National Park Service

U.S. Department of the Interior

Fort Donelson National Battlefield

Kentucky and Tennessee

Fire Management Plan

Environmental Assessment

December 2017

This page intentionally left blank.

Fire Management Plan

Environmental Assessment

Public Comment

Public scoping for the FMP update and EA was pursued through the distribution of an informative brochure, including distribution to the Fort Donelson National Battlefield stakeholders via mail. In addition, a press release was sent to various media outlets and was sent via email to partners and constituents on the National Battlefield mailing list. All information was posted on the Park website and the project was set up for review and comment in the NPS Planning, Environment, and Public Comment website (PEPC). One open house style meeting was also conducted to offer further opportunities for the public and various agencies to gather information of the proposed addition of the use of fuel treatments, targeted herbicide use to aid in maintenance of fuelbreaks and defensible space, as fire management tools, and to solicit feedback for direction in the EA.

If you wish to comment on the environmental assessment, you may mail comments to the name and address below or post comments online at http://parkplanning.nps.gov/fodo. This environmental assessment will be open for public review for 30 days. Before including your address, phone number, email address, or other personal identifying information in your comments, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. Although you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Superintendent
Fort Donelson National Battlefield
P.O. Box 434
174 National Cemetery Drive
Dover, TN 37058

Table of Contents

List of Tables

List of Figures

Purpose and Need

Introduction

The Fort Donelson National Cemetery was established in 1867. Fort Donelson National Battlefield (FODO or National Battlefield) was established as a national military park in 1928 partially for the purpose of " historical and professional military study" and to "preserve and interpret the historic battleground" associated with the 1862 Civil War battle of Fort Donelson. Decades later, the Dover Hotel and surrounding land where Confederate General Simon Buckner surrendered to Ulysses S. Grant, was acquired and restored. The National Battlefield consists of 5 non-contiguous units—Fort Donelson, Dover Hotel, Confederate Breakout, Union Reorganization, and Fort Heiman—that encompass approximately 1,065 acres (Figure 1). Additionally, the National Battlefield is a cultural landscape that contains contributing features, such as two historical river artillery battery positions along the Cumberland River, approximately 2.5 miles of outer earthworks, the historic Dover Hotel, monuments and iron position markers, and the Fort Donelson National Cemetery. More information regarding the fundamental purposes and guidance for management of the National Battlefield may be found in the 2009 Long-Range Interpretive Plan at https://www.nps.gov/hfc/pdf/ip/fodo-lrip-2009.pdf and the 2011 Foundation Statement.

The National Park Service (NPS) is proposing to revise the 2003 Fire Management Plan (FMP) for the National Battlefield. The 2003 fire management strategies/tools include wildfire suppression, mechanical/manual work along three sections of the National Battlefield perimeter that borders private residences, and mowing. This Environmental Assessment (EA) evaluates the impacts that could result from continuing current fire management (No-action Alternative) or implementation of one action alternative. At the conclusion of the National Environmental Policy Act (NEPA) required analysis and decision-making process, the alternative selected for implementation will become the fire management tools/strategies for the National Battlefield FMP and will be included in a new FMP.

This EA has been prepared in accordance with the NEPA and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500–1508), the Department of Interior regulations implementing NEPA (43 CFR 46), and NPS Director's Order 12 (NPS 2011).

Purpose of and Need for Action

Purpose

The purpose of the proposal is to revise the FMP for the National Battlefield to comply with Director's Order 18 (DO-18; NPS 2008a) and Reference Manual-18 (RM-18), which states that all parks with burnable vegetation must have an approved fire management plan (NPS 2014). In addition, the purpose of the revision is to add the use of additional fire management tools/strategies and incorporate battlefield lands acquired since the 2003 FMP.

Need for Action

A revised FMP is needed to meet current NPS policies. The NPS has made revisions and updates to RM-18, Wildland Fire Management (NPS 2014) to comply with the 2009 Guidance for Implementation of Federal Wildland Fire Management Policy (U.S. Department of the Interior and U.S. Department of Agriculture 2009) since the 2003 FMP was written.

The revision of the National Battlefield FMP is needed to allow the use of prescribed fire management treatments to accomplish resource objectives. Resource objectives include revegetation of historic landscapes according to the original historic planting plans and vegetation management associated with the historic landscape restoration (NPS 2009). The current FMP also does not adequately reflect updated fire management techniques, strategies, and fire terminology. An updated FMP would provide a management framework for all FODO wildfire suppression activities and planned prescribed fire treatments that would best meet overall resource management and human value protection goals.

The current strategy of suppression of all wildfires and lack of a natural fire regime has resulted in the natural succession of forest stands to closed canopy forests with dense understories of shade/fire intolerant species, such as elm (*Ulmus* spp.), maple (*Acer* spp.), American Beech (*Fagus grandifolia*), and sweetgum (*Liquidambar styraciflua*). Historically, the vegetation consisted of mixed hardwood forests with a more open understory of grasses and forbs, and local agricultural fields. The dense forest stands have reduced the integrity of the historic cultural landscape within the National Battlefield by encroaching upon historic fields and obscuring the views and vistas that help a visitor to understand the conditions of the Battlefield in 1862, such as topography and water sources (NPS 2015a). There is a need to restore, protect, and maintain the historic cultural landscape, reduce hazardous fuel loads, and improve the health and vigor of the vegetation communities, while at the same time protecting visitors, employees, facilities, and adjacent private property.

Objectives in Taking Action

Objectives are purpose statements that describe what should be accomplished for the action to be considered successful (NPS 2015b). Based on consideration for the purpose and need for action, the National Battlefield's enabling legislation, other park planning documents, and the NPS mission and policy guidance, the following fire management objectives were developed with park staff during internal scoping:

1. Prioritize protection of firefighters, staff, and the public in all fire management activities.
2. Facilitate the protection of park cultural resources, infrastructure, recreational values, other fundamental resource values, and the protection of adjacent private property from park wildland fires.
3. Restore, protect, and maintain historic cultural landscapes.
4. Reduce hazardous fuels to reduce the risk of high-intensity wildfires.
5. Promote communication and cooperation on fire management activities between agencies and the public.

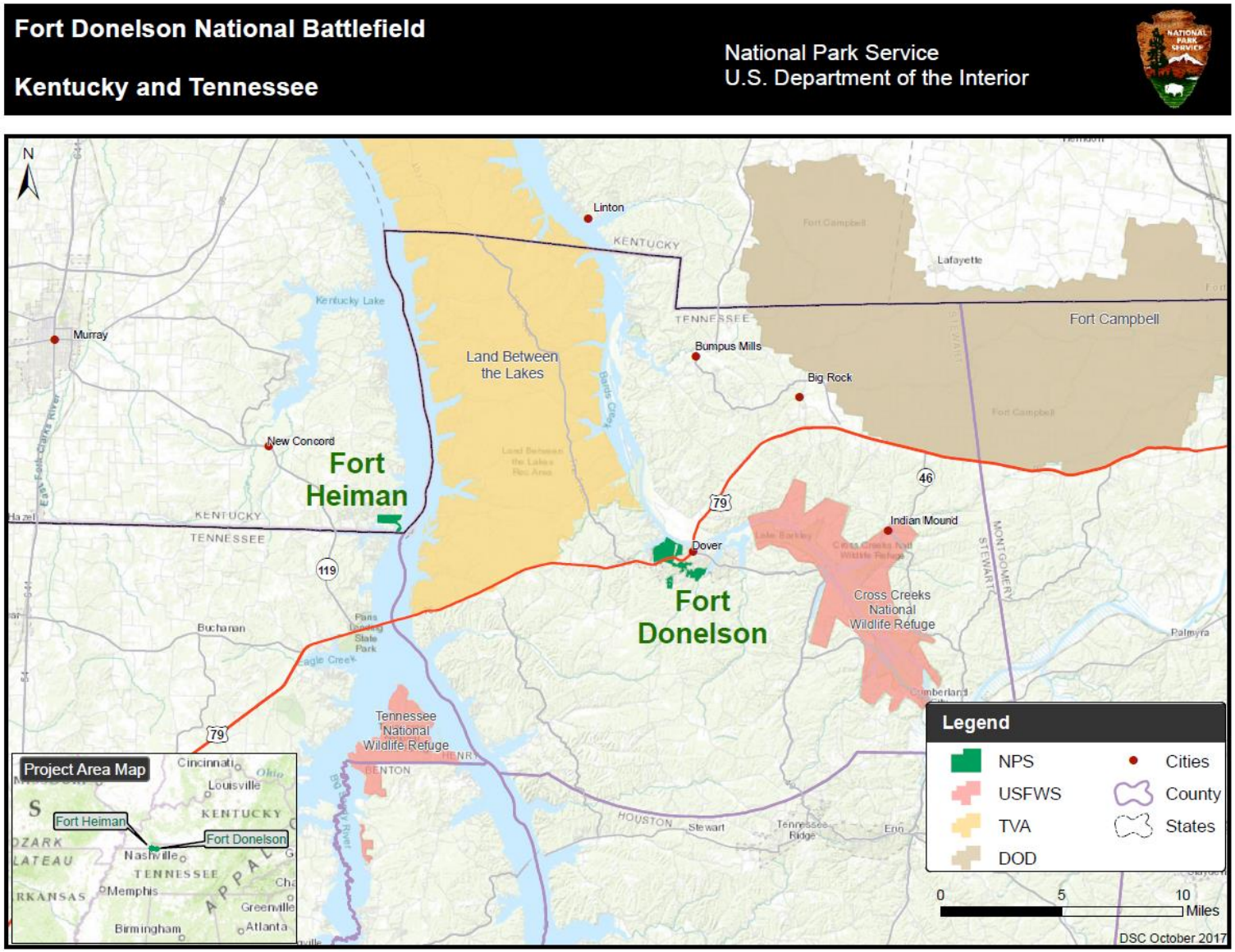

FIGURE 1. FORT DONELSON NATIONAL BATTLEFIELD VICINITY MAP

Relationship to Other Laws, Regulations, and Policies

Numerous laws, regulations, and federal policies guide the decisions and actions regarding this EA. The primary legal and regulatory requirements that relate to fire management in the National Battlefield include the following listed below.

In accordance with the *NPS Management Policies 2006*, the wildland fire management program will be designed to protect natural and cultural resources; address potential impacts on public and private land adjacent to the National Battlefield; protect public health and safety; and provide safety considerations for visitors, employees, and developed facilities.

Director's Order 18 (DO-18; NPS 2008a) states that each park with burnable vegetation must have an approved Fire Management Plan that will address the need for adequate funding and staffing to support its fire management program. The DO-18 defines what an approved FMP must include emphasizing that firefighter and public safety is the first priority and seek an interagency approach to managing fires on an ecosystem basis across agency boundaries. This order also directs parks to identify, manage, and where appropriate, reduce hazardous fuels.

Reference Manual 18 (RM-18; NPS 2014) is derived from DO-18 and provides comprehensive, more detailed guidance and policy for NPS fire management programs. The NPS RM-18 emphasizes that the fire management program will respond and manage wildfires and prescribed fires to protect the public, communities and infrastructure, conserve natural and cultural resources, and restore and maintain ecological integrity. This management emphasis is based on the federal cohesive strategic goals as follows:

1. **Restore and Maintain Landscapes:** Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
2. **Create Fire-Adapted Communities:** Human populations and infrastructure can withstand a wildfire without loss of life and property.
3. **Respond to Wildfire:** All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

Director's Order 28 (DO-28) requires the consideration of impacts on historic properties that are listed or eligible to be listed in the National Register of Historic Places (NRHP). The DO-28 states that FMPs should address cultural resource concerns and protect archeological sites, historic structures, and cultural landscape features.

Authority for implementing a fire management program at FODO originates with the Organic Act of the National Park System (1916). The Organic act mandates that NPS "…promote and regulate the use of Federal areas known as national parks, monuments, and reservations…by such means and measures as to conform to the fundamental purpose of said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (6 U.S.C. 1)."

Issues and Impact Topics

This section identifies the impact topics that could be affected by the alternatives. Impact topics are derived from issues identified during internal and public scoping. When determining whether to retain an issue for more detailed analysis in this EA, the interdisciplinary team considered, among other things, whether or not:

- the environmental impacts associated with the issue are central to development of a fire management plan or of critical importance;
- a detailed analysis of environmental impacts related to the issue is necessary to make a reasoned choice between alternatives;
- the environmental impacts associated with the issue are a big point of contention among the public or other agencies; or

- there are potentially significant impacts to resources associated with the issue.

Ultimately, it is important for decision makers and the public to understand the impacts that each of the alternatives under consideration would have on specific resources. Therefore, the NPS uses impact topics as headings to indicate which resources would be affected and to organize the discussions of the affected environment and environmental consequences section.

The impact topics carried forward for analysis in Chapter 4 of this EA include:

- Air quality
- Soils
- Vegetation (including invasive species)
- Water resources
- Wildlife
- Special status species
- Archeological resources
- Cultural landscapes
- Visitor use and experience
- Human health and safety

Impact Topics Dismissed from Further Analysis

Using the same considerations noted previously, the following impact topics were initially considered but were subsequently dismissed from analysis.

Indian Trust Resources. Secretarial Order 3175 mandates any anticipated impacts to Indian trust resources from proposed project or action by the Department of Interior agencies be explicitly addressed in environmental documents. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. The NPS consulted with the affiliated Native American tribes to determine whether any trust resources could be impacted by implementing a fire management plan at the National Battlefield. Following consultation, NPS has determined that there are no Indian Trust resources that would be affected by fire management activities. Therefore, Indian Trust Resources was dismissed as an impact topic carried forward for analysis in this EA.

Environmental Justice. Presidential Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (1998) requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing the disproportionately high and/or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities.

According to the Environmental Protection Agency, environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The goal of fair treatment is not to shift risks among populations, but to identify potentially disproportionately high and adverse environmental effects, and identify alternatives that may mitigate these impacts.

Calloway and Stewart counties contain both minority and low-income populations; however, environmental justice was dismissed as an impact topic for the following reasons:

- The park staff and planning team actively solicited public participation as part of the planning process and gave equal consideration to all input from persons regardless of age, race, income status, or other socioeconomic or demographic factors.

- Implementation of any alternative would not result in any identifiable adverse human health effects. Therefore, there would be no direct or indirect adverse effects on any minority or low-income population.
- The environmental impacts associated with implementation of any alternatives would not disproportionately affect any minority or low-income population or community.
- Implementation of any alternatives would not result in any identified environmental effects that would be specific to any minority or low-income community.
- The economic impacts resulting from implementation of any of the alternatives may be adverse, but they would not disproportionately affect minority or low-income populations. In addition, the park staff and planning team do not anticipate that the impacts on the socioeconomic environment would alter the physical and social structure of nearby communities.

Based on this rationale, environmental justice was dismissed and not carried forward for analyses in this EA.

Alternatives

This section describes the two alternatives, the No-action Alternative and the Proposed Action (revised fire management plan), that the NPS is considering for fire management activities in the National Battlefield. Alternatives represent different means for meeting the purpose, need, and objectives described in Chapter 1. A range of alternatives were developed that include a set of reasonable alternatives as well as alternatives considered but eliminated from detailed analysis. A reasonable alternative is one that is technically and economically feasible as well as meets the project objectives to a large degree.

Alternative A—No-action Alternative

Alternative A would continue using the strategies in the 2003 FMP and under current Federal Wildland Fire and National Park Service policies—the main components are suppression of wildfires and manual and mechanical treatments of some vegetation.

Wildfire Suppression

All wildfires, human-caused and naturally-ignited fires, would continue to be suppressed at minimum cost, and would consider both firefighter and public safety, and protecting values at risk. Values at risk include property, structures, natural and cultural resources, and community infrastructure. Throughout the National Battlefield, firefighters utilize minimum impact suppression techniques (MIST) for all wildfire suppression activities. MIST is the concept of using the minimum tool to safely and effectively accomplish a task (NPS 2014). Tactics often involve the use of natural barriers, vegetation changes, roads, and trails for firelines.

Wildfire suppression response actions and guidance are based on national fire policy (Interagency Standards for Fire and Fire Aviation Operations 2017, Chapters 3, 9–16). Suppression strategies used to manage wildfires could include indirect or direct attack tactics. Direct attack methods utilize techniques to actively extinguish the burning edge of the wildfire. Indirect attack methods occur further away from the fire edge and focus on removing fuel availability for the fire. Examples of indirect attack include burning of vegetation along roads or other natural barriers to confine the fire to a determined area, removing fuels and mowing around infrastructure, and applying water or foam to values at risk, such as cultural or natural resources or infrastructure, to decrease fire behavior and intensity. Protecting buildings or other localized, specific resources is also called point protection, which focuses on protection of specific values from fire damage.

Wildfire suppression activities could use application of foam, water, and/or retardant by ground equipment or aircraft, allow limited off-road use of wildland fire engines, potential use of heavy equipment, such as fire plows/dozers when approved by the Superintendent. Upon Superintendent approval, fire plows might be used during wildfires if critical values were threatened, if other alternatives are ineffective, and/or for fires that pose serious risk to life and property. Mechanical equipment use is prohibited unless authorized by the Superintendent in NPS cultural areas due to the potential to damage cultural sites. In general, roads, trails, or natural features are used for firelines.

Manual and Mechanical Treatments

Manual and mechanical thinning of wildland vegetation is allowed under the 2003 FMP to prevent wildfire damages and protect values. The techniques that could be used could include but is not limited to chainsaws, bush hogs, and mowing, and would continue to help prevent woody and invasive plant species from encroaching on open fields and Battlefield cultural features. These manual and mechanical techniques could be used to reduce hazard fuels along the park boundary that borders private residences. Manual and mechanical thinning would involve selective thinning of smaller diameter (4 inches in diameter or less) hardwoods, pines, and invasive exotic plant species.

Mechanical treatments include hazard fuel reduction activities which allow creating 12-foot wide fuelbreaks along approximately a half mile of the National Battlefield boundary using a bush hog. This action allows selective removal of identified hazard fuels adjacent to the 12-foot wide fuelbreak for additional 30-feet.

Identified hazard fuels include dead and downed trees, ladder fuels, exotic vegetation, and small trees less than 4-inches in diameter. All slash material would be hauled off site using trucks or trailers.

Alternative B—Proposed Action (Preferred Alternative)

This alternative would implement all of the above actions in Alternative A, and would include the following:

- prescribed fire including prescribed pile burning of slash material[1];
- additional manual and mechanical work to include wheeled or, tracked vehicles such as masticators and utility task vehicles for fuelbreaks, defensible space, and forest restoration; and
- herbicide treatments to aid in maintenance of fuelbreaks and defensible space.

All treatments would be implemented under carefully prescribed conditions, plans, and approved objectives to restore, protect, and enhance cultural and natural resources in the National Battlefield. This suite of techniques would allow the restoration, protection, and maintenance of the historic cultural landscape, reduce hazardous fuel loads, and improve the health and vigor of the vegetation communities, while at the same time protecting visitors, employees, firefighters, facilities, and adjacent private property. The National Battlefield staff would coordinate with resource specialists to pre-plan locations of values at risk and determine required mitigation measures.

