

Fuels Treatment Monitoring Plan
Fredericksburg and Spotsylvania National Military Park
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I. INTRODUCTION

Fredericksburg and Spotsylvania National Military Park (Fredericksburg and Spotsylvania NMP, the park) is located approximately 50 miles (80 km) south of Washington, D.C. The park is spread out over a 110-square mile (285 km²) area in the city of Fredericksburg, Virginia, at the junction of Interstate 95 and State Route 3, and in Caroline, Orange, Spotsylvania, and Stafford Counties.

It is comprised of four separate Civil War battlefields: Fredericksburg, Spotsylvania Courthouse, Chancellorsville, and Wilderness, and four related sites: Salem Church, Chatham Manor, Jackson Shrine, and the Fredericksburg National Cemetery. The park has an authorized acreage of 9,550 ac (3,850 ha), of which the Federal Government currently owns 7,200 ac (2,900 ha). Approximately 5,300 ac (2,150 ha) lie within Spotsylvania County (FRSP FMP 2003).

The park lies along the transition (fall) line between the Tidewater and the Piedmont regions. Park-owned lands are drained by the Rapidan, Rappahannock, Po, Ni, and York Rivers. The area supports an eastern North American riparian and woodland habitat on a substrate of the Appalachian Piedmont and the Atlantic Coastal Plain. The park provides rich forest and wetlands, developed parkland, farmsteads, and historic landscapes. The geography of the area consists of gently rolling hills within the Piedmont Plateau.

On four separate occasions, the main eastern armies of the United States and the Confederate States fought major battles in and around Fredericksburg, Virginia. The woods and fields of the battles are the primary resources of the park: federal lands encompass 1,100 ac (445 ha) of open fields, 5,600 ac (2266 ha) of forest, and 110 mi (177 km) of boundary. In addition, the park has significant terrain features, historic roads and traces, structures, house sites, ruins, cemeteries, monuments, markers, and historic objects. A number of historic structures dating from the mid-19th century add to the park's significance, including more than 37 mi (60 km) of earthworks built by the soldiers, Salem Church, the house where Stonewall Jackson died, Ellwood, Chatham Manor, and several other structures that were landmarks on the historic fields. More than 15,000 Federal soldiers killed in or near Fredericksburg are buried in the national cemetery. The park also includes 23 mi (37 km) of trails (FRSP FMP 2003).

The park's 2003 Fire Management Plan (FRSP FMP 2003) approves suppression, prescribed fire, and non-fire treatments to accomplish the primary resource management goal of the wildland fire management program, which is to preserve, restore, maintain, and protect the cultural and natural landscape. All wildland fires, defined as "any non-structure fires, other than prescribed fires, that occur in the wildland," will be suppressed.

The park will implement long and short term monitoring to assess accomplishments and to determine the effects of management activities on cultural and natural resources. Monitoring of prescribed fires is intended to provide information for quantifying and predicting fire behavior and its ecological effects on park resources while building a historical record. It

measures parameters common to all fires: fuels, topography, weather, and fire behavior. In addition, ecological changes such as species composition and structural changes will be monitored for several years after a fire. Monitoring will help to define the effectiveness of the fire management program by assessing the vegetative effects of fire. This information will be very useful in adjusting the prescribed fire program to better meet short and long-term resource objectives.

The Northeast Region Fire Effects Monitoring Crew began monitoring fire effects at the park in 2004. This Monitoring Plan describes procedures for monitoring the effects prescribed fire and non-fire (primarily brush-hogging) treatments used to modify fuels in the Spotsy Fields Monitoring Unit at Fredericksburg and Spotsylvania National Military Park.

All prescribed fires are monitored regardless of size. Prior to ignition of a burn unit, monitoring plots will be installed. These plots will be read before and after the burn to gather pre- and post-burn data. During prescribed burning, monitoring will include mapping, weather and fire behavior observations, and direct observation of first order fire effects. Operational monitoring provides a check to insure that the fire remains in prescription, and serves as a basis for evaluation and comparison of management actions in response to measured, changing fire conditions, and changes such as fuel conditions and species composition. The Northeast Region Fire Effects Monitoring Crew will assist the park in establishing and reading monitoring plots.

Monitoring of non-fire applications (primarily mowing and manual brush-cutting) will be done to determine if the project objectives were met. This monitoring is a visual assessment, and is conducted by park staff.

II. RESOURCE AND FIRE MANAGEMENT GOALS AND OBJECTIVES

A. *Resource Management Goals and Objectives*

The General Management Plan for Fredericksburg and Spotsylvania NMP (GMP; FRSP 1986) states, “Resources management and land protection recommendations will be implemented to preserve and protect the park setting.” The GMP established the following general management objectives related to fire management:

- Manage the natural resources of the park in a manner that complements the [historical] purpose of the park.
- Create visitor appreciation for the historical environmental conditions and scenes on the battlefield, by removing or adding vegetation in areas of great historical significance, to the extent possible, to duplicate as closely as possible the scene during the 1860's within the historical zone.
- Protect earthworks, road traces, and other battle-related features from damaging changes caused by either natural or human forces, by selective vegetation management and limiting access to them.
- Identify, evaluate, protect, maintain, and interpret the park's cultural resources to preserve their original fabric and workmanship and, where necessary, stabilize and rehabilitate them in a manner consistent with legislative mandates and NPS policies

The objectives for natural resources are consistent with the following general issues presented in the GMP:

- The park's 38 miles (61 km) of earthworks have received very little maintenance in the past, and measures need to be taken to reduce deterioration. Recent studies have shown that earthworks can best be preserved if large trees are removed from them.
- Many areas that were open fields at the time of the battles, and played key roles in those battles, are now forested. Similarly, some areas that were heavily forested during the battle action are now open fields. Both of these factors make interpretation and understanding of the battle strategies difficult.

The FMP is a component of the park's Resources Management Plan (RMP; FRSP 1999) and is designed to facilitate the achievement of the park's cultural and natural resource management objectives. These objectives are documented in the park's RMP, and are derived from the park's enabling legislation of February 14, 1927 (44 Stat. 1091), the General Management Plan, and the Statement for Management (FRSP 1991). The objectives of the park's RMP relating to fire provide for the preservation, restoration, maintenance, and protection of the cultural and natural resources of the park. These objectives are embodied in the following resource management objectives:

- FRSP-N-007.026, Develop a Fire Management Program to Include Prescribed Fire Component
- FRSP-N-008.008, Develop Open Fields Management Plan
- FRSP-N-011.032, Develop Exotic Plant Management Plan
- FRSP-C-015.025, Investigate and Stabilize Earthworks
- FRSP-C-016.026, Restore Historic Ground Cover

B. Fire Management Goals and Objectives

The fire management program, carefully guided by resource management objectives, should protect cultural resources through prescribed fire and suppression of wildland fire. The program should also perpetuate the natural resources and their associated natural processes using wildland fire (FRSP FMP 2003). The overall goals for fire management are to restore natural ecological processes and habitat similar to pre-European times in certain areas and to manage historically open fields and earthworks, while addressing protection of park resources and surrounding land uses. The park's objectives for fire management relevant to monitoring of fuels treatments are as follows:

- Protect cultural and natural resources and intrinsic values from unacceptable impacts attributable to fire and fire management activities.
- Apply prescribed fire as a method of restoring, preserving, and maintaining the park's cultural and natural landscape, as well as mitigating hazardous fuels.
- Organize and maintain a fire management capability which consistently applies the highest standards of professional and technical expertise.
- Encourage research to advance understanding of fire behavior, effects, ecology, and management.
- Integrate fire management with all other aspects of park management.
- Gain knowledge of the ecological role of fire in the eastern hardwood forest types, with particular emphasis on the pine-oak hickory forest and native grasses through research and for the purpose of preservation of the cultural resources of the park.
- Encourage regeneration of oak species that require disturbance to promote biodiversity.

III. ECOLOGY AND LANDSCAPE MANAGEMENT

The elevation of Fredericksburg and Spotsylvania NMP ranges from near sea level, along the Rappahannock River below Chatham Manor, to more than 500 ft (150 m) near the western boundary of Wilderness Battlefield. The battlefield sites at Chancellorsville, Wilderness, and Spotsylvania Courthouse are located in the Piedmont physiographic province of the eastern United States. The battle for Fredericksburg occurred along the ridge that forms the fall line separating the Piedmont from the Coastal Plain province. Fredericksburg Battlefield is in an urban environment that extends from Marye's Heights in Fredericksburg along the ridge overlooking the Rappahannock River. The floodplain below the ridge is flat to gently rolling. The peneplain beyond the ridge is a series of Piedmont terraces cut by numerous small streams. Chatham Manor lies in the Coastal Plain province, an area characterized by gentle slopes (FRSP FMP 2003).

Numerous streams and swamps on gently rolling wooded plateaus dissect Chancellorsville, Wilderness, and Spotsylvania Courthouse Battlefields. Chancellorsville Battlefield lies on the divide separating the watershed of the Rappahannock River from the Po and the Ni rivers, and Spotsylvania Courthouse Battlefield lies between the drainage areas of the Po and the Ni rivers. The site of the Wilderness Battlefield is in the Wilderness Run drainage, which flows north into the Rapidan River. Streams in the park generally have good sustained flows. The availability of groundwater varies with the underlying rock formations, but in most areas of the two counties, an adequate supply of water may be obtained from springs and wells. Water quality depends on the chemical content of both underground and surface waters, the tidal influence of larger surface streams, and the degree of contamination from residential and industrial development (FRSP FMP 2003).

