.

Under Alternative B, cemeteries, houses, outbuildings, fences, historic orchards, and other structures and improvements at cultural sites scattered throughout BISO would be at lower risk as accumulations of fuels are reduced in and around a site or structure. Wildfires in these areas would not be as intense with the result that less aggressive fire fighting operations could halt the spread of the wildfire, resulting in fewer acres burned and less impactive suppression efforts.

Alternative B: Cultural Resources Cumulative Impacts

Impacts to cultural resources for Alternative B are similar to those of Alternative A.

Social Resources

BISO Visitor Use

BISO Visitor Use Affected Environment

The total number of visitors to BISO during the period from 1995 to 2016 was approximately 15.3 million. The park receives an average of 761,769 visitors each year. Visitation peaked in 2001 and has generally declined from 2002 to the present, increasing slightly from 2004 to 2005 and then declining again, more recently, from 2011 to 2014, with an increase in visitation occurring from 2015 to 2016. Seasonal visitor use patterns at BISO are generally predictable throughout the year. Visitation at BISO increases throughout the summer with peak visitation occurring in October. Spring visitor use is moderate to high, with visitor numbers increasing during the summer months. Winter season use is relatively light, with January and February accounting for the lowest percentage of park visitors. Wildland fire management operations are important to BISO due to the potential impacts that might occur to visitor experiences.

The NPS or its licensed concessionaires operate the facilities within BISO. Facilities include: two developed campgrounds, one lodge, a horse stable, two visitor centers, 11 river accesses, and numerous recreational opportunities. The NPS owns 9 acres of land in Stearns, KY, outside BISO boundaries. The Stearns Visitor Services Division office and a maintenance building are operated at this site. The NPS also owns 20 acres of land located between BISO headquarters and Oneida, TN. This land was acquired for potential use as a visitor center and is currently undeveloped (NPS 1997).

Effects of Fire on BISO Visitor Use

Fire negatively effects BISO visitor use by direct mortality or causing injuries depending on severity of contact with flames. Fire also restricts visitor access to areas that are burning. Fire can produce haze which limits also limits visitors viewsheds.

BISO Visitor Use: Impact Analysis of Alternatives

Analyses of the potential intensity of impacts to visitor were derived from park staff's observations of the effects of fire on visitors and from literature on fire impacts on visitors.

BISO Visitor Use Impacts of Alternative A

Alternative A includes wildfire, wildfire and prescribed burn operations and mechanical/manual fuels reduction operations.

Wildfires and wildfire suppression operations require BISO restrictions to visitor access in active wildfire suppression areas deemed unsafe for visitors. These restrictions are not frequent as BISO experiences approximately two wildfires per year, therefore it is expected that impacts to visitors would be adverse short term, generally less than 2 days to two weeks, depending on

the duration of the suppression operation and unlikely to restrict visitors from all areas of BISO because it is not expected all areas of BISO will be closed due to a wildfire event.

Prescribed burn operations also require access restrictions similar to wildfire suppression operations. The planned nature of the prescribed burn allows fire managers to time prescribed burns to periods when visitor use is lower or to notify visitors in advance of operations. Short term adverse impacts to visitor experience would result from localized area closures in and near prescribed fire operations and the presence of smoke during prescribed fire management activities could restrict visitor access for health and safety reasons. The duration of impacts would correlate to the duration of prescribed burn activities and would be minimized through the use of mitigation practices. The use of prescribed fire and its effects on vegetation may present an opportunity for education and interpretation of natural resource values and processes, which may result in a beneficial impact

An indirect positive impact of the fire management program under Alternative A would be the regrowth of grasses and forbs in burned areas increasing chances for visitors to enjoy viewing native flowers. Associated with burned vegetation regrowth could be improved wildlife viewing due to openings created by fire management activities. Many animals are drawn to areas that have burned as forage improves in these areas as regrowth occurs during the current growing season or next growing season.

Alternative A would have little impact on visitor use except for large wildfire occurrences. During these events, large sections of BISO may have to be closed for extended periods; park infrastructure may need to be rebuilt and cultural resources may be damaged or destroyed limiting enjoyment opportunities for visitors.

Under Alternative A, the continued use of short term restrictions would continue indefinitely. However, many of these restrictions would involve remote sections of BISO. Visiting school groups that conduct field trips during the spring and fall could be impacted because their field activities coincide with the primary fire season.

Alternative A: BISO Visitor Use Cumulative Impacts

Other cumulative impacts that could occur at BISO are restrictions around abandoned minerals management and mine reclamation projects. Short term restrictions for routine and emergency repair of park infrastructure. Planned rehabilitation of BISO infrastructure as well as maintenance and repair. Well site logging as well as gas development and maintenance also could restrict visitor use at BISO.

BISO Visitor Use Impacts of Alternative B

Alternative B includes wildfires, managed wildfire for multiple objectives, wildfire and prescribed fire operations as well as natural debris pile burning associated with mechanical/manual hazard fuels reduction operations.

Impacts of Alternative B on visitor use would be similar to Alternative A. Direct restriction of visitor access to wildfire areas may be longer due to active management of wildfire for multiple objectives. The duration of these restrictions is based on how long the fire is beneficial, as soon as the wildfire does not meet management objectives it will be suppressed. Adverse impacts to visitor use are expected to be short term, several days to several weeks and restrictions localized to the area of the wildfire and wildfire operations.

Prescribed burn operations are expected to have similar impacts as Alternative A.

Mechanical/manual fuels would have the same impacts as Alternative A. The additional of natural debris pile and burning projects is unlikely to have negative effects on visitor use at BISO. Few visitors are in BISO when piles are burned. Some visitors will be restricted from operations which require heavy equipment or chainsaws to accomplish the work. These restrictions would be short –term only during actual operations.