Prescribed Fire

Prescribed fire would be used to reduce hazard fuels, to restore, protect, and maintain cultural landscapes, to emulate the natural fire frequency, to improve the health and vigor of vegetation communities, and to help control non-native and woody vegetation. All prescribed fire treatments would have an agency prepared burn plan developed following all interagency and NPS procedures. (NWCG PMS-484 2014), and approved by the Superintendent. Because the National Battlefield does not have sufficient staff to manage a prescribed fire, all prescribed burn plans would identify personnel needed from all required NPS and/or interagency partner resources needed to implement the treatment . This includes cooperators such as the NPS Mississippi River Fire Management Zone Office, federal, state, and local partners. Each prescribed burn plan would identify ignition techniques and patterns, which could include ground and/or aerial ignition. Aerial ignition of ground vegetation/fuels is accomplished utilizing an aerial platform (typically a manned helicopter) equipped with an aerial ignition devices designed to discharge individually ignited fuel containers that fall to the ground in a controlled pattern. Prescribed burns that exceed prescribed burn prescription parameters and are not meeting prescribed fire and/or resource objectives would be suppressed. The annual acres treated using prescribed fire would be up to 750 acres. This goal would be implemented through the application of multiple prescribed fires burned at different times of the year. Approximately 72 acres (68 in FODO unit and 4 in Fort Heiman unit) located adjacent to residences and other structures would be excluded from prescribed fire treatment, but may have mechanical treatments employed in these areas or be left to provide a buffer between the National Battlefield and its neighbors.

The prescribed fire return intervals for FODO would vary based on the vegetation communities present and if being used for maintenance or restoration (Table 1).

[1] Prescribed fire including pile burning of slash material is different from debris burning. Debris burning includes activities such as disposal of vegetative material generated from maintenance activities (e.g., mowing or tree trimming), manual or mechanical hazardous fuels reduction, etc. Under RM-18 Section 6.7, and with Superintendent approval, FODO is allowed to burn vegetation without a prescribed burn plan or fire personnel as long as a specific set of criteria are met. These criteria include minimal potential to burn into the wildland environment, minimal impact to the public and minimal impact to natural and cultural resources. The currently used debris burning site at FODO is located at the water line near the maintenance building. Future debris burning sites would be located in mechanically cleared areas with open viewsheds.

TABLE 1. FIRE RETURN INTERVALS BASED ON VEGETATION COMMUNITY AND RESTORATION AND MAINTENANCE REGIMES

Vegetation Type	Fire Return Intervals (years)	Restoration Goals
▶ Southern Oak-Hickory ▶ Central Interior Upland Cherrybark Oak Forest ▶ White Oak–Mixed Oak Dry-Mesic Alkaline Forest	2–4 for Restoration 4–8 for Maintenance	Restoration of historic fuel loading, pole density, cover of herbaceous species; exotics species reduction
▶ Cultivated meadows ▶ Successional Broom-sedge	1–3 For Restoration 2–6 for Maintenance	Restoration of historic fuel loading, stimulate herbaceous species, exotics species reduction
▶ Fort Heiman Kentucky Barrens	2–4 for Restoration 4–8 for Maintenance	Restoration of remnant Barrens vegetation via woody encroachment and exotic species reduction. Open canopy to restore Blackjack oak (*Quercus marilandica*)

Expanded Manual and Mechanical Treatments

Manual treatments would include the use of hand tools and handheld power tools, such as chainsaws. Mechanical treatment work includes wheeled and/or tracked vehicles such as masticators, mowers, and utility task vehicles. Mechanical and manual treatments would be used to reduce hazard fuels, prepare for prescribed burns, restore historic landscape and forest conditions, create and maintain fuelbreaks and defensible space, and reduce the risk of wildfires. Mechanical fuels treatments would have an approved plan that is prepared in accordance with 2014 RM-18 Chapter 7 guidance.

Mastication, which involves mechanical cutting or chopping of small undesirable trees, and brush into chunks, chips, or strips is done via low ground pressure wheeled or tracked equipment operated off road. Mastication could be used on brush or trees up to 4 inches in diameter in select areas to restore the integrity of the historic landscape by reducing woody encroachment and restoring the natural structure of forest stands with a more open understory of grasses and forbs. Furthermore, restoring the natural forest structure would help to restore the integrity of the historic landscape by reestablishing historic viewsheds that illustrate the 1862 Battlefield conditions.

The annual acreage treated mechanically would be up to 500 acres per year. Creation of fuelbreaks along areas of the FODO boundary is included in this acreage.

Herbicide Use

Targeted herbicide treatments would be used to aid in the maintenance of fuelbreaks and defensible space to slow vegetation regrowth. Targeted herbicide could include hand spray applications or backpack sprayer to limit re-sprouting along fuelbreaks, defensible space, or landscape scenes around high value areas, such as historic sites. All herbicides used would be U.S. Environmental Protection Agency approved and would be applied following the specified label conditions. All herbicide use proposals would be submitted to the NPS Pesticide Use Proposal System for evaluation and approval before use. Approval comes only after regional and/or national level staff consider factors such as the target use, location of where the application will occur, potential threatened and endangered species concerns, potential for contamination of surface or ground water, persistence in the ecosystem, safety to employees and the public, and type of application (spot spraying). The National Battlefield staff utilizes the NPS-designated recordkeeping system for purchasing, storing, tracking, and maintaining each approved product. Generally, herbicide use would be coordinated with prescribed burning and/or mechanical/manual projects as needed to supplement those treatments.

The annual acres treated by herbicides would be up to 500 acres.

Fire Management Actions and Components

Table 2 summarizes alternative actions and FODO fire management program components. While not all listed activities are performed by fire management staff, they are related to vegetation management, which is an activity that has bearing on the fire management program. Additionally, Table 1 highlights the primary differences between the alternatives.

TABLE 2. COMPARISON OF FIRE MANAGEMENT RELATED ACTIVITIES FOR EACH ALTERNATIVE

Fire Management Activities and Program Components	Alternative A (No-Action Alternative)	Alternative B (Proposed Action)
Wildfires would continue to be suppressed	X	X
Direct and indirect attack and confine/contain strategies could be utilized in suppression.	X	X
Wildfire control tactics may include application of foam, water, and/or retardant; off-road use of vehicles with suppression equipment; use of wildland fire engines; vegetation cutting by chainsaws and tracked or wheeled equipment; and potential use of heavy equipment such as fireplows or bulldozers, when approved by the FODO Superintendent.	X	X
Burned Area Emergency Rehabilitation Actions (BAER) could occur after wildfires.	X	X
Protection of adjacent private property would be a priority and considered in all phases of fire management.	X	X
Minimum Impact Suppression Techniques (MIST) would be utilized whenever possible to protect battlefield values.	X	X
Community cooperation and coordination with neighbor and partner agencies would be emphasized.	X	X
Mechanical treatments using wheeled/tracked equipment, such as masticators, could be considered and used for forest restoration, hazard fuel reduction, and defensible space goals.		X
Mowers would continue to be used to maintain the open fields and Battlefield cultural features.	X	X
Slash cut and hauled from wildland could continue to be burned in control, non-wildland areas.	X	X
Prescribed burns could be utilized to achieve identified objectives with approved burn plans.		X
Approved herbicides could be used to aid in maintenance of fuelbreaks and defensible space activities.		X

Mitigation Measures

The following mitigation measures were developed to minimize the degree and/or severity of adverse effects to resources found in the National Battlefield and would be implemented with the action alternative, as needed. The battlefield management staff would include these mitigation measures in the new FMP. Some of them would be utilized under either alternative, although their influence may differ depending on which alternative is selected.

Fire Managers would work with the FODO staff and other agencies to ensure that the park operations, natural, and cultural concerns, and impacts on neighbors are considered in planned projects and wildfires. These mitigation measures are based on best practices balanced with law and agency regulations. They may be updated over time as park management goals are updated, new science becomes available, new species recovery actions are developed, new cultural sites are identified, and/or better techniques and efficiencies are

learned. Updates would be incorporated in accordance with this EA and the decision document and current law and policy.

The mitigation measures would be incorporated into the new FMP, *Wildland Fire Decision Support System* (WFDSS) that is utilized during a wildfire, and fire management work as applicable.

General

- For all wildfires and fire management activities National Battlefield and Zone Fire Management Officer (FMO) and fire management staff would consider tools, procedures, and equipment that least impact natural and cultural resources. Risk to these values would be balanced with safety, fire, and land/resource management objectives. Managers and firefighters would consider Minimum Impact Suppression Techniques (MIST) on all projects and incidents to minimize impacts of fire response operations. See page 91, *Incident Response Pocket Guide, January 2014*.
- The Zone FMO and fire management staff would utilize indirect/confine type strategies as preferred tactics in suppressing and managing most wildfires beyond initial attack. When appropriate, wildfire incident commanders will utilize confine/contain type strategies in suppression of wildfires that resist containment beyond initial attack. MIST guidance, including burnout of indirect fuelbreaks, will be followed as appropriate when planning and implementing fire suppression activities.
- Point protection to protect identified park values would be utilized in all areas.
- National Battlefield management staff would use fire effects monitoring, resource databases and GIS mapping to determine locations of sensitive species, resource values, and important human/infrastructure values. These would help in predicting and evaluating wildfire and project-specific effects, and help develop specific incident/project objectives and mitigations.
- All prescribed burns would have a written and approved prescribed fire burn plan, as required by the *Interagency Prescribed Fire Planning and Implementation Procedures Guide (April 2014)*. The Guide includes resource, safety, and public mitigation considerations that are to be implemented on each project.
- After major wildfires, BAER would be considered in consultation with regional office and resource specialists.

Air Quality

- Coordination with state air quality, forestry agencies, and adjacent agencies and landowners regarding prescribed fires would occur to limit cumulative smoke impacts.
- Fire/park staff would perform public and neighbor notification procedures for all prescribed burns and wildfires focusing on residents and activities that might be impacted. Known sensitive receptors would be specifically notified in advance when possible by NPS staff.
- Smoke management tools, such as modeling programs, would be utilized before prescribed fires to help determine predicted smoke paths and effects. Smoke transport winds would be assessed by prescribed fire and wildfire managers to determine impacts to sensitive receptors, travel and transportation corridors, and populated areas. Coordination would occur with appropriate federal, state and local agencies.
- Signage, closure, and escorted travel would be considered or coordinated with appropriate state and local agencies if smoke were expected to impact roadways.
- Timing and methods of ignition on prescribed burns would be regularly assessed and reviewed to help minimize smoke impacts. Accelerated mop-up would be used where possible to minimize smoldering.

Soils

- Natural and manmade features (such as roads, trails, water bodies, pre-existing firelines), or vegetation change barriers would be utilized when possible for wildland fire control lines to minimize the need for new line construction and soil disturbance.

- Where constructed firelines are necessary, they would be built to the minimum depth and width needed for safe control operations for both prescribed fire and wildfires. Where appropriate, blow lines could be created using a backpack leaf blower that clears the leaf litter to mineral soil. Light scraping and/or blow lines would minimize ground disturbance. Hand lines should blend with natural or cultural features to the extent possible.
- Firelines would be rehabilitated as soon as possible after fires are out to prevent erosion, other impacts, and negative visual effects. Hand line soil disturbance should be pulled back over the disturbed area and covered with cut vegetation debris.
- Firelines on the park boundary or fuelbreaks are considered park infrastructure; they are used to prevent fires from leaving/entering the park and as prescribed fire control lines. They may be maintained in place, but would get full considerations to minimizing soil, environmental, and visual impacts.
- Zone FMO and fire management staff would utilize water, pumps, and hose lines when possible for wetlines or to back-up firelines, to minimize the amount of fireline construction and habitat disturbance.
- If equipment is authorized by the Superintendent to be taken off road, resource advisors (READs) would advise equipment operators on techniques to minimize soil and vegetation disturbance, compaction, and displacement. Turning of equipment often causes the most damage, so work would be planned to minimize turning. Untrained or new operators may be accompanied by more experienced operators or READs to recommend low-impact techniques.
- Prescribed fire and wildfire suppression burnouts would avoid widespread, intense, and long-duration surface burning if possible to prevent soil damage and erosion.

Water Resources

- If aviation resources are utilized, water would be the preferred agent used for aviation drops on wildland fires. Use of foam or fire retardant drops must have Superintendent approval before use, and would usually not be considered unless risk to life or major property loss appears inevitable.
- Helicopters would be required to pre-wash their buckets/tanks in a disinfectant solution before use on all prescribed fires to prevent potential transfer of exotic organisms. For wildfires, pre-washing should be done whenever possible for incoming helicopters, however where structures or critical values are immediately threatened, and drops are immediately needed, pre-washing may not be feasible.
- Helicopter dip sites from surface water sources must be approved by the park before use.
- If pumps are utilized on wildland fire operations, appropriate containment systems would be employed to prevent leakage of gas, oil or other fluids.
- When considering use of mobile motorized equipment (tracked or wheeled vehicles), equipment with fluid leaks would not be utilized. Refueling, filling, or mixing of gas and other fluids would be avoided in sensitive areas and near surface waters.
- No dozers or tractor plows would be used without Superintendent approval. If equipment is authorized, stream or water crossings would be minimized. If necessary, crossings or damages will be promptly restored and rehabilitated in consultation with resource specialists.
- Staff utilizing herbicide would be trained in accordance with park Integrated Pest Management policies and procedures related to approved handling, storage, transportation, mixing, spill prevention, and application procedures.
- Widespread high-severity fire will be avoided when possible in prescribed fires and wildfire suppression activities to minimize severe runoff effects into surface waters and riparian areas.
- Equipment operation would be avoided on steep slopes, fragile or highly erosive soils, and in or immediately adjacent to watercourses or stream beds.

Natural Resources

- Consultation with the U.S. Fish and Wildlife Service for impacts to federally listed species would be completed prior to any planned fire management activity. Appropriate emergency consultations would be initiated during major wildfire operations.
- Upon notification of a wildfire, FODO resource staff or READs would examine maps and information resources to assess and discuss potential wildlife/habitat/cultural effects; they would then advise fire managers on protection of wildlife/habitat/cultural values.
- When planning, and before initiating treatments or prescribed burns, resource and/or staff specialists would be consulted to determine presence of and effects on sensitive species. Specific mitigation actions would be developed to minimize impacts on species of concern.
- WFDSS management requirements and strategic objectives would be developed and pre-loaded into WFDSS to guide firefighters in protecting sensitive species or habitats from wildfire management impacts.
- Project work, such as mastication, mowing, and brush cutting equipment use may be curtailed in some areas during prime avian breeding season or northern long-eared bat or Indiana bat breeding season. Northern long-eared bat and Indiana bat guidelines and mitigation measures are below.
- The following mitigation measures would apply for the northern long-eared bat and Indiana bat:
    - Conduct necessary mature tree removal or thinning activities during winter (November 15–March 31) to avoid removing roost trees and injuring or killing Indiana bats (*Myotis sodalis*) or northern long-eared bats (*M. septentrionalis*). This will also minimize impacts to pups in unidentified roosts.
    - Avoid clearing suitable spring staging and fall swarming habitat within a 5-mile radius of known federally listed bat hibernacula during the staging and swarming seasons (April 1 to May 15 and August 15 to November 14, respectively).
    - Manage forests to ensure a continual supply of snags and other suitable maternity roost trees.
    - For the northern long-eared bat, the optional framework to streamline Section 7 consultation would be used by the National Battlefield as required to assist with protection of this species and habitat; see (https://www.fws.gov/midwest/endangered/mammals/nleb/s7.html). Accordingly, NPS will make a determination as to whether a specific fire management activity is exempted from incidental taking prohibitions in the final 4(d) rule. At least 30 days in advance of funding, authorizing, or carrying out a specific fire management activity, the NPS will provide written notification of the determination to the USFWS Cookeville Ecological Services Field Office.
    - After providing for public and firefighter safety, attempt to prevent any wildfire from burning to within a quarter mile of a known hibernaculum.
    - After providing for public and firefighter safety, attempt to prevent any wildfire from burning to within 150 feet of a known maternity roost tree, if one is found in the National Battlefield.
- Contact the appropriate USFWS Cookeville Ecological Services Office as soon as it is practical in the event of any wildfire that burns within a quarter mile of a known hibernaculum or 150 feet of a known occupied maternity roost tree, or that occurs during the maternity season (approximately April 1–August 15). Note: This procedure follows the "Emergency Consultation Process" as defined by USFWS.
- Firing patterns on prescribed burns would be considered that allow escape routes for wildlife.
- Helicopter use would be modified as feasible to lower the risk of bird collisions.
- If new threatened and endangered species (T&E) or sensitive species are identified at the National Battlefield, park management would consult with resource or wildlife specialists and fire managers with the latest science or understanding of those species. Resource management staff would develop best fire management practices related to those species or habitat as required by law and policy, and then add new information to the FMP with the goal of keeping fire management activities operational for the good of fire-dependent species and habitat. Resource management staff would consult with

appropriate wildlife management agencies to get recommendations/keep them abreast of the National Battlefield's efforts.

- Chainsaw work involving bucking and felling of live and dead large, mature trees would be minimized to what is needed for firefighter and/or public safety, or necessary fire control operations. Natural and cultural resources guidelines would be followed.
- Slash disposal areas, if needed, would be identified that are not in sensitive wildlife habitat.
- After or during the wildfire or other activity, resource specialists would direct formal or informal consultation with the US Fish and Wildlife Service and/or state wildlife agencies on the status of the species, its recovery plan (if any), and previous agreements between the parks and the agencies.
- For the northern long-eared bat, the optional framework to streamline Section 7 consultation would be used by the parks as required to assist with protection of this species and habitat; see (https://www.fws.gov/midwest/endangered/mammals/nleb/s7.html).
- Vegetation would be removed, cut, or manipulated along firelines to the minimum width necessary to effectively stop or minimize fire spread based on expected fire behavior and to minimize disturbances that often promote invasive species (see soils above).
- Mowing or mastication may be utilized when possible for firelines to avoid scraping or exposing soils, providing fewer soil disturbance opportunities for establishment of invasive plants. Water delivery systems installed and operated by firefighters would usually be used for holding on these firelines.
- The National Battlefield would develop equipment washing (weed washing) procedures in their FMP to minimize the spread of exotic vegetation or seeds when using equipment from outside the park.
- Constructed firelines would be rehabilitated immediately after fires are out to prevent erosion, visual effects, and minimize establishment of invasive plants.
- Post-wildfire, post-treatment monitoring would be conducted to check for establishment of new invasive species populations. If found, staff would develop specific invasive control or treatment plans as necessary.
- Prescribed fire would usually utilize prescriptions that minimize widespread, intense, and long-duration surface burning of soils to prevent opportunities for invasive plant species establishment.
- Off-road equipment use would be minimized; if needed operators would be trained or supervised to minimize soil and vegetation disturbance, compaction, and displacement.

Cultural Resources

- Cultural resource specialist would be consulted for all fire management activities to provide recommendations to avoid adverse impacts to cultural resources and ensure that actions are compatible with the broader historic landscape purpose and would enhance the cultural landscape in the long-term.
- The assigned FODO cultural resource representative would coordinate as needed with the appropriate State Historic Preservation Office to help identify effects, actions and mitigations on cultural resources by wildfires and fire management activities. Identify cultural sites in advance of wildfire, prescribed fire, or fuels treatment activities when possible in order to plan avoidance and mitigation strategies.
- Fire management staffs will have access to maps showing cultural landscapes, so that they know when and where to initiate cultural landscape consultation.
- Educate assigned fire personnel about the significance of cultural sites, how to identify obvious sites, and appropriate actions and notifications to be made if new sites are encountered. Remind assigned firefighters to never pick up or disturb artifacts or cultural resources, but to report and document their presence.
- The cultural resource specialist(s) would be contacted immediately if previously unrecorded cultural resources are discovered during any wildland fire operations. The cultural resources would be avoided, recorded, and protected.