The open fields of the battlefield contain many native grasses, sedges, shrubs, herbaceous plants and tree seedlings. Common native grasses and sedges include, beaked panic grass (*Panicum anceps*), poverty oatgrass (*Danthonia spicata*), rosette grass (*Dichanthelium dichotomum*), broomsedge (*Andropogon virginicus*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*) and sedges (*Carex* spp.). Shrubs include blackberry (*Rubus* spp.) and winged sumac (*Rhus copallinum*) and herbaceous plants include trailing bush clover (*Lespedeza procumbens*) yarrow (*Achillea millefolium*) and cinquefolia (*Potentilla* spp.) Tree seedlings include blackjack oak (*Quercus marilandica*), sweet-gum (*Liquidambar styraciflua*) and locust (*Robinia pseudoacacia*). Additionally, there are a few exotic species of concern found in the fields. Some of which include, but are not limited to, Japanese Honeysuckle (*Lonicera japonica*), colonial bent grass (*Agrostis capillaris*), sweet vernal grass (*Anthoxanthum odoratum*), cat's ear (*Hypochaeris radicata*) and red sorrel (*Rumex acetosella*).

The forest community structure of park lands responds to two major factors: past land use and soil conditions. The forest patterns reflect past land use in successional stages from pioneer community types (pine) to disturbance climax communities (oak-hickory). The vegetation of the battlefields is classified as oak-hickory forest in the temperate deciduous biome. Typical tree species include oaks (*Quercus* spp.), hickories (*Carya* spp.), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), and yellow poplar (*Liriodendron tulipifera*). Subcanopy trees consist of dogwood (*Cornus racemosa*), redcedar (*Juniperus virginiana*), tupelo (*Nyssa sylvatica*), and sassafras (*Sassafras albidum*). Shrub species include mountain laurel (*Kalmia latifolia*), blackberries (*Rubus* spp.), poison ivy (*Toxicodendron radicans*), and American hazelnut (*Corylus americana*). Virginia pine (*Pinus virginiana*) and shortleaf pine (*P. echinata*) are found in areas recently cultivated or pastured (FRSP FMP 2003).

The interspersed vegetative types provide habitats for a wide variety of wildlife in the park. Open land wildlife includes rabbits (Eastern cottontail, *Sylvilagus floridanus*), groundhogs (*Marmota monax*), and several bird species normally found in cropland, pasture, and meadows such as bobwhite quail (*Colinus virginianus*), eastern phoebe (*Sayornis phoebe*), American crow (*Corvus brachyrhynchos*), blue jay (*Cyanocitta cristata*), mourning dove (*Zenaidura macroura*), hawks (*Buteo* spp.), owls, and field sparrows (*Spizella pusilla*). Woodland wildlife includes white-tailed deer (*Odocoileus virginianus*), gray squirrels (*Sciurus carolinensis*), raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), opossum (*Didelphis marsupialis*), striped skunk (*Mephitis mephitis*), and a number of small mammals such as the Eastern cottontail and meadow vole (*Microtus pennsylvanicus*). Woodland birds include wild turkey (*Meleagris gallopavo*), ruffed grouse (*Bonasa umbellus*), woodpeckers, and warblers. Wetland wildlife includes beaver (*Castor canadensis*), mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), and water birds that live along streams, ponds, marshes, and swamps such as ducks and geese. There is also a wide variety of reptiles and amphibians, including the red spotted newt (*Notophthalmus viridescens*), northern cricket frog (*Acris crepitans*), northern leopard frog (*Rana pipiens*), green frog (*Rana clamitans*), snapping turtle (*Chelydra serpentina*), and eastern painted turtle (*Chrysemys picta*) (FRSP FMP 2003).

Except for occasional transient species, no federally listed or proposed endangered or threatened wildlife are known to be endemic to Fredericksburg and Spotsylvania NMP. No federally listed or proposed endangered or threatened plant species occur in the park. From 1989 to 1991, the Virginia Department of Conservation and Recreation's Division of Natural Heritage conducted an inventory for Natural Heritage Resources in FRSP. Natural Heritage Resources include "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest." Two populations of the state-rare plant, red milkweed (*Asclepias rubra*) were recorded in the 1993 final report (Ludwig, 1993). The state ranking for red milkweed is S2, which means that it is very rare and imperiled, with 6 to 20 occurrences or few remaining individuals in Virginia, or vulnerable to extirpation in Virginia. The plants were found at two locations. The first location, adjacent to Stuart Drive, had one sterile plant when observed in July 1990. The second location, in the headwaters of Little Hunting Run, is in a partially

open, low-nutrient, groundwater seepage area. Nine sterile plants were observed in October 1992. Management recommendations provided in the 1993 final report include monitoring the long-term health of the plant population, land use, and management practices and consulting with Department of Natural Heritage staff to avoid negative impacts to the rare plant should land use or management practices change. The small whorled pogonia (*Isotria medeoloides*), a Federally listed endangered species, has been found in the area but none have been found in the park (FRSP FMP 2003). Neither of these two species is found within the vicinity of the Spotsylvania burn unit.

Native American Indian uses of fire in this area are unknown. Exclusion or suppression of natural fire began in the mid-1800s and has changed the vegetative composition of the park, which in turn has affected wildlife habitat requirements. The fuel loading has significantly increased because of the successional changes from mostly open oak/hickory woodlands to a thick undergrowth in the oak/hickory woodlands. Currently it is the policy of the park to suppress all fires, both human-caused and lightning ignitions. This attempt to eliminate fire from the environment has altered the natural cyclic burning of the ecosystem (FRSP FMP EA 2003).

The park was classified as a Class II park in the clean air act of 1977. This designation relates to the amount of air quality degradation that is allowable. This classification allows only moderate amounts of degradation of the existing air quality condition. In 1992, Stafford County was listed as a "non-attainment" area under the Clean Air Act, suggesting serious air quality problems. Hydrocarbon pollution from three major areas, the Washington, D.C., Richmond, VA, and Fredericksburg, VA, metro areas, are potential contributors to the decline of air quality in the park (FRSP FMP 2003).

Another contributing factor is development around the park: it is estimated that 40% of the boundary is in some stage of development. The land adjacent to the Park is rapidly undergoing conversion from rural farmland and commercial forest to residential communities and commercial development. The area surrounding the park has experienced a surge of growth in the past 15 years as a result of increased use of I-95 as a major north-south transportation corridor. This expansion has resulted in new industries and increased development and traffic adjacent to the park. Air pollution may be causing yet undetermined impacts on the park's natural and cultural resources (FRSP FMP 2003).

IV. MONITORING DESIGN

Wildland and prescribed fire monitoring at Fredericksburg and Spotsylvania NMP is conducted according to the National Park Service Fire Monitoring Handbook (FMH; NPS 2001). The FMH describes four levels of monitoring. The first two monitoring levels, environmental and fire observation monitoring (levels 1 and 2), provide information to guide fire management strategies for wildland and prescribed fires, and provide a base for short-term change and long-term change monitoring (levels 3 and 4). Environmental monitoring (level 1) is conducted daily during the fire season. Wildland fires will be monitored at the fire observation level (level 2), non-fire fuels treatments will be monitored at the short-term change monitoring level (level 3), and prescribed fires will be monitored at the fire observation, short-term change, and long-term change monitoring levels (levels 2, 3, and 4).

A. *Environmental and Fire Observation Monitoring*

1. Environmental Monitoring

Environmental monitoring provides the basic background information needed for decision-making, and occurs before a fire starts (or is started). At Fredericksburg and Spotsylvania NMP, the types of environmental data that will be collected are weather, fire danger rating, fuel conditions, and concerns and values to be protected.

Weather data is collected daily during the fire season at weather station #442301 at Chancellorsville Battlefield, Spotsylvania County, Virginia, approximately 50 miles to the north of Richmond. Weather and spot weather forecasts are obtained as needed from the National Weather Service Sterling office.

Concerns and values to be protected are identified in the FMP (FRSP FMP 2003), and during the planning process for each fuels treatment project.

2. Fire Observation Monitoring

Fire observation monitoring occurs when there is an ongoing fire and includes two stages: reconnaissance, a basic overview and assessment of the fire; and fire conditions, monitoring of the dynamic aspects of an ongoing fire.

On wildland fires, the fire observation data that will be collected for each fire are those data required for completion of the Wildland Fire Report. The reconnaissance data are fire cause and ignition point, final fire location and size, fuel model, and vegetation type. The fire conditions data are basic topographical information (elevation, slope, aspect, and position on slope) and initial attack resources. On larger fires and fires initial attacked by park personnel, additional data such as fire behavior, weather, threats and constraints, smoke volume and movement, and suppression

actions may also be collected. Fire observation data for wildland fires will be recorded in the Wildland Fire Report.