Alternative B: BISO Visitor Use Cumulative Effects

Cumulative effects of Alternative B are similar to Alternative A.

Chapter 4: COORDINATION and CONSULTATION

Under the provisions of the Endangered Species Act of 1973, as amended, the Service must work with other federal and state agencies to protect, conserve and enhance the continued existence of any endangered species or threatened species. Any actions that may impact these species are subject to review by the U.S. Fish and Wildlife Service. A copy of this document will be made available to the U.S. Fish and Wildlife Service for consultation under Section 7 of the Endangered Species Act.

The National Historic Preservation Act, as amended in 1992 (16 USC 470 *et seq.*); the National Environmental Policy Act; the NPS Cultural Resource Management Guideline (1994), and NPS Management Policies (2000) require the consideration of impacts on cultural resources listed, or eligible for listing, on the National Register of Historic Places. The actions described in this document are also subject to Section 106 of the National Historic Preservation Act, under the terms of the 1995 Programmatic Agreement among the NPS, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers. Impacts to cultural resources; therefore, have been analyzed and will be reviewed in accordance with applicable laws, policies and agreements.

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Appendix A: Glossary of Terms

Terms change over time, therefore the following link to current National Wildfire Coordinating Group Glossary of Wildland Fire Terminology provides the latest definitions of wildland fire terms.

https://www.nwcg.gov/glossary-of-wildland-fire-terminology

Appendix B: List of Classified Structures in Big South Fork National River and Recreation Area

Table 3: Classified Structures at the BISO

Resource	Type	Date Constructed	LCS Number	Eligibility Status	Description
Litton/Slaven Barn	Structure	1900	92182	Eligible, 1981	The barn is listed as a contributing building and currently serves as a museum that houses the exhibits within the proposed Big South Fork Rural Historic District.
Litton/Slaven House and Cabin	Structure	1900	92183	Eligible, 1981	The Litton/Slaven House and Cabin is listed as a contributing building, and is currently serving as a wayside exhibit within the proposed Big South Fork Rural Historic District.
Litton/Slaven Earthen Dam	Super structure	1900	232905	Eligible, 1981	Currently the dam forms part of a hiking trail that runs above the farmstead.
Blevins, Oscar. House	Structure	1879	92185	Eligible, 1981	House is listed as a contributing building and is currently serving as an exhibit in the proposed Big South Fork Rural Historic District.
Blevins, Oscar. Corn Crib	Structure	1879	504439	Eligible, 1981	The corn crib exhibits the vernacular design and construction techniques of the former residents of an isolated Cumberland Plateau community.
Blevins, Oscar. Outbuilding	Structure	1870s–1880s	511850	Eligible, 1981	The outbuilding exhibits the vernacular design and construction techniques of the former residents of an isolated Cumberland Plateau community.
Blevins, John. Barn	Structure	1925	92186	Eligible, 1981	The John Blevins Simpson Barn was constructed in 1925 and assessed as eligible for inclusion into the national register under criteria A and C due to its association with the historic subsistence farming culture of the Cumberland Plateau. The barn is an exemplary example of the vernacular folk architecture of Southern Appalachia. The barn currently serves as a warehouse for general supply storage.

Resource	Type	Date Constructed	LCS Number	Eligibility Status	Description
Blevins, John. House	Structure	1824	92187	Eligible, 1981	The John Blevins House is listed as a contributing building within the proposed Big South Fork Rural Historic District and currently serves as a dormitory.
Blevins, John. Corn Crib	Structure	1920	92188	Eligible, 1981	The corn crib currently is being utilized as general storage facility.
Blevins, John. Smithy	Structure	1920	92189	Eligible, 1981	The John Blevins Smithy, built in 1920, originally served as a mill. Currently, the structure is being utilized as a general storage facility.
Litton, John. Cabin Ruins at Parched Corn Creek	Structure	1881	100405	Eligible, 1981	The cabin was assessed as eligible for inclusion into the national register due to its representation of an exemplary example of log barn construction on the Cumberland Plateau. Unfortunately this cabin burned to the ground in 1997 leaving only the standing, cut stone chimney.
Privy at Parched Corn Creek	Structure	1960s–1970s	100406	Not Eligible, 1981	The privy has been dated to approximately the late 1960s / early 1970s based on oral history. The privy originally served as a latrine, but is not in use or maintained. The structure was assessed as not eligible for inclusion into the national register despite its close proximity to the old Armpie Blevins farmstead. The structure is determined to be a noncontributing component of the Big South Fork Rural Historic District.
Blevins, Lora. Corn Crib	Structure	1929	92178	Eligible, 1981	The Lora Blevins Corn Crib is listed as a contributing structure within the proposed Big South Fork Rural Historic District and currently serves as an exhibit.
Blevins, Lora. House	Structure	1929	92179	Eligible, 1981	The Lora Blevins house was built in 1929, is listed as a contributing building in the Big South Fork Rural Historic District, and was recently determined a contributing feature of a Component Landscape as documented in a 1998 NPS Cultural Landscape Inventory, Level 1. The house currently serves as an exhibit.