- Firelines and ground disturbance would be avoided in known cultural resource areas. If work must occur near known cultural resources, mowing or mastication would be considered instead of ground disturbance to avoid exposing mineral soils and buried cultural materials.
- In collaboration with cultural resource specialists, the Zone FMO and fire management staff would utilize defensive and point protection tactics to prevent damage to historic, cultural, and ethnographic sites.
- When prescribed burns occur within or near cultural resources, the mitigations would be documented and updated in park records to help evaluate protection effectiveness over time. The recorded mitigations would also be immediately available for reference if wildfires later occurred in that area.

Human Health/Safety and Visitor Use and Experience

- The National Battlefield would continually emphasize the safety of fire and park staff, and the public as the highest priority in all fire management activities. Safety often drives fire-related decision making.
- The FODO management personnel or Zone FMO and fire management staff would ensure public notification procedures occur for all prescribed burns or other fuel projects that may affect park neighbors. For long duration wildfires, regular media releases would inform locals and visitors about expected impacts of the fire, especially related to smoke and closures or restrictions.
- Signs or notices may be posted at appropriate places to inform incoming visitors of fire situations. Fire management staff would work with protection staff and local agencies on posting smoke hazard signs if smoke could impact roadways.
- Neighbors, visitors, local residents, and adjacent communities would be notified of all fire management activities that have the potential to impact them.
- Initial attack fire staff or cooperators would determine the proximity of new wildfires to visitors, adjacent landowners, and communities. They would coordinate with rangers/law enforcement staff and local agencies as necessary to inform them of the potential risk and coordinate evacuations as necessary.
- To prevent exposure to hazards where fire/vegetation management activities are underway, visitors would be kept out of the immediate vicinity of mastication, tree falling, low-level aviation operations, prescribed fires, and other special equipment use.
- Educational outreach (e.g., interpretive and media releases) would emphasize the importance of fire processes to the local ecosystem and would promote the long-term benefits of fire to fire-dependent species, wildlife, cultural landscapes, and related local economies.
- As burned areas are opened to visitors after a fire, signs would be posted informing the public of potential hazards in the burned areas, (snags, stump holes, etc.).
- Chainsaw use would be minimized along trails and adjacent to developed areas. Stumps would be flush cut; butt ends of logs would be turned away from trails and public areas.
- Other visual impacts of wildland fire management activities would be minimized. Temporary interpretive signage would be utilized to explain projects or incidents whenever possible.

Alternatives Considered but Dismissed

The use of wildfires managed for multiple objectives including resource objectives as a fire management tool was considered. This means that wildfires could be allowed to burn under carefully defined conditions to achieve resource related goals and objectives. This strategy is most often used at large acreage parks with significant natural areas or large wilderness areas. Resource objectives and goals could include habitat enhancement for a special status species, wildlife values, hazard fuel reduction, and reintroducing fire into fire dependent ecosystems. This alternative was dismissed because of the relatively small acreage of the Battlefield, the non-contiguous land parcels, the extensive wildland urban interface surrounding the Battlefield, and the lack of assigned fire staff and equipment for managing such fires at the Battlefield. For these reasons this alternative was dismissed from further analysis.

Affected Environment and Environmental Consequences

This section describes the affected environment and environmental consequences within the project area as they relate to the implementation of the proposed alternatives as described in the Alternatives Chapter. This EA analyzes both beneficial and adverse impacts that could result from implementing the alternatives considered. This chapter is organized by the impact topics presented in the Purpose and Need for Action Chapter.

Methodology for Analyzing Impacts

In accordance with Council on Environmental Quality regulations, direct, indirect, and cumulative impacts are described (40 CFR §1502.16). General definitions for potential impacts are described as follows:

Direct: An effect that is caused by a proposed action and occurs in the same time and place of implementation (40 CFR §1508.8).

Indirect: An effect that is caused by a proposed action but is later in time or farther removed in distance from the action (40 CFR §1508.8).

Cumulative Impacts Analysis

As defined by NEPA regulations (40 CFR §1508.7), "Cumulative impacts result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions." Cumulative impacts are considered for both alternatives.

Cumulative impacts were determined by combining the impacts of the alternative with other past, present, and reasonably foreseeable future actions. Past, present, and reasonably foreseeable actions that could contribute to cumulative impacts include:

- Continued rural development near the National Battlefield that results in conversion of rural and undeveloped lands to more intense human uses.
- Fire management activities in adjacent lands.

Air Quality

Affected Environment

The National Battlefield was classified as a Class II area under the 1977 amendments to the Clean Air Act (42 U.S.C. §7401 et seq.). Class II areas are allowed to increase emissions of particulate matter. Sulfur dioxide, nitrogen, and nitrogen dioxide are allowed beyond the baseline concentrations as long as the National Ambient Air Quality Standards established by the Environmental Protection Agency are not exceeded. Data collected and analyzed by the Cumberland Piedmont Inventory and Monitoring Network from 2005 to 2009 show visibility (FODO air quality related value) and ozone levels and its associated potential for foliar injury as significant concerns (NPS 2013a, Sullivan 2016). Air quality related values (AQRVs) are resources that may be affected by changes in air quality. The National Battlefield is currently within a designated attainment area, meaning that the park is in compliance with National Ambient Air Quality Standards (NAAQS) for criteria pollutants. Wildfires and prescribed fires generate particulate matter, ozone, nitrogen dioxide, and carbon monoxide (Hyde et al. 2017); all pollutants are regulated under the NAAQS.

Prior to all prescribed fires the National Battlefield staff would notify and obtain an open burning permit from the Tennessee Division of Forestry. The Kentucky Division of Air Quality would be notified prior to prescribed fires in the Fort Heiman unit. The notification would identify the location, size, and purpose of the prescribed burn, as well as distance to smoke sensitive areas. Prescribed burn plans would include mitigation measures to minimize impacts on public safety when winds have the potential to carry significant smoke that could impact traffic corridors, communities, and visitor safety.

Analysis of Alternatives and Impacts on Air Quality

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

Wildfire suppression and manual and mechanical thinning of open fields and Battlefield cultural features and hazard fuel reduction along the park boundary that borders private residences would continue. Hazard fuel loads would be retained in the forest stands, which have resulted in dense understories of elm, red maple, and sweetgum from ecological succession and may continue to accumulate in untreated forested areas, which could lead to localized, intense wildfires. Wildfires could adversely affect air quality and visibility within the National Battlefield and the surrounding area from particulate matter (ash) and smoke emissions, therefore impacting a FODO AQRV. Degradation of visibility could affect how far and how well cultural vistas and landscape features may be seen as well as visibility along transportation corridors, such as Fort Donelson Parkway and secondary roadways within FODO. In addition, air quality standards for particulate matter and ozone may temporarily be exceeded within and adjacent to the burn area, which could affect smoke sensitive receptors and communities downwind, such as schools, private residences, and the town of Dover. The extent of the adverse impacts would depend on the fire location, size, fuel type (trees, grass), and wind direction. Fugitive dust generated from fire suppression activities and increased vehicle traffic associated with fire crews would also temporarily affect air quality, but would be limited in scale to where the suppression activities were occurring. However, there has been only one wildfire to date, which burned approximately 0.1 acres, therefore it is expected that wildfires would continue to be infrequent.

Air pollutants and dust would be generated by use of gasoline-powered equipment for mechanical and manual thinning and fuel reduction projects. Fugitive dust could also be generated from driving on unpaved roads to treatment sites. The direct adverse effect of these pollutants on air quality, given the limited size and scale of the projects and infrequency of activity, would be localized and last until the completion of the treatment.

Cumulative Impacts

Smoke and particulate matter from wildfires and prescribed fires on adjacent lands (private properties, other agencies), emissions from traffic within and outside the National Battlefield, emissions or smoke from agricultural operations, and the potential for private development near the National Battlefield contribute to adverse cumulative impacts on air quality. Development near the National Battlefield could increase the potential for human caused fires and the spread of a wildfire from flammable housing materials (Stein et al. 2013). Wildfires within the National Battlefield have been infrequent and short duration, thus negligibly contributing to adverse cumulative impacts. Under Alternative A, impacts to air quality from emissions generated by mechanical and manual treatments would be temporary lasting until the treatment was completed, thus contributing negligibly to adverse cumulative impacts.

Impacts of Alternative B—Proposed Action

Impacts would be similar as described for Alternative A for wildfires and associated fire suppression activities, including emission of air pollutants from the operation of mechanical equipment and vehicles. Overall, fire management activities under Alternative B would reduce the potential for future intense wildfires, which could produce large particulate matter loads into the air, degrading the air quality and visibility. Under Alternative B, the use of prescribed fires, including pile burning of slash materials could temporarily impact air quality within and adjacent to the burn area from smoke and particulate emissions, but would not be expected to exceed national or state air quality standards. However, low-intensity prescribed fires could impact adjacent communities and roadways (Hardy et al. 2001, Achtemeir 2009, Hyde et al. 2016) and historic vistas and viewsheds through reduced visibility. In the southeast, residual smoke from prescribed fires combined with high ambient relative humidity conditions could generate fog that impairs visibility along roads that may result in traffic related accidents (Achtemeir 2003, 2009) or reduce visibility of cultural vistas and viewsheds in valleys or along waterways. The National Battlefield would conduct prescribed burns on no more than 70% (750 acres) out of the park unit's entire 1,065 acres annually. Up to about 750 acres could be treated annually in a series of prescribed burn events, which would control the amount of smoke generated.

Prescribed fires would have a prescribed burn plan that would coordinate ignitions with optimal weather conditions for combustion and smoke dispersal away from smoke-sensitive areas. Prescribed fires would not be allowed when atmospheric conditions exist that could permit air quality degradation to the degree that negatively affects public health for an extended period of time (federal and state air quality standards would be the basis for this decision). In addition, impacts to smoke-sensitive areas, such as private residences, would be minimized for prescribed fires by limiting the amount of acres burned at one time and timing ignitions early in the day to allow for combustion that is more complete during daytime conditions. The amount and duration of smoke impacts to air quality would last as long as the prescribed burn activities. Prescribed fire smoke situations that threaten smoke-sensitive areas, such as road corridors, in a significant way that mitigation measures could not alleviate dispersion or safe driving conditions may trigger suppression of a prescribed fire.

Under Alternative B, the increased use of mechanical work would temporarily impact air quality from exhaust emissions generated from internal combustion powered equipment and vehicles. Impacts to air quality from use of mechanical equipment would be temporary in nature, lasting until the treatment was completed.

Targeted herbicide use could result in herbicide in the air temporarily within the treatment area due to spray drift and volatilization (evaporation of liquid to gas). Implementing mitigation measures and the minimal use of herbicide treatments would reduce the potential for drift into non-target areas and the amount released into the air through volatilization. Airborne herbicide risks have been documented as insignificant in smoke, even when prescribed fires are applied immediately after herbicide application (McMahon and Bush 1991, Bush et al. 1998).

Cumulative Impacts

Adverse cumulative impacts from wildfires and mechanical treatments would be the same as described for Alternative A. Alternative B could temporarily impact air quality within and adjacent to the burn area from smoke and particulate emissions. In addition, prescribed burns could temporarily reduce the visibility along adjacent road corridors and communities and historic vistas and viewsheds. The contribution to adverse cumulative impacts on air quality would be negligible because air quality impacts would only last as long as the prescribed burn activities and mechanical treatments. Fire management activities under Alternative B would reduce hazard fuel loads in the forest stands by opening the canopy, thus reducing the potential for localized, intense wildfires that could adversely affect air quality and visibility (a FODO AQRV) within the National Battlefield and the surrounding area. Therefore, Alternative B would also contribute to beneficial cumulative impacts to air quality.

Soils

Affected Environment

Predominant soils in the National Battlefield include Bodine gravelly silt loams, Lax silt loams, and Sengtown gravelly silt loams, which are derived from limestone (Thornberry-Ehrlich 2009). Deep, well-drained soils are found in narrow strips along drainages, in depressions and floodplains, and old high terraces of major streams and rivers. Moderately drained soils are found in upland undulating ridges and drainages. Poorly drained soils are found in some upland flats and low stream terraces.

Analysis of Alternatives and Impacts on Soils

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

Under this alternative wildfire suppression and manual and mechanical thinning and hazard fuel reduction along the park boundary that borders private residences would continue. Hazard fuel loadings in forested areas would be retained and continue to accumulate, which could increase the potential for intense wildfires that are difficult to contain. The soils within the National Battlefield have the potential for low and moderate damage due to fire (NRCS 2017). Low levels of damage result in light ground char, mineral soil is not changed, leaf litter may be charred or partially consumed, original forms of surface materials (needle litter or lichens) may be visible, and very little to no change in runoff response (Ice et al. 2004). Moderate levels of damage result in

moderate ground char, usually unaltered soils structure, decreased infiltration due to fire-induced water repellency may be observed, litter is charred or consumed, shallow light colored ash layer and burned roots and rhizomes are usually present, and an increase in runoff response may be moderate to high (Ice et al. 2004). Intense wildfires could remove soil organic matter and standing vegetation, lower soil pH and nitrogen content, or kill rhizomes and mycorrhizae. Removal of ground cover and/or the duff/litter layer exposes the soil surface to precipitation and wind events and could increase the potential for erosion, loss of topsoil, or long-term soil changes to occur. Loss of soils or a change in infiltration ability due to the impacts of wildfire could result in increased sediment into nearby streams and less water available within the soils. Adverse impacts to soils would be expected to last until regrowth of ground cover occurs. Restoration and regrowth of ground cover would depend on the location, severity, and size of burned areas by the wildfire.

Wildfire suppression actions such as constructed firelines and the use of vehicles could compact soils and cause erosion. Minimum impact suppression tactics (e.g., water diversion devices on firelines to reduce erosion risk, re-contour area) would be used to reduce suppression action impacts. Impacts to soils from minimum impact suppression tactics would affect a smaller area compared to the total area burned, which would be the primary source of soil erosion.

Mechanical equipment used during hazardous fuel reduction treatments could impact soils in small, localized areas along the battlefield boundary due to increased erosion by removing larger vegetation, rutting, or compaction of soils. However, mechanical equipment used would have rubber tires, which reduces the potential for soil rutting. Tracks from mechanical equipment would be expected to last until the following growing season. Implementing appropriate mitigation measures (See Mitigation Measures Section) such as using mechanical equipment when soils are dry and using existing trails or roads when possible would help to reduce potential impacts to soils.

Cumulative Impacts

Cumulative impacts to soil resources from other activities include continued maintenance and construction activities within the park and wildland fires originating from adjacent lands (e.g., private agricultural burning, other landowner prescribed burns). Implementation of Alternative A, would be expected to have a negligible contribution to adverse cumulative impacts to soils within the park. Implementation of Alternative A would continue to suppress wildfire which increases the risk for higher intensity wildfire which could adversely affect soils. There would be a negligible contribution to adverse cumulative impacts because the increased potential for wildfires, which could temporarily increase soil erosion until growth of vegetation occurs, would remain under this alternative.

Impacts of Alternative B—Proposed Action

Impacts to soils would be the same as described under Alternative A for wildfire suppression actions. Using prescribed fires as a vegetation/fuels management tool would reduce hazard fuel loads, which would increase the potential for localized, lower intensity ground wildfires. Lower-intensity wildfires as well as prescribed fires would release nutrients and minerals into the soil, which stimulates seed production and helps to perpetuate fire-dependent vegetation communities (Neary et al. 2005, Rau et al. 2007, Knapp et al. 2009). In addition to recycling nutrients back into the soils, raising pH, and increasing minerals and salt concentrations in the soil, the ash, charcoal, and vegetation residue resulting from incomplete combustion aids in soil buildup and soil enrichment by adding organic matter to the soil profile. The added material works in combination with living and dead and dying root systems to make the soil more porous, better able to retain water, and less compact while increasing needed sites and surface areas for essential microorganisms, mycorrhizae, and roots (Vogl 1979, Wright and Bailey 1982, Knapp et al. 2009). Following a prescribed fire, wind and water erosion may increase temporarily until revegetation occurs.

Prescribed fires would impact soils by partially removing protective surface vegetation and litter, and organic matter in the soil, thereby temporarily exposing the soils to a higher potential for both water and wind erosion. However, prescribed fires would be designed to not completely consume live and dead vegetation, so the exposure of soils would be less than in high-intensity wildfires. A prescribed fire that exceeds burn

prescription and burns "hot" could result in the loss of regenerative plant tissues in the soils (Miller 2000). However, fire management personnel would contain and/or suppress out-of-prescription prescribed fires, reducing the potential for, and effects of, any large areas of high-burn severity prescribed fires.

Mechanical equipment used during hazardous fuel reduction treatments (e.g., defensible space, fuelbreaks, thinning) could impact soils in localized areas due to increased erosion by removing larger vegetation, rutting, or compaction of soils. Masticators generally are tracked, which distributes the weight of the machine over a wider area, reducing the potential for rutting. Tracks from mechanical equipment would be expected to last until the following growing season. Implementing appropriate mitigation measures (see Mitigation Measures Section) such as using mechanical equipment when soils are dry and using existing trails or roads when possible would help to reduce potential impacts to soils. Additionally, trees removed would be cut or chopped into chunks, chips, or strips and could be scattered on the sites, releasing the nutrients back into the soils. Opening the forest canopy in treated areas would allow more sunlight to reach native, ground dwelling vegetation, giving them a competitive advantage and increasing soil stability and production in treated areas by providing ground cover that would prevent erosion from water or wind events. This would also decrease hazardous fuels which would increase the probability of low-intensity surface fires.

Targeted herbicide application, such as hand application, could result in herbicide migration into the soil. However, the NPS would use herbicides that do not have short or long-term residual implications to soil, water, wildlife, or humans. The mitigation measures (Mitigation Measures Section), limited use as follow-up treatment to prescribed fire and mechanical treatments and low volume/low acreage application of herbicide to specific basal or foliar plant areas, would also help minimize chances for overspray and migration into the soil.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative A. Prescribed fires and mechanical treatments could cause temporary, localized increased erosion until revegetation occurred. However, the use of prescribed burns and mechanical treatments would reduce hazard fuel loads, increasing the potential for lower intensity ground fires that would aid in soil buildup and enrichment from increased nutrient and mineral availability. Alternative B could be expected to contribute negligibly to adverse cumulative impacts as soil impacts would be distributed throughout the National Battlefield rather than being concentrated to one large area or conducted all at one time.

Vegetation (Including nonnative and exotic species)

Affected Environment

The National Battlefield consists of four natural forest communities that cover about half of the Fort Donelson unit—White Oak–Mixed Oak Dry-Mesic Alkaline Forest, Central Interior Upland Cherrybark Oak Forest, Central Interior Beech–White Oak Forest, and Sycamore–Silver Maple Calcareous Floodplain Forest (White 2005, Jordan and Madden 2010). The other half of the Fort Donelson unit consists of successional mesic forests dominated by tuliptree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), and pine (*Pinus* spp.), and native grasslands and open lawns (Jordan and Madden 2010, Sundin et al. 2013). Vegetation at the National Battlefield primarily consists of an oak-hickory association with a mix of pine stands and mixed grass vegetation. The common forest types are described below. The vegetation report by the Nature Conservancy (White 2005) provides a more detailed description of the vegetation communities found in the battlefield area. While the vegetation within the battlefield may be categorized into several types, these types can be generalized to an oak-hickory forest type. The oak-hickory type historically had an understory fire regime characterized by infrequent, low-intensity surface fires occurring during the spring and fall months (Wade et al. 2000).