On prescribed fires, the minimum reconnaissance data that will be collected for each fire are final fire location and size, minimum resources required, fuel model and vegetation type, predicted fire behavior, observed and forecasted weather, and resource and safety threats and constraints. The minimum fire conditions data that will be collected are basic topographical information (elevation, slope, aspect, and position on slope) and weather conditions at time of ignition. Additional data, such as smoke volume and movement, hourly weather observations, observed fire behavior, and ignition and holding actions may also be collected. Fire observation data for prescribed fires will be recorded in the Prescribed Fire Monitoring Report or Prescribed Fire Completion Report and in the Wildland Fire Report.

B. Short- and Long-term Monitoring

Short-term change monitoring can provide information about fuel reduction and vegetative change, in order to facilitate a quantitative evaluation of progress toward meeting management objectives. The recommended standard for monitoring short-term change is to collect descriptive information on fuels and vegetation structure and composition, in more detail than the basic information collected during fire conditions monitoring. Data are collected primarily through sampling of permanent monitoring plots, starting before treatment and continuing up to two years after treatment. Short-term monitoring will be conducted on non-fire fuels treatments and prescribed fires.

Long-term change monitoring is concerned with the identification of significant trends over time, in order to inform management decisions. Procedures for short-term monitoring and for long-term monitoring are similar, but differ in timing and emphasis. Data are collected primarily through sampling of permanent monitoring plots. Monitoring begins when (and where – usually the same plots are used) short-term change monitoring ends and continues until the area is treated again. Some trends may be useful even if they do not have a high level of certainty. Long-term change monitoring will be conducted on prescribed fires.

C. Monitoring Unit Description

To facilitate the management of fires in the park, the park has been divided into two Fire Management Zones: the Prescribed Fire Zone, which is contained entirely within the Spotsylvania Courthouse Battlefield (see Figure 4 in Appendix A), and the Suppression Zone, consisting of the portions of Spotsylvania Courthouse Battlefield not contained in the Prescribed Fire Zone and the remainder of the park. A single monitoring unit has been designated; it is called the Spotsy Fields Monitoring Unit and it corresponds with the Prescribed Fire Zone. The Spotsy Fields Monitoring Unit contains several project areas. This section describes characteristics of the monitoring unit that are common to all of the

project areas. Section D. Project Areas – Individual Characteristics describes features of the individual project areas.

1. Physical Description

Spotsylvania Courthouse Battlefield is located in the Piedmont physiographic province of the eastern United States, between the drainage areas of the Po and the Ni rivers. Numerous streams and swamps dissect the gently rolling plateaus of the battlefield. Elevation ranges from near sea level to approximately 500 ft (150 m) with mostly gentle (0-15%) slopes on all aspects. The soils are deep to moderately deep and well- to moderately-well drained, with a dominantly clayey or loamy subsoil.

2. Biological Description

The Spotsy Fields Monitoring unit consists mostly of open fields and earthworks, with small areas of oak/hickory forest. The vegetation is predominantly native, warm season grasses (usually 2-3 ft (½-1 m) tall and approximately 50% cover), mixed in with exotic, cool season grasses (approximately 10% cover), woody shrubs (10% cover), and small herbaceous plants. The woody shrubs include blackberry (*Rubus spp.*) and winged sumac (*Rhus copallinum*). Tree seedlings include blackjack oak (*Quercus marilandica*), sweet-gum (*Liquidambar styraciflua*) and locust (*Robinia pseudoacacia*).

3. Desired Future Conditions

The target condition for Spotsy Fields at Fredericksburg and Spotsylvania NMP is to maintain them in native herbaceous vegetation under 1 m (3.3 ft) tall in order to:

- Preserve the open vistas of the historic scene so that visitors can see across the battlefields and get a feel for the scene the soldiers faced during the battles
- Maintain the fields in herbaceous vegetation, because it is likely that the area was fallow agricultural fields at the time of the battle.
- Reduce the need to manage vegetation on earthworks using mechanical means, in order to reduce impacts to the cultural resources of the earthworks.
- Minimize the amount of petroleum fuels used to manage vegetation by using fire instead of mechanical equipment such as tractors to prevent encroachment of woody vegetation into fields.
- Preserve wildlife habitat for native wildlife with appropriately timed prescribed burns and bush-hogging, so as to reduce mortality of wildlife as a result of bush-hogging activities.

Desirable species include, among other native warm season grasses, beaked panic grass (*Panicum anceps*), poverty oatgrass (*Danthonia spicata*), rosette grass (*Dichanthelium dichotomum*), broomsedge (*Andropogon virginicus*), little bluestem (*Schizachyrium scoparium*) and Indian grass (*Sorghastrum nutans*).

4. Management Objectives

The purpose of prescribed burning and other fuels treatments at Fredericksburg and Spotsylvania NMP is to protect and preserve the cultural resources of the park, to manage vegetation, and to reduce fuel loading. The management objectives of fuels treatments in the Spotsy Fields monitoring unit are to:

- Achieve a total percent cover of herbaceous species of at least 95%.
- Maintain at least 75% of the total percent cover of herbaceous species in native species.
- Maintain the average height of the vegetation at less than 1 m (3.3 ft).

5. Treatment Objectives

Treatment objectives refer to the objectives of individual prescribed fire and/or mowing treatments. These vary from unit to unit and year to year, but the following are representative:

- Treat 90 to 100% of the project area.
- Relative percent cover of exposed mineral soil will not exceed 5% immediately post-burn.
- Top-kill at least 50% of woody plants by the first full growing season post-burn.

6. Objective Variables and Monitoring Objectives

The objective variables are total percent cover of herbaceous species (including percent cover of native herbaceous species and percent cover of nonnative herbaceous species), cover of woody species, and average height of vegetation. Cover is often used when measuring grasses due to the difficulty in counting individual grass stems. Furthermore, it does not require the identification of the individuals as density does. However, when measuring cover it can vary dramatically within a growing season, so sampling must be done at the same time each year (Elzinga et al. 1998). The monitoring objectives are:

- Monitor the total percent cover of herbaceous species, native herbaceous species, and nonnative herbaceous species to be 80% confident that the calculated total percent cover are within 20% of the estimated true values.
- Monitor the total percent cover of woody species less than 1 m (3.3 ft) tall, including shrubs, vines, and young trees, to be 80% confident that the calculated total percent cover is within 20% of the estimated true value.
- Monitor the average height of the vegetation, to be 80% confident of detecting a 0.25 m (10") increase in the average height, with a 20% chance of a false-change error.

7. Sampling Design

Transects are placed by stratified random sampling in each of the six fields within the Spotsy fields monitoring unit using ArcGIS. These coordinates are downloaded to a Garmin GPS unit (NAD 83) and become the potential plot origin points. After navigating to the start point, the dial of a compass is spun to a random bearing to select the azimuth of the transect. If the origin point or the random bearing at which the transect follows meet any of the pre-determined rejection criteria for plot selection, a new random bearing is selected; if the location still meets any of the rejection criteria the potential plot location is rejected and the next one is considered. Rejection criteria are described below in section IV.C.9.

Once the start point has been identified it is marked with an origin stake (rebar or orange plastic stake). This rebar is 1-2 ft long, approximately 0.5 in-diameter rebar, sunk into the ground with not more than four inches above ground level to facilitate mowing over the plots. Rebar not within sight of designated visitor use areas such as trails may be spray-painted a bright color, usually orange, to make it easier to re-locate. Rebar is capped with aluminum or bright yellow plastic rebar caps. Aluminum caps may or may not have marking information stamped on them; plastic caps all have *NPS FIRE* stamped on them. Plot markings appear on die-stamped aluminum rebar caps, die-stamped aluminum tags attached to the rebar with wire, or some combination of the two. The origin is marked with 0P and the transect number. A second piece of the rebar is placed along the azimuth at 30.3 meters (0.3 m past the end of the 30 m transect, in order to minimize the interference of the rebar at the 30 m data point).

8. Field Measurements

The location of the stake at the origin, and sometimes the last stake as well, is identified (marked) using a GPS (NAD83). Plot locations and directions to each plot are recorded on a FMH-5 Plot Location Data Sheet and stored in the plot binder in the Fire Effects Monitoring office at Shenandoah National Park, Luray, VA. Electronic data layers containing plot location information are maintained on the Fire Monitor desktop computer, in the Fire Effects Monitoring office at Shenandoah. ArcGIS maps are also available of the plot locations and burn units on the Fire Monitor desktop computer.

Herbaceous and shrub data will be collected on point-intercept transects. Starting at 30 cm (.3m) from 0P (origin stake) lower a bicycle flag, graduated in decimeters, perpendicular to the ground (except on slopes) at 30 cm intervals along the tape for a total of 100 points or 3,000 cm. At each point the species that touch the pole are recorded, counting an individual species once even if the pole touches it more than once. The species are recorded tallest to shortest with the height of the tallest being recorded on the appropriate data sheet. If no vegetation is intercepted record the substrate (litter, bare soil, moss, etc). Record dead annual vegetation as you would

live vegetation and count dead branches of living plants as live vegetation. Species are recorded using the first three letters of the Genus and first three letters of the species either on a paper data form or using a PDA. Additional information can be found in the National Park Service Fire Monitoring Handbook (NPS FMH, 2003).