Resource	Type	Date Constructed	LCS Number	Eligibility Status	Description
Blevins, Lora. Pole Barn	Structure	1929	92177	Eligible, 1981	The Lora Blevins Pole Barn was built in 1929 and is listed as a contributing building in the proposed Big South Fork Rural Historic District. The barn currently serves as an exhibit.
Ranson Boyatt Farmstead Ruins	Structure	Unknown	416703	Eligible, 1981	The farmstead typifies the confined but picturesque setting that many of the first farming settlers of the Upper Cumberland adapted to in the mid to late nineteenth century. The Ranson Boyatt Farmstead Site has integrity of location and setting, exhibiting extant cultural artifacts and landscape features from the original Boyatt farmstead.
Low Water Bridge	Structure	Unknown	579462	Eligible, 1981	The LCS contains only limited information pertaining to the status of the bridge and its description.
Coal Tipple at Blue Heron	Structure	1939	578708	Eligible, 1981	The Blue Heron Tipple was mechanized in the 1930s. It separated the various sizes of coal coming from the mine in coal cars. The tipple is currently part of Blue Heron, or Mine 18, Mining Community.

Source: NPS 2009f.

Appendix C: State Listed Animal Species Present in Big South Fork National River and Recreation Area

Table 4: State Listed and Present Species in BISO

Species	Status[1]	Habitat description
Eastern Big-eared Bat *Corynorhinus rafinesquii*	TN – D KY – S	Found in southeastern U.S. Roosts in caves, mines, buildings (TDEC 2009).
Gray Bat *Myotis grisescens*	TN – E KY – T Federal – E	Found in southeastern U.S. Relies on a small number of caves to roost (<8) (TDEC 2009).
Eastern Small-footed Bat *Myotis leibii*	TN – D KY – T	Found in eastern U.S. Opportunistic roosting in summer (under loose bark, buildings, hollow trees, crevices, etc.). Winters in caves (TDEC 2009).
Woodland Jumping Mouse *Napaeozapus insignis*	TN - D	Prefers boreal spruce–fir and hemlock hardwood forests with thick underbrush. Large range with limited suitable habitat (TDEC 2009).
Eastern Woodrat *Neotoma magister*	TN - D	Has a large habitat ranging from low wetlands and swamps to higher forested areas. Feeds primarily on plant material (TDEC 2009).
Smokey Shrew *Sorex fumeus*	TN - D	Is a northern and mountain species with range that moves south into Appalachia (TDEC 2009).
American Black Bear *Ursus americanus*	KY – S	Prefers mixed deciduous–coniferous forests with a thick understory (NatureServe 2009).
Evening Bat *Nycticeius humeralis*	KY – S	Prefers deciduous and mixed forest interspersed with cultivated areas. Commonly found along waterways (NatureServe 2009).
Bald Eagle *Haliaeetus leucocephalus*	TN-T	Can live in numerous habitats. Prefers large rivers, lakes, and forests of mixed to uniquely conifer or hardwood (TDEC 2009).
Cerulean Warbler *Dendroica cerulea*	TN - D	Inhabits deciduous forests throughout eastern U.S. Migrates through southern U.S. to South America. Breeding grounds are in north and central part of country (TDEC 2009).
Swainson's Warbler *Limnothlypis swainsonii*	TN - D	Breeds in forests of southeastern U.S. Migratory bird that inhabits understory, hunts in leaf litter, and migrates to Central America and Caribbean (TDEC 2009).
American Coot *Fulica americana*	KY – E	Inhabits freshwater lakes, ponds, marshes, and larger rivers; wintering is also on brackish estuaries and bays. Also on land bordering these habitats. Calm open water with plenty of algae and other aquatic vegetation (NatureServe 2009).
Dark-eyed Junco *Junco hyemalis*	KY – S	Inhabits coniferous and deciduous forest, forest edge, clearings, bogs, open woodland, brushy areas adjacent to forest, and burned-over lands; in migration and winter, utilizes a variety of open woodland, brushy, and grassy habitats (NatureServe 2009).

Species	Status[1]	Habitat description
Golden-winged Warbler *Vermivora chrysoptera*	KY – T	Inhabits deciduous woodland, usually in dry uplands or areas of thick undergrowth in swampy areas; woodland edge with low cover; hillside scrub; overgrown pastures; abandoned farmland; power line right-of-ways; recently logged sites; bogs; forest openings; and in territories usually having patches of herbs and shrubs, sparse tree cover, and a wooded perimeter (NatureServe 2009).
Great Blue Heron *Ardea herodias*	KY – S	In freshwater and brackish marshes, along lakes, rivers, bays, lagoons, ocean beaches, mangroves, fields, and meadows. Nests commonly high in trees in swamps and forested areas, less commonly in bushes, or on ground, rock ledges, and coastal cliffs. Often nests with other herons (NatureServe 2009).
Savannah Sparrow *Passerculus sandwichensis*	KY – S	Prefers habitat with short to intermediate vegetation height, intermediate vegetation density, and a well developed litter layer. These preferred habitats cover a wide range of vegetation types, including alpine and arctic tundra, coastal salt marshes, sedge bogs, grassy meadows, and native prairie (NatureServe 2009).
Sharp-shinned Hawk *Accipiter striatus*	KY - S TN - D	Found in forest and open woodland, coniferous, mixed, or deciduous, primarily in coniferous in more northern and mountainous portion of range (NatureServe 2009).
Southeastern Five-lined Skink *Eumeces inexpectatus*	KY – S	These skinks often are under or in ground litter, logs, piles of wood, or stumps, which appear to be important elements of the habitat (NatureServe 2009).
Green Salamander *Aneides aeneus*	TN - D	Found in damp (but not wet) crevices in shaded rock outcrops and ledges. Also found beneath loose bark and in cracks of standing or fallen trees (e.g., in cove hardwoods), and sometimes in or under logs on the ground (NatureServe 2009).
Black Mountain Dusky Salamander *Desmognathus welteri*	TN - D	Is highly aquatic; found in streams and springs in wooded parts of range (TDEC 2009).
Cumberland Bean Pearly Mussel *Villosa trabalis*	Federal –E TN-E KY-E	Has a limited range in Virginia, Kentucky, N. Carolina, Alabama, Georgia, and Tennessee. Found in water less than 3 ft in swift moving currents and sandy/gravel substrate (TDEC 2009).
Tan Riffleshell *Epioblasma florentina walkeri*	Federal-E, h TN-E KY-E	Occurs in a substrate of course gravel sand, gravel, and some silt in current, and in less than 3 feet of water (Parmalee and Bogan 1998).
Little-winged Pearly Mussel *Pegias fabula*	Federal-E TN-E KY-E	Prefers cool, clear tributary streams with high gradients and swift currents. Inhabits the Cumberland Plateau and is thought to exist in only a handful of stream reaches (TDEC 2009).
Cumberlandian Combshell *Epioblasma brevidens*	Federal-E TN-E KY-E	Occurs in Virginia, Mississippi, Kentucky, Tennessee, and Alabama, in streams with coarse gravel or gravel substrate (TDEC 2009).
Clubshell *Pleurobema clava*	Federal-E, h TN-E KY-E	Occurs in medium sized and large rivers at depths of 15 to 18 feet on a firm substrate of sand and gravel (Parmalee and Bogan 1998).
Cumberland Elktoe *Alasmidonta atropurpurea*	Federal-E TN-E KY-E	Occurs only in Kentucky and Tennessee. Prefers fine substrates and more slow moving current, usually in smaller streams (TDEC 2009).