Vegetation of the Fort Heiman unit has not been comprehensively inventoried nor classified, although Inventory and Monitoring Program vegetation plots were established between 2011 and 2013 on Fort Heiman. The Fort Heiman Unit is dominated by oak-hickory forests, comprising over 60% in the canopy (NPS 2013b). Based on the FODO Forest Vegetation Monitoring Summary 2011–2015, plots within Fort Heiman were

found to contain a significant component of standing dead blackjack oak (*Quercus marilandica*) in addition to various grass species (NPS 2017a). There is evidence that at one time this area was significantly more open and subject to fire due to the shade-intolerance of blackjack oak and its adaptation to a 4–6 year fire return interval to perpetuate this species (Landfire 2012). The NPS Cumberland Piedmont Network (CUPN) staff noted that this site may have been part of western Kentucky barrens. Shade-tolerant oaks such as *Quercus falcata* and *Quercus stellata* are now dominant within the stand.

White Oak-Mixed Oak Dry-Mesic Alkaline Forest is located in a transitional zone between the driest ridges and the more mesic ravine communities, and may range up to the ridgetops in areas where the soil is deeper and the exposure to extremes in temperature and moisture is limited. The overstory is dense and typically includes white oak (*Quercus alba)*, red oak (*Quercus rubra*), black oak (*Quercus velutina*), and Chinquapin oak (*Quercus muehlenbergii*). Typical associates include shagbark hickory (*Carya ovata*) and white hickory *(Carya alba*). Subcanopy dominants include shade tolerant species such as southern sugar maple (*Acer barbatum*), slippery elm (*Ulmus rubra*), black walnut (*Juglans nigra*), American ash (*Fraxinus Americana*), American hophornbeam (*Ostrya virginiana*), American hornbeam (*Carpinus caroliniana*), and serviceberry (*Amelanchier arborea*). Typical shrubs include Ohio buckeye (*Aesculus glabra*), pawpaw (*Asimina trilobal*), eastern redbud (*Cercis Canadensis*), flowering dogwood (*Cornus florida*), strawberry bush (*Euonymus americanus*), Carolina buckthorn (*Frangula caroliniana*), and rusty blackhaw (*Viburnum rufidulum*). Woody vines include Virginia creeper (*Parthenocissus quinquefolia*) and poison ivy (*Toxicodendron radicans*). The herbaceous layer generally has a high diversity of spring ephemerals and summer herbs, and sedge species are usually an important component.

Central Interior Upland Cherrybark Oak Forest is located on low to upper slopes and ridgetops of various aspects. Occurring in mid- to late-successional stands, species composition can vary greatly depending upon the age of the stand and the exposure/aspect of the site. Mixtures of tuliptree and other early-successional tree species are often associated with younger stands. Cherrybark oak (*Quercus pagoda*) or southern red oak (*Quercus falcata*) are often associated with stands on ridgetops. Other canopy species may include Shumard's oak (*Quercus shumardii*), northern red oak, white oak, and hickory spp., and most contain at least some hophornbeam and/or ironwood in the understory or shrub layer. The Central Piedmont Upland Cherrybark Oak Forest is a globally rare community, but is common in FODO and does not appear to have significant management challenges facing it. However, it should be monitored for problems with invasive exotic species.

Central Interior Beech-White Oak Forest are found on the most mesic, broadly north-facing (also NW and NE facing), mid to lower steep slopes along drainages in the park. Dominant vegetation is at least 40 percent beech (100 percent in some areas) along with some oaks, especially northern red oak. The herbaceous layer consists of mayapple (*Podophyllum peltatum*), rue anemone (*Thalictrum thalictroides*), and aniseroot (*Osmorhiza longistylis*), as well as some sedges; with understory species consisting of sugar maple (*Acer saccharum*), beech, and sassafras. Shrub species most common include ironwood (*Carpinus caroliniana*), pawpaw, and hophornbeam.

Sycamore-Silver Maple Calcareous Floodplain Forest is located where the U.S. Army Corps of Engineers impoundment floodplain meets creek outflow areas to form flat, frequently flooded areas of vegetation within the park. Dominant species include silver maple (*Acer saccharinum*) with small amounts of sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), and other species. The forest community types that are particularly in need of management include all of the forested wetland types, which are susceptible to invasion by invasive exotic species such as Japanese stiltgrass and privet.

A priority for land management of these natural forest communities includes exotic invasive species control and preservation. There have been 665 plant species identified within the National Battlefield with 109 of these being non-native plant species (about 16%) and 27 considered aggressive invasive plant species (White 2005). These aggressive invasive plant species are threats to native vegetation communities because they could actively outcompete and replace native species.

Analysis of Alternatives and Impacts on Vegetation

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

Wildfire suppression actions could remove, cut, or trample vegetation from line cutting operations along control lines. Tracked or wheeled equipment approved by the Superintendent or vehicles that carry fire personnel and equipment could also trample or remove vegetation. New fireline construction could occur when utilizing MIST tactics to minimize effects on vegetation and other resources. Wildfires would be contained using existing natural barriers, roads, or trails when possible.

Potential spread of invasive, non-native plants and seeds could occur from equipment used by fire crews during wildfire suppression efforts (e.g., fireline construction equipment, carried on equipment from outside the area) or could be naturally distributed by wind or animals. The spread of invasive, non-native plants could degrade the aesthetics of the historical landscapes and could make the forests more vulnerable to wildfire (Zouhar et al. 2008). Spread of invasive species could also alter fuelbed structure of the forests (Zouhar et al. 2008). Soil disturbance and bare areas from fireline construction could lead to increased opportunities for establishment and/or spread of invasive, non-native plant species. Mitigation measures would be implemented such as, cleaning equipment before and after use, firelines re-contoured and covered with cut vegetation debris, and utilizing targeted herbicide application and monitoring after fires to minimize potential impacts.

Under Alternative A, the oak dominated forests would remain a closed canopy structure that favors shade tolerant species. These shade/fire intolerant species would continue to exclude grasses, forbs, and oak seedlings leading to a decline in the regeneration and sustainability of the oak woodland. Fire exclusion has created a fuel complex that approximates mesic forests with dominant successional species, such as *Acer rubrum, A. saccharum, Fagus grandifolia,* and *Liriodendron tulipifera*. Over time fire-dependent vegetation communities such as the oak and mixed oak, tuliptree and cherrybark oak forests—could continue to decline in species composition and diversity as well as the overall health and vigor of the forest stands. Unmanaged fuel loads could increase the potential for intense wildfires which could remove large tracts of vegetation and soil organic matter (duff/litter), altering soil resources (e.g., kill rhizomes and mycorrhizae), which could lead to changes in vegetation species composition, structure, and diversity. Removing most standing vegetation and organic matter could also create bare and burned soils susceptible to increased opportunities for invasive and non-native plant species to become established.

Mechanical and manual thinning and hazard fuel reduction would remove vegetation around open fields and Battlefield cultural features to prevent encroachment of woody and invasive plant species. Mechanical treatments would also include hazard fuel reduction within a 12-foot wide area along a half mile of the boundary fence and 30 feet adjacent to maintain a fuelbreak, which would remove up to 2.5 acres of vegetation, including non-native, invasive species. Vehicles and crews associated with mechanical work could temporarily trample or remove vegetation adjacent to the 30-foot buffer. The trampled vegetation would be expected to recover after the mechanical work is completed.

Under Alternative A, the incremental impacts to vegetation resources within the National Battlefield would continue with manual and mechanical treatments used to reduce hazard fuels along one-half mile of the National Battlefield boundary and thinning to maintain and protect cultural landscapes.

Cumulative Impacts

Activities that could contribute to adverse cumulative impacts to vegetation resources within the park include fire management activities on adjacent lands. Due to the history of wildfire suppression and the accumulation of hazard fuel loads within the forested areas of the park, these areas are vulnerable to spread of wildfire from adjacent lands. In the event of a spreading wildfire, the fire could adversely impact the forest and the magnitude of impact would be dependent upon the characteristics of the fire. Impacts could range from minor alterations to the vegetation resulting in negligible impacts to substantial modifications of vegetation resulting in removal of large tracts of vegetation and soil organic matter (duff/litter), alteration of soil resources (e.g., kill rhizomes and mycorrhizae), which could lead to changes in vegetation species composition, structure, and diversity.

Impacts of Alternative B—Proposed Action

Impacts to vegetation would be the same as described under Alternative A for wildfire suppression actions. Implementing prescribed fires would emulate a natural fire regime that perpetuates species diversity and composition and structure of the oak and mixed oak, tuliptree and cherrybark oak fire-dependent forest communities. Prescribed fires would benefit the native vegetation communities over the long term by rejuvenating the soils with a temporary influx of nutrients and minerals, which stimulates seed production (Neary et al. 2005) and helps to perpetuate fire-dependent vegetation communities by reducing small tree density and promoting understory growth of grasses and forbs. Prescribed fire return intervals would be as described in Chapter 2 for restoration or maintenance goals. Higher fire frequencies for restoration goals would stimulate an increase in grasses and forbs (Peterson et al. 2007). While the use of prescribed fires could result in the loss of individual plants and communities of plants, prescribed fires are typically low-intensity surface fires that help to maintain and enhance the survival of fire-dependent vegetation communities and seedbeds. Furthermore, beneficial impacts to vegetation communities would be long term due to reducing non-native plant species, thus competition for available resources, and enhancing the diversity, structure, composition, and integrity of fire-dependent vegetation communities, such as mixed oak communities by increasing seed production. Over time, the use of prescribed fire would be expected to decrease the potential for intense wildfires by reducing hazard fuel loads. Maintaining traditional prescribed fire behavior would lead to the increased vigor and health of the existing fire-dependent vegetation communities in the National Battlefield by shifting the current closed canopy shade/fire tolerant species composition to oak dominated forests with open canopies and diverse understories of grasses and forbs.

The increased ability to use mechanical treatments would reduce hazardous fuels, help to restore the health, vigor, and species diversity of native forests, and create defensible space and fuelbreaks where needed. The use of wheeled/tracked equipment, such as masticators, to improve the structure, species composition and diversity, and resilience of forests could result in the damage to non-targeted trees or spread of invasive plant species. The FODO staff would implement mitigation measures to reduce potential impacts to non-target trees. Mechanical treatments would benefit vegetation by helping to perpetuate a more open forest structure, which would increase sunlight and moisture availability for growth and germination of grasses and forbs. Mechanical treatments would be used in combination with prescribed fire to help accomplish forest restoration.

Targeted herbicide application used only as a follow up treatment to help maintain fuelbreaks and defensible space or around high value areas, such as historic sites would reduce the chances to over spray or apply to non-target plants. Thus, mitigation measures, limited use, and targeted herbicide application to specific basal or foliar plant areas would minimize chances of over spraying and impacting non-target plants.

Cumulative Impacts

Activities that could contribute to cumulative impacts to vegetation resources within the park include fire management activities on adjacent lands as described under Alternative A. With the proposed actions under Alternative B, in time, the risk of the spread of wildfires from adjacent lands would decrease as fuel loads within the forested areas of the park become more actively managed. Alternative B would temporarily impact larger areas of vegetation from the use of prescribed fire and mechanical treatments until regeneration of vegetation occurred (typically within a growing season). With time, Alternative B would contribute to beneficial impacts to vegetation resources by reducing hazard fuel loads, thus reducing the potential for intense wildfires and restoring structure and diversity of native forest stands with the return of a natural fire regime in combination with mechanical and herbicide treatments. Implementation of Alternative B would be expected to improve vegetation conditions and contribute to beneficial cumulative impacts. Forest structure and composition as well as health and vigor would be expected to improve over the current conditions, thus improving vegetation conditions.

Water Resources

Affected Environment

The Fort Donelson unit is located within the Lower Cumberland watershed. It is bordered on the north by the impounded Cumberland River and to the west by Hickman Creek, a flooded tributary of the Cumberland. The eastern most section of the "Confederate Breakout Area" is bordered by Lick Creek, a tributary to Lake Barkley. There are four streams that traverse through the Fort Donelson unit—Indian Creek, Erin Hollow, and two unnamed tributaries to Hickman Creek and Indian Creek (Sundin et al. 2013). Two unnamed wetlands (0.02 acres) were identified in the 2004 inventory (Roberts and Morgan 2006). One wetland (0.01 ac) is a palustrine, scrub-shrub wetland with persistent vegetation and is seasonally flooded and the other (0.01 ac) is a palustrine, emergent wetland having persistent vegetation and is temporarily flooded. Both wetlands would provide natural fire breaks due to the persistent vegetation and retained moisture within the wetlands; however, due to their size the contribution is likely small.

Fort Heiman is located in the Kentucky Lake watershed. The unit is bordered on the east and south by the Kentucky Lake impoundment; the lake is not included in park lands. No flowing surface water resources are located in this unit, although wetlands and ephemeral pools may be present (Roberts and Morgan 2006).

Water quality has been monitored since 2003 as part of the Cumberland Piedmont Inventory and Monitoring Program (Meiman 2009). There have been no water quality issues since monitoring began (Sundin et al. 2013). All surface waters within the Fort Donelson unit are considered "Exceptional Tennessee Waters" which prohibit discharge and other pollution sources, while criteria are defined as Tennessee's "Fish & Aquatic Life and Recreational" standards, a combination of the highest standards under the Clean Water Act as promulgated by the state (Sundin et al. 2013).

Analysis of Alternatives and Impacts on Water Resources

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

Under Alternative A, wildfires would continue to be suppressed and manual and mechanical thinning and hazard fuel reduction would be limited to open fields and Battlefield cultural features and along one-half mile of the National battlefield boundary. Hazardous fuel loads within the forested areas of the park would remain and would continue to accumulate, which would increase the potential for intense wildfires. Wildfires under these conditions could burn or remove vegetation along stream banks, resulting in increased soil erosion and sediment and nutrient yields from the plant biomass burned into the streams. Vegetation removal or reduction could cause a temporary increase in water temperatures, negligible soil erosion, and sediment and nutrient yield. Vegetation would be expected to recover quickly with hydrological conditions returning to pre-fire conditions.

Wildfires could provide a temporary influx of nutrients to the banks of water resources from the plant biomass burned. The influx of nutrients stimulates seed production and new vegetation growth, helping to perpetuate the vegetation and wildlife species associated with water resources in the National Battlefield. The influx of nutrients, especially nitrate, into surface waters may be a concern following a wildfire. A wildfire simulation with 100% overstory mortality showed the only increase of nitrate into surface waters, which was attributed to the reduced nitrogen uptake from no vegetation present (Vose et al. 2005). Therefore, the intensity and duration of impacts to water quality from the temporary influx of nutrients would depend on the fire intensity, amount and frequency of precipitation events following a wildfire, and the ability of the remaining vegetation to act as a filter.

In wildfire suppression tactics, fire engines and other equipment may be driven off-road to control the fire perimeter. In many areas of the National Battlefield, this would be difficult to impossible due to thick trees and steep or rocky slopes. In most cases the NPS would utilize indirect tactics to contain the fire at nearby roads, trails, or natural barriers, depending on conditions. Wildfire suppression tactics could impact water quality by use of adjacent fire engines and vehicles on the roads, ATVs or UTVs, and other equipment that may release localized quantities of oil or other petroleum products or increase turbidity if standing water is present. The use

of fire retardants, gels, or foams, by fire engines or retardants, helicopter, or fixed winged aircraft, could also temporarily alter the water quality of surface waters if misapplied or mishandled. These fire suppression chemical agents contain detergents or fertilizer type chemicals that temporarily change the water quality, interfering with the ability of fish gills to absorb oxygen and other aquatic organisms. These impacts are temporary as dilution occurs with stream flow and mixing of the impacted water downstream. The degree of impact would depend on the amount of foam or retardant dropped into the water body, the size of the water body, and the volume of flow. However, mitigation measures would limit the use, type, and proximity to water bodies (i.e., no use within 300 feet of water bodies) making potential impacts to water quality minimal.

Use of equipment or ATVs and UTVs for off-road travel (with Superintendent Approval) could destabilize banks of water bodies. These impacts would be mitigated by minimizing off-road travel, utilizing READs, and prompt rehabilitation of any damaged stream banks.

Water drops used to suppress fires may be obtained from water near the National Battlefield, such as Tennessee River or Cumberland River, which ensures that the water quality of dropped water is similar to existing surface water resources. In addition, air tankers and helicopters used for water drops must rinse out tanks prior to responding to fires in the park.

Cumulative Impacts

Actions that contribute to adverse cumulative impacts include existing practices at the battlefield and adjacent private facilities (septic tanks), roads leading to water bodies, adjacent upstream forestry operations and agricultural practices. Alternative A would contribute negligibly to adverse cumulative impacts to water resources from the use of vehicles, equipment, and foams for wildfire suppression tactics. Under Alternative A, there would be a negligible contribution to adverse cumulative impacts because the potential wildfires could temporarily increase soil erosion until growth of vegetation along stream banks occurred.

Impacts of Alternative B—Proposed Action

Impacts to water resources would be similar as described under Alternative A for wildfires with temporary increase in temperature, erosion, and sediment and nutrient yields from the removal of vegetation. However, prescribed fires would be lower-intensity surface fires that would be expected to leave vegetation along the banks to act as filters for water resources. Prescribed fires could provide a temporary influx of nutrients to the soils along the stream banks from the plant biomass burned. The influx of nutrients stimulates seed production and new vegetation growth, helping to perpetuate the vegetation and wildlife species associated with water resources in the battlefield, such as wetlands and riverine systems (Craft and Casey 2000, Battle and Golladay 2001). The influx of nutrients, especially nitrate, into surface waters may be a concern following a prescribed fire. However, studies have found no change in nitrate concentrations following a prescribed fire from pre-fire conditions in pine-mixed hardwood and mixed oak forests in the southeast (Vose et al. 2005, Elliott and Vose 2006). Therefore, the intensity and duration of prescribed fire impacts to water quality would depend on the timing and intensity of precipitation events before re-establishment of burned vegetation, and the ability of the remaining vegetation to act as a filter. Vegetation would be expected to recover quickly with hydrological conditions returning to pre-fire conditions.

The increased ability to use mechanical treatments is not expected to increase ground disturbance near water bodies from the current fire management strategies as the use of wheeled/tracked equipment (i.e., masticators) would be used in the upland forests to support forest restoration efforts not in the floodplain. Furthermore, FODO resource managers would plan mechanical treatments to minimize water quality impacts. Mechanical treatments would not occur near streams or surface waters, thus impacts would be mitigated by avoidance, where possible. If mechanical work is unavoidable near a stream or surface water body, immediate rehabilitation would occur using appropriate restoration measures. Given the annual acreage of up to 500 acres treated by mechanical works would be spread across the National Battlefield and mitigation measures that would be implemented, the additional use of mechanical treatments would not be expected to have much effect on water resources.

The increased ability to reduce hazardous fuels and thinning dense forest stands could increase the probability for localized, lower-intensity ground fires. Potential water quality impacts to streams from lower-intensity surface fires would be the same as described above for prescribed fires.

