FIRE MANAGEMENT PLAN

for

JEWEL CAVE NATIONAL MONUMENT

United States Department of the Interior
National Park Service
Jewel Cave National Monument
Custer, South Dakota

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JEWEL CAVE NATIONAL MONUMENT

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TABLE of CONTENTS

List of Tables

List of Figures

I. INTRODUCTION

A. REQUIREMENTS

The Fire Management Plan (FMP) is an addendum to Jewel Cave National Monument's Resource Management Plan (1999). This plan outlines a detailed program of actions to be taken by Jewel Cave National Monument to meet the fire management goals for the area.

The plan is guided by Director's Order-18 (DO-18) (http://www.nifc.nps.gov/fire/policy/do18/do18.htm) which requires that all park units with vegetation capable of sustaining fire develop a FMP. Until a FMP is approved, the Monument will aggressively suppress all wildland fires, taking into account the safety of firefighting personnel, the visiting public and protection of all resources at risk on the unit.

B. GOALS AND OBJECTIVES TO ACHIEVE

Overall resource management objectives for the Monument guide the FMP. Resource management objectives determine whether fire may be used as a tool to manipulate vegetation and how it will be managed.

In general, protection of natural and cultural resources is the primary objective of Monument management. To maintain the desired appearance of vegetative resources while reducing the potential for serious damage to those resources requires action beyond nature taking its course. As fire, either natural (lightning) or anthropogenic (human-caused) has been a part of the landscape on the Monument, it is a management tool with high potential for success.

1. Unit Objectives

- To plan and manage surface resources and developments in order to maintain, restore, and protect natural systems and conditions within Jewel Cave National Monument, including the underlying cave ecosystem.
- To work with the Black Hills National Forest and neighboring landowners to ensure that land uses adjacent to the Monument do not threaten portions of the Jewel Cave system that extend beyond Monument boundaries.
- To identify, document, and protect significant vegetative and wildlife resources within the Monument.
- To identify, document and protect significant cultural resources within the Monument.

2. National Fire Plan Goals

In addition to existing planning document objectives, there are 4 goals in the National Fire Plan (NFP) (http://www.fireplan.gov/)that are addressed in unit fire management plans.

Goal 1. Improve Prevention and Suppression – Improvements in cooperative efforts with other Federal agencies will result from direction in this plan.

Goal 2. Reduce Hazardous Fuels – Future treatments beyond the planning horizon of this document, both mechanical and prescribed fire will assist meeting this goal at Jewel Cave.

Goal 3. Restore Fire Adapted Communities – Projects proposed for Goal 2 will be a

starting point for the restoration of fire to the vegetative community on the Monument.

Goal 4. Promote Community Assistance – No local communities are generally affected by actions on the Monument. The entire unit is surrounded by the Black Hills National Forest.

C. NEPA AND OTHER COMPLIANCE

An Environmental Assessment (EA) guides the FMP and complies with National Environmental Policy Act (NEPA) (http://www4.law.cornell.edu/uscode/42/ch55.html#PC55) requirements and National Park Service (NPS) policy. The completed EA analyzes environmental impacts of the operations detailed in this plan.

The FMP will implement activities in accordance with the regulations and directions governing the protection of historic and cultural properties as outlined in the Department of Interior Manual, Part 519 (519 DM), and Code of Federal Regulations (36 CFR 800). The National Historic Preservation Act of 1966 (NHPA), as amended, Section 106, (http://www4.law.cornell.edu/uscode/16/470.html) sets the requirements for the protection of the cultural resources found on the unit.

There are no threatened or endangered species identified as resident on the unit. Because some listed species may be occasional visitors an Endangered Species Act, Section 7 consultation will be requested from the U.S. Fish and Wildlife Service.

The EA, State Historic Preservation Officer concurrence and Section 7 consultation results are found in Appendix D.

D. AUTHORITY FOR IMPLEMENTATION

The legal authority for the operation of the fire management program is found in 16 U.S.C. Chapters 1 and 3. The specific authorities can be found in 620 DM 1.1, (http://elips.doi.gov/elips/release/3203.htm). The Organic Act of the National Park Service (August 25, 1916, Section 102) provides the authority for implementation of this plan.

The authority for FirePro funding (Normal Fire Year Programming) and all emergency fire accounts is found in the following authorities:

1. Section 102

Section 102 of the General Provisions of the Department of the Interior's annual Appropriations Bill provides the authority under which appropriated monies can be expended or transferred to fund expenditures arising from the emergency prevention and suppression of wildland fire.

2. Public Law 101-121

Department of the Interior and Related Agencies Appropriation Act of 1990 established the funding mechanism for normal year expenditures of funds for fire management purposes.

3. 31 USC 665 (E) (1) (B)

This section of the US Code provides the authority to exceed appropriations due to wildland fire management activities involving the safety of human life and protection of property.

II. COMPLIANCE WITH POLICY AND RELATION TO OTHER PLANS

A. NPS AND 2001 FEDERAL FIRE MANAGEMENT POLICY

This FMP is prepared to meet the policy requirements of Director's Order 18, Wildland Fire Management dated November 17, 1998. The primary NPS policy consideration from DO 18 is: "Wildland fire may contribute to or hinder the achievement of park objectives. Therefore, park fire management programs will be designed to meet resource management objectives prescribed for various areas of the park and ensure that firefighter and public safety are not compromised."

The goals of the NPS wildland fire management program are to:

- Conduct a vigorous and safe wildland fire management program with the highest professional and technological standards.
- Identify the type of wildland fire that is most appropriate to specific situations and areas.
- Efficiently accomplish resource management objectives through the application and management of prescribed and wildland fires.
- Continually evaluate the wildland fire program operations and accomplishments to better meet program goals by refining treatment and monitoring methods, and by integrating applicable technical and scientific advancements.

In addition, preparation of this plan meets the requirements set forth in Department of Interior Manual 620 (620 DM) and the requirements of the Federal Fire Policy update of 2001. The 2001 Federal Fire Management Policy update addresses 17 distinct items, the foremost being safety; all Fire Management Plans and resulting activities must reflect this commitment. The full text of the policy, Secretarial Transmittals, and Appendices may be found at (http://www.nifc.gov/fire_policy/index.htm).

B. RELATION TO ESTABLISHING LEGISLATION

Also considered policy to guide the development of the FMP are the following legal authorities:

1. Establishment

Executive order by President Theodore Roosevelt signed February 7, 1908 established Jewel Cave National Monument.

2. Administration

Jewel Cave National Monument is administered under the Organic Act of August 25, 1916, which established the National Park Service. This act states the purpose of the National Park Service is, "…to conserve the scenery and natural and historic objects and the wild life 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".

3. Threatened or Endangered (T&E) Species

Jewel Cave National Monument does not contain any known, resident, threatened or endangered species as listed under the Endangered Species Act of 1973 (http://endangered.fws.gov/esa.html). The implementation of the Monument's fire

management program will not jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of critical habitat. Fire management operations will consider appropriate actions to identify and protect from adverse effects any rare, threatened or endangered species subsequently located within the Monument.

C. OBJECTIVES OF GENERAL MANAGEMENT PLAN RELATED TO FIRE MANAGEMENT

Only one management objective in the General Management Plan (GMP) directly relates to implementation of a fire management program: "To preserve and protect surface and subsurface resources from threats originating within and outside the boundary."

D. OBJECTIVES OF RESOURCE MANAGEMENT PLAN RELATED TO FIRE MANAGEMENT

1. Manage Surface Resources

To plan and manage surface resources and developments in order to maintain, restore, and protect natural systems and conditions within Jewel Cave National Monument, including the underlying cave ecosystem.

2. Cooperative Protection of Cave System

To work with the Black Hills National Forest and neighboring landowners to ensure that land uses adjacent to the Monument do not threaten portions of the Jewel Cave system that extend beyond Monument boundaries.

3. Protect Vegetation and Wildlife

To identify, document, and protect significant vegetative and wildlife resources within the Monument.

4. Protect Cultural Resources

To identify, document and protect significant cultural resources within the Monument.

E. ACHIEVING GMP AND RMP OBJECTIVES THROUGH THE FMP

Fire can be used to maintain, restore and protect natural systems on the Monument. With proper planning and execution, prescribed fire can manipulate vegetation to produce healthier forests less prone to stand-replacing crown fire as an essential element of the karst landscape. At the same time fuel management, using both mechanical means and prescribed fire, can reduce the risk to the historic structures, and NPS infrastructure on the unit. With an expected increase in ground fuel loads over the next several years resulting from the Jasper Fire of 2000, implementation of the FMP will assist in achieving the four RMP objectives listed under item D above.

The monument was affected by a major wildland fire in August and September of 2000. The Jasper Fire burned approximately 83,500 acres in the Black Hills including 95% of the Monument. Because most of the Monument was affected, little prescribed fire activity is expected during the 5 year planning horizon in this document. Implementation of this plan will, however, provide a good starting point for fire management as fuels loads increase and vegetation recovers.

F. FMP PROGRAM STATEMENT

The FMP is a detailed description of the actions necessary to carry out fire management policies and achieve both GMP and RMP objectives. Legal mandates related to the unit's establishment are also supported by the FMP.

Initiation of a hazard fuels management program including use of prescribed fire will assist in reducing levels of hazardous fuels, thereby reducing the risk of additional large, catastrophic fires while providing increased defensibility of NPS infrastructure on the Monument.

III. SCOPE OF WILDLAND FIRE MANAGEMENT PROGRAM

A. MONUMENT FIRE MANAGEMENT GOALS

The primary goals for the Monument's fire management program are:

- To promote a program that ensures firefighter and public safety.
- A reduction in human-caused fires.
- Ensure appropriate suppression response capability to meet expected fire complexity.
- Increase use of prescribed fire for restoration of fire dependent ecosystems.

B. WILDLAND FIRE MANAGEMENT ELEMENTS

1. Wildland Fire

a. Suppression – All wildfires will receive an appropriate suppression response. The Monument has a limited number of staff, Monument personnel will be encouraged to qualify for and maintain fire qualifications. If resource needs exceed the Monument's ability, local resources from cooperating agencies will be requested. Additional resources from other Northern Great Plains Area parks and through the Custer Interagency Zone Dispatch Center may be requested.

Suppression strategies will seek to control the spread of wildland fires through either direct or indirect attack. Modes of attack will be determined by the on site Incident Commander with consideration given to various fire parameters and an assessment of values at risk including firefighter safety and protection of the visiting public.

b. Wildland Fire Use – There will be no Wildland Fire Use for Resource Benefit on this unit due to the relatively small size of the Monument and lack of adequate numbers of staff to oversee monitoring needs.

2. Fuels Management

a. Prescribed Fire – Prescribed fire has been in use intermittently at Jewel Cave since the mid-1980's. Continued use of prescribed fire will assist in maintaining the landscape vista. In addition, prescribed fire may be used in conjunction with other hazard fuel management practices to maintain a safe zone around the Monument's infrastructure. There is no immediate plan to use prescribed fire for the near future (5-7 years) as a result of fuel conditions following the Jasper Fire. Annual review of fuel conditions will determine treatment types and schedules. As fuel conditions indicate a need to apply a prescribed fire treatment, the schedule will be inserted into Appendix I.

Prescribed fire will be a part of the management process to restore and maintain the Monument's scenic vistas. In addition, fire will be used to thin and maintain the forest in a condition similar to that at establishment in 1908.

b. Non-Fire Applications – There is potential for some mechanical hazard reduction as stressed trees die. Mechanical treatment has been used to reduce fuels in the vicinity of NPS buildings. These treatments will continue as needed to maintain adequate clearance to protect buildings. Along trails and other areas of public visitation, mechanical treatments may be used to remove hazard trees that could

pose a threat to visitors.

C. DESCRIPTION OF FIRE MANAGEMENT UNIT (FMU)

The entire Monument is considered one FMU. Damages resulting from the Jasper Fire in August, 2000 are found over the entire unit. Because of the effects of the wildland fire, individual burn units within the Monument will be developed along with a 5-year prescribed fire schedule in approximately 5-7 years. Exact burn unit boundaries will be developed as fuel loads increase and treatments become necessary to meet management objectives. Development of the unit boundaries and specific unit prescriptions will be driven by the objectives of the treatment unit.

Jewel Cave National Monument is located on the southwestern slope of the Black Hills Uplift, 13 miles west of Custer, SD and 24 miles east of Newcastle, WY. The Monument encompasses 1,274.56 acres and is accessed by U.S. Highway 16. A USFS road (FS 278) crosses the southeastern portion of the Monument.

1. Characteristics

a. Geology –The area bedrock is primarily the Minnelusa Formation, with some underlying Paha Sapa Limestone (Madison Formation) showing through. Jewel Cave is situated entirely in the Paha Sapa Limestone. Elevation ranges from 5,090' to 5,880' above mean sea level.

Two canyons dominate the surface topography: Hell Canyon on the west and Lithograph Canyon on the southeast with the junction of the two at the south boundary of the unit. A public road exists in the bottom of Lithograph Canyon and a Monument fire road traverses the bottom of Hell Canyon.

The cave is affected by barometric pressure and thus "breathes" with changes in atmospheric pressure. This phenomenon may have an effect on air quality within the cave although little problem was noted during the Jasper Fire. Additional research is needed to determine the potential effects on air quality in the cave during fire events.

b. Hydrology – Intermittent streams occur on the canyon bottoms, however in recent years these have been mostly dry. Two springs are currently active on the Monument: Prairie Dog and Chokecherry. Prairie Dog Spring was formerly used by the USFS for cattle grazing on adjacent lands. Two wells with a capacity of 7 and 10 gallons per minute respectively supply the developed portion of the Monument.

Following the 2000 Jasper Fire, a significant change in water flows in Lithograph Canyon has occurred. USFS studies to determine flow rates and other hydrology changes are ongoing. There is some concern that the emergency entrance and emergency power supply to the cave could be damaged by increased flash flood flows in the canyon. The USFS has completed a hydrological assessment (Parenti, 2001) showing areas upstream of the Monument suffering greater fire damage relative to ground cover, duff removal and forest mortality. A greater opportunity for increased surface water flow exists and may be a factor in visitor use and protection as well as cave infrastructure protection until vegetation is reestablished.

The effect of vegetative change on water quality is also unknown at this time. Water quantity and quality has an effect of the cave system but is not fully understood.

Proposals are in the Resource Management Plan to study the effects of both on the cave system.

c. Flora – The ponderosa pine (*Pinus ponderosa*) vegetation type covers 90% of the surface environment. Prior to the Jasper Fire, the forest could be classified as a forest of variable density with some old growth stands and dense young forest stands. As a result of the fire, significant changes in stand composition have occurred. Many areas of the dense young growth were burned, creating openings that should support future ponderosa growth. Stands of larger trees were affected in a wide variety of ways. Depending on the slope, aspect, time of day burned, prior treatment by prescribed fire, and other variables, tree damage ranged from cool understory burning to crown fire with 100% tree mortality in patches of varying size, but ranging up to 100 acres. Areas recently treated with prescribed fire appear to have been affected the least.

   Understory composition currently consists of early successional species, including several species of *Ribes*, Fireweed (C*hamerion angustifolium*), numerous grasses both native and exotic, and varieties of goldenrod.

   Open meadows are found on the unit, generally in the canyon bottoms.

   A complete list of species noted on the unit and reported in the National Park Service Inventory and Monitoring Program is found in Appendix C.

d. Fauna – Many species of birds and mammals inhabit both meadow and forest habitats. Deer, coyotes (*Canis latrans*), red squirrels (*Tamiasciurus hudsonicus*), rabbits, chipmunks (*Tamias minimus*), mice, bushy-tailed woodrats (*Neotoma cinerea*), chickadees (*Parus atricapillus*), Cassin's finches (*Carpodacus cassinii*), and others are found in abundance. Other mammals and birds reported occasionally include; elk (*Cervus elaphus*), mountain lion (*Puma concolor*), great-horned owls (*Bubo virginianus*), hawks, golden eagles (*Aquila chrysaetos*), and turkey vultures (*Cathartes aura*).

   Nine species of bats have been reported on the Monument (RMP, 1999). Six species frequently utilize the cave, the remaining three are found in other habitats in the Monument. Four of the nine species have been designated as U.S. Fish and Wildlife Service "species of concern." Four species are monitored by the South Dakota Natural Heritage Program. Jewel Cave currently is home to the largest known hibernating colony (over 900 members) of Townsend's Big-Eared Bat (*Corynorhinus townsendii)*, a USFWS listed "species of concern."

   The Tawny Crescent Butterfly, known to have been sighted on the Monument in the past, is rare in South Dakota. Work is needed to determine the presence, distribution and effects of fire on this species.

   A complete list of species noted on the unit and reported in the National Park Service Inventory and Monitoring Program is found in Appendix C.

e. Threatened and Endangered Species – Currently there are no known species listed under the Endangered Species Act resident on the Monument. Species that may be occasional visitors include the bald eagle (*Haliaeetus leucocephalus*), gray wolf (*Canis lupus*) and mountain lion.

f. Cultural Resources

(1). Archeology – Of the 20 archeological sites at the Monument, 16 sites are prehistoric and four sites are of Euro-American origin, dating since 1861 A.D. The four Euro-American sites include remains of early developments at Jewel Cave (Michauds' residence/hotel) and remains of agricultural activity. The 16 prehistoric sites include one site which appears to have three cultural levels (Plains Woodland or Late Prehistoric, 500-1300 A.D.; Middle Archaic 4,000-2,000 B.C.; and a level below the Middle Archaic). Sheveland lists four of the sites as being in good condition. The remaining sites have yet to be evaluated for condition.

(2). Historic Structures – The historic cabin near the original cave entrance is the only intact historic structure in the monument. The foundation of the Jewel Cave Hotel is in the same vicinity, as are the remains historic sites that might be associated with CCC activity in the area.

(3). Cultural Landscapes – No cultural landscapes have been formally identified, although the historic area, which contains the original cave entrance, CCC era developments, and the historic ranger cabin, should be evaluated. A Cultural Landscapes Inventory (CLI) has been started for the Historic Area, but is not complete.

g. Unit Infrastructure – The Visitor Center, employee housing area and support facilities are listed in the table below. During the Jasper Fire heavy suppression resource use was necessary to protect these facilities.

Table 1 – Real Property List

Facility	Number of Units	Value
Apartment Complex	1	300,000
Historic Ranger Cabin (Irreplaceable)	1	250,000
Maintenance Shop	1	600,000
Metal Storage Buildings	2	20,000
Restrooms	1	250,000
Pole Barn	1	30,000
Offices	1	150,000
Residences	2	300,000
Visitor Center/Headquarters	1	3,000,000
Well House	1	15000
Total		**4,915,000**

2. Fire Management Objectives

a. Contain 95% of all wildland fires at less than 5 acres to protect park resources.

b. Use appropriate methods of fuel management around 20% of buildings annually to reduce risk of damage to infrastructure in future wildland fires.

c. Increase public awareness of the role of fire in natural processes and the use of fire to manage wildland fuels through interpretative displays.

d. Protect the visiting public from all wildland fire while continuing to provide services traditionally found on the unit.

3. Management Considerations

a. Provide for the safety of suppression forces, and Monument visitors.

b. Aircraft resources may be used with FS/BLM approved retardants, but retardant will be kept out of streams.

c. Bulldozers will generally not be used in suppression operations, and will not be used during prescribed fires. In extreme wildfire conditions bulldozer use may be authorized by the superintendent.

d. Engines may be restricted from areas identified as possessing a significant hazard to engine and crew members if operated off road. Generally, engines will not be used off roads.

e. During wildland suppression actions that require ground disturbance a trained archeologist will be consulted and should be on-site.

f. All appropriate cultural and archeological clearances will be obtained as part of the planning process for prescribed fires.

g. Prescribed fires will not be ignited during county-wide or state established burn restrictions.

h. Maintain Class II air quality standard.

4. Historic Role of Fire

Early explorers to the Black Hills region described the forest as being open with few understory trees, with groves of ponderosa pine on rolling hills and rocky ridges (Progulske, 1974). The grassland predominated, and horse and wagon travel was easy. Accounts of natural fires during this period portray them as creeping along the surface for several days to weeks, eliminating the scant understory and litter, but rarely harming mature trees. These recurring surface fires encouraged herbaceous growth by recycling vital nutrients and improving the penetration of precipitation and sunlight to the forest floor.

With the establishment of the Black Hills Forest Reserve in 1898 a fire suppression policy was adopted and wildland fire frequency decreased. Since that time fuels have accumulated, pine has invaded adjacent grasslands, forest density has increased, and wildlife forage species have declined. As a result, the potential for wildfires to develop into costly conflagrations increased (Progulske, 1974).

A study conducted in the mid-1990's (Brown and Sieg, 1996) on Jewel Cave provides additional insight into the fire regime and effects on ponderosa pine vegetation in the

Monument. Samples from trees dating to the 1500's indicate that, until about 1900, fire likely burned on the Monument at approximately 16 year intervals (fire regime of 1-45 years). The longest period with no widespread fire was from 1890 to 1994 (year of data collection). This study also indicates that most fires occurred during the later part of the growing season, probably during late July through September.

In August of 2000 the results of the vegetative changes became apparent. The Jasper Fire, human caused, burned over 83,500 acres of the Black Hills including nearly all the Monument at a cost of $11 million (JECA Staff) .

Following the Jasper Fire, much of the forest habitat on Jewel Cave has been returned to an early successional stage of growth. Monitoring vegetative changes as they occur will provide baseline information for future prescribed fire operations.

Records of recent fire occurrence at Jewel Cave are limited. Only five fires were recorded from 1972 to 1985, burning approximately 4 ¾ acres. Prior to 1972, records were kept at the USFS District Office in Custer, SD, however, during relocation, these records were lost. From 1982 on, fire reports have been entered into the Department of Interior Shared Applications Computer System (SACS) in Boise, ID. The data in Table 2 below is the SACS record of wildland fire occurrence on the Monument since 1983. Seven of the eleven fires reported in SACS show no acres as they were assists to the Forest Service on lands adjacent to the Monument.

Table 2 – Wildland Fire Occurrence

Jewel Cave National Monument Wildland Fire Occurrence History 1983-2001			
Year	Month	Number of Fires	Number of Acres
1983	May	1	
	June	1	
	August	1	
1984	June	1	
1985	August	1	
	September	1	
1987	September	1	
1989	September	1	
1991	June	2	
2000	August	1	
Total		11	

Prescribed fire has been applied to Monument lands occasionally since 1986, Table 3, below, shows year and acreage burned. Several of the fires were near the developed area and resulted in hazard fuel reductions.

Table 3 – Prescribed Fire History

Jewel Cave National Monument Prescribed Fire History 1986-1999			
Year	Month	Number of Fires	Number of Acres
1986	November	1	
1990	December	1	
1993	October	1	
1996	October	1	
1999	September	1	
Total		5	

The value of prescribed fire was illustrated anecdotally during the Jasper Fire. Areas burned in the 1999 prescribed fire did not suffer the same fire intensity when the wildland fire burned into that area. Scorch, mortality and other fire effects were much more moderate in the area treated with prescribed fire.

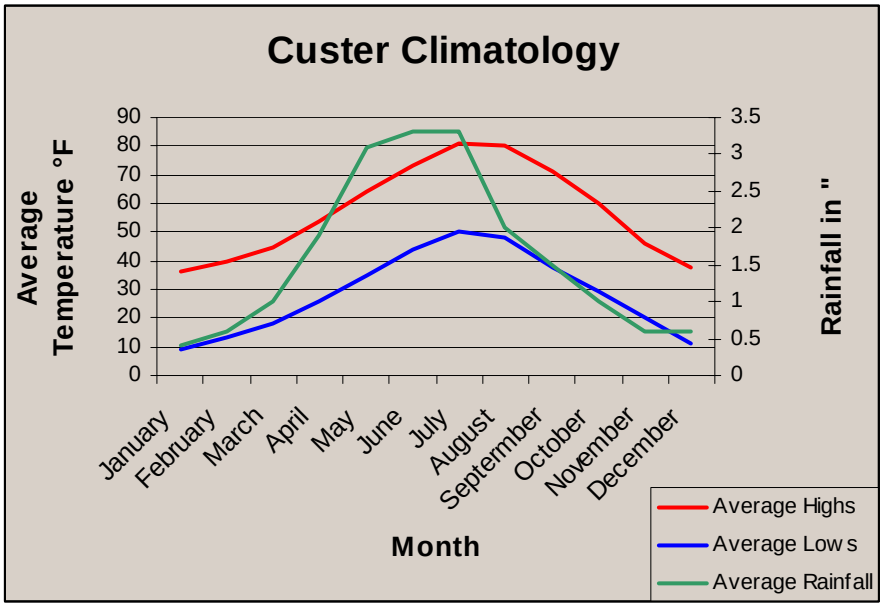
5. Wildland Fire Management Situation

a. Climate – Based on records from Custer, SD, the average annual precipitation is 19.3 inches with frequent, brief electrical storms occurring during the summer months. Minimal to moderate snow cover is the rule from late December through March with the annual average snowfall being 30 inches. Average high temperatures range from 36°F in January to 81°F in July. Average lows range from 9°F in January to 50°F in July. Record temperatures range from -43°F to 100°F. Monument temperatures have been higher than the Custer records several times in the last twenty years. These ranges are expected to be slightly different at the Monument due to location and elevation differences. The chart in Figure 1 below shows temperature and rainfall distribution as Custer, SD.

b. Fire Season – The normal fire season in the Black Hills extends for approximately 200 days, from mid-April through October. Effects of weather on fuels drive the severity of the season. Fire danger is expected to be at the highest level during the summer months. The combination of high daytime temperatures, relatively warm overnight temperatures and reduced cloud cover act to keep fuel moistures low and fuel temperatures high. In addition, numerous lightning storms occur during this period with many of them “dry”, that is with little or no rain accompanying the lightning. USFS records indicate that approximately 74% of wildland fires on the adjoining Black Hills National Forest are lightning caused.