Species	Status[1]	Habitat description
Dromedary Pearly mussel *Dromus dromas*	Federal-E, h TN-E KY-X	An inhabitant of shoals and riffles, it has been collected in a gravel and sand substrate in about 3 feet of water (Parmalee and Bogan 1998).
Oyster Mussel *Epioblasma capsaeformis*	Federal-E, h TN-E KY-E	Usually found in shallow riffles in fast water less than 3 feet in depth in a gravel and sand substrate (Parmalee and Bogan 1998).
Fluted Kidneyshell *Ptychobranchus subtentum*	Federal-C KY-S	Primarily a stream and small river species, inhabiting a sand or sand and gravel substrate in riffles with fast current, usually at depths of 2 feet or less (Parmalee and Bogan 1998).
Spectaclecase *Cumberlandia monodonta*	Federal-C TN-E KY-E	Found in medium to large rivers, in substrates from mud and sand to gravel, cobble, and boulders (TDEC 2009).
Olive Darter *Percina squamata*	TN – D KY – E	Occurs in upland rivers in Blue Mountain and Cumberland Plateau regions of Tennessee, and Cumberland River drainage. Occupies streams with steep gradients and fast moving water over boulders and bedrock (Etnier and Starnes 1993).
Ashy Darter *Etheostoma cinereum*	TN – T KY - S	Has a fragmented range of silt free streams and slow pool edges around rubble and boulders in the Cumberland, Duck, and Tennessee river basins (Etnier and Starnes 1993).
Emerald Darter *Etheostoma baileyi*	TN – D	Found in rocky pools and sometimes riffles of Upper Kentucky and Cumberland river drainages (Etnier and Starnes 1993).
Arrow Darter *Etheostoma sagitta*	TN – D	Prefers shallow, cool pools and slow to moderate current runs in intermittent streams (Etnier and Starnes 1993).
Tippecanoe Darter *Etheostoma tippecanoe*	TN – D	Found in warm, clear larger rivers with gravel substrate (Etnier and Starnes 1993).
Blackside Dace *Phoxinus cumberlandensis*	TN - T KY - T	Inhabits small, clear, cool woodland streams over sandstone, shale, or sand substrates in Upper Cumberland River drainage in Kentucky and Tennessee (Etnier and Starnes 1993).
Duskytail Darter *Etheostoma percnurum*	KY – E	Inhabits large streams to moderately large rivers. Occurs in gently flowing pools, generally in the vicinity of riffles, with substrate of large rocks strewn over bedrock or sand and gravel (Etnier and Starnes 1993).
Mountain Brook Lamprey *Ichthyomyzon greeleyi*	KY – T	Inhabits small upland rivers and creeks with gravel substrate (Etnier and Starnes 1993).

1. E represents endangered, T represents threatened, S represents species of special concern in Kentucky, C represents federal candidate species, D represents Tennessee species deemed in need of management

Appendix D: State listed vascular plants in Big South Fork NRRA in KY & TN

FOOTNOTES FOR THIS TABLE: LT = listed threatened; S1 = critically imperiled; S2 = imperiled; S3 = vulnerable; S4 = apparently secure; S5 = secure; SNR = unranked, conservation status not yet assessed; SH = historical, possibly extirpated; SU = unrankable due to lack of or conflicting information; N/A=not applicable.