Two digital photographs will be taken of each transect during each data collection visit. One will be taken as the photographer stands far enough away from the transect to capture the cap of the closest rebar. Thus, the framing of the picture will depend on the slope and the horizon. The photo should encompass the tape and the rebar at either end. A 2 m range pole or bicycle flag will be held at the opposite end of the tape to provide a distinct point of reference. Ideally, the pole will be placed on the opposite end of the transect without a person holding it, but if necessary a person may be in the shot to help stabilize the pole. This person should face their back to the camera to avoid being immortalized in the plot photo. Additionally, a person holding a sign board, with the relevant plot information, will stand closest to the photographer so that only the board and possibly an arm is visible in the photo. The photographer should also make sure that sign board does not obstruct the view of the plot. Three pictures will be taken, for a total of six pictures, at either end of the transect (0P and 30P).

Plots will be monitored once to establish baseline data (regardless of whether or when the area was last treated), and then during the first, second, and fifth growing season after burning. If the prescribed burn program is successful and mowing treatments are reduced to less than once every other year, then if time permits plots may be monitored during the first, second, and fifth growing season after both burning and mowing treatments in order to compare the effects of burning to those of mowing. Because of the wide variety and variable frequency of treatments (disturbances), plot status will be indicated only by the four-digit year in which the data were collected. Plots may be monitored any time from May to early October, preferably in June or September when the largest number of grasses and sedges are in bloom and are therefore more easily identifiable.

Table 1. Native (no shading) and exotic/invasive (grey shading) species of interest for the Spotsy Fields Monitoring Unit, Fredericksburg and Spotsylvania NMP.

Common name	Scientific name	Family	Native?
Broomsedge	<i>Andropogon virginicus</i>	Poaceae	Y
Little bluestem	<i>Schizachyrium scoparium</i>	Poaceae	Y
Indiangrass	<i>Sorghastrum nutans</i>	Poaceae	Y
Winged sumac	<i>Rhus copallinum</i>	Anacardiaceae	Y
Blackberry	<i>Rubus</i> spp.	Rosaceae	Y
Beaked panic grass	<i>Panicum anceps</i>	Poaceae	Y
Poverty oatgrass	<i>Danthonia spicata</i>	Poaceae	Y
Trailing bush clover	<i>Lespedeza procumbens</i>	Fabaceae	Y
Rosette grass	<i>Dichanthelium dichotomum</i>	Poaceae	Y
Japanese Honeysuckle	<i>Lonicera japonica</i>	Caprifoliaceae	N
Colonial bent grass	<i>Agrostis capillaris</i>	Cyperales	N
Sweet vernal grass	<i>Anthoxanthum odoratum</i>	Poaceae	N
Cat's Ear	<i>Hypochaeris radicata</i>	Asterales	N
Red sorrel	<i>Rumex acetosella</i>	Polygonales	N

9. Rejection Criteria

Rejection criteria:

- Reject any transect that falls within 5 m of a developed or landscaped area such as pavement, unpaved road, motor road mowline, trail, structure, yard, or power line or other right-of-way.
- Similarly, reject any transect that falls within 5 m of a distinct physical barrier such as a slough, ditch, drainage, creek, or cliff.
- Reject any transect that falls within 5 m of the burn unit boundary or park boundary or within 5 m of forest edge.

10. Data Management and Analysis

Data are collected and managed by the Northeast Regional Fire Effects Monitoring Crew (NER FEM Crew), which is based at Shenandoah National Park, under the oversight of the Mountains-to-the-Sea Park Group Fire Ecologist. Data are stored at the NER FEM Crew's home office in the Fire Office at Shenandoah National Park in Luray, Virginia. Data are organized and stored in both hard-copy, in binders and folders, and in electronic form, using the FFI data management software program. The master FFI database is maintained by the Lead Fire Effects Monitor on the FEM desktop computer in the Shenandoah Fire Office. The database is backed up regularly (after each update to the database) in a separate location on the FFI desktop hard

drive, and every night on an external hard drive. Primary quality control for data collected in the field on hard copy is accomplished at the time of data entry into the computer and again when reports of data printed for hard-copy storage are reviewed. Primary quality control for data collected in the field electronically on PDAs is accomplished only when reports of data printed for hard-copy storage are reviewed. Data are also reviewed prior to analysis.

Data analysis procedures are still under development at the time of writing of this Plan. Minimum plot numbers have not been calculated; as additional plots are installed and a data analysis scheme is developed, minimum sample sizes will be estimated.

D. Project Areas – Individual Characteristics

1. Upton Field

Physical Description / Location – Upton Field is an 11.8 ac (4.8 ha) unit in the shape of a boomerang, located west of Anderson Drive to the south of Grant Drive.

Biological Description – The majority of this field is comprised of grasses including, poverty oat grass (*Danthonia spicata*) and red fescue (*Festuca rubra*). Woody species include blackberry (*Rubus*), blackjack (*Quercus marilandica*) and winged sumac (*Rhus copallinum*). Prevalent herbs include cinquefoil (*Potentilla* spp.) and yarrow (*Achillea millefolium*). Exotic species of concern include Japanese honeysuckle (*Lonicera japonica*) and the invasive sweet vernal grass (*Anthoxanthum odoratum*).

2. McCoull House Field

Physical Description / Location – McCoull House Field is a 19.3 ac (7.8 ha) unit located around and mostly to the west of McCoull house drive, and extending west to Anderson Drive in a few places. This area also includes two small fields to the east adjacent to the gravel road.

Biological Description – The majority of this field is comprised of grasses including, Beaked panic grass (*Panicum anceps*), poverty oat grass (*Danthonia spicata*) and red fescue (*Festuca rubra*). Woody species include blackberry (*Rubus*), blackjack (*Quercus marilandica*) and winged sumac (*Rhus copallinum*). Prevalent herbs include cinquefoil (*Potentilla* spp.) and yarrow (*Achillea millefolium*). Exotic species of concern include Japanese honeysuckle (*Lonicera japonica*) and the invasive sweet vernal grass (*Anthoxanthum odoratum*). This field been visually observed to have an increase in broomsedge (*Andropogon virginicus*) and little blue stem (*Schizachyrium scoparium*) after subsequent treatments of fire.

3. Harrison House Field

Physical Description / Location – The Harrison House Field is a 29.7 ac (12.0 ha) unit located south of Gordon Drive and east of the intersection of Gordon Drive and Anderson Drive.

Biological Description – The majority of this field is comprised of grasses including, Beaked panic grass (*Panicum anceps*), poverty oat grass (*Danthonia spicata*) and cypress rosette grass (*Dichanthelium dichotomum*). Woody species include blackberry (*Rubus spp.*), locust (*Robinia pseudoacacia*) and winged sumac (*Rhus copallinum*). Herbs include bush clover (*Lespedeza procumbens*) and goldenrod (*Solidago spp.*). Exotic species of concern include hairy cat's ear (*Hypochaeris radicata*), Japanese honeysuckle (*Lonicera japonica*) and the invasive grasses sweet vernal grass (*Anthoxanthum odoratum*) and colonial bent grass (*Agrostis capillaris*).

4. Crescent Field

Physical Description / Location – Crescent Field is a crescent-shaped unit of 5.3 ac (2.1 ha) located west of Bloody Angle Trail and Gordon Drives where they intersect Burnside Drive.

Biological Description – The majority of this field is comprised of grasses including, poverty oat grass (*Danthonia spicata*) and red fescue (*Festuca rubra*). Woody species include blackberry (*Rubus*), blackjack (*Quercus marilandica*) and winged sumac (*Rhus copallinum*). Prevalent herbs include cinquefoil (*Potentilla spp.*) and yarrow (*Achillea millefolium*). Exotic species of concern include Japanese honeysuckle (*Lonicera japonica*) and the invasive sweet vernal grass (*Anthoxanthum odoratum*).

5. Native Grass Field

Physical Description / Location – The Native Grass Field is a 4.8 ac (2.0 ha) triangular unit located east of Bloody Angle Trail and north of Burnside Drive, near the two roads' intersection with Gordon Drive.

Biological Description – This unit was treated with herbicide in 1997 and seeded with the native warm season grasses big bluestem (*Andropogon gerardii*) little bluestem (*Schizachyrium scoparium*), switch grass (*Panicum virgatum*), and Indian grass (*Sorghastrum nutans*), which currently dominate in the unit.

6. Middle Field

Physical Description / Location – Middle Field is 7.2 ac (2.9 ha) field at the southern portion of the Landrum House Field which borders it to the north. The dividing line, between the two fields, is the tree line which partially dissects the two fields.

Biological Description – The majority of this field is comprised of grasses including, poverty oat grass (*Danthonia spicata*) and red fescue (*Festuca rubra*). Woody species include blackberry (*Rubus*), blackjack (*Quercus marilandica*) and winged sumac (*Rhus copallinum*). Prevalent herbs include cinquefoil (*Potentilla* spp.) and yarrow (*Achillea millefolium*). Exotic species of concern include Japanese honeysuckle (*Lonicera japonica*) and the invasive sweet vernal grass (*Anthoxanthum odoratum*).