All herbicide treatment areas would have individual treatment plans, developed by the FODO resource staff, employing specific mitigation measures (see mitigation measures section), after approval of herbicide use by the NPS regional office. Approvals may be given after considering numerous factors including: the target use, location where the application will occur, potential threatened and endangered species concerns, potential for getting into surface or ground water, persistence in the ecosystem, safety to employees and the public, and type of application (e.g. spot spraying). Furthermore, all herbicides used in or near water bodies or wetlands would be applied according to the labels to ensure potential for herbicide drift is unlikely.

Cumulative Impacts

Adverse cumulative impacts to water resources would be similar to those described under Alternative A. However, Alternative B would contribute to beneficial cumulative impacts to water resources due to the increased ability to reduce hazardous fuel loads in forested areas, which increases the potential for localized, lower-intensity fires that would leave vegetation along the banks of water resources to serve as filters to protect water quality, thus producing less sedimentation and erosion compared to Alternative A.

Wildlife

Affected Environment

The National Battlefield provides and protects habitat for many mammal, bird, reptile, amphibian, and fish species. The battlefield park hosts approximately 30 mammal species including white-tailed deer (*Odocoileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), and red fox (*Vulpes vulpes*) (Kennedy et al. 2007). Mature oak forests at the National Battlefield provide habitat for tree-roosting bat species, such as the eastern red bat (*Lasiurus borealis*). The Cumberland River provides important foraging habitat for the federally listed endangered gray bat (*Myotis grisescens*) due to its steady supply of insects.

Over the years approximately 177 avian species recorded at the battlefield park, and the forest habitat supports species such as woodpeckers (*Picoides* spp.), Acadian flycatcher (*Empidonax virescens*), and wood thrush (*Hylocichla mustelina*) (Stedman and Stedman 2005). In addition, the Cumberland River is a natural migration corridor for many avian species, and Cross Creeks National Wildlife Refuge which contains large amounts of waterfowl is located across the river from the battlefield park. Raptors found at the battlefield park include barred owl (*Strix varia*), osprey (*Pandion haliaetus*), bald eagle (*Haliaeetus leucocephalus*), Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk (Buteo lineatus), broad-winged hawk (*Buteo platypterus*), and red-tailed hawk (*Buteo jamaicensis*). A resident pair of bald eagles has raised more than eight chicks at the park since 2004. Grassland dependent avian species such as northern bobwhite quail (*Colinus virginianus*), field sparrow (*Spizella pusilla*), and grasshopper sparrow (*Ammodramus savannarum*) are either absent or present in very low numbers likely due to road noise and barge traffic, urban development along the National Battlefield boundary, and frequent mowing of vegetation to the river's edge.

The park supports 17 amphibian species including seven salamanders, eight frogs, and two toads. Additionally, the park is host to 20 reptile species which includes two turtles, four lizards, and fourteen snakes (Scott and Davenport 2005). The only venomous snake found within the park is the copperhead (*Agkistrodon contortrix*), a member of the viper family.

Within the park, Indian Creek is the only stream large enough to support fish species. Fish species observed in Indian Creek include fringed darter (*Etheostoma crossopterum*), creek chub (*Semotilus atromaculatus*), rainbow darter (*Etheostoma caeruleum*), and largescale stoneroller (*Campostoma oligolepis*) (Zimmerman 2007).

Analysis of Alternatives and Impacts on Wildlife

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

Use of mechanical treatments would temporarily displace individual wildlife species within and near the treatment area. Displacement would be expected to last until the treatments were completed as mechanical treatments are limited to open fields and cultural features and one-half mile along the National Battlefield boundary.

Forest stands would remain closed canopy forests and continue to retain dense shade tolerant trees in the understory, which could change species composition and structure of native vegetation leading to a more homogenous habitat state, thus degrading wildlife habitat quality. Due to continuation of wildfire suppression, fire dependent and adapted vegetation species may decline. Fire dependent vegetation may decrease in prevalence and vigor with negative effects on wildlife species adapted to those vegetation types. Conner et al. (1999) and Perkins et al. (2008) have shown that suppression of fire in hardwood dominated forests leads to gray squirrels (*Sciurus carolinensis*) replacing fox squirrels (*Sciurus niger*). In addition, potential for localized, intense wildfires that could remove large tracts of vegetation would increase due to continued accumulation of fuel loads in forested areas. Indirect effects to vegetation due to increased potential for locally severe wildfires could include physical alteration of vegetation structure, composition, and function, resulting in degradation of wildlife habitat quality.

The general wildlife communities under Alternative A would be expected to remain as they currently exist. However, an intense wildfire could alter the current vegetation structure or species composition which could alter the wildlife communities within the forested areas of the park. Communities would initially be limited to those that could colonize recently burned areas and would slowly shift to early successional communities.

The degree of impacts from wildfires on wildlife is influenced by many variables such as the time of year, fire behavior, fire size, location, fuel composition, and soil moisture. Wildfire suppression tactics would temporarily increase disturbance to individuals within and near the burn area due to noise from human presence and equipment, smoke, fire itself, and vegetation removal. Temporary loss of habitat and displacement may occur for individuals within the burn unit. Displacement of individuals could last until revegetation occurs; however, temporal displacement would be linked to the intensity of burn and degree of which vegetation was altered. Some species may not return until vegetation has matured sufficiently to support some wildlife species with specific habitat requirements such as the presence of mature trees for some bird species. Additional disturbances to wildlife could result from helicopters transporting firefighter personnel and low-level fixed winged aircraft and retardant drops that could be used in fire suppression actions. Displacement due to aircraft related operations would be temporary, species would likely return once the noise and activity ends. Additionally, reproduction and survival for individuals could be impacted from increased stress and loss of foraging opportunities from removal of vegetation after a high-intensity wildfire. Mortality of small and less mobile wildlife species, such as turtles, snakes, and small mammals may also occur from wildfires. Depending on the spatial scale of the burn, less mobile species affected by the fire would begin to repopulate the area; however, initially, there could likely be dramatic losses immediately post fire. Larger, mobile, wildlife such as deer would not likely be harmed by fire but could be displaced for a period of time.

During drought conditions, Indian Creek, the fish-bearing water body, could be impacted by wildfires that spread into the floodplain from removal of streamside vegetation that provides shade, increasing the water temperature until revegetation occurs. Impacts to fish populations would depend on the severity, size, location, and proximity to fish populations, as downstream reaches could cool rapidly if vegetation is present (Johnson 2004). Individual fish could be temporarily displaced downstream to unburned areas (Rinne and Jacoby 2005). Wildfires could result in mortality, although few studies have documented direct mortality (Rinne and Jacoby 2005). Indian Creek could also experience large pulses of water from precipitation events and an increase in sedimentation from woody debris and ash from wildfires. This could lead to a temporary increase in turbidity and degraded water quality, which could adversely affect riparian habitats and fish.

Cumulative Impacts

Current and future routine park maintenance activities within the battlefield park, traffic along roads, and wildland fires on adjacent lands contribute to adverse cumulative impacts on wildlife. Maintenance activities such as mowing increase the potential for temporary displacement of wildlife while activities are occurring. The contribution to adverse cumulative impacts on wildlife would be negligible because wildlife impacts would only last as long as the maintenance activities. Alternative A could contribute to adverse cumulative impacts due to displacement and habitat alteration from wildfires and the increased potential for wildlife habitat degradation over time from succession to a more homogenous habitat state.

Impacts of Alternative B—Proposed Action

Impacts to wildlife and their habitat would be similar as described under Alternative A for mechanical treatments and wildfire suppression. The use of additional fuel and vegetation management tools would increase the success rate of restoring fire as an ecological process, thus increasing the prevalence and vigor of fire dependent vegetation and benefitting associated native wildlife species present in the battlefield park. In addition, the ability to reduce dense understories could increase wildlife habitat quality and available ground forage. The potential for wildfires to be lower intensity ground fires, which would have less of an impact on wildlife and their habitat, would increase under Alternative B. Reducing the adverse impacts to wildlife and their associated habitats would be beneficial to wildlife and would help to maintain sustainable biodiversity within forested areas.

Prescribed fire could benefit individual wildlife species and their habitat by emulating the natural fire regime and creating a more historic and natural vegetation pattern across the battlefield park (creating localized, but not widespread areas of early succession vegetation), enhancing the variety and diversity of vegetation communities and wildlife habitat present (Keyser and Ford 2005). Prescribed fires would provide more nutrients to the soils in the short-term, which would increase new plant growth and improve the amount of ground and grass species available and the nutritional quality of this forage for wildlife species. Burned areas generally green up earlier than non-burned areas, thus providing earlier grazing (Redmon and Bidwell 2003). The effects of treatments on forest understory composition and growth vary. A study in Piedmont pine-dominated forest in South Carolina found that post treatment sapling densities and graminoid forb cover differed among fire, thinning, and fire combined with thinning treatments (Phillips and Waldrop 2008). Overall, the use of fire and other tools to recreate historic forest conditions is recommended for wildlife because it helps restore a mosaic of ecosystem types that can benefit multiple species (Van Lear and Harlow 2000). Thus, the use of prescribed fire would help to maintain and restore the abundance and diversity of fire-adapted vegetation communities and wildlife habitat present and reducing the potential for future severe wildfires.

The understory structure of pine forests can influence the composition of bird communities (Johnston and Odum 1956). Many bird and small mammal species could benefit from periodic burns which could create and maintain desirable forest structure for these species (Block et al. 2016). In mixed pine-hardwood forests, burns that reduced the midstory hardwood component and reduced the structural complexity and cavity availability within the forest have been linked to declines in avian diversity (Block et al. 2016). Prescribed fires could negatively impact nesting resident and migratory birds if conducted during the breeding season (generally between March–August) through mortality of nests, eggs, and/or fledglings that are unable to flee or avoid smoke or fire. To mitigate potential impacts, prescribed fires would be implemented, when possible, outside the breeding season and avoiding primary nesting areas. Effects of prescribed fire on avian breeding success post burn–vary by species and are influenced by the intensity of the burn. Post burn, bird abundance and species richness do not substantially change or increase several years following a fire. Typically, species dependent on dense shrubs decline due to loss of habitat (Zebehazy et al. 2004, Greenburg et al. 2007) and species preferring more open areas increase following a fire. The local raccoon population could also impact avian breeding season success due to raccoon avian nest predation. A study conducted in longleaf pine and mixed pine–oak habitats found that raccoons were 52% and 80% less likely to occur in two study stands burned the previous growing season compared to unburned stands, respectively (Jones et al. 2004).

The use of mechanical treatments to reduce hazard fuels and to create and maintain defensible space and fuelbreaks would increase the potential for localized, lower intensity ground fires further protecting and maintaining native wildlife species and their habitat. Temporary displacement or disturbance to wildlife species within and near the treatment areas could occur from equipment use and field crews. Overall, reducing fuel loads within the forested areas to reduce the intensity of prescribed burns as well as potential wildfires should have beneficial impacts to most species within these areas of the park. The habitat which supports these species is a low-intensity fire, fire adapted system; reducing the potential for greater intensity fire should help to maintain suitable habitat and forage for many wildlife species.

Targeted herbicide application as a follow up treatment to mechanical treatments, such as foliar application to specific basal or foliar plant areas, would minimize chances for overspray and applying to non-target plants. Thus, mitigation measures, limited use, low-volume application of herbicide to specific basal or foliar plant areas, and following all labels would minimize chances for overspray and impacting non-target plants. In addition, herbicides commonly used for vegetation management (e.g., triclopyr Garlon 4®/Element™ 4, glyphosate, imazapyr, sulfometuron, metsulfuron methyl, hexazinone) have been designed to target biochemical processes unique to plants and have low levels of direct toxicity or risk to wildlife and fish when used in accordance with label specifications (Tatum 2004). Herbicides commonly used for vegetation management also degrade quickly upon entering the environment and are neither persistent nor bioaccumulate (Tatum 2004).

Cumulative Impacts

Cumulative impacts on wildlife under this alternative are similar to those described for Alternative A. Adverse cumulative impacts to wildlife for Alternative B would be the same as described for Alternative A. However, over time wildfire suppression actions would be less than Alternative A as hazardous fuel loads within forested areas decrease with prescribed burns. Alternative B would restore the natural fire regime which would improve wildlife habitat and habitat quality in forested areas.

Special Status Species

Affected Environment

Under the Endangered Species Act (ESA), the NPS has the responsibility to address impacts to federally listed threatened or endangered species. National Park Service policy dictates that an assessment of impacts for federal candidate species, proposed federal species, and state listed species occur during the NEPA process. For the purpose of this analysis, a list of federally and state listed species was obtained from the following sources: 1) federally listed species that may occur in or near the battlefield park from the U.S. Fish and Wildlife Service (USFWS) IPAC website (http://ecos.fws.gov/ipac/) on April 6, 2017 (Consultation numbers 04EK1000-2017-SLI-0382 and 04ET1000-2017-SLI-0413); 2) battlefield park official species list from NPSpecies (NPS 2017b); and 3) state listed species that may occur in Stewart or Calloway counties.

Several animal species of special management concern are known to occur in the National Battlefield (Table 3). Three federally listed species—Indiana bat (*Myotis sodalis*), Northern long-eared bat (*Myotis septentrionalis*), and Price's potato bean (*Apios priceana*)—may be impacted by fire management activities. Approximately 13 sensitive bird species have been reported including the state endangered Peregrine Falcon (Falco peregrinus) as a transient (Stedman and Stedman 2005, Sundin et al. 2013). Two state plant species of concern may be impacted by the proposed fire management activities—the barbed rattlesnake-root (Prenanthes barbata) and purple milkweed (*Asclepias purpurascens*). No federal or state threatened or endangered reptile or amphibian species have been reported from the battlefield park (Sundin et al. 2013).

Species eliminated from detailed analysis in this EA include: 1) species that are associated with large, open bodies of water, and aquatic habitats as these areas would not be affected by fires; and 2) species that are not a resident or breeding species. There is no designated critical habitat, as defined by the USFWS, within Fort Donelson.

TABLE 3. FEDERAL AND STATE-LISTED ENDANGERED, THREATENED, AND SPECIES OF CONCERN WITH POTENTIAL TO OCCUR IN FODO.

Species	Federal Status*	State Status*	Potential to Occur
Mammals			
Gray bat (*Myotis grisescens*)	E	TN–E KY–T	The battlefield park is adjacent to foraging habitat for the gray bat, Cumberland and Tennessee rivers (Kennedy et al. 2007). This bat has not been documented in the battlefield park
Northern long-eared bat (*Myotis septentrionalis*)	T	—	Summer roosts in tree bark, cavities, and snags. Winter hibernacula are typically in caves or mines (USFWS 2015). This bat has been documented in the battlefield park.
Indiana bat (*Myotis sodalis*)	E	TN–E	Inhabits wooded areas where they usually roost under loose tree bark on dead or dying trees. This bat has not been documented in the battlefield park, but suitable habitat is available.
Plants			
Price's potato bean (*Apios priceana*)	T	TN–E KY–E	This plant occurs in lightly disturbed areas along open wooded slopes and floodplain edges among mixed hardwoods. This plant has been documented in the battlefield park at a forest edge.
Purple Milkweed (*Asclepias purpurascens*)	—	TN–SC	This plant occurs in open fields, forest edges, or thickets. This plant has been documented as rare in the battlefield park.
Barbed rattlesnake-root (*Prenanthes barbata*)	—	TN–SC	Inhabits open areas, barrens, and right-of-ways. This plant has been documented as rare in the battlefield park.

*E = endangered, T = threatened, SC = species of concern
*Sources: KSNPC Endangered, Threatened, and Special Concern Plants, Animals, and Natural Communities known to occur in Calloway County (http://naturepreserves.ky.gov/pubs/publications/KSNPC_countylist.pdf); TN Department of Environment & Conservation Rare Species by County (http://environment-online.state.tn.us:8080/pls/enf_reports/f?p=9014:3); and NPSpecies List.

Analysis of Alternatives and Impacts on Special Status Species

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

Impacts Common to All Species

Under this alternative, the current fire management program would continue. Forest stands would likely continue to retain dense understories and to accumulate hazard fuels, which could lead to increased potential

for severe and intense wildfires that are difficult to suppress/manage. Severe and intense wildfires could remove large tracts of vegetation, causing habitat loss and displacement of special status species. Without sufficient ecological restoration in fire-adapted habitats, small trees would continue to increase in density and abundance, potentially changing species composition and structure of native vegetation and forests, leading to a more homogenous habitat state.

Special status species would respond to wildfires with the degree of impacts depending on the time of year, fire behavior, fire size, location, fuel composition, and other variables. Wildfire suppression tactics such as construction of firelines, use of portable pumps, fire engines on roadways, and noise from human presence and fire equipment could temporarily displace or stress special status wildlife species within and near the burn area.

Mammals

The populations of the threatened northern long-eared bat and endangered Indiana bat are at risk due to the impact of white-nose syndrome on both of these species. Both bat species are also threatened by loss of and modification of summer forest habitat (USFWS 2016a). Loss, modification, and destruction of habitat including loss or removal of roost trees are a substantial threat to populations of northern long-eared bats (NatureServe 2017). Indiana bat is susceptible to loss of connectivity of forested lands; however, white-nose syndrome appears to be the primary threat driving the loss of populations throughout its range (NatureServe 2017). While both species are most vulnerable to white-nose syndrome, it is likely that they are more vulnerable to additional stressors such as destruction of habitat than otherwise expected (USFWS 2016a).

Mechanical treatments along a half mile of the National Battlefield boundary or wildfire suppression activities could remove suitable roost trees for northern long-eared or Indiana bats. It is not known which, if any, trees in the battlefield park are used by these bat species. Under this alternative, trees would be removed by mechanical treatment during the winter (November 15–March 31) when bats are unlikely to be present. If trees must be removed outside of these dates, an emergence count would be completed prior to tree removal to ensure bats are not occupying trees marked for removal. If bats are using the trees, tree cutting would not occur until bats had left the roosting tree(s) and it is determined there are additional suitable roosting trees in the area available for bats to use. Additionally, if summer maternity roosts are identified, the surrounding forest and foraging areas within 2.5 miles of the documented maternity roost tree would be maintained in as natural a state as possible, meaning no fire management activities would likely be able to occur within the 2.5 radius without concurrence from the U.S. Fish and Wildlife Service. These areas would be monitored to ensure human disturbance is minimized. Reducing human-related disturbance around nursing colonies of northern long-eared bats is crucial because this species appears to be very sensitive to human disturbance, sometimes moving a nursing colony following a single human disturbance event (NatureServe 2017). These measures would avoid adverse impacts to bats and their habitat as a result of mechanical treatments and the human activities associated with them. Northern long-eared and Indiana bats would benefit from these mitigation measures by maintaining suitable summer roosting and maternity colony habitat for these bat species.

Under this no-action alternative, hazard fuels would likely continue to accumulate in untreated forest stands, increasing the potential for localized and potentially severe wildfires. Numerous potential effects to Indiana and northern long-eared bats could occur as a result of wildfire. Wildfire may affect bats directly via heat and smoke that could potentially drift into rocky cliff roost sites or disrupting roosting and indirectly by modifying habitat, but these effects are largely unknown and would likely vary by season and roost guild (Perry 2012). Loss of maternity roosts or other roosts could result in a temporary or permanent loss of individuals post fire. Studies suggest fire generally has beneficial effects on bat habitat by creating snags, reducing understory and midstory vegetation, opening forests, and possibly by increasing insect prey abundance (Perry 2012). The degree and extent of effects would depend largely on the season in which fire occurs and what the species are doing during that time. Specific mitigation measures have been developed for northern long-eared bats and Indiana bats to minimize adverse impacts (USFWS 2016b) (See Section 2.6).