Table 5: State listed vascular plants in Big South Fork NRRA in KY & TN

Scientific Name	Common Name	Fed rank	KY Rank	TN Rank
Aconitum uncinatum	southern blue monkshood	N/A	S2	S3
Actaea rubifolia	Appalachian bugbane	N/A	S2	S3
Adiantum capillus-veneris	common maidenhair	N/A	S2S3	SNR
Ageratina luciae-brauniae	Lucy Braun's snakeroot	N/A	S3	S3
Aureolaria patula	spreading yellow false foxglove	N/A	S3	S3
Baptisia australis	blue wild indigo	N/A	S3	S3
Baptisia tinctoria	yellow wild indigo	N/A	S1S2	SNR
Bartonia virginica	yellow screwstem	N/A	S2	SNR
Berberis canadensis	American barberry	N/A	S1	S2
Boykinia aconitifolia	boykinia	N/A	S1S2	SNR
Buchnera americana	American bluehearts	N/A	S3S4	S3
Calopogon tuberosus	tuberous grasspink	N/A	S1	SNR
Calycanthus floridus	eastern sweetshrub	N/A	S2	SNR
Campanula aparinoides	marsh bellflower	N/A	SU	S2
Cardamine rotundifolia	American bittercress	N/A	S3S4	S2S3
Carex austrocaroliniana	tarheel sedge	N/A	S3	S2S3
Carex echinata ssp. *echinata*	star sedge, stellate sedge	N/A		S1
Carex emoryi	Emory's sedge	N/A	S3	
Carex leptonervia	nerveless woodland sedge	N/A	S1	SNR
Carex purpurifera	purple sedge	N/A	S3S4	S3
Carex straminea	eastern straw sedge	N/A	S2	SNR
Castanea dentata	American chestnut	N/A	S1	S2S3
Castanea pumila	Allegheny chinquapin	N/A	S2	SNR
Ceanothus herbaceus	prairie redroot	N/A	S2	S2
Chrysogonum virginianum	green and gold	N/A	S1	S2
Clematis glaucophylla	whiteleaf leather flower	N/A	S3	S1
Comptonia peregrina	sweet fern	N/A	S1	S1
Conradina verticillata	Cumberland rosemary	LT	S1	S3
Coreopsis pubescens	hairy coreopsis, star tickseed	N/A	S2S3	SNR

Scientific Name	Common Name	Fed rank	KY Rank	TN Rank
Cyperus lancastriensis	manyflower flatsedge	N/A	S3	SNR
Cypripedium kentuckiense	Kentucky lady's slipper	N/A	S1S2	S2
Cystopteris tenuis	brittle bladderfern	N/A	S2S3	S1S2
Decodon verticillatus	swamp loosestrife	N/A	S3	S3
Deschampsia flexuosa	wavy hairgrass	N/A	S2	SNR
Dichanthelium aciculare	needleleaf rosette grass	N/A	S3	S1
Dryopteris carthusiana	spinulose woodfern	N/A	S3	S1
Elephantopus tomentosus	devil's grandmother	N/A	S3	SNR
Eriophorum virginicum	tawny cottongrass	N/A	S1	S1S2
Euonymus obovatus	trailing strawberry bush	N/A	S5	S2
Euphorbia mercurialina	mercury spurge	N/A	S1S2	SNR
Eurybia saxicastellii	rockcastle aster	N/A	S1S2	S1S2
Fothergilla major	witch alder	N/A		S2
Gaylussacia brachycera	box huckleberry	N/A	S2S3	S2S3
Goodyera repens	lesser rattlesnake plantain	N/A	S1S2	S1
Gymnopogon ambiguus	bearded skeletongrass	N/A	S2S3	SNR
Hexastylis contracta	mountain heartleaf	N/A	S1	S3
Hieracium scabrum	rough hawkweed	N/A	S4	S2
Hydrocotyle americana	American marshpennywort	N/A	SH	S1
Hypericum crux-andreae	St. Peterswort	N/A	S2S3	SNR
Hypericum nudiflorum	early St. Johnswort	N/A	SH	S2
Juglans cinerea	butternut, white walnut	N/A	S2S3	S3
Lathyrus palustris	slenderstem peavine	N/A	S2	S1
Lechea minor	thymeleaf pinweed	N/A	S2	SNR
Lilium superbum	turk's cap lily	N/A	S1S2	SNR
Lycopodiella appressa	southern bog clubmoss	N/A	S1	SNR
Lycopus uniflorus	northern bugleweed	N/A	S1S2	SNR
Lysimachia tonsa	Appalachian loosestrife	N/A	S4	S2S3
Maianthemum canadense	Canada beadruby	N/A	S2	SNR
Marshallia grandiflora	Monongahela Barbara's buttons	N/A	S1	S2
Matelea carolinensis	maroon Carolina milkvine	N/A	S1	SNR
Melampyrum lineare var. *latifolium*	narrowleaf cowwheat	N/A	S2	SNR
Melanthium parviflorum	Appalachian bunchflower	N/A	S2	SNR
Minuartia cumberlandensis	Cumberland stitchwort	LE	S1	S2
Minuartia glabra	Appalachian stitchwort	N/A	S1S2	S3
Monotropsis odorata	sweet pinesap	N/A	S2	S2
Oenothera linifolia	threadleaf evening primrose	N/A	S1S2	SNR

Scientific Name	Common Name	Fed rank	KY Rank	TN Rank
Oenothera perennis	little evening primrose	N/A	S1S2	SNR
Orontium aquaticum	golden club	N/A	S2	SNR
Parnassia asarifolia	kidneyleaf grass of Parnassus	N/A	S1	SNR
Phegopteris connectilis	long beech fern	N/A		S1
Philadelphus inodorus	scentless mock orange	N/A	S1S2	S4S5
Phlox stolonifera	creeping phlox	N/A	S3	SNR
Platanthera cristata	crested yellow orchid	N/A	S1S2	S2S3
Platanthera flava var. *herbiola*	palegreen orchid	N/A	S4S5	S2
Platanthera integrilabia	white fringeless orchid	LT	S1	S2S3
Podostemum ceratophyllum	hornleaf riverweed, threadfoot	N/A	S3	SNR
Pogonia ophioglossoides	snakemouth orchid	N/A	S1	S2
Polygala cruciata	drumheads	N/A	S1	S3
Polygala paucifolia	gaywings	N/A	S1	SNR
Polygala polygama	racemed milkwort	N/A	S2	SNR
Populus grandidentata	big tooth aspen	N/A	S4	S2
Potamogeton tennesseensis	Tennessee pondweed	N/A		S2
Rhododendron catawbiense	Catawba rhododendron	N/A	S2S3	SNR
Rhododendron cumberlandense	Cumberland azalea	N/A	SNR	S3
Rhynchosia tomentosa	twining snoutbean	N/A	S1S2	SNR
Rhynchospora chalarocephala	loosehead beaksedge	N/A		S1
Robinia hispida var. *rosea*	bristly locust	N/A	S2S3	SNR
Salix humilis var. *tristis*	prairie willow	N/A	S2S3	SNR
Sanicula marilandica	black sanicle	N/A	S2S3	SNR
Silphium trifoliatum var. *latifolium*	whorled rosinweed	N/A	SNR	S3
Solidago arguta var. *boottii*	Boott's goldenrod	N/A	S3	SNR
Solidago curtisii	mountain decumbent goldenrod	N/A	S3	S4
Solidago gracillima	Virginia goldenrod	N/A	S2	S1
Sphenopholis pensylvanica	swamp wedgescale	N/A	S1S2	SNR
Spiraea virginiana	Virginia spiraea	LT	S2	S2
Stenanthium diffusum	Wofford's featherbells	N/A		S1
Stenanthium gramineum	eastern featherbells	N/A	S2S3	SNR
Stewartia ovata	Mountain Camellia	N/A	S3	SNR
Symphyotrichum concolor	eastern silver aster	N/A	S2	SNR
Symphyotrichum laeve	smooth blue aster	N/A	S2S3	SNR
Talinum teretifolium	quill fameflower	N/A	S1	S2
Taxus canadensis	American yew	N/A	S2S3	S1

Scientific Name	Common Name	Fed rank	KY Rank	TN Rank
Tephrosia spicata	spiked hoarypea	N/A	S1S2	SNR
Thuja occidentalis	white cedar	N/A	S2S3	S3
Trichomanes boschianum	Appalachian bristle fern	N/A	S3S4	S1S2
Trillium luteum	yellow wakerobin	N/A	S4	S2S3
Trillium sulcatum	furrowed wakerobin	N/A	S5	S3
Vaccinium erythrocarpum	southern mountain cranberry	N/A	S1	SNR
Vallisneria americana	American eelgrass	N/A	S2S3	SNR
Viburnum nudum	possum haw	N/A	S1	SNR
Viola sagittata var. *ovata*	arrowleaf violet	N/A	S3	SNR
Vitis labrusca	fox grape	N/A	S2S3	SNR
Vitis rupestris	sand grape	N/A	S2	S1
Vittaria appalachiana	Appalachian shoestring fern	N/A	S3	SNR

Appendix E: Fire Management Mitigation Measures

Air Quality

***Mitigation Practices to Reduce Air Quality Impacts*:** The Environmental Protection Agency (EPA) recognizes that wildland fires of all kinds (wildfire, prescribed fires, etc.) contribute to regional haze, and there is a complex relationship between what is considered a natural source of fire versus a human caused source of fire. For example, the increased use of prescribed fire in some areas may lead to particulate emissions levels lower than those that would be expected from a catastrophic wildfire. Given that in many instances the purpose of prescribed fire is to restore the natural fire cycles to the forest ecosystems, EPA will work with state and federal land managers to support development of enhanced smoke management plans to minimize the effects of emissions on public health and welfare (EPA 1999).

Several methods are available to reduce the impacts to air quality including, (1) minimizing the area burned, (2) reducing the fuel loading in the area to be burned through mechanical pretreatment, (3) reducing the amount of fuel consumed by fire through the use of smaller units, and (4) minimizing emissions per ton of fuel consumed by burning under favorable conditions or using different firing techniques. Another action that can be taken to minimize fire emission includes rapid and complete mopup of fuels known to contribute to poor air quality or impact human health.

Secondary emissions are pollutants formed in the atmosphere by photochemical transformation of primary emissions. They include oxidants such as ozone that is a criteria pollutant as defined by the EPA. The specific emission factors for secondary emissions from prescribed burning are unknown but are believed to be relatively small (Haddow 1989). For ozone to form, nitrogen oxide (NOx) is required as well as volatile organic compounds (VOCs) emissions in the presence of sunlight. The amount of NOx and VOCs generated would be dependent on the types of fuel burned, the moisture content, and the temperature of the combustion process (Carson, personal communication). Currently, readings taken at all air monitoring stations nearest the BISO are meeting the National Ambient Air Quality Standards for ozone and PM10 (EPA website). Prescribed burns would not be conducted under conditions favorable to the formation of ozone.

Prescriptive elements in prescribed burn plans would specify the proper conditions necessary to increase smoke dispersal and enhance burning, thereby reducing impacts from smoke.

Under the Clean Air Act, the Service is responsible for protecting air quality within park boundaries, and to take appropriate action to do so, when reviewing emission sources both

within and in proximity to parks (Malkin 1994, Clean Air Act, as amended). Therefore, all prescribed burns would be conducted in accordance with regulations established by the Commonwealth of Kentucky, the State of Tennessee and the Clean Air Act.

Soils

***Mitigation Practices to Reduce Soil Impacts*:** Prescriptions designed to reduce fire severity during prescribed fire operations would be followed. Existing roads and trails would be used to the greatest extent possible as control lines for both wildfires and prescribed fires. Tactics involving the use of leaf blowers and hand tools that do not result in soil disturbance would be employed to construct fire lines, where appropriate. Fire management personnel would rehabilitate firelines after the fire management operation is completed to reduce or eliminate soil loss through erosion.

Water Quality

Mitigation Practices to Reduce Water Quality Impacts

Fire suppression chemicals: Fire retardants will be used in BISO under the following emergency situations:

1. response associated with potential loss of human life
2. potential destruction of park developments (headquarters complex, Bandy Creek complex, Station Camp Horse Camp, Bear Creek Horse Camp, Blue Heron complex)
3. potential consumption of structures associated with identified cultural landscapes (Lara Blevins, Litton-Slaven, Oscar Blevins, Charit Creek)
4. potential fire escape from NPS lands in areas of Wildland Urban Interface or private land

Use of aerial applied fire retardant cannot occur within 300 feet of a waterway (Redbook 2018) and ground based applications of fire foams will not occur within 100 feet of a waterway (Redbook 2018 allows park to determine distance).

Despite these stipulations, there is a possibility that retardant **or** foam could interface with tributary streams during fire suppression. Therefore, NPS has outlined mitigation measures that should be taken in the event of accidental fire chemical inputs to streams that support T&E species (see Biological Assessment for the Fire Management Plan Update).

In addition to the measures identified in the soils section, whenever possible, vegetation would be protected adjacent to streams and other water courses. This vegetation should sufficiently slow the flow of any runoff to permit debris and soil to be deposited before it could reach a stream or river. Site specific mitigation practices would be included in prescribed burn plans when appropriate. Activities would be coordinated with neighboring landowners and agencies to avoid impacting a specific watershed.

Oil and Gas Sites

Mitigation Practices to Reduce Oil and Gas Sites Impacts:

Fire managers view oil and gas sites as special hazard areas. The following are recommended operations:

1. use mechanical means in combination with prescribed fire to reduce hazard fuel accumulations around oil and gas well facilities and aid in fire suppression activities by reducing fire intensity and severity.
2. prescribed fire treatment areas would not be designated in areas of the park where there is high potential for fires that may adversely impact oil and gas facilities.
3. recommends that NPS staff work with petroleum producers to develop and maintain defensible space1 around well heads and storage tanks and mark feeder and other pipelines at or below the surface

Vegetation

Mitigation Practices to Reduce Vegetation Impacts:

Managed wildfire for multiple objectives will take into account the type of vegetation that is being burned, the benefits of fire to that vegetation and when it is being burned as part of the active monitoring process.

Prescribed burning has direct and indirect effects on the environment. Proper use of prescribed fire and evaluation of the benefits and costs of a burn require knowledge of how fire affects vegetation (Wade 1989). Prescribed burns will be implemented with appropriate consideration given to the historical role of fire and the potential impacts of its reintroduction to a given community. The intensity and frequency of fire in a given plant community will be precisely controlled to meet resource objectives. The timing of prescribed burns will be driven by a desire to realize maximum benefit to a target species or community while minimizing adverse environmental effects.

[1]. Defined as an area, either natural or manmade, where material (such as flammable brush, vegetation, or other fuels) that could cause a fire to spread, has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and resources or lives at risk (National Fire Plan 2004).

Wildlife and Aquatic Species

Mitigation Practices to Reduce Wildlife and Aquatic Species Impacts: Due care would be taken to avoid impacts to ground nesting birds and other wildlife during sensitive periods. Additional protection would be afforded listed species (see Threatened and Endangered Species).

Managed Species of Concern

***Mitigation Practices to Reduce Managed Species of Concern Impacts*:** In order to minimize or correct impacts to aquatic managed species of concern MIST operational procedures will be used as well as BISO restrictions on foam and fire retardant use near water and only during threats to life or property. Helicopter bucket dipping in the Big South Fork River will be restricted to pools designated by the BISO. Incident management will consult with a Resource Advisor regarding the location of approve pools. Drafting, in accordance with Interagency Standards for Fire and Fire Aviation Operations (USDOI & USDA, 2018) and the Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations (WCGS, 2017), will be allowed throughout except from areas with known locations of threatened or endangered aquatic species. For the prescribed fire program, the potential impacts to listed species and our mitigations will be addressed on an annual basis when individual burn plans are submitted for Section 7 review.

Known locations of federal and state listed species would be protected during wildfire suppression operations unless it is known that fire enhances a particular species. All known listed species in a prescribed burn unit would be evaluated prior to a prescribed burn and protected as specified in the prescribed burn plan. All such measures would be identified in prescribed burn plans and in a site specific, preattack wildfire suppression plan.

In addition to the constraints to fire suppression activities for both wildfires and prescribed fires, the following operational measures will be taken to minimize siltation, erosion, chemical inputs to waterways, and adverse effects on rare species and sensitive habitats:

1. NPS consults with the US Fish & Wildlife Service to develop prescribed burn plans that are in compliance with Section 7, of the Endangered Species Act.
2. When available, a Resource Advisor will respond to wildfires and report to the Incident Commander (IC). The Resource Advisor will use GIS and knowledge of the resources to advise the IC of potential impacts of the fire and proposed suppression tactics on T&E species/habitat.