7. Landrum House Field

Physical Description / Location – Landrum House Field consists is a 46.4 ac (18.7 ha) field. The south western edge of the unit is bordered by bloody angle trail which used to be drivable by car (Bloody angle drive) until 2007 when it was converted to a walking trail. The southern portion of Landrum House Field is divided by a tree line that partially dissects the field. The southern portion of the field will be referred to as Middle field.

Biological Description – The majority of this field is comprised of grasses including, poverty oat grass (*Danthonia spicata*) and red fescue (*Festuca rubra*). Woody species include blackberry (*Rubus*), blackjack (*Quercus marilandica*) and winged sumac (*Rhus copallinum*). Prevalent herbs include cinquefoil (*Potentilla* spp.) and yarrow (*Achillea millefolium*). Exotic species of concern include Japanese honeysuckle (*Lonicera japonica*) and the invasive sweet vernal grass (*Anthoxanthum odoratum*).

E. Monitoring of Non-fire Treatments

Hazard fuels at Fredericksburg and Spotsylvania NMP are typically managed through mowing (grasses and other herbaceous vegetation), raking or vacuuming (fallen leaves), cutting and chipping (woody vegetation), or other mechanical or cultural means.

Fuels around buildings, boundaries, roads, trails, picnic areas and other sites occasionally accumulate sufficient fuel density to create a hazard to real property, historic resources, or human health and safety. These fuels are usually managed by mechanical removal, primarily mowing and weed-whacking; fuels are removed from these areas at least twice annually.

Firebreaks are maintained around most structures, monuments, roads, trails, and support structures (fences, flagpoles, bridges, walls, picnic tables, etc.) in the park. Firebreaks are typically maintained by mowing during the growing season, depending on the importance

of the resource, the amount of visitation in the area, and the availability of funding, staff and equipment.

Monitoring of non-fire fuels treatments at Fredericksburg and Spotsylvania NMP is conducted subjectively on an as-needed basis by maintenance staff, with assistance from other on-site park staff. No monitoring units are designated, no formal monitoring schedule is enforced, no plots are installed, and no data are recorded or analyzed.

V. ROLES AND RESPONSIBILITIES

A. *Roles and Responsibilities*

This section discusses areas of responsibility for implementation of the fire management program by specific park position. There may be instances that the same person functions in two areas of responsibility, e.g., the Natural Resource Management Specialist and the Park Fire Coordinator may be the same person. The purpose of this section is to clearly define areas of responsibility directly related to monitoring; more detailed descriptions can be found in the Fire Management Plan (FRSP FMP 2003).

Superintendent. Fire management is the ultimate responsibility of the Superintendent, with technical duties and accompanying responsibilities delegated to staff members. The Superintendent will be responsible for management of the program within Departmental and National Park Service policy, Director's Order 18 Wildland Fire Management, and all relevant laws and regulations.

Chief Ranger. The Chief Ranger is responsible for implementation and execution of all aspects of the Fire Management Program except research and for overall coordination, direction, and supervision of wildfire prevention, preparedness, suppression, and monitoring. The Chief Ranger has line authority over the Park Fire Coordinator

Natural Resource Management Specialist. Fire research efforts are coordinated by the Natural Resource Management Specialist. S/he serves as the primary resource advisor for project fires or prescribed fires and for the ecological aspects of the monitoring program. S/he develops natural resource objectives for prescribed fire and assists in the development of the monitoring design, including monitoring objectives, protocols, and desired precision.

Park Fire Coordinator. The Park Fire Coordinator is responsible for park fire management program activities. S/he develops the annual prescribed fire program, including writing or assisting in the preparation of prescribed fire plans, implementing approved prescribed fires, ensuring the preparation of individual prescribed fire plans in accordance with Reference Manual-18, planning and coordinating prescribed fire operations, and assuring that qualified personnel are assigned to monitor fire behavior.

Fire Management Officer. The park's Fire Management Officer is the Mountains-to-the-Sea Park Group Fire Management Officer at Shenandoah National Park. This individual is responsible for providing administrative and operational fire management assistance and oversight.

Regional Fuels and Fire Ecology Program Manager. The Regional Program Manager is responsible for overseeing the Fire Ecology and Monitoring program in the region, for approving non-tradition data collection protocols, and for obtaining and distributing funding for fire ecology and monitoring activities.

Park Group Fire Ecologist. The Mountains-to-the-Sea Park Group Fire Ecologist is based at Shenandoah National Park and is responsible for providing fire ecology assistance and expertise to the park at the planning and implementation levels, including training and providing fire effects monitors for prescribed burns, providing technical input into prescribed fire objectives and prescribed burn plans, developing and overseeing the monitoring program, and writing and maintaining this Monitoring Plan. Requests for use of the Northeast Region Fire Effects Monitoring Crew will be made to the Park Group Fire Ecologist.

Lead Fire Monitor. The Lead Fire Monitor for the Northeast Region Fire Effects Monitoring Crew is responsible for data collection, data entry into electronic format, and management and storage of paper and electronic monitoring data. S/he is responsible for training and providing day-to-day direction for the Monitoring Crew and for coordinating with the park Natural Resources Specialist on protocols and plant identification.

Northeast Region Fire Effects Monitoring Crew. The Northeast Region Fire Effects Monitoring Crew is comprised of one Lead Monitor and one to four seasonals under the supervision of the Mountains-to-the-Sea Park Group Fire Ecologist. The crew is responsible for actual data collection and data entry, as directed by the Lead Monitor.

B. Work Plans and Prioritization

Annual prescribed burning planning and project prioritization will be developed by the Natural Resource Management Specialist, in consultation with the Fire Management Officer. Scheduling and prioritization of fire effects monitoring will be developed by the Park Group Fire Ecologist in cooperation with the Natural Resource Management Specialist/Park Fire Coordinator. Monitoring of non-fire fuel treatments will be accomplished by the park maintenance division. Requests for assistance from the Park Group Fire Ecologist or Regional Fire Effects Monitoring Crew may be made at any time, but preferably prior to the turn of the fiscal year.

VI. REPORTING AND ADAPTIVE MANAGEMENT

A Prescribed Fire Monitoring Report or Prescribed Fire Completion Report will be prepared for each prescribed fire treatment. Generally, this will be the responsibility of the lead Fire Monitor making burn-day observations. In the event a monitor is not present during the burn, the Prescribed Fire Completion Report will be the responsibility of the Park Fire Coordinator and will consist of a brief summary of events, an estimate of whether objectives were achieved, and the forecasted and observed weather conditions for the duration of the burning period.

Annually, the Park Group Fire Ecologist will prepare a Fire Effects Monitoring Annual Report for the Northeast Regional Office summarizing data collection and analysis accomplished during the previous calendar year; fuels treatment monitoring conducted by the Northeast Region Fire Effects Monitoring Crew at Fredericksburg and Spotsylvania NMP will be included in this report. The report, and a summary of any data analysis conducted during the calendar year, will be supplied to the Natural Resource Specialist at the park each year in December (or the following January).

The results of fire effects monitoring will be used to direct and focus future management actions. Table 2 below describes some results which would indicate that management objectives are not being met, some possible reasons that the objectives might not be met, and some possible changes that could be made to management activities that might help meet the objectives. (Note that “treatments” includes any combination of mowing and/or burning.)

Table 2. Examples of adaptive management.

Results which would indicate objectives are not being met:	Possible reasons:	Possible responsive management actions:
Herbaceous frequency is less than 95% and fails to increase after three treatments.	The season of treatment does not sufficiently stress undesired species.	Experiment with alternative seasons for mowing and/or burning.
Native species comprise less than 75% of the total herbaceous frequency, and fail to increase after three treatments.	The treatment, especially burn treatments, is not severe enough.	Try to burn hotter, by burning under the upper end of the prescription, adjusting the prescription to be hotter, or burning when there are more fuels available.
	The treatment type is not appropriate.	If burning, try mowing; if mowing, try burning; or try a different combination.

Results which would indicate objectives are not being met:	Possible reasons:	Possible responsive management actions:
	The season of treatment favors disturbance-adapted undesired species.	Experiment with alternative seasons for mowing and/or burning.
Herbaceous frequency was 95% or more, and falls below 95%, and after three treatments is still less than 95% and not beginning to recover.	The treatment, especially burn treatments, is too severe.	Try to burn cooler, by burning under the lower end of the prescription, adjusting the prescription to be cooler, or reducing available fuels by mowing before burning.
Native species comprised 75% or more of the total frequency, but now comprise less than 75%, and after three treatments still comprise less than 75% without beginning to recover.	The treatment type is not appropriate.	If burning, try mowing; if mowing, try burning; or try a different combination.
	Treatment is occurring too frequently.	Treat less often, at longer intervals between treatments.
The average height of the vegetation is more than 1.0 m (3.3 ft) after a second plot read.	This is a management trigger: the vegetation is growing and it has been some time since the last treatment.	Schedule a mow or burn treatment.

VII. CONSULTATION, COLLABORATION, COORDINATION, AND REVIEW

This Monitoring Plan was prepared by KellyAnn Gorman, Mountains-to-the-Sea Park Group Fire Ecologist, in consultation with:

- Gregg Kneipp, Natural Resource Management Specialist, Fredericksburg and Spotsylvania National Military Park
- Missy Forder, Lead Fire Monitor, Northeast Region Fire Effects Monitoring Crew

Collaboration with the Mid-Atlantic Exotic Plant Management Team and the Mid-Atlantic Inventory and Monitoring Network will be coordinated through the park Natural Resource Management Specialist. Collaboration with other national parks and with interagency resources will be coordinated through the Park Fire Coordinator (also the Natural Resource Management Specialist at the time of writing of this Plan).

The following persons reviewed the plan or portions of it:

- Missy Forder, Lead Fire Monitor, Northeast Region Fire Effects Monitoring Crew
- Doug Wallner, Northeast Region Fuels and Fire Ecology Program Manager
- Gregg Kneipp, Natural Resource Management Specialist, Fredericksburg and Spotsylvania National Military Park
- (technical reviewer goes here)

VIII. BIBLIOGRAPHY AND REFERENCES CITED, ACRONYMS AND ABBREVIATIONS

DOI = Department of the Interior

Elzinga, C.L., Salzer, D.W., and Willoughby, J.W. 1998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1. Denver, Colorado: Bureau of Land Management National Business Center.

FEM = Fire Effects Monitoring.

FFI = FEAT-FireMON Integrated, a database management software designed for managing fire effects monitoring data.

FMH = National Park Service Fire Monitoring Handbook (NPS 2001).

FMO = Fire Management Officer.

FMP = Fire Management Plan.

Fredericksburg and Spotsylvania National Military Park (FRSP). 2003. Fire Management Plan (FMP). Fredericksburg, Virginia: Fredericksburg and Spotsylvania National Military Park. (cited in text as FRSP FMP 2003)

Fredericksburg and Spotsylvania National Military Park (FRSP). 2003. Environmental Assessment for Wildland and Prescribed Fire in Fredericksburg and Spotsylvania National Military Park (FMP). Fredericksburg, Virginia: Fredericksburg and Spotsylvania National Military Park. (cited in text as FRSP FMP EA 2003)

Fredericksburg and Spotsylvania National Military Park (FRSP). 1999. Resources Management Plan: Fredericksburg and Spotsylvania National Battlefield Park. Fredericksburg, Virginia: Fredericksburg and Spotsylvania National Military Park.

Fredericksburg and Spotsylvania National Military Park (FRSP). 1991. Statement for Management: Fredericksburg and Spotsylvania National Battlefield Park. Fredericksburg, Virginia: Fredericksburg and Spotsylvania National Military Park.

Fredericksburg and Spotsylvania National Military Park (FRSP). 1986. General Management Plan: Fredericksburg and Spotsylvania National Battlefield Park. Fredericksburg, Virginia: Fredericksburg and Spotsylvania National Military Park.

FRSP = Fredericksburg and Spotsylvania National Military Park.

NER = Northeast Region of the National Park Service

NMP = National Military Park; in this case, Fredericksburg and Spotsylvania NMP.

NPS = National Park Service.

Orwig, D. and Abrams, M.D. 1994. Woody Vegetation and Fuel Survey For Evaluating Wildfire Hazard In Three Fredericksburg Battlefields. Natural Resources Technical Report 95/0. Philadelphia, Pennsylvania: Mid-Atlantic Region, National Park Service.

Orwig, D. and Abrams, M.D. 1991. Woody Vegetation and Fuel Survey For Evaluating Wildfire Hazard In Spotsylvania Battlefield. Natural Resources Technical Report 91/052. Philadelphia, Pennsylvania: Mid-Atlantic Region, National Park Service.

RMP = Resource Management Plan; in this case, specifically Fredericksburg and Spotsylvania NMP's Resources Management Plan (FRSP 1999).

USDI National Park Service. 2001. Fire Monitoring Handbook. Boise (ID): National Interagency Fire Center. 274p.

IX. APPENDIXES

A. *Maps.....*

B. *Data Collection Tools*

C. *Data Sheets Examples.....*

D. *Plant List and Voucher Collection.....*

E. *Job Hazard Analysis.....*

Figure 2. Map: Park brochure, close-up of Spotsylvania Courthouse Battlefield, Fredericksburg and Spotsylvania National Military Park, showing tour stops and major roads.

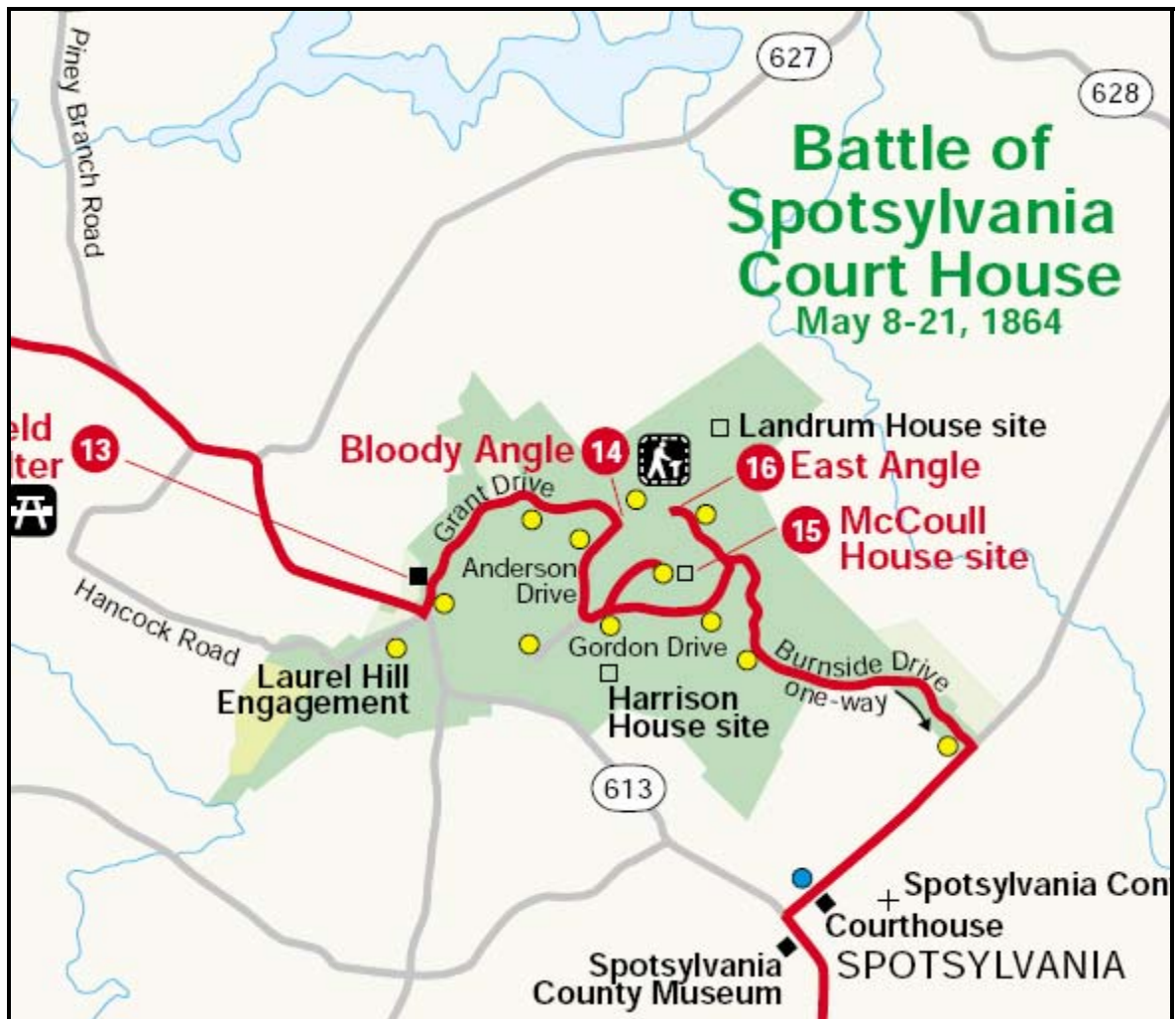


Figure 3. Map: Gray-scale aerial photograph of Spotsylvania Courthouse Battlefield, Fredericksburg and Spotsylvania National Military Park, showing the park boundary, paved roads, the trail, and the prescribed burn zone (the prescribed burn zone is shown in more detail in Figure 4).

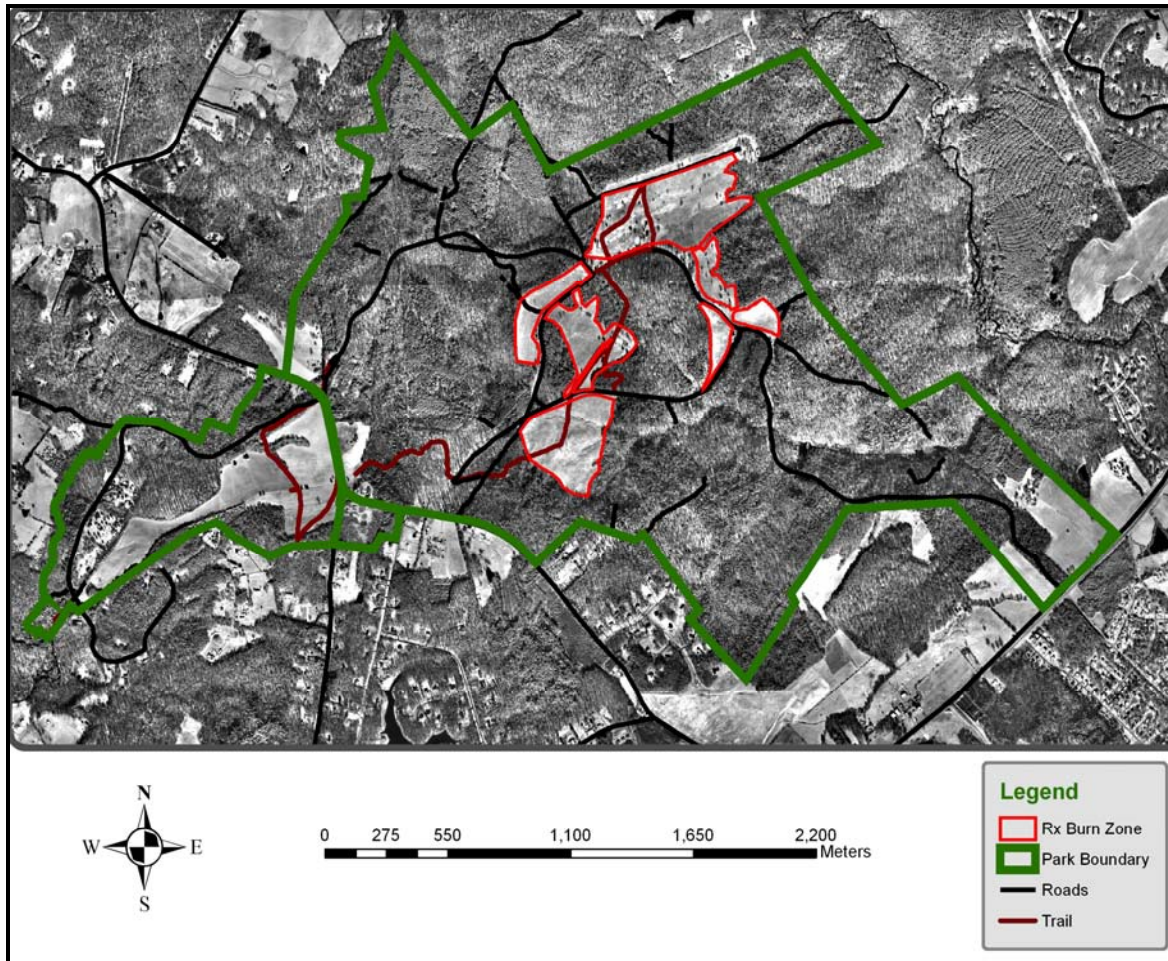
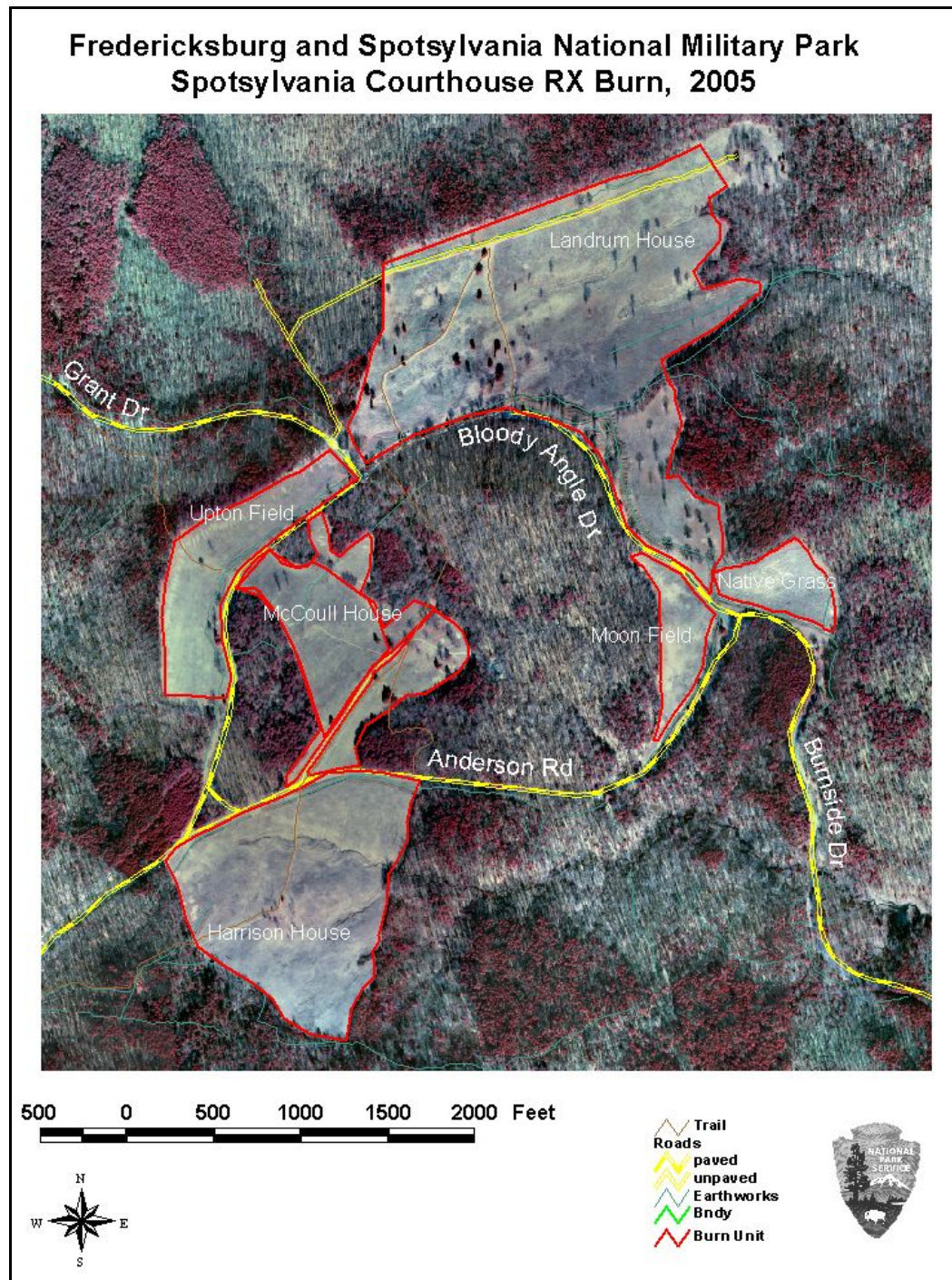


Figure 4. Map: Color infra-red aerial photograph of Spotsylvania Courthouse Battlefield, Fredericksburg and Spotsylvania National Military Park, showing the prescribed burn zone and the area, in acres, of each treatment unit. For clarity, clockwise from top: Landrum House Field, 46.4 ac (18.7 ha); Middle Field, 7.2 ac (2.9 ha); Native Grass Field, 4.8 ac (2.0 ha); Crescent Field, 5.3 ac (2.1 ha); Harrison House Field, 29.7 ac (12.0 ha); McCoull House Field, 19.3 ac (7.8 ha), and Upton Field, 11.8 ac (4.8 ha).



B. Data Collection Tools and References

See the NPS Fire Monitoring Handbook (NPS 2001) for recommended tools, field data collection tips, and data collection accuracy standards.

USDI National Park Service. 2003. Fire Monitoring Handbook. Boise (ID): National Interagency Fire Center. 274p.

Field Guides (list is not comprehensive, only those most commonly used):

Gleason, H.A. and Cronquist, A. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, 2nd ed. Bronx, New York: The New York Botanical Garden.

Newcomb, L. 1977. Newcomb's Wildflower Guide. New York: Little, Brown and Company.

Petrides, G.A. 1972. A Field Guide to Trees and Shrubs. New York: Houghton Mifflin Company.

C. Data Sheets Examples

See Appendix A of the NPS Fire Monitoring Handbook (NPS 2001) for data sheets.

D. Plant List and Plant Specimen Voucher Collection

The plant list for wildland and prescribed fire monitoring at Fredericksburg and Spotsylvania NMP is maintained by the Lead Monitor for the Northeast Region Fire Effects Monitoring Crew, in the FFI database in the Lead Monitor's desktop computer in the Fire Office at Shenandoah National Park, Luray, VA. This standard for this species list is the USDA NRCS PLANTS, National Plant Data Center, Baton Rouge, LA 70874-4490 USA. <http://plants.usda.gov>

No plant specimen voucher collection is maintained for Fredericksburg and Spotsylvania NMP, although the Northeast Region Fire Effects Monitoring Crew does maintain an informal notebook of sedge and grass specimens on notecards as an aid to learning and plant identification. Monitoring staff use professional knowledge, technical expertise of park staff at both Fredericksburg and Spotsylvania NMP and at Shenandoah National Park, and various field guides, particularly those listed in Appendix B, for plant identification. Specimens that are especially difficult to identify may be tagged and bagged and compared to specimens in the herbarium in the Inventory and Monitoring building at Shenandoah National Park.

E. Job Hazard Analysis

The Job Hazard Analysis for monitoring activities for the Northeast Regional Fire Effects Monitoring Crew appears in Figure 6 below. A full size version is available in electronic or hard-copy format in the Fire Office at Shenandoah National Park, Luray, VA.

Figure 5. Job Hazard Analysis for Fire Effects Monitoring activities.

United States Dep't of the Interior NATIONAL PARK SERVICE	WORK PROJECT / ACTIVITY Fire Effects Monitoring – Field and Office	LOCATION Various parks in the Northeast and National Capitol Regions	UNIT Northeast Region Fire Effects Monitoring Crew, based at Shenandoah National Park
JOB HAZARD ANALYSIS (JHA)	NAME OF ANALYST KellyAnn Gorman (Adam Luras, OZAR)	JOB TITLE Fire Ecologist (Lead Fire Monitor)	DATE PREPARED 05/10/2006 (04/26/2006)
TASK / PROCEDURES	HAZARDS	ABATEMENT ACTION(S)	
Field Monitoring	Tick bites – Lyme disease, Rocky Mountain Spotted Fever, infection, etc.	- Spray clothing with insect repellent as a barrier or use clothing made of repellent-impregnated fabric. If using DEET, do not apply directly to skin, apply to clothing only - Each outer garment should overlap the one above it; tuck in shirt tails and covertrouser legs with high socks, boots, or gaiters. - Conduct spot-checks on a regular basis, during the work day and at home, especially hair and clothing; crew members will check each other when possible. - If a tick becomes attached, pull it by grasping it as close as possible to the point of attachment and pull straight out with gentle pressure. Wash skin with soap and water. Record dates of exposure and removal and species or description of tick on monthly Tick Log. Do not try to remove the tick by burning with a match or covering it with chemical agents. - If you can not remove the tick or parts detach, seek medical help. - Watch for warning signs of illness: a large red spot or "bull's-eye" rash near the bite area, fever, chills, headache, joint and muscle ache, significant fatigue, and facial paralysis are reactions that may appear within two weeks of the attack. Symptoms specific to Lyme disease include: confusion, short-term memory loss, and disorientation. - See also Ticks JHA	
		- Adjust the thermostat as necessary. - Alternate indoor and outdoor activities whenever possible. - Take breaks periodically. - Eat lunch outside when weather permits. - See also Work in Office Setting Job Hazard Analysis.	
Other		- Use appropriate containers for storage of supplies, especially chemicals. - Clean up spills using appropriate methods for the material. - Be familiar with the MSDSs for products you are working with and follow the recommendations if applicable.	
SUPERVISOR'S SIGNATURE /s/ KellyAnn Gorman		TITLE Fire Ecologist	DATE 10 May, 2006

Fredericksburg and Spotsylvania National Military Park
Fuels Treatment Monitoring Plan, 2007

	Insect stings – Allergic reactions, painful stings	- Be alert for nests or hives, especially in brush or hollow logs or snags. Watch for insects travelling in and out of one location. - If you or anyone you are working with is known to have allergic reactions to bee stings, tell the rest of the crew and your supervisor. Make sure you carry emergency medication with you at all times. - Wear long sleeve shirts and trousers; tuck in shirt.. Bright colors and metal objects may attract bees. - If you are stung, cold compresses may bring relief. - If a stinger is left behind, scrape it off the skin. Do not use a tweezers as this squeezes the venom sack, worsening the injury. - If the victim develops hives, asthmatic breathing, tissue swelling, or a drop in blood pressure, seek medical help immediately.
	Insect bites, especially mosquitos – Skin irritation, encephalitis	- Wear long pants; consider long sleeves as well if you are particularly susceptible. - Avoid heavy scents. - Spray clothing with insect repellent as a barrier or use clothing made of repellent-impregnated fabric. If using DEET, do not apply directly to skin, apply to clothing only. - Carry after-bite medication to reduce skin irritation. - Try not to scratch (too much)!
	Heat injuries – Sunburn, dehydration, heat exhaustion	- Drink at least 1/2 qt. of water every hour. Limit caffeine intake. A small amount of sport drink is okay, but water is better –if you do chose to use a sport drink, drink at least twice as much water as sport drink. Carry a sufficient amount of water for the entire shift. - Eat a little bit, even if you're not hungry, to naturally replenish salts and minerals. This is much more effective than sports drinks. - Avoid long exposure to sun – use natural shade and sunshades. - Wear a hat with wide brim for shade. - Apply sunscreen to any exposed skin; reapply periodically throughout the day. Wear long sleeve if you are particularly susceptible. - Eat lunch in a shaded area. - Be alert for early signs of heat-related illness, such as thirst, headache, confusion, crankiness, muscle weakness, or excessive
		- or unusual fatigue. Monitor yourself and others. - If you do notice signs of heat illness, take immediate steps to remediate the problem, such as drinking more water and resting in the shade for ½ to 1 hour. If symptoms do not lessen, seek medical assistance.
	Cold injuries – Frostbite, hypothermia	- Be aware that it doesn't have to be cold for you to get hypothermia, especially if it's windy or you're wet. - Dress appropriately for the weather. Dress in layers. - Be prepared for changes in the weather. Never go anywhere without rain gear. - Eat and drink appropriately, even though it's not hot. - Be alert for early signs of cold-related illness, such as chills, shivering, stiffening or whitening of extremities, confusion, slurred speech, muscle weakness, or excessive or unusual fatigue. Monitor yourself and others. - If you do notice signs of cold illness, take immediate steps to remediate the problem, such as putting on more layers, moving to a warm place to warm up, drinking a warm beverage, and engaging in increased physical activity. If symptoms do not lessen, seek medical assistance.
	Off-trail hiking – Uneven terrain, tripping hazards, steep slopes, loose footing, etc.	- Wear appropriate footwear – sturdy boots or shoes with a closed toe and a textured sole such as a lug sole. Ankle support is highly recommended in steep or rocky terrain. - Look for and test secure footing. - Walk, never run, down slopes. - Maintain a safe distance between people – at least ten feet. - In heavy undergrowth, lift knees high to clear unseen obstacles. - Wear eye protection. - Maintain good communication with co-workers. - Know how to fall: try to land in the least obstructed spot, protect your head and back, and don't stick out your arms to break a severe fall. We care more about you than we do the equipment in your hands.

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	Wildlife – Venomous snakes, biting animals	- Use trails where possible. - Use common sense about wild animals - stay away, don't bother them, never feed them, don't get between a mother and young. - If you anticipate animals, walk slowly and make noise to let them get out of your way. - Be alert for places snakes like to be, such as under warm, sunny rocks and in piles of debris. Watch where you put feet and hands. If you expect rattlesnakes, wear leather boots. - In case of an animal bite: wash thoroughly with soap and water. Any animal bite that breaks the skin requires medical attention. - In case of a venomous snake bite: stay calm. Move the affected part (and the affected person) as little as possible. Wash the bite with ordinary soap and water. Seek medical assistance promptly. DO NOT: apply ice or heat, use a tourniquet, make cuts or incisions, suck on the bite, or try to catch the snake.
	Working in burning and recently burned areas – Fire, stump holes, snags, residual heat	- Do not work beyond your qualifications or supervisor direction. - Wear all Personal Protective Equipment (PPE) during fire operations and in recently burned areas. - Be alert for fire weakened trees, stump holes, and residual heat. - See also Prescribed Fire Operations Job Hazard Analysis.
Driving	Driving	- Perform vehicle checks before driving to ensure vehicle is safe to operate and all safety equipment is on board and working. - Secure all equipment against movement. - Plan your route before departing. - Practice defensive driving and follow all rules of the road. - Always wear seat belts. - Do not eat or use a cell phone while driving. - Back carefully; use a spotter. - Do not drive on roads for which the vehicle is not intended (for example, don't take the two-wheel-drive van out on a two-track). - Avoid fatigue – take breaks, share driving, respect work:rest ratio guidelines. - Report any accident to your supervisor, regardless of how minor. - See also Light Vehicle Operation Job Hazard Analysis.
	Fueling	- Turn off the engine. - Don't smoke. - Do not use a cell phone. - No one (passengers or driver) should re-enter the vehicle during fueling. - See also Light Vehicle Operation Job Hazard Analysis.
Indoor Work	Computer use – Eye strain, fatigue, repetitive motion injuries	- Avoid fatigue by taking breaks, mixing data entry with other job duties, and sharing tasks with coworkers as appropriate. - If you need corrective lenses, wear them. - Perform exercises or minor calisthenics periodically, stretch frequently, and use correct posture and keyboarding position.
	Electricity – shorts, shocks, fires, etc.	- Do not overload outlets. - Use the shortest extension cord that will suffice for the purpose. - Use surge protectors. - Keep cords organized and tidy; especially, keep cords out of walkways. - Remove a plug from the outlet by grasping the plug and pulling straight out – never pull on the cord or at an angle.
	Personal injury – Slips, trips, falls, muscle strains and pulls	- Keep equipment and office supplies organized and tidy. - Use good form when lifting: lift with your knees, never overreach, ask for assistance. - Use a stool or step ladder for reaching supplies stored above shoulder height; never stand on a chair. - Walk, don't run. - Look where you're going. - Close drawers immediately and completely. - Clean up spills immediately.
	Workspace – Inadequate lighting, poor air circulation, etc.	- Use appropriate and sufficient lighting; request additional lighting if necessary. - Open doors between offices; open windows whenever the weather permits.

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