Plants

In untreated forest stands, hazard fuels would likely continue to accumulate, increasing the potential for localized, severe wildfires and reducing open areas suitable for Price's potato bean, barbed rattlesnake-root, and purple milkweed. Dense forest understories may create habitat more suitable for shade-loving plants that could outcompete the special status plant species. An intense wildfire may result in injury or mortality of individual plants or populations. The likelihood of mortality depends on the intensity, severity, and size of the fire. Thus, under this alternative these special status plant species would continue to experience loss of suitable habitat and this could result in loss of these species within the forested areas of the park.

Under this alternative, there would be no mechanical treatments conducted within or near known special status plant populations.

Cumulative Impacts

Current and future routine park maintenance activities within the battlefield park, traffic along the roads, and wildland fires on adjacent lands contribute to adverse cumulative impacts on special status species. Maintenance activities such as mowing and maintenance of the right-of-way of roads within the park increase the potential for temporary displacement of special status wildlife species and the potential for destruction of suitable habitat for special status plant species including Price's potato bean. Displacement of special status species would last the duration of activities occurring. The contribution to adverse cumulative impacts on special status species would be negligible for most species because impacts would only last as long as the maintenance activities. Special status plant species may experience more adverse impacts due to potential loss of suitable habitat related to maintenance activities. The contribution to adverse cumulative impacts would be slight. Due to the history of wildfire suppression and the accumulation of hazardous fuel loads within the forested areas of the park, these areas are vulnerable to spread of wildfire from adjacent lands. In the event of a wildfire spreading to the park from adjacent lands, the fire could impact the forest resulting in a loss of suitable habitat for special status wildlife species. Special status species could be negatively impacted from such an event especially if the wildfire results in a loss of suitable tree roosts for northern long-eared and Indiana bats. While bat species could experience a loss of suitable habitat, the spread of wildfire could alter the canopy within the park such that some of the special status plant species could experience gains in suitable habitat thus contributing to beneficial cumulative impacts.

Impacts of Alternative B—Proposed Action

Impacts to special status species and their habitat would be similar to those described under Alternative A for mechanical treatments and wildfire suppression. Utilizing prescribed fires to reduce hazard fuels would increase the potential for lower-intensity ground fires, which are easier to manage/suppress and have less impact on special status species and their specific habitats. In addition, prescribed burns could open the midstory vegetation layer in prescribed burn areas which would promote growth and germination of grasses and forbs, filling in the mixed-grass component of the forest understory. Prescribed burn plans would include mitigation measures to minimize any potential impacts to special status species and their habitat.

Mechanical treatments would increase the potential for lower-intensity ground fires, which are easier to manage or suppress, are more beneficial for restoration, and help to further protect and maintain special status species and their habitat by reducing hazard fuel loads in forest stands and opening the closed forest canopies and reducing the dense shade tolerant tree understories. Actions that lead to long term retention of special status species' habitats would result in beneficial impacts to special status species. Many special status species that occur within the park are vulnerable to degraded habitat or complete loss of habitat. Reducing the fuel loads in the forested areas would reduce the likelihood of an intense prescribed or wildfire which could result in degradation of suitable habitat or even loss of habitat for many of the special status species known to occur within the park.

Targeted herbicide application, such as foliar application to specific basal or foliar plant areas, would minimize chances for overspray and applying to non-target plants. Thus, mitigation measures, limited use, low-volume application of herbicide to specific basal or foliar plant areas, and following all labels would minimize chances

for overspray and impacting non-target plants. In addition, herbicides commonly used for vegetation management (e.g., triclopyr [Garlon 4®/Element™ 4], glyphosate, imazapyr, sulfometuron, metsulfuron methyl, hexazinone) have been designed to target biochemical processes unique to plants and have low levels of direct toxicity or risk to wildlife species when used in accordance with label specifications (Tatum 2004). Herbicides commonly used for vegetation management also degrade quickly upon entering the environment and are neither persistent nor bioaccumulate (Tatum 2004). Over time, using targeted herbicide as a follow-up treatment to reduce and/or maintain brush regrowth along fuelbreaks or forest restoration would reduce or cease the need for repetitive mechanical treatments, thus minimizing reoccurring disturbances to special status species. Reducing reoccurring human disturbances would be beneficial to both bat species but especially to the northern long-eared bat which is more sensitive to human disturbances and those disturbances can result in a disruption in the natural process reproduction.

Mammals

Northern long-eared bats depend on larger trees and snags to provide cavities for roosting. Some large snags could be lost if burned during prescribed fire; however, prescribed fires also have the potential to create new snags. Prescribed fire has the potential to affect northern long-eared and Indiana bats via heat and smoke that could potentially drift into rocky cliffs and roost sites or disrupting roosting and indirectly by modifying habitat, but these effects are largely unknown and likely vary by season and roost guild (Perry 2012). Mitigation measures would be implemented to avoid potential effects to listed bat species as a result of prescribed fire. For example, the battlefield park would consult with the USFWS for effects to federally listed species when developing individual prescribed burn plans. Based on the results of consultation, prescribed burns and mechanical treatments may be limited to November 15 through March 31, unless a qualified biologist conducts a pre-project survey for bats and determines that bat habitat is not present in the proposed treatment area. Fire management personnel would be briefed on all potential resources of concern, specifically listed bat species, and their locations within a burn unit to facilitate avoidance of habitat for these species. In addition, consideration would be made regarding the seasonality of prescribed burns and the life history of bat species to ensure that potential adverse effects are avoided. Studies suggest fire generally has beneficial effects on bat habitat by creating snags, reducing understory and midstory vegetation, opening forests, and by increasing insect prey abundance (Perry 2012). While the use of herbicides could alter vegetation and thus insect availability in the treatment areas, a more diverse vegetation community in the absence of invasive weeds is likely to support a larger assortment of insects on which bats prey.

Northern long-eared bats have been shown to select roost sites with different characteristics in fire-managed areas compared to unmanaged areas in Appalachian forests. Johnson et al. (2009) found that bats in fire-managed areas selected roost cavity trees that were smaller in diameter, higher in crown class, and located in stands with lower basal area, gentler slopes, and had higher percentage of fire-killed stems than randomly selected trees. Roosts were often surrounded by trees in the upper crown classes, were associated with larger canopy gaps, and had higher daily mean and max temperatures compared to roosts in unmanaged forests. Fire-managed areas also had more available roost sites. Lacki et al. (2009) found that home ranges and foraging behavior in northern long-eared bats did not differ in forests before and after prescribed fire. Bat home ranges were closer to burned areas, which had higher abundances of insects. Bats also chose roosts after fires in trees with a greater number of cavities and a higher percentage of bark coverage. More roosts were observed in burned areas than in unburned habitats. They concluded that prescribed fire may benefit bats. Johnson et al. (2012) found that prescribed fire could affect availability and distribution of roosts within roost tree networks.

Alternative B may indirectly adversely affect both species of bats during prescribed burn events due to the risk of fire-mediated destruction of active summer roosts (e.g., loss of snags). Depending on the timing of spring burns, bats could be directly impacted by the burns; however, the park would coordinate burn plans with the USFWS to reduce the potential of direct impact to bats. Prescribed fires proposed under Alternative B would also benefit both bat species by increasing suitable habitat and roost availability due to the effects of low-intensity prescribed burns and the possibility to generate new snags. Both bat species would also benefit from increased arthropod abundance post-fire events which could increase forage opportunities. Actions proposed

under Alternative B are unlikely to adversely affect the northern long-eared and Indiana bats because bat habitat could be improved through the use of fire, and mitigation measures would be implemented to avoid adverse impacts resulting from fire management activities. Thus, this alternative may impact bats, but habitat and occupancy should still remain and occur, and impacts would be negligible to minor and of long duration due to the time scale of forest succession and snag life.

Gray bats are cave dependent species for roosts. Since there are no caves in FODO, they are not known to have either maternity or hibernation roosts on the battlefield park. However, since there are major gray bat cave roosts nearby, they certainly transit through the battlefield park to forage along the rivers and larger streams. They may also forage in FODO to some extent. The most likely adverse impact on gray bat from prescribed burn events would likely be to temporarily displace bats from small flyways or foraging areas during a burn. However, since burns would be coordinated to not impact northern long-eared and Indiana bats during summer roosting, only a few gray bats would potentially be active either in very late activity season (November) or very early activity season (March) during burns. Because gray bats tend to utilize more open habitats, prescribed fires would potentially benefit them by opening some closed habitat.

Section 7 Determination of Effect. Alternative B may affect but is not likely to adversely affect the northern long-eared bat, Indiana bat, or gray bat. Concurrence in this determination will be sought from the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.

Plants

Low-intensity, ground fires that typically occur with prescribed fires and in areas with lower fuel loads are less likely to result in injury or mortality than high-intensity fires that could occur in areas with greater fuel loads. It is anticipated that mortality of individual special status plant species is likely to occur with prescribed fire. It is also anticipated that regularly recurring fire would maintain conditions required for establishment of new individuals of fire-dependent species, such as Price's potato bean, barbed rattlesnake-root, and purple milkweed. Prescribed fire and forest thinning are recommended management tools to maintain open canopies and eliminating competition from encroaching, invasive plants such as crown vetch (*Securigera varia*) (Chafin 2008, Sundin et al. 2013). The fire management activities carried out under Alternative B would result in reduced fuel loads and subsequently localized, lower intensity ground fires. These conditions are most likely to represent the greatest chance of long-term survival of the federally threatened and state listed special status plant species. The Zone FMO and fire management staff would be able to plan prescribed fires for habitat maintenance. As a result, the timing, frequency, intensity and spatial area would be more predictable and could be modified as new data emerges.

Mechanical treatments are not expected to impact special status plant species, because special status plant species would be avoided and not removed by mechanical treatments.

Section 7 Determination of Effect. Alternative B may affect but is not likely to adversely affect the Price's potato bean because suitable habitat could be improved through the use of fire, and mitigation measures would be implemented to avoid adverse impacts resulting from fire management activities. Concurrence in this determination will be sought from the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.

Cumulative Impacts

Cumulative impacts would be similar as to those described under Alternative A. Alternative B would contribute to beneficial cumulative impacts due to improved habitat quality and maintained and/or restored fire-adapted vegetation communities. Contribution to adverse cumulative impacts would be the same as described for Alternative A due to increased noise and disturbance to individual special status animal species and potential injury or mortality of individual special status plant species.

Cultural Resources

Affected Environment

The National Battlefield exists to preserve and protect the location of this pivotal battle of the Civil War. As such, the Fort Donelson National Battlefield and Fort Heiman were nominated to the National Register of Historic Places (NRHP) in 1976 as historic districts. A historic district is defined as a geographically definable area, urban or rural, possessing a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united by past events or aesthetically by plan or physical development (Little et al. 2000).

The Fort Heiman Unit is located in Calloway County, Kentucky atop a high bluff along the Tennessee River. The remote unit features several hundred yards of Confederate fortification, a Union artillery fort, historic road traces, and a historic family cemetery.

The nomination of the Fort Donelson National Battlefield was amended in 1996 to increase the number of contributing resources to 30—including two sites, twenty-one structures, and seven objects. The new contributing features listed included features constructed since the Civil War as the site was developed into a cemetery and battlefield park. The listed features include Cemetery Wall, Bivouac of the Dead Tablets, Flagstaff, Landscape features at the Cemetery, Park roads and associated stonework, Federal Earthworks, War Department Tablets, French's Battery, and Maney's Battery (NPS 2015a).

There are 10 core archaeological sites identified at the National Battlefield as listed below. All 10 sites are listed in the National Register of Historic Places under the umbrella designation of Fort Donelson National Battlefield and these include the following:

- Battlefield
- Dover Hotel
- Historic roads
- Two house sites
- Picnic area
- The Freedmen's Camp
- Wynn's Ferry Road Community
- Lock Complex
- National Cemetery Complex

The National Battlefield protects 29 historic structures. Three are buildings (the Dover Hotel, the cemetery carriage house, and the cemetery lodge) and the remaining consists of earthworks, river batteries, and other specific historic features on the landscape. All FODO historic structures are also listed in the National Register of Historic Places under the umbrella designation for the National Battlefield as a whole. Structures at FODO were evaluated as part of the September 2016 Wildland Fire Risk Assessment process. Fire personnel evaluated access, fuels, topography, construction design and materials, and hazards around each facility. The assessment provided a numerical score and risk adjective rating for each facility. The collected data will support incident response and fuels planning. The structure ratings are depicted on the Operations Mapsheet and the report can be found in appendix F-9 of the FMP. Structures on the newly acquired lands are currently being assessed in an ongoing Historic Resource Study.

Analysis of Alternatives and Impacts on Cultural Resources

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

The Zone FMO and fire management staff coordinate with the cultural resource staff (the National Battlefield and NPS Southeast Regional Office), Southeast Archeological Center, and appropriate tribal groups to avoid known cultural sites and historic structures. Resource protection measures included in the 2003 FMP serve to protect FODO cultural resources by limiting ground disturbance intensity using hand tools, blowers, and hand and/or chainsaws to construct firelines and avoiding the use of fire retardant. Mowing would continue around

cultural features such as earthworks, open fields, and structures to suppress woody vegetation and to maintain defensible space.

However, the structure of the forest stands would remain as closed canopies with dense understories and continue to accumulate hazard fuels, which could increase the potential for intense wildfire adjacent to the sites, structures, and objects that comprise FODO. Intense wildfires could cause discoloration of surface artifacts and features, burning of perishable materials, checkering or cracking of glass and ceramic artifacts, melting of metal features and/or artifacts, and distortion of historic structures from expansion of materials (Ryan et al. 2012). Archaeomagnetic dates and pollen counts could also be altered from a high-intensity wildfire. Overall impacts would depend on the timing, location, intensity, and extent of the wildfire and the mitigation efforts that could be implemented.

Wildfire suppression activities could result in displacement of cultural material and/or features on the ground surface, exposure of surface materials due to ground disturbance from wildfire management activities, or disturbance to cultural material immediately below the surface from vehicles due to earth moving or compaction. Indirect adverse impacts could include exposure of artifacts and/or features from erosion and loss of vegetation near cultural sites, which could increase looting. Mitigation measures (see Mitigation Measures Section) would reduce or eliminate many impacts from wildfire suppression actions.

Cumulative Impacts

Activities that could contribute to adverse cumulative impacts to FODO cultural resources include development (logging, agricultural, and residential) and natural erosion along the earthworks. Cultural resources are nonrenewable, and damage or loss from any activity would gradually diminish the types, number, and integrity of cultural resources present. Alternative A would continue to maintain defensible space around FODO features and structures and remove invasive species, reducing the potential risk to cultural resources by intense wildfires. Alternative A would contribute negligibly to adverse cumulative impacts due to the minimal soil disturbance associated with new fireline construction and vehicles. Unanticipated discoveries during proposed activities typically results in work ceasing in the area and a qualified NPS staff member visiting the site to assess conditions and recommend a course of action in consultation with the Tennessee or Kentucky State Historic Preservation Officer. Therefore, there would be no cumulative adverse impacts to archeological sites, historic structures, or objects at the National Battlefield under the No Action Alternative from planned mechanical treatments by NPS.

Section 106 Summary. After applying the Advisory Council on Historic Preservation's criteria of adverse effect (36 CFR part 800.5, *Assessment of Adverse Effects*), the NPS concludes that implementation of Alternative A would generally result in no adverse effect on archeological resources.

Impacts of Alternative B—Proposed Action

Impacts to cultural resources would be similar to those described under Alternative A for wildfire suppression actions. The addition of prescribed fire would protect FODO cultural resources by helping to reduce hazard fuel loads, increasing the potential for wildfires and prescribed fires to be localized, lower intensity, surface fires and reducing the potential risk of damage to cultural resources. All prescribed burns would have plans that allow for advance clearance and mitigation measures for cultural resources. Should new archaeological resources be identified during prescribed burns or mechanical treatments, all work would cease in the immediate vicinity of the discovery until the resource could be identified and documented and an appropriate mitigation strategy developed in consultation with the State Historic Preservation Officer. Any known cultural resources would be marked with special flagging and mitigation measures would be taken to protect identified resources from prescribed burns.

The additional use of mechanical treatments, such as masticators, and targeted herbicide application would increase the degree and range of protection for FODO sites, structures, and objects. Mechanical treatments would be used to reduce hazard fuel loads adjacent to the cultural resources, maintain and create defensible space around and near cultural resources, and increase the ability to achieve desired resource conditions that more closely resemble the FODO historic landscape and setting.

The use of mechanical treatments to thin the dense successional forests would result in ground disturbance from vehicle use or compaction, which could physically damage, disturb, or expose artifacts and/or features. Erosion and looting of cultural resources could be augmented from the exposure of artifacts. Mechanical treatments could also result in the displacement of cultural resources from their original spatial context. However, with avoidance of known cultural resources and implementation of mitigation measures, potential adverse impacts would be minimized.

Targeted herbicide application applied by hand to specific basal or foliar plant areas would minimize chances for overspray and migration into the soil. Additionally, targeted herbicide application would use herbicides that do not have short- or long-term residual implications to soils. No impacts from herbicide application on the ability to carbon date excavated cultural material are expected. Herbicide use would only damage potential radio carbon samples if the herbicide contained a large volume of petrochemicals (USFS 2010).

Implementation of mitigation measures and limited herbicide use as a follow-up treatment to mechanical treatments to help maintain fuelbreaks and defensible space would also help to minimize impacts to cultural resources by minimizing vegetation cutting and ground disturbance near FODO sites, structures, and objects.

Cumulative Impacts

Cumulative impacts to FODO cultural resources would be similar to those described under Alternative A. Alternative B would contribute to beneficial cumulative impacts to FODO cultural resources by minimizing the potential for future severe wildfires as the acres of hazard fuels are reduced and creation and maintenance of defensible space increases within and adjacent to archeological sites, historic structures, and cultural objects.

Section 106 Summary. After applying the Advisory Council on Historic Preservation's criteria of adverse effect (36 CFR part 800.5, *Assessment of Adverse Effects*), the NPS concludes that implementation of Alternative B would generally result in no adverse effect on archeological resources.

Cultural Landscapes

Affected Environment

The entire National Battlefield, including Fort Heiman, is listed as an historic district in the National Register of Historic Places. The Fort Donelson National Battlefield cultural landscape exhibits strong integrity to two historic periods: the Civil War Period (1861–1865) and the Commemorative Period following the war (1866–1942). All sections of the National Battlefield have significance from the Civil War Period, while only the Fort Donelson National Cemetery and the core of the National Battlefield are related to the Commemorative Period. Component landscapes include Fort Donelson, River Artillery Battery Positions, Picnic Area, Visitor Center and Park Entrance, Confederate Monument, Eddyville Loop Road, Grave's Battery Loop Road, Wynn's Ferry Loop Road, Fort Donelson National Cemetery, Dover Hotel, and Fort Heiman. All of the landscapes and component landscapes are located in Dover, Tennessee with the exception of Fort Heiman, which is located in Calloway County, Kentucky. More detailed information on the cultural landscape and component landscapes can be found in the Fort Donelson National Battlefield Cultural Landscape Report (https://irma.nps.gov/DataStore/Reference/Profile/2229809).