Jewel Cave utilizes information provided by the weather station (#393505, Elk Mountain) at Wind Cave National Park, approximately 22 miles southeast of the Monument. Fuels, topography and weather conditions on the Monument are similar to that station. Weather information is archived in the Weather Information Management System (WIMS) and available for Monument use.

Figure 1 – Custer, SD Climatology



c. Fuel Characteristics – The fuels at Jewel Cave fall into Northern Forest Fire Laboratory (NFFL) models 2 (Timber Grass and Understory), model 9 (Hardwood Litter) and model 10 (short needle, heavy dead). Conditions during the summer affect fuels and subsequent fire behavior. Where fire has been a frequent visitor, fire behavior is generally restrained with creeping and some short runs seen.

As shown in Figure 1, rainfall peaks in June and July while the average temperature peaks in July. After July, drying conditions exist until snowfall, usually in November. All fuel classes show a decrease in moisture into the fall. This timing reflects conclusions drawn by Brown and Sieg, 1996 regarding the seasonal occurrence of a majority of fires in their dendrochronology study at Jewel Cave.

Expected average and extreme fire behavior estimates are shown in the tables below. Calculations were made using the BEHAVE Fire Behavior Prediction System software, Version 4.4. Input values were derived from observations by fire staff on site.

Table 4 – Fuel Model 2 – Average Fire Behavior

Inputs		Outputs	
Fuel Model	2	Rate of Spread (chains/hour)	64
1 hour fuel moisture	6	Heat/Unit Area (BTU/ft²)	498
10 hour fuel moisture	7	Fireline Intensity (BTU/ft/s)	580
100 hour fuel moisture	10	Flame Length (feet)	8.4
Herbaceous Fuel			

Moisture	30		
Mid-Flame Wind Speed (mph)	6		
Slope (%)	10		

Table 5 – Fuel Model 2 – Extreme Fire Behavior

Inputs		Outputs	
Fuel Model	2	Rate of Spread (chains/hour)	409
1 hour fuel moisture	6	Heat/Unit Area (BTU/ft²)	498
10 hour fuel moisture	7	Fireline Intensity (BTU/ft/s)	3728
100 hour fuel moisture	11	Flame Length (feet)	19.8
Herbaceous Fuel Moisture	30		
Mid-Flame Wind Speed (mph)	17		
Slope (%)	20		

Table 6 – Fuel Model 9 – Average Fire Behavior

Inputs		Outputs	
Fuel Model	9	Rate of Spread (chains/hour)	12
1 hour fuel moisture	6	Heat/Unit Area (BTU/ft²)	370
10 hour fuel moisture	7	Fireline Intensity (BTU/ft/s)	80
100 hour fuel moisture	10	Flame Length (feet)	3.4
Mid-Flame Wind Speed (mph)	6		
Slope (%)	10		

Table 7 – Fuel Model 9 – Extreme Fire Behavior

Inputs		Outputs	
Fuel Model	9	Rate of Spread (chains/hour)	66
1 hour fuel moisture	6	Heat/Unit Area (BTU/ft²)	370
10 hour fuel moisture	7	Fireline Intensity (BTU/ft/s)	450
100 hour fuel moisture	11	Flame Length (feet)	7.5
Mid-Flame Wind Speed (mph)	17		
Slope (%)	20		

Table 8 – Fuel Model 10 – Average Fire Behavior

Inputs		Outputs	
Fuel Model	10	Rate of Spread (chains/hour)	8
1 hour fuel moisture	6	Heat/Unit Area (BTU/ft²)	1218
10 hour fuel moisture	7	Fireline Intensity (BTU/ft/s)	182
100 hour fuel moisture	10	Flame Length (feet)	4.9
Live Woody Fuel Moisture	150		
Mid-Flame Wind Speed (mph)	6		
Slope (%)	10		

Table 9 – Fuel Model 10 – Extreme Fire Behavior

Inputs		Outputs	
Fuel Model	10	Rate of Spread (chains/hour)	49
1 hour fuel moisture	6	Heat/Unit Area (BTU/ft²)	1290
10 hour fuel moisture	7	Fireline Intensity (BTU/ft/s)	1157
100 hour fuel moisture	11	Flame Length (feet)	11.5
Live Woody Fuel Moisture	90		
Mid-Flame Wind Speed (mph)	17		
Slope (%)	20		

Based on the BEHAVE runs, only lithic scatters on the surface are expected to be affected by wildland fire passing over them. Those effects would vary depending on the composition of the article and soil temperature, soil moisture and other factors. It is generally thought that fire has passed over the landscape numerous times with minimal effect. More damage is likely to be done to artifacts during suppression operations than by the fire itself. The historic cabin and other buildings would be protected by commitment of suppression resources to that task.

Effects on vegetation are not expected to be severe unless a crown fire occurs. Otherwise, some mortality of understory shrubs, seedlings and small trees is possible. Grasses and forbs will not be affected as resprouting from roots and rhizomes is the normal situation and the species found on the unit are, for the most part, fire adapted.

Wildlife populations will be affected slightly by both fire and smoke. The effects will be temporary, lasting for perhaps 6-24 hours after the passage of the flame front. Large animals are not expected to show mortality. Some small mammals such as field mice may be caught by the flame front but mortality is not expected to be heavy.

Regeneration of vegetation provides an excellent habitat for these small species and natural reproduction will quickly repopulate the area. Overall short-term impacts on fauna will be minimal while long-term changes in habitat conditions will be beneficial.

Ground dwelling reptile and insect populations are not expected to be affected.

d. Fire Regime Alteration – The presettlement fire regime was one of generally light, frequent ground fires. These fires would kill some seedlings, saplings and pole sized trees as well as much of the understory brush. Dendrochronology studies (Brown and Sieg, 1996) indicate that following European settlement in the late 1800's, landscape scale fire virtually disappeared from the area.

   A number of human influences have affected the fire regime. Among the primary influences are forest product removal and grazing. Federal fire suppression policies instituted in the early 1920's also resulted in a strong protection ethic that allowed a buildup of fuel volumes resulting in fewer, but generally more severe fires such as the Jasper Fire in 2000.

   One objective of this plan is the restoration of fire to its rightful place in the environment. There is no commercial use of lands within the Monument so restoration of fire to the ecosystem here will not affect any local economy.

   More information about the fire history of the area is found in Section III.C.4.

e. Control Problems – Control of wildland fires is expected to be more difficult over the next five to ten years as a result of the increase in fuels from trees killed in the Jasper Fire.

   Fire suppression issues on the Monument include the amount of vertical fuels, and the potential for high intensity fires requiring indirect attack suppression tactics, as those fuels fall. The topography on the unit also creates potential problems by affecting fire behavior. Continuing efforts to reduce hazard fuels with prescribed fire are essential to reduce control problems during future wildland fires. Habitat and fuel load changes resulting from the Jasper Fire indicate a monitoring status for the next 5-7 years. Should fuel loads increase to pre-fire levels, initiation of prescribed fire operations to reduce fuels will be considered.

   Mechanical hazard fuel reduction will be the operation of choice in areas surrounding NPS buildings. Most work would be accomplished by cutting and removing trees and brush. Normal maintenance operations, grass and weed cutting, for example, have fuel reduction as a secondary benefit.

f. Values at Risk – The primary values to be considered on the Monument are the NPS infrastructure and historic ranger cabin. These improvements are also the primary concentration points for visitors. To a lesser degree, the trails around the Visitor Center and in the vicinity of the historic entrance will draw visitors although not to the same extent or density. A more complete discussion of values at risk may be found in Section III.C.1.f.

   Other detailed descriptions of values at risk may be found in the GMP and RMP.

IV. WILDLAND FIRE MANAGEMENT

A. GENERAL MANAGEMENT CONSIDERATIONS

1. GMP Direction

Fire Management strategies on the Monument are directed to suppression of all wildland fires regardless of cause. A primary management objective from the GMP requires protection of "…surface and subsurface resources from threats originating within and outside the boundary."

With increases in ground fuel loads expected over the next several years as result of the Jasper Fire, prompt response and aggressive suppression action with proper regard to firefighter safety is essential. Additional response actions are described in the Step-up Plan found in Appendix I.

2. Implementation Procedures

A Wildland Fire Implementation Plan (WFIP) will not be required as a general rule as no wildland fire use is considered under this plan. The exception would be in the case of multiple starts where priorities for suppression become necessary. If multiple starts occur, a WFIP Stage I Initial Fire Assessment will be completed for each incident, the results will be used to determine initial attack priorities until adequate suppression forces can be placed on the line.

B. WILDLAND FIRE USE

Because the unit is only 1,274 acres in size, has a small staff and is surrounded by Black Hills National Forest, Wildland Fire Use is not considered feasible and will not be implemented in this plan.

C. WILDLAND FIRE SUPPRESSION

1. Fire Behavior

Fire behavior expected under both average and extreme conditions for the major fuel types on the unit can be found in the tables in Section III of this plan. Because fuel loads will be constantly changing as trees die from fire related stress, predicted fire behavior can change rapidly depending on weather conditions. It is incumbent upon all who are involved with fire management activities to keep park management and fire management personnel aware of current conditions. This awareness will allow proactive response to mitigate identified above normal fire conditions.

2. Preparedness Actions

a. Prevention – The objectives of the Monument's fire prevention program are: to prevent human caused wildland fires and, to incorporate prevention messages into interpretive programs. Coordination with the Forest Service is essential to ensure a consistent and clear prevention message. At Staffing Class 3 or higher in the Step-up Plan, the full range of prevention actions in the Prevention Plan (Appendix J) will be implemented until the fire danger has abated.

Due to the remote location of the unit, signs warning of fire danger conditions and/or restricted activities are normally posted by the USFS in Custer, SD and Newcastle, WY.

Verbal contacts or warnings of fire danger may be made during parking lot patrols, interpretive tours, surface talks or visitor contacts at the information desk.

Warning signs are also posted as appropriate in the Visitor Center area.

Enforcement of Monument regulations, including fire restrictions, is performed by commissioned Monument law enforcement Officers.

b. Annual Training/Fitness Testing – Eight hours of annual refresher training emphasizing safety will be required for red-carded Monument staff. Fitness testing using the current approved physical testing regimen will be completed prior to the start of fire season for all personnel that are to carry a Fire Qualification (Red) Card.

In addition, each year the Monument's Fire Coordinator and the Northern Great Plains Area Fire Management Officer will assess current qualifications of the unit's fire qualified personnel. From this assessment, current and future training needs for both the Monument and individuals will be determined. Training will be obtained through services of the Northern Great Plains Area Fire Management Office or through interagency training courses. All firefighting personnel will meet the training, experience and physical standards for their fire position as found in Wildland and Prescribed Fire Qualification System Guide PMS 310-1.

c. Readiness – Each year prior to and after the fire season, the Fire Coordinator will conduct an inventory of the Monument fire cache. Any needed supplies or equipment will be requested through the Northern Great Plains Area Fire Management Office. The Fire Coordinator will also be responsible for ensuring that the Monument's fire tools and engines are maintained in a state of readiness, especially during the fire season. A listing of Normal Unit Strength cache stocking is found in Appendix E, 2. Preparedness Inventory.

d. Fire Weather and Fire Danger

(1). Weather Stations – Jewel Cave utilizes information provided by weather station 393505, Elk Mountain, Wind Cave National Park. Fuels, topography and weather conditions on the Monument are similar to that station. Weather information is archived in the Weather Information Management System (WIMS) and available for Monument use.

(2). NFDRS – JECA uses NFDRS Model C, Burning Index (BI) as the trend monitoring index and fire danger prediction scale. The Step-up Plan in Appendix I shows the break points for each individual staffing class along with the actions, both preparedness and prevention, required in each class.

(3). Monthly Risk Analysis – When weather and fuels appear to be outside the expected parameters, a monthly risk analysis will be conducted by the Northern Great Plains FMO as needed. Items considered will include those in the following table. Results should be passed on to the regional FMO for compilation and use for requesting

additional funds and/or resources for wildland fire suppression.

Table 10 – Monthly Risk Analysis

Monthly Risk Analysis		
Factor	**Current Level**	**Historic Average**
Temperature Levels (Highs)		
Temperature Levels (Lows)		
Precipitation Levels		
Keetch-Byram Drought Index		
1000 hour Fuel Moistures		
Live Fuel Moistures		
Unusual Weather Events Ice storms, hard freezes		None
Unusual fire load		
30-90 day temperature forecast		None
30-90 day precipitation forecast		None

e. Step-up Staffing Plan – The Step-up Plan contains preparedness and prevention actions to be taken as fire danger increases.

Weather observations will be taken at the fire weather station at Wind Cave daily via the automated weather station. NFDRS fuel model C will be used as the primary model for rating fire danger. Weather observations and fuel measurements will be taken each burning period, and the NFDRS BI computed. Specific actions and trigger points are listed in the Step-up Plan in Appendix I.

3. Pre-Attack Plan

This is basically a checklist of items to be considered prior to wildland fire occurrence. The table is divided into four parts that correspond to four of the functions found in the Incident Command System and is found in Appendix G. Items that are available at Jewel Cave are marked as such.

4. Initial Attack

a. Setting initial attack priorities involves determining the risk of fire to visiting public and firefighters, resources at risk, existing fires and threat to adjoining property. With multiple ignitions, priorities are: public safety, cultural resources, NPS infrastructure, and natural habitats. All fires will be aggressively suppressed with due consideration of firefighter and public safety.

Maps of developed areas, and cultural resources are available in the Monument office.

b. Normally initial attack crews will be comprised of at least two persons fully equipped with personal protective equipment. A radio and tools such as rakes, back-pack pumps, etc., will be carried in all patrol vehicles. Additional gear may be provided by back-up personnel as needed.

Small fires will be controlled, if possible by an initial attack handcrew. An initial attack crew on a larger fire will be reinforced by additional firefighters. If additional personnel or equipment are needed on the fire, the Incident Commander will notify

the Park Fire Coordinator who will arrange for additional suppression forces and/or personnel to be available for initial dispatch.

c. Confinement as an Initial Attack Suppression Strategy – Confinement strategies may be used at Jewel Cave, if, in the opinion of the Initial Attack Incident Commander, direct suppression would put firefighters at risk due to terrain considerations, lack of adequate IA staffing or other safety issues.

If a confinement strategy is considered, it should be supported by completion of a Wildland Fire Implementation Plan (WFIP).

d. Response Times – For most fires, response time by NPS equipment and personnel will run up to 30 minutes depending on location of fire and responding personnel.

e. Management Constraints - The suppression tactics to be used at Jewel Cave include use of water or foam firelines in conjunction with natural barriers to reduce damage potential from suppression actions. Water will normally be supplied by engines operating from established roads and/or trails. There are three primary management constraints that apply to fire suppression operations:
- The use of mechanized earthmoving equipment (tractor plows, bulldozers, etc) in suppression or prescribed fire operations is not authorized.
- Engines will be restricted from areas identified as potentially affected by vehicle traffic where rutting, soil compaction or other habitat damage could occur.
- Handlines will be constructed only in areas where damage to archeological and/or historic resources is not likely to occur.

f. Local Issues – Close communication with local units of government and the USFS should keep wildland fire controversy to a minimum. There are no tribal issues.

5. Extended Attack and Large Fire Suppression

a. Extended Attack Needs – Based on the fire history from 1983, few fires will remain uncontrolled past the first burning period. The largest fire since 1983 was the Jasper Fire which basically covered the entire Monument. Historically, most fires have been adjacent to roads in the area, easily accessed and quickly suppressed.

Should additional assistance be required, support will come first from the Black Hills National Forest. An Memoranda of Understanding with the Forest and several nearby parks is included in Appendix E.

The Custer Zone Dispatch Center in Custer, SD is informed of any fire activity at the park. The Center also processes requests for additional resources.

b. Implementation Plan Requirements – A Wildland Fire Implementation Plan will not be required on initial attack fires as full suppression is established as the Appropriate Management Response. WFSA development will be required at the point where the second burning period will not see control of fire spread. At this point a WFSA will be completed each day until the fire is surrounded by firelines or natural or other barriers that will stop fire spread.

c. Complexity Decision – When a WFSA has been completed for use during the operations on a second burning period, the fire will be considered to be an extended

attack fire.

d. Delegation of Authority – A sample limited delegation of authority to an incident commander is included in Appendix E.

6. Exceeding Existing WFIP

If the periodic reassessment of a WFIP indicates that a change in strategy is needed, the following actions will be taken:

a. If the fire is the result of an escaped prescribed fire, A Wildland Fire Situation Analysis will be completed and a new strategy selected based on the results.

b. If the initial attack appropriate management response was a confinement strategy and operations continue into a second operational period, a WFSA will be completed and new strategy selected as appropriate.

7. Minimum Impact Suppression Tactics (MIST)

Minimum Impact Suppression Tactics (MIST) – Director's Order #18 states that: "Methods used to suppress wildland fires should minimize impacts of the suppression action and the fire, commensurate with effective control and resource values to be protected." There are three primary management constraints that support MIST operations:

- Bulldozers will generally not be used in suppression or prescribed fire operations. However, their use may be authorized by the superintendent during extreme wildland fire conditions.
- Engines will be restricted from areas identified as potentially affected by vehicle traffic where rutting, soil compaction or other habitat damage could occur.
- Handlines will be constructed only in areas where damage to cultural resources is not likely to occur.

8. Fire Rehabilitation

Possible rehabilitation needs include those associated with fireline construction, snag felling, road repair, fence replacement, and mop-up activities. Proper placement of hand constructed firelines should reduce the need for major work. Areas with handlines will be restored to their pre-fire condition as soon as possible. The nature of fires on the Monument indicates that long term rehabilitation should not normally be necessary. If a Burned Area Emergency Rehabilitation (BAER) Team is required on the Monument an archeologist or cultural resource specialist will be part of the team.

9. Records and Reports

The Northern Great Plains Fire Management Officer is responsible for all fire management records and reports.

A. Individual Fire Report: The form for documenting a wildland fire is the Individual Fire Report (Department of Interior Form DI 1202). The report provides a historical record of the fire regime for the monument. All fires within the boundaries must be documented with this form, including fires that go out on their own. The form is also used by the Department of Interior to record fire occurrences. Support actions in which monument personnel respond to fires outside the monument (including out of state) are

also to be reported on this form. For firefighters to receive credit for work performed on any fire, the National Park Service must have a DI 1202 with an incident number on file.

The incident commander for the fire is typically the person responsible for preparation of the individual fire report. In most cases, this is the individual who put the fire out. That person may also complete a Case Incident Report (Form 10-343). The Northern Great Plains Fire Management Office Fires will assign each fire a number. Instructions for filling out the report are found in *Reference Manual* 18.

For large fires, a complete fire report will include, as applicable:

- written policies, guidelines or authority statements signed by the superintendent
- copies of equipment purchased or personnel request orders
- all situation maps
- personnel lists, including emergency firefighter time slips
- press clippings
- accident reports
- all weather data reports and records
- documentation of financial charges made against the incident
- rehabilitation plan

The completed individual fire reports are to be submitted to the Northern Great Plains Area Fire Management Officer, who will review the report and enter it into the NPS wildland fire management computer system.

B. Training And Experience Records: The Shared Applications Computer System at the National Interagency Fire Center is the central repository for all individual fire experience and training records. The Northern Great Plains Area Fire Management Officer is responsible for entering all training and experience data into the computer and for ensuring that the information is up to date.

C. Daily Situation Report: Daily situation reports are required on those days when the burning index reaches the 90th percentile and the monument moves into staffing class IV and V or when a fire has started or is on going. The monument will notify the Northern Great Plains Area Fire Management Officer, who will enter the report into the NPS Shared Applications Computer System by 9:30 AM THE FOLLOWING DAY.

D. Resource Order Form: All assistance requests must be documented on the Resource Order Form (National Fire Equipment Schedule Form 1470). These forms can be transmitted by telephone. The order form is an obligating procurement document.

E. Delegation of Authority: Whenever an incident management team is ordered, the superintendent must provide a written limited delegation of authority and a briefing package to the incoming incident commander. The Northern Great Plains Fire Management Officer has templates for this document.

Table 11, below is a checklist of possible wildland fire documents and the individual usually responsible for completing them.

Table 11 – Wildland Fire Reporting Checklist

Checklist of Wildland Fire Documents and Reports		
Document	**Revision or Preparation Frequency**	**Responsible Party**
DI-1202	Each incident	Incident Commander
WFSA	As needed	Superintendent, IC
Fire Weather	Daily in season	FMO
Fire Situation Report	Daily in season	FMO
Fire Danger	Daily in season	FMO
Fire Complexity Analysis	Per Incident as Needed	Incident Commander
Monthly Risk Analysis	Monthly	FMO, Fire Coordinator
Pre-Attack Plan	Annually	FMO, Fire Coordinator
Wildland Fire Critique	Each Incident	Suppression staff on the individual fire

V. FUELS MANAGEMENT

A. LONG-TERM FUELS MANAGEMENT

Prescribed fire has been in use intermittently at Jewel Cave since the mid-1980's. Continued use of prescribed fire will assist in maintaining the scenic landscape vista. Restoring fire to the landscape at Jewel Cave will reduce the potential for future fires like the Jasper Fire.

In addition, prescribed fire will be used in conjunction with other hazard fuel management practices to maintain a safe zone around the Monument's infrastructure.

There is no immediate plan to use prescribed fire or broad-based mechanical treatments for the near future (5-7 years). Annual review of fuel conditions resulting from the Jasper Fire will determine treatment types and schedules. There is potential for some earlier mechanical hazard reduction as fire stressed trees die. When fuel conditions indicate a need to apply either mechanical or prescribed fire treatment, the schedule will be inserted into Appendix H.

Fire can be used to maintain, restore and protect natural systems on the Monument in accordance with RMP objectives 1 and 3. At the same time fuel management, using both mechanical means and prescribed fire, can reduce the risk to the historic structures, and NPS infrastructure on the unit meeting RMP objective 4.

B. PRESCRIBED FIRE

1. Annual Preparation

Prescribed burning may be used throughout Jewel Cave National Monument to accomplish resource management objectives as outlined in this plan. The Fire Management Coordinator will prepare the annual prescribed fire plan with assistance from the Area Fire Management Officer. The program will detail all burn projects proposed for the coming year and will specify objectives of each burn. The program plan will be submitted to and reviewed by the Superintendent for approval.

The Fire Management Officer will recommend a Prescribed Fire Burn Boss for each specific planned burn. The Burn Boss will conduct a field reconnaissance of proposed burn locations with monument staff to discuss objectives and special concerns and to gather all necessary information to develop the Burn Plan. After completion of field reconnaissance, a prescribed fire Burn Plan will be developed.

The park is divided up into nine burn units along administrative and natural barriers:

1. Highway
2. Corner
3. Hill Top
4. Pass Creek
5. Canyon
6. Cave
7. Roadway
8. VC
9. Lithograph

Presently the goal, in order to meet resource objectives, will be to burn each unit on a multiple year rotation. Each unit will be burned, as weather conditions and personnel permit, on a twelve-year rotation. The prescribed fire schedule will be evaluated annually to evaluate resource objectives and check burning rotation time frames.

2. Long-term Prescribed Fire Relation to FMU

Only one FMU exists on the Monument. Burn units are not yet fully identified as some areas of the unit require an evaluation following the Jasper Fire to determine the appropriate fuel management level of effort (see number 1 above).

3. Personnel Requirements

Because the regular Monument staff is small, it is unlikely that any prescribed fires proposed will be accomplished solely by Monument personnel. Other fire qualified personnel from group units may be asked to assist on an ad hoc basis. Specific burn plans will be developed by the burn boss, the AFMO for Prescribed Fire, and the FMO with input from Jewel Cave staff.