3. Mechanical fuel reduction will be used to create a fire break around Charit Creek, thereby reducing the need for retardant use in the event of a wildfire in the vicinity.
4. Hazard fuel breaks will be maintained along portions of the BISO's wildland urban interface (WUI). These WUI buffers are intended to reduce the risk of wildfire to private property adjacent to the BISO. Properly maintained WUI buffers will increase the potential to contain wildfires within the boundaries of the BISO, thereby reducing the potential need for retardant use.
5. WUI fuel breaks will be created and maintained using prescribed fire and mechanical means.
6. Prescribed fire treatment areas will not be designated in areas of the park where there is high potential for coal fires or where fires may adversely impact oil and gas facilities.
7. Periodic and post treatment monitoring of T&E species and habitats will allow for more careful analysis of treatment effects. Future management actions will be adapted to reflect the better understanding of fire effects provided through monitoring.
8. Because of the scarcity of mature shortleaf pine (*Pinus echinata*) in the BISO, following a recent southern pine beetle epidemic, efforts will be made to protect residual mature shortleaf pine stands from destructive crown fires. Controlled fire prescriptions will be designed to eliminate encroaching hardwoods and white pine (*Pinus strobus*) while minimizing shortleaf pine mortality.
9. To minimize impacts of wildfire and prescribed fire on potential Indiana bat, gray and Northern long-eared bats roosting habitat, NPS will implement these measures when feasible:
10. During and after wildland fire suppression, snags will be removed only in proximity to firelines, and then only when snag presence poses a risk to fire containment or to firefighter safety.
11. Prescribed fires in forested habitats will be conducted from October 15 to March 31, when nonflying young are less likely to be present in maternity roosts and no known roost trees or hibernaculum are present.

Plant Species of Concern

Mitigation Practices to Reduce Plant Species of Concern Impacts*:*

Known locations of federal and state listed species would be protected during wildfire suppression operations unless it is known that fire enhances a particular species. All known listed species in a prescribed burn unit would be evaluated prior to a prescribed burn and protected as specified in the prescribed burn plan. All such measures would be identified in prescribed burn plans and in a site specific, preattack wildfire suppression plan.

In addition to the constraints to fire suppression activities for both wildfires and prescribed fires, the following operational measures will be taken to minimize siltation, erosion, chemical inputs to waterways, and adverse effects on rare species and sensitive habitats:

1. NPS consults with the USFWSUSFWS to develop prescribed burn plans that are in compliance with Section 7, of the Endangered Species Act.
2. A Resource Advisor will respond to wildfires and report to the Incident Commander (IC). The Resource Advisor will use GIS and knowledge of the resources to advise the IC of potential impacts of the fire and proposed suppression tactics on T&E species/habitat.
3. Mechanical fuel reduction will be used to create a fire break around Charit Creek, thereby reducing the need for retardant use in the event of a wildfire in the vicinity.
4. Hazard fuel breaks will be maintained along portions of the BISO's wildland-urban interface (WUI). These WUI buffers are intended to reduce the risk of wildfire to private property adjacent to the BISO. Properly maintained WUI buffers will increase the potential to contain wildfires within the boundaries of the BISO, thereby reducing the potential need for retardant use.
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10. During and after wildland fire suppression, snags will be removed only in proximity to firelines, and then only when snag presence poses a risk to fire containment or to firefighter safety.
11. Prescribed fires in forested habitats will be conducted from October 15 to March 31, when nonflying young are less likely to be present in maternity roosts.

Cultural Resources

Mitigation Practices to Reduce Cultural Resources Impacts: The following mitigation practices would be used at the BISO to minimize negative impacts to cultural resources:

1. Suppression of wildfires would attempt to contain ignitions before they are able to gain size, which would provide protection to archeological resources located outside the wildfire burn area
2. Hazard fuels would be reduced in and around known cultural resource sites. Fires burning in grassland areas are easier to suppress and burn with shorter residence times, meaning that prolonged heating would be minimal and damage to artifacts unlikely. Fires burning in the denser shrub and forested areas are more difficult to suppress, however, resulting in longer residence times and increased surface and subsurface heating that would damage metal, ceramic, bone, and stone artifacts and stone and brick foundations (NPS 2005).
3. MIST guidelines and cultural resource advisors would be used to minimize impacts to cultural resources.
4. Woody materials immediately adjacent to historic buildings would be carefully removed with hazard fuel reduction projects, using hand tools and, as appropriate, chainsaws or brushcutters.
5. Prior to conducting a prescribed burn, archeological surveys would be conducted to determine if cultural resources were present.
6. The National Park Service Management Guideline number 28 (Chapter 5, p70) requires an archeologist "review and assess all proposed undertakings that could affect archeological resources to ensure that all feasible measures are taken to avoid resources, minimize damage to them, or recover data that otherwise would be lost".
7. Cultural site protection efforts could range from avoidance to assigning engines to protect structures and other cultural properties and features that could be damaged by fire. Plant features associated with cultural landscapes would be protected by various methods selected through consultation with the cultural resources management specialist.
8. Methods used to protect plants may include using foam, mowed buffers and fire lines, and mechanical barriers.
9. Protection measures would be evaluated for their effectiveness and all fire management work around National Register eligible structures and cultural landscape features would be coordinated with the cultural resource management specialist
10. The concurrence of the appropriate State Historic Preservation Officer (SHPO) would be obtained, by consulting formally in writing.

Visitor Use

***Mitigation Practices to Reduce Visitor Use Impacts*:** When it would be necessary to close an area during wildfire suppression and prescribed fire operations in order to provide for visitor protection, all affected trailheads would be signed so that closures would be easily recognized. Measures to be taken to provide for visitor safety, such as posting traffic warning signs and public notices, would be identified in the prescribed burn plan or the daily wildfire operations plan. Interpretative programs would be presented, when appropriate, to better

inform the public of the role of fire in the ecosystem and how fire can be used to accomplish management objectives. The BISO would work with adjacent landowners and the Forest Service to coordinate activities so that the visiting public would be impacted as little as possible.