The Fort Heiman site and the 10 FODO battlefield properties were nearly entirely wooded with open understories during pre-settlement times. Native Americans maintained the hardwood forests through fire before Euro-American settlement in order to provide favorable conditions for bison, which they hunted. After Euro-American settlers arrived, many forests were cleared to make way for farming, and currently only patches of marginal, second-growth forest remain, mixed with cropland, pasture, grazing land, and developed areas.

National Battlefield vegetation has changed dramatically since the 1862 battle. Current vegetation is much thicker than historic cover, primarily due to the lack of fire as a natural disturbance. The absence of fire has also led to the loss of forest gaps as forests have become closed, which has led to the reduced integrity of the historic cultural landscape within the National Battlefield by encroaching upon historic fields and obscuring

the views and vistas that help a visitor to understand the conditions of the Battlefield in 1862 (NPS 2015a). Treatment recommendations for the Fort Donelson National Battlefield cultural landscape include updating the park's FMP to keep selected forest understory open, managing selected open fields to help restore, maintain, and protect historic views, implementing prescribed burns to maintain open understory conditions, and managing fields for native warm season grasses and forbs (NPS 2015a).

Analysis of Alternatives and Impacts on Cultural Landscapes

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

Under this alternative, the FODO fire management program would continue to operate as they have with full suppression of wildfires, mowing of grass areas, and removing woody and invasive vegetation with handheld mechanical tools. In general, this would result in beneficial impacts to the FODO cultural landscape by preventing woody and invasive plant encroachment on open fields and near contributing cultural features of the cultural landscape. However, the lack of prescribed burning as a fuels management option could result in relatively less effective prevention of fuel buildup adjacent to cultural landscapes. This could lead to increased potential for wildfires that are difficult to suppress/manage. The suppression of wildfires would help preserve important features of these landscapes. Given the mitigation measures in place for the consideration of cultural resources during suppression activities and cultural resource specialists to help make fire management decisions, the suppression of wildfires would have little effect on the cultural landscapes.

Forest stands would continue to accumulate and retain hazard fuels within and adjacent to the cultural landscape and component landscapes, which could hinder restoration, protection, and maintenance of the cultural landscape. Wildfires under these conditions could remove large tracts of vegetation which could lead to the cultural landscape and its component landscapes not being representative of the two time periods of cultural significance and diminished visual integrity. Impacts on contributing elements of the cultural landscape would be the same as discussed in the Cultural Resources Section. The degree of impacts would depend on the intensity, duration, location, and size of the wildfire. It is important to note that the battlefield park, in recent history, has experienced one wildfire that burned about 0.1 acres; therefore, it is expected that unplanned wildfires would be rare events.

Wildland fire suppression actions and tactics would consider type and location of contributing elements to the cultural landscapes. Most emergency management actions for wildfires would allow for protection of contributing elements to the cultural landscape (archaeological sites, historic structures). There is potential for emergency management responses for wildfires to adversely impact contributing elements of the cultural landscape. Fires or damage from suppression activities could result in unacceptable changes to character-defining elements of historic districts or structures. Fires could also remove important landscape elements, structures or historic sites, and create large amounts of unsightly burned and scorched vegetation, and un-vegetated areas from new firelines or intense burning, diminishing the visual integrity of the cultural landscape. Alternative A could also lead to reduced integrity of the cultural landscape, as brush and small trees in the understory continue to increase in density compared to the historic period that represents the cultural landscape. The Tennessee or Kentucky State Historic Preservation Officer would be notified of management responses to unplanned wildland fires.

The continued increase of forest stand density and closed canopies of forest stands would also reduce the integrity of the historic cultural landscape because dense forest stands would alter the historic character of the views and vistas that were part of the conditions of the Battlefield in 1862.

Cumulative Impacts

Activities that could contribute to adverse cumulative impacts to cultural landscapes include past development, park management activities, natural erosion along the earthworks, fire management activities planned by other agencies, and wildfires originating from adjacent lands. Cultural landscapes are nonrenewable, so damage or loss from any activity would gradually diminish the integrity of the cultural landscape present. Alternative A would continue to maintain defensible space around structures and remove invasive species, reducing the potential risk to portions of the cultural landscape by intense wildfires. Alternative A would contribute to

adverse cumulative impacts due to the increased risk for intense wildfires in untreated areas within and adjacent to the cultural landscape and associated vegetation loss and soil or ground disturbance.

Impacts of Alternative B—Proposed Action

Impacts to cultural landscapes would be similar to those described under Alternative A for wildland fire suppression activities. The use of prescribed fires in combination with mechanical treatments would aid in the maintenance and restoration of the historic cultural landscapes by thinning forest stands and removing trees and woody plants that have encroached upon historic fields and obscured the views and vistas that help a visitor to understand the conditions of the Battlefield in 1862 and enhancing cultural resources that contribute to the cultural landscape, such as maintaining open fields. The additional fuel or vegetation management tools would increase the degree and range of protection for the FODO cultural landscape by reducing hazard fuel loads adjacent to contributing cultural resource elements, maintaining and creating defensible space around and near contributing cultural resource elements, and increasing the ability to achieve desired resource conditions.

The use of prescribed fire would increase the ability and efficiency to reduce hazard fuels thus increasing the protection and maintenance of the cultural landscape and its contributing elements. The potential for localized, lower intensity ground fires, which are easier to manage/suppress, would increase, thus reducing the potential risk of damage to cultural landscapes and associated historic resources. Lower intensity ground fires should help to maintain more open cultural landscapes and historic viewsheds representative of the historic period, and increase abundance of native plants found in the area during the historic period. Prescribed fires would help to restore the forest structure to a more open canopy with a diverse forb and grass understory. Creating a more natural fire regime would favor native plants and reduce competition from invasive plants.

Mechanical treatments to thin the dense successional forests would help to restore the forest structure and species composition to conditions more representative of the historic periods of significance. Mechanical treatments could consist of minor trimming or vegetation removal around structures in an effort to create and maintain defensible space. Historic plantings would not be removed. Mechanical thinning and hazard fuel reduction work under this alternative would benefit cultural landscapes by aiding in the restoration of open areas and historic viewsheds. Targeted herbicide application applied by hand to specific basal or foliar plant areas would minimize chances for overspray and migration into the soil. Additionally, targeted herbicide application would use herbicides that do not have short- or long-term residual implications to soils. Implementation of mitigation measures, limited use as a follow-up treatment to selected mechanical treatments would also help to minimize impacts to the cultural landscape by minimizing vegetation cutting and ground disturbance.

Cumulative Impacts

Cumulative impacts to cultural landscapes from past, present, and reasonably foreseeable actions are similar to those described under Alternative A. Alternative B would contribute to beneficial cumulative impacts to FODO cultural landscapes by restoring the structure and species composition of the forest stands to conditions that represent the historic period of significance, which would also improve and restore the historic views and vistas important for understanding the conditions of the Battlefield of 1862. Additionally, prescribed fires in combination with mechanical and targeted herbicide treatments would minimize the potential for future intense wildfires as hazard fuel loads are reduced and creation and maintenance of defensible space increases within and adjacent to the cultural landscape and contributing archeological sites and historic structures.

Visitor Use and Experience

Affected Environment

Data for annual number of visitors at FODO is available starting in 1934. Visitation rose steadily after World War II, and rapidly jumped in time for the park centennial (2016). Visitation peaked in 1968–1969 with just over a million visitors each year, visitation dropped off immediately afterwards and declined steadily to a

consistent pace of approximately 200,000 annual visitors, which has held for the past two decades. The overall average visitation rate approximately is 260,000 visitors per year (Sundin et al. 2013).

Seasonable Visitation Patterns
Summer visitation is considerably higher than winter visitation. However, pleasant weather, combined with spring blossoms or autumn foliage, create peak visitation during spring and fall weekends (NPS 2017c).Seasonal variations in visitor use are as follows:

- **Spring**: heaviest use occurs on weekends and is usually concentrated around the National Cemetery, the visitor center, river batteries, and the surrounding area. Increased use by seniors and school groups occurs, as well as hikers, joggers, and picnickers.
- **Summer**: family groups on extended vacations dominate the park. Peak daily use occurs between the hours of 11:00 a.m. and 4:00 p.m. The heaviest use is on the weekends.
- **Fall**: senior citizen and organized tour use increases, especially in October. Use is concentrated on weekends. Area residents make increased use of the park for recreational activities.
- **Winter**: visitation is the lightest of any season. Area residents and business commuters predominate during this period.

Visitor Activities
Resources available for visitor use include one visitor center, thirteen picnic tables, 1,065 acres of battlefield park, six miles of tour road, and 5.7 miles of hiking trails.

People visit the park to experience the natural and historic features of the region. Visitor activities include hiking and bird watching. Since 2004, visitors have watched a year-round resident pair of bald eagles that have had more than eight chicks. Most visitor use takes place at the core archaeological sites, including the battlefield, earthworks, and cemetery. The battles, location, historic resources, and historic significance of the park make it unique among the other parks and recreational areas of the surrounding region. The park's driving tour is the primary way for people to experience FODO.

A FODO visitor study from the summer of 2007 revealed the most common activities in which visitor groups participated were viewing exhibits in the visitor center (86%), self-guided tour (84%), and viewing movies in the visitor center (60%) (NPS 2008b). The most commonly visited sites were the visitor center (96%), River Batteries (92%), Fort Donelson (84%), and the Confederate Monument (82%) (NPS 2008b). The site most often listed as most important to the visit was River Batteries (46%).

Other activities mentioned by visitors included walking and biking for exercise, watching living history presentations, picnicking, bird watching, and photography.

Analysis of Alternatives and Impacts on Visitor Use and Experience

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

Under Alternative A, there would be temporary visitor use restrictions within treatment areas so that no visitors are near where mechanical treatments are actively being applied or where wildfires are present. Noise associated with mechanical treatments such as chainsaws or mowers near the cultural features could temporarily disrupt the visitor experience. The noise disturbance would last until the treatment was completed.

Structures of the forest stands would remain as closed canopies with a dense understory of vegetation. The structure of the forested areas would continue to accumulate hazard fuel loads, increasing the risk for intense wildfire which could increase the potential for longer closures in portions of the park as well as a potential for the loss of large tracts of vegetation in the forests. Wildfires could also produce smoke that alters or reduces the visibility of historic scenes and scenic views which would adversely impact visitor use and experience while smoke is present.

Cumulative Impacts

Activities that could contribute to cumulative impacts to visitor use and experience include fire management activities planned by other agencies and landowners, wildfires occurring on adjacent lands, noise from vehicles

and boats, and maintenance activities within the park. Continued population growth in the municipality of Dover could increase the number of local visitors to the National Battlefield. Adverse cumulative impacts of Alternative A would negligibly affect visitor use and experience as the closures would be temporary and site-specific. Due to the small size and infrequency of wildfires in the past adverse cumulative impacts on visitor use and experience from temporary closures due to wildfires are expected to be negligible and infrequent.

Impacts of Alternative B—Proposed Action

Impacts under Alternative B would be similar as described for Alternative A, in regard to wildfires and mechanical treatments. The additional mechanical treatments, prescribed fire, and use of targeted herbicide application proposed under this alternative could increase the potential for temporary closures to visitor use areas. However, these additional vegetation or fuel management tools would increase the spatial extent of hazard fuel reductions within the forested areas; decreasing the potential for intense wildland fires. The decreased potential for intense wildfires would reduce the need for wildfire management or suppression activities, resulting in fewer disturbances from noise and closures to visitors. The presence of fire, smoke, and blackened areas could present an opportunity for education and interpretive programs of natural resources and the benefits of prescribed fire as emulating natural processes to aid in the restoration of fire-dependent vegetation communities. Educational opportunities associated with the natural fire-adapted ecosystems within the park could enrich the visitor use and experience in the park.

The use of prescribed fires in combination with mechanical treatments and targeted herbicide application would result in restoration of the historic cultural landscapes and opening up the views and vistas of the park. Restoring the line of sight from historic viewsheds would benefit visitor use and experience by allowing the visitor to understand the conditions of the Battlefield in 1862. Increasing the ability to restore and maintain historic cultural landscapes and native, fire-adapted communities would also enhance wildlife viewing opportunities and experiencing the National Battlefield forest ecosystem.

Cumulative Impacts

Adverse cumulative impacts to visitor use and experience for Alternative B are similar to those described under Alternative A. Alternative B would contribute to beneficial cumulative impacts by enhancing visitor experience of visualizing the historical context of the 1862 Civil War battle from restoration and maintenance of the cultural landscape. Additionally, visitor use and experience would benefit from the restoration of the historic views and vistas, which would enhance the understanding the conditions of the Battlefield in 1862.

Human Health and Safety

Affected Environment

The health and safety of firefighters, visitors, employees, and surrounding residents and neighbors of the battlefield is a primary objective of this FMP. The battlefield neighbors, visitors, local residents, and adjacent communities would be notified of all fire management activities that have the potential to impact them. Fire management activities and wildfires could pose unplanned, unforeseen risks to the public and employees, but firefighters and battlefield staff face direct risks when engaged in suppression-related activities. Smoke on roads and waterways in and adjacent to the battlefield is a visibility concern for traffic. In addition, smoke emissions from wildland fires could be an air quality issue to surrounding residents and the visiting public. The flaming front of a fire could put members of the visiting public, residents, park employees, and firefighters at risk. Accidents and unintended consequences could be more prevalent in chaotic, emergency wildfire situations. For this reason, risk areas from wildfires or prescribed fires would be closed to the public; mitigations would be implemented as soon as recognized and practical, such as media information issuances, closures and/or restrictions, and traffic control for smoke visibility.

The past and current fire management program in the National Battlefield has worked to mitigate the long-term threat to the safety of visitors, employees, local residents, and surrounding landowners. These actions include removing hazard fuel loads using mechanical treatments along approximately one-half mile of the National

Battlefield boundary that helps to create a 12-foot wide fuelbreak within the wildland urban interface and mowing of open fields to help prevent woody and invasive plant species encroachment. These activities would continue under all alternatives.

Analysis of Alternatives and Impacts on Human Health and Safety

Impacts of Alternative A—No-action Alternative (Continue Current Fire Management)

There would be adverse impacts to firefighter health and safety from wildfire suppression efforts, such as intense exposure to heat, smoke inhalation, accidental spills, injures from the use of firefighting equipment, and in severe cases injuries from wildfires. Impacts to the public could include smoke inhalation, and in severe cases injuries from wildfires.

Under Alternative A, wildfires would be suppressed as outlined in the 2003 FMP. In most cases, wildfires would utilize indirect tactics to contain the wildfire at nearby roads, trails, or natural barriers, depending on conditions. New fireline construction does not usually happen due to access, safety, terrain limits, but could occur when utilizing MIST tactics to minimize effects on resources. Fuel break construction during wildfire suppression efforts could pose safety risks to firefighters from the use of equipment. Each crew member is trained in the use of firefighting equipment, but accidental injuries may still happen. Adherence to guidelines concerning firefighter accreditation and equipment and procedural safety guidelines would minimize accidents.

Acute smoke inhalation by firefighters from wildfires starts with acute eye and respiratory irritation and shortness of breath and may progress into headaches, dizziness, and nausea depending on the duration of exposure. Most firefighter exposure to smoke has been considered nonhazardous, with a small percentage exceeding recommended exposure limits for carbon monoxide, the primary inhalation hazard, and respiratory irritants (USDA 2000).

The forests would retain dense stands that could increase the potential for severe wildfires that are harder to suppress/manage and increase smoke emissions which would increase the risk to human health and safety. The degree of impacts would vary depending on size of the fire, the location, extent, timing, and other factors related to the fire. In the event of a potentially severe wildfire within the battlefield, the Zone FMO and fire management staff would coordinate public notification, restrictions, closures, and evacuation efforts with park law enforcement staff and local emergency response agencies. The extent of public notice would depend on the specific fire situation. Assuring visitor, local residents, and staff safety would take priority over other park activities.

Cumulative Impacts

Actions outside the park that could have an impact on public health and safety include continued development of lands adjacent to the National Battlefield. Continued development would increase the wildland urban interface boundaries, which could increase hazard fuel loadings and the number of homes and structures at risk, thus increasing the risks to firefighters and the public in those areas during an intense wildfire. The impacts of Alternative A would contribute negligibly to adverse cumulative impacts to human health and safety due to the temporary and localized exposure to associated fire risks (e.g., heat, smoke inhalation) and the continued use of manual and mechanical treatments to reduce hazard fuel loads and create defensible space around National Battlefield cultural features. Additionally, fuelbreak work along a half mile of the National Battlefield boundary within the wildland urban interface would continue, which decreases the potential for intense wildfires and associated risks to people and structures.

Impacts of Alternative B—Proposed Action

Human health and safety impacts would be the same as described under Alternative A in regards to wildland fire suppression and fuels/vegetative management activities. Prescribed fire, mechanical and manual treatments, and herbicide treatments involve more pre-planning and implementing activities under defined conditions. This normally allows for better health and safety protections and precautions under planned and controlled workplace conditions than the inopportune times that often occur during wildfires, which is usually during more severe weather and fuel conditions. Health and safety of Zone FMO and fire management staff

would be enhanced when additional fire personnel would be brought in, as needed, from interagency cooperators for prescribed fires. Human safety is the primary objective for prescribed burns and all park activities; additional fire staff brought in would help to ensure safety mitigations were implemented. Therefore, the potential for impacts associated with management actions (though it is not possible to eliminate all risk) would be reduced overall.

The additional mechanical treatments, prescribed fire, and targeted herbicide use as a follow-up treatment to mechanical treatments would increase the ability to reduce hazard fuel loads and increase defensible space and fuelbreaks along the battlefield boundaries. The use of prescribed fire in combination with mechanical and herbicide treatments would be expected to increase the probability for lower-intensity, surface wildfires that are easier to suppress/manage, thus less risk to human health and safety. Additionally, the increased fuelbreaks along the boundary of the National Battlefield and the hazard fuel reduction work would be expected to increase the safety for homes located in the wildland-urban interface by reducing the potential for a wildfire or prescribed fire spreading from FODO to private residences.

All herbicide treatment areas would have individual treatment plans and would only use U.S. EPA approved herbicides. Targeted herbicide use would be implemented after signage was placed at all entryways to the treatment area and all visitors were out of the area. All FODO staff utilizing herbicide would be trained in approved procedures related to proper handling, storage, transportation, mixing, spill prevention, and application procedures. Furthermore, the Federal Insecticide, Fungicide, and Rodenticide Act and federal water quality monitoring indicate that the use of herbicides in forestry practices, such as ecological restoration efforts and prescribed fire, constitutes low risk to humans (Shepard et al. 2004).

Cumulative Impacts

Actions outside the National Battlefield that could contribute to cumulative impacts on public health and safety are the same as described for Alternative A. The impacts of Alternative B would contribute negligibly to adverse cumulative impacts to human health and safety due to the temporary and localized exposure to associated fire risks (e.g., heat, smoke inhalation). Alternative B would also contribute to beneficial cumulative impacts to human health and safety because the use of prescribed fires, additional mechanical treatments, and targeted herbicide application would further reduce hazard fuel loads, thus decreasing the potential for intense wildfires and associated risks to people and structures.

Consultation and Coordination

Agency Consultation

In accordance with the ESA, FODO management staff consulted with the FWS with regards to federally listed species. A copy of the EA will be sent to the FWS for review along with a request for their concurrence with the determination of effects on federally listed species for this EA.