4. Fire Behavior and Fire Effects Monitoring

A Monitoring Plan is in the development stage and will be included as Appendix F when complete. Fire weather data used in development of prescriptions is available in the Weather Information Management System (WIMS). This information provides some of the inputs for the BEHAVE modeling tool. A qualified individual will be on-site to monitor and record weather and fire behavior observations during the burn. When combined with the information reported on fire effects, a reasonably complete evaluation of the operation should emerge.

5 Critique of Prescribed Fire Operation

The following items, as a minimum, will be reviewed following each prescribed fire operation.

- Were any unsafe acts noted?
- Were burn objectives met within an acceptable range of results?
- What should be done differently to obtain desired results or get better results?
- Was there any deviation from plan? If so, why?
- Was prescription appropriate?
- Were weather changes a factor in accomplishing burn?
- Problems and general comments:

6. Documentation and Reporting

The following table lists the reports and other documents required for prescribed fire operations.

Table 12 – Prescribed Fire Reporting Checklist

Checklist of Prescribed Fire Documents and Reports		
Document	**Revision or Preparation Frequency**	**Responsible Party**
FirePro Project Submission	Annual	FMO
Original Signed Prescribed Fire Plan	Each Project	Regional Director
Checklist of Pre-Burn Prescribed Fire Activities (no specific form)	Each Project	Prescribed Fire Burn Boss
All Reviewer Comments	Each Project	Reviewers

Checklist of Prescribed Fire Documents and Reports		
Document	**Revision or Preparation Frequency**	**Responsible Party**
All Maps	Each Project	FMO\Prescribed Fire Burn Boss
Notification Checklist	Each Project	Prescribed Fire Burn Boss
Permits such as burn, smoke, etc.	Each Project	FMO\Prescribed Fire Burn Boss
Monitoring data	Each Project	Prescribed Fire Monitor
Weather forecasts	Each Project	FMO\Prescribed Fire burn Boss
Agency Administrator Go/No-Go Pre-Ignition Approval	Each Project	Superintendent
Operational Go/No-Go Checklist	Each Project	Prescribed Fire Burn Boss
Incident Action Plan(s)	Each Project	FMO\Prescribed Fire Burn Boss
Unit logs, Daily Validation or other unit leader documentation	Each Project	FMO\Prescribed Fire Burn Boss
Press Releases, Public Comments, and Complaints	Each Project	Local Park Staff
Smoke dispersal information	Each Project	FMO\Prescribed Fire Burn Boss
Post fire analysis (Critique)	Each Project	All Participants in Operation
Fire Occurrence (DI-1202) report (Must also be reported in SACS)	Each Project	Prescribed Fire Burn Boss

Time and filing deadlines are associated with each of these reports and will control scheduling and response times.

7. Historic Fuel Treatment

The map depicting historic treatments will be a part of the GIS, annual treatment information will be added as completed. A map with the most recent treatments will also be found in Appendix E.

C. PRESCRIBED FIRE BURN PLAN

Prescribed burn plan requirements at Jewel Cave National Monument are similar to the requirements at other NPS units. A detailed outline and discussion is found in RM-18, Chapter 9, Exhibit 15 (http://www.nps.gov/fire/fire/policy/rm18/index.htm). JECA plans have the following specific requirements:

- Signature Page
- Executive Summary
- Description of Area
- Goals and Objectives
- Risk Management
- Project Complexity
- Organization
- Cost
- Scheduling
- Pre-burn Considerations
- Ignition and Holding Actions
- Wildland Fire Transition Plan
- Protection of Sensitive Features
- Public and Firefighter Safety
- Smoke management
- Interagency Coordination and Public Information
- Monitoring
- Post Fire Rehabilitation

- Reporting Needs
- Appendices
  - Reviewer Comments
  - Technical Reviewer Checklist and Comments
  - Project Map
  - Prescribed Fire Complexity Rating Worksheet
  - Fire Modeling Outputs
  - Holding Resources Worksheet
  - Agency Administrator GO/NO-GO Pre-ignition Approval
  - Prescribed Fire Operations GO/NO-GO Checklist

D. EXCEEDING PRESCRIBED FIRE PLAN

In instances where the Wildland Fire Transition Plan is implemented, a WFSA will be completed and an appropriate management response will be initiated based on the WFSA.

E. AIR QUALITY AND SMOKE MANAGEMENT

1. Air Quality Issues

Under the provisions of the Clean Air Act (PL 88-206, as amended), (http://www.epa.gov/oar/oaq_caa.html) Jewel Cave National Monument is considered a Class II Area. Under State of South Dakota Air Quality Regulations (http://www.state.sd.us/denr/DES/AirQuality/openburn.htm), this classification is one of non-degradation or maintenance of the present air quality. Short term adverse conditions may exist during periods of prescribed burning or wildland fire. Smoke from prescribed fire is presently considered a natural phenomena resulting from land management activities.

A unique air quality issue at Jewel Cave relates the phenomena of "cave breathing" in response to atmospheric conditions. The condition itself is well documented; the amount of smoke that could potentially enter the cave during these breathing episodes is not known. Based on anecdotal information during the Jasper Fire of 2000, it does not appear that smoke is drawn into the cave in any great quantities during an "inhale" cycle. Since fires have been occurring on a regular basis for thousands of years in the Jewel Cave area, if smoke is "inhaled" into the cave, it should be considered a natural event.

Because the unit is small, it is more likely that smoke generated off site will have a greater effect on visibility in the Monument than NPS produced smoke.

2. Smoke Management

a. Class I Airsheds – There is one Class I airshed within 50 miles of Jewel Cave. The Black Elk Wilderness, on the Black Hills National Forest, is a Class II area approximately 25 miles east-northeast of the Monument. Prescribed fires would be small and of short duration thus not causing more than minimal visibility impacts.

b. Smoke Sensitive Areas – The primary sensitive area at Jewel Cave is the Visitor

Center and housing area. Of secondary consideration is US Highway 16 through the Monument. No private holdings are close enough to be considered although occasional impacts could affect Forest Service visitor facilities.

c. Local/Regional Smoke Management Restrictions

An understanding of local meteorological conditions is essential to fire managers if adequate smoke dispersal is to be accomplished. Fire managers at Jewel Cave will consult with meteorologists before any prescribed fire activities are initiated.

Both short and long term meteorological forecasts must be considered with emphasis on local barometric winds and pressure changes as they relate to cave air exchanges. All possible measures should be taken to prevent large amounts of smoke and fire related air pollutants from entering the cave system.

Careful observation of fuel moisture and other fire behavior factors can also assist in mitigating smoke problems. Other management actions including mop-up of heavy fuels can also reduce smoke production. All state air quality regulations will be observed on prescribed fires.

d. Mitigation Strategies

(1). Planned prescribed fires – Fires to improve resource values will have a smoke dispersion component in the prescription. If smoke creates a prolonged hazard or significant nuisance, appropriate actions will be taken to mitigate the condition causing the problem or the fire will be suppressed.

(2). Suppression – Suppress or mop up smoldering fuels when they are likely to generate smoke management "problems."

(3). Ignition – Ignite smoldering fuels to get them to burn with an active flame, which generates less emissions. Flaming combustion also generates convection columns, which raise smoke above ground level.

(4). Types of Fires – Use backing fires when possible.

(5). Dispersion – Recognize poor dispersion conditions that will last several days, such as the predicted passage of a slow-moving warm front; a lingering high pressure system with stable atmosphere; or high humidity conditions, and adjust burning strategies as necessary.

(6). Residual Smoke – When a fire has burned for an extended period of time and generated a lot of residual smoke, the NPS will consider appropriate actions to minimize additional smoke production.

(7). Firefighter Safety – During high smoke production phases of a prescribed fire operation, crews will be rotated out of high smoke areas.

(8). Sensitive Areas – Planned prescribed fire ignitions in sensitive areas will be done either when visitation is low, or the Superintendent will restrict entry to areas

potentially impacted by smoke.

e. Guidelines

The following are the management guidelines for all phases of the fire management program.

- No prescribed fires will be ignited during air pollution alerts, temperatures inversions or when a burn ban has been established by local units of government
- Fire weather forecasts will be used to predict smoke dispersal.
- Burning will be done only when conditions result in rapid smoke dispersal.
- Proper firing techniques to lower smoke production will be utilized.
- Smoke projection maps will be prepared to assist in projecting smoke dispersal patterns.
- Local law enforcement and fire agencies will be notified of any planned prescribed fire so they may provide any needed assistance with traffic flow if any problems with smoke dispersal occurs.
- Prescribed fires will be planned and conducted when proper wind flow will disperse smoke over unpopulated or low density populated areas.
- Federal Clean Air Act standards will not be violated by any prescribed fires.

F. NON-FIRE APPLICATIONS

Mechanical treatment of hazard fuels is not expected on a large scale basis during this planning horizon. Occasional removal of a dead or dying tree that poses a threat to the visiting public or Monument employees may occur. Most mechanical projects would involve use of chainsaws and other small tools and would be in the vicinity of NPS infrastructure.

1. Annual Activities

Each approved project will require the presence either local employees or possibly members of a fire use module to cut and remove fuels from the project area. A request will be made during the prior year for funding to cover project costs.

2. Seasonal Restrictions

Because of the noise associated with chainsaw work, an off-season timing would be preferred to limit impacts on visitor use and enjoyment.

3. Monitoring

Short and long-term monitoring will concentrate on measurements of acres treated and stems removed. Monitoring will be as defined in the Fire Effects Monitoring Plan (Appendix F).

4. Critique of Project

The following items, as a minimum, will be reviewed following each mechanical treatment.

- Were any unsafe acts noted?

- Were treatment objectives met within an acceptable range of results? :
- What should be done differently to obtain desired results or get better results?
- Was there any deviation from plan? If so, why?
- Were weather changes a factor in completing treatment?
- Problems and general comments:

5. Cost Accounting

Records of costs associated with the project will be kept by the unit administrative assistant.

6. Documentation and Reporting

The following table lists the reports and other documents required for non-fire fuel treatment operations.

Table 13 – Mechanical Treatment Reporting Checklist

Checklist of Mechanical Fuel Treatment Documents and Reports		
Document	**Revision or Preparation Frequency**	**Responsible Party**
FirePro Project Submission	Annual	FMO
Signed Project Plan	Each Project	Superintendent
Project Maps	Each Project	FMO\Project Manager
Notification Checklist	Each Project	Local Staff\Project Manager
Permits	Each Project	Local Staff
On-Site Effects Reporting	Each Project	Monitor
Unit Logs or Other Documentation	Each Project	Local\Project Staff
Contracts	Each Project	Local\Project Staff
Project Critique	Each Project	Project Staff

Time and filing deadlines are associated with each of these reports and will control scheduling and response times.

7. Annual Project List

When fuel conditions indicate a need to apply mechanical treatment, the schedule will be inserted into Appendix H.

VI. FIRE MANAGEMENT ORGANIZATION AND RESPONSIBILITIES

A. FIRE ORGANIZATION STRUCTURE

Due to the small size of the unit and limited number of staff, individual staff members have responsibilities both inside, and outside of, the fire management program. There is no separate fire staff on the unit.

1. Superintendent or Designee

Superintendent is responsible for the overall program direction. Has final decision making authority for management operations. Approves and signs Interagency Agreements pertaining to the Monument.

2. Fire Management Officer

FMO, Northern Great Plains Area (NGPA) – Coordinates fire management activities within the NGPA, providing assistance and advice as needed. Reviews and advises the Superintendent on requests for fire emergency assistance, operational activities required for the implementation of the Fire Management Plan, and completeness and accuracy of all final fire reports.

Coordinates all prevention, pre-suppression, suppression, monitoring, and post fire activities at the Monument. Coordinates, prioritizes, and submits all FirePro funding requests for fire program activities. Reviews all prescribed burn plans to insure policy requirements are met. Also maintains qualification records for all personnel involved in suppression and prescribed fire activities. Coordinates the implementation of Fire Management Plan with other agencies on adjacent land and develops cooperative fire agreements with other federal, state, and local agencies. The FMO is the primary interagency fire management contact.

3. Assistant Fire Management Officer (AFMO), Prescribed Fire

In cooperation with the Monument's Fire Coordinator and the FMO, coordinates the development and execution of short and long range plans for prescribed fires, hazard fuel projects, as well as Prescribed Fire Plans for individual projects.

4. Assistant Fire Management Officer (AFMO), Suppression and Training

Coordinates suppression-related activities in cooperation with the Monument's Fire Coordinator. Reviews and approves Fire Reports (DI-1202). Issues Task Books for red carded personnel, coordinates fire dispatching and fire training.

5. Fire Ecologist

Analyzes fire effects data, communicates findings to fire staff and Monument resource management staff, coordinates research, acts as a liaison with resource managers, assists in writing various plans and compliance documents. Presents data to resource and fire managers through written reports and oral presentations in a manner and format that will be useful in the decision-making process. Assist with writing prescribed fire objectives and prescriptions for burning. Assists with defining desired future conditions

for Monument's vegetation.

6. Lead Fire Effects Monitor for NGPA

Is responsible for designing and carrying out the Fire Effects Monitoring Plan and descriptions of monitoring types. Also responsible for all standard (NPS Fire Monitoring Handbook 2001) fire effects monitoring activities in the Monument coordinating activities with the Monument Fire Coordinator.

7. Fire Program Management Assistant for NGPA

Provides technical and administrative support for the Area Fire Management Officer and all parks within the NGPA. Also assists with dispatching and mobilization activities. Collects and records daily fire weather observations and enters data into Weather Information Management System (WIMS).

8. Fire Coordinator

Has overall supervisory responsibility for the integration of fire management activities with other operations in the Monument. Coordinates, with the Fire Management Officer, fire prevention activities, wildfire suppression, and post-fire activities occurring within the Monument. Maintains the fire cache in a condition adequate to undertake initial attack actions on fires occurring on lands within the Monument, ensuring that all equipment and supplies are in good working condition. Determines fire qualifications and training needs of all Monument personnel who are to be made available for fire duties and informs the FMO of this information. During any fire operations, wildland fire or prescribed fires, may act as liaison between NPS personnel, other agencies and general public. Is responsible for day to day fire management operations at the Monument level.

9. Administrative Technician

Provide administrative support in procuring any needed supplies and equipment, responsible for proper documentation of personal services.

10. Maintenance Staff

Provide technical assistance in area of suppression equipment available to include light tools and knowledge in locating known utilities and services.

B. FIREPRO FUNDING

FirePro funding is available for approved equipment needs and prescribed fire operations. Project proposals, for prescribed fire and mechanical projects, are submitted through normal channels for approval. No staffing is funded by FirePro.

C. FIRE ORGANIZATION STRUCTURE RELATED TO PARK ORGANIZATION

1. Superintendent or Designee

Responsible for the overall program direction. Has final decision making authority for management operations. Approves and signs Interagency Agreements pertaining to the unit. Approves WFSAs for escaped wildland fires or prescribed fires.

2. Fire Management Officer

Fire Management Officer (FMO), Northern Great Plains Area (NGPA) – Coordinates fire management activities within the NGPA, providing assistance and advice as needed. Reviews and advises the Superintendent on requests for fire emergency assistance, operational activities required for the implementation of the Fire Management Plan, and completeness and accuracy of all final fire reports.

3. Natural Resource Specialist

During any fire operations, wildland fire suppression, or planned prescribed fires, will act as liaison between NPS personnel, other agencies and general public.

4. Fire Ecologist

Works with Natural Resource Specialist to accomplish monitoring and evaluation of prescribed fire effects. Individual is assigned to NGPA office and serves several locations.

D. INTERAGENCY COORDINATION AND AGREEMENTS

The Monument maintains a good working relationship with the Black Hills National Forest and other NPS units in the Northern Great Plains Area.

Assistance is available through the Northern Great Plains Interagency Dispatch Office. The dispatch office is located in Rapid City, SD and can be contacted for assistance at any time circumstances dictate. This contact will bring any resources necessary to the assistance of the park.

E. KEY INTERAGENCY CONTACTS

Details are found in Appendix E.

Northern Great Plains Interagency Dispatch, (605) 393-8017.
Hells Canyon District Ranger, Black Hills National Forest, (605) 673-4853

F. FIRE-RELATED AGREEMENTS

Two agreements exist for cooperative fire operations. One is with the Black Hills National Forest and defines responsibilities, initial attack zones and dispatch criteria. The second is an intra-agency agreement between NPS units in the Northern Great Plains area. There are no agreements with any local governments. Copies of the agreements are found in Appendix E.

VII. FIRE RESEARCH

A. PREVIOUS AND ONGOING FIRE RELATED RESEARCH

There has been one significant fire related research project on the Monument. A fire history study to determine fire frequencies, timing, season of burning and spatial patterns was conducted in the mid 1990's with publication of the results in 1996 (Brown and Sieg, 1996.). This study indicated Mean Fire Intervals of from 16 to 32 years. A literature review associated with this paper also indicated a less dense forest prior to the advent of European settlement.

B. FIRE RESEARCH NEEDS

Several research needs were identified by Monument staff following the Jasper Fire in 2000 and are listed below with a brief explanation of the project/need.

- Assess water quality and stream flow in streams on the Monument. Canyon stream flows, particularly in Lithograph Canyon, have been documented to be higher since the Jasper Fire (Parenti, 2001). A project was proposed in FirePro to complete this assessment.
- Assess differences in runoff and erosion in relation to burn severity. A project was proposed in FirePro to complete this assessment.
- Determine changes in quantity or quality of water entering Jewel Cave as a result of the Jasper Fire. There is concern that increased surface stream flows may have an effect on the flow of water into the cave system. An additional concern is related to canyon flows that threaten the emergency power supply and the supplemental cave entrance.
- Compare the response of native and non-native understory vegetation species to different burn severity. A project was proposed in FirePro to complete this assessment.
- Determine how ponderosa pine regeneration is affected by burn severity. A project was proposed in FirePro to complete this assessment.

Neither FirePro project was funded in FY 2002. Several avenues are possible to accomplish the research. The NGPA fire ecologist could promote needed research with universities in the area encouraging researchers to prepare proposals for NPS Fire Science Funding, Joint Fire Science Program funding or cooperative funding with other interested organizations.

VIII. MONITORING

A program to monitor fire effects has been in place since 1998. A monitoring plan that describes all fire effects monitoring will become Appendix F to this plan.

Currently there are a number of severity plots located in areas burned by the Jasper Fire. These plots are scheduled to be evaluated during the first, second and fifth year after the fire. Funding of a requested research proposal could extend the monitoring of these plots beyond the current schedule. A study comparing pre- and post-fire satellite imagery to determine fire severity is ongoing. Future fires beyond a minimum size should be examined using this same method.

Fire effects monitoring will be conducted by the NGPA fire effects crew following the guidance provided by the NPS Fire Monitoring Handbook (2001). Monitoring includes sampling permanent vegetation plots measuring such variables as: overstory and pole trees, brush, groundcover, dead and down fuels and duff, and taking photo points. Normal sampling occurs pre-burn, immediate post-burn then at 1 year, 2 year, 5 year and 10 year intervals.

Adequate funding for long term fire effects monitoring is essential as the major vegetative disturbance resulting from the Jasper Fire provides an opportunity to measure change as natural recovery takes place.

Annual fire effects monitoring results are provided to park staff, providing information on the success of prescribed fires or effects of wildland fires in meeting resource objectives. These results also provide a measure of whether desired habitat conditions are being approached.

IX. PUBLIC SAFETY

A. ISSUES AND CONCERNS

As hazards exist in both wildland and prescribed fires, safety will always be the highest priority. Smoke that affects the entrance road or U.S. 16 can affect the safety of the visiting public. While other roads on and adjacent to the Monument (mostly one lane gravel roads) are not heavily traveled, smoke and reduced visibility is still of concern, particularly with emergency vehicles using the same roads. The flaming front of a fire can, potentially, put unsuspecting members of the visiting public at risk. For this reason, areas affected by fire of any cause will be closed to the public.

B. MITIGATION

In order to make NPS employees and the general public aware of such hazards, the following mitigation measures will be considered:

- The general public will be made aware of wildland fires and prescribed fires through press releases and general interpretive presentations.
- The general public will not be allowed access to any areas that have active fire, or unmitigated safety hazards.
- Safety briefings will be conducted for NPS personnel prior to any participation in wildland suppression or prescribed fires.
- Appropriate regulatory and/or enforcement agencies will be notified prior to any prescribed fires to assist in safely managing vehicular traffic. Warning signs will be posted along roadways as necessary.
- All fire personnel will be reminded of the "Watch Out Situations" and will be expected to comply with the "Fire Orders".
- A short-term concern is the number of dead and dying trees on the Monument. Storm or wind events can cause these trees to fall, especially as time since fire increases. Warning signs should be installed on trails, along roads, parking lots or other areas where visitors maybe present.

X. PUBLIC INFORMATION AND EDUCATION

A. CAPABILITY AND NEEDS

Because visitors check in at the Visitor Center for cave tours, an excellent opportunity is available for fire information dissemination. To further public information and education, the following guidelines will be followed:

- Timely and accurate information will be provided to the media and Monument visitors regarding the status of fire actions and suppression efforts on and adjacent to the Monument.
- Informational handouts explaining the fire management program will be prepared and updated as necessary. During periods when prescribed fires are burning, these handouts will be distributed to Monument visitors.
- The prescribed fire program will be discussed in informal contacts with Monument personnel and visitors.
- Unit personnel living on the Monument will be notified when fire, particularly wildland fire, is a threat to Monument residential areas.

As most visitors spend some time in the Visitor Center, it is highly recommended that some sort of map display be set up to show areas of the Monument where prescribed fire is being used with slides showing the before and after conditions of the treated areas. With current technology, this type of display could also be available on the unit's website.

B. RESPONSE TO INCREASING FIRE ACTIVITIES

When the Staffing Class is at SC-4 or SC-5, information will be prominently displayed in the Visitor Center. Patrol activity on the Monument may be increased to detect potential fires and to monitor visitor activity. At SC-5 it may become necessary to close the facility to protect the public.

XI. PROTECTION OF SENSITIVE RESOURCES

A. ARCHEOLOGICAL/CULTURAL/HISTORIC RESOURCES

1. Archeological Resources

There are approximately 20 known lithic scatter sites to be considered during fire management operations on the Monument. Firelines for prescribed fires will avoid the known areas. To the greatest extent possible, wildland suppression actions will avoid these sites if known. An archeologist or cultural specialist should be brought on site during any significant suppression operations.

If Native American human remains and/or objects are found during fire operations, the site will be evaluated by staff or regional archeologists in accordance with Sec. 3, Native American Grave Protection Resource Act (NAGPRA).

2. Historic Resources

These include the old CCC camp area, the historic cave entrance, historic ranger cabin, and remains of the Jewel Cave Hotel. The ranger cabin is irreplaceable.

3. Mitigation

Personnel taking part in suppression actions as well as prescribed fires will be briefed on the potential for disturbance of such resources. Any and all control actions undertaken will minimize the impact on such resources; wet line and foam are the preferred minimum impact suppression techniques. Handline construction will be avoided during prescribed fire operations in identified archeological sites.

B. NATURAL RESOURCES

1. Resources

The vegetative resources are generally fire adapted and require no specific protection. An extremely large and active fire such as the Jasper Fire could result in a crown fire with commensurate damage to the forest cover.

A severe fire burning ground fuels at high temperature, could affect soils and consequently water quality. Both surface and cave water quality and quantity are critical to the Monument's environment.

Most wildlife species in the vicinity of the Monument will be minimally affected by fire. The exception would be during a catastrophic fire like the Jasper Fire when several deer, a mountain lion and elk were known to have died. Small mammals are generally more affected by fire. The rejuvenation of vegetation and strong breeding instinct usually repopulate affected areas within one to two years. The bat population in the cave proper was not affected by the Jasper Fire and is not expected to be affected by any other fire activities.

2. Mitigation

Prescribed fires will be planned to do the least amount of damage to the soil so that water quality remains high and potential erosion is minimized. Frequent, light fires will be used to restore the natural role of fire to the lands on the Monument. Smoke management planning will consider the effects of cave breathing in an attempt to minimize smoke impacts to either the bat population or visitors to the cave.

C. INFRASTRUCTURE

1. Unit Infrastructure

NPS buildings on the unit are shown in Table 1 and valued in the 2002 FirePro run at $4,915,000. There are no inholdings in the Monument and the surrounding land is under the jurisdiction of the USFS.

2. Mitigation

Most of the Monument facilities are in wooded areas and extensive hazard reduction operations have been conducted to protect them. Continued thinning and prescribed fire will be used to maintain a reduced risk of wildland fire damaging the Monument's infrastructure.

XII. FIRE CRITIQUES AND ANNUAL PLAN REVIEW

A. INTRODUCTION

1. Scope

All wildland fires and fire-related incidents will be reviewed. All prescribed fires will be reviewed.

2. Reviews

Reviews are conducted for one or more of the following purposes:

a. To examine the progress of an on-going fire incident and to confirm effective decisions or correct deficiencies.

b. To identify new or improved procedures, techniques or tactics.

c. To compile consistent and complete information to improve or refine Monument, regional or national fire management programs.

d. To examine anomalous fire-related incidents in order to determine cause(s), contributing factors, and where applicable, recommends corrective actions. If negligence is indicated, the circumstances will be reported and investigated in accordance with applicable regulations, policies or guidelines.

e. To determine the cost effectiveness of a fire operation.

3. Authority

The authority to convene a fire review rests with the Monument superintendent, regional director, or the Associate Director, Park Operations and Education. It is the clear responsibility of the superintendent to call for a review, to insure timely completion, and to implement recommended actions. The regional director has responsibility to follow-up with the superintendent: that reviews are established and completed in a timely manner, and that recommended actions are completed. The superintendent may request technical support from Fire Management Program Center, regional, park or interagency personnel with the appropriate expertise.

4. Incident Types

All wildland fire incidents which result in human entrapment, fatalities, or serious injuries, or result in incidents with potential, will be investigated and reviewed.

5. Associate Director

The Associate Director, Park Operations and Education, will convene an ad-hoc team to review Service-wide fire management programs subsequent to the occurrence of any significant, controversial or unusual wildland fire management activities.

6. Purpose

All reviews will be conducted as constructive critiques aimed at determining the facts related to the specific fire or fire management program. They will identify commendable actions, techniques and decisions as well as areas which need improvement. Reviews are intended to resolve operational issues, not impose punitive actions.

B. FIRE REVIEWS

1. "Hotline" Review

The purpose of the hotline review is to examine the progress of an on-going fire incident, regardless of size. The review will provide a confirmation of the decisions being made daily in the Wildland Fire Situation Analysis or determine where the decision process has been faulty and corrective actions are needed.

The "hotline" review is normally conducted by the Monument's fire management officer (or an official who has designated fire program management responsibilities) in conjunction with the incident commander on the fire.

These reviews require no special reporting. Documentation of "hotline" reviews should be included in the normal fire report narrative.

2. Incident Management Team (IMT) Closeout and Review

The Monument superintendent will conduct a closeout review with the IMT prior to their release from the fire incident. The purpose of this review is to ensure complete transition of the incident management back to the unit and evaluate the status of any incomplete fire business. RM 18, Chapter 13, Exhibit 1 (http://www.nps.gov/fire/fire/policy/rm18/index.htm) contains a sample Close-Out Review with Incident Management Team.

3. Unit Level Review

The superintendent or his/her designated representative should conduct the unit level review. The superintendent will appoint other qualified persons, including the unit fire management officer (or an official who has designated fire program management responsibilities) to be a part of the review. The purpose of this review is to provide the superintendent with information to recognize commendable actions and to take needed corrective action(s). Costs associated with the review will be charged to the account assigned to the fire with the approval of the regional fire management officer. A copy of the complete report will be sent to the regional fire management officer, who will review it and, if appropriate, forward a copy to the Fire Management Program Center.

4. Regional Level Review

A regional level review may be conducted for any fire that:

a. Crosses a park's boundary into another jurisdiction without the approval of an interagency agreement.

b. Results in adverse media attention.

c. Involves serious injury, significant property damage, or an incident with potential.

d. Results in controversy involving another agency.

The regional level review normally will be conducted at the unit where the fire occurred. The regional fire management officer or his/her designated representative will convene the review. Attendees will include the superintendent of the unit, unit fire management officer (or the official who has designated fire program management responsibilities), the incident commander(s) for the fire, and other individuals agreed upon by the regional director and superintendent. If possible, the review team should visit the actual fire site as part of the review. A copy of the review report will be sent to the Fire Management Program Center. Costs associated with the review will be charged to the account assigned to the fire.

5. National Level Review

A national level review may be conducted for any fire that involves Service wide or national issues, including:

a. Significant adverse media or political interest.

b. Multi-regional resource response.

c. A substantial loss of equipment or property.

d. A fatality, or multiple, serious fire-related injuries (three or more personnel).

e. Any other fires that the Associate Director, Park Operations and Education, wants reviewed.

The national level review normally will be conducted at the unit where the fire occurred. The National Fire Management Officer or his/her designated representative will convene it. It will be attended by the superintendent of the unit, the fire management officer, the regional fire management officer, the incident commander(s) for the fire, and other individuals agreed upon by the National Fire Management Officer, the regional director and the superintendent. If possible, the review team should visit the actual site of the fire as part of the review. All costs associated with the review will be charged to the account assigned to the fire.

RM 18, Chapter 13, Exhibit 2 (http://www.nps.gov/fire/fire/policy/rm18/index.htm) provides an outline for final reports of fire reviews. RM 18, Chapter 13, Exhibit 3 (http://www.nps.gov/fire/fire/policy/rm18/index.htm) provides a checklist of sample questions, which might be asked during a fire review. These two documents should be used for unit, regional and national level reviews.

6. Entrapment and Fire Shelter Deployment Review

Fire shelter deployment is defined as the use of a fire shelter for its intended purpose in any situation other than training. Use of the terms "precautionary deployment", "practice deployment" and "entrapment deployment" are not acceptable or recognized. Entrapments and fire shelter deployments will be reviewed in order to gather complete

and accurate information to determine the reasons for the deployment. Corrective recommendations will be developed to minimize future situations which might lead to other shelter deployments. All entrapments and fire shelter deployments will be reported to the regional fire management officer, who will be responsible for developing the review team in cooperation with the Fire Management Program Center. The team leader will contact the superintendent for reporting information. See RM 18, Chapter 3 (http://www.nps.gov/fire/fire/policy/rm18/index.htm) for investigation and reporting requirements.

All entrapments and fire shelter deployments will be investigated as soon as possible after the deployment incident. RM 18 , Chapter 13, Exhibit 4 (http://www.nps.gov/fire/fire/policy/rm18/index.htm) provides specific directions for conducting an entrapment or shelter deployment review. RM 18, Chapter 13, Exhibit 5 (http://www.nps.gov/fire/fire/policy/rm18/index.htm) provides an outline format for final reports on entrapment and fire shelter deployment reviews.

C. PROGRAM REVIEWS

1. Operations Evaluations

Operations evaluations of NPS units and regions may include review of fire management programs to assure compliance with established Service standards.

2. Annual Fire Program Review

The superintendent will convene an ad-hoc team to review Monument fire activity during any year in which significant, unusual or controversial fire activity occurs. This review team should analyze the reports from any reviews to determine what, if any, operational changes should be initiated. The review team will develop findings and recommendations and establish priorities for action.

3. FirePro Review

Annually, the FMO will conduct a FirePro audit and review of the Monument values at risk, research, equipment and project needs. This review will be completed on the schedule set by the Fire Management Program Center.

4. Fire Readiness Review

Fire readiness or preparedness reviews, utilizing the Interagency Fire Readiness Review Guide as adapted for Monument-specific needs, should be conducted annually prior to the established fire season by Monument fire management staff.

XIII. CONSULTATION AND COORDINATION

The following individuals and groups were consulted during the preparation of this plan.

Doug Alexander, Fire Management Officer, Northern Great Plains Area Parks

Bill Gabbert, Former Fire Management Officer, Northern Great Plains Area Parks

Cody Wienk, Fire Ecologist, Northern Great Plains Area Parks

Dan Morford, Prescribed Fire Specialist, Northern Great Plains Area

Steven Ipswitch, AFMO, Northern Great Plains Area

Fred Bird, Fire Management Officer, Midwest Regional Office

Cal Gale, Natural Resource Consultant, Baldwin, WI 54002

Webb Smith, Mangi Environmental Group

Dan Lick, Wildlife Biologist/ Inventory and Monitoring Coordinator, Midwest Regional Office

Black Hills National Forest

Custer Volunteer Fire Protection District

U.S. Fish and Wildlife Service

XIV. APPENDICES

APPENDIX A

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U.S. Geological Survey, Northern Prairie Research Center herbarium listing for common names of plants at (http://www.pwrc.usgs.gov/history/herbarium/category.htm)

APPENDIX B

B. DEFINITIONS

A consistent list of terms and their definitions has been developed and approved by the NWCG. This list of defined terms includes terms obsolete under the new policy. Additional terms used in this reference guide but not defined by NWCG are from the Fire Effects Information System and other sources. The sources may be found in the References Cited (Appendix A).

Appropriate Management Response – Specific actions taken in response to a wildland fire to implement protection and fire use objectives. This term is a new term that does not replace any previously used term.

Backfire – A fire set along the inner edge of a fireline to consume the fuel in the path of a fire or to change the fire's convection column.

BI – Burning Index. A number related to the contribution that fire behavior makes to the amount or effort needed to contain a fire in a particular fuel type within a rating area. An Index for describing Fire Danger.

Climax – A biotic community that is in equilibrium with existing environmental conditions and represents the terminal stage of an ecological succession (Smith 2000).

Cover – The proportion of ground covered by the aerial parts of individuals of a species, usually expressed as a percentage (Grieg-Smith 1983). Total cover for all species on a site can exceed 100%. However, TOP-COVER, the proportion of ground for which a species provides the uppermost cover, cannot exceed 100% (Grieg-Smith 1983). Mueller-Dombois and Ellenberg (1974) consider basal area a special kind of "cover," but FEIS does not usually use COVER in this way.

Crown Fire – Fire that burns in the crowns of trees and shrubs. Usually ignited by a surface fire. Crown fires are common in coniferous forests and chaparral-type shrublands (Brown 2000).

Direct Effects of Fire – Described in FEIS plant species summaries under FIRE EFFECTS; IMMEDIATE FIRE EFFECT ON PLANT and DISCUSSION AND QUALIFICATION OF PLANT RESPONSE.

Duff – Partially decomposed organic matter lying beneath the litter layer and above the mineral soil. Includes the fermentation and humus layers of the forest floor (02 soil horizon) (Brown 2000).

Ecosystem – An interacting system of interdependent organisms.

Expected Weather Conditions – Those weather conditions indicated as common, likely, or highly probable based on current and expected trends and their comparison to historical weather records. They are the most probable weather conditions for this location and time. These conditions are used in making fire behavior forecasts for different scenarios (one necessary scenario involves fire behavior prediction under "expected weather conditions).

Experienced Severe Weather Conditions – Those weather conditions that occur infrequently, but have been experienced on the fire site area during the period of weather records. For example, rare event weather conditions that significantly influence fires may have occurred only once, but their record can be used to establish a baseline for a worst-case scenario. These are the most severe conditions that can be expected. These conditions are used in making fire behavior forecasts for different scenarios (one necessary scenario involves fire behavior prediction under "experienced severe weather conditions).

Fire Cycle – Length of time for an area equal to the entire area of interest to burn; size of the area of interest must be clearly specified (McPherson and others 1990).

Fire Duration – The length of time that combustion occurs at a given point. Fire duration relates closely to downward heating and fire effects below the fuel surface as well as heating of tree boles above the surface.

Fire Exclusion – The policy of suppressing all wildland fires in an area (Smith 2000).

Fire Frequency = Fire Occurrence – Number of fires per unit time in a specified area (McPherson and others 1990).

Fire Intensity – A general term relating to the heat energy released in a fire. FEIS usually uses more specific terms to describe rate of heat release. See FIRELINE INTENSITY below.

Fire Interval – Time (in years) between two successive fires in a designated area (i.e., the interval between two successive fire occurrences); the size of the area must be clearly specified (McPherson and others 1990).

Fire Management Plan (FMP) – A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire Management Unit (FMU) – Any land management area definable by objectives, topographic features, access, values-to-be-protected, political boundaries, fuel types, or major fire regimes, etc., that sets it apart from management characteristics of an adjacent unit. FMU's are delineated in Fire Management Plans (FMP). These units may have dominant management objectives and pre-selected strategies assigned to accomplish these objectives.

Fire Regime – Describes the patterns of fire occurrence, size, and severity - and sometimes, vegetation and fire effects as well - in a given area or ecosystem (Agee 1994, Mutch 1992, Johnson and Van Wagner 1985). A fire regime is a generalization based on fire histories at individual sites. Fire regimes can often be described as cycles because some parts of the histories usually get repeated, and the repetitions can be counted and measured. The fire regime on a particular kind of site or in a particular ecosystem is not cyclic in a deterministic sense; it is, rather, a story about climate, human use, other disturbance, and species dispersion as they have all changed and interacted to affect an ecosystem, both suddenly and subtly, over millennia. The concept of fire regime as story lets us think about the future in that type or ecosystem as a question, perhaps a choice, rather than a destiny. According to Agee (1994), "A fire regime is a generalized way of

integrating various fire characteristics. The organization may be according to the characteristics of the disturbance..., dominant or potential (climax) vegetation on the site..., or fire severity, the magnitude of effects on dominant vegetation...." According to Mutch (1992), "A natural fire regime is the total pattern of fires over time that is characteristic of a natural region or ecosystem. The classification of fire regimes includes variations in ignition, fire intensity and behavior, typical fire size, fire return intervals, and ecological effects." According to Johnson and Van Wagner (1985), "... fire regime is a multivariate system characterized by (i) the fire history measured in fire frequency or fire return period, (ii) fire intensity measured in kW/m, and (iii) depth of burn (duff removed) measured in kg/m, or percent...."

Fire-Resistant Species – Species with morphological characteristics that give it a lower probability of being injured or killed by fire than a FIRE-SENSITIVE species, which has a "relatively high" probability of being injured or killed by fire (McPherson and others 1990). Implies that the organism does not get injured by things that would seem able to injure it (Johnson and Van Wagner 1985). (Rowe (1983) uses a more restrictive definition of resistance - relating it only to plants with aboveground parts that survive fire.)

Fire Severity – Degree to which a site has been altered or disrupted by fire; also used to describe the product of fire intensity and residence time (McPherson and others 1990, Agee 1994, Rowe 1983).

Fire Suppression Specialist – Staff specialist with primary duties of managing the preparedness and suppression programs.

Fire Use – The combination of wildland fire use and prescribed fire application to meet resource objectives

Fireline Intensity – The rate of heat release per unit time per unit length of fire front. Numerically, the product of the heat of combustion, quantity of fuel consumed per unit area in the fire front, and the rate of spread of a fire, expressed in kW/m (McPherson and others 1990).

Flame Length – The length of flames in a fire front measured along the slant of the flame, from the midpoint of its base to its tip. Flame length is mathematically related to fireline intensity and tree crown scorch height (Brown 2000).

FMO – Fire Management Officer.

FMP – Fire Management Plan.

Fuel – Fuel is comprised of living and dead vegetation that can be ignited. It is often classified as dead or alive and as natural fuels or activity fuels (resulting from human actions, usually from logging operations). Fuel components refer to such items as downed dead woody material by various size classes, litter, duff, herbaceous vegetation, live foliage etc. (Brown 2000).

Fuel Continuity – A qualitative description of the distribution of fuel both horizontally and vertically. Continuous fuels readily support fire spread. The larger the fuel discontinuity, the greater the fire intensity required for fire spread (Brown 2000).

Fuel Loading – The weight per unit area of fuel, often expressed in tons per acre or tonnes per hectare. Dead woody fuel loadings are commonly described for small material in diameter classes of 0 to 1/4-, 1/4 to 1-, and 1 to 3-inches and for large material in one class greater than 3 inches (Brown 2000).

Fuel Moisture – percent or fraction of oven dry weight of fuel. It is the most important fuel property controlling flammability. In living plants it is physiologically bound. Its daily fluctuations vary considerably by species but are usually above 80 to 100%. As plants mature, moisture content decreases. When herbaceous plants cure, their moisture content responds as dead fuel moisture content, which fluctuates according to changes in temperature, humidity, and precipitation (Brown 2000).

FWS – U.S. Fish and Wildlife Service, Department of the Interior.

GIS – Geographic Information System

GMP – General Management Plan. A park document that describes broad management goals and objectives for NPS units.

GPS – Geographic Positioning System

Ground Fire – Fire that burns in the organic material below the litter layer, mostly by smoldering combustion. Fires in duff, peat, dead moss and lichens, and punky wood are typically ground fires (Brown 2000).

Hazard Fuel – A fuel complex that, by nature, presents a hazard to socio-politico-economic interests when ignited. The hazard fuel condition can be mitigated through hazard fuel reduction.

Hazardous fuels – Those vegetative fuels which, when ignited, threaten: public safety, structures and facilities, cultural resources, natural resources, and/or natural processes. Also: fuels that permit the spread of wildland fires across administrative boundaries except as authorized by agreement, and fuel accumulations and arrangement may be within the natural range of variability and still be hazardous because of the proximity to values at risk.

Headfire – A fire spreading or set to spread with the wind (National Wildfire Coordinating Group 1995).

ICMR – Incident Commander Multiple Resources

ICSR – Incident Commander Single Resource.

Initial Attack – The first aggressive suppression action taken on a fire, consistent with firefighter and public safety, and values to be protected.

Initial Attack Incident Commander – Leader of first response fire suppression forces.

Ladder Fuels – Shrubs and young trees that provide continuous fine material from the forest floor into the crowns of dominant trees (Smith 2000).

Litter – The top layer of the forest floor (01 soil horizon); includes freshly fallen leaves, needles, fine twigs, bark flakes, fruits, matted dead grass and other vegetative parts that

are little altered by decomposition. Litter also accumulates beneath rangeland shrubs. Some surface feather moss and lichens are considered to be litter because their moisture response is similar to that of dead fine fuel.

Long-Term Effects – Effects lasting more than 10 years. (Personal communication (Oct. 21, 1998) with Wendell Hann, Fire Ecologist and assistant to National Fuels Specialist, U.S. Department of Agriculture, Forest Service).

Mast – Fruits of all flowering plants used by wildlife, including fruits with fleshy exteriors (such as berries) and fruits with dry or hard exteriors (such as nuts and cones).

Mean Fire Interval – Arithmetic average of all FIRE INTERVALs determined, in years, for a designated area during a specified time period; the size of the area and the time period must be specified.

Mitigation Actions – Mitigation actions are considered to be those on-the-ground activities that serve to check, direct, or delay the spread of fire; and minimize threats to life, property, and resources. Actions may include mechanical and physical non-fire tasks, specific fire applications, and limited suppression actions. These actions will be used to construct firelines, reduce excesssive fuel concentrations, reduce vertical fuel continuity, create fuel breaks or barriers around critical or sensitive sites or resources, create "blacklines" through controlled burnouts, and to limit fire spread and behavior.

Mixed-Severity Fire Regime – Fire regime in which fires either cause selective mortality in dominant vegetation, depending on different species' susceptibility to fire, or vary between understory and stand replacement (Smith 2000).

MOA – Memorandum of Agreement

MOU – Memorandum of Understanding.

National Fire Danger Rating System (NFDRS) – A widely used system to predict several measures of fire probability and resistance to control.

National Fire Plan (NFP) – A plan prepared by agencies of the U.S. Departments of Agriculture and Interior to reduce adverse effect from unwanted wildland fires.

Natural Fire – Fires ignited by natural means (usually lighting).

NFFL Model – One of the thirteen fuel models used to predict fire behavior using the fire spread formulas developed by Rothermel (1972).

NPS – National Park Service, Department of the Interior.

Organic Soils – Deep layers of organic matter that develop in poorly drained areas such as bogs, swamps, and marshes (Brown 2000).

Preparedness – Activities that lead to a safe, efficient and cost effective fire management program in support of land and resource management objectives through appropriate planning and coordination. This term replaces presuppression.

Prescribed Fire – Any fire ignited by management actions to meet specific objectives. Prior

to ignition, a written, approved prescribed fire plan must exist, and National Environmental Protection Act requirements must be met. This term replaces management ignited prescribed fire.

Presettlement Fire Regime – The time from about 1500 to the mid- to late-1800s, a period when Native American populations had already been heavily impacted by European presence and before extensive settlement by European Americans in most parts of North America, before extensive conversion of wildlands for agricultural and other purposes, and before fires were effectively suppressed in many areas (Smith 2000).

Prescribed Fire Plan – A plan required for each fire application ignited by managers. It must be prepared by qualified personnel and approved by the appropriate Agency Administrator prior to implementation. Each plan will follow specific agency direction and must include critical elements described in agency manuals. Formats for plan development vary among agencies, although the content is identical.

Prescribed Fire Specialist – The staff specialist with primary duties of managing both the prescribed fire and Wildland Fire Used for Resource Benefit (where applicable) programs.

Prescription – Measurable criteria which define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economic, public health, environmental, geographic, administrative, social or legal considerations.

Relict – A biotic community or fragment of a community that has survived some important change, often to become in appearance an integral part of existing vegetation

Resource Management Plan (RMP) – Park planning document that describes resource management goals and objectives for NPS units.

Sere – A succession of plant communities leading to a particular plant association (Smith 2000).

Short-Term Effects – Effects lasting less than 10 years (Personal communication (Oct. 21, 1998) with Wendell Hann, Fire Ecologist and assistant to National Fuels Specialist, U.S. Department of Agriculture, Forest Service).

Snag – A standing dead tree from which the leaves and some of the branches have fallen (Smith 2000).

Stand-Replacement Fire Regime – Fire regime in which fires kill or top-kill aboveground parts of the dominant vegetation, changing the aboveground structure substantially. Approximately 80 percent or more of the aboveground, dominant vegetation is either consumed or dies as a result of fires. Applies to forests, shrublands, and grasslands (Smith 2000).

Succession – The gradual, somewhat predictable process of community change and replacement leading toward a climax community; the process of continuous colonization and extinction of populations at a particular site (Smith 2000).

Suppression – see Wildland Fire Suppression

Surface Fire – Fire that burns in litter and other live and dead fuels at or near the surface of the ground, mostly by flaming combustion (Brown 2000).

T&E – Threatened and Endangered plants and animals. Also referred to as listed species.

Top-Kill – Kills aboveground tissues of plant without killing underground parts from which the plant can produce new stems and leaves (Smith 2000).

Total Heat Release – The heat released by combustion during burnout of all fuels, expressed in BTU per square foot or kilocalories per square meter (Brown 2000).

Underburn – Understory fire.

Understory Fire Regime – Fire regime in which fires are generally not lethal to the dominant vegetation and do not substantially change the structure of the dominant vegetation. Approximately 80 percent or more of the aboveground dominant vegetation survives fires. Applies to forest and woodland vegetation types (Smith 2000).

Urban Interface – Locating structures (homes, offices, and other developments) in wildland fuel complexes. Also known as wildland-urban interface.

Urban Intermix – Locating structures (homes, offices, and other developments) in wildland fuel complexes. Also known as wildland-urban interface.

USFS – United States Forest Service

Wildfire – An unwanted wildland fire. *This term was only included to give continuing credence to the historic fire prevention products. This is NOT a separate type of fire.*

Wildland Fire – Any non-structure fire, other than prescribed fire, that occurs in the wildland. This term encompasses fires previously called both wildfires and prescribed natural fires.

Wildland Fire Management Program – The full range of activities and functions necessary for planning, preparedness, emergency suppression operations, and emergency rehabilitation of wildland fires, and prescribed fire operations, including non-activity fuels management to reduce risks to public safety and to restore and sustain ecosystem health.

Wildland Fire Situation Analysis (WFSA) – The decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economic, political, and resource management objectives.

Wildland Fire Suppression – An appropriate management response to wildland fire that results in curtailment of fire spread and eliminates all identified threats from the particular fire. All wildland fire suppression activities provide for firefighter and public safety as the highest consideration, but minimize loss of resource values, economic expenditures, and/or the use of critical firefighting resources.

Wildland Fire Use – The management of naturally-ignited wildland fires to accomplish specific, pre-stated, resource management objectives in pre-defined geographic areas outlined in Fire Management Plans. Operational management is described in the Wildland Fire Implementation Plan (WFIP). Wildland fire use is not to be confused with

"fire use," a broader term encompassing more than just wildland fires.

APPENDIX C

C. SPECIES LISTS

The following species lists are derived from an Excel© Spreadsheet. The lists are not all inclusive and constitute a "work in progress" as the Inventory and Monitoring Program matures. The latest information should be available at Monument headquarters.

Table 14 –Plant List

Common Name	Accepted Scientific Name	Source
Alderleaf Juneberry	*Amelanchier alnifolia*	MARRIOTT AND HARTMAN 1986
Alfalfa	*Medicago sativa*	MARRIOTT AND HARTMAN 1986
Alkali Muhly	*Muhlenbergia asperifolia*	MARRIOTT AND HARTMAN 1986
Alpine Sweetvetch	*Hedysarum alpinum*	MARRIOTT AND HARTMAN 1986
Alsike Clover	*Trifolium hybridum*	MARRIOTT AND HARTMAN 1986
Alyssumleaf Phlox	*Phlox alyssifolia*	MARRIOTT AND HARTMAN 1986
American Black Currant	*Ribes americanum*	MARRIOTT AND HARTMAN 1986
American Brooklime	*Veronica americana*	MARRIOTT AND HARTMAN 1986
American Dragon-Head	*Dracocephalum parviflorum*	MARRIOTT AND HARTMAN 1986
Anise Hyssop	*Agastache foeniculum*	MARRIOTT AND HARTMAN 1986
Aromatic Aster	*Symphyotrichum oblongifolium*	MARRIOTT AND HARTMAN 1986
Ballhead Gilia	*Ipomopsis congesta*	MARRIOTT AND HARTMAN 1986
Barnyard Grass	*Echinochloa muricata*	MARRIOTT AND HARTMAN 1986
Bastard Toad-Flax	*Comandra umbellata*	MARRIOTT AND HARTMAN 1986
Beak-Seeded Knotweed	*Polygonum achoreum*	MARRIOTT AND HARTMAN 1986
Bearberry, Kinnikinik	*Arctostaphylos uva-ursi*	MARRIOTT AND HARTMAN 1986
Bibract Verbena	*Verbena bracteata*	MARRIOTT AND HARTMAN 1986
Biennial Sagewort	*Artemisia biennis*	MARRIOTT AND HARTMAN 1986
Big Bluestem	*Andropogon gerardii*	MARRIOTT AND HARTMAN 1986
Black Medick	*Medicago lupulina*	MARRIOTT AND HARTMAN 1986
Black-eyed Susan	*Rudbeckia hirta*	MARRIOTT AND HARTMAN 1986
Blanketflower	*Gaillardia aristata*	MARRIOTT AND HARTMAN 1986
Blue Columbine	*Aquilegia brevistyla*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Blue Flax	*Linum perenne*	MARRIOTT AND HARTMAN 1986
Blue Grama	*Bouteloua gracilis*	MARRIOTT AND HARTMAN 1986
Bluebell Bellflower	*Campanula rotundifolia*	MARRIOTT AND HARTMAN 1986
Blue-Eyed Mary	*Collinsia parviflora*	MARRIOTT AND HARTMAN 1986
Bluntleaf Sandwort	*Moehringia lateriflora*	MARRIOTT AND HARTMAN 1986
Bluntseed Sweetroot	*Osmorhiza depauperata*	MARRIOTT AND HARTMAN 1986
Boxelder	*Acer negundo*	MARRIOTT AND HARTMAN 1986
Breadroot Scurfpea	*Pediomelum esculentum*	MARRIOTT AND HARTMAN 1986
Brittle Pricklypear	*Opuntia fragilis*	MARRIOTT AND HARTMAN 1986
Broom Snakeweed	*Gutierrezia sarothrae*	MARRIOTT AND HARTMAN 1986
Buffalo Bur	*Solanum rostratum*	MARRIOTT AND HARTMAN 1986
Buffalograss	*Buchloe dactyloides*	MARRIOTT AND HARTMAN 1986
Bull Thistle	*Cirsium vulgare*	MARRIOTT AND HARTMAN 1986
Burweed	*Iva xanthifolia*	MARRIOTT AND HARTMAN 1986
Campion	*Silene drummondii var. drummondii*	MARRIOTT AND HARTMAN 1986
Canada Bluegrass	*Poa compressa*	MARRIOTT AND HARTMAN 1986
Canada Buffaloberry	*Shepherdia canadensis*	MARRIOTT AND HARTMAN 1986
Canada Goldenrod	*Solidago canadensis*	MARRIOTT AND HARTMAN 1986
Canada Gooseberry	*Ribes oxyacanthoides*	MARRIOTT AND HARTMAN 1986
Canada Wildrye	*Elymus canadensis*	MARRIOTT AND HARTMAN 1986
Canadian Horseweed	*Conyza canadensis*	MARRIOTT AND HARTMAN 1986
Canadian Thistle	*Cirsium arvense*	MARRIOTT AND HARTMAN 1986
Canadian White Violet	*Viola canadensis*	MARRIOTT AND HARTMAN 1986
Cheatgrass	*Bromus tectorum*	MARRIOTT AND HARTMAN 1986
Choke Cherry	*Prunus virginiana*	MARRIOTT AND HARTMAN 1986
Cliff Brake	*Pellaea glabella*	MARRIOTT AND HARTMAN 1986
Clustered Broomrape	*Orobanche fasciculata*	MARRIOTT AND HARTMAN 1986
Common Cattail	*Typha latifolia*	MARRIOTT AND HARTMAN 1986
Common Hops	*Humulus lupulus*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Common Motherwort	*Leonurus cardiaca*	MARRIOTT AND HARTMAN 1986
Common Mullein	*Verbascum thapsus*	MARRIOTT AND HARTMAN 1986
Common Plantain	*Plantago major*	MARRIOTT AND HARTMAN 1986
Common Spikerush	*Eleocharis palustris*	MARRIOTT AND HARTMAN 1986
Common Sunflower	*Helianthus annuus*	MARRIOTT AND HARTMAN 1986
Common Yarrow	*Achillea millefolium*	MARRIOTT AND HARTMAN 1986
Cream Peavine	*Lathyrus ochroleucus*	MARRIOTT AND HARTMAN 1986
Creeping Bentgrass	*Agrostis stolonifera*	MARRIOTT AND HARTMAN 1986
Crested Beardtongue	*Penstemon eriantherus*	MARRIOTT AND HARTMAN 1986
Crested Wheatgrass	*Agropyron cristatum*	MARRIOTT AND HARTMAN 1986
Crown Vetch	*Coronilla varia*	MARRIOTT AND HARTMAN 1986
Curly Dock	*Rumex crispus*	MARRIOTT AND HARTMAN 1986
Curlycup Gumweed	*Grindelia squarrosa*	MARRIOTT AND HARTMAN 1986
Desert Alyssum	*Alyssum desertorum*	MARRIOTT AND HARTMAN 1986
Dotted Gayfeather	*Liatris punctata*	MARRIOTT AND HARTMAN 1986
Downy Ryegrass	*Leymus innovatus*	MARRIOTT AND HARTMAN 1986
Drummond False Pennyroyal	*Hedeoma drummondii*	MARRIOTT AND HARTMAN 1986
Dwarf Juniper	*Juniperus communis*	MARRIOTT AND HARTMAN 1986
Dwarf Prairie Rose	*Rosa arkansana*	MARRIOTT AND HARTMAN 1986
Edible Valerian	*Valeriana edulis*	MARRIOTT AND HARTMAN 1986
Ellisia	*Ellisia nyctelea*	MARRIOTT AND HARTMAN 1986
Eltrot	*Heracleum sphondylium*	MARRIOTT AND HARTMAN 1986
European Stickseed	*Lappula squarrosa*	MARRIOTT AND HARTMAN 1986
False Boneset	*Brickellia eupatorioides*	MARRIOTT AND HARTMAN 1986
False Melic	*Schizachne purpurascens*	MARRIOTT AND HARTMAN 1986
Falseflax	*Camelina microcarpa*	MARRIOTT AND HARTMAN 1986
Fetid Marigold	*Dyssodia papposa*	MARRIOTT AND HARTMAN 1986
Field Chickweed	*Cerastium arvense*	MARRIOTT AND HARTMAN 1986
Field Pennycress	*Thlaspi arvense*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Fineleaf Hymenopappus	*Hymenopappus filifolius*	MARRIOTT AND HARTMAN 1986
Fireweed	*Chamerion angustifolium*	MARRIOTT AND HARTMAN 1986
Fowl Bluegrass	*Poa palustris*	MARRIOTT AND HARTMAN 1986
Fowl Manna Grass	*Glyceria striata*	MARRIOTT AND HARTMAN 1986
Foxtail Barley	*Hordeum jubatum*	MARRIOTT AND HARTMAN 1986
Fringed Loosestrife	*Lysimachia ciliata*	MARRIOTT AND HARTMAN 1986
Fringed Sagebrush	*Artemisia frigida*	MARRIOTT AND HARTMAN 1986
Golden Currant	*Ribes aureum*	MARRIOTT AND HARTMAN 1986
Golden Smoke	*Corydalis aurea*	MARRIOTT AND HARTMAN 1986
Goldenweed	*Machaeranthera pinnatifida*	MARRIOTT AND HARTMAN 1986
Green Bog Orchid	*Coeloglossum viride*	MARRIOTT AND HARTMAN 1986
Green Foxtail	*Setaria viridis*	MARRIOTT AND HARTMAN 1986
Green Needlegrass	*Nassella viridula*	MARRIOTT AND HARTMAN 1986
Greenbriar	*Smilax herbacea*	MARRIOTT AND HARTMAN 1986
Ground Plum Milkvetch	*Astragalus crassicarpus*	MARRIOTT AND HARTMAN 1986
Groundsel	*Senecio jacobaea*	MARRIOTT AND HARTMAN 1986
Gypsyflower	*Cynoglossum officinale*	MARRIOTT AND HARTMAN 1986
Hairy Goldenaster	*Heterotheca villosa*	MARRIOTT AND HARTMAN 1986
Hairyseed	*Lomatium foeniculaceum*	MARRIOTT AND HARTMAN 1986
Hard Fescue	*Festuca trachyphylla*	MARRIOTT AND HARTMAN 1986
Hare's Ear Mustard	*Conringia orientalis*	MARRIOTT AND HARTMAN 1986
Hedge Nettle	*Stachys palustris*	MARRIOTT AND HARTMAN 1986
Henbane	*Hyoscyamus niger*	MARRIOTT AND HARTMAN 1986
Hooker-Townsend Daisy	*Townsendia hookeri*	MARRIOTT AND HARTMAN 1986
Hook-Spurred Violet	*Viola adunca*	MARRIOTT AND HARTMAN 1986
Horehound	*Marrubium vulgare*	MARRIOTT AND HARTMAN 1986
Horned Spurge	*Euphorbia brachycera*	MARRIOTT AND HARTMAN 1986
Idaho Fescue	*Festuca idahoensis*	MARRIOTT AND HARTMAN 1986
Indian Paintbrush	*Castilleja sessiliflora*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Indian Ricegrass	*Achnatherum hymenoides*	MARRIOTT AND HARTMAN 1986
Indiangrass	*Sorghastrum nutans*	MARRIOTT AND HARTMAN 1986
Inland Bluegrass	*Poa nemoralis*	MARRIOTT AND HARTMAN 1986
Inland Saltgrass	*Distichlis spicata*	MARRIOTT AND HARTMAN 1986
Japanese Brome	*Bromus japonicus*	MARRIOTT AND HARTMAN 1986
Kentucky Bluegrass	*Poa pratensis*	MARRIOTT AND HARTMAN 1986
Lambert's Crazyweed	*Oxytropis lambertii*	MARRIOTT AND HARTMAN 1986
Lanceleaf Bluebells	*Mertensia lanceolata*	MARRIOTT AND HARTMAN 1986
Lanceleaf Figwort	*Scrophularia lanceolata*	MARRIOTT AND HARTMAN 1986
Lanceleaf Stonecrop	*Sedum lanceolatum*	MARRIOTT AND HARTMAN 1986
Lance-Leaved Ground-Cherry	*Physalis virginiana*	MARRIOTT AND HARTMAN 1986
Leafy Spurge	*Euphorbia esula*	MARRIOTT AND HARTMAN 1986
Leopard Liliy	*Fritillaria atropurpurea*	MARRIOTT AND HARTMAN 1986
Lesser Burrdock	*Arctium minus*	MARRIOTT AND HARTMAN 1986
Little Bluestem	*Schizachyrium scoparium*	MARRIOTT AND HARTMAN 1986
Little Seeded Ricegrass	*Piptatherum micranthum*	MARRIOTT AND HARTMAN 1986
Louisiana Sagewort	*Artemisia ludoviciana*	MARRIOTT AND HARTMAN 1986
Low Larkspur	*Delphinium bicolor*	MARRIOTT AND HARTMAN 1986
Lowland Bladder-Fern	*Cystopteris fragilis*	MARRIOTT AND HARTMAN 1986
Marsh Muhly	*Muhlenbergia racemosa*	MARRIOTT AND HARTMAN 1986
Maryland Sanicle	*Sanicula marilandica*	MARRIOTT AND HARTMAN 1986
Meadow Barley	*Hordeum brachyantherum*	MARRIOTT AND HARTMAN 1986
Meadow Brome	*Bromus commutatus*	MARRIOTT AND HARTMAN 1986
Meadow Deathcamas	*Zigadenus venenosus*	MARRIOTT AND HARTMAN 1986
Meadow Rue	*Thalictrum fendleri*	MARRIOTT AND HARTMAN 1986
Meadow Zizia	*Zizia aptera*	MARRIOTT AND HARTMAN 1986
Mintweed	*Salvia reflexa*	MARRIOTT AND HARTMAN 1986
Missouri Goldenrod	*Solidago missouriensis*	MARRIOTT AND HARTMAN 1986
Missouri Milkvetch	*Astragalus missouriensis*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Missouri Pincushion	*Escobaria missouriensis*	MARRIOTT AND HARTMAN 1986
Montana Wheatgrass	*Elymus albicans*	MARRIOTT AND HARTMAN 1986
Mountain Blueeyed Grass	*Sisyrinchium montanum*	MARRIOTT AND HARTMAN 1986
Mountain Deathcamas	*Zigadenus elegans*	MARRIOTT AND HARTMAN 1986
Mountain Honeysuckle	*Lonicera dioica*	MARRIOTT AND HARTMAN 1986
Mountain Lily	*Leucocrinum montanum*	MARRIOTT AND HARTMAN 1986
Mountain Ninebark	*Physocarpus monogynus*	MARRIOTT AND HARTMAN 1986
Muttongrass	*Poa fendleriana*	MARRIOTT AND HARTMAN 1986
Narrowleaf Gromwell	*Lithospermum incisum*	MARRIOTT AND HARTMAN 1986
Needle-And-Thread	*Hesperostipa comata*	MARRIOTT AND HARTMAN 1986
Nesom Prairie Goldenrod	*Oligoneuron album*	MARRIOTT AND HARTMAN 1986
Nodding Brome	*Bromus porteri*	MARRIOTT AND HARTMAN 1986
Nodding Onion	*Allium cernuum*	MARRIOTT AND HARTMAN 1986
Nodding Stickseed	*Hackelia deflexa*	MARRIOTT AND HARTMAN 1986
Northern Bladderpod	*Lesquerella arenosa*	MARRIOTT AND HARTMAN 1986
Northern Bog Violet	*Viola nephrophylla*	MARRIOTT AND HARTMAN 1986
Nutall's Violet	*Viola nuttallii*	MARRIOTT AND HARTMAN 1986
Oregongrape	*Mahonia repens*	MARRIOTT AND HARTMAN 1986
Oriental Lomatium	*Lomatium orientale*	MARRIOTT AND HARTMAN 1986
Ovalleaf Milkweed	*Asclepias ovalifolia*	MARRIOTT AND HARTMAN 1986
Pale Agoseris	*Agoseris glauca*	MARRIOTT AND HARTMAN 1986
Palespike	*Lobelia spicata*	MARRIOTT AND HARTMAN 1986
Pennsylvania Cinquefoil	*Potentilla pensylvanica*	MARRIOTT AND HARTMAN 1986
Pennsylvania Pellitory	*Parietaria pensylvanica*	MARRIOTT AND HARTMAN 1986
Pineapple Weed	*Matricaria discoidea*	MARRIOTT AND HARTMAN 1986
Plains Milkweed	*Asclepias pumila*	MARRIOTT AND HARTMAN 1986
Plains Muhly	*Muhlenbergia cuspidata*	MARRIOTT AND HARTMAN 1986
Plains Pricklypear	*Opuntia polyacantha*	MARRIOTT AND HARTMAN 1986
Plains Silver Sagebrush	*Artemisia cana*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Plains Wallflower	*Erysimum capitatum*	MARRIOTT AND HARTMAN 1986
Ponderosa Pine	*Pinus ponderosa*	MARRIOTT AND HARTMAN 1986
Porcupine Grass	*Hesperostipa spartea*	MARRIOTT AND HARTMAN 1986
Poverty Oatgrass	*Danthonia spicata*	MARRIOTT AND HARTMAN 1986
Prairie Crocus	*Anemone patens*	MARRIOTT AND HARTMAN 1986
Prairie Dropseed	*Sporobolus heterolepis*	MARRIOTT AND HARTMAN 1986
Prairie Junegrass	*Koeleria macrantha*	MARRIOTT AND HARTMAN 1986
Prairie Pepperweed	*Lepidium densiflorum*	MARRIOTT AND HARTMAN 1986
Prairie Thermopsis	*Thermopsis rhombifolia*	MARRIOTT AND HARTMAN 1986
Prairie Wedgescale	*Sphenopholis obtusata*	MARRIOTT AND HARTMAN 1986
Prairiesmoke	*Geum triflorum*	MARRIOTT AND HARTMAN 1986
Prickly Lettuce	*Lactuca serriola*	MARRIOTT AND HARTMAN 1986
Prickly Rose	*Rosa acicularis*	REED 2001
Purple Aster	*Machaeranthera canescens*	MARRIOTT AND HARTMAN 1986
Purple Aster	*Symphyotrichum laeve*	MARRIOTT AND HARTMAN 1986
Purple Cliffbrake	*Pellaea atropurpurea*	MARRIOTT AND HARTMAN 1986
Purple Coneflower	*Echinacea pallida*	MARRIOTT AND HARTMAN 1986
Purple Threeawn	*Aristida purpurea*	MARRIOTT AND HARTMAN 1986
Quackgrass	*Elymus repens*	MARRIOTT AND HARTMAN 1986
Quaking Aspen	*Populus tremuloides*	MARRIOTT AND HARTMAN 1986
Rabbitbrush	*Ericameria nauseosa*	MARRIOTT AND HARTMAN 1986
Red Baneberry	*Actaea rubra*	MARRIOTT AND HARTMAN 1986
Red Clover	*Trifolium pratense*	MARRIOTT AND HARTMAN 1986
Red Pussytoes	*Antennaria rosea*	MARRIOTT AND HARTMAN 1986
Red Raspberry	*Rubus idaeus*	MARRIOTT AND HARTMAN 1986
Red-Osier Dogwood	*Cornus sericea*	MARRIOTT AND HARTMAN 1986
Richardson Needlegrass	*Achnatherum richardsonii*	MARRIOTT AND HARTMAN 1986
Richardson's Alumroot	*Heuchera richardsonii*	MARRIOTT AND HARTMAN 1986
Rock Clematis	*Clematis columbiana*	MARRIOTT AND HARTMAN 1986
Rockjasmine	*Androsace septentrionalis*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Rocky Mountain Iris	*Iris missouriensis*	MARRIOTT AND HARTMAN 1986
Rocky Mountain Juniper	*Juniperus scopulorum*	MARRIOTT AND HARTMAN 1986
Rough Bluegrass	*Poa trivialis*	MARRIOTT AND HARTMAN 1986
Roughfruit Fairybells	*Disporum trachycarpum*	MARRIOTT AND HARTMAN 1986
Roughleaf Ricegrass	*Oryzopsis asperifolia*	MARRIOTT AND HARTMAN 1986
Round-Headed Blazing Star	*Liatris ligulistylis*	MARRIOTT AND HARTMAN 1986
Rush Skeletonplant	*Lygodesmia juncea*	MARRIOTT AND HARTMAN 1986
Russian Olive	*Elaeagnus angustifolia*	MARRIOTT AND HARTMAN 1986
Russian Thistle	*Salsola kali*	MARRIOTT AND HARTMAN 1986
Sanberg Bluegrass	*Poa secunda*	MARRIOTT AND HARTMAN 1986
Sand Dropseed	*Sporobolus cryptandrus*	MARRIOTT AND HARTMAN 1986
Sawsepal	*Penstemon glaber*	MARRIOTT AND HARTMAN 1986
Scarlet Beeblossom	*Gaura coccinea*	MARRIOTT AND HARTMAN 1986
Scarlet Globemallow	*Sphaeralcea coccinea*	MARRIOTT AND HARTMAN 1986
Sego Lily	*Calochortus gunnisonii*	MARRIOTT AND HARTMAN 1986
Selfheal	*Prunella vulgaris*	MARRIOTT AND HARTMAN 1986
Seneca Snakeroot	*Polygala senega*	MARRIOTT AND HARTMAN 1986
Sharppoint Microseris	*Nothocalais cuspidata*	MARRIOTT AND HARTMAN 1986
Shepherd's Purse	*Capsella bursa-pastoris*	MARRIOTT AND HARTMAN 1986
Shooting-Star	*Dodecatheon pulchellum*	MARRIOTT AND HARTMAN 1986
Showy Frasera	*Frasera speciosa*	MARRIOTT AND HARTMAN 1986
Showy Milkweed	*Asclepias speciosa*	MARRIOTT AND HARTMAN 1986
Shrubby Cinquefoil	*Dasiphora floribunda*	MARRIOTT AND HARTMAN 1986
Shy Wallflower	*Erysimum inconspicuum*	MARRIOTT AND HARTMAN 1986
Sidebells Wintergreen	*Orthilia secunda*	MARRIOTT AND HARTMAN 1986
Sideoats Grama	*Bouteloua curtipendula*	MARRIOTT AND HARTMAN 1986
Silver Buffaloberry	*Shepherdia argentea*	MARRIOTT AND HARTMAN 1986
Silverleaf Scurfpea	*Pediomelum argophyllum*	MARRIOTT AND HARTMAN 1986
Silvery Lupine	*Lupinus argenteus*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Skunkbush	*Rhus trilobata*	MARRIOTT AND HARTMAN 1986
Slender Greenthread	*Thelesperma megapotamicum*	MARRIOTT AND HARTMAN 1986
Slender Lipfern	*Cheilanthes feei*	MARRIOTT AND HARTMAN 1986
Slender Wheatgrass	*Elymus trachycaulus*	MARRIOTT AND HARTMAN 1986
Slender Wildparsley	*Musineon tenuifolium*	MARRIOTT AND HARTMAN 1986
Slimflower Scurfpea	*Psoralidium tenuiflorum*	MARRIOTT AND HARTMAN 1986
Small Soapweed	*Yucca glauca*	MARRIOTT AND HARTMAN 1986
Smooth Brome	*Bromus inermis*	MARRIOTT AND HARTMAN 1986
Smooth Horsetail	*Equisetum laevigatum*	MARRIOTT AND HARTMAN 1986
Smooth Onosmodium	*Onosmodium molle*	MARRIOTT AND HARTMAN 1986
Spiny Phlox	*Phlox hoodii*	MARRIOTT AND HARTMAN 1986
Spiny Sowthistle	*Sonchus asper*	MARRIOTT AND HARTMAN 1986
Spotted Coral-Root	*Corallorrhiza maculata*	MARRIOTT AND HARTMAN 1986
Spreading Dogbane	*Apocynum androsaemifolium*	MARRIOTT AND HARTMAN 1986
Starry False Solomon's Seal	*Maianthemum stellatum*	MARRIOTT AND HARTMAN 1986
Stinging Nettle	*Urtica dioica*	MARRIOTT AND HARTMAN 1986
Stinkgrass	*Eragrostis cilianensis*	MARRIOTT AND HARTMAN 1986
Sulphur Indian Paintbrush	*Castilleja sulphurea*	MARRIOTT AND HARTMAN 1986
Summer Cypress	*Kochia scoparia*	MARRIOTT AND HARTMAN 1986
Sweetgrass	*Hierochloe alpina*	MARRIOTT AND HARTMAN 1986
Switchgrass	*Panicum virgatum*	MARRIOTT AND HARTMAN 1986
Tall Wheatgrass	*Thinopyrum ponticum*	MARRIOTT AND HARTMAN 1986
Timber Oatgrass	*Danthonia intermedia*	MARRIOTT AND HARTMAN 1986
Timothy	*Phleum pratense*	MARRIOTT AND HARTMAN 1986
True Mountain Mahogany	*Cercocarpus montanus*	MARRIOTT AND HARTMAN 1986
Tufted Milkvetch	*Astragalus spatulatus*	MARRIOTT AND HARTMAN 1986
Tumblegrass	*Schedonnardus paniculatus*	MARRIOTT AND HARTMAN 1986
Tumblemustard	*Sisymbrium altissimum*	MARRIOTT AND HARTMAN 1986
Twinflower	*Linnaea borealis*	MARRIOTT AND HARTMAN 1986

Common Name	Accepted Scientific Name	Source
Upright Prairie Coneflower	*Ratibida columnifera*	MARRIOTT AND HARTMAN 1986
Violet Prarieclover	*Dalea purpurea*	MARRIOTT AND HARTMAN 1986
Wavyleaf Thistle	*Cirsium undulatum*	MARRIOTT AND HARTMAN 1986
Wax Currant	*Ribes cereum*	MARRIOTT AND HARTMAN 1986
Western Poison Ivy	*Toxicodendron rydbergii*	MARRIOTT AND HARTMAN 1986
Western Wheatgrass	*Pascopyrum smithii*	MARRIOTT AND HARTMAN 1986
Western White Clematis	*Clematis ligusticifolia*	MARRIOTT AND HARTMAN 1986
White Beardtongue	*Penstemon albidus*	MARRIOTT AND HARTMAN 1986
White Campion	*Silene latifolia*	MARRIOTT AND HARTMAN 1986
White Clover	*Trifolium repens*	MARRIOTT AND HARTMAN 1986
White Milkwort	*Polygala alba*	MARRIOTT AND HARTMAN 1986
White Or Paper Birch	*Betula papyrifera*	MARRIOTT AND HARTMAN 1986
White Prairie Aster	*Symphyotrichum falcatum var. falcatum*	REED 2001
White Prarieclover	*Dalea candida*	MARRIOTT AND HARTMAN 1986
White Sweetclover	*Melilotus alba*	MARRIOTT AND HARTMAN 1986
Whitlow Grass	*Draba reptans*	MARRIOTT AND HARTMAN 1986
Wildbergamot Beebalm	*Monarda fistulosa*	MARRIOTT AND HARTMAN 1986
Wormseed-Mustard	*Erysimum cheiranthoides*	MARRIOTT AND HARTMAN 1986
Wormwood	*Artemisia dracunculus*	MARRIOTT AND HARTMAN 1986
Wyoming Besseya	*Besseya wyomingensis*	MARRIOTT AND HARTMAN 1986
Yellow Salsify	*Tragopogon dubius*	MARRIOTT AND HARTMAN 1986

Table 15 –Reptile List

Common Name	Accepted Scientific Name	Source
Sagebrush Lizard	*Sceloporus graciosus*	SDNHP 2000
Smooth Green Snake	*Liochlorophis vernalis*	SDNHP 2000

Table 16 –Mammal List

Common Name	Accepted Scientific Name	Source
13 Lined Ground Squirrel	*Spermophilus tridecemlineatus*	
Badger	*Taxidea taxus*	
Big Brown Bat	*Eptesicus fuscus*	JONES ET AL 1983
Bobcat	*Lynx rufus*	JONES ET AL 1983
Bushy-Tailed Woodrat	*Neotoma cinerea*	JONES ET AL 1983
Coyote	*Canis latrans*	JONES ET AL 1983
Deer Mouse	*Peromyscus maniculatus*	JONES ET AL 1983
Desert Cottontail	*Sylvilagus audubonii*	JONES ET AL 1983
Dwarf Shrew	*Sorex nanus*	
Elk	*Cervus elaphus*	
Ermine	*Mustela erminea*	
Fringed Myotis	*Myotis thysanodes*	SDNHP 2000
Hayden's Shrew	*Sorex haydeni*	
Hispid Pocket Mouse	*Chaetodipus hispidus*	
Hoary Bat	*Lasiurus cinereus*	JONES ET AL 1983
House Mouse	*Mus musculus*	
Least Chipmunk	*Tamias minimus*	JONES ET AL 1983
Little Brown Bat	*Myotis lucifugus*	JONES ET AL 1983
Long Legged Myotis	*Myotis volans*	
Long Tailed Vole	*Microtus longicaudus*	JONES ET AL 1983
Long Tailed Weasel	*Mustela frenata*	
Masked Shrew	*Sorex cinereus*	BOGAN AND ROMATNIK 1994
Meadow Vole	*Microtus pennsylvanicus*	JONES ET AL 1983
Meadow Vole	*Microtus pennsylvanicus*	
Mink	*Mustela vison*	
Mountain Lion	*Puma concolor*	
Mule Deer	*Odocoileus hemionus*	
Northern Flying Squirrel	*Glaucomys sabrinus*	
Northern Grasshopper Mouse	*Onychomys leucogaster*	
Northern Myotis	*Myotis keenii*	SDNHP 2000
Northern Pocket Gopher	*Thomomys talpoides*	JONES ET AL 1983
Nuttall's Cottontail	*Sylvilagus nuttallii*	JONES ET AL 1983
Olive-Backed Pocket Mouse	*Perognathus fasciatus*	
Ords Kangaroo Rat	*Dipodomys ordii*	
Plains Harvest Mouse	*Reithrodontomys montanus*	
Porcupine	*Erethizon dorsatum*	JONES ET AL 1983
Prairie Vole	*Microtus ochrogaster*	JONES ET AL 1983
Raccoon	*Procyon lotor*	
Red Bat	*Lasiurus borealis*	
Red Fox	*Vulpes vulpes*	
Red Squirrel	*Tamiasciurus hudsonicus*	JONES ET AL 1983
Silver-Haired Bat	*Lasionycteris noctivagans*	SDNHP 2000
Small-Footed Myotis	*Myotis leibii*	JONES ET AL 1983
Southern Red Backed Vole	*Clethrionomys gapperi*	JONES ET AL 1983
Spotted Skunk	*Spilogale putorius*	
Striped Skunk	*Mephitis mephitis*	
Townsend's Big-Eared Bat	*Corynorhinus townsendii*	SDNHP 2000
Western Harvest Mouse	*Reithrodontomys megalotis*	
White Footed Mouse	*Peromyscus leucopus*	
White Tailed Deer	*Odocoileus virginianus*	

Table 17 –Bird List

Common Name	Accepted Scientific Name	Source
American Crow	*Corvus brachyrhynchos*	SDOU 1991
American Redstart	*Setophaga ruticilla*	SDOU 1991
American Robin	*Turdus migratorius*	SDOU 1991
Black-Capped Chickadee	*Parus atricapillus*	SDOU 1991
Brown Creeper	*Certhia americana*	SDNHP 2000
Brown-Headed Cowbird	*Molothrus ater*	SDOU 1991
Cassin's Finch	*Carpodacus cassinii*	SDNHP 2000
Chipping Sparrow	*Spizella passerina*	SDOU 1991
Clark's Nutcracker	*Nucifraga columbiana*	PETERSON 2001
Common Nighthawk	*Chordeiles minor*	SDOU 1991
Common Poorwill	*Phalaenoptilus nuttallii*	SDNHP 2000
Cordilleran Flycatcher	*Empidonax occidentalis*	SDOU 1991
Dark Eyed Junco	*Junco hyemalis*	SDOU 1991
Downy Woodpecker	*Picoides pubescens*	SDOU 1991
Dusky Flycatcher	*Empidonax oberholseri*	SDOU 1991
Great Horned Owl	*Bubo virginianus*	SDOU 1991
Hairy Woodpecker	*Picoides villosus*	PETERSON 2001
House Wren	*Troglodytes aedon*	SDOU 1991
Killdeer	*Charadrius vociferus*	PADELFORD 1993
Lewis' Woodpecker	*Melanerpes lewis*	SDNHP 2000
Macgillivray's Warbler	*Oporornis tolmiei*	SDOU 1991
Mountain Bluebird	*Sialia currucoides*	SDOU 1991
Mourning Dove	*Zenaida macroura*	SDOU 1991
Northern Flicker	*Colaptes auratus*	SDOU 1991
Ovenbird	*Seiurus aurocapillus*	SDOU 1991
Pine Siskin	*Carduelis pinus*	SDOU 1991
Red Breasted Nuthatch	*Sitta canadensis*	SDOU 1991
Red Crossbill	*Loxia curvirostra*	SDOU 1991
Red Winged Blackbird	*Agelaius phoeniceus*	PETERSON 2001
Red-Tailed Hawk	*Buteo jamaicensis*	SDOU 1991
Ruby-Crowned Kinglet	*Regulus calendula*	PETERSON 2001
Solitary Vireo	*Vireo solitarius*	SDOU 1991
Swainson's Thrush	*Catharus ustulatus*	SDOU 1991
Townsend's Solitaire	*Myadestes townsendi*	SDOU 1991
Turkey Vulture	*Cathartes aura*	SDOU 1991
Violet Green Swallow	*Tachycineta thalassina*	SDOU 1991
Warbling Vireo	*Vireo gilvus*	SDOU 1991
Western Tanager	*Piranga ludoviciana*	SDOU 1991
White Breasted Nuthatch	*Sitta carolinensis*	SDOU 1991
White-Throated Swift	*Aeronautes saxatalis*	SDOU 1991
Yellow Rumped Warbler	*Dendroica coronata*	SDOU 1991

APPENDIX D

D. NEPA AND NHPA COMPLIANCE

A Letter dated November 24, 2004, was received from South Dakota State Historic Preservation Officer. There were no concerns for the over all plan. It was requested that the State Officer be advised when individual projects are planned for the Monument.

APPENDIX E

E. ANNUAL REVISION DOCUMENTS

1. Fire Call-up List

The Monument will insert this list and revise annually.

2. Preparedness Inventory

Table 18 – Cache Inventory

Category	Product	On Hand	Reorder Level	Max Stocking	Need to Order	Number Ordered
Nomex	**Brush Coat, Large lined**	**1**	**2**			
Nomex	**Brush Coat, Medium lined**	**1**	**2**			
Nomex	**Brush Coat, Small lined**	**1**	**1**			
Nomex	**Brush Coat, X-Large lined**	**2**	**2**			
Nomex	**Brush Coat, XX-Large lined**	**1**	**1**			
Nomex	**Flight Suit - 40R**	**0**	**0**			
Nomex	**Flight Suit - 40S**	**0**	**0**			
Nomex	**Jeans, 26"-30" X 33"**	**2**	**4**			
Nomex	**Jeans, 28 x 30**					
Nomex	**Jeans, 28 x 34**					
Nomex	**Jeans, 28"-32" X 33"**	**2**	**4**			
Nomex	**Jeans, 30 x 30**					
Nomex	**Jeans, 30 x 34**					
Nomex	**Jeans, 32 x 30**					
Nomex	**Jeans, 32 x 34**					
Nomex	**Jeans, 34 x 30**					
Nomex	**Jeans, 34 x 34**					
Nomex	**Jeans, 34"-38" X 33"**	**2**	**6**			
Nomex	**Jeans, 36 x 30**					
Nomex	**Jeans, 36 x 34**					
Nomex	**Jeans, 38 x 30**					
Nomex	**Jeans, 38 x 34**					
Nomex	**Jeans, 40 x 30**					
Nomex	**Jeans, 40 x 34**					
Nomex	**Jeans, 40"-44" X 33"**	**2**	**2**			
Nomex	**Jeans, 42 x 34**					
Nomex	**Jeans, 44 x 34**					
Nomex	**Jeans, 46 x 34**					
Nomex	**Jeans, 48 x 34**					
Nomex	**Jeans, Female, 10**					
Nomex	**Jeans, Female, 12**					
Nomex	**Jeans, Female, 14**					
Nomex	**Jeans, Female, 16**					
Nomex	**Jeans, Female, 8**					
Nomex	**Shirt, Large and Large Long**	**2**	**4**			
Nomex	**Shirt, Medium**	**4**	**6**			
Nomex	**Shirt, Small**	**2**	**2**			
Nomex	**shirt, X Large and Long**	**2**	**4**			
Nomex	**Shirt, X-Small**	**1**	**1**			
Nomex	**Shirt, XX-Large**	**2**	**2**			
Medical-1st	**10-Man Ist Aid Kit**	**1**	**1**			
Medical-1st	**Alcohol Pads**					
Medical-1st	**Bandaids**					
Medical-1st	**Burn Dressings - Assorted**	**0**	**1**			
Medical-1st	**Burn Kit**	**1**	**1**			
Medical-1st	**Cold Packs**	**2**	**4**			

Category	Product	On Hand	Reorder Level	Max Stocking	Need to Order	Number Ordered
Medical-1st	**CPR - Masks**	**1**	**1**			
Medical-1st	**First Aid Kit, individual**	**3**	**6**			
Medical-1st	**Gauze Pads**					
Medical-1st	**Insect Repellent**					
Medical-1st	**Irrigation Solution-Saline**	**1**	**1**			
Medical-1st	**Latex Surgical Gloves - Large**					
Medical-1st	**Triple Antibiotic**					
Medical-1st	**Wounded Warrior**					
PPE, Other	**Canteen Holders**	**4**	**8**			
PPE, Other	**Canteen, 1 Qt.w/o cover**	**12**	**30**			
PPE, Other	**Canteen, 4-Qt.**	**1**	**1**			
PPE, Other	**Earplugs**	**50**	**200**			
PPE, Other	**Glasses, Safety**	**3**	**6**			
PPE, Other	**Gloves, Large**	**3**	**6**			
PPE, Other	**Gloves, Medium**	**3**	**6**			
PPE, Other	**Gloves, Small**	**3**	**6**			
PPE, Other	**Gloves, X-Large**	**3**	**6**			
PPE, Other	**Gloves, X-small**	**2**	**4**			
PPE, Other	**Goggle, Dust**	**2**	**4**			
PPE, Other	**Headlamp, 4 AA cell (or**	**3**	**6**			
PPE, Other	**Helmet Chin Strap**	**3**	**6**			
PPE, Other	**Helmet Suspensions**	**4**	**8**			
PPE, Other	**Helmet, Red, Bullard (Wildfire)**					
PPE, Other	**Helmet, Yellow (Wildfire**	**4**	**6**			
PPE, Other	**Pouch, yellow (for web gear)**	**2**	**4**			
PPE, Other	**Protector, Face & Neck**	**3**	**6**			
PPE, Other	**Red Pack, Personal Gear**	**6**	**3**			
PPE, Other	**Shelter, Fire, with case**	**4**	**6**			
PPE, Other	**Shelter, Practice**	**1**	**1**			
PPE, Other	**Shelter,cover**					
PPE, Other	**Web Gear, Eagle (for Engine**					
PPE, Other	**Web gear, yellow GSA**	**4**	**6**			
PPE, Other	**Wool Blankets**	**0**	**0**			
Batteries,	**Battery, "AA"**	**48**	**96**			
Batteries,	**Battery, "D" cell**	**12**	**16**			
Batteries,	**Battery, King, Clamshell**					
Batteries,	**Battery, King, rechargeable**					
Batteries,	**Battery, Motorola, HT600**					
Fittings	**Adapter, 1" NPSH - 1" NH**	**1**	**1**			
Fittings	**Adapter, 1-1/2", NPSH-NH**	**1**	**1**			

Category	Product	On Hand	Reorder Level	Max Stocking	Need to Order	Number Ordered
Fittings	**Coupling, DBL F., 1 1/2" NH**	**1**	**2**			
Fittings	**Coupling, DBL F., 1" NPSH**	**1**	**1**			
Fittings	**Coupling, DBL F., 2 1/2" NH**	**1**	**1**			
Fittings	**Coupling, DBL M., 1 1/2" NH**	**1**	**1**			
Fittings	**Coupling, DBL M., 1: NPSH**	**1**	**1**			
Fittings	**Foot Valve - 1 1/2"**	**1**	**1**			
Fittings	**Gated Wye, 1 1/2"**	**4**	**6**			
Fittings	**Gated Wye, 1"**	**1**	**1**			
Fittings	**Increaser, 1" NPSH to 1 1/2"**	**1**	**1**			
Fittings	**Nozzle, 3/4" tips s/s**	**2**	**3**			
Fittings	**Nozzle, Barrel, 1 1/2"**	**1**	**1**			
Fittings	**Nozzle, Barrel, 1"**	**4**	**8**			
Fittings	**Reducer, 1 1/2" NH to 1" NPSH**	**4**	**6**			
Fittings	**Reducer, 2 1/2" NH to 1 1/2"**	**1**	**1**			
Fittings	**Reducer, 2 1/2" NH to 2" NPSH**	**1**	**1**			
Fittings	**Strainer 2"**	**1**	**2**			
Fittings	**Valve, shutoff, ball, 1 1/2"**	**1**	**1**			
Fittings	**Valve, shutoff, ball, 1"**	**1**	**2**			
Hose	**Hardline Suction - 1" X 8**	**0**	**0**			
Hose	**Hose, 3/4" X 50' P Line**	**2**	**4**			
Hose	**Hose, Filler 1 1/2" x 25'**	**1**	**2**			
Hose	**Hose, High Pressure 1" x 50'**	**1**	**1**			
Hose	**Hose, Suction, 1 1/2" x 8'**	**0**	**0**			
Hose	**Hose, Suction, 2" x 8'**	**1**	**1**			
Hose	**Hose, Syn., 1 1/2" x 100'**	**6**	**10**			
Hose	**Hose, Syn., 1 1/2" x 50'**	**0**	**0**			
Hose	**Hose, Syn., 1" x 100'**	**5**	**7**			
Tools	**Axe**					
Tools	**Backpack Pump, collapsable**	**4**	**6**			
Tools	**Backpack Pump, Liner**	**4**	**6**			
Tools	**Backpack Pump, rigid**					
Tools	**Bolt Cutter**	**0**	**0**			
Tools	**Brush Hook**					
Tools	**Buck Saw**					
Tools	**Chain Saw**					
Tools	**Clamp, Hose**	**1**	**2**			
Tools	**Combi-Tool**	**1**	**2**			

Category	Product	On Hand	Reorder Level	Max Stocking	Need to Order	Number Ordered
Tools	**Council Rake**	**2**	**3**			
Tools	**Double Headed Axe**					
Tools	**File, 12" Mill Bastard each**	**2**	**4**			
Tools	**Fire, Swatter (flapper)**	**3**	**6**			
Tools	**Handle, Pulaski**	**1**	**2**			
Tools	**Hydrant Wrench, Adjustable**	**1**	**1**			
Tools	**McLeod**	**2**	**3**			
Tools	**Pail, Collapsable**	**1**	**1**			
Tools	**Priming Pump**	**1**	**1**			
Tools	**Pulaski**	**3**	**5**			
Tools	**Rake, collapsible, fire**	**1**	**1**			
Tools	**Rake, leaf**	**1**	**2**			
Tools	**Reinhart - Bent Shovel**	**1**	**2**			
Tools	**Sandpaper, Med. Grit, Pkg. Of**	**.5**	**1**			
Tools	**Shovel**	**3**	**6**			
Tools	**Spanner, 1 1/2" & 2 1/2"**	**1**	**2**			
Tools	**Torch, Drip**	**2**	**3**			
Foam	**Foam, Class A, Firetrol, 4 Oz.**					
Foam	**Foam, Class A, Silvex, 5-gal**	**2**	**4**			
Misc.	**Backpack (bladder) Bag Pump**	**1**	**3**			
Misc.	**Belt Weather Kit**	**1**	**1**			
Misc.	**Filter, water (portable)**	**1**	**1**			
Misc.	**Flagging, "Escape Route"**	**2**	**14**			
Misc.	**Flagging, "Hazard"**					
Misc.	**Flagging, "Killer Tree"**					
Misc.	**Flagging, Red & White**	**4**	**6**			
Misc.	**Flashlight, 3-cell**	**1**	**1**			
Misc.	**Fluids, Thirst-Quenching, 16-oz**	**0**	**0**			
Misc.	**Fusees, case of 72**	**.5**	**1**			
Misc.	**Knapsack, (Packsack)**	**2**	**3**			
Misc.	**Mark III pump**					
Misc.	**MRE's, Case of 12**	**1**	**1**			
Misc.	**Paint, Black, spray**					
Misc.	**Paint, Red, spray**					
Misc.	**Psychrometer**	**1**	**1**			
Misc.	**Pumkin, 2000 gl or +**					
Misc.	**Sleeping Bags**	**3**	**4**			
Misc.	**Sleeping Pad**	**3**	**4**			
Misc.	**Tape, Filament**	**1**	**1**			
Misc.	**Tape, Masking**	**1**	**1**			
Misc.	**Tent, 2-person**	**3**	**4**			

The updated table is available through the NGPA cache inventory application.

APPENDIX E

Interpark Agreement
Between:

Northern Great Plains Area Fire Management

AND
Agate Fossil Beds National Monument
Badlands National Park
Devils Tower National Monument
Jewel Cave National Monument
Mount Rushmore National Memorial
Scotts Bluff National Monument, and
Wind Cave National Park

Revised February 13, 2003

ARTICLE I. PURPOSE

The FIREPRO process arranges for the funding for fire staff to support the seven NPS units listed above. This grouping is known as the Northern Great Plains Area (NGPA). These positions will be referred to in this document collectively as the "Fire Staff". The purpose of this agreement is to define the mutual responsibilities of the Fire Staff and staff from the other NPS units in the Northern Great Plains Area in terms of fire management activities.

ARTICLE II. RESPONSIBILITIES

The duties of the Fire Staff will include providing professional and technical support for the fire management programs at all NGPA units.

A. Specific responsibilities of the Fire Management Staff include:

1. Assist in the development and implementation of wildland fire prevention, preparedness, suppression, and aviation programs through site visits, program and readiness reviews, inspections, cache inventories and other staff work.

2. Assist in coordination of fire-related reports, correspondence, preparation and/or review of fire management plans, and aviation plans. Participate in other fire management planning as requested.

3. Assist in coordination and implementation of prescribed fire programs, fuel treatments, and fire use programs according to unit fire management plans.

4. Coordinate, through appropriate zone coordination center, mobilization of National Park Service personnel for fire assignments.

5. Develop, coordinate, and conduct fire-related training as necessary to meet wildland fire needs of the units and interagency needs according to approved fire management plans, and local and national guidelines.

6. Manage fire qualification and training records in the Shared Applications Computer System (SACS), including: initial record input; updating fitness scores, training, experience, and issue incident qualification cards. Fire Staff will provide an annual timetable to each unit fire coordinator for transferring the information to

the Fire Program Assistant so that it can be input into the SACS.

7. Communicate with respective units on issues and concerns prior to representing the Northern Great Plains Area at meetings, conferences, seminars, and other functions as requested and required, including: South Dakota Interagency Fire Council, Board of Directors for the Northern Great Plains Dispatch Center, Multiagency Coordination Group, NPS Intermountain and Midwest Regional Offices and others.

8. Coordinate NPS role in the interagency fire community; developing interagency agreements, cooperative agreements, and other agreements necessary for carrying out wildland fire management.

9. The Fire Staff will coordinate with the respective park fire coordinator, out-of-park work requests for the engine crews at BADL and WICA, including pre-positioning of resources in response to preparedness issues and fuels projects.

B. Responsibilities of the superintendents of Northern Great Plains Area include:

1. Make requests for assistance through the fire management office with sufficient lead time to meet due dates and set-up meetings. Each unit superintendent will designate a unit fire coordinator who requests program assistance, budget, and training needs through the Fire Management Officer.

2. Submit fire experience and fire training records (using the EZ form), physical fitness scores, physical exam results (pass or fail), individual fire reports (DI-1202), availability reports, and situation reports, following established times and due dates. Unit fire coordinators will be responsible for maintaining fire readiness to the level identified in the park's fire management plan.

3. Notify the Fire Staff as soon as practical of any fire restrictions, closures, or fire occurrences.

4. Participate in the overall fire management of the Great Plains area units and of the NPS by committing to sharing of training and available personnel upon request.

5. The Superintendent of Wind Cave National Park will be the official supervisor of the Fire Management Officer (FMO). The other Superintendents will also work closely with the FMO and will provide input to the Wind Cave Superintendent for the FMO's performance appraisal.

ARTICLE III. WORK GROUP

The Fire Management Staff Officer will facilitate a Fire Management Work Group, which meets at least once a year to review budget inputs prior to submission, review the Interpark Agreement, and prioritize work plan activities. The Work Group will be composed of the Fire Coordinators from the park units covered by this Agreement.

ARTICLE IV. FUNDING

Program costs (e.g. travel/per diem, communication, supplies and materials) incurred by the Fire Staff will be charged to FIREPRO accounts. In addition, any costs associated with the work group may be funded through FIREPRO accounts assigned to each park unit. If personnel are working on a project, which has been individually funded, such as a prescribed fire, the overtime and travel costs for personnel may be paid from the appropriate project funds. The annual budget request will be reviewed and concurred with by the Work Group so that any supplemental requests, i.e.: physical exams, personal protective equipment, training, cache items, capital equipment, and hazard fuel reduction projects, are reflected in the annual budget request.

ARTICLE V. LOCATION OF THE FIRE STAFF

While it needs to be very clear that the fire staff serves all seven parks, they will be located at Wind Cave National Park, with the exception of the Black Hills Fire Use Module, which is located at Jewel Cave National Monument. These two parks will provide office facilities to the extent practical. If funding is secured to build a dedicated facility for the NGPA staff, at a location to be determined later, this agreement can be modified if necessary to reflect the change. The Fire Staff will endeavor to minimize adverse impacts on the parks as much as possible, including paying for electricity and heating used in their fire facilities.

ARTICLE VI. TERM OF AGREEMENT

The term of this Agreement will be 5 years, beginning in fiscal year 2003. It is renewable at the end of each five-year period by written letter of agreement signed by each of the superintendents of the Northern Great Plains Area.

Amendments to this Agreement can be made at any time subject to the written concurrence and approval of all superintendents.

_____ _____
Superintendent Date
Agate Fossil Beds National Monument

_____ _____
Superintendent Date
Badlands National Park

_____ _____
Superintendent Date
Devils Tower National Monument

_____ _____
Superintendent Date
Jewel Cave National Monument

_____ _____
Superintendent Date
Mount Rushmore National Memorial

_____ _____
Superintendent Date
Scotts Bluff National Monument

_____ _____
Superintendent Date
Wind Cave National Park

_____ _____
NGP Fire Management Officer Date

Z:\agreements\agreement-Interpark-2003.doc

APPENDIX E

ANNUAL OPERATING PLAN
between
THE BLACK HILLS NATIONAL FOREST
and
DEVILS TOWER NATIONAL MONUMENT
MOUNT RUSHMORE NATIONAL MEMORIAL
JEWEL CAVE NATIONAL MONUMENT
and
WIND CAVE NATIONAL PARK

I. PURPOSE

This Operating Plan establishes specific procedures for Interagency Fire Protection by each agency on forest/range fires reported within the Black Hills National Forest, Devils Tower National Monument Mount Rushmore National Memorial, Jewel Cave National Monument, and Wind Cave National Park.

II. AUTHORITY

1. Listed under Interagency Cooperative Fire Protection Agreement #1102-0005-95-013, between agencies of the United States Department of Agriculture, agencies of the United States Department of the Interior and the State of South Dakota.

III. GENERAL

1. Crew Definition

   Crews normally consist of two fire-qualified perpersonnel with engine, but may consist of additional resources depending values at risk and incident potential.

2. Reporting a Fire

   When a smoke is detected and reported, it will be the responsibility of the detecting agency to promptly notify the other agency dispatch center so initial attack crews may be promptly dispatched.

3. Contact Points

   A. Forest Service – All requests will be directed to the Interagency Dispatch Center located at Custer, SD

   B. National Park Service – Requests will be made to the headquarters of the appropriate National Park Service Area.

4. Release of Resources

   A. All crews assigned to an incident will be utilized until demobilized.

   B. Other agency crews will normally be demobilized first.

   C. Home unit requests for early release of specified personnel or equipment will be honored whenever possible, when made through the appropriate contact point.

IV. INITIAL ATTACK PROCEDURES

1. Black Hills National Forest

A. Adjective ratinq class of Moderate -High

Forest Service District fire crews, unless otherwise notified by the National Park Service through the zone dispatcher, will:

(1) Respond to all-fires reported within the boundaries of Jewel Cave National Monument and the Mount Rushmore National Memorial.

(2) Respond to fire on Wind Cave National Park as follows:

(a) All fires west of US 385 and State Hwy 87

(b) Fires east of US 385 and State Hwy 87 upon request.

B. Adjective Ratinq Class of Very High -Extreme -Red Flag Alert

(1) Forest Service District crews, unless otherwise notified by the National Park Service, will:

(a) Respond to all fires within the boundaries of Jewel Cave National Monument and Wind Cave National Park and Mount Rushmore National Memorial.

(b) Respond to fires of Devils Tower National Monument upon request only.

(2) Available helicopters and/or air tankers will dispatched to National Park Service lands or requested through the Custer Zone Dispatcher.

2. National Park Service

Adjective Ratinq Class of Moderate and above, including Red Flag Alerts

A. National Park Service crews from Wind Cave and Jewel Cave, unless otherwise notified by Forest Service Zone Dispatcher, will respond to all reported fires on National Forest 1and within three (3) miles of contiguous Park boundaries. Crews from these units, if asked and available, will respond forest-wide.

B. National Park Service crews from Mount Rushmore, unless otherwise notified by the Forest Zone Dispatcher, will respond to all fires on National Forest lands within one (1) mile contiguous to National Memorial boundary.

C. National Park Service crews from Devils Tower, if requested, will respond to fires in the Bearlodge Ranger District of the Black Hills National Forest.

V. REVIEW/PERIOD OF AGREEMENT

This Operating Plan will be reviewed annually to evaluate the effectiveness of action by all parties and to provide for amendment prior to Feb. 28.

VI. DISCRIMINATION

The parties of this Memorandum of Understanding shall not discriminate against any employee or applicant for employment because of race, color, religion, sex or National origin. They will take affirmative action to insure that applicants

are employed, and that employees are treated fairly during employment without regard to race, color, religion, sex or National origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

They further agree to post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the responsible officers setting for the provisions of the nondiscrimination clause.

All parties agree to insert the foregoing provision in subcontracts hereunder, except subcontracts for standard commercial supplies or raw materials.

VII. OFFICIAL NOT TO BENEFIT

No member of or delegate to Congress, or resident Commissioner, shall be admitted to any share or part of this contract, or to any benefits that may arise therefrom.

IV. IN WITNESS WHEREOF, the parties hereto have executed this Operating Plan as of the date last signed below.

Supervisor Black Hills National Forest Date

Superintendent, Wind Cave National Park Date

Superintendent, Mount Rushmore National Memorial Date

Superintendent, Devils Tower National Monument Date

Superintendent, Jewel Cave National Monument Date

APPENDIX E

4. Sample Delegation of Authority

Jewel Cave National Monument
Custer, SD

Limited Delegation of Authority

As of 1800, September 2, 2001, I have delegated authority to manage the Hell Canyon 1 fire, number 0102, Jewel Cave National Monument, to Incident Commander, John Doe and his Incident Management Team.

The fire which originated as an arson fire on August 31, 2001, is burning in habitat adjacent to the Jewel Cave boundary. My considerations for management of this fire are:

1. Provide for firefighter safety.

2. I would like the fire managed in such a manner that suppression actions will cause little environmental damage as possible.

3. Key features requiring priority protection are: historic ranger cabin, and NPS infrastructure.

4. Restrictions for suppression actions are no tracked vehicles will be utilized.

5. Minimum tools for use are Type II/III helicopters, and chainsaws.

6. My agency advisor will be the Park Fire Coordinator.

7. Managing the fire cost-effectively for the values at risk is a significant concern.

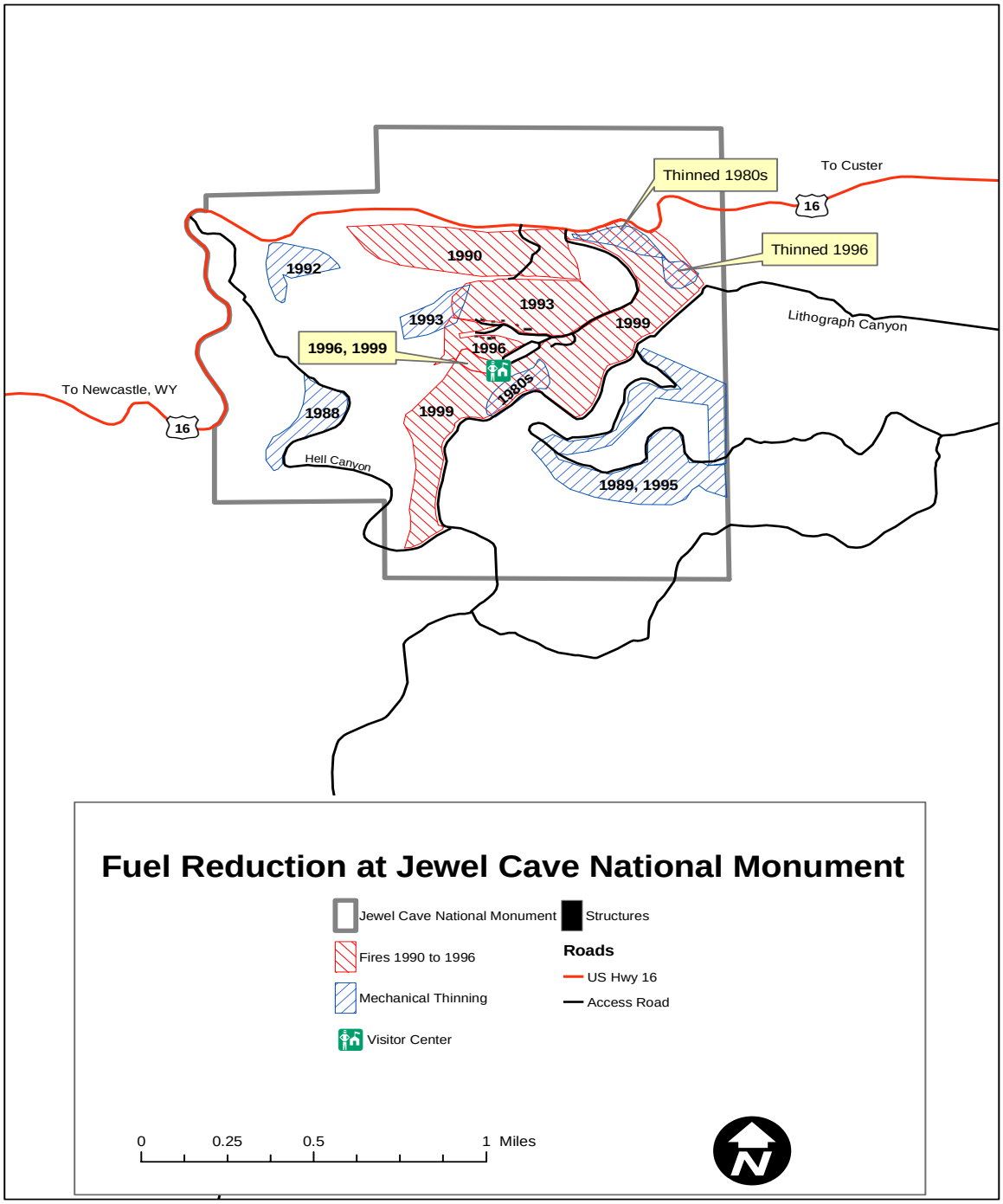
8. Providing training opportunities for park personnel is requested to strengthen our organizational capabilities.

Superintendent, Jewel Cave National Monument
September 2, 2001

APPENDIX E

5. Historic Fuel Treatments

Figure 2 – Historic Fuel Treatment Map



APPENDIX E

6. Interagency Contacts

Organization	Contact	Address	Phone Number
USFS, Black Hills National Forest, Hells Canyon Ranger District	Mike Loyd, District Ranger	Custer, SD 57730	(605) 6733-4853
Northern Great Plains Interagency Dispatch Center	Duty Dispatcher	Rapid City, SD	(605) 393-8017

APPENDIX F

F. WILDLAND AND PRESCRIBED FIRE MONITORING PLAN

National Park Service

Jewel Cave National Monument, South Dakota

Fire Effects Monitoring Plan

INTRODUCTION

Prescribed fire will be used to maintain and restore the fire adapted ecosystems at Jewel Cave. National Park Service (NPS) Reference Manual 18 states, "Monitoring is a critical component of fire management and the Fire Monitoring Plan is important to identify why monitoring will be done, what will be monitored, how it will be monitored, where it will be done, and how often it will be completed." Monitoring of these fires is mandated in Director's Order #18: Wildland Fire Management issued in 1998. Section 5.2, *Fire Management Plans* (no. 10) states, "Include procedure for short and long term monitoring to document that overall program objectives are being met and undesired effects are not occurring". Section 5.8 directly addresses *Prescribed Fire Monitoring*:

a) Fire effects monitoring must be done to evaluate the degree to which objectives are accomplished.
b) Long-term monitoring is required to document that overall programmatic objectives are being met and undesired effects are not occurring.
c) Evaluation of fire effects data is the joint responsibility of fire management and natural resource management personnel.

MONITORING DESIGN

SAMPLING DESIGN

All plots established at Jewel Cave follow standard Fire Monitoring Handbook (FMH) (2003) protocols. The sampling design for the FMH plots are contained in the individual monitoring unit description sheets found in Appendix 1. Long-term photo monitoring points will also be established in the future.

FIELD MEASUREMENT

The individual variables to be measured are defined in the monitoring unit descriptions found in Appendix 1. All plots are marked with steel rebar approximately thirty centimeters in height. Each piece of rebar has a brass tag indicating its location within the plot. The rebar at the zero end of each plot has a tag with complete plot data as specified by the handbook. All locations have been georeferenced with a GPS unit. A hard copy of each plot location is retained in the Northern Great Plains Fire Management Office (NGP) at Wind Cave National Park. A digital text file with UTM coordinates and ArcView 'shape' file are also on file at the NGP. The Northern Great Plains Fire Monitoring Team will retain copies and backups and will be responsible for providing updated versions to Jewel Cave as needed.

MONITORING LOCATION

Currently there are five monitoring plots at Jewel Cave (Fig. 1).

PRESCRIBED FIRE MONITORING PARAMETERS

Jewel Cave has adopted the NPS FMH (2003) as a guide for fire effects monitoring. The handbook identifies four monitoring levels:

Level 1 – Reconnaissance	Fire Cause, location, size, fuel and vegetation types, relative fire activity, potential for spread, current and forecasted weather, resource or safety threats and constraints, and smoke volume and movement

Level 2 – Fire Conditions	Fire monitoring period, ambient conditions – topographic and fire weather, fuel model, fire characteristic, and smoke characteristic
Level 3 – Immediate Post fire Effects	Fuel reduction, vegetative change or other objective dependent variables with in 1 to 5 years after a prescribed fire
Level 4 – Long-term Change	Continued monitoring of Level 3 variables to measure trends and change over time

The FMH plots that have been described in this document thus far are being used to examine levels 3 and 4.

Wildland fires that are suppressed will be monitored at levels 1 and 2 with observations entered into the park's monitoring database. In the event that long-term fire effects plots are burned in a wildland fire, they will be read by the NGP Fire Monitoring Team, according to the schedule of plot rereads following a prescribed fire treatment. Level 1 and 2 monitoring observations will be filed with the final fire package and a copy placed with the records for the Fire Management Unit that was burned.

Prescribed fires will meet at least the Level 1 and 2 recommended standards. If there are FMH plots in a unit, information on Level 3 and 4 Variables will be collected.

Level 1 variables

Reconnaissance monitoring provides a basic overview of the fire event. The following variables will be collected on all fires.

- Fire cause (origin), location and size
- Fuels and vegetation type
- Relative fire activity
- Potential for further spread
- Current and forecasted weather
- Resource or safety threats and constraints
- Smoke volume and movement

Specific information on the collection of these variables can be found in the NPS Fire Monitoring Handbook (2003) or the RX-91 – 'Monitoring Prescribed and Wildland Fire' text.

Level 2 variables

Fire conditions monitoring provides information on fire weather, fire behavior and resource values at risk. The following variables will be collected and summarized in a monitoring report on all prescribed fires.

- Fire monitoring period
  - fire number and name
  - observations data and time
  - monitor's name
- Ambient conditions
  - topographic variables
  - slope (%)
  - aspect
- Fire weather variables
  - dry bulb temperature
  - relative humidity
  - wind speed

  - wind direction
  - fuel shading and/or cloud cover
  - time-lag fuel moisture
  - live fuel moisture
  - drought index
- Soil moisture
- Fuel model
- Fire characteristics
  - linear rate of spread
  - perimeter or area growth
  - flame length
  - fire spread directions
- Smoke characteristics (based on state and local requirements)

INTENDED DATA ANALYSIS

Plot installations will be based on prescribed fire priorities and with the intention of achieving a statistically valid sample size within five years for the priority monitoring units. The Northern Great Plains Fire Ecologist will be responsible for checking the minimum plot numbers in all units that have more than five plots installed. Each monitoring unit description delineates the variables that will be analyzed. When minimum plot numbers have been reached, objectives will be evaluated after the data have been checked to meet the assumptions of the statistical test. If the data meet the assumptions, including normality, then confidence intervals will be used for change over time comparisons. If data do not meet the assumptions, a statistician will be consulted. Correlation of Level 2 data with vegetation data can be done with either regression or multivariate analysis.

The Northern Great Plains Fire Ecologist will compare data with fire effects research that has been completed in the park and area. Inconsistencies should lead the ecologist to examine different methodologies, data interpretation, and potential research questions.

MONITORING IMPLEMENTATION SCHEDULE

Prescribed fire unit schedule

Appendix G of the Fire Management Plan identifies the planned prescribed fire schedule for the next several years. The unit rotation is based on a 5 to 15 year fire return interval. Units dominated by non-native species may require shorter burn intervals to meet desired objectives. A map of the prescribed fire units is also included (Fig. 4).

Timing of monitoring

All plots are currently monitored at peak diversity for the native vegetation approximately halfway between the peak in cool and warm season grasses. At Jewel Cave, this occurs in July and August. All plots are currently being read pre-burn, immediately post-burn, and 1, 2, 5, 10, and 20 years post-burn.

Pre-burn Sampling

Pre-burn sampling will be done during peak phenology. Plots should be installed the growing season before prescribed fires. All plots that have not burned within 2 years of installation will not be reread until that unit is again scheduled to burn. These plots can also be considered for control plots depending on long-term prescribed fire planning.

Post-burn sampling

Post-burn sampling will be done immediately post-burn and 1, 2, 5,10, and 20 years after the prescribed fire. Plots that burn in the spring will be read at peak phenology that summer, and then at the regular 1, 2, 5, 10, and 20 year schedule. The 1-Year reads for grassland plots burned in the spring are during the growing season the same year as the prescribed fire, and the 2-year read occurs in the following year. The 1-year reads for forest plots burned in the spring are during the growing season one year after the prescribed fire. Fall prescribed fires will be read the following summer as 1 year post-burn reads. If a unit is scheduled to be burned for a second or third time between reads, an additional pre-burn read will be added. For example, a unit burned in the spring of 2000 would be sampled within 4weeks following the fire, 1 year read summer 2000, 2 year read summer 2001, and 5 year read summer 2004. The unit is then scheduled to burn again in 2008. A second pre-burn read should be added summer 2007.

DATA MANAGEMENT

Other monitoring programs have shown that between 25-40% of the time associated with monitoring should be on data management. The data for Jewel Cave is collected and managed by the Northern Great Plains Fire Monitoring Team located at Wind Cave National Park, Hot Springs, South Dakota. All data collected at Jewel Cave will be entered and checked by this team at their office. Generally the seasonal field staff enters and checks data. This process is supervised the NGP Lead Monitor and Fire Ecologist. Original copies of all data will be kept at the team's office. Hard copies of the Plot Location Data Sheets will be archived at Jewel Cave in the Resource Management files. The Lead Monitor will provide monitoring data to the Jewel Cave Resource Management staff annually on CD for archiving. Data are currently entered and analyzed in the FMH software. It is backed up to the server at Wind Cave. It will be sent annually to Jewel Cave and the Midwest Regional Ecologist in conjunction with the annual report. Global positioning data of plot locations are stored on CD at the Fire Monitoring Office at Wind Cave.

QUALITY CONTROL

Data quality will be ensured through proper training of the crew in data collection and a system of checks in the data entry process. All paper and electronic data sheets will be checked by the lead crewmember before leaving a plot for data accuracy and completeness. Data will be summarized annually and results reported to the park and regional fire ecologist. A program review should happen every 3-5 years to maintain consistency of data collection and analysis and re-assessment of program requirements. More frequent review may be necessary if there are significant staffing changes, additional ecological concerns, or by request of the park or monitoring crew.

SOURCES OF DATA ERRORS

Errors in recording can be reduced by checking all data sheets for completeness and accuracy before leaving the plot. Standardized crew training at the beginning of the season will insure all data are being collected in the same manner by all crewmembers. Transcription errors will be corrected by checking all data once entered in the computer. Collecting voucher specimens and using the study collection to verify plant identifications can minimize incorrect identification of plant species. All unknown plant species will be collected or photographed and added to the unknown plant database. These photos can be used as a field reference to insure that all unknowns are consistently observed. Jewel Cave Resource Management personnel will be notified of unknowns of particular concern so special attention can be given to identify it.

The impacts of monitoring include compacting of fuels and vegetation and the collection of voucher plant specimens. Compaction can be minimized by crew

awareness as to where data are collected. Voucher specimens are not collected in the plot – if no other specimen is found, the unknown plant will be photographed and added to the unknown plant photo database. Accurate plot locations including GPS data will aid in plot location and minimize vegetative compaction. Test all directions by having new crewmembers use previously written directions to ensure accuracy. Incomplete or missing data will be corrected as soon as possible. Plot protocols need to be reviewed annually with the seasonal crew prior to beginning work to insure that data are accurately collected. Problems encountered by the field crew must be brought to the attention of the lead monitor and fire ecologist.

RESPONSIBLE PARTIES

Administrative duties will be assigned as follows:

- *Northern Great Plains Fire Ecologist*: Plan revision, crew supervision, data management and data analysis
- *Superintendent, Jewel Cave National Monument*: Park liaison
- *Northern Great Plains Lead Monitor*: Data collection, data entry, data management and field crew supervision
- *Midwest Regional Fire Ecologist*: Coordinate program reviews

MANAGEMENT IMPLICATIONS OF MONITORING RESULTS

Monitoring results will be summarized and presented to the park in the fall meeting of the Fire Committee with the NGP Fire management Officer, Prescribed Fire Specialist and Fire Ecologist. This meeting helps coordinate fire activities including prescribed fire for the park in the coming year. The annual report information can be conveyed to the Jewel Cave Resource Management Division in an additional meeting as requested.

Review of the data summary and analysis by the NGP Fire Ecologist, Prescribed Fire Specialist, and Jewel Cave Resource Management staff should determine if the current program is moving the vegetation towards the desired conditions and/or having unwanted results. Targets should be reviewed and refined, and prescribed fire prescriptions and other vegetation management techniques could be adjusted to compensate. This review could also generate questions that may lead to fire effects research being conducted in the park. Information from the Jewel Cave program could be analyzed with other parks from the NGP group as appropriate and should be presented to other parks and at scientific meetings and publications.

CONSULTATION AND COORDINATION

The Northern Great Plains Fire Monitoring Team is responsible for coordination and consultation with other parks in the group, fire management personnel, and the Midwest Regional Fire Ecologist. Jewel Cave Resource Management staff will be responsible for coordination and consultation with the park and all other cooperators.

LITERATURE CITED

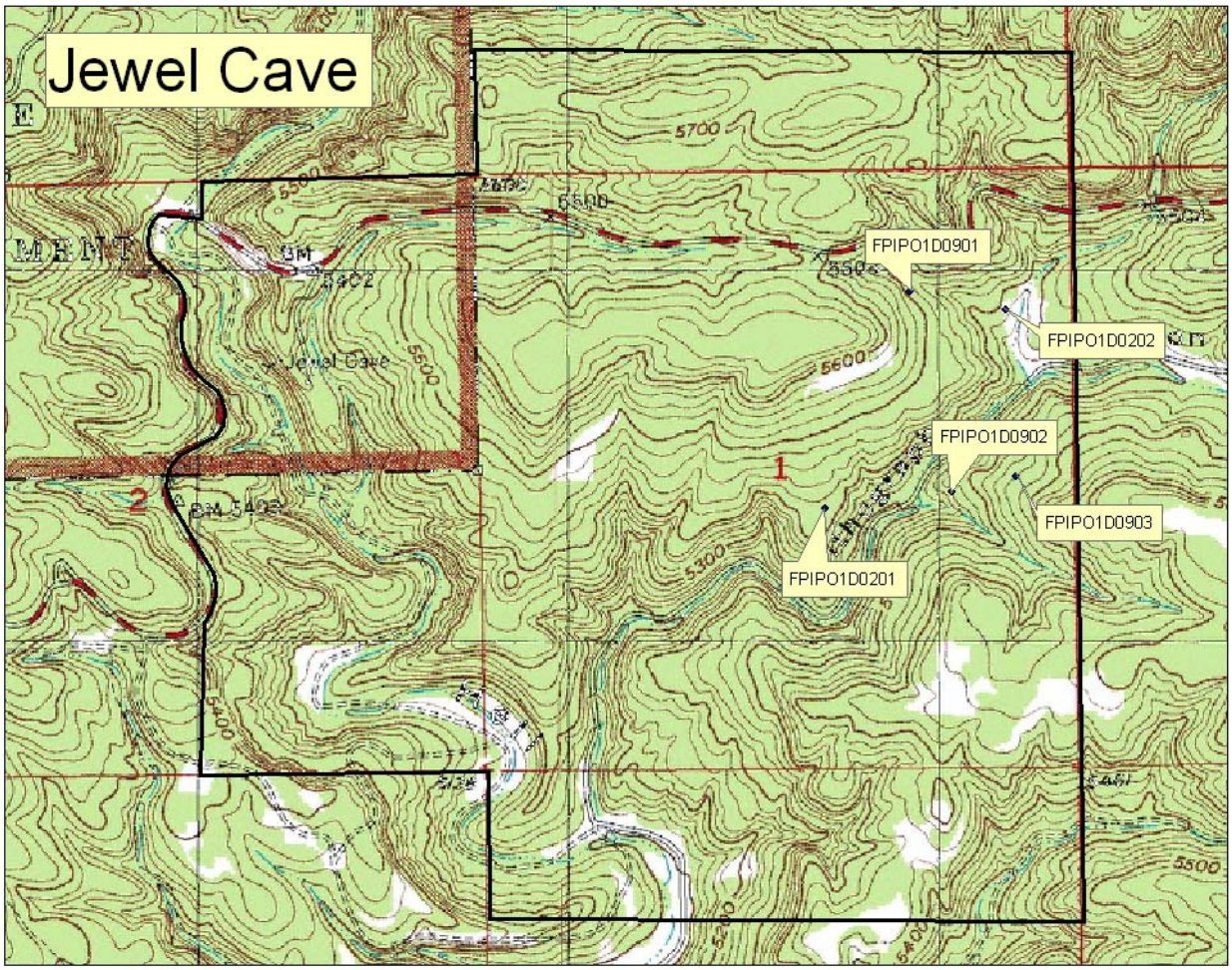
USDI National Park Service. 1998. Directors order #18: wildland fire management.

USDI National Park Service. 1999. Reference manual 18.

USDI National Park Service. 2003. Fire monitoring handbook. National Interagency Fire Center, Boise, ID. 274 pp.

FIGURES

FIGURE 1. LOCATION OF FIRE EFFECTS MONITORING PLOTS.



APPENDICES

APPENDIX 1 – MONITORING UNIT DESCRIPTION SHEETS

FMH-4 **MONITORING TYPE DESCRIPTION SHEET** Park: **JECA**

Monitoring Type Code: FPIPO1D02 **Date Described: 6/11/98**

Monitoring Type Name: Ponderosa Pine Savanna

Prepared by: A. Thorstenson, B. Kobza, G. Kemp, A. Powers, K. Paintner

Physical Description:
Gently sloping areas to steep canyons. Elevation 5000-5,700 ft.

Biological Description:
Overstory dominated by ponderosa pine *Pinus ponderosa*. Understory is predominantly little blue stem *Schizachyrium scoparium*, sideoats grama *Bouteloua curtipendula*, sedge *Carex spp*., Saskatoon serviceberry *Amelanchier alnifolia*, Rocky Mountain juniper *Juniperus scopulorum*, western snowberry *Symphoricarpus occidentalis*, smooth brome *Bromus inermis*, golden currant *Ribes odoratum*, skunkbush *Rhus aromatica*, and common chokecherry *Prunus virginiana*. Common forbs are: downy paintbrush *Castilleja sessiliflora*, spiny phlox *Phlox hoodii*, prairie ragwort *Senecio plattensis*, and stemless hymenoxys *Hymenoxys acaulis.*

Rejection Criteria:
Large outcroppings or barren areas >20% of the plot; slopes >60%; areas with anomalous vegetation; monitoring type boundaries; riparian areas or areas dominated by deciduous trees (> 30% cover); areas within 30 meters of roads, man-made trails, and human created clearings.

Burn Prescription:
Units will be burned between April until green-up, or September through November.

Fire Prescription Elements	
RH **- 25-55%**	Average Rate of Spread - 0-3 chs/hour
Bulb **- 30-85 °F**	**Live Fuel Moisture**
Average Mid-flame winds **- 0-20 mph**	1-hour TLFM **- 6-14 %**
Fuel loading **- 3-5 tons per acre**	10-hour TLFM **- 8-15 %**
Average Flame Length - **0.4-1.5 feet**	100-hour TLFM **- 10-30 %**

Burn Goals:
Reduce total fuel load, reduce overstory canopy cover, maintain native herbaceous and shrub cover, reintroduce fire into ecosystem.

Prescribed Fire Objectives:

Immediate Post Burn

- Reduce total fuel loading by at least 60% immediate postburn.
- Maintain herbaceous and shrub cover.

Two Years Post Burn

- Reduce overstory density by 15-30% within 2 years
- Limit mortality of deciduous trees to 20% or less
- Preserve multi-aged stands of Ponderosa pine.
- Reduce homogenous pockets of pole sized Ponderosa

Fire Monitoring Variables (in order of importance**) :**

- Total fuel load
- Density of overstory and pole-sized ponderosa pine
- Total understory cover
- Total shrub density.

Selection Criteria:
Areas dominated by Ponderosa pine with a minimum of 7 overstory trees per plot. Understory composed of grass, forbs, and shrubs.

Notes: Shrub density will be collected for rhizomatous species such as snowberry by a stem count method.

FMH-4 PLOT PROTOCOLS

GENERAL PROTOCOLS		YES	NO		YES	NO
Preburn	Control Plots/Opt		•	Herb Height/Rec	•	
	Herbaceous Density/Opt		•	Belt Transect Width: 5 meters *		
	OP/Origin Buried		•	Abbreviated Tags	•	
	Voucher Specimens/Rec	•		Stakes Installed: 17		
	Stereo Photography/Opt		•	Crown Intercept/Opt		•
	Brush Individuals/Rec		•	Herb. Fuel Load/Opt		•
	Herbaceous Data Collected at: **Q4-Q1**					
	*** see notes section.**					
Burn	Duff Moisture/Rec		•	Flame Zone Depth/Rec	•	
Postburn	Herbaceous Data/Opt: FMH - 17			Herb. Fuel Load/Opt		•
	100 Pt. Burn Severity/Opt		•			

FOREST PLOT PROTOCOLS		YES	NO		YES	NO
Overstory	Area sampled: 50 x20m			Quarters Sampled: Q1-Q4		
	Tree Damage/Rec	•		Crown Position/Rec	•	
	Dead Tree Damage/Opt		•	Dead Crown Position/Opt	•	
Pole-size	Area Sampled: 25 x10m			Quarters Sampled: Q1		
	Height/Rec	•		Poles Tagged/Rec		•
Seedling	Area Sampled: 5 x 10m			Quarters Sampled: Subset of Q1		
	Height/Rec	•		Seedlings Mapped/Opt		•
Fuel Load	Sampling Plane Length: 6, 6, 12, 100, 100			Fuel Continuity/Opt		•

	Aerial Fuel Load/Opt		•			
Postburn	Char Height/Rec	•		Mortality/Rec	•	

Rec = Recommended Opt = Optional

FMH-4 **MONITORING TYPE DESCRIPTION SHEET** Park: **JECA**

Monitoring Type Code: FPIPO1D09 **Date Described:** 6/11/98

Monitoring Type Name: Ponderosa Pine Forest

Prepared by: A. Thorstenson, B. Kobza, G. Kemp, A. Powers, K. Paintner

Physical Description:
Gently sloping areas to steep canyons. Elevations from 5000 - 5,700 ft.

Biological Description:
Overstory dominated by ponderosa pine *Pinus ponderosa*. Understory is predominantly little blue stem *Schizachyrium scoparium*, sideoats grama *Bouteloua curtipendula*, sedge *Carex spp.*, Saskatoon serviceberry *Amelanchier alnifolia*, Rocky Mountain juniper *Juniperus scopulorum*, western snowberry *Symphoricarpus occidentalis*, smooth brome *Bromus inermis*, golden currant *Ribes odoratum*, skunkbush *Rhus aromatica*, and common chokecherry *Prunus virginiana*. Common forbs are: downy paintbrush *Castilleja sessiliflora*, spiny phlox *Phlox hoodii*, prairie ragwort *Senecio plattensis*, and stemless hymenoxys *Hymenoxys acaulis.*

Rejection Criteria:
Large outcroppings or barren areas >20% of the plot; slopes >60%; areas with anomalous vegetation; monitoring type boundaries; riparian areas or areas dominated by deciduous trees (> 30% cover); areas within 30 meters of roads, man-made trails, and human created clearings.
Notes: Brush density will be collected for rhizomatous species such as snowberry by a stem count method.

Burn Prescription:
Units will be burned between April until green-up, or September through November.

Fire Prescription Elements	
RH **- 25-55%**	**AVERAGE RATE OF SPREAD** - 0-3 CHS/HOUR
Bulb **- 30-85 o F**	**LIVE FUEL MOISTURE**
Average Mid-flame winds **- 0-20 mph**	1-hour TLFM **- 6-14 %**
Fuel loading **- 3-5 tons per acre**	10-hour TLFM **- 8-15 %**
Average Flame Length - **0.4-1.5 feet**	100-hour TLFM **- 10-30 %**

Fire Management Objectives:

Immediate Post Burn

- Reduce total fuel loading by at least 60% immediate postburn

Two Years Post Burn

- Reduce overstory density by 15-30% within 2 years
- Maintain herbaceous and shrub cover.
- Limit mortality of deciduous trees to not greater than 20%.
- Preserve multi-aged stands of Ponderosa pine.
- Reduce homogenous pockets of pole sized Ponderosa.

Monitoring Variables (in order of importance):

- Total fuel load
- Density of overstory ponderosa pine
- Total understory cover
- Total brush density.

Selection Criteria: Areas dominated by Ponderosa pine with a minimum of 10 overstory trees per plot.

FMH-4 PLOT PROTOCOLS

GENERAL PROTOCOLS		**YES**	**NO**		**YES**	**NO**
Preburn	Control Plots/Opt		•	Herb Height/Rec	•	
	Herbaceous Density/Opt		•	Belt Transect Width: 5 meters *		
	OP/Origin Buried		•	Abbreviated Tags	•	
	Voucher Specimens/Rec	•		Stakes Installed: All		
	Stereo Photography/Opt		•	Crown Intercept/Opt		•
	Brush Individuals/Rec		•	Herb. Fuel Load/Opt		•
	Herbaceous Data Collected at:			**Q4-Q1**		
	*** see notes section.**					
Burn	Duff Moisture/Rec		•	Flame Zone Depth/Rec	•	
Postburn	Herbaceous Data/Opt: FMH - 17			Herb. Fuel Load/Opt		•
	100 Pt. Burn Severity/Opt		•			

FOREST PLOT PROTOCOLS		**YES**	**NO**		**YES**	**NO**
Overstory	Area sampled: 50 x20m			Quarters Sampled: Q1-Q4		
	Tree Damage/Rec	•		Crown Position/Rec	•	
	Dead Tree Damage/Opt		•	Dead Crown Position/Opt	•	
Pole-size	Area Sampled: 25 x10m			Quarters Sampled: Q1		
	Height/Rec	•		Poles Tagged/Rec		•
Seedling	Area Sampled: 5 x 10m			Quarters Sampled: Subset of Q1		
	Height/Rec	•		Seedlings Mapped/Opt		•
Fuel Load	Sampling Plane Length: 6, 6, 12, 50, 50			Fuel Continuity/Opt		•
	Aerial Fuel Load/Opt		•			

			•			
Postburn	Char Height/Rec	•		Mortality/Rec	•	

Rec = Recommended Opt = Optional

LONG TERM PHOTO MONITORING SHEET

Plot # _____ **Park: _____** **Date: _____**

Burn Unit: _____ **Recorders: _____**

UTM Zone:_____	**Camera height: _____ft.**	**Elevation: _____ft**
UTMN:_____	**Lens size: _____mm**	**Slope along transect: _____%**
UTME:_____	**Distance from pole: _____ft.**	**Slope of terrain: _____%**
Datum:_____	**Azimuth from camera to pole: ____**	**No. of Photos Taken: _____**
EPE:_____	**Height on pole used for shot: _____ft**	**Compass Bearing(s):**

Describe the route to the plot, include or attach a hand drawn map illustrating these directions, including the plot layout, and significant features:

Visit	Initial/ Date	Comments
Install/Pre		
Immediate Post		
1 Year Post		
2 Year Post		
5 Year Post		
10 Year Post		

APPENDIX G

G. PRE-ATTACK PLAN

Table 19 – Pre-Attack Plan

Function/Item	Available	Needed	Not Needed
Command			
Pre-attack WFSA			
Pre-positioning Needs			
Draft Delegation of Authority	X		
Management Constraints	X		
Interagency Agreements	X		
Evacuation Procedures			
Structural Protection Needs	X		
Closure Procedures			
Operations			
Water Sources	X		
Control Line Locations			
Natural Barriers	X		
Safety Zones			
Flight Routes/Restrictions			
Staging Area Locations			
Helispot/Helibase Locations			
Logistics			
ICP Location			
Roads/Trails with Limitations	X		
Utilities	X		
Medical Facilities	X		
Stores/Restaurants/Services	X		
Rental Equipment Sources			
Construction Contractors			
Sanitary Facilities	X		
Law Enforcement/Fire Departments	X		
Communications (availability)			
Maintenance Facilities	X		
Sanitary Landfills	X		
Planning			
Park Base Map	X		
Area Topographic Maps	X		
Infrared Imagery			
Vegetation/Fuel Maps			
Hazard Maps (ground and aerial)	X		
Special Visitor Use Areas			
Land Ownership Status			X
Archeological/Cultural Resource Maps	X		
Sensitive Plant Area Maps			

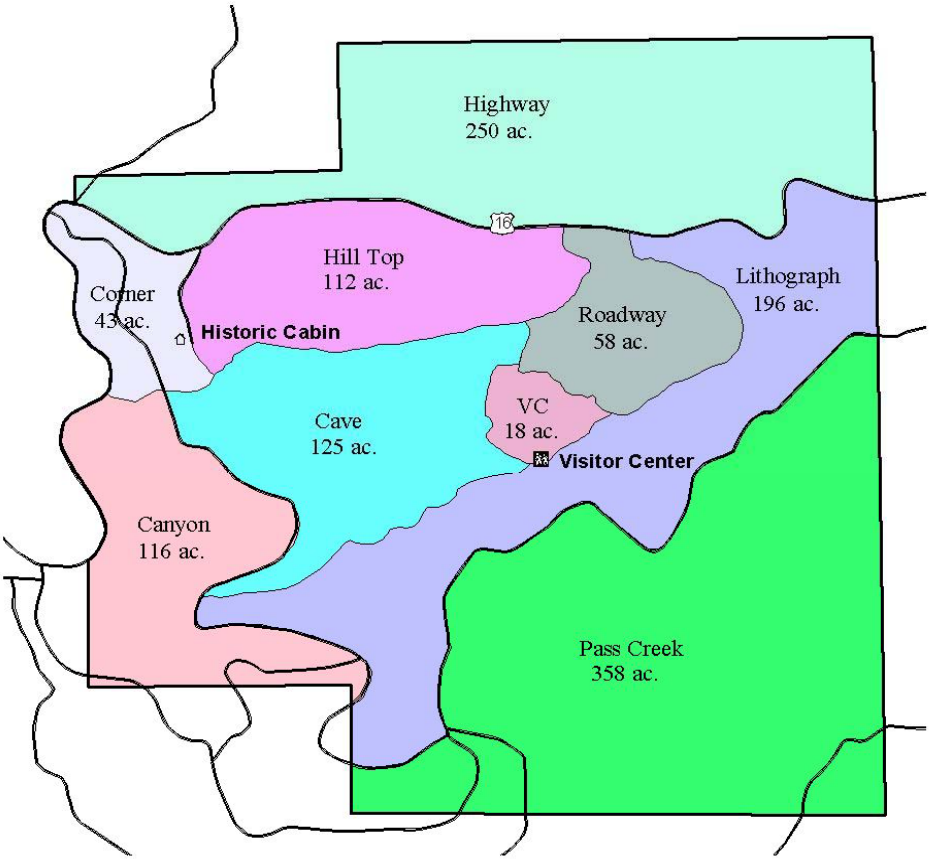
APPENDIX H

H. LONG-TERM PRESCRIBED FIRE AND HAZARD REDUCTION PLAN

1. Multi-year prescribed fire schedule

Highway	Pass Creek	Roadway
Corner	Canyon	VC
Hill Top	Cave	Lithograph

Jewel Cave
Prescribed Fire Map



APPENDIX I

I. STEP-UP PLAN

Table 20 – Step-up Plan

Staffing Class SC	Fuel Model	Burning Index	Step up Actions
SC-1	C	0-10	Monument will continue with normal operations. Emphasis on equipment maintenance.
SC-2	C	11-20	All actions under SC-1 plus the following: Engine should be fully equipped and filled.
SC-3	C	21-42	All actions under SC-2 plus the following: Staff notified of fire weather conditions. Prevention plan implemented. Fire awareness incorporated in public contacts. Record of available staff and locations maintained. Under unusual conditions, the FMO or Monument Superintendent may upgrade the staffing level from SC-3 to SC-4 if there is an unusually high level of visitor use, a possibility of lightning caused fires being detected, or if the National Fire Danger Rating System (NFDRS) appears to under-predict the actual fire danger.
SC-4	C	43-51	All actions under SC-3 plus: Northern Great Plains FMO may open emergency preparedness account. Overtime may be authorized to enhance fire preparedness by firefighters working their days off or after normal working hours in the evening to staff the engine. Off-duty roster kept of trained personnel. Primitive road use restricted in tall grass areas. Use of chainsaws for other than fire suppression curtailed.

Staffing Class SC	Fuel Model	Burning Index	Step up Actions
			May supplement Monument personnel with outside overhead, crews and equipment as unwanted wildfire occurrence increases. Automatic dispatch of USFS personnel and helicopter to reported fires per Memorandum of Understanding between NPS and Black Hills National Forest.
SC-5	C	52+	All actions under SC-4 plus: Additional fire qualified personnel may be on paid standby duty and readily available for suppression.

APPENDIX J

J. FIRE PREVENTION PLAN

JEWEL CAVE NATIONAL MONUMENT

WILDLAND FIRE PREVENTION PLAN

PREPARED BY:

Chief Ranger, Jewel Cave NM

APPROVED BY:

_____

Superintendent, Jewel Cave NM

_____

Northern Great Plains Area, Fire Management Officer

PREVENTION PLAN

A. OBJECTIVES

To reduce the threat of human caused wildland fires through employee and visitor awareness and education.

To reduce the threat of human caused wildland fires arising from improper practices and procedures of residential and outdoor working employees.

B. GENERAL ACTIONS

All NPS employees, volunteers, and cooperative association employees shall be responsible for becoming familiar with this document and the implementation of its policies.

Surface interpretive programs will be developed and presented to integrate wildland fire and its prevention as alternative resource management programs.

Two wildland fire level danger signs will be .manufactured and located within the monument. Locations to install them are on Route 16 at the east and west entrances of the monument.

Fire prevention will become a topic discussed at each safety meeting.

Annual inspection of monument for potential risk areas.

Patrols of Monument road system on Red Flag Warning days.

HUMAN-CAUSED FIRES 1991-2001

In the ten year study period, there have been three human-caused fires affecting Jewel Cave NM, two occurring on the unit in 1991. The third, in 2000, started on Forest Service lands near the boundary and burned about 95% of the Monument.

Of significance is the decrease in visitor use from 152,893 in 1991 to 125,593 in 2001.

Human-caused fires are not expected to increase in numbers or frequency, although drier weather patterns may facilitate ignition and spread in some years.

SPECIFIC FIRE PREVENTION ZONE RATINGS/ACTION ITEMS

FP ZONE #1 - SERVICE AND RESIDENTIAL AREA

RISK

High During fire season, residential occupation is at maximum. All permanent residences and the maintenance shop are equipped with wood burning stoves. The stoves experience most use during winter, which is the driest season.

HAZARD

Moderate Patchy stand of Ponderosa pine with flashy grass understory. Some amount of dead and dying material resulted from Jasper Fire.

VALUE

High Maintenance structures, Visitor Center and residential housing are located in this area.

SPECIFIC PREVENTION ACTIONS REQUIRED

1. Initiate hazardous fuel reduction program to include inspection and mechanical removal of hazardous materials from around structures and residences.

2. Inspect area annually and monitor throughout fire season for compliance.

3. Education for residents.

Responsible Persons:

Chief Ranger

FP ZONE #2 HISTORIC AREA

RISK

High Significant visitor use in area for picnicking waiting for tours during fire season.

HAZARD

Moderate Patchy ground and aerial fuels with paved road parking lots. Some amount of dead and dying material resulted from Jasper Fire.

VALUE

High Location of historic cabin, old growth timber, archeological remains of CCC camp.

SPECIFIC PREVENTION ACTIONS REQUIRED

1. Ranger contacts/enforcement.

2. Integrate prevention theme into interpretive talks.

Responsible Persons:

Chief Ranger
Seasonal Interpreter Supervisor

FP ZONE #3 -REMAINDER OF MONUMENT

RISK

Low Very little visitor recreational use. Change in use patterns of US RT 16 traffic may cause further review of risk assessment.

HAZARD

Moderate Steep to moderate slopes covered with thick to patchy Ponderosa pine overstory with grassy ground cover. Some amount of dead and dying material resulted from Jasper Fire.

VALUE

Moderate Minimal number of outbuildings with no cultural resources. Forested area is not merchantable and value is based on aesthetic panoramic view.

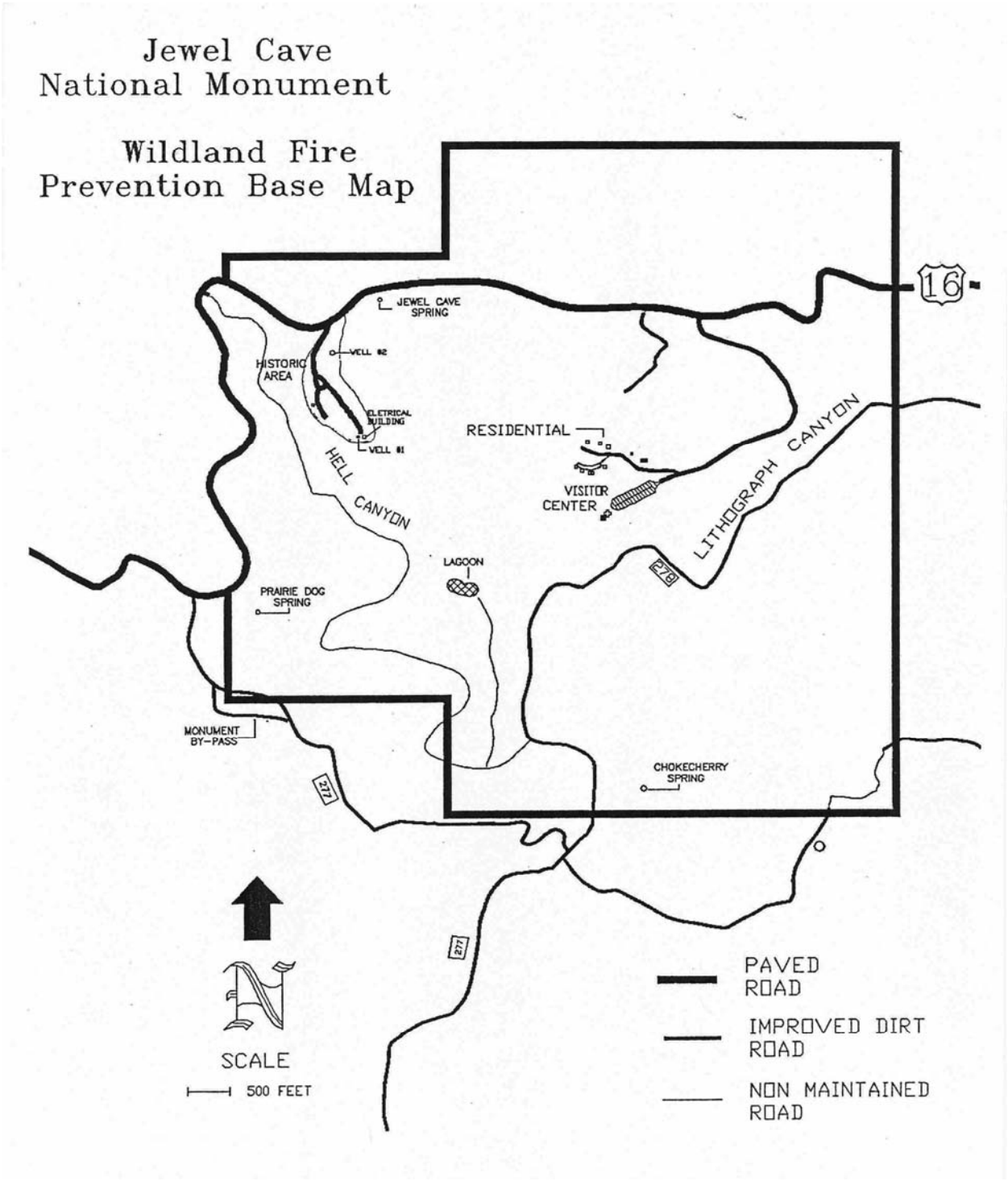
SPECIFIC PREVENTION ACTIONS REQUIRED

1. Covered in the General Actions section.

Responsible Person:

Chief Ranger

Figure 3 – Prevention Plan Base Map



APPENDIX K

K. RENTAL EQUIPMENT AGREEMENTS

No current agreements for rental equipment.

APPENDIX L

L. CONTRACTS FOR SUPPRESSION AND PRESCRIBED FIRE RESOURCES

No current contracts for suppression or prescribed fire resources.