In accordance with Section 106 of the NHPA, as amended in 1992 (16 USC 470 *et. seq.*), NPS contacted the Tennessee Historical Commission and Kentucky Heritage Council, the State Historic Preservation Offices (SHPO), by letter dated June 29, 2016, during the public scoping period asking for information concerning cultural resources. As of the date of publication of this EA, no agency comments have been received. A copy of this EA will be sent to Tennessee and Kentucky SHPOs for review and comment.

American Indian Consultation

The 7 affiliated American Indian tribes (see list below) were contacted by scoping letter dated June 29, 2016, informing them of the proposed action and soliciting comments. Information from the tribes also was requested to determine if any ethnographic resources are in the project area and if the tribe wanted to be involved in the environmental compliance process. As of the date of this EA, no comments were received. The Cherokee Nation responded that they had no comments for the EA. The tribes that are traditionally associated with the National Battlefield will have an opportunity to review and comment on this EA.

American Indian Tribes contacted include the following:

- Absentee-Shawnee Tribe of Indians of Oklahoma
- Cherokee Nation
- Chickasaw Nation
- Eastern Band of Cherokee Indians
- Eastern Shawnee Tribe of Oklahoma
- Shawnee Tribe
- United Keetoowah Band of Cherokee Indian

References

Achtemeir, G. L.

2003 On the Origins of "Superfog": A Combination of Smoke and Water Vapor that Produces Zero Visibility over Roadways. In *Second International Wildland Fire Ecology and Fire Management Congress and Fifth Symposium on Fire and Forest Meteorology*, November 16–20, Orlando, Florida, pages 1-4.

2009 On the Formation and Persistence of Superfog in Woodland Smoke. *Meteorological Applications* 16:2015–225.

Battle, J. M. and S. W. Golladay

2001 Hydroperiod Influence on Breakdown of Leaf Litter in Cypress Gum Wetlands. *American Midland Naturalist* 146:128–145.

Block, W. M., L. M. Conner, P. A. Brewer, P. Ford, J. Haufler, A. Litt, R. E. Masters, L. R. Mitchell and J. Park

2016 *Effects of Prescribed Fire on Wildlife and Wildlife Habitat in Selected Ecosystems of North America.* The Wildlife Society Technical Review 16-01. The Wildlife Society, Bethesda, Maryland, USA.

Bush, P. B., D. G. Neary, and C. K. McMahon

1998 *Fire and Pesticide: Air Quality Considerations.* University of Georgia, Agricultural and Environmental Services Laboratories, Athens, GA.

Chafin, L. G.

2008 *Barbed Rattlesnake-Root.* Available online at: http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/prenanthes_barbata.pdf.

Conner, L. M., J. L. Landers, and W. K. Michener

1999 Fox Squirrel and Gray Squirrel Associations within Minimally Disturbed Longleaf Pine Forests. *Proceedings of the Southeastern Association of Fish and Wildlife Agencies* 53:364-374.

Craft, C. B. and W. P. Casey

2000 Sediment and Nutrient Accumulations in Floodplain and Depressional Freshwater Wetlands of Georgia, USA. *Wetlands* 20:323–332.

Elliott, K. J. and J. M. Vose

2006 *Fire Effects on Water Quality: A Synthesis of Response Regulating Factors Among Contrasting Ecosystems.* Paper presented at the Second Interagency Conference on Research in the watersheds, May 16-18, 2006.

Greenberg, C. H., A. L. Tomcho, J. D. Lanham, T. A. Waldrop, J. Tomcho, R. J. Phillips, and D. Simon

2007 Short-term Effects of Fire and Other Fuel Reduction Treatments on Breeding Birds in a Southern Appalachian Upland Hardwood Forest. *Journal of Wildlife Management* 71:1906–1916.

Hardy, C. C., R. D. Ottmar, J. L. Peterson, J. E. Core, and P. Seamon, editors

2001 *Smoke Management Guide for Prescribed and Wildland Fire: 2001 Edition*. NFES 1279. National Interagency Fire Center, National Wildfire Coordinating Group, Fire Use Working Team, Boise, ID.

Hyde, J. C., J. Blades, T. E. Hall, R. D. Ottmar, and A. Smith

2016 *Smoke Management Photographic Guide: A Visual Guide for Communicating Impacts.* General Technical report PNW-GTR-925. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

Hyde J. C., K. M. Yedinak, A. F. Talhelm, A. M. S. Smith, D. M. J. S. Bowman, F. H. Johnson, P. Lahm, M. Fitch, and W. T. Tinkham

2017 Air Quality Policy and Fire Management Responses Addressing Smoke from Wildland Fires in the United States and Australia. *International Journal of Wildland Fire* 26:347–363.

Ice, G. G., D. G. Neary, and P. W. Adams

2004 Effects of Wildfire on Soils and Watershed Processes. *Journal of Forestry* 102: 16–20.

Johnson, J. B., J. W. Edwards, W. M. Ford, and J. E. Gates

2009 Roost Tree Selection by Northern Myotis (*Myotis septentrionalis*) Maternity Colonies Following Prescribed Fire in a Central Appalachian Mountains Hardwood *Forest. Forest Ecology and Management* 258:233–242.

Johnson, S. L.

2004 Factors Influencing Stream Temperatures in Small Streams: Substrate Effects and a Shading Experiment. *Canadian Journal of Fisheries and Aquatic Sciences* 61:913–923.

Johnston, D. W. and E. P. Odum

1956 Breeding Bird Populations in Relation to Plant Succession on the Piedmont of Georgia. *Ecology* 37:50-62.

Jones, D. D., L. M. Conner, T. H. Storey, and R. J. Warren

2004 Prescribed Fire and Raccoon Use of Longleaf Pine Forests: Implications for Managing Nest Predation? *Wildlife Society Bulletin* 32:1255–1259.

Jordan, T. R. and M. Madden

2010 *Digital Vegetation Maps for the NPS Cumberland- Piedmont I&M Network: Final Report November 1, 2010.* Natural Resource Technical Report NPS/CUPN/NRTR—2010/406. National Park Service, Fort Collins, Colorado.

Kennedy, M. L., J. B. Jennings, and H. L. LaMountain

2007 *Inventory of Mammals at Fort Donelson National Battlefield.* National Park Service.

Keyser, P. D. and W. M. Ford

2005 Influence of Fire on Mammals in Eastern Oak Forests. In *Proceedings of Fire in Eastern Oak Forests: Delivering Science to Land Managers*, edited by Dickinson, M. B., 180–190. General Technical Report-NRS-P-1, USDA Forest Service Northern Research Station, Columbus, OH.

Knapp, E. E., B. L. Estes, and C. N. Skimmer

2009 *Ecological Effects of Prescribed Fire Season: A Literature Review and Synthesis for Managers.* General Technical Report PSW-GTR-224. USDA Forest Service, Pacific Southwest Research Station, Albany, CA.

Lacki, M. J., D. R. Cox, L. E. Dodd, and M. B. Dickinson

2009 Response of Northern Bats (*Myotis septentrionalis*) to Prescribed Fires in Eastern Kentucky Forests. *Journal of Mammalogy* 90:1165–1175.

LANDFIRE

2012 *Existing Vegetation Type Layer, LANDFIRE 1.3.0.* US Department of the Interior, Geological Survey. Available online at: https://www.landfire.gov/version_comparison.php?mosaic=Y.

Little, B., E. M. Seibert, J. Townsend, J. H. Sprinkle, Jr., and J. Knoerl

2000 *Guidelines for Evaluating and Registering Archeological Properties Bulletin.* Available online at http://www.nps.gov/nr/publications/bulletins/arch/.

McMahon. C. K. and P. B. Bush

1991 *No Herbicide Residues Found in Smoke from Prescribed Fires.* USDA Forest Service, R8-MB 56, Atlanta, GA.

Meiman, J.

2009 *Cumberland Piedmont Network Water Quality Report.* Third Serial: Fort Donelson National Military Park NPS/SER/CUPN/NRTR—2009/002. National Park Service, Atlanta, GA.

Miller, M.

2000 Fire Autecology. In *Wildland Fire in Ecosystems: Effects of Fire on Flora*, edited by Brown, J. K. and J. K. Smith, pages 9–34. General Technical Report RMRS–42. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT.

National Park Service (NPS)

2008a Director's Order 18: Wildland Fire Management. Available online at: http://www.nps.gov/policy/Dorders/DO-18.html.

2008b *Fort Donelson National Battlefield Visitor Study Summer 2007.* Park Studies Unit Visitor Services Project Report 190.

2009 *Fort Donelson National Battlefield 2009–2018 Long-Range Interpretive Plan.* Fort Donelson National Battlefield, Dover, TN. Available online at: https://www.nps.gov/hfc/pdf/ip/fodo-lrip-2009.pdf.

2011 Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making. Available online at: https://www.nps.gov/policy/DOrders/DO_12.pdf.

2013a *Air Quality in National Parks: Trends (2000–2009) and Conditions (2005–2009)*. Natural Resource Report NPS/NRSS/ARD/NRR—2013/683. National Park Service, Denver, CO.

2013b *Fort Donelson National Battlefield Forest Vegetation 2013 Resource Brief.* National Park Service, Cumberland Piedmont Network Inventory and Monitoring Program, Mammoth Cave, KY.

2014 *Wildland Fire Management Reference Manual 18*. Branch of Wildland Fire, Division of Fire and Aviation. Available online at: http://www.nps.gov/fire/wildland-fire/resources/documents/nps-reference-manual-18.pdf.

2015a *Fort Donelson National Battlefield Cultural Landscape Report.* Fort Donelson National Battlefield, Dover, TN.

2015b *National Park Service NEPA Handbook.* National Park Service, Denver, CO. Available online at: https://www.nps.gov/subjects/nepa/upload/NPS_NEPAHandbook_Final_508.pdf.

2016 *Annual Park Recreation Visitation Report.* Available online at: https://irma.nps.gov/Stats/SSRSReports/Park%20Specific%20Reports/Annual%20Park%20Recreation%20Visitation%20(1904%20-%20Last%20Calendar%20Year)?Park=FODO

2017a *Fort Donelson National Battlefield Forest Vegetation Monitoring Summary, 2011–2015.* National Park Service, Cumberland Piedmont Network Inventory and Monitoring Program, Mammoth Cave, KY.

2017b *NPS Certified Species List for Fort Donelson National Battlefield.* Available online at: https://irma.nps.gov/App/Species/Search.

2017c *Fort Donelson National Battlefield Monthly Use Report.* Available online at: https://irma.nps.gov/Stats/SSRSReports/Park%20Specific%20Reports/Monthly%20Public%20Use?Park=FODO.

Natural Resources Conservation Service, United States Department of Agriculture (NRCS)

2017 *Web Soil Survey*. Available online at: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

National Wildfire Coordinating Group (NWCG)

2014 *Interagency Prescribed Fire Planning and Implementation Procedures Guide*. Available online at: http://www.nwcg.gov/sites/default/files/products/pms484.pdf.

Natureserve

2017 *NatureServe Explorer: An Online Encyclopedia of Life [web application]*. Version 7.0. NatureServe, Arlington, VA. U.S.A. Available online at: http://explorer.natureserve.org.

Neary, D. G., K. C. Ryan, and L. F. DeBano

2005 *Wildland Fire in Ecosystems: Effects of Fire on Soils and Water.* General Technical Report RMRS-GTR-42, USDA Forest Service, Rocky Mountain Research Station, Ogden, UT.

Perkins, M. W., L. M. Conner, and M. B. Howze

2008 The Importance of Hardwood Trees in the Longleaf Pine Forest Ecosystem. *Forest Ecology and Management* 255:1618-1625.

Perry, R. W.

2012 A Review of Fire Effects on Bats and Bat Habitat in the Eastern Oaks Region. In *Proceedings of the 4th Fire in Eastern Oak Forests Conference*, edited by Dey, D. C., M. C. Stambaugh, S. L. Clark, and C. J.Schweitzer, 170–191. General Technical Report GTR-NRS-P-102, USDA Forest Service, Northern Research Station, Newton Square, PA.

Peterson, D. W., P. B. Reich, and K. J. Wrage

2007 Plant Functional Group Responses to Fire Frequency and Tree Canopy Cover Gradients in Oak Savannas and Woodlands. *Journal of Vegetation Science* 18:3–12.

Phillips, R. J. and T. A. Waldrop

2008 Changes in Vegetation Structure and Composition in Response to Fuel Reduction Treatments in the South Carolina Piedmont. *Forest Ecology and Management* 255:3107–3116.

Rau, B. M., R. R. Blank, J. C. Chambers, and D. W. Johnson

2007 Prescribed Fire and Time: Soil Extract-able Nitrogen and Phosphorus Dynamics in a Great Basin Sagebrush Ecosystem. *Journal of Arid Environments* 7: 362–375.

Redmon, L. A., and T. G. Bidwell

2003 *Management Strategies for Rangeland and Introduced Pastures.* Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources.

Rinne J. N. and G. Jacoby

2005 Aquatic Biota, Fishes, Invertebrates. In *Wildland Fire in Ecosystems: Effects of Fire on Soils and Water*, edited by D.G. Neary, K.C. Ryan, and L.F. DeBano (revised 2008), pages 135–143. General Technical Report RMRS-GTR-42-vol.4. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT.

Roberts, T. H. and K. L. Morgan

2006 *Inventory and Classification of Wetlands at Fort Donelson National Battlefield, Dover, TN*. National Park Service. Tennessee Technological University. Cookeville, TN.

Ryan, K. C., A. T. Jones, C .L. Koerner, and K. M. Lee

2012 *Wildland Fire in Ecosystems: Effects of Fire on Cultural Resources and Archaeology.* General Technical Report RMRS-GTR-42-3. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

Shepard, J. P., J. Creighton., and H. Duzan

2004 Forestry Herbicides in the United States: An Overview. *Wildlife Society Bulletin* 32*:*1020–1027.

Scott, A. F. and J. Davenport

2005 *Inventory of the amphibians and reptiles of Fort Donelson National Battlefield, Stewart County, Tennessee*. National Park Service.

Stedman, S. J. and B. H. Stedman

2005 *Final Report of Bird Inventory: Fort Donelson National Battlefield, 2003–2005*. National Park Service.

Stein, S. M., S. J. Comas, J. P. Menakis, M. A. Carr, S. I. Stewart, H. Cleveland, L. Bramwell, and V. C. Radeloff

2013 *Wildfire, Wildlands, and People: Understanding and Preparing for Wildfire in the Wildand-Urban Interface*. General Technical Report RMRS-GTR-299. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Sullivan, T. J.

2016 *Air Quality Related Values (AQRVs) for Cumberland Piedmont Netwrok (CUPN) Parks: Effects from Ozone, Visibility Reducing Particles, and Atmospheric Deposition Acids, Nutrients, and Toxics.* Natural Resource Report NPS/CUPN/NRR–2016/1164. National Park Service, Fort Collins, CO.

Sundin, G., L. Worsham, N. Nibbelink, G. Grossman, and M. Mengak

2013 *Natural Resource Condition Assessment for Fort Donelson National Battlefield.* Natural Resource Report NPS/FODO/NRR—2013/621. National Park Service, Fort Collins, Colorado.

Tatum, V. L.

2004 Toxicity, Transport, and Fate of Forest Herbicides. *Wildlife Society Bulletin* 32:1042–1048.

Thornberry-Ehrlich, T. L.

2009 *Geologic Resources Inventory Scoping Summary Fort Donelson National Battlefield, Tennessee.* U.S. Department of the Interior, National Park Service, Geologic Resources Division.

U.S. Department of Agriculture (USDA)

2000 *Smoke Exposure at Western Wildfires.* Research Paper PNW-RP-525. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

U.S. Forest Service

2010 *South Fork Salmon River Subbasin Noxious and Invasive Weed Management Program Final Environmental Impact Statement: Krassel and McCall Ranger Districts, Payette National Forest, Cascade Ranger District, Boise National Forest, Valley County and Idaho County, Idaho*. Payette National Forest, McCall, ID.

U.S. Department of the Interior and U.S. Department of Agriculture

2009 *Guidance for Implementation of Federal Wildland Fire Management Policy*. Available online at: https://www.nifc.gov/policies/policies_documents/GIFWFMP.pdf.

U.S. Environmental Protection Agency (US EPA)

1998 *Final Guidance for Incorporating Environmental Justice Concern's in EPA's NEPA Compliance Analysis.* Washington, DC. Available online from https://www.epa.gov/sites/production/files/2015-04/documents/ej-guidance-nepa-compliance-analyses.pdf.

U.S. Fish and Wildlife Service (USFWS)

2015 *Northern Long-Eared Bat (Myotis septentrionalis) Fact Sheet.* Available online from http://www.fws.gov/midwest/endangered/mammals/nleb/pdf/NLEBFactSheet01April2015.pdf.

2016a Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and activities Excepted from Take Prohibitions.

2016b *Key to the Northern Long-Eared Bat 4(d) Rule for Federal Actions that May Affect Northern Long-Eared Bats.* Available online from https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/KeyFinal4dNLEB_FedAgencies17Feb2016.pdf.

Van Lear, D. H. and R. F. Harlow

2000 Fire in the Eastern United States: Influence on Wildlife Habitat. In *Proceedings: The Role of Fire in Nongame Wildlife Management and Community Restoration: Traditional Uses and New Directions*, edited by Ford, W. M., Russell, K. R., and Moorman, C. E., 2–10. General Technical Report NE-288, USDA Forest Service, Northeastern Research Station, Newton Square, PA.

Vogl, R. J.

1979 Some Basic Principles of Grassland Fire Management. *Environmental Management* 3:51–57.

Vose, J. M.; S. H. Laseter, and S. G. McNulty

2005 Stream Nitrogen Responses to Fire in the Southeastern U.S. Contributing Paper at the *3rd International Nitrogen Conference*, edited by Zhu, Z., K. Minami, and G. Xing, 577–584.

Wade, D. D., B. L. Brock, P. H. Brose, J. B. Grace, G. A. Hoch, and W. A. Patterson III

2000 Fire in Eastern Ecosystems. In *Wildland Fire in Ecosystems: Effects of Fire on Flora*, edited by Brown, J. K. and J. K. Smith, pages 53–96. General Technical Report RMRS–42. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT.

White, R. D.

2005 *Vascular Plant Inventory and Plant Community Classification for Fort Donelson National Battlefield*. NatureServe, Durham, NC.

Wright. H. A. and A. W. Bailey

1982 *Fire Ecology: United States and Canada*. John Wiley and Sons, New York.

Zebehazy, L. A., J. D. Lanham, T. A. Waldrop, and K. F. Connor

2004 *Seasonal Avifauna Responses to Fuel Reduction Treatments in the Upper Piedmont of South Carolina: Results from Phase 1 of the National Fire and Fire Surrogate Study.* General Technical Report SRS-71. USDA Forest Service Southern Research Station.

Zimmerman, J. C.

2007 *Seasonal Variations in Fish Assemblages of Small Warmwater Streams in Four Southeastern National Parks.* Master of Science Thesis, University of Tennessee, Knoxville.

Zouhar, K, J. K. Smith, S. Sutherland, and M. L. Brooks

2008 *Wildland Fire in Ecosystems: Fire and Nonnative Invasive Plants.* General Technical Report RMRS-GTR-42-volume 6. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT.