National Park Service
U.S. Department of the Interior

Guadalupe Mountains National Park
Texas

Fire Management Plan
Environmental Assessment
2005

Fire Management Plan
Environmental Assessment
GUADALUPE MOUNTAINS NATIONAL PARK
Texas

Guadalupe Mountains National Park, located 110 miles east of El Paso, Texas, needs to update its fire management plan to incorporate new policies and advances in fire research and operations. Fire management plan goals regard safety as the highest priority, then focus on protection of sensitive resources from fire, use of fire to accomplish resource management objectives, monitoring effects of fire program activities, and also require that the process be open and cooperative. Three alternatives are retained for analysis in this Environmental Assessment. The No Action Alternative allows wildland fire use over most of the park, but conservative decision criteria result in suppression of virtually all natural ignitions. Alternative A allows wildland fire use under less restrictive criteria throughout the park backcountry areas and calls for automatic suppression only in areas containing park developments and burnable historic structures. Alternative B pushes the boundaries of the managed area north to include Upper North McKittrick Canyon on USDA Forest Service land in the state of New Mexico. Alternative B, the National Park Service and environmentally preferred alternative, thus includes an active partnership with Lincoln National Forest Guadalupe Ranger District. Fire management strategies employed at Guadalupe Mountains National Park would generally result in some short-term, minor adverse effects but long-term beneficial effects to life and property, visitor experience, cultural resources, vegetation and wildlife, unique sites and wilderness, erosion and debris flow, and air quality.

If you wish to comment on this environmental assessment, you may mail comments to the name and address below. This environmental assessment will be available for public review for 30 days. Comments shall be received until March 7, 2005. Please note that names and addresses of people who comment become part of the public record. If you wish to have your name and/or address withheld, you must state this prominently at the beginning of your comment. All submissions from organizations and businesses, or from individuals identifying themselves as representatives or officials of organizations or businesses, shall be made public in their entirety.

Direct questions and send comments to:
Superintendent
Guadalupe Mountains National Park
HC 60 Box 400
Salt Flat, TX 79847

Executive Summary

Overview

Guadalupe Mountains National Park needs to update its fire management plan (FMP) to incorporate new policies and advances in fire research and operations. FMP goals regard safety as the highest priority, then focus on protection of sensitive resources from fire, use of fire to accomplish resource management objectives, monitoring effects of fire program activities, and the requirement that the process be open and cooperative. Three alternatives are retained for analysis in the environmental assessment (EA).

Members of the public, federal, state, and local agencies, and the National Park Service (NPS) identified important issues during two scoping periods. An internal scoping meeting took place in March 2002. On October 10, 2002, the public scoping period was announced with the publication in the Federal Register of a Notice of Intent to prepare an Environmental Impact Statement (EIS) for an updated Guadalupe Mountains FMP. The park jointly held four public meetings with neighboring Carlsbad Caverns National Park in November 2002. The parks lie five miles apart, display similarities in vegetation and geology, share a Fire Management Officer and other fire staff, and are operating on similar schedules for updating their FMPs. As Guadalupe Mountains National Park progressed on compliance for NEPA, federally listed species, and cultural resources, analyses showed an absence of significant adverse effects. Thus a Notice of Intent was published in the Federal Register on December 17, 2004 to produce an EA rather than an EIS. The level of analysis of effects is the same for both documents, the approval process, however is more streamlined for an EA because it discloses findings of no significant impacts to the environment from proposed management actions, where as an EIS discloses significant impacts.

The EA is comprised of five major sections: purpose and need (that outlines major fire program goals and objectives), alternative actions, description of the affected environment, environmental consequences, and consultation and coordination. The document presents a range of fire management alternatives, dismisses unreasonable ones, and looks at how well the remaining alternatives meet the program goals. It identifies the core issues that are likely to be affected by fire management activities. Finally, it identifies the environmental consequences likely to result as the alternatives impact each issue.

Alternatives

The *No Action Alternative* (continuing the direction in the 1996 FMP) allows wildland fire use over most of the park, but suppression of virtually all natural ignitions continues. The 1996 FMP also encourages a cooperative approach with neighboring landowners, and to date collaboration has taken the form of long-standing (and successful) interagency suppression practices. Administrative considerations have tended to be the cause of “no-go” decisions for wildland fire use. During fire season, resource (fire crews and equipment) availability is frequently a problem. Needed personnel to manage wildland fire use, particularly fire use managers, are rarely available. No-go decisions can also result from the perceived need to give the fire-weary public a rest, and local fires that otherwise might benefit resources are suppressed during regionally active fire seasons.

Alternative A allows wildland fire use under less restrictive criteria throughout the park backcountry areas and calls for automatic suppression only in areas containing park developments and burnable historic structures. Alternative A keeps program activities inside the park boundary. Alternative A defines a relatively small fire management unit (FMU) #1 surrounding (1) the visitor center area and the facilities and residences south of the highway and (2) the developed area at Dog Canyon. This FMU applies full suppression and prescribed burning, limited non-fire fuels treatments, and no wildland fire use. The rest of the park comprises the second FMU, with protection emphasis for special features, such as historic properties, McKittrick Canyon, and habitats of threatened and endangered species.

Under *Alternative B* (preferred), NPS and the Forest Service (USFS) co-manage fire activities on a 2000-acre area north of the park on the Guadalupe Ranger District of the Lincoln National Forest that contains the headwaters of McKittrick Canyon, an important park watershed. This arrangement contrasts with the No Action Alternative (continuing the direction of the 1996 FMP), which describes a cooperative arrangement but has not resulted in joint activities beyond suppression. Alternative A dictates that NPS manage within its boundaries, although fire would be allowed to exit the park when stopping it proves too dangerous.

Under Alternative B's FMU #2, wildland fire use, prescribed fire, non-fire fuels treatments, and suppression are management options. FMU #2 extends across the north boundary to include portions of the McKittrick Canyon watershed that lie on Forest Service land. The park will cooperate with the USFS on prescribed fire, wildland fire use, and fire effects monitoring, as well as appropriate management response activities (refer to Appendix A for the glossary of FMP terms). Projects along the park's north boundary would be expanded to include appropriate forest lands. Suppression will be the rule along portions of the park boundary adjacent to private property.

Under Alternative B, fire use managers will be available to oversee wildland fire use at Guadalupe Mountains National Park whenever needed. In addition, local and regional administrators will tolerate higher levels of risk to property in the short term when declaring fire use, in order to lessen the danger in the long term of high-severity fires. Threats to life are, however, the first consideration in making wildland fire use decisions. As under No Action, the park will use non-fire means to prepare burn units and to reduce fuels around significant natural resources, unique sites, and cultural resources, especially flammable historic structures. Minimum impact management and rehabilitation practices are implemented as under No Action (1996 FMP).

Elements Common to All Alternatives

Appropriate Management Response

Automatic suppression of all wildland fires is no longer the rule in national parks. "Appropriate management response" in fire operations jargon refers to specific actions taken in response to a wildland fire to meet protection and fire use objectives. Under all the reasonable alternatives, the appropriate management response is developed from analysis of the local situation, values-to-be-protected, management objectives, external concerns, and land use. Suppression or containment of a fire in a larger area could be appropriate management responses. The NPS would continue to

suppress all human-caused (non-prescribed) fires in a manner that causes the least damage to resources, people, and property. All wildland fires would be monitored daily or more frequently in accordance with the Fire Monitoring Handbook and the Wildland Fire Situation Analysis. The park will continuously update information on fire size, location, behavior, smoke dispersal, safety conditions, and effects.

Prescribed Fire Program
Prescribed fires are intentionally ignited to accomplish objectives, such as restore grasslands or thin forests and woodlands. Burns take place in specific areas under predetermined conditions identified in approved burn plans. Common to the three alternatives retained for analysis is a schedule of prescribed burns through approximately 2009. A certified National Wildfire Coordinator Group Prescribed Burn Boss will supervise and appropriate levels of staffing will be available for each prescribed fire under all three alternatives. Fire behavior and weather will be monitored during all prescribed fires. The Fire Monitoring Handbook will be used as a basis for monitoring. The park acknowledges that multiple burns will be needed to recreate the conditions that allow wildland fire to play its natural role. Lessons from past burns continue to be incorporated into the planning for future burns.

Non-fire Fuels Treatments
Under all alternatives, the park may use non-fire means to reduce fuel loads and create fuel breaks around developments. To date, the park has used mechanical treatments around park infrastructure and historic buildings to reduce fuel loads. Some mechanical fuel reduction has also been carried out as pretreatment in prescribed burn units. There are no plans to use non-fire fuels treatments on a large scale. The amount of future clearing depends on the resources needing protection and the amount and type of surrounding vegetation.

Minimum Impact Management
Minimum impact management philosophy guides the selection of management response, especially in wilderness. Park staff will manage wildland fire use and suppression in ways that minimize unnecessary impacts to resources and convey the importance of this strategy to all fire management forces. Minimum impact management strives to minimize landscape alteration and disturbance to natural and cultural resources while safeguarding human lives and accomplishing resource-related objectives. Without compromising safety, lines will be located where they do the least damage, minimize tree cutting, and use natural firebreaks when possible. Staging areas will be placed with care. Agency resource advisors will be consulted prior to implementing management tactics.

Despite the best intentions of minimum impact management, wildland fire actions often create the need for short-term or long-term rehabilitation. Staff will consult with specialists (archeologists, hydrologists, geologists, paleontologists, plant ecologists, wildlife biologists) to determine short- and long-term needs and to write rehabilitation plans for each fire. They then will implement and monitor the plans. Common rehabilitation recommendations include flush cutting stumps, brushing in handlines, removing all trash, installing erosion control devices, planting in burned areas, and felling hazardous trees.

Environmental Impacts

The Guadalupe Mountains NP inter-disciplinary team agreed on the following areas for analysis of the effects of the three fire program alternatives:

Impact topic 1: Life and Property
Fire is an effective tool for reducing hazard fuels, but it is also a threat to the public, firefighters, park staff, developed areas, and neighboring properties.

Impact topic 2: Visitor Experience
Potential restrictions on access to burning areas, road closures, and smoke can alter visitor experience, but the fire program also provides interpretive opportunities.

Impact topic 3: Cultural Resources
Fire may help reduce surrounding hazard fuels and maintain the historic scene, but historic structures, landscapes, and artifacts may incur fire damage.

Impact topic 4: Vegetation
Fire will benefit many species populations in the long term but will kill and injure some individual plants in the short term; prudent application of fire maintains desirable mosaic patterns of vegetation.

Impact topic 5: Wildlife
Fire will benefit many species populations in the long term but will kill and injure some individual animals in the short term.

Impact topic 6: Unique Sites and Sensitive Species
Fire could alter unique sites and affect endemic or uncommon species.

Impact topic 7: Non-indigenous Species
Fire may aid invasion of non-indigenous species but may also prove to be a control tool.

Impact topic 8: Geology and Geohazards
Removal of vegetation by fire can contribute to erosion, flooding, and damage of fossils.

Impact topic 9: Air Quality
Smoke from fires can be unhealthy and temporarily impact visibility.

Fire management strategies employed at Guadalupe Mountains National Park would generally result in some short-term, minor adverse effects but long-term beneficial effects to life and property, visitor experience, cultural resources, vegetation, wildlife, unique sites and sensitive species, geology and geohazards, and air quality. Fire program activities may contribute to increased spread of non-indigenous plants, and such adverse effects would require more vigilant monitoring and eradication efforts.

Cooperative fire management of North McKittrick Canyon, the NPS and environmentally preferred Alternative B, benefits the integrity of the McKittrick Canyon watershed in the park.

Allowing typical wind-driven fires moving southwest to northeast to cross the forest boundary in steep, rugged terrain is safer than trying to suppress them. The Lincoln National Forest limits fuel treatment activities (non-fire treatments such as thinning) to areas where buildups threaten life, property, or high resource value areas. Fuel treatments are planned such that goals apply to the project area as a whole and not on a per-acre basis.

This cooperative plan is a step toward multi-agency/owner fire management for the entire Guadalupe Mountains landscape sometime in the future. This alternative recognizes that restoring fire and using a mixture of prescribed fire and wildland fire benefits the park's ecological communities.

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Chapter I: Introduction

Guadalupe Mountains National Park, established in 1972, covers 86,416 acres of mountain and desert land in Texas on the Texas-New Mexico border (Figure I-1). The park is located 110 miles east of El Paso, Texas and 55 miles southwest of Carlsbad, New Mexico, and encompasses the highest and southernmost portion of the Guadalupe Mountains. Rising from the desert plain, this mountain mass contains portions of the Capitan Reef, the world's most extensive and significant Permian limestone fossil reef. The canyons within the park, particularly McKittrick Canyon on the northeast end, provide dramatic displays of geological sequences and contain relict and unusual plant communities. Of the area within the park's boundaries, 46,850 acres are Congressionally-designated wilderness.

Changes in NPS policies, philosophies, and terminology, as well as new resource information, require that a new fire management plan (FMP) be developed. The plan guides all aspects of a park's fire program. The NPS goal of FMP updates at five year intervals recognizes the continually changing fire context within parks. The existing plan at Guadalupe Mountains National Park was authorized in 1996.

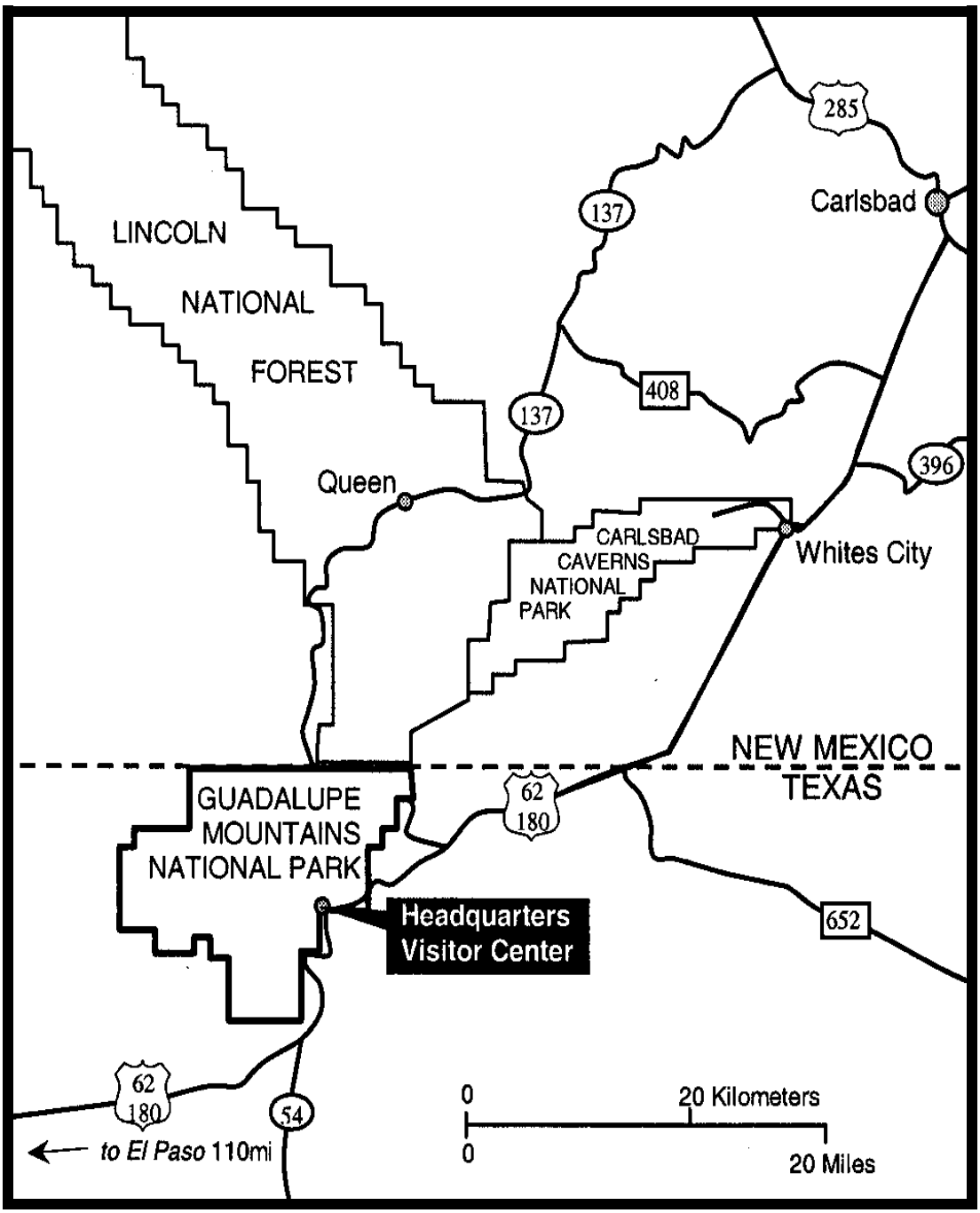
This Environmental Assessment for the 2005 FMP develops three alternatives. The first of the three is the No Action Alternative that would maintain the four fire management units (FMU) described by the 1996 FMP. The second alternative designates a small FMU around park developments with full suppression and prescribed burning as management options. The rest of the park makes up the second unit, where wildland fire use, prescribed fire, suppression, and non-fire fuels treatment would be tools for fire management. The third alternative would extend FMU #2 of the second alternative across the northern boundary to include portions of the McKittrick Canyon watershed that lie on Forest Service land. This alternative would be a step toward cooperative fire management of the Guadalupe Mountains on a landscape scale.

Purpose and Need

The *purpose* of the proposed action is to implement a new FMP at Guadalupe Mountains National Park. The approved plan will provide a framework for making fire-related decisions and serve as an operations manual. The document specifies and justifies fire management goals and objectives. Laws and policies decree some of the elements, while others have been decided by the parties, including the public, that have participated in the process of creating the plan.

The proposed action is *needed* because the existing FMP was approved in 1996. The NPS goal of FMP updates at five year intervals acknowledges the rapidly changing fire context in parks—a new plan will help bring practices up to date with knowledge.

Figure I-1. Location of Guadalupe Mountains National Park



Ecologists are increasing our understanding of the role of fire in biotic communities. Fire scientists are learning more about fire behavior as firefighting techniques also improve. Policies have been rewritten to incorporate these advances as well as to respond to growing concern at many levels about the legacy of the fire suppression era. High-severity events are now occurring where historically, frequent, low-intensity fires formerly kept fuel buildup in check.

Recent experience with fires in the Guadalupes has also increased the knowledge base and needs to be incorporated into the new plan. Formal records and the collective memory of people within and surrounding the park offer insights into local fire history and behavior that assist fire planning. A new FMP will also incorporate increased understanding of the use and suitability of standard fuel models to the vegetation in the park.

Regulations and Policies

The NPS recognizes the occurrence as well as the absence of fire as important factors influencing parks. Fire management policies are set forth in section 4.5 of 2001 NPS Management Policies (NPS 2001) and are summarized below:

- fire management programs will meet resource management objectives while ensuring protection of life and property
- parks with vegetation capable of burning will prepare FMPs and address funding and staffing required by fire programs
- fire plan development will include the NEPA compliance process and necessary collaborations with outside parties
- fires in vegetation are to be classified as wildland or prescribed fires
- wildland fires are managed according to considerations of resource values, safety, and cost
- prescribed fires are ignited to achieve resource management goals and closely monitored to determine whether they successfully meet objectives
- parks lacking approved plans must suppress all wildland fires using methods that minimize impacts while protecting life, property, and resource values
- suppression in wilderness will adhere to the minimum tool concept (NPS 2001)

Many other plans and policies direct the formulation of the FMP and the environmental analysis that supports it:

- Archaeological Resources Protection Act (1979) – provides for the protection of archeological resources on public lands
- American Indian Religious Freedom Act (1978) – protects access to sites, use and possession of sacred objects and freedom to worship through ceremonials and traditional sites
- Clean Air Act (as amended 1990) – includes national ambient air quality criteria; states that federal land managers have an affirmative responsibility to protect air quality related values from adverse impacts
- A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan (National

Interagency Fire Center 2002) – outlines a comprehensive approach to the management of wildland fire, hazardous fuels, and ecosystem restoration and rehabilitation on Federal and adjacent State, tribal, and private forest and range lands in the United States.

- Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making (NPS 2001, revision pending) – interprets the National Environmental Policy Act for the NPS
- Director's Order 18: Wildland Fire Management: (NPS 1998) – expresses NPS fire policy
- Endangered Species Act (1973) – provides for listing and protection of endangered and threatened species and their critical habitat; requires consultation under Section 7 if any listed species may be adversely affected
- Executive Order 11988: Floodplain Management (1977) – provides for the protection of floodplains
- Executive Order 11990: Wetlands Protection (1977) – provides for the protection of wetlands
- Federal Water Pollution Control Act (1972; amended as "Clean Water Act" in 1977) - limits discharges into US waters to maintain water quality
- Federal Wildland Fire Management Policy (1995) and Review and Update (National Interagency Fire Center 2001) – provides a common approach to wildland fire management for U.S. Department of Interior agencies and the USFS
- Guadalupe Mountains National Park General Management Plan (2005) – determines overall management direction for the park for 15 to 20 years
- Guadalupe Mountains National Park Resources Management Plan (NPS 1992) – sets natural and cultural resources management and research priorities
- Managing Impacts of Wildland Fires on Communities and the Environment, and Protecting People and Sustaining Resources in Fire Adapted Ecosystems—A Cohesive Strategy (USDOI/USDA 2002) – manages the impact of wildland fires on communities and the environment
- National Fire Plan (2001) – manages the impact of wildland fires on communities and the environment
- National Parks and Recreation Act (1978) – requires park management to provide measures for the preservation of the area's resources, consider how development affects public enjoyment, identify visitor carrying capacity, and propose any changes to boundaries
- National Park Service Organic Act (1916) – defines NPS management responsibilities as conserving scenery, natural and historic objects, and wildlife to provide for the enjoyment of future generations
- National Environmental Policy Act (1969) – requires federal agencies to consider environmental values and integrate them into their proposed actions (abbreviated as NEPA).
- National Historic Preservation Act (1966) – guides preservation of historic properties
- Native American Graves Protection and Repatriation Act (NAGPRA 1990) – provides a process for museums and federal agencies to return certain Native American cultural items to their descendants and affiliated tribes

- Reference Manual 77 (NPS 1999 and in progress) – offers comprehensive guidance to NPS employees responsible for managing, preserving, and protecting the natural resources found in National Park System units
- Wilderness Act (1964) - outlines criteria for consideration of areas as part of National Wilderness Preservation System and the restrictions that apply to use and management of these areas
- Wildland Fire Management, Reference Manual 18 (NPS 2002) – contains NPS wildland fire management requirements and procedures

General Management Plan and Resources Management Plan Objectives

Implementation of the new FMP helps the park meet some resource objectives listed in the Resources Management Plan (Guadalupe Mountains NP 1992). These address the perpetuation of native species and communities, protection of cultural resources, human safety, interpretation to the public, and enactment of NPS philosophies and policies. In addition, the FMP is a detailed program of action to carry out fire management policies and objectives.

GMP Objectives

Work on a new General Management Plan (GMP) was on-going while this FMP was developed. The October 2000 "Park Management Topic Outlines," is a document to help outline fire planning considerations (among others) for the new GMP. Major headings are fire history, current management practices, resources at risk, desired conditions, and program needs. Fire is seen as a tool for natural resource management, promoting preservation and restoration of ecosystem function, and the draft GMP offers this direction: "To the extent possible, reintroduce the natural role of fire and fire regimes in the park's ecosystem through wildland and prescribed fire options identified in the park's Fire Management Plan."

RMP Objectives

The following fire-related objectives from the Guadalupe Mountains National Park Resources Management Plan (RMP—1992*)* integrate legislative mandates with NPS policy:

- Ensure the preservation and health of endangered and park endemic species.
- Reintroduce the natural role of fire in park ecosystems to the maximum extent possible.
- Manipulate terrain and vegetative cover in order to restore natural conditions on lands altered by human activity.

Fire may be utilized as a resource management tool to meet other objectives of the Resources Management Plan**:**

- Re-establish native plants and animals upon their original range.
- Perpetuate native animal life for its essential role in natural ecosystems.
- Manipulate population numbers of exotic plant and animal species, up to and including total eradication, whenever such species threaten protection or interpretation of park resources.

USDA Forest Service (USFS)
The 1986 land management plan for the Lincoln National Forest currently permits the activities of suppression, wildland fire use, prescribed fire, and non-fire treatments proposed for the upper North McKittrick Canyon watershed under Alternative B, as described in Chapter II. Wildland fire use, however, is restricted to 1,000 acres per event. Approval of this EA and selection of Alternative B (Cooperative Watershed Plan) will expand the allowable wildland fire use acreage.

Parties to the Plan

The proposed plan is the result of work by seven broad groups of people.

- *Inter-Disciplinary Team* (IDT): The IDT is composed primarily of individuals from the park and NPS who are ultimately responsible for carrying out the plan that results from this EA. The team included expertise in natural and cultural resources, fire operations, park administration, and visitor services. The Guadalupe team also included a partner from the University of Arizona who served as overall editor for the plan and EA.
- *USDA Forest Service*: The Guadalupe Ranger District of the Lincoln National Forest, the park's neighbor to the north.
- *Other Federal Agency Cooperators*: A Biological Assessment was prepared and submitted to the United States Fish and Wildlife Service (USFWS) Ecological Services in Albuquerque on 1-27-2004. The park had initially consulted with both Texas and New Mexico USFWS Ecological Services Field Offices, and the New Mexico office became the designated lead for generating the Biological Opinion pertaining to Mexican spotted owl issues.
- *State Natural Resources Agencies:* Texas Parks and Wildlife Department (9-18-03) and New Mexico Department of Game and Fish (2-13-04) were also consulted about species requiring consideration as the park plans for fire activities.
- *Texas Historical Commission:* A Cultural Resources Component that summarizes cultural resources concerns and protection measures relative to the park fire program was submitted to the Texas Historical Commission/State Historic Preservation Office on 12-28-2004.
- *Tribal Governments*: The public scoping newsletter was sent to:
    - Apache Tribe of Oklahoma, Anadarko OK
    - Comanche Tribe, Lawton OK
    - Fort Sill Apache Tribe, Apache OK
    - Hopi Tribe, Kykotsmovi AZ
    - Jicarilla Apache Tribe, Dulce NM
    - Kiowa Tribe, Carnegie OK
    - Mescalero Apache Tribe, Mescalero NM
    - Pueblo of Isleta, Isleta NM
    - Pueblo of Zia, Zia Pueblo NM
    - Pueblo of Zuni, Zuni NM
    - San Carlos Apache Tribe, San Carlos AZ
    - White Mountain Apache Tribe, White River AZ
    - Ysleta del Sur Pueblo (Tigua), El Paso TX

- *Interested Public*: Public scoping (described in detail in Chapter II) took place during fall 2002. Public comment favored implementation of the alternative selected as environmentally preferred in this EA.

Goals and Objectives

The interdisciplinary team (IDT) developed the following goals and objectives (bulleted) for the Guadalupe Mountains National Park fire program.

Protect people and property as the highest priority.
- Provide for the safety of visitors, firefighters, and staff.
- Directly protect real and personal property from the effects of fire.
- Reduce fuels with prescribed fire and thinning in places where wildland fire is a threat to people and property.
- Implement programs to prevent unplanned human-caused ignitions and reduce human-caused wildland fires.
- Strive to meet health and safety standards that relate to fire, particularly for air quality and on-the-job safety (for example, OSHA regulations).

Protect park natural and cultural resources from undesirable effects of fire and suppression.
- Reduce fuels with prescribed fire and thinning in places where fire would adversely affect park resources.
- Employ minimum impact suppression tactics, particularly in wilderness or other sensitive areas.
- Keep fire out of sensitive areas.

Suppress unwanted fire.
- Ensure park is adequately prepared to suppress unwanted wildland fire.
- Automatically suppress human-caused fire.
- Prevent unwanted fire from spreading onto neighboring government and private lands.

Allow fire to assume its natural role in park ecosystems with justification.
- Determine fire-related data needs relative to natural resources.
- In particular, attempt to determine (1) range of natural variation related to fire (in time, space, and intensity), (2) role of fire, and (3) fire effects on species in Chihuahuan Desert and Guadalupe Mountains ecosystems.
- Search for scientific results relative to data needs and apply to fire program.
- Promote research in the park relative to data needs and apply results to fire program.
- Tap the experience of individuals familiar with fire in the Guadalupe Mountains.
- Monitor fire effects and incorporate results into fire program.
- Determine desired conditions before allowing or introducing fire.

Use wildland and prescribed fire for resource management purposes.
- Return fire to fire-dependent ecosystems.
- Specify and aim for desired conditions.

- Keep fire use within the natural range of variation (in time, space, and intensity).
- Reduce fuels in places where fire would adversely affect resources.
- Look for opportunities to use fire to restore and maintain cultural landscapes.

Manage fire cooperatively with neighboring agencies and private land owners as well as other stakeholders.

- Maintain open lines of communication.
- Collaboratively plan and implement fire operations.
- Enter cooperative agreements covering fire-related activities.
- Jointly conduct fire research programs.
- Jointly deliver consistent messages about fire prevention and management.

Coordinate fire activities with all park divisions and the public.

- Openly communicate about fire activities with all park divisions.
- Incorporate appropriate fire management tasks into all park divisions.
- Keep the public informed about park fire operations, taking advantage of interpretive opportunities when presented.

Environmental Issues

Specialists in the NPS and the University of Arizona on the IDT identified issues and concerns affecting the proposed actions. NEPA also requires consideration of a specific list of mandatory topics. Table I-1 contains those topics and the IDT's assessment of how they apply to Guadalupe Mountains National Park. Appendix B is a list of issues compiled by the IDT at its March 12-13, 2002 meeting with the help of the NPS Intermountain Region environmental screening form. After putting together the extensive list contained in Appendix B, the IDT and other parties to the plan named above distilled these issues into the list of impact topics and issue statements that follows.

Impact topic 1
Life and Property
Fire is an effective tool for reducing hazard fuels, but it is also a threat to the public, firefighters, park staff, developed areas, and neighboring properties.

Impact topic 2
Visitor Experience
Potential restrictions on access to burning areas, road closures, and smoke can alter visitor experience; but the fire program also provides interpretive opportunities.

Impact topic 3
Cultural Resources
Fire may help reduce surrounding hazard fuels and maintain the historic scene, but historic structures, landscapes, and artifacts may incur fire damage.

Impact topic 4
Vegetation
Fire will benefit many species populations in the long term but will kill and injure some individual plants in the short term; prudent application of fire maintains the mosaic pattern of vegetation.

Impact topic 5
Wildlife
Fire will benefit many species populations in the long term but will kill and injure some individual animals in the short term.

Impact topic 6
Unique Sites and Sensitive Species
Fire could alter unique sites and affect endemic or uncommon species.

Impact topic 7
Non-indigenous Species
Fire may aid invasion of non-indigenous species but may also prove to be a control tool.

Impact topic 8
Geology and Geohazards
Removal of vegetation by fire can contribute to erosion, flooding, and damage of fossils.

Impact topic 9
Air Quality
Smoke from fires can be unhealthy and temporarily impact visibility.

Table I-1. NEPA Mandatory Topics

Category	How Addressed
Plans and Policies	Relevant plans and policies are listed above in Chapter I.
Energy Requirements and Conservation	Vehicle use to support fire management activities consumes fuel. A return to more natural fire processes saves resources consumed in fighting fire. Because energy consumption is not a factor that affects selection of fire management strategies, the impact topic was dismissed from further consideration.
Consumption of Natural or Depletable Resources, and Conservation Potential	Fire and fire management activities consume renewable natural resources such as vegetation and water and non-renewable vehicle fuel. Consumption of vegetation is discussed under all impact topics. Because consumption of other resources is not a factor that affects selection of fire management strategies, the rest of this impact topic was dismissed from further consideration.
Urban Quality	Guadalupe Mountains National Park is located in a rural area. Therefore, this impact topic was dismissed from further consideration.
Socially or Economically Disadvantaged Populations	Fire management actions must consider impacts to humans (Goal 1). There are no impacts predicted to fall predominantly upon disadvantaged populations. Guadalupe Mountains National Park is located in a sparsely populated rural area. Therefore, this impact topic was dismissed.
Wetlands and Floodplains	NPS is required to address effects of fire management actions on these floodplains (E.O. 11988). Fire can alter hydrologic processes which may increase erosion and flooding potential; this possibility is addressed under several natural resources impact topics in this EA: vegetation (4), wildlife (5), unique sites and sensitive species (6), and geology and geohazards (8).
Prime and Unique Agricultural Lands	These lands are not found within the park, per USDA Natural Resources Conservation Service, therefore, this topic was dismissed from further consideration.
Federally Listed Species	The park has consulted with the USFWS on a new FMP, prepared a Biological Assessment that analyzes effects primarily on Mexican spotted owl. In this EA, under impact topic (6) (unique sites and

	sensitive species), Chapter III provides background and Chapter IV summarizes the BA's analysis.
Important Cultural Resources	These features fall under the cultural resources impact topic (3) in this EA. The park has produced a cultural resources matrix analyzing cultural issues. In this EA Chapter III provides background and Chapter IV summarizes the CRC's analysis; the matrix is attached to this EA as Appendix C. Thirteen affiliated tribes have been informed about the FMP.
Ecologically Critical Areas	Such areas are addressed under impact topic (6) (unique sites and sensitive species) in this EA.
Public Health and Safety	These highest priority concerns are addressed under the life and property impact topic (1) in this EA.
Sacred Sites	This area is addressed under the cultural resources impact topic (3) in this EA.
Indian Trust Resources	There are no Indian Trust Resources at Guadalupe Mountains National Park; therefore, this topic was dismissed from further consideration in this EA.

Chapter II: Alternatives

This chapter describes the alternatives for fire management planning at Guadalupe Mountains selected for analysis in this EA. Each alternative proposes a different mixture of fire management techniques in the park, as well as mechanical methods to reduce hazard fuels in developed areas. A detailed description of the impacts of each alternative follows in Chapter IV, Environmental Consequences.

The National Environmental Policy Act (NEPA) requires analysis of a no action alternative, in this case a continuation of the current fire management program. This program includes mechanical fuel removal, prescribed fire, wildland fire use for resource benefits, and appropriate management response strategies (suppression). It has been in effect since 1996. Since that time, prescribed and wildland fire have been used in the interior of the park, but because of fire program constraints, burning for fuel reduction and resource benefit has not been allowed outside the park's core area. This has resulted in continued heavy fuel accumulations along the park boundary in certain areas. In addition, the park's fire program requires alignment with the National Fire Plan and the 2001 Federal Fire Policy.

Generation of Alternatives

The action alternatives considered in this EA were developed using park staff expertise; comments and concerns expressed by the public; existing park plans; NPS Policies; the National Fire Plan and Federal Wildland Fire Management Policy; input from federal, state, and local agencies; and input from cooperators from the University of Arizona, School of Natural Resources.

Members of the public, the NPS, and federal, state, and local agencies identified important issues during two scoping periods. An internal scoping meeting took place in March 2002. On October 10, 2002, the public scoping period was announced with the publication in the Federal Register of a Notice of Intent to prepare an Environmental Impact Statement for an updated Guadalupe Mountains FMP. The park jointly held four public meetings with neighboring Carlsbad Caverns National Park in November 2002. The parks lie five miles apart, display similarities in vegetation and geology, share a Fire Management Officer and other fire staff, and are operating on similar schedules for updating their FMPs. Meeting dates and attendance (signed in) were as follows:

November 18, El Paso, TX: 2
November 19, Dell City, TX: 5
November 20, Queen, NM: 17
November 21, Carlsbad, NM: 18

At these meetings, ample staff from the park were on hand to discuss the alternatives and issues presented in this document. Written comments expressed support for (1) returning fire to the landscape and (2) working cooperatively with neighbors to manage fire. As the park progressed on compliance for NEPA, federally listed species, and cultural resources, analyses showed an absence of significant adverse effects. Thus a Notice of Intent was filed on December 17, 2004 to

produce an EA rather than an EIS. The level of analysis of effects is the same for both documents, the approval process, however is more streamlined for an EA because it discloses findings of no significant impacts to the environment from proposed management actions, where as an EIS discloses significant impacts.

Resource Analysis

Chapter III describes the environmental context for the alternatives introduced in this chapter. Fire history, fire ecology, and prescribed burn program results are summarized below. This background is needed to understand why the park has a fire program and also why managers would now like to accommodate more fire than before.

Fire History and Ecology
Fire studies at Guadalupe Mountains National Park and elsewhere in the Guadalupe Mountains suggest fire may have been a regular event prior to the 20th century. Data show that the frequency, extent, and severity of presettlement fires varied among vegetation types. Small fires burned in mixed coniferous forest in the Guadalupes on average every 5 years from 1554-1842 (Ahlstrand 1981). Alan Taylor and students from the University of Pennsylvania are currently studying changes in forest structure and composition. Preliminary data indicate that the elimination of fire in 1922 is coincident with an increase in forest density and basal area as well as a compositional shift from fire tolerant species (i.e., southwestern white pine and ponderosa pine) to fire intolerant species (i.e., Douglas fir).

Fire history in lower elevation communities is less clear. Piñon-juniper woodland follows a fire regime of irregular, stand-replacing fires of patchy extent. A frequency of 10-30 years is known to keep piñon-juniper woodlands more open and grassy (Wright 1990), with stand replacement and regrowth requiring as much as 300 years (Paysen et al. 2000). Fire in desert scrub and desert grassland is thought to be an irregular event, dependent on years of higher precipitation when fine fuels necessary to carry fire are produced. An average fire return interval of at most 10-15 years is suggested for desert grassland (Ahlstrand 1982; Kittams 1972; McClaran and Van Devender, eds., 1995).

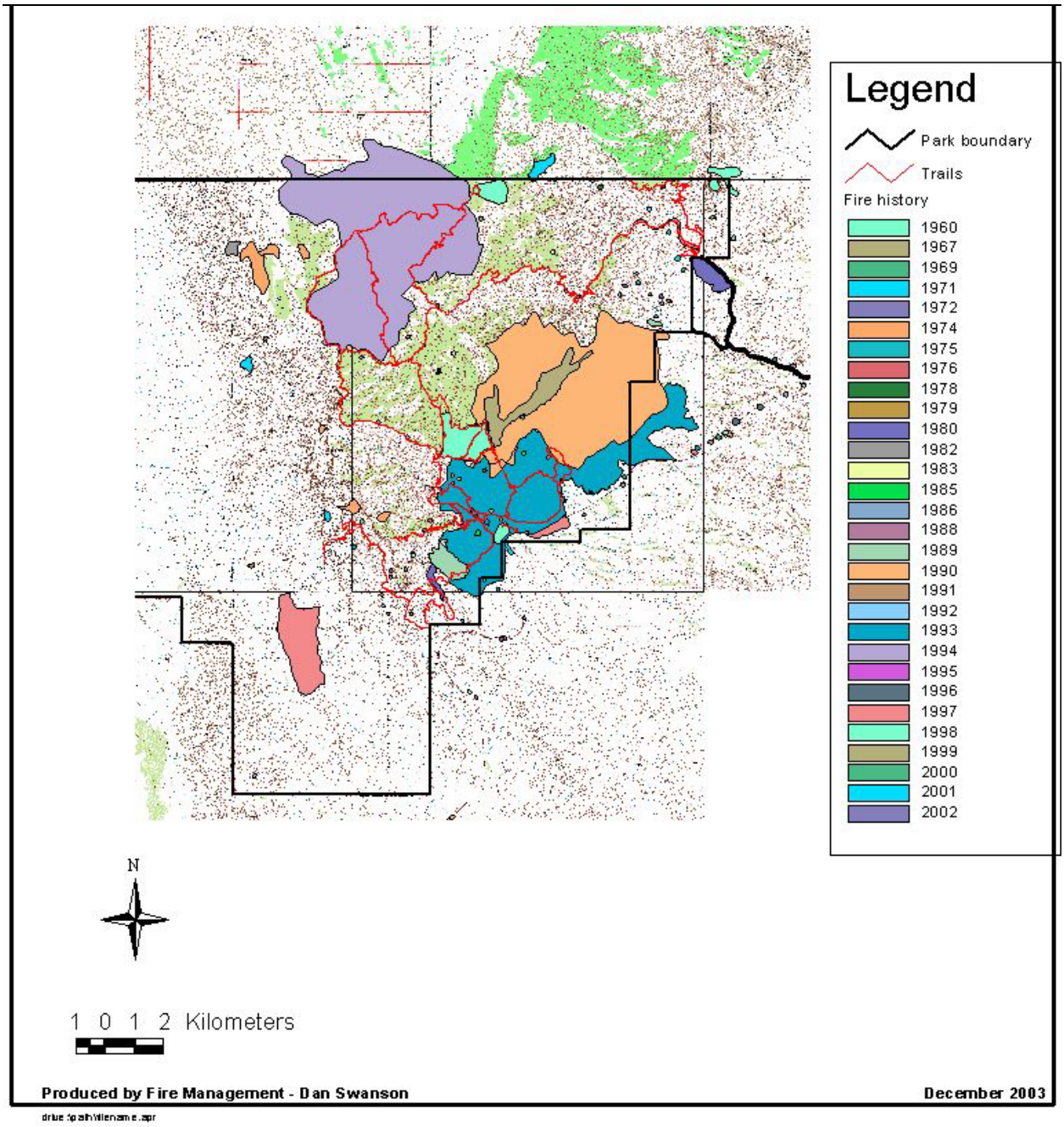
Burn Program
Managers at the park recognized the effects of fire exclusion and fire suppression in the early 1970s. With the approval of the 1985 full-spectrum FMP, that allowed fire as a management tool, the park began re-establishing fire as one of the natural processes maintaining park ecosystems. They also recognized that carefully placed fires could reduce fuels built up around valuable cultural and natural resources and help protect them from destructive wildland fires. Since 1979, the park has carried out 13 prescribed burns covering roughly 7600 acres.

Fire managers have also embraced the idea of letting naturally ignited fires burn if they meet predetermined conditions and are predicted to fulfill park objectives. Such situations are now called wildland fire use. A candidate ignition must meet both environmental and administrative requirements to avoid suppression. Managers exercise extreme caution when deciding not to suppress fires, and very little territory has actually burned under wildland fire use at Guadalupe Mountains. Since 1974, 22 lightning ignitions have met the criteria for wildland fire use, burning

approximately 35 acres in all. No potentially large fire has been allowed to burn under wildland fire use.

Figure II-1 maps the fires recorded at the park, including both wildland fires and prescribed burns.

Figure II-1. Recorded fires at Guadalupe Mountains National Park, 1960-2003



Elements Common to All Alternatives

Appropriate Management Response
Automatic suppression of all wildland fires is no longer the rule in national parks. "Appropriate management response" in fire operations jargon refers to specific actions taken in response to a wildland fire to meet protection and fire use objectives. Under all the reasonable alternatives, the appropriate management response is developed from analysis of the local situation, values-to-be-protected, management objectives, external concerns, and land use. Suppression or containment of a fire in a larger area could be appropriate management responses. The NPS would continue to suppress all human-caused (non-prescribed) fires in a manner that causes the least damage to resources, people, and property. All wildland fires would be monitored daily or more frequently in accordance with the Fire Monitoring Handbook and the Wildland Fire Situation Analysis. The park will continuously update information on fire size, location, behavior, smoke dispersal, safety conditions, and effects.

Prescribed Fire Program
Prescribed fires are intentionally ignited to accomplish objectives, such as restore grasslands or thin forests or woodlands. Burns take place in specific areas under predetermined conditions identified in approved burn plans. Common to the three alternatives retained for analysis is a schedule of prescribed burns through approximately 2009 (Table II-1 and Figure II-2). Conditions of burn units and expected effects are discussed in Chapters III and IV, respectively.

A certified Prescribed Burn Boss will supervise and appropriate levels of staffing will be available for each prescribed fire under all three alternatives. Fire behavior and weather will be monitored during all prescribed fires. While the Fire Monitoring Handbook (NPS 2003) will be used as a basis for monitoring a Fire Monitoring Plan will be developed for the park. The park acknowledges that multiple burns will be needed to recreate the conditions that allow wildland fire to play its natural role. Lessons from past burns continue to be incorporated into the planning for future burns.

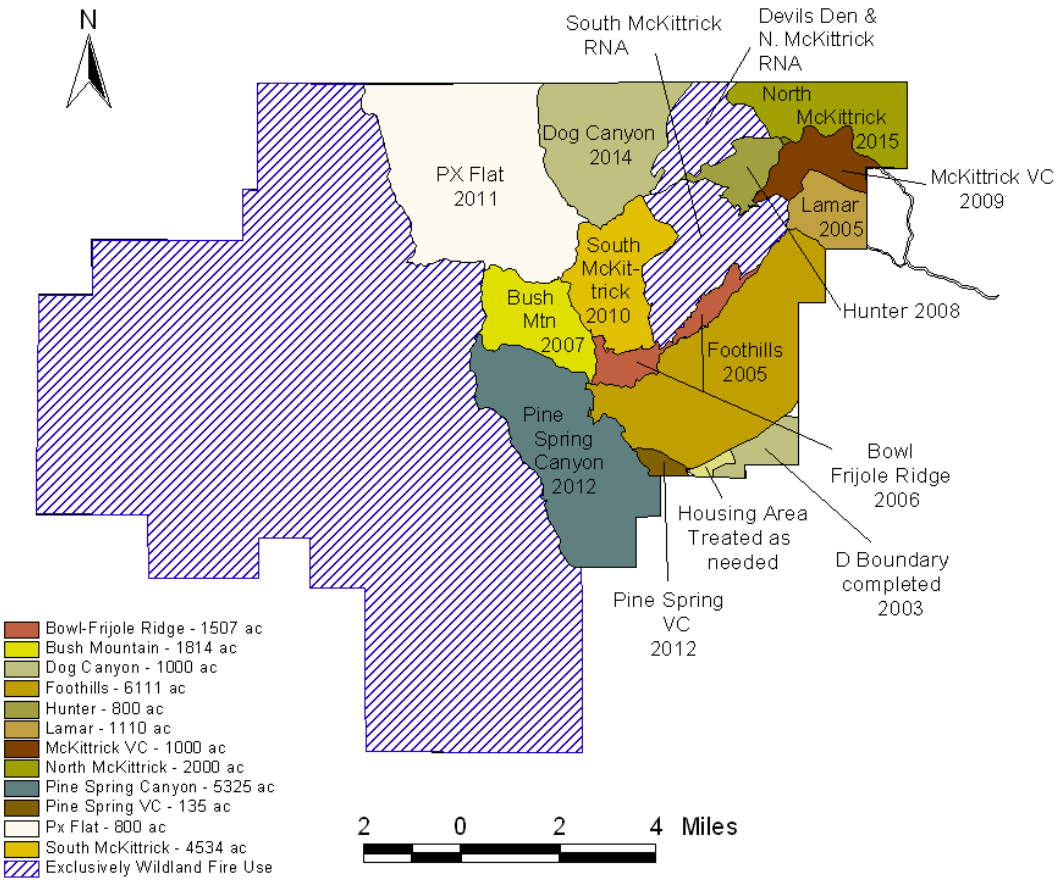
Table II-1. Proposed schedule of prescribed burns under 3 retained alternatives

National Fire Danger Rating System Fuel Models:
C = Open pine stands with grass and understory with brush and shrubs adding little to the fuel loading
G = Dense conifer stands with overmature overstory with heavy dead tree debris
L = Perennial grasslands with shrubs and trees occupying less than one-third of the area
T = Shrub-grass combinations where shrubs occupy at least one-third of the site, burn easily, and are not dense enough to shade out grasses and forbs

Burn unit name	Year Proposed	Target Acres	Fuel Models	Purpose of project
Prescribed burn units (also eligible for wildland fire use)				
Lamar	FY05	1110	L	maintain species composition, remove "dead and down" that threaten specific resources, allow low-intensity fire in canyon bottom
Foothills	FY05	6111	L	reduce juniper encroachment (but not eliminate); increase grass
Bowl 2nd Entry & Frijole Ridge	FY06	951	C-386 ac G-565 ac	reduce fuel loads in a mature forested area, allow for low-intensity fire
Bush Mountain	FY07	1888	C-944 ac G-944 ac	thin overstocked Douglas-fir, reduce competition, enhance health of remaining trees (let them get bigger)
Hunter	FY08	833	T	maintain species composition, remove "dead and down" that threaten specific resources, allow low-intensity fire in canyon bottom
McKittrick VC	FY09	1118	T	maintain species composition, remove "dead and down" that threaten specific resources, allow low-intensity fire in canyon bottom
South McKittrick	FY10	2453	C-817 ac G-818 ac T-818 ac	thin overstocked Douglas-fir, reduce competition, enhance health of remaining trees (let them get bigger)
PX Flat	FY11	7236	G-2419 ac L-4817 ac	part of the area burned in the Marcus fire; maintain pinyon-juniper/grass savanna
Pine Springs VC	FY12	135	L	reduce fuels around structures, remove mistletoe infested trees

Burn unit name	Year Proposed	Target Acres	Fuel Models	Purpose of project
Pine Springs Canyon	FY12	5324	G-2662 ac L-2662 ac	maintenance burn after fires in the lower areas in the 80s and 90s; rocky terraces should slow down fire; south-facing slopes will burn hot
Dog Canyon	FY14	3632	L	clean up understory, restore to condition class 1
North McKittrick (w/USFS)	FY15	2344	T	maintain species composition, remove "dead and down" that threaten specific resources, allow low-intensity fire in canyon bottom
Wildland fire use only:				
Devil's Den and N McKittrick RNAs	na	1586	C-793 T-793	maintain species composition, remove "dead and down" that threaten specific resources, allow low-intensity fire in canyon bottom
South McKittrick RNA	na	3087	C-1029 G-1029 T-1029	thin overstocked Douglas-fir, reduce competition, enhance health of remaining trees (let them get bigger)

Figure II-2. Fuels management units within the boundary of Guadalupe Mountains National Park retained for analysis for the three alternatives. Units are labeled with their name and scheduled treatment year. Legend lists units and size of targeted treatment area.



Non-fire Fuels Treatments
Under all alternatives, the park may use non-fire means to reduce fuel loads and create fuel breaks around developments. To date, the park has used mechanical treatments around park infrastructure and historic buildings to reduce fuel loads. Some mechanical fuel reduction has also been carried out as pretreatment in prescribed burn units. There are no plans to use non-fire fuels treatments on a large scale. The amount of future clearing depends on the resources needing protection and the amount and type of surrounding vegetation.

Minimum Impact Management
Minimum impact management philosophy guides the selection of management response, especially in wilderness. Park staff will manage wildland fire use and suppression in ways that minimize unnecessary impacts to resources and convey the importance of this strategy to all fire management forces. Minimum impact management strives to minimize landscape alteration and disturbance to natural and cultural resources while safeguarding human lives and accomplishing resource-related objectives. Without compromising safety, lines will be located where they do the least damage, minimize tree cutting, and use natural firebreaks when possible. Staging areas will be placed with care. Agency resource advisors will be consulted prior to implementing management tactics.

Despite the best intentions of minimum impact management, wildland fire actions often create the need for short-term or long-term rehabilitation. Staff will consult with specialists (archeologists, hydrologists, geologists, paleontologists, plant ecologists, wildlife biologists) to determine short- and long-term needs and to write rehabilitation plans for each fire, then will implement and monitor the plans. Common rehabilitation recommendations include flush cutting stumps, brushing in handlines, removing all trash, installing erosion control devices, contour felling of dead trees, lop and scatter, revegetating burned areas, and felling hazardous trees.

Range of Alternatives

The alternatives represent different ways of managing fire at Guadalupe Mountains National Park that are predicted to have different outcomes. Key distinctions among the alternatives involve arrangement of FMUs, overall planning area boundary, and conditions for wildland fire use. FMUs are areas of the park governed by distinct management strategies. Boundaries are clear, and procedures are laid out in detail for each FMU.

Alternatives Retained for Analysis

No Action Alternative (Existing Plan):
The existing (1996) FMP uses four FMUs, defined by their distinctive topographic and plant-community characteristics. The 1996 plan dictates that the causes of all fires will be determined to make proper management decisions. The NPS will suppress all unplanned human-caused fires in a manner that causes the least damage to resources, people, and property. Figure II-3 is a map that defines the four FMUs of the 1996 plan. FMU #1 encompasses the McKittrick Canyon drainage including the "The Bowl." Also included in the FMU are the Devils Den and North McKittrick Canyon Research Natural Areas and North McKittrick Canyon on the Lincoln National Forest. FMU #2 comprises the Eastern Escarpment and Pine Springs Canyon and the

Delaware Basin. FMU #3 includes the entire west side of the park below the escarpment, including the new addition. FMU #4 covers Dog Canyon and West Dog Canyon at the north end of the park.

Three fire management zones overlay the FMUs (Figure II-4). These three zones allow wilderness and non-wilderness fire use, modified suppression, and prescribed fires. Wildland fire use for resource benefit (formerly called prescribed natural fire) is an option when lightning fires coincidentally meet objectives defined by park managers. Unplanned ignitions by humans are not allowed to burn in any FMU. The wildland fire use zone includes the entire wilderness area and extends west to include the non-wilderness portion of the park on the west side. Wildland fire use and prescribed fire are available as resource management tools, as is mechanical fuel reduction when consistent with minimum tool guidelines for equipment use in designated wilderness (NPS 2001). The superintendent is authorized to make exceptions for motorized equipment when determined necessary to insure the public safety or protect park resources. In this zone, natural (lightning) ignitions will be designated wildland fire use if in compliance with the prescription parameters. Prescriptions must consider the likelihood of fire escape from the unit, threats to human life and property, facilities, cultural resources, sensitive species, or other important resources.

Table II-2 is the wildland fire use decision matrix under No Action; all questions must be answered "yes" to permit a natural ignition to burn and more specific prescription conditions must be met:

- No more than three other wildland fire use fires may be burning within the park
- Energy release component less than 66 (within wilderness) or 17 (outside wilderness)
- Burning Index less than 40
- A Haynes Index of 5 or 6, indicating atmospheric stability and minimal fire growth potential

Under the decision guidelines (Table II-2) and prescription parameters spelled out in the 1996 FMP, the park has declared 22 lightning ignitions wildland fire use; these fires burned a total of 35 acres (in an 86,416-acre park).

Figure II-3. Arrangement of Fire Management Units under the No Action Alternative

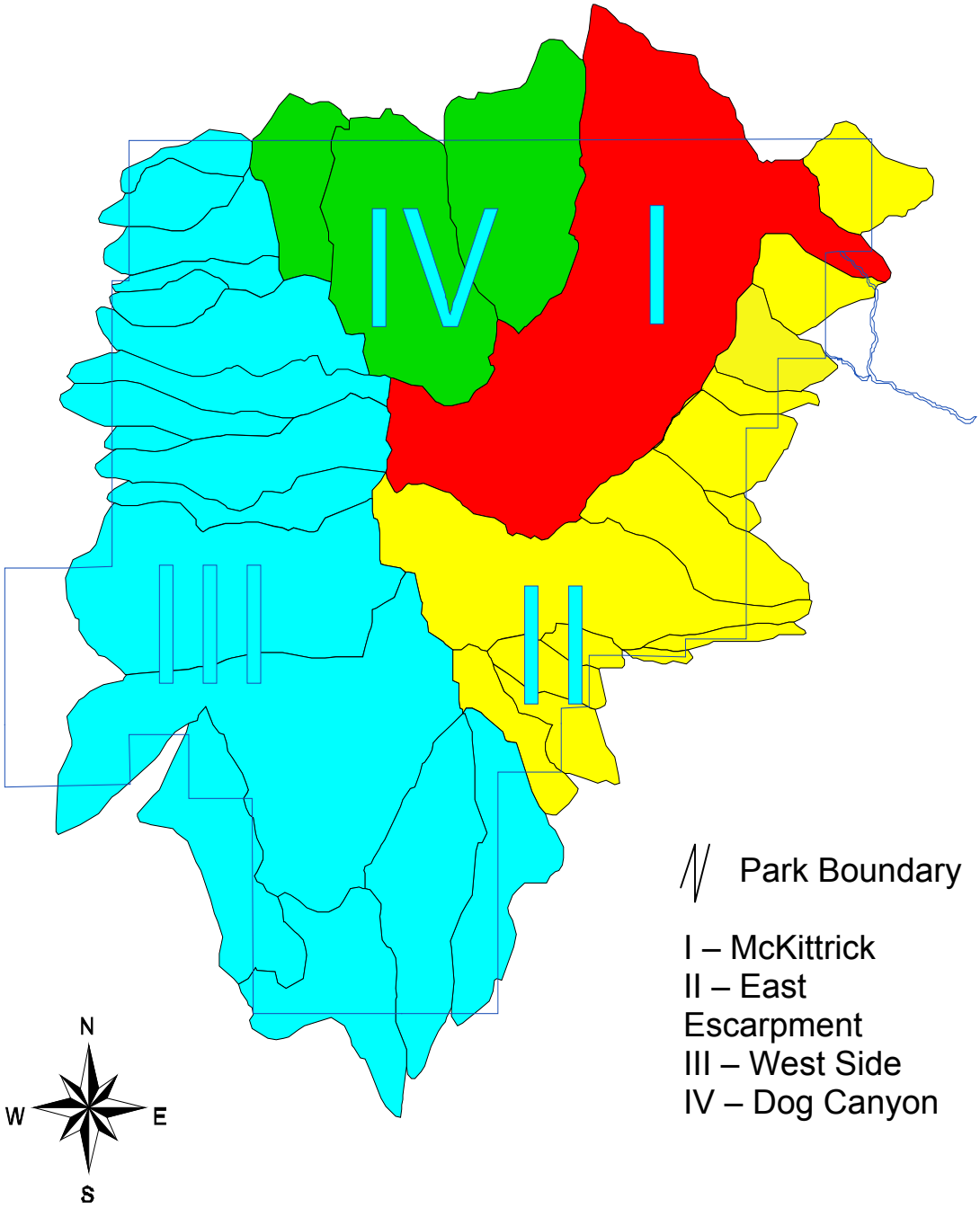


Figure II-4. Fire Management Zones from the 1996 FMP

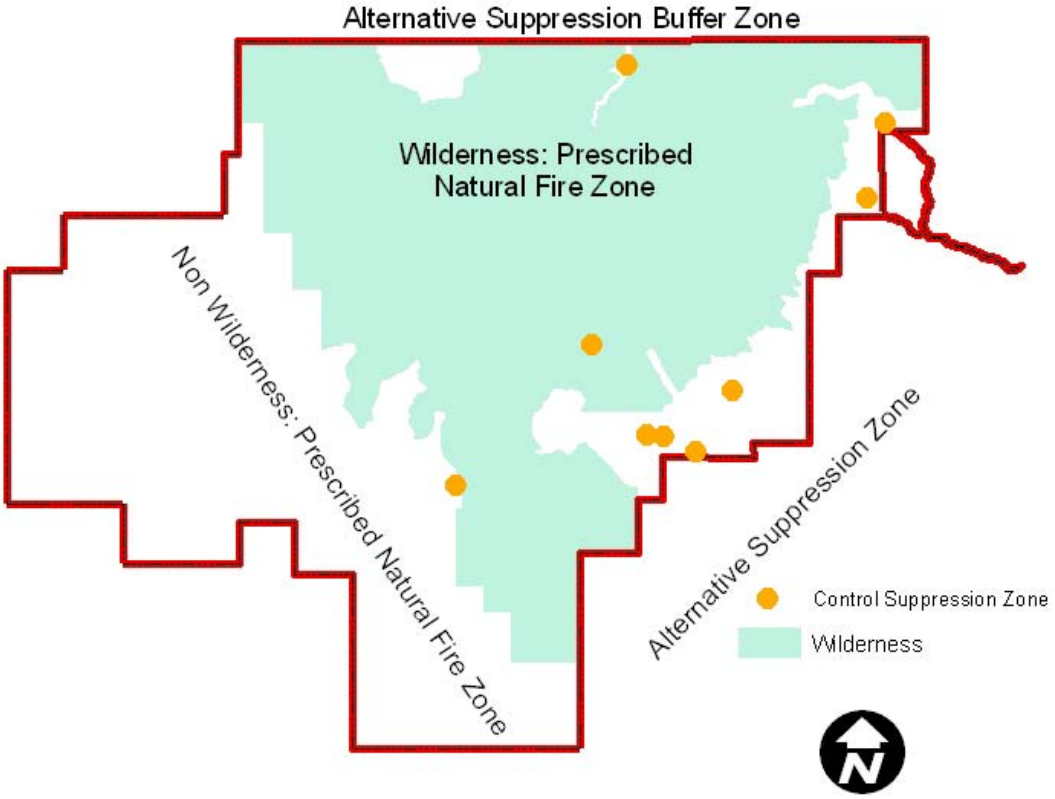


Table II-2. Wildland fire use decision criteria from the 1996 FMP

Must answer YES to all criteria to reach a GO decision.

Any NO answers result in a NO-GO decision and declaration of a wildland fire. Once declared, the fire cannot be reverted to wildland fire use.

Decision Criteria	Questions
Ignition	Is it a natural source? Is location within wildland fire use zone?
Management Objectives	Are resource objectives being met?
Size	Is the current and expected size known? Is there no potential for escape from MMA (maximum management area)?
Fuels	Are live fuel moistures within prescription?
Weather	Are drought indicators acceptable (1000-hr TLFM*, Palmer drought index)?
Topography	[Conditions acceptable?]
Resource Availability	Are local, regional or national resources available?
Personnel Safety	[Conditions acceptable?]
Public Safety	[Conditions acceptable?]
Environmental Constraints	Are smoke dispersal, direction acceptable?
Political Constraints	Is it within policy or approved FMP?

**TLFM = time-lag fuel moisture. 1000-hr TLFM is a measure of moisture content of fuel diameters ≥3 inches and expressed as the percent moisture relative to dry weight.*

The Alternative Suppression Zone includes the non-wilderness portions of the park on the Eastern Escarpment and Coyote Peak and Upper Dog Canyon on the north end (Figure II-4). This zone allows prescribed fire and appropriate management response.

Any prescribed fire that escapes the predetermined boundaries or otherwise no longer meets prescription will be declared a wildland fire if the initial holding actions are not successful. In this zone, a declared wildland fire will receive an initial assessment and the appropriate management response will be determined.

The Control Suppression Zone represents the remainder of the park (Figure II-4). This zone occurs as nine separate units encompassing significant cultural or administrative resources susceptible to fire. These include the Frijole Ranch, Williams Ranch House, Pinery Butterfield Stage ruins, McKittrick Canyon visitor center, Pine Springs campground, Dog Canyon Ranger Station complex, Ship on the Desert, Pine Top administrative patrol cabin, and the Park Headquarters/Visitor Center in Pine Springs Canyon. In this zone, prescribed fire and mechanical fuel reduction are management tools for the purposes of fuel reduction or vegetation management. All unplanned ignitions with the potential to enter this zone will be suppressed.

Two-FMU Plan (Alternative A)
This alternative defines a relatively small FMU #1 surrounding (1) the visitor center area and the facilities and residences south of the highway and (2) the developments at Dog Canyon (Figure II-5). This FMU applies full suppression and prescribed burning. The rest of the park comprises the second FMU, with protection and suppression emphasis for special features, such as historic properties, McKittrick Canyon, and habitats of threatened and endangered species. In FMU #2, wildland fire use, prescribed fire, suppression, and the elements common to all alternatives are management options. This alternative recognizes that restoring fire and using a mixture of prescribed fire and wildland fire use benefits park ecological communities. Fires would be suppressed at the park boundary.

Administrative considerations have tended to be the cause of “no go” decisions for wildland fire use. During fire season, resource (fire crews and equipment) availability is frequently a problem. Needed personnel to manage wildland fire use, particularly fire use managers, are rarely available. No-go decisions can also result from the perceived need to give the fire-weary public a rest, and local fires that otherwise might benefit resources are suppressed during regionally active fire seasons.

Figure II-5. Two-FMU plan arrangement under Alternative A.

Pine Springs and Dog Canyon areas are delineated as FMU #1, and the rest of the park comprises FMU #2.

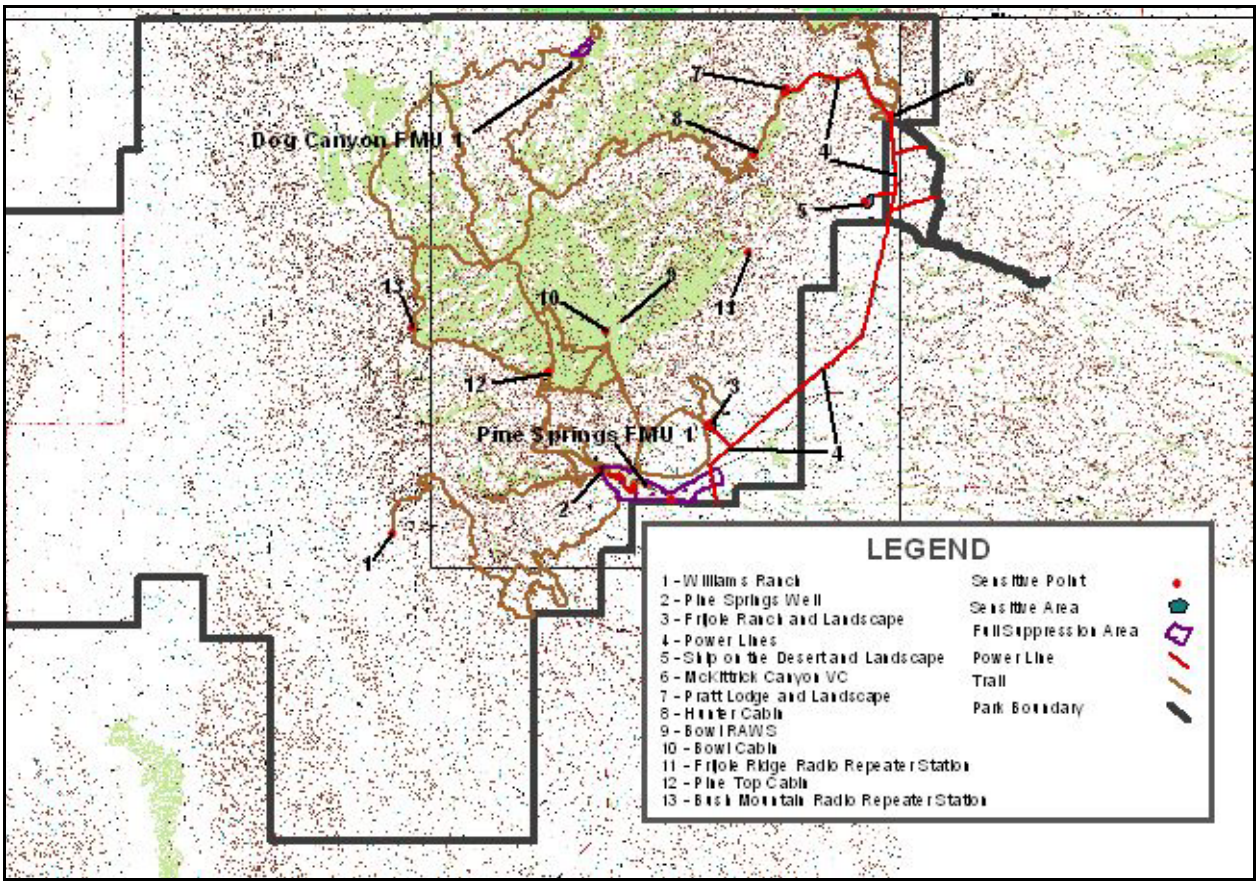


Table II-3 proposes a new set of decision criteria that may result in more wildland fire use under Alternative A. Under the assumption of Alternative A, fire use managers will be available to oversee wildland fire use at Guadalupe Mountains National Park whenever needed. In addition, local and regional administrators will tolerate higher levels of risk to property in the short term when declaring fire use, in order to lessen the danger in the long term of high-severity fires. Threats to life retain the highest priority when making decisions. As under No Action, the park will use non-fire means to reduce fuels around significant natural resources, unique sites, and cultural resources, especially flammable historic structures. Minimum impact management and rehabilitation practices are implemented as under No Action (1996 FMP).

Table II-3. Go/no-go decision criteria under Alternatives A and B.
Must answer YES to all criteria to reach a GO decision.
Any NO answers result in a NO-GO decision and declaration of a wildland fire. Once declared, the fire cannot be reverted to wildland fire use.

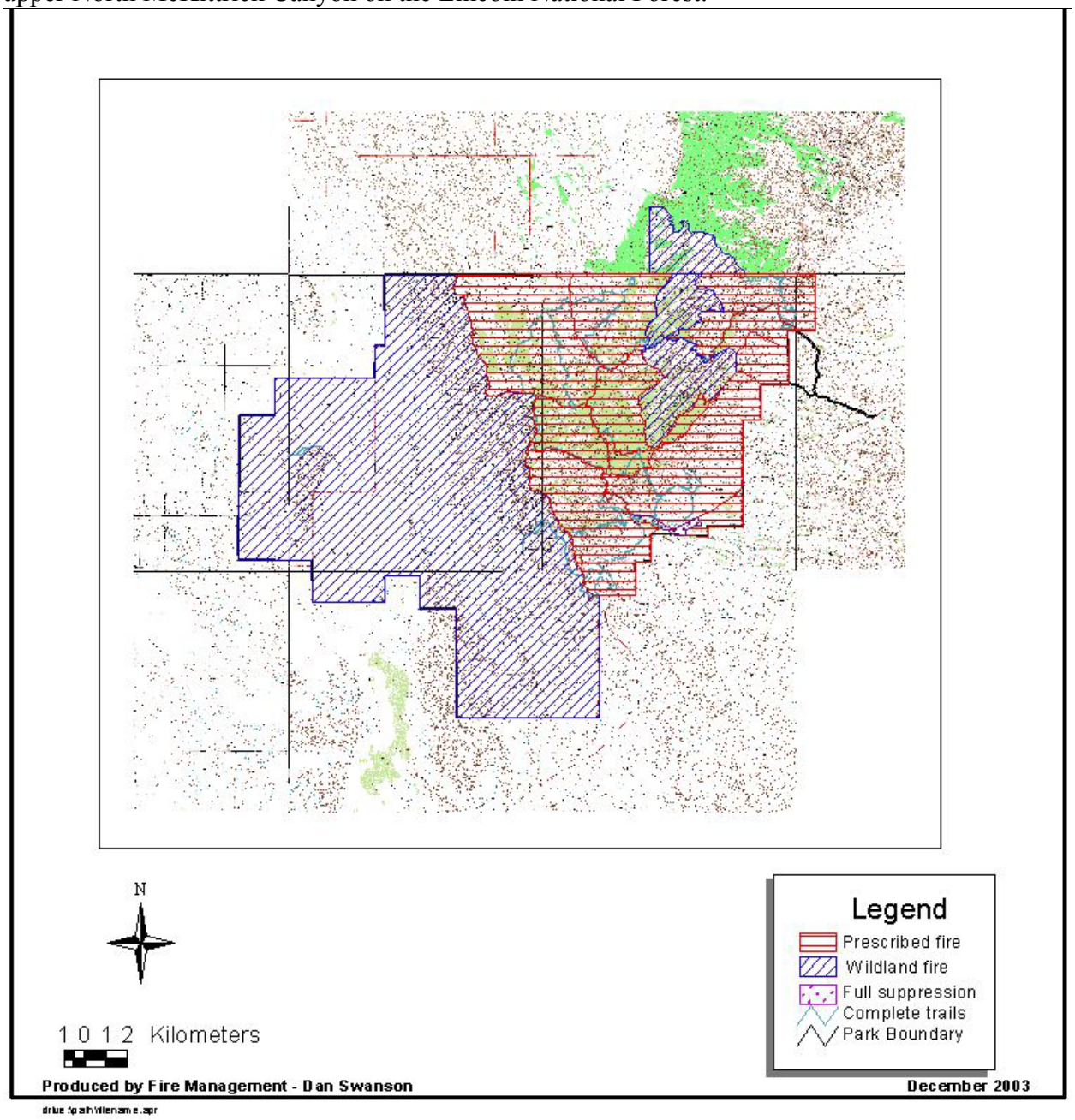
Decision Criteria	Questions
Ignition	Is it a natural source? Is the location within the fire management unit permitting wildland fire use?
Management Objectives	Are resource objectives being met? Are potential effects on natural and cultural resources within the acceptable range of effects and variability?
Size	Is the current and expected size known? Would an escape or the potential for escape from the maximum management area be acceptable?
Fuels	Are live fuel moistures within prescription?
Weather	Are local forecasts and drought indicators (1000-hr TLFM, Palmer drought index) acceptable?
Topography	Is the terrain accessible and safe for crews to work in locations for potential holding actions along the maximum management area boundary?
Resource Availability	Are local, regional or national resources available?
Safety of Life and Property	Can the threats to firefighters, staff, visitors, residents, neighbors, associated property, and infrastructure be minimized?
Environmental Constraints	Are smoke dispersal and direction acceptable?
Political Constraints	Is managing this fire for wildland fire use compliant with current policy, moratoriums, political constraints, funding and efficiency issues?

Preferred Alternative (Alternative B)
This alternative is a variation on the two-unit plan that extends backcountry FMU #2 beyond the north boundary to include portions of the McKittrick Canyon watershed that lie on Forest Service land (Figure II-6). Ideally, the park will cooperate with the Forest Service on prescribed fire, wildland fire use, fire effects monitoring, as well as appropriate management response activities. Suppression will be the rule along portions of the park boundary adjacent to private property.

The area proposed for joint fire activities on Forest Service lands has been called the Zone of Cooperation (ZOC). Guadalupe Mountains National Park and the Lincoln National Forest will co-manage fire on about 2,000 acres of USFS land in Upper North McKittrick Canyon under Alternative B (see Figure II-6). This land north of the park boundary contains the headwaters of an important park watershed. As outlined in the Lincoln National Forest Land and Resource Management Plan, the ZOC lies in the southwest corner of the South Guadalupe Management Area (3A), also designated as the Guadalupe Escarpment Wilderness Study Area (USDA Forest Service 1986) and is managed as wilderness. Timber harvesting, mineral extraction, and oil and gas leasing are excluded activities. An 827-acre parcel included in the ZOC has been recommended for designation as the Upper McKittrick Research Natural Area (RNA). As an RNA, it is the site of dispersed, non-motorized recreation compatible with research. The district's website describes it as "the perfect place for seekers of solitude." Its inclusion makes the management of fire safer, cheaper, and more likely to mimic natural patterns. This cooperative plan is a step toward multi-agency/owner fire management for the entire Guadalupe Mountains landscape sometime in the future.

Cooperative fire management of Upper North McKittrick benefits the integrity of the lower watershed in the park. Allowing typical wind-driven fires moving southwest to northeast to cross the forest boundary in steep, rugged terrain is safer than trying to suppress them. Wildland fire use decision criteria, prescription parameters, and suppression tactics relative to sensitive resources remain the same under Alternative B as for Alternative A. Minimum impact management and rehabilitation follow guidelines proposed under No Action. The Lincoln National Forest limits fuel treatment activities (non-fire treatments such as thinning) to areas where buildups threaten life, property, or high resource value areas. Fuel treatments are planned such that goals apply to the project area as a whole and not on a per-acre basis.

Figure II-6. Fire management under Alternative B. Hatched area north of the boundary is upper North McKittrick Canyon on the Lincoln National Forest.



Alternatives Considered but Dismissed

Total Suppression
In today's more enlightened climate relative to fire, this option might seem extreme. However, the park's concern about (1) safety of visitors (particularly backcountry campers) and staff, (2) historic structures and landscape features, and (3) spread of fire to neighboring properties make total suppression a legitimate consideration.

Reason for dismissal: Fire is clearly needed to restore some park plant communities to health and renew wildlife habitat. The park staff has the experience needed to allow fires to burn safely. It is NPS policy to restore fire into ecosystems where it previously occurred naturally.

Full Wildland Fire Use for Resource Benefit
Concern about the long-term health of plant communities puts the other extreme option on the table. If the park's forests, woodlands, and grasslands are to move back to their "natural" state, it could be argued that all fires should be allowed to burn. Because the preservation of life and property is the priority for fire management operations, the plan under this alternative would protect individual features and structures with small buffer zones and otherwise permit fires to burn unless conditions were unsafe or fire behavior is outside of prescriptions.

Reason for dismissal: Administrative considerations decrease the attractiveness of this alternative. Appropriate decision making on a case-by-case basis would be prohibitively complicated and time-consuming. Moreover, decision makers would always need to be present to decide whether to fight fires burning very close to places that require protection. In inhabited areas there would be no safety margin for sudden changes in fire conditions.

Summary of Reasonable Alternatives

Table II-4 summarizes important features of each retained alternative described above and the degree to which these alternatives meet FMP purpose, need, goals, and objectives. Table II-5 reviews impacts of alternatives over the nine issue areas. Each of the retained alternatives contains a different mixture of the same elements: suppression, prescribed fire, and wildland fire use for resource benefit. There is no way to specify exactly how much of each strategy would apply if any one of the alternatives were selected, because the "amount" of each fire form depends on weather and chance ignitions. We can speculate that No Action-Alternative A (Two-FMU Plan) and Alternative B (Cooperative Watershed), in that order, move from causing the fewest short-term, direct adverse effects and fewest long-term direct and indirect benefits to causing the most short-term, direct adverse effects and most long-term benefits. Impacts are analyzed in detail in Chapter IV.

The environmentally preferable alternative is defined as "the alternative that will promote the national environmental policy as expressed in the National Environmental Policy Act's Section 101. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (Council on Environmental Quality 1981).

Table II-4. Effectiveness of Alternatives in Meeting Goals and Objectives

	No Action **1996 Plan**	**Alternative A** **Two FMU Plan**	**Alternative B** **Cooperative Watershed Plan**
Major Features	Four FMUs with three fire management zones - a central zone that allows wildland fire use and prescribed fire under certain conditions, surrounded by a second suppression zone. The third zone encompasses sensitive resources and structures and calls for suppression to protect these features.	A small FMU encompassing developed areas and allows prescribed burns but not wildland fire use for fuel reduction. The backcountry FMU allows prescribed fire and wildland fire use out to park boundaries. The park would cooperate with park neighbors on fire management actions.	Adaptation of Alternative A; backcountry FMU would extend out to include portions of the McKittrick Canyon watershed on Forest Service land. Fire would be managed cooperatively in this area.
Goals and Objectives			
1. Protect life and property.	Effective; reducing threats to life and property is the highest priority.	Effective; reducing threats to life and property is the highest priority.	Effective; reducing threats to life and property is the highest priority.
2. Protect park resources from undesirable effects of fire.	Effective in the short term.	Effective in the short and long term.	Most effective in the short and long term.
3. Suppress unwanted fire.	Effective in the short term, but future fires may become too hot to handle as fuels build up.	Effective.	Effective.
4. Allow fire to assume its natural role in park ecosystems with justification.	Somewhat effective, given conservative wildland fire use for much of the park.	More effective, given wildland fire use over most of the park under relaxed decision criteria.	Effective, given wildland fire use over most of the park, plus adjoining Forest Service lands.

	No Action **1996 Plan**	**Alternative A** **Two FMU Plan**	**Alternative B** **Cooperative Watershed Plan**
5. Use wildland fire use and prescribed fire for resource management purposes.	Least effective in applying fire for maintaining fire-influenced historic scenes and patterns of succession.	Effective. Allows fire over most of the area up to park boundaries for management purposes.	Most effective at duplicating fire's landscape effects, reinforcing historic scene and natural patterns of succession.
6. Manage fire cooperatively with neighboring agencies and private landowners.	Moderately effective, as it specifies some collaboration with the Forest Service.	Least effective. Insulates the park from surrounding lands by limiting cross-boundary use of fire.	Most effective at establishing cooperation with neighboring agencies and private landowners.
7. Coordinate fire activities with all park divisions and the public.	Effective	Effective	Effective

Table II-5. Impact Summary

No Action **1996 Plan**	**Alternative A** **Two FMU Plan**	**Alternative B** **Cooperative Watershed Plan**
1. **Life and Property**: *Issues—Fire is an effective tool for reducing hazard fuels, but it also is a threat to the public, firefighters, park staff, developed areas, and neighboring properties. Plan overview—Safety is the highest-level consideration. The FMP dictates actions for contingencies when life and property are threatened.*		
No Action places firefighters at risk more often than A and B. With more suppression than A and B, No Action minimizes short-term, adverse impacts to life and property such as the Visitor Center and Pratt Cabin; such impacts would be minor or negligible in intensity. Long-term potential for moderate, adverse impacts to firefighter and public safety and property during periods of severe fire conditions.	With increased wildland fire use under Alternative A, short-term, adverse impacts to public safety and property would be minor with appropriate protective measures. Minor, long-term, beneficial impacts to life and property would accrue as management objectives are met. Stopping fire at the boundary could increase risks associated with air attack.	Short-term, adverse impacts to public safety and property would be minor with appropriate protective measures under Alternative B. Moderate, long-term, beneficial impacts to life and property on both NPS and Forest Service lands would accrue as management objectives are met.
2. Visitor Experience: *Issues—Potential restrictions on access to burning areas, road closures, and smoke can inconvenience visitors, but the fire program also provides interpretive opportunities. Plan overview— Prescribed burning limits severe fires that create considerable inconveniences. The park can use the occasion to inform visitors of the role of fire in ecosystems.*		
Impacts would be adverse but short-term and minor and during severe fire conditions would likely also apply to destinations on the Lincoln National Forest. Wilderness suppression activities could allow noisy equipment. No Action can result in the most extensive fuel buildups that can feed future high-severity fires. Charred landscapes from such fires may be long-term, moderate, adverse effects. Fires can be interpretive opportunities, and communication is the key mitigation technique.	Effects of Alternative A would also be adverse but short-term and minor, similar to No Action. The park would see greater wildland fire use and less suppression, decreasing the need to temporarily compromise wilderness through the use of mechanized tools and over-flights. However, stopping fires at boundaries could require occasional, concentrated suppression efforts. Over time, the risk of future high-severity fires is lessened as more of the park experiences wildland fire use and long-term, adverse effects become minor.	Effects of Alternative B are similar to Alternative A—adverse in the short-term, but minor. With fires not requiring control at the north boundary (where prevailing winds tend to push them), disruption of visitor experience by boundary suppression actions is reduced. The risk of long-term high-severity fires is further reduced under Alternative B, as more wildland fire use treats more acres because fires showing potential to spread onto the Lincoln can be allowed to burn.

No Action **1996 Plan**	**Alternative A** **Two FMU Plan**	**Alternative B** **Cooperative Watershed Plan**
3. Cultural Resources: *Issues—Historic structures, landscapes, and artifacts may incur fire damage. Plan overview—Prescribed burning and mechanical thinning will reduce fuel buildup near structures and sites. Fire will be kept away from the most sensitive areas.*		
Minor, cumulative, adverse, short-term impacts from successive suppression actions accrue under No Action. Loss of site-concealing vegetation; cracking and flaking of stone or concrete foundations; alteration of landscapes; and burning of flammable resources, including structures are direct effects. Erosion and damage of integrity of resources on the ground after suppression-related disturbance is the main indirect effect. Greatest potential, with continued suppression, for moderate adverse impacts to cultural resources in the long-term, particularly damage to flammable historic structures.	For Alternative A, minor direct and indirect adverse impacts to cultural resources would occur as described for No Action, with long-term benefits to cultural resources from reduction in fuel loads in and around sensitive areas throughout the park. Potential for damage to wooden structures decreases, and cumulative impacts to cultural resources from repeated suppression activities would decrease in relation to the No Action alternative.	Minor direct and indirect impacts would occur as described under No Action, with the greatest long-term benefits under Alternative B from the reduction in fuel loads in and around sensitive areas throughout the park and reduced suppression activity along the north boundary. Benefits accrue to Lincoln National Forest areas that are part of joint fuels treatment projects. Cumulative impacts to cultural resources from repeated suppression activities would decrease in relation to the No Action alternative.
4. Vegetation: *Issues—Fire will benefit many species populations in the long term but will kill and injure some individual plants; large-scale fire affects the mosaic pattern of vegetation. Plan overview— Fire thins crowded stands and promotes sprouting and germination of many plant species. Prescribed burning allows for more control over fire timing, location, and effects and may reduce the threat of large-scale fires.*		
Under No Action, potential for moderate, long-term adverse impacts to landscape-scale vegetation patterns accrues as suppression continues, particularly in the park high country. The park would continue to progress from “natural” fire regime to “suppression” landscape. Lack of fire will continue to maintain shrublands where grasslands once occurred, and create dense thickets out of historically open woodlands.	The existing fuel buildups in the high country will remain difficult to alleviate and adverse impacts may still occur but likely on a smaller scale, compared with No Action. Greater wildland fire use under Alternative A reduces the likelihood of high-severity, landscape altering events. Overall, Alternative A has a moderate, beneficial impact in the long-term.	Under Alternative B, adverse impacts occur on the smallest scale, relative to the other two alternatives. The alternative potentially offers the greatest amount of fire meeting prescription over the park landscapes. Fires showing potential to cross the north boundary would not have to be suppressed. Overall, Alternative B has a moderate, beneficial impact in the long-term.

No Action **1996 Plan**	**Alternative A** **Two FMU Plan**	**Alternative B** **Cooperative Watershed Plan**
5. Wildlife: *Issues—Fire will benefit many species populations in the long term but will kill and injure some individual animals in the short term. Plan overview—Wildlife benefits from fire-renewed habitat. Conditions for prescribed fire and wildland fire use promote low to moderate-intensity burns and maintain mosaics of burned and unburned habitat.*		
Continued suppression of most fires under No Action would minimize minor, short-term, direct adverse impacts to animals. Prescribed fire, thinning, wildland fire, and suppression actions could cause small changes to populations through loss of individual animals. The potential for long-term adverse impacts to particular species with continued habitat degradation and threats of high-severity fires during periods of severe fire conditions would be moderate. Moderate adverse cumulative impacts resulting from successive suppression actions are expected.	With more fire use under Alternative A, greater short-term, adverse impacts to individual animals are expected in relation to No Action. Fires will consume stumps, logs, and snags that may be nesting and foraging sites for woodpeckers, small owls, and small mammals, but fire also creates more of such sites. Managing for burn mosaics keeps such impacts minor. Re-sprouting of shrubs after burns provides new forage for browsers. Short-term adverse impacts to particular species would be minor to moderate with appropriate protective measures. The long-term threat of high-severity fires would subside with park-wide application of prescribed fire and wildland fire use. Particular species would benefit as management objectives are met.	The effects of Alternative B would be similar to Alternative A, and the effects to animals within the ZOC would be similar to those experienced within the park. The long-term threat to the park's resources from high-severity fires will further decrease as management objectives for the ZOC are met, reducing the opportunity for fire encroachment from neighboring Forest Service land. Allowing fires that meet prescriptions to burn the upper North McKittrick watershed decreases the likelihood of high-severity fires that can result in adverse indirect effects (erosion and sedimentation) on aquatic animals downstream.
6. Unique Sites and Sensitive Species: *Issues—Fire could alter unique sites and affect endemic or uncommon species. Plan overview—Prescribed fire can be managed to minimize impacts. Fire promotes plant germination and renews habitat for many wildlife species.*		
Continued suppression under No Action would result in minor, short-term, direct adverse impacts to unique sites and sensitive species. Prescribed and wildland fire could result in increased sediment loads in streams and springs and small changes to populations of sensitive species. Prescribed fire should lead to major, indirect, long-term beneficial effects. The potential for long-term adverse impacts to fire-sensitive species with continued habitat degradation and threats of high-severity fires during periods of severe fire conditions would be moderate. Moderate adverse impacts resulting from successive suppression actions are expected.	With more fire use under Alternative A, greater short-term, adverse impacts to individual plants and animals are expected in relation to No Action. Fires will consume nesting and foraging sites for woodpeckers, small owls and mammals, but fire also creates more of such sites. Managing for burn mosaics keeps such impacts minor. Resprouting of shrubs after burns provides new forage for browsers. Short-term adverse impacts would be minor with appropriate protective measures. The long-term threat of high-severity fires would subside with park-wide application of prescribed fire and wildland fire use. Particular species would benefit as management objectives are met.	The effects of Alternative B would be similar as Alternative A, and the effects to plants and animals within the ZOC would be similar to those experienced within the park. The long-term threat to the park's resources from high-severity fires will further decrease as management objectives for the ZOC are met, reducing the opportunity for fire encroachment from neighboring Forest Service land. Wildland fire use in the upper North McKittrick watershed decreases the likelihood of high-severity fires that can result in adverse indirect effects (erosion and sedimentation) on sensitive plants and animals downstream. Benefits in the long-term are greater than Alternative A.

No Action 1996 Plan	Alternative A Two FMU Plan	Alternative B Cooperative Watershed Plan
7. Non-indigenous Species: *Issues—Fire may aid invasion of non-indigenous species but also may serve to be a control tool. Plan overview—Many native species respond positively to renewing effects of fire. Research can increase understanding of fire effects to non-indigenous species.*		
No Action is predicted to have minor, short-term, adverse effects with the most use of suppression. Suppression disturbances potentially prepare more areas for colonization by exotics in the short-term; high-severity fires from fuels buildup potentially prepare large areas for colonization over the long-term with moderate adverse effects. Prescribed fires reduce fuels but often target developed areas where exotics may be poised to spread. The occurrence of exotics is highly localized in the park and the mitigation measures (surveys and removal of undesirable species) would be applied in all instances where feasible.	Alternative A is predicted to have minor to moderate, short-term, adverse effects. The potential for exotic plant spread exists from both allowing fires to burn, thus clearing areas for colonization, and from disturbing the ground during suppression actions, but less so than under No Action. The occurrence of exotics is highly localized in the park and mitigation measures would be applied in all instances where feasible. Less reliance on suppression compared to the No Action Alternative reduces the long-term adverse effects.	Alternative B is predicted to have minor, short-term, adverse effects. There should be less suppression disturbance, but more extensive wildland fire use, and prescribed burns that cross the north boundary. The occurrence of exotics is highly localized in the park and mitigation measures would be applied in all instances where feasible. Long-term effects are similar to Alternative A.
8. Geology and Geohazards: *Issues—Removal of vegetation by fire can contribute to erosion, flooding, and damage of fossils. Plan overview: Prescribed fire can be managed to limit impacts to sensitive resources. The erosion and sedimentation are natural processes associated with fire.*		
Fire management-related impacts to geology and geohazards would be adverse but short-term and minor to moderate in intensity under No Action. No change to existing conditions is expected in the short-term. Potential continues for moderate, short-term, adverse impacts to soil stability and flood potential during periods of severe fire conditions followed by monsoon-like rainfall events. Potential in the long-term for moderate, adverse impacts to geology and from geohazards, accrues as suppression continues, fuels build, and the likelihood of high-severity fire increases.	Alternative A is similar to No Action and would also result in minor to moderate short-term adverse effects. However, over the long-term soil stability becomes less threatened as the potential for future high-severity wildland fire is reduced. Greater wildland fire use would lessen the adverse effects in the long-term by reducing fuel loads and connectivity throughout the park and therefore reduce erosion of mineral soil potentially exposed by high-intensity fires.	Alternative B, which might see fires crossing from the park to Forest Service land in upper North McKittrick Canyon, also has the potential for minor to moderate, short-term, adverse effects. Fire management actions in the upper reaches of the watershed will affect downstream reaches in the short-term, but would further lessen the potential adverse effects of future wildland fire events on geological features and from geohazards in the long-term.

No Action **1996 Plan**	**Alternative A** **Two FMU Plan**	**Alternative B** **Cooperative Watershed Plan**
9. Air Quality: *Issues—Smoke from fires can be unhealthy and impact visibility. Plan overview—Prescribed burns that reduce fuels are conducted under conditions that comply with regulations and minimize potential for unhealthy air.*		
No Action minimizes short-term, adverse impacts to air quality and visual values through the active suppression of most fires. Impacts to air quality during prescribed burns and wildland fire use would be minor in intensity with required mitigation to meet state air quality standards. With increasing fuel loads, potential grows for moderate adverse impacts to air quality during severe fire conditions in the long-term. The park's use of fire as a tool for meeting resource objectives has a cumulative effect on the airshed in combination with all other activities in the region producing airborne particulates.	Under Alternative A, greater use of fire for resource management may result in more smoke being released for any given period and short-term, minor, adverse impacts. Fire prescriptions would be required to meet air quality standards. Over the long-term, air quality and visual values benefit from reduced fuels and decreased potential for high-severity wildfires that produce large quantities of smoke.	Alternative B would have effects similar to Alternative A, with greater potential for short-term, minor, adverse impacts with more extensive wildland fire use and prescribed burning. Prescribed and wildland fire use actions in the ZOC in the long-term increase the extent of reductions in fuels and fuel connectivity and thus reduce the likelihood that a fire will grow into a larger smoke-generating event.

NEPA Sections 101 and 102
The goals characterizing the environmentally preferable condition are described in Section 101 of the National Environmental Policy Act (NEPA). NEPA Section 101 states that "….it is the continuing responsibility of the Federal Government to …(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice; (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

Using the above discussion as a guide, the environmentally preferred alternative is Alternative B, the Cooperative Watershed Plan. Alternative B does the best job of balancing natural and cultural resource management needs with safety concerns and involves the most interagency coordination. No Action, likely the alternative putting the least amount of fire on the landscape, results in the greatest amount of fuel buildup and the greatest likelihood of high-severity fire. Such fire would leave the land in questionable condition for future generations, be aesthetically unpleasant, and potentially harm important historic, cultural, and natural resources. Alternative A lies between Alternative B and No Action (but closer to Alternative B) in fulfilling the requirements of NEPA section 101. This document presents the analysis to justify selection of Alternative B in accordance with the guidelines set forth in NEPA Section 102, which outline the obligations of all agencies of the Federal Government in regard to environmental protection.

Mitigation Measures
Under all alternatives the park will undertake reasonable efforts to minimize and mitigate the negative effects of the fire program. Proposed measures for doing so appear in the analysis in Chapter IV. In general, under the safety impact topic, mitigation consists primarily of public education/notification and reduction of hazardous fuels. Visitor experience concerns are also mitigated through public education and notification. Mitigating impacts on cultural and natural resources is accomplished through pre-fire surveys, reduction of fuels around sensitive sites, avoiding sites and harmful suppression tactics wherever possible, and using resource advisors during fire activities.

Chapter III: Affected Environment

This chapter provides information about the park environment necessary to understand the effects of the alternatives presented in Chapter IV. Appendix D lists the scientific names for plant and animal species mentioned in several sections of this chapter.

Lincoln National Forest land in upper North McKittrick Canyon has been designated a Zone of Cooperation (ZOC) where the forest and park will jointly manage fire. The extent of the ZOC and rationale for inclusion was introduced in Chapter I. An 827-acre parcel included in the ZOC has been recommended for designation as the Upper McKittrick Research Natural Area (RNA). The information contained in this section comes from interviews with Lincoln National Forest District Ranger Jamie Kingsbury, Fire Ecologist Chad Stewart, and District Biologist Larry Paul, as well as the Lincoln National Forest Plan (USDA Forest Service 1986), amendments, and other documents.

ZOC information is presented at the end of each impact topic section below.

Impact Topic 1 (Life and Property)

Guadalupe Mountains National Park is located in Culberson and Hudspeth counties, Texas, east of El Paso, and southwest of Carlsbad, New Mexico (see Figure I-1). The park's northern boundary is also the Texas-New Mexico state line. A mixture of private and government lands border the park. Public lands on the New Mexico side include holdings of the Forest Service, Lincoln National Forest-Guadalupe Ranger District; DOI BLM, Las Cruces and Roswell districts (Carlsbad Resource Area); and the state of New Mexico. Public lands adjacent to the park in Texas are primarily school and General Land Office lands, i.e., State land. Some private land borders the park in New Mexico. In Texas, except for several subdivided parcels, mostly large ranches lie next to the park. Several rights-of-way and pipelines cross the park.

There are 8.5 miles of paved road and 21.5 miles of graded and primitive road to provide access within the park. There are 89 miles of formally designated and signed trails, seven trailheads, two developed campgrounds, ten backcountry campgrounds, and seven picnic areas. Developed areas are located at: (1) Pine Springs Headquarters/Visitor Center, maintenance and housing area, (2) McKittrick Canyon Visitor Center, (3) Dog Canyon, and (4) Frijole Ranch. Facilities located at these developed sites comprise a significant component of the visitor facilities in the park. Several historic structures are also found throughout the park, as discussed under Impact 3 (Cultural Resources).

The steep and rugged terrain, limited surface water, limited access routes, frequent high winds, and confined canyon bottoms all combine to create hazardous situations under extreme fire behavior. Many of the more popular visitor use areas are in locations with heavy accumulations of fuel and difficult access. In addition, some of the park's trails and high visitor use areas are in canyon bottoms that could be dangerous under certain conditions. The park's most heavily visited area, McKittrick Canyon, has both a canyon bottom trail and heavy accumulations of fuel within the canyon and on the slopes above it.

The lightning associated with summer thunderstorms is the primary agent causing the start of natural fires. Summer storms are often fast moving and localized, with the period of rainfall of short duration and usually accompanied by high winds, thunder, and lightning. The natural fire season does not coincide with the spring and fall periods of highest visitation.

In 2002 trail counters detected the following numbers of people at Pine Springs, Frijole Ranch, McKittrick Canyon, and Dog Canyon:

January	1,505
February	1,634
March	5,351
April	3,710
May	4,119
June	3,916
July	3,097
August	2,049
September	2,369
October	5,119
November	3,803
December	1,697

Peaks in March and October coincide with college spring breaks and McKittrick fall color, respectively.

ZOC Life and Property: Upper North McKittrick Canyon is rugged, steep country that is lightly used for recreation and grazed under a single lease. Hunters will enter the area, but users are mostly occasional cavers who must obtain permits to explore gated caves. A grazing permittee's 17,311-acre allotment lies in Management Area 3A, mostly outside of the ZOC. Currently, the entire Guadalupe Ranger District is under "expanded suppression with the option to manage as prescribed fire [wildland fire use, in current terminology]." Lincoln National Forest staff are currently amending a policy that lifts the 1000-acre limit on wildland fire use.

For any wildland fire use situation, under Alternative B, NPS and the Forest Service will bring in fire use teams when available. The Forest Service will continue to suppress fires in upper North McKittrick until it is apparent that not doing so will result in the fire becoming a serious threat. In Ponderosa pine, the suppression point is crown fire over 40% of the trees. The Guadalupe Ranger District Fire Ecologist is developing thresholds for other vegetation types. Fences and signs are the main developments requiring protection from fire.

The Forest Plan directs maintaining fuel breaks and constructing additional fuel breaks as needed for protection of life and property.

Impact Topic 2 (Visitor Experience)

The park averages over 200,000 visitors each year. Visitor activities include hiking (both day hiking and overnight backpacking), camping, nature study, photography, and horseback riding. May through August is the peak season park wide; however, smaller peaks occur during spring semester break, during the autumn colors, and other holidays. Much of the park's backcountry, especially McKittrick Canyon and Guadalupe Peak, can be visited on day hikes and these two areas receive a high percentage of the park's annual visitation. McKittrick Canyon, in particular, experiences heavy visitation in October and November, when the autumn colors draw 1,600-2,000 people per weekend. Overnight backcountry use in the park is relatively small in relation to annual visitation, approximately 3,000 backpackers per year.

Staff notify visitors to Guadalupe Mountains National Park of fire management activities that might affect their experience. The park's public information office and incident fire information personnel distribute information through press releases, special notices and other communications, as needed, to inform other agencies, communities and individuals of fire management activities. For some fire management activities, visitors are provided information at the Visitor Center, while signs are used to inform visitors along major thoroughfares, including roads and trails. Staff at the Visitor Center post information on cautions, closures, and restrictions, as needed, and are available to answer questions and provide interpretation regarding fire management activities and their purposes. All backpackers receiving permits are advised by park staff at the Visitor Center of fire danger conditions, and backcountry staff keep backcountry visitors informed of fire danger, locations, and progress. Overall, the park's goal is to minimize the impact of fire activities on visitor experience and promote public safety.

ZOC Visitor Experience: The Forest Service manages upper North McKittrick Canyon as wilderness used primarily by dispersed visitors and cavers. All caves require permits for entry, and processing time is at least two weeks. Maintaining scenic values and quiet are high priorities. A Management Area 3A goal (USDA Forest Service 1986 p. 112) includes providing " . . . interpretive services to enhance understanding and appreciation of the area's special features." There are no developed campgrounds in the Guadalupe Ranger District, but camping is allowed in most areas. The Camp Wilderness Ridge (easy) hiking trail along the northern boundary of the ZOC connects with the park's (more difficult) Permian Reef Geology Trail.

Impact Topic 3 (Cultural Resources)

For many centuries, the remote Guadalupe backcountry was the domain of the Ndé (Mescalero Apache). In the 1880s, the Guadalupe Mountains became the last stronghold for Apache chief Victorio, whose last battle with the legendary "Buffalo Soldiers" of the 9th and 10th Cavalry Regiments occurred not far to the south. Ranching played a prominent role in the history of the area, as did the Butterfield Overland Mail Stage that ran through Guadalupe Pass from September 1858 to August 1859. Wallace Pratt purchased approximately 5,000 acres of McKittrick Canyon in the 1930s. Pratt was a petroleum geologist whose love for the beauty of the place moved him to donate the property to the NPS in 1959 for all to enjoy.

As a result of these activities, numerous historic structures exist in the park. These structures are located primarily at (1) Frijole Ranch, (2) Pratt Cabin and the Hunter Line Cabin in McKittrick Canyon, (3) Ship on the Desert, (4) the Pinery (an old station of the Butterfield Stage route), and (5) Williams Ranch. In addition, there are several other historic structures scattered around the park. All of these structures are included in the List of Classified Structures (LCS) for the park (Table C-5, Appendix C). The LCS for the park lists a total of 19 buildings of the 34 classified structures in the park. In addition, more than 400 archeological sites have been identified in the park, including burned rock hearths, midden rings and mounds, lithic and ceramic scatters, rock shelters, caves and pictographs.

The Pinery, the structures at Frijole Ranch, and those at Pratt Cabin in McKittrick Canyon are included on the National Register of Historic Places. Also, 27 of the recorded archeological sites are presently listed in the National Register of Historic Places, as the McKittrick Canyon Archeological District. The Butterfield Stage route itself and the Wallace Pratt residence (Ship on the Desert) have been determined as eligible for listing in the National Register, but additional documentation is needed to promote them to National Register status. Management emphasis for these resources is on preservation, protection, and interpretation of cultural resources and their settings. An NPS team from the Archeological Sites Hazardous Fuels Assessment Program (ASHFAP) conducted an assessment of fuel types found at various cultural resource sites. Their report provides suggestions on how to mitigate the effects of fire at these sites (NPS 1998).

ZOC Cultural Resources: For Management Area 3A, the primary cultural resources of concern are features associated with caves. Forest Plan prescriptions direct managers to evaluate cultural resource sites found during other activities, to protect sites, and generally to comply with the National Historic Preservation Act.

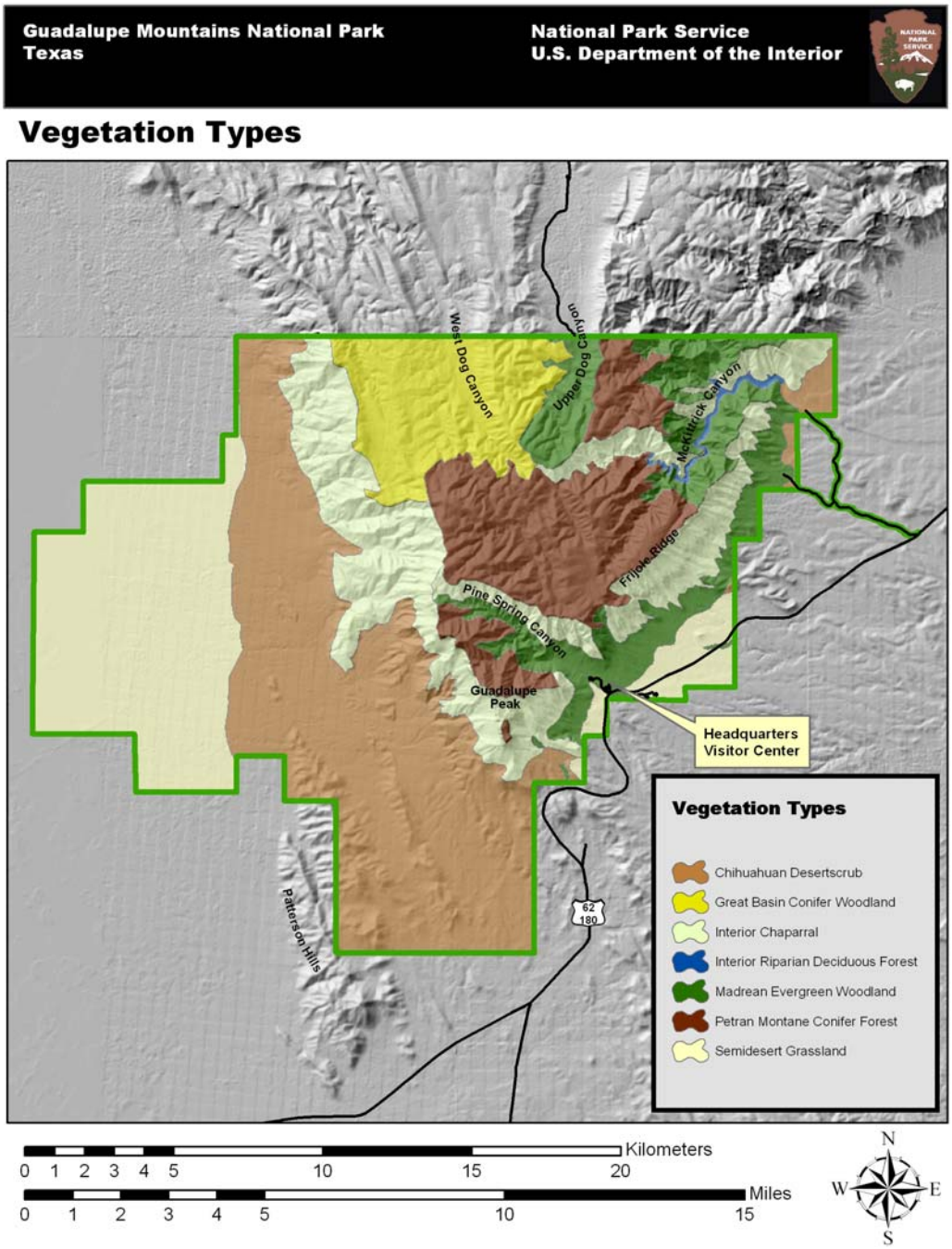
Impact Topic 4 (Vegetation)

Guadalupe Mountains National Park lies in an area of exceptionally high relief created by an uplifting of a portion of the Capitan Reef to form an extensive V-shaped plateau. The elevations in the 86,416-acre park vary widely, ranging from a little over 3,650 feet to 8,749 feet on Guadalupe Peak, the highest point in Texas. On the desert floor the terrain is relatively level. In contrast, the topography of the escarpment is extreme, with its steep talus slopes, precipitous cliffs, decomposing rock ledges and deep canyons. The vegetation communities display all the diversity that would be expected in a landscape of such character. Visitors to Guadalupe Mountains National Park might find themselves in desertscrub, grasslands, chaparral, woodlands, and coniferous forest, depending on the elevation, exposure, and topography where they are standing. Striking desert succulents, canyon fall color, and high country conifers are all part of the park's appeal. Park records identify more than 1,000 species of plants in the park, with 22 as plant species of special concern; 17 of these 22 are endemic to the Guadalupe Mountains.

Endemic plants are also a special feature of Guadalupe Mountains National Park. Unique taxa occur (1) in nooks on limestone cliffs and ledges, (2) in high-elevation forested canyon bottoms, and (3) along streams at lower elevation (Northington and Burgess 1979). Impact topic 6 (Unique Sites and Sensitive Species) introduces protected plants (with official status) within the park.

In the Guadalupe Mountains, the lowest elevations receive about 9 inches of rain per year (PX Well/elevation 3,867 feet), at the Visitor Center (elevation 5,734 feet) the annual average is 18.31 inches, and higher elevations (Bowl/elevation 8,118 feet) receive over 25 inches. The elevational moisture gradient is paralleled by a vegetation gradient. As elevation increases, the desertscrub community surrounding the Guadalupe Mountains becomes progressively replaced by less drought-tolerant species, until at the highest elevations a mixed conifer forest is attained (see Figure III-1).

Figure III-1. Distribution of vegetation types at Guadalupe Mountains National Park



Research by Ahlstrand (1981) shows that fire has historically been an active and recurring force in the Guadalupe Mountains coniferous forest. Tree rings within the park record regular fires over the 500-year period from A.D. 1496 to 1980, with fire occurrence in at least 71 of the years. Fires occurred at an average interval of 17 years through the late 1800s. From this period through 1922, the fire frequency decreased to an average of one every 30 years. This decline in frequency closely parallels the development of the ranching industry in the region and the subsequent reduction of fine carrier fuels (grasses and forbs). Fire scars from the trees sampled indicate that fires burning in 1808, 1830, 1842, 1857, and 1879 burned an average minimum area of 5.2 square kilometers (1,298 acres), and that these fires were low intensity and lasted for several days.

Prehistorically, the pattern of fire may have fluctuated—either through climate change or direct use of fire by early indigenous peoples—but the presence of regular fire has never waned. Consequently, it is assumed that the landscape in this mountain range is strongly influenced by fire, and the plants are adapted to or even dependent upon disturbances created by periodic fires.

With the arrival of Euro-Americans into the area, the patterns of fire changed dramatically, mostly from grazing and intense fire suppression activities in the 20th century. Some forest habitats have become denser, and more prone to high-severity, stand-replacing fires. For the purposes of fire management planning, seven vegetation types have been defined. These types correspond with Brown-Lowe-Pase biomes as summarized most recently in Brown (1994—Univ. of Utah Press reprinting of *Biotic Communities of the Southwest*). Figure III-1 shows the distribution of these vegetation types in the park. Appendix D provides scientific names for the common names used in the text.

The following discussion assigns a fire regime condition class to each of the plant community types. Condition classes are defined as follows (Schmidt et al. 2002):

Condition class I: Fire regimes are within a historical range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within a historical range. Fires burning in class I lands pose little risk to the ecosystem and have positive effects to biodiversity, soil productivity, and hydrologic processes. Typical management replicates the historical fire regime through periodic application of prescribed fire or through wildland fire use.

Condition class II: Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range. Wildland fires burning in class II lands can have moderately negative impacts to species composition, soil conditions, and hydrological processes. Typical management requires moderate levels of restoration treatment, such as a combination of prescribed fire with mechanical treatment.

Condition class III: Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the

following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range. Wildland fires burning in class III lands may eliminate desired ecosystem components, exacerbate the spread of unwanted non-native species, and result in dramatically different ecological effects compared to reference conditions. Typical management requires high levels of restoration treatment, such as mechanical treatments, before fire can be used to restore desired ecosystem function. Intensive efforts, which may include seeding, herbicide application, biomass removal, and other types of rehabilitation, are required for class III lands.

Rocky Mountain (Petran) Conifer Forest (122.3 in Brown)
Conifer forest grows in the highest areas of the Guadalupe Mountains, primarily on north-facing aspects and in canyon bottoms at elevations above 5,610 feet. The coniferous forest associations occur in The Bowl, but notable stands occur throughout the higher elevations near Bush Mountain, Blue Ridge, and the McKittrick Canyon drainage.

Common species: Douglas-fir, southwestern white pine, ponderosa pine, Colorado pinyon pine, Gambel oak, chinkapin oak, Knowlton hophornbeam, bigtooth maple, quaking aspen, Utah serviceberry.

This structural vegetation type has the following characteristics:

- **Present structure:** This vegetation type is overmature to mature with a decadent component. The overstory is primarily Douglas-fir, which is more abundant and dominant than historically. There is a high stocking density of small trees (<3 in dbh), and ladder fuels are building up. Recent insect damage is apparent in Douglas-fir and ponderosa pine. Quaking aspen is diminishing within the Douglas-fir. Research indicates this area was historically dominated by ponderosa pine, southwestern white pine, Gambel oak stands, and hophornbeam.
- **Condition class:** III or II to III. Assessment is based on departure from fire return interval and composition. Historic fire return interval was 5-30 years (Ahlstrand 1981). However, the last major fires occurred in 1922 and 1990. The long interval is likely due to intense grazing, not suppression.
- **Condition on recent burns:** From the 1990 fire, the current condition of burned areas is an early seral stage characterized by exposed soil, some grass, some annual forbs, some woody shrubs, some juniper-oak shrub, and mescalero gooseberry. There has been little recruitment. Pines have not made it to maturity; sprouts are not surviving. There is a poor mosaic of variability because approximately 75% of the burn area was high severity.
- **Fuel model:** Mostly 10 (timber- litter and understory).
- **Insect/disease:** Insect damage in Douglas-fir became apparent in 2000 due to prolonged drought and high stocking. Most ponderosa pine has mistletoe at a low infestation level. Insect damage is currently low, but has the potential to spread.
- **Problem invasives in type:** No problem at present.

Great Basin Conifer Woodland (122.4 in Brown)
Pinyon and juniper woodlands are found at the lower slopes of both Upper Dog and West Dog Canyons, occurring on all aspects at elevations from 6,270 to 6,765 feet.

Common species: Colorado pinyon pine, one-seed juniper, alligator juniper, Rocky Mountain juniper, gray oak, smallseed sacahuista, sotol, blue grama, hairy grama, black grama, sand dropseed

- **Present structure:** This vegetation type is dominated by Colorado pinyon pine, one-seed juniper, and, to a lesser extent, alligator juniper. The general structure is an open canopy woodland savanna with fine-stemmed needlegrass. There is higher tree cover (>35%) and lower grass cover than expected historically. Most of this vegetation type burned patchily in 1994.
- **Condition class:** High II. Assessment is based on a 5-30 year desired fire interval based on the assumption that historically these areas were much less woody and more grassy.
- **Condition on recent burns:** This area has not burned for 10 years despite lack of grazing pressure. In some areas, soil is gone due to intense grazing in the past. Past fires were hot and fast, but brief. There is currently less tree cover in burned areas than in unburned areas. Grass relative abundance is about the same as unburned areas. No data is available on tree recruitment.
- **Fuel model:** 2 (timber- grass and understory).
- **Insect/disease:** No evidence of problems.
- **Problem invasives in type:** Exotic grasses are present around historic cattle tanks, but are not widespread.

Madrean Evergreen Woodland (123.3 in Brown)
Madrean woodland is so named due to its affinities with the vegetation of the Sierra Madre Occidental in Mexico. These woodlands are found mainly in McKittrick and Pine Spring canyons and around the visitor center at the base of the escarpment.

Common species: gray oak, sandpaper oak, chinkapin oak, scrub oak, alligator juniper, Texas madrone, catclaw mimosa, sideoats grama, blue grama, hairy grama, Englemann prickly-pear

- **Present structure:** This vegetation type is dominated by gray oak, alligator juniper, Texas madrone, and ponderosa pine. There is a dense shrub component (gray oak, catclaw mimosa, sotol, and New Mexico agave) and a relatively large number of large-diameter gray oaks. The understory was probably less dense historically. Heavy mistletoe is present in some oak areas due to the high oak density, especially near high visitor use areas and the park housing area. A 1993 fire burned a large portion of this vegetation type.
- **Condition class:** II. Large Texas madrones and gray oaks with fire scars indicate that low-intensity, understory fires occurred here in the past. Historic fire interval was probably 10-30 years (Abbott 1998).
- **Condition on recent burns:** The 1993 fire resulted in the death of all large madrones at Juniper Spring, and a prescribed burn in the mouth and lower reaches of McKittrick Canyon in 1997 killed a few mature madrones, probably due to an unnaturally high level of understory buildup in both of these areas. A few fires were patchy, leaving the overstory mostly unchanged (except for some large trees killed in intense burn areas) while reducing mimosa and sotol. Scrub oak and yuccas are recovering. Wildlife is keeping new madrones from surviving due to browsing. Oaks seem to be returning in shrub form rather than tree form at present.

- **Fuel model:** Mostly 6 (dormant brush, hardwood slash), some 2 (timber- grass and understory).
- **Insect/disease:** Mistletoe is present in dense oak groves, probably at a higher than natural level of parasitism. Flat-headed wood borers were attracted to scorched pinyon pine after the 1993 fire in some areas. These insects probably killed scorched, but living, trees.
- **Problem invasives in type:** Limited exotic grasses are present along roads and disturbed areas, but are not widespread in this vegetation type. Some Russian thistle invaded following the fires and has persisted. Known patches of horehound were set back for several years after the 1993 fire and have not returned to pre-fire levels.

Interior Chaparral (133.3 in Brown)
Shrub-dominated communities inhabit the western escarpment sides and canyons of the Guadalupe Mountains and are prevalent on the south-facing slopes of McKittrick and Pine Spring canyons. While forming a brushy land cover, this chaparral lacks the volatility and denseness of some interior (Arizona) chaparral. Brown (1994) describes a "Coahuilan" chaparral subgroup that occurs in Mexico, southern New Mexico, and Texas that is highly analogous to Arizona chaparral, as is Dick-Peddie's (1993) "montane scrub" vegetation. These types share many species with the park, but the absence of manzanita and presence of grasses create a distinctive formation.

Common species: hairy mountain-mahogany, desert buckbrush, gray oak, scrub oak, sotol, blue grama, bush muhly, sand dropseed.

- **Present structure:** This vegetation type is dominated by sotol, desert buckbrush, hairy mountain-mahogany, scrub oak, and blue grama, with occasional individual faxon yucca and alligator juniper plants. There is more shrub cover (~70%) than grass cover (~30%). Areas burned in a 1993 fire were reduced to rock and bare soil, but shrubs came back from basal sprouting. Combined fires in 1990, 1993, and 1994 burned about 50% of this vegetation type, mostly in the northern and eastern parts of the park.
- **Condition class:** I. The species composition is normal, but the fire interval is longer than natural. Historic fire interval was probably 30-60 years (Wright 1990; Payson et al. 2000).
- **Condition on recent burns:** This vegetation type is very resilient. Areas that burned in the 1990s have mostly recovered. Burned areas have lower shrub cover and shrub height than unburned areas, but shrub density and grass cover are about equal.
- **Fuel model:** 6 (dormant brush, hardwood slash).
- **Insect/disease:** No evidence of problems.
- **Problem invasives in type:** Exotic sheep graze here. The extent of non-indigenous grass invasion is unknown, but suspected to be minor.

[Chihuahuan] Semidesert Grassland (143.1 in Brown)
Desert grassland is most prominent on alluvial fans or bajadas at the base of the escarpment, or on the lower slopes that extend toward the desert.

Common species: blue grama, hairy grama, black grama, bush muhly, cottontop, alkali sacaton, honey mesquite, Mormon tea, catclaw acacia, sotol, lechuguilla, ocotillo, soaptree yucca, Spanish dagger, encroaching redberry juniper.

- **Present structure:** This vegetation type is dominated by invasive woody perennials, especially redberry juniper and soaptree yucca. Annual herbaceous forbs and cacti are present to a lesser extent. There are about 10 dominant species of native grasses, including blue grama, three-awn, hairy grama, cane bluestem, alkali sacaton, and sand dropseed. Although the current vegetation structure is about 70% grass cover and 30% perennial shrubs, there are probably more shrubs than historically present because there is less shrub cover in areas that have burned frequently. Furthermore, in 1903 and 1940, prairie dog towns were noted in this vegetation type. At present, the area is too woody for prairie dogs.
- **Condition class:** II. The historic fire frequency was probably 5-10 years.
- **Condition on recent burns:** The 1993 Pine Fire burned a large extent of this vegetation type. Some was also burned during the 1997 McKittrick Canyon burn. The fires knocked back catclaw mimosa, reduced desert succulents in size but not quantity, and reinvigorated grass growth. Annual herbaceous plant diversity increased immediately following the fires, but then tapered off. There is presently little visible difference between the 1997 prescribed burned and unburned areas.
- **Fuel model:** 2 (timber- grass and understory).
- **Insect/disease:** None noted.
- **Problem invasives in type:** Russian thistle, wooly mullein, Malta star thistle, and horehound all readily invade disturbed areas, including burned areas.

Chihuahuan Desertscrub (153.2 in Brown)
Considerable portions of the region below the west and east escarpments are dominated by microphyllous shrubs. Creosotebush-dominated associations occur on the upper and middle bajada west of the Guadalupe Mountains; pink quartz sand dunes, gypsum dunes, and the bolsons all support somewhat distinct plant communities.

Common species: creosotebush, honey mesquite, fourwing saltbush, ocotillo, mariola, tarbush, tobosagrass, alkali sacaton, prickly-pear, cholla, kingcup cactus, banana yucca, fluffgrass, bush muhly, black grama.

- **Present structure:** This vegetation type is dominated by prickly pear, cholla, kingcup cactus, sotol, creosotebush, mesquite, yucca, whitethorn acacia, viscid acacia, ocotillo, lechuguilla, mariola, javelina bush, range ratany, and crucifixion thorn. Black grama, hairy grama, and sand dropseed are also present. The overall structure is characterized by 50% rock and bare ground, 20-40% shrub cover, and 10% or less grass cover. There was probably much greater grass cover prior to heavy grazing, but it may be impossible to replace grasses because the soil is gone.
- **Condition class:** II. Grasses are greatly reduced from natural levels. Very infrequent fires are likely.
- **Condition on recent burns:** No recent burns because fire does not carry in this vegetation type. Lightning strikes will burn, for example, a single sotol.
- **Fuel model:** No model is assigned to this type because of too little and discontinuous fuels. The closest fuel model is 2 (timber- grass and understory), but fuel in this vegetation type is too discontinuous to fit.
- **Insect/disease:** None noted.

- **Problem invasives in type:** Exotic sheep.

Interior Deciduous Forest and Woodland

Broadleaved deciduous trees grow primarily at springs and in streambeds at low elevations of the region and become the dominant growth form on stream terraces and in canyonheads above 4,920 feet. Deciduous woodland dominants change with location.

Common species: Rio Grande cottonwood and black willows can occur primarily outside canyons, with little walnut inside the canyons, but as the stream gradient increases, Knowlton hophornbeam and velvet ash replace these species and are themselves replaced by bigtooth maple, chinkapin oak, and Texas madrone, especially on upper terraces, around springs, and in canyon heads. McKittrick Canyon provides the best example of this biotic community.

Other species: western soapberry, alligator juniper, and ponderosa pine

- **Present structure:** This vegetation type is dominated by bigtooth maple, ash, madrone, chinkapin oak, black willow, western soapberry, and little walnut. There is a fairly continuous overstory and the understory is denser than the normal historic level. Redberry juniper is becoming established in the understory. Riparian grasses, such as saltgrass, are also present.
- **Condition class:** II, due to over dense understory. Historically, there were probably low intensity fires at intervals synchronized with surrounding vegetation types. Fires covered small areas and stand replacing fires were infrequent.
- **Condition on recent burns:** This vegetation type was burned in the 1993 Pine Fire and the 1997 McKittrick Canyon burn. The Pine Fire burned this vegetation type at two springs, having a stand-replacing effect at one spring and minimal effects at the other. The McKittrick Canyon burn had minimal effects on this vegetation type; the understory returned to pre-fire density quickly.
- **Fuel model:** Variable, some 2 (timber- grass and understory), some 6 (dormant brush, hardwood slash), some 3 (tall grass).
- **Insect/disease:** None noted.
- **Problem invasives in type:** None observed.

ZOC Vegetation:

The Forest Service classifies most of Management Area 3A as pinyon-juniper woodland with an understory of grasses, shrubs, and succulents (Great Basin Conifer Woodland, above). Upper North McKittrick contains canyon-bottom riparian vegetation composed of species also found in the park (Interior Deciduous Forest and Woodland, above). The proposed Research Natural Area encompasses a mountain mahogany shrub community that occurs between 6,600 and 7,200 feet elevation. According to the Forest Plan (USDA Forest Service 1988), the RNA designation for this area "emphasizes" natural processes, protects natural features, and preserves examples of natural ecosystems in an unmodified condition for research and educational purposes.

In amending the Forest Plan to allow naturally ignited fires to grow to a size greater than 1,000 acres, the Forest Service acknowledges the role of fire in shaping the Guadalupe Mountains

landscapes. Currently, fires will be suppressed when the value of threatened resources exceeds the cost of suppression. Managers are interested in maintaining the mix of higher elevation woodlands and lower elevation grasslands and shrublands; to avoid vegetation type conversion, crown fires that spread to more than 40% of a stand of ponderosa pine will be suppressed. Currently, removal of fine fuels by grazing may limit spread of ground fires, which alters the structure and composition of the vegetation over time. The Forest Plan calls for protecting and enhancing riparian habitat.

Impact Topic 5 (Wildlife)

Wildlife

From the Chihuahuan desert to the coniferous forest, the mountain's diverse ecosystems are habitat to a diverse array of animal species (Appendix D provides scientific names for the common names used in the text). The diversity of faunal species in the park is further accentuated by the overlap in this area of several biotic regions: Rocky Mountain, Madrean, Chihuahuan Desert, and Great Plains. Numerous species reach their limits of distribution in the Guadalupe Mountains area. The Guadalupe Mountains uniqueness in this respect is one reason the park was established.

The Guadalupe Mountains are home to 60 species of mammals. Some, such as mountain lion, bobcat, and black bear are reclusive, while mule deer are very common and often seen. The park also hosts an elk herd introduced in the 1920s by J. C. Hunter (whose lands later became part of the park), from populations in the Black Hills of South Dakota. Merriam's elk had previously been hunted out of the Guadalupes and the rest of its range in the southwestern U.S. Smaller mammals include coyotes, black-tailed jackrabbits, desert cottontails, ringtails, and gray foxes. Rock squirrels are common throughout the park, and the Mexican vole is endemic to the higher elevations. Several species of bats may be observed at dusk, including the Brazilian free-tail bat and the pallid bat.

A diverse array of bird species use the park (303 in all) and over 95 species breed here. Many are found nowhere else in Texas and are more common elsewhere in North America. Others are more easily found to the south, and occur here at the northern extent of their range. The desert lowlands are home to several species of sparrows, verdin, the roadrunner, and the cactus wren, to name a few. Bird species commonly seen in the middle elevations in the park are the canyon towhee, rufous-crowned sparrow, juniper titmouse, western scrub jay, and scaled quail. In summer the Scott's oriole, Say's phoebe, white-throated swifts, and turkey vultures are commonly present. The high country forests of Douglas-fir and western white and ponderosa pine provide an entirely different habitat for birds such as mountain chickadee, Steller's jay, red-breasted nuthatch, pygmy nuthatch, red crossbill, and hairy woodpecker. Birdwatchers who come to the park hope to see rare magnificent and blue-throated hummingbirds and Montezuma quail.

The park hosts 46 reptiles, and 9 amphibians. Several lizard species are a common sight in the park, particularly the southwestern fence lizard, the Chihuahuan spotted whiptail, Hernandez's short-horned lizard, and Big Bend tree lizard. The western diamond-backed rattlesnake, striped whipsnake, and mountain patch-nosed snake are also common. The more common amphibians in the park include the Rio Grande leopard frog, Couch's spadefoot, and red-spotted toad.

Changes in fire regime as discussed under Vegetation, above, are thought to have had profound effects on the natural diversity, abundance, and distribution of wildlife in the park. In addition, the fire suppression activities themselves can affect wildlife through direct disturbance of animals and habitats.

ZOC Wildlife:

Forest visitors may encounter turkeys, deer, elk, coyotes, mountain lions, raccoons, squirrels, bobcats, skunks, badgers, and porcupines.

The Forest Service manages for "indicator species" whose presence is related to intact ecosystem structure and function. The Lincoln National Forest Plan (USDA Forest Service 1986) lists the following pairs of indicator animal species and plant communities/vegetation structural components:

Meadowlark: Grama Galleta Grassland (open weedy grassland)
Rufous crowned sparrow: Desert Shrub (brushy mountain slopes)
Mule deer: Woodland (scrubby cover, browse species present, closed landscape)
Plain titmouse: Woodland (trees with natural cavities)
Pygmy nuthatch: Ponderosa Pine (snags and large trees)
Elk: Mixed Conifer (conifer forest, mountain meadows, and areas with little or no grazing)
Mexican vole: Mixed Conifer (mesic mountain meadows)
Hairy woodpecker: Aspen (aspen snags and mature aspen)
Red squirrel: Englemann spruce (mixed conifer forest with interlocking crowns and trees of cone-bearing age)

Mule deer, juniper (plain) titmouse, pygmy nuthatch, elk, and Mexican vole are species most likely to be found in the ZOC.

Impact Topic 6 (Unique Sites and Sensitive Species)

The U.S. Congress set aside Guadalupe Mountains National Park to preserve "outstanding geological values together with scenic and other natural values of great significance." Geological resources are discussed under Impact Topic 8; the "other natural values" of concern appear below.

McKittrick Canyon
McKittrick Canyon sits along the eastern side of the Guadalupe Mountains along the New Mexico-Texas border, and forms the cornerstone of what has become Guadalupe Mountains National Park. Within the towering walls exists an environment of diversity and contrast, one that has been termed "the most beautiful spot in Texas." The canyon cuts a 2,000-foot deep chasm through the Permian limestone of the escarpment and contains a small, discontinuous, spring-fed stream. This perennial water, and the shade and cooler temperatures created by the sheltering canyon, sustains a riparian ecosystem apparent for its contrast with the surrounding Chihuahuan desert beyond. The canyon is also noted for the assemblage of species that occur within its

confines, representing such distinct life zones as the Great Plains, Rocky Mountains, and the northern hardwood forests.

McKittrick Canyon also stands out for its long human history, perhaps due to the perennial water found here. The McKittrick Canyon Archeological District preserves the heritage of human use and occupation of this unique oasis in the desert. According to archeological evidence unearthed in and near the canyon, the earliest inhabitants occupied the area over 12,000 years ago. Much later in history, the Mescalero Apaches inhabited the canyon. In more recent history, Wallace E. Pratt, a young geologist captivated by the beauty and geology of the canyon, built a cabin in 1931-32 at the confluence of North and South McKittrick. Built only of stone and wood, the cabin served as his part-time home and summer retreat.

Riparian Habitat
At least 90 taxa of aquatic invertebrates have been found in McKittrick Canyon (Guadalupe Mountains National Park 1996), which supports fish and amphibians not found elsewhere in the park. An abundance of grasses and flowering forbs also find a home here, including the rare Chaplin's Columbine. This small plant with its delicate yellow flower can be found adjacent to the creek or growing along seeps in the canyon walls. Tree species are also found along the creek, such as bigtooth maple and velvet ash. From late October to early November the foliage of these trees turns to brilliant reds, oranges, and yellows, creating a scene unusual in this part of Texas and drawing thousands of visitors to the canyon each year.

Springs
A number of springs, mostly near the base of the south end of the escarpment, are habitat for water-loving plants, important sustainers of wildlife, and popular sites for visitors. Visitors to Frijole Ranch can easily reach Smith and Manzanita springs via the Smith Spring trail. Springflows tend to be sensitive to vegetation dynamics; removing vegetation can free up water and increase flows, but intact canopies of plants occurring around springs help keep spring areas from drying out.

Benchmark for the Middle Permian
The strata that define the international standard for the Middle Permian (geologic) period are located in Guadalupe Mountains National Park. The Middle Permian benchmark is composed of three stratotype sections in three locations—Getaway Ledge, Stratotype Canyon, and Nipple Hill.

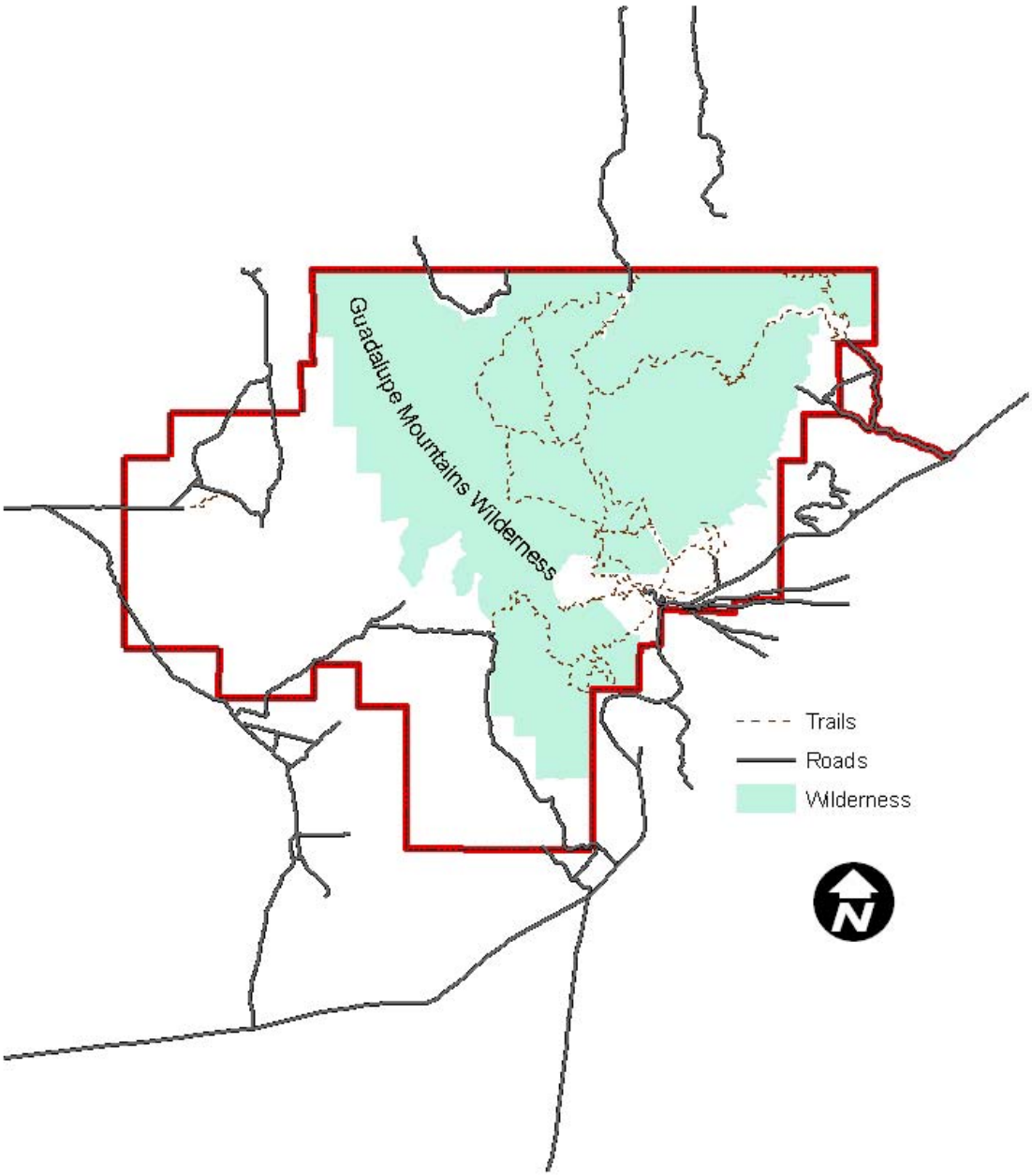
Research Natural Areas
Three areas in the park have been nominated for designation as Research Natural Areas due to their unique natural features, condition and scientific interest. These areas are (1) Devil's Den Canyon, (2) Upper South McKittrick Canyon (above Hunter Line Cabin), and (3) The Middle Fork of North McKittrick Canyon. The park manages these areas as closed to all use except authorized research. Wildland fire use can be permitted in these areas.

Wilderness
Approximately 46,850 acres in Guadalupe Mountains National Park is designated wilderness. The area is generally defined by the Frijole Ridge escarpment on the east and the foothills of the Brokeoff Mountains on the west, extending south just beyond El Capitan Peak (see Figure III-2).

Elevations within the wilderness range from 4,000 feet to approximately 8,600 feet near the summit of Guadalupe Peak. In addition to designated wilderness, much of the remaining park backcountry is managed as wilderness.

The Wilderness Act of 1964 defines wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." The Act states that except as necessary to meet the minimum requirements for the administration of the area for the purpose of the Act, including health and safety emergencies, there shall be no permanent or temporary road, no use of motor vehicles or motorized equipment, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any Wilderness area. The Act contains a special provision for the use of aircraft when necessary to control fire. NPS Management Policies direct that fire management activities in wilderness areas conform to the basic purposes of wilderness; actions taken to suppress wildland fires in wilderness areas must use the minimum tool concept to protect natural and cultural features and to minimize the lasting impacts of the suppression actions.

Figure III-2. Park map showing wilderness boundary



Special-Status Plants
A number of Federal and State-listed plant species occur within Guadalupe Mountains National Park. There are no species currently listed as Federal threatened or endangered, and only one species as threatened by the Texas Parks and Wildlife Department (TPWD). There are a number of USFWS *species of concern*—this is an informal designation for species in need of concentrated conservation actions, depending on the status of the population and the type and degree of threats. An inventory of the plants listed, proposed for listing, and recognized as requiring special consideration follows in Table III-1. The plants considered most at risk in the event of a high-intensity fire are discussed below.

Guadalupe fescue
This species is a candidate for listing as threatened or endangered. Guadalupe fescue is a loosely tufted perennial grass 17 to 32 inches tall with slender stems and rough leaves curving upward from a rhizomatous base. The 1931 type locality for Guadalupe fescue is in South McKittrick Canyon near Pratt Cabin, where it was recorded from "shaded moist slopes" along the creek at 6,500 feet elevation (Aiken et al. 1996). The grass has not been documented in the park since a 1952 collection by Hubert Nixon and is thought to be extirpated in the Guadalupe Mountains. It is considered highly palatable to grazers, and grazing pressure prior to the establishment of the park in 1972 may have led to its disappearance (Desert Botanical Garden 1999). Currently the only known population in the United States occurs in the Chisos Mountains of Big Bend National Park. It is not known whether fire would potentially benefit this species' habitat. Plants are often found scattered in patches in the dense understory of pine-oak-juniper woodlands.

Guadalupe mescal bean
Guadalupe mescal bean is an evergreen shrub restricted to sandy, gypseous soils in the Guadalupe Mountains of Texas and New Mexico (Sivinski 1999). Its habitat is Chihuahuan desertscrub and juniper savanna between 5,260 and 6,650 feet elevation. It has no status with USFWS, but is protected by the Forest Service and states of Texas and New Mexico.

Guadalupe violet
The Guadalupe violet was discovered in the park in 1987 in a limestone crevice on the eastern lip of the mountain (Powell and Wauer 1990). The plant is an herbaceous perennial that grows to 6 to 12 inches. It is thought to be a relict from wetter times and is currently only known from the park. It is a Federal species of concern and considered critically imperiled in the state of Texas.

Chisos agave, gypsum wild buckwheat, paper spine cactus and Guadalupe Mountains aster are all rare plants that have been documented in the Guadalupe Mountains region but not in the park.

Table III-1. Sensitive Plants Associated with Guadalupe Mountains National Park or the Lincoln National Forest Zone of Cooperation under Alternative B

Common Name	Scientific Name	Status[a]	Habitat
Species occurring on rocky ledges or in other areas relatively protected from fire:			
Chaplin's golden columbine	*Aquilegia chrysantha* var. *chaplinei*	USFS, S1, SOC-NM	Wet, limestone crevices and gravel alluvium—areas where moisture causes fire to lay down
Gypsum milkvetch	*Astragalus gypsodes*	S2, SOC-NM	Gypseous soils in Chihuahuan desert scrub—sites where fire doesn't carry because of widely spaced vegetation
Payson's hiddenflower	*Cryptantha paysonii*	(regional endemic)	Rocky limestone slopes
Guadalupe rabbitbrush	*Chrysothamnus nauseosa* var. *texensis*	SOC-F, USFS, S1	In crevices on faces of limestone cliffs and huge boulders; seen after 1990 Frijole and 1993 Pine Fires around Smith Spring
Guadalupe pincushion cactus	*Escobaria guadalupensis*	SOC-F, USFS, S1	Limestone crevices and rocky soils in open woodland; park staff have seen similarly sized hedgehog cacti survive fires
McKittrick pennyroyal	*Hedeoma apiculatum*	SOC-F, USFS, S2 (DL), SOC-NM	Limestone cliff crevices, bottoms and slopes of several drainages; no changes to study plot population size observed after 1990 Frijole Fire
Burgess' broomsage	*Lepidospartum burgessii*	SOC-F, S1, E-NM	Stabilized gypsum dunes –sites where fire doesn't carry because of widely spaced vegetation
Cardinal penstemon	*Penstemon cardinalis* ssp. *Regalis*	USFS, S2, SOC-NM	Limestone ledges and gravel alluvium; plant observed in burned over gravel areas after 1993 Pine Fire
Fiveflower rockdaisy	*Perityle quinqueflora*	SOC-NM	Limestone cliffs and canyon bottoms–sites where fire doesn't carry because of widely spaced vegetation
Guadalupe milkwort	*Polygala rimulicola* var. *rimulicola*	SOC-NM	Limestone cliffs and canyon bottoms
Warnock's ragwort	*Senecio warnockii*	(regional endemic)	Known from one location in the park; restricted to gypsum

Common Name	Scientific Name	Status[a]	Habitat
Sparseflower jewelflower	*Streptanthus sparsiflorus*	SOC-F, S2, SOC-NM	Gravel alluvium and limestone ledges in canyon bottoms; regeneration observed after the 1993 Pine Fire in Pine Springs and Smith Canyon draws
Guadalupe valerian	*Valeriana texana*	S3, SOC-NM	More mesic crevices in limestone cliffs and ledges above 6,000 feet—sites where fire doesn't carry because of widely spaced vegetation
Mat leastdaisy	*Chaetopappa hersheyi*	SOC-F	Limestone cliff crevices where fire wouldn't carry on the surface, but where intense fire in overstory could shower down embers
Species whose entire known population might be affected by a high-intensity fire:			
Guadalupe mescal bean	*Sophora gypsophila* var. *guadalupensis*	USFS, S1, SOC-NM	Mostly restricted to a gypsum outcrop in a single drainage near the north edge of the park, west of Dog Canyon; population survived the 1994 Marcus Fire
Guadalupe violet	*Viola guadalupensis*	SOC-F, S1	Limestone crevice on east side of mountains; plants would be threatened directly by fire or indirectly by habitat change if two Douglas-firs immediately adjacent burned
Likely fire-adapted species occurring in fire-prone habitats:			
Glass Mountain coralroot	*Hexalectris nitida*	SOC-F, USFS, E-NM	Oak humus in well-drained, gravelly areas.
Chisos coralroot	*Hexalectris revoluta*	S1	Humus in oak groves along rocky creekbeds in mountain canyons
Biennial woolywhite	*Hymenopappus biennis*	S2	Rocky soils in grasslands and open woodlands above 6,000 feet; thrived after 1990 Frijole fire and not seen as dense since 2-3 years post-fire
Strong bladderpod	*Lesquerella valida*	S1	Open slopes; hasn't been seen in recent years

Common Name	Scientific Name	Status[a]	Habitat
Trans Pecos beargrass	*Nolina arenicola*	SOC-F, S2	Sand dune areas and shrublands on steep limestone slopes; observed to resprout after moderate-intensity fire
Culberson County skullcap	*Scutellaria laevis*	SOC-F, S1	Mountain slopes and along arroyos, 3,900 feet to 6,000 feet
Rare species once found in the park but no longer known from the park:			
Guadalupe fescue	*Festuca ligulata*	C-F, S1	Pine-oak-juniper woodlands
McKittrick's snowberry	*Symphoricarpos guadalupensis*	SOC-F, SH	Understory component in Ponderosa pine-Douglas fir forests; collected once then never seen again
Rare species known from the region but not found at the park to date:			
Chisos agave	*Agave glomeruliflora*	SOC-F, S1, USFS	Chihuahuan desert grassland slopes in W. TX; hybrid origin—reported by Gentry (1982) in the Guadalupe Mtns; could be affected by high-intensity fire
Gypsum wild-buckwheat	*Eriogonum gypsophilum*	T-F	Known only from three locations in Eddy Co., New Mexico; restricted to soils that are almost pure gypsum
Paper spine	*Sclerocactus papyracanthus*	SOC-F, S1	Gypsum flats
Guadalupe Mountains aster	**Symphyotrichum laeve* var. *geyeri*	S1	Limestone soils along streams and wooded canyons above 5,000 feet, limited distribution

*name *(Aster laevis* var. *guadalupensis)* updated according to National Plant Data Center (plants.usda.gov 2003)

[a] Status:
T-F=Federal Threatened
C-F=Candidate for listing as Federal Threatened or Endangered
SOC-F= Federal Species of Concern
SOC-NM = New Mexico Species of Concern
USFS=USDA Forest Service, Region 3 sensitive
E-NM= New Mexico Endangered
T-NM= New Mexico Threatened
DL = De-listed

Rank (State):
S1=less than 6 occurrences known in State; critically imperiled in State; especially vulnerable to extirpation

S2=6-20 known occurrences in State; imperiled in the state because of rarity; very vulnerable to extirpation
S3=21-100 known occurrences in State; either rare or uncommon in State; vulnerable to extirpation
SH= historical in Texas; not verified within the past 50 years but suspected to be extant

Sources:

Agency Status of NM Rare Plants. New Mexico Rare Plant Technical Council. Nmrareplants.unm.edu/nmrptc/agency.htm (no date found).

A List of the Rare Plants of Texas, January 2002 edition. Texas Parks and Wildlife Department.

Federal Endangered, Proposed, and Candidate Species and Species of Concern in New Mexico. May 2003 revision.

Federally Listed as Threatened and Endangered Species of Texas. June 24, 2003.

Regional Forester's Sensitive Plant and Animal Species List dated July 21, 1999.

Special-Status Animals

Table III-2 presents special status (federal and state) animal species known to be, or potentially could be, present in Guadalupe Mountains National Park. The following species have federal status and were treated in the Biological Assessment prepared for USFWS:

Yellow-billed cuckoo *(Coccyzus americanus)*
Black-tailed prairie dog *(Cynomys ludovicianus)*
Southwestern willow flycatcher *(Empidonax traillii extimus)*
Northern aplomado falcon *(Falco femoralis septentrionalis)*
Black-footed ferret *(Mustela nigripes)*
Mexican spotted owl (*Strix occidentalis lucida*)

Only the Mexican spotted owl (MSO) is fully developed in the Biological Assessment because it alone received a "likely to adversely affect" determination relative to fire program activities at the park. The range-wide 1990 population estimate for the southwestern United States was 2,160 birds. MSO has declined because of habitat loss and alteration. It is extremely rare and local in Texas. Harvest of old-growth timber stands, even-aged timber harvest systems, and wildland fires have contributed to loss of habitat. In Texas, MSO have been seen in or near Guadalupe Mountains National Park, and on property of The Nature Conservancy in the Davis Mountains of Jeff Davis County. The owls have never been found in any other mountain ranges in Texas.

Table III-2. Special Status Wildlife Species Associated with Guadalupe Mountains National Park or the Lincoln National Forest Zone of Cooperation under Alternative B

Common Name	Species Name	Status[a]	Habitat
Species that require special consideration relative to fire activities:			
Mexican spotted owl	*Strix occidentalis lucida*	T-F, T-T, USFS	Mixed conifer, ponderosa pine, and pinyon-juniper; steep slopes and canyons with rocky cliffs between 5,300 feet and 6,500 feet; rare, breeder
Species that may require consideration relative to fire activities:			
Northern goshawk	*Accipiter gentilis*	SOC-F, USFS	Inhabits mature forest; occasional spring or fall visitor to the park
Western burrowing owl	*Athene cunicularia hypugea*	SOC-F	Grasslands/shrublands, often use the burrows of prairie dogs and other burrowing animals; rare; occurs in only burnable part of the salt flat area (NW corner); more frequent fire would likely create more habitat
Yellow-billed cuckoo	*Coccyzus americanus*	C-F, USFS	Records from 1991 and 1996 in mouth of McKittrick Canyon
Townsend's big-eared bat	*Corynorhinus townsendii*	SOC-F	Roosts in caves and mine shafts where it may be sensitive to smoke
Black-tailed prairie dog	*Cynomys ludovicianus*	C-F	Historically present but currently absent from NW corner salt flat area; more frequent fire would likely create more habitat
Black-footed ferret	*Mustela nigripes*	E-F, E-TX	Associated with black-tailed prairie dog towns
Bell's vireo	*Vireo bellii*	USFS, T-NM	Prefers dense, low, shrubby vegetation in riparian areas
Likely fire-adapted species using fire-prone habitats:			
Limestone tiger beetle	*Cicindela politula petrophila*	SOC-F	Limestone outcrops and crevices

Common Name	Species Name	Status[a]	Habitat
Ferruginous hawk	*Buteo regalis*	SOC-TX, SOC-NM, USFS	Low-lying areas in desertscrub and desert grassland; transient
American peregrine falcon	*Falco peregrinus anatum*	SOC-F, E-TX, USFS	Canyons and rocky terrain, nests in cliffs; rare, breeder; recently removed from endangered species list
Texas horned lizard	*Phrynosoma cornutum*	SOC-F, T-TX	Desertscrub and desert grassland, near populations of harvester ant; common
Hernandez's short-horned lizard	*Phrynosoma hernandesi hernandesi*	T-TX	Forested areas and semiarid plains at higher elevations; common
Guadalupe southern pocket gopher	*Thomomys umbrinus guadalupensis*	SOC-F, T-NM, USFS	Montane and valley areas in shallow rocky soils, often associated with lechuguilla (*Agave lechuguilla*); uncommon
Black bear	*Ursus americanus*	T-TX	Remote mountainous areas or thickets along watercourses; uncommon
Rare species known from the region but not found at the park to date:			
Southwestern willow flycatcher	*Empidonax trailii extimus*	E-F, E-TX, E-NM	No valid records; likely prefers more densely vegetated riparian habitat than present at park
Northern aplomado falcon	*Falco femoralis septentriolnalis*	E-F, E-TX, E-NM	If species recovers, might use park's west-side grasslands

[a] Status:
E-F=Federal Endangered
T-F=Federal Threatened
C-F=Candidate for listing as Federal Threatened or Endangered
SOC-F= Federal Species of Concern
SOC-NM = New Mexico Species of Concern
SOC-TX = Texas Species of Concern
USFS=USDA Forest Service, Region 3 sensitive
E-NM= New Mexico Endangered
T-NM= New Mexico Threatened
E-TX= Texas Endangered
T-TX= Texas Threatened

Sources:

Federal Endangered, Proposed, and Candidate Species and Species of Concern in New Mexico. May 2003 revision.

Federally Listed as Threatened and Endangered Species of Texas. June 24, 2003.

Texas Parks and Wildlife Department. www.tpwd.state.tx.us

Federal Endangered, Proposed, and Candidate Species and Species of Concern in New Mexico. May 2003 revision.

Regional Forester's Sensitive Plant and Animal Species List dated July 21, 1999.

ZOC Unique Sites and Sensitive Species: In managing the Guadalupe Ranger District as wilderness, the Forest Service is particularly interested in protecting limestone caves, the RNA, and Mexican spotted owl. Caves will be managed as wild, but gated according to their unique content and hazards to cavers.

The Forest Plan (USDA Forest Service 1986—Table 14) lists 12 sensitive plant species in Management Area 3A (brackets denote common named used by USFS):

- Mat least daisy [Hershey's cliff daisy] (*Chaetopappa hersheyi*)
- Guadalupe rabbitbrush [rubber rabbitbrush] *(Chrysothamnus nauseosus* ssp. *texensis*)
- Lee's pincushion cactus *(Coryphantha sneedii* var. *leei)*
- Sneed's pincushion cactus *(Coryphantha sneedii* var. sneedii)
- Guadalupe pincushion cactus [Guadalupe mountain foxtail cactus] *(Escobaria guadalupensis)* in the Guadalupe Mountains (Baker and Johnson 2000)
- McKittrick pennyroyal (*Hedeoma apiculatum)*
- Guadalupe milkwort [Steyermark's milkwort] *(Polygala rimulicola)*
- Summa sage (*Salvia summa)*
- Guadalupe mescal bean *(Sophora gypsophila* var. *guadalupensis)*
- Lyreleaf jewelflower *(Streptanthus carinatus)*
- Sparseflower jewelflower [Guadalupe jewelflower] *(Streptanthus sparsiflorus)*
- Guadalupe valerian [Texas tobacco root] (*Valeriana texana*)

Four plants from the above list were not included in Table III-1 (Sensitive Plants of Guadalupe Mountains National Park). Baker and Johnson (2000) assign both *Coryphantha sneedii* varieties to the genus *Escobaria*. Their work shows that the *Coryphantha sneedii* in Guadalupe Mountains National Park is actually *Escobaria guadalupensis*, which is listed in Table III-1. *Streptanthus carinatus* was initially thought to be rarer than it actually is. *Salvia summa* is considered rare, but found in sufficient numbers and widely distributed enough to persist (Worthington 1999).

North of the park boundary Mexican spotted owl pairs have been found in canyon habitat and vegetation structure similar to the park (Larry Paul, Lincoln National Forest Guadalupe Ranger District Biologist, personal communication).

Impact Topic 7 (Non-indigenous Species)

Table III-3 lists 50 non-indigenous plant species for Guadalupe Mountains National Park. In addition, non-indigenous animals inhabit the park, including deliberate introductions of elk and

rainbow trout. These imports from elsewhere can have species, community-level, or ecosystem-level effects, by (1) significantly altering natural processes such as fire regimes, nutrient cycling, hydrology, or successional patterns, (2) by altering species composition and reducing populations of native species, or (3) through hybridization with native species. Some species are disruptive if they affect localized resources such as archeological features or scenic qualities on a broad scale.

Most non-indigenous plant species enter the park from nearby infested areas by vegetative growth, by windblown seed, or being carried by birds, mammals, or people (and their vehicles). Barbary sheep *(Ammotragus lervia)*, escaped from a game ranch in the Sacramento Mountains to the north in the late 1950s, fill the niche formerly occupied by native bighorns *(Ovis canadensis)*. There are the non-indigenous but historically meaningful rainbow trout put in McKittrick Creek by Judge Hunter. Elk now inhabiting the park were brought in from Rocky Mountain populations after native elk were extirpated.

Table III-3. Non-indigenous Plant Species at Guadalupe Mountains National Park
(3-13-02 list)

Common Name	Scientific Name	Family
Trees		
Salt cedar* **	*Tamarix ramosissima*	Tamaricaceae
French tamarisk* **	*Tamarix gallica*	
Chinese elm	*Ulmus pumila*	Ulmaceae
Grasses and Forbs		
Bishop's weed	*Ammi visnaga*	Apiaceae
Wild celery	*Apium graveolens*	Apiaceae
Wild oat	*Avena fatua*	Poaceae
Japanese brome	*Bromus japonicus*	Poaceae
Cheatgrass	*Bromus tectorum*	Poaceae
Rescuegrass	*Bromus unioloides*	Poaceae
Desert Bird-of-paradise	*Caesalpinia gilliesii*	Fabaceae
Malta starthistle*	*Centaurea melitensis*	Asteraceae
Field bindweed	*Convolvulus arvensis*	Convolvulaceae
Shining tickseed	*Corispermum nitidum*	Chenopodiaceae
Bermuda grass*	*Cynodon dactylon*	Poaceae
Flixweed tansymustard	*Descurainia sophia*	Brassicaceae
Barnyardgrass	*Echinochloa crus-galli*	Poaceae
Mediterranean lovegrass	*Eragrostis barrelieri*	Poaceae
Stinkgrass	*Eragrostis cilianensis*	Poaceae
Spreading lovegrass	*Eragrostis pectinacea*	Poaceae
	Eragrostis pectinacea var. *miserrima*	Poaceae
Filaree	*Erodium cicutarium*	Geraniaceae
Common horehound*	*Marrubium vulgare*	Lamiaceae

Common Name	Scientific Name	Family
Black medic	*Medicago lupulina*	Fabaceae
Alfalfa	*Medicago sativa*	Fabaceae
White sweetclover	*Melilotus albus*	Fabaceae
Spearmint	*Mentha spicata*	Lamiaceae
Blue panicum	*Panicum antidotale*	Poaceae
Broomcorn millet	*Panicum miliaceum*	Poaceae
African rue*	*Peganum harmala*	Rutaceae
Buckhorn plantain	*Plantago lanceolata*	Plantaginaceae
Broadleaf plantain	*Plantago major*	Plantaginaceae
Annual bluegrass	*Poa annua*	Poaceae
Rabbitfoot grass	*Polypogon monspeliensis*	Poaceae
Bluebunch wheatgrass	*Pseudoroegneria spicata*	Poaceae
Watercress	*Rorippa nasturtium-aquaticum*	Brassicaceae
Asian tumbleweed**	*Salsola collina*	Chenopodiaceae
Russian thistle**	*Salsola tragus*	Chenopodiaceae
Yellow bristlegrass	*Setaria glauca*	Poaceae
Green bristlegrass	*Setaria viridis*	Poaceae
Forked catchfly	*Silene gallica*	Caryophyllaceae
Prickly sowthistle	*Sonchus asper*	Asteraceae
Common sowthistle	*Sonchus oleraceus*	Asteraceae
Johnson grass*	*Sorghum halepense*	Poaceae
Dandelion	*Taraxacum officinale*	Asteraceae
Salsify	*Tragopogon dubius*	Asteraceae
Oyster-root	*Tragopogon porrifolius*	Asteraceae
Spike burgrass	*Tragus berterorianus*	Asteraceae
Puncture vine*	*Tribulus terrestris*	Zygophyllaceae
Wheat	*Triticum aestivum*	Poaceae
Woolly mullein**	*Verbascum thapsus*	Scrophulariaceae
Spiny cocklebur**	*Xanthium spinosum*	Asteraceae

* target species of the NPS Chihuahuan Desert Exotic Plant Management Team
**target species of park eradication efforts

The NPS Chihuahuan Desert Exotic Plant Management Team has identified 7 species of particular concern whose biology is reviewed below. Information for all but African rue comes from Guertin and Halvorson (2003), an in-depth review of NPS-selected exotics completed for southern Arizona parks that contain many of the same exotic species found in the Guadalupes. Park staff also supplemented the list with park specific information.

- Malta starthistle is an Old World winter annual (sometimes biennial) whose seeds germinate with fall rains. Seeds are dispersed short distances by wind and longer distances via movements of humans, animals, water, and soil. Vehicles transport seeds on tires, facilitating distribution along roadsides. The plant is mainly found along roads at Guadalupe Mountains National Park but has recently been found along trails, presumably from seed transported in boot treads. Research is needed regarding effects of fire on this species; experimental herbicide treatments are underway.

- Bermuda grass is a long-lived perennial that reproduces via rhizomes (below ground), stolons (above ground), and seeds. It is wind-pollinated, and seeds disperse via water and soil movement, machinery, and human activities. They can pass through animals and stay viable. It lives in open sites that experience disturbance and also low-lying, moist areas. Rhizomes can resprout after topkill. At this time Bermuda grass is restricted to Frijole Ranch and is not viewed as potentially spreading (or controlled) by fire management activities.

- Horehound is a drought-tolerant Old World perennial that reproduces by seeds. It may be self-fertile. Spiny, hooked seeds attach easily to animal fur and human clothing; they also spread by water and vehicles. Horehound establishes on infertile soils and is often the first colonizer in eroded areas. At the park it occupies old home- or ranch-sites and stockpens. The Frijole Ranch area is a hotbed of horehound production.

- African rue is an Old World perennial that reproduces primarily by seeds but can produce new shoots when severed (CA Department of Fish and Game 2003). Seeds fall near parent plants and are spread by water, humans, machinery, and animal feet, fur, and feathers. It does well along dry roadsides and on degraded rangelands and can tolerate saline conditions. It dies back in winter and has a long, deep taproot. There is one patch of African rue at the park—half of the area is a mixture of rue and grasses, and the other half is a mixture of rue and creosote bush. Fuel loads at this location are too low to carry fire. Herbicide treatments are underway.

- Perennial Johnson grass reproduces via seeds and rhizomes that produce plants more quickly than seeds. It withstands high levels of desiccation and other adverse conditions, and heat (up to 90º F) increases sprouting. Seeds drop near parents and can be spread by wind and water, ingestion by birds and cattle, as contaminants in grain and hay, and by farm equipment. It prefers depressions, roadsides, riparian areas, and cultivated fields. Johnson grass invades native grasslands after flooding. Its size, fast-growing sprouts, and dense patches help it outcompete smaller natives. Johnson grass occurs in roadside ditches, near the Dog Canyon horse corral, and by the Pine Springs maintenance area. The park would be unlikely to burn in these places since they are close to developments.

- Salt cedar and French tamarisk have been planted for erosion control and windbreaks and began invading riparian areas in the Southwest in the late 1800s. The trees spread via prolific seed production, resprouting, and layering. Disturbance is not a prerequisite for colonization. A few trees were present along roads and old ranch areas. They have been removed and successfully treated, however, the western addition to the park is geographically close to several thickets of salt cedar in the Dell Valley.

- Puncture vine is a prostrate, mat-forming summer annual. Seedlings emerge with early spring moisture flushes and do best in dry, sandy, uncompacted soil. It self-pollinates and likes barren areas and hot summers. Seeds are burrs that easily stick to animals, humans, and tires. Puncture vine populations can explode over a short time thanks to long-term viability of seeds in soil. The plant occurs in the park near the maintenance yard and housing areas.

Park staff are also actively eradicating the species described below (Guertin and Halvorson 2003):

- Asian tumbleweed and Russian thistle are warm-season annuals that reproduce by seed and occupy disturbed areas. They are wind pollinated, and seeds disperse when the wind breaks off mature plants at the base and rolls them across the landscape. Plants tolerate hot, very dry conditions. Tumbleweeds inhabit a large area by the Butterfield Station interpretive stop car park. The populations wax and wane with rainfall. Park staff will be trying removal of seedlings to control plants at the Dog Canyon horse corral.

- Woolly mullein is an herbaceous biennial or annual that invades open disturbed areas, wetlands, and meadows. Seeds germinate with summer rains, and likelihood of survival to a second year increases with earlier germination. Tiny seeds are viable for decades; they slip below the soil surface and are brought back with disturbance. The plant generally disappears as bare areas become vegetated. In the park, mullein is found in Dog Canyon, in the Bowl, and along roadsides. It seems to show up any place horses can get to.

- Spiny cocklebur invades open areas such as roadsides, pastures, meadows, and disturbed places. This annual is common along waterways and moist areas. Burs hitchhike on humans and animals and can float. Germination occurs with summer rains. Cocklebur occurs only around the housing area.

ZOC Non-indigenous Species: Non-indigenous species are not a concern at this time in the Guadalupe Ranger District. The Forest Plan prohibits "…introduction of exotic or non-indigenous wildlife species onto the forest unless appropriate studies and experience indicate minimal impacts on indigenous and native species."

Impact Topic 8 (Geology and Geohazards)

The Guadalupe Mountains are world-renowned for their geology. Geologists assign the Guadalupe Mountains to Trans-Pecos Texas, a mixed-age, mixed-origin basin-and-range complex studied extensively due to its association with the energy-rich Permian Basin (Brand and Jacka 1979). The Guadalupe Mountains are a highly dissected and eastward tilted plateau, extending

approximately 10 miles into Texas from the New Mexico border and forming a wedge that comes to a point at El Capitan Peak. El Capitan is an exposed remnant of a marine fossil reef formed about 250 million years ago. At that time a vast tropical ocean covered portions of present-day Texas and New Mexico. Over millions of years, the calcareous skeletons of marine organisms, along with lime precipitated from the seawater, built up to form the 400-mile-long, horseshoe-shaped Capitan Reef. The ancient reef complex now towers above the Chihuahuan Desert in the Guadalupe Mountains in a general northeast trend, and forms the escarpment on the eastern side of the wedge. The western side of the wedge, composed of the Brokeoff Mountains, exhibits a northwesterly trend. Extensive bajadas have developed along the western foothills where streams have deposited material in gently sloping fans.

Park elevations range from 3,650 feet to 8,749 feet on Guadalupe Peak, the highest point in Texas. Desert floor terrain is relatively level. In contrast, the topography of the escarpment is severe. Steep talus slopes, sheer cliffs, decomposing rock ledges, and long side canyons hamper access to the park's high country. There are 32 known caves in the park, as well.

Most of the water sources of the Guadalupe Mountains originate in the higher mountains that rim the upper region and appear as springs and seeps at the base of the escarpment. Springs and tributaries between mountain peaks and ridges are few. Water resources in the park are rare, with only nine permanent springs identified, although numerous intermittent springs and seeps exist. Streams cut across rock layers, allowing the ground waters to drain into the canyons. Surface waters tend not to collect, and streams are intermittent due to the permeability of the substrata. In general, drainage is rapid in the mountains, slow in the basins, and absent in the bolsons. Flash floods are frequent after intense summer storms.

Upland soils are mostly light reddish brown to brown clay loams, clays, and sands over reddish, loamy to clayey, calcareous, gypsic or saline subsoils. These include many areas of shallow soils and rocklands. Sizeable areas of deep sands exist. Soils differ considerably as a function of both elevation and aspect in the Guadalupe Mountains. As elevation increases, more leaching of $CaCO_3$ is evident; soils also become more clayey, contain more organic matter, and show decreased percent base saturation. Soils on north aspects, compared to south aspects, exhibit similar trends.

The fossil reef and associated sedimentary layers contain a rich assemblage of Permian period fossils. Sponges, fusilinids, brachiopods, and ammonoids are among the many fossils found there. For many species, this is the type locality of that fossil and it is known from few if any other places. The biggest threat from fire to these resources is fire suppression activities.

ZOC Geology and Geohazards: Like the park, the Lincoln National Forest lands included under Alternative B are characterized by very steep slopes, with caves also a prominent geologic feature.

Impact Topic 9 (Air Quality)

Guadalupe Mountains National Park was designated as a Class I airshed by the 1977 amendments to the Clean Air Act (Public Law 95-217). Air quality of the Guadalupe Mountains region has

historically been excellent; visibility at Guadalupe Mountains averages 80 miles and can exceed 155 miles on the clearest days. Dust, particularly during the spring windy season, decreases visibility, and pollution from sources in the region's metropolitan areas, power plants, and smelters is increasing. Haze has reduced visibility at times to less than 50 miles and presently maximum visibility only occurs one percent of the time, with a fifty percent reduction fifty percent of the time. The net effect has been a measurable reduction in visibility, which is of paramount importance to visitor appreciation of the mountain and its environs. Smoke management is a factor in fire planning, but in general, smoke dispersion is excellent.

As specified by Section 118 of the Clean Air Act, (42 USC 7418), amended in 1992, NPS fire management activities that result in the discharge of air pollutants (e.g., smoke, carbon monoxide, and other pollutants from fires) are subject to, and must comply with, all applicable Federal, state, interstate, and local air pollution control requirements. Guadalupe Mountains National Park is required to obtain necessary permits for prescribed fires, comply with the National Ambient Air Quality Standards (NAAQS) both inside and outside unit boundaries, and protect visibility according to its congressionally mandated Class I area status. Air quality monitoring at Guadalupe Mountains has been ongoing since 1987 and currently the NPS operates a sampling station at Signal Peak, with 24-hour sampling analyzing particulate matter, sulphur dioxide, nitrogen oxide, and heavy metals. Baseline ozone data was collected from 1987 to 1992.

ZOC Air Quality: The Forest Plan dictates that management activities will result in air quality equal to or better than that required by the applicable federal, state, and local standards or regulations. The USFS will monitor air quality at the minimum level necessary to comply with the Clean Air Act.

Chapter IV: Environmental Consequences

The new fire management program is predicted to have positive environmental consequences. The nature of fire, however, does not allow us to guarantee that there will not be negative effects. In general, this document argues that negative effects in the short-term may be necessary to achieve benefits over the long-term.

This chapter evaluates the three alternatives retained for consideration in Chapter II.

Methodology

This EA analyzes three alternatives that apply different mixtures of the same elements: wildland fire use, suppression, prescribed burning, and non-fire treatments such as mechanical thinning. The framers of these alternatives envision No Action to result in the most suppression and highest risk of future conflagrations. Alternative A automatically suppresses only in FMU #1 areas (visitor centers, housing, and offices), leaving most of the park able to accept wildland fire use that can help reduce the incidence of future large-scale fires. Alternative B includes co-management of fire by NPS and the Lincoln National Forest of the upper North McKittrick Canyon watershed. Including this parcel in the FMP benefits the entire watershed, since the health of the upper reaches affects the lower portions. Fire projects in upper North McKittrick Canyon might slow spread of fire from the Lincoln to the park; fires may move up or down canyon depending on the wind.

There is no way to predict with absolute certainty what will actually happen, but each alternative could conceivably have a very similar outcome. To date, few fires have met the "go" of the go/no-go criteria and prescriptions that allow wildland fire use. The safest management response under a suppression situation might call for letting fires burn to natural boundaries rather than controlling them locally, and the results might be indistinguishable from wildland fire use in the same area. The same schedule of prescribed burning within the park would apply to all three alternatives. Thus, it is possible that the actual program outcome could be the same mixture of wildland fire and prescribed fire/thinning for all three alternatives, with the expansion onto the Lincoln National Forest in Alternative B as the only major difference.

In order to conduct this chapter's analysis it is assumed that there will be wildland fire use in increasing amounts and suppression in decreasing amounts looking across the range of No Action-Alternative A-Alternative B. The amount of prescribed fire could be the same for No Action and Alternative A, with increased burning on Forest Service land in upper North McKittrick Canyon under Alternative B.

Under NEPA, environmental consequences of alternatives are defined in terms of:

- context (are effects site-specific, local, or regional?)
- intensity (are effects negligible, minor, moderate, major, or constituting impairment?)
- duration (are effects short term or long term?)
- timing (do the effects vary with the timing of alternative actions?)

Analysis also includes direct, indirect, and cumulative effects of plan alternatives and their elements. Finally, measures to minimize or mitigate potential environmental effects of alternatives are presented. The analyses are based on the literature and experience of NPS professionals and others knowledgeable about the park and the issues.

Cumulative Impacts

The Council on Environmental Quality defines *cumulative effect* as "the effect on the environment that results from the incremental effect of the action(s) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) undertakes such action." (40 CFR § 1508.7) Assessment of cumulative effects is based on a scenario for the park developed by the Interdisciplinary Team (IDT). It includes:

- beetle kills over large wooded areas of the park
- helicopter activities for rabies control program
- ongoing exotic plant colonization and management activities over the tenure of the FMP
- ongoing education programs over the tenure of the FMP
- ongoing weathering and exposure of cultural resources
- ongoing increase in cover and density of woody species
- past and future prescribed fire, wildland fire use, and non-fire treatments at the park
- past and future suppression activities at the park
- wildland and prescribed fire and thinning on Forest Service land in the Guadalupe Mountains over the tenure of the FMP
- grazing, hunting, and other activities on the Forest Service Zone of Cooperation
- other fire activities in the region over the tenure of the FMP (Bureau of Land Management, Carlsbad Caverns National Park, state lands, and private lands)

Impairment

The analysis predicts whether alternatives will result in impairment. The NPS is required by law to guarantee that resources are passed on to future generations "unimpaired." Thus, NPS is prohibited from taking any action that would or would likely impair the integrity of a resource or value essential to the purpose or identity of the park. NPS-specific "impairment" language appears for each impact topic. In this EA, the professional judgment of staff, relevant studies, and public input are the basis for impairment determinations. Impairment determinations are made only for natural and cultural resource topics.

Appendices

Appendices to this chapter include a cultural resources matrix (Appendix C) prepared as part of the Cultural Resources Component for evaluation by the Texas Historical Commission (the State Historic Preservation Office). A summary of fire effects on vegetation (Appendix E) is also included. These documents address impacts to (1) cultural resources and (2) dominant plant species, respectively. Appendix D lists scientific names for plants and animals discussed in this EA.

Impact Topic 1 (Life and Property)

Fire is an effective tool for reducing hazard fuels, but it is also a threat to the public, firefighters, park staff, and developed areas.

The first and foremost objective for fire management is the protection of life, property, and resources from the unacceptable effects of wildland or prescribed fire. Life and property encompasses park staff, firefighters, and visitors as well as park developments and personal property of everyone concerned. Life and property on neighboring lands are also of concern. Protecting the safety of hikers and firefighters and the integrity of cultural sites and developed areas are the chief concerns at the park.

The alternatives represent strategies ranging from maximum suppression in the short-term that comes with continued high-severity fire danger from accumulated fuels to more fire sooner with less danger later. In the high country, heavy fuels (brush and mixed conifers), wind, and steep slopes pose serious threats to firefighters. Prescribed burning and thinning as specified by the multi-year fuels treatment schedule (see Table II-1) contribute to reducing threats to safety and impacts to park developed areas and resources under all alternatives. An effective evacuation plan is crucial to guaranteeing visitor safety in the event of a large fire. Because major fires at Guadalupe Mountains National Park are generally fast moving, wind-driven events, they generally last a few days at most.

Alternative B provides the best protection of life and property in the long-term.

Life and Property Intensity and Duration of Effects Defined

Negligible: The impact is at the lowest levels of detection—no injuries or property damage.

Minor: The impact is slight but detectable.

Moderate: The impact is readily apparent.

Major: The impact is severely adverse or exceptionally beneficial.

Short-term: Within the duration of a specific fire program activity (for example prescribed burn or suppression action).

Long-term: Beyond the duration of a specific fire program activity.

Assessment Methodology

Assessment of effects of alternatives on life and property is based on experiences to date in the park. Fuel reduction programs have been successful at preventing damage and loss; people management practices during fire operations have circumvented injury and loss of life.

No Action Alternative

Impact Analysis
Under the 1996 FMP, the threat of impacts to life and property peaks in the late spring; impacts are immediate when there is a fire. Fire location matters—fires of similar size and intensity in different locations pose very different threats to life and property. Fire intensity (related to risks to life and property) is a function of condition class—vegetation in condition class III potentially burns the most intensely (see page 54 for definitions). Prescribed burning and thinning would reduce intensity of future fires in the same place. The direct effects of the No Action alternative cause negligible to minor impacts to visitor and staff safety and property in the short-term (especially to firefighters) but cause the most impacts in the long-term because of increasing threat of high-severity wildland fires. Because the most suppression is predicted for this alternative, risks to fire crews are highest. Prescribed burning and thinning would reduce the intensity of future fires in the same place. The indirect effect of the alternative is a heightened risk of flood/mass transport events after a big fire. Suppression actions in allowed wildland fire use situations increase long-term threats to life and property from high-severity wildland fire.

Mitigation actions are: Public education and notification; onsite protective measures to minimize the public's exposure; preparation or update of current cooperative agreements for fire suppression on neighboring lands; mechanical hazard fuel reduction; construction of fire breaks around sites; evacuation plans.

Cumulative Effects
Cumulative effects on life and property include concerns within the park only for No Action and Alternative A. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effects analysis finds:

- Ongoing education programs can potentially avoid injury to people in the park during fire operations and have a minor beneficial effect.
- Past and future prescribed burns, wildland fire use, and non-fuel treatments in the park would reduce fuels and lower risk of wildland fire, having a moderate beneficial effect.
- Ongoing fire suppression activities can have a moderate adverse effect on life and property.
- Ongoing increases in woody plant species cover and density would increase fuels and risk of wildland fire, having a minor negative effect.
- Wildland fire on Forest Service land in the Guadalupes over the tenure of the plan may move into the park and reduce fuels to lower risks of negative effects from future fires (negligible to minor beneficial effect, because winds usually send fire the other direction).

Cumulative effects on life and property are predicted to be minor—other activities are likely to change threats to life and property very little. Except for beetle kills, elements of the cumulative scenario—anti-rabies helicopter activities, exotic plant management, and other agency fuel treatment activities contribute to improving "life and property."

Conclusion
This alternative, continuing under the direction of the 1996 FMP, may place firefighters at risk more often than Alternative A and B. Otherwise, with maximum suppression, No Action minimizes short-term, adverse impacts to the public, staff, and property; such impacts would be

minor or negligible in intensity. In the long-term, there is a potential for moderate adverse impacts to firefighter and public safety and property during periods of severe fire conditions. Under this alternative, life and property concerns would be handled under the practices dictated by the 1996 FMP.

Alternative A

Impact Analysis
The timing/context of Alternative A, which calls for greater wildland fire use, is the same as the No Action Alternative. The intensity and duration of effects are similar to No Action Alternative, though threats are reduced with increased wildland fire use. The direct effects are a potential increase in minor, direct, adverse impacts to life and property with increased use of fire. Long-term threats to safety and property will be reduced as wildland fire use and prescribed fire management objectives are met. The highest threat would be to firefighters along the north boundary of the park, since Alternative A proposes that fire activities be contained within park boundaries. The indirect effects of post-fire flood/mass transport event risks are reduced with more wildland fire use—low-to-moderate-intensity events with mosaic burning patterns.

The mitigation actions are the same as the No Action Alternative.

Cumulative Effects
The cumulative effects are the same as the No Action Alternative.

Conclusion
With increased wildland fire use, short-term, adverse impacts to public safety and property would be minor with appropriate protective measures. Minor, long-term, beneficial impacts to life and property would accrue as management objectives are met.

Alternative B

Impact Analysis
The timing/context of Alternative B is similar to the No Action Alternative except context expands with inclusion of upper North McKittrick Canyon. As the upper North McKittrick landscape is treated by fire, likelihood of fires spreading from the ZOC to the park decreases. The duration and intensity of effects is similar to Alternative A with prescribed burning and wildland fire use extending to upper North McKittrick, thus reducing potential for high-severity future fires there. The direct effects are similar to Alternative A with prescribed burning and wildland fire use extending to upper North McKittrick, thus reducing potential for future major direct effects in that area. The indirect effects are also similar to Alternative A, though threats to McKittrick Canyon subside further with inclusion of the upper watershed.

The mitigation actions are the same as the No Action Alternative.

Cumulative Effects
The cumulative effects are the same as the No Action Alternative, but extend to the Zone of Cooperation.

Conclusion
Short-term, adverse impacts to public safety and property would be minor with appropriate protective measures. Moderate, long-term, beneficial impacts to life and property would accrue as management objectives are met.

Impact Topic 2 (Visitor Experience)

Potential restrictions on access to burning areas, road closures, and smoke can alter visitor experience; but the fire program also provides interpretive opportunities.

Fire program activities will affect the experience of visitors. Campground, trail, and road closures can restrict access to the active fire zone, and park staff close the backcountry during suppression actions. Smoke may temporarily degrade spectacular views that are part of the park's attraction. Interpretation of fire events adds to the visitor experience and helps build acceptance of fire as a necessary ecological agent on the landscape.

During fire activities, park staff attempt to reduce impacts on visitors but above all, to promote public safety. The park's public information office and incident fire information personnel distribute press releases and special notices to inform other agencies, communities, and individuals of fire management activities. Staff at the Visitor Center post information on cautions, closures, and restrictions, as needed, and are available to answer questions and provide interpretation regarding fire management activities and their purposes. Signs are used to inform visitors along roads and trails. All backpackers receiving permits are advised by park staff at the Visitor Center of fire danger conditions, and backcountry staff keep backcountry visitors informed of fire danger, locations, and progress.

For each alternative under consideration, prescribed burning is a major component. Wildland fire use plays a greater role for Alternatives A and B than for No Action. Because natural ignitions must meet burn prescriptions and safety-related criteria, the effects of wildland fire use on visitor convenience are not expected to differ from those resulting from prescribed burns during the actual events. Park officials can plan specifically for prescribed burns, while they must have a plan in place for accommodating visitors during unpredictable suppression and wildland fire use activities. Visitors will be subject to less helicopter disruption with wildland fire use and prescribed burning than with suppression. Visitors are exposed to fewer hazards in the long-term from high-severity fires.

Visitor Experience Intensity of Effects Defined

Negligible: The impact on visitor experience is at the lowest levels of detection.

Minor: The impact is slight but detectable, and would affect few visitors.

Moderate: The impact is readily apparent, and would affect many visitors.

Major: The impact is widespread or locally unavoidable and would affect most visitors.

Short-term: Within the duration of a specific fire program activity (for example, prescribed burn or suppression action).

Long-term: Beyond the duration of a specific fire program activity.

Assessment Methodology
Staff considered past experience with visitors during fire events and general knowledge of visitor patterns and expectations to determine impacts.

No Action Alternative

Impact Analysis
Prescribed burning in spring coincides with the peak of visitor season which may affect visitor access to certain areas and or zones in the park.The greatest risk of fire, though, is in late spring, which is also a popular time for visitors. The intensity and duration would vary with each fire. Mandatory suppression over most of the park should shorten fire duration, causing any restrictions to be short-term. Burned areas might continue to disappoint visitors. Suppression and mitigation should minimize direct effects. Indirect effects include the memory of past fires, which may discourage visitation. In addition, visitor inconvenience could result from post-fire restoration activities.

Mitigation actions are to: Inform visitors about fire activities via newspaper, radio, and internet, at the visitor center, other frontcountry contact locations, and throughout the park; inform visitors of alternative destinations in the region; provide interpretation and visitor education during fire activities; minimize fire size and intensity; coordinate burns with adjacent and nearby land managers to minimize cumulative impacts in the region.

Cumulative Effects
Cumulative effects on visitor experience include concerns within the park and surrounding recreation areas of the Lincoln National Forest. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effects analysis finds:

- Helicopter activities for the rabies control program will add minor adverse impacts on visitor experience, considering visitors seek out the park for “remote” wilderness experiences.
- Ongoing education programs can turn possible disappointment with fire program inconveniences into opportunities to learn, thus having a minor to moderate beneficial effect.
- Past and future prescribed burns, wildland fire use, and non-fuel treatments in the park would reduce fuels and lower risk of wildland fire, having a moderate beneficial effect.
- Wildland fire on USFS land in the Guadalupes over the tenure of the plan may make the area a less desirable destination and have a minor negative effect on visitor experience and tourism and at the same time reduce fuels to lower risks of negative effects from future fires (a moderate beneficial effect).

The presence of smoke, helicopter overflights, as well as campground, trail, and road closures during suppression actions, prescribed burns, and wildland fire use events are minor, short-term adverse effects on visitor experience. Because no major park projects that might inconvenience

visitors are scheduled during the FMP tenure, cumulative impacts to visitor experience will accrue from actions on nearby lands, particularly the Lincoln National Forest.

Fire activities on neighboring lands may compound inconveniences of the fire program for visitors but effects will be minor and short-term due to the speed at which fires move across Guadalupe Mountains landscapes.

Conclusion
Fire-management-related impacts to visitor experience would be adverse but short-term and minor under the No Action Alternative. Because of suppression activities, wildland fire use, and prescribed burning, visitors might be subjected to cooking restrictions in campgrounds, closed sections of trails, or smoke-clouded views. Potential for short-term adverse impacts to visitor convenience would continue during periods of severe fire conditions and would likely also apply to alternate destinations on the Lincoln National Forest. Depending on the dangers presented by fires, restrictions on wilderness overflight and mechanized tool use might be relaxed. Because this alternative results in the most suppression activity, it also can result in the most extensive fuel buildups that can feed future high-severity fires. Severely charred landscapes from such fires may be long-term moderately adverse effects to visitor experience. Under No Action, fire events can continue to serve as interpretive opportunities, and communication is the key mitigation technique.

Alternative A

Impact Analysis
Greater wildland fire use for resource benefits would result in unpredictable periods of inconvenience due to more fire. The duration and frequency of visitor use restrictions would decrease over time due to reduction in fuel load. The direct effects are minor adverse impacts to visitor convenience under mitigation (for example, air attack disturbance and altered wilderness experiences) while the indirect effects are the same as the No Action Alternative.

Mitigation actions are similar to the No Action Alternative with increased emphasis on benefits of wildland fire use through communication with the public.

Cumulative Effects
Cumulative effects are similar to the No Action Alternative but a greater allowance for fire will create more minor adverse experiences for visitors in the short-term.

Conclusion
Effects of Alternative A on visitor experience would also be adverse but short-term and minor, similar to No Action. Under this alternative, the park would experience greater wildland fire use and less suppression. This difference would decrease the need to temporarily compromise wilderness through the use of mechanized tools and overflights. However, stopping fires at boundaries could require occasional, concentrated suppression efforts. Over time, the risk of future high-severity fires is lessened as more of the park experiences wildland fire use, and long-term adverse effects become minor.

Alternative B

Impact Analysis
The timing and context of Alternative B is similar to Alternative A with more unpredictable periods of inconvenience. The duration/intensity is also similar to Alternative A with the least inconvenience to visitors in the long-term. Direct effects are similar to Alternative A with lower fire risks over time with hazard fuel reduction and the indirect effects are the same as the No Action Alternative.

Mitigation actions are the same as Alternative A.

Cumulative Effects
Similar to No Action plus acceptance of fire in upper North McKittrick adds possible new inconvenience to visitors looking for alternative destinations.

Conclusion
Effects of Alternative B are similar to Alternative A—adverse in the short-term, but minor. With fires not requiring control at the north boundary (where prevailing winds tend to push them), disruption of visitor experience by boundary suppression actions is reduced. The risk of long-term high-severity fires is further reduced under Alternative B. More wildland fire use treats more acres because fires that are headed onto the Lincoln National Forest can be allowed to burn.

Impact Topic 3 (Cultural Resources)

Historic structures, landscapes, and artifacts may incur fire damage, while fire may help reduce surrounding hazard fuels, uncover new sites, and maintain the historic scene.

Cultural resources are subject to adverse effects that primarily result from exposure to flames, heat, and smoke as well as ground disturbance from suppression activities or post-fire erosion (Jones and Euler 1986; Lentz et al. 1996; Traylor et al. 1990). These effects are not generally reversible; historic wooden structures do not "grow back" after a fire to become what they were before, and disturbed lithic and ceramic scatters do not rearrange themselves into their original positions. Thus it is important that the fire program be designed to avoid impacts to cultural resources.

The literature primarily contains analyses conducted after wildland fires and a few experimental studies conducted as part of prescribed burns; it is not surprising that intensity of impacts increases with temperature and duration of the fire. Lentz et al. (1996), in their study of impacts to archeological resources following the Henry Fire in New Mexico, recorded substantial fire effects on artifacts under all fire intensities. The recorded damage to artifacts was as deep as 20 cm subsurface. Fuel loading was the critical variable in the severity of these effects.

Appendix C is the cultural resource matrix prepared for the section 106/SHPO approval process. The element's cultural resources matrix identifies resources, risks from fire program activities, and mitigation measures. The cultural resource matrix contains analysis drawn partly from the NPS ASHFAP report. This report makes specific recommendations for: Ship-on-the-Desert

Research Center and landscape, Pratt Lodge and landscape, Hunter Line Cabin, McKittrick Canyon alcove, ring middens, Frijole Ranch and landscape, Pine Springs Stage Station, Williams Ranch and landscape, Pine Springs Creek ring middens, Bowl Cabin, the old Butterfield Stage trace, and three other archeological sites. Though approximately 3% of the park has been inventoried, sites without description are highly likely to fall into matrix categories. Priorities include minimizing ground-disturbing suppression activities and removing fuel loads to reduce effects of fire on known archeological resources and historic properties. In the long term, it is believed that cultural resources may benefit from the reduced risk of high-severity wildland fire, which has a much greater potential to compromise the integrity of such resources.

The No Action alternative may offer the best short-term protection from direct impacts of fire because it calls for the most suppression, but it also holds most potential for suppression damage. Alternative B would bring the best long-term protection by reducing fuel loads and the likelihood of widespread fires as well as not necessarily requiring suppression of wildland fires on the north boundaries. Fuel reduction efforts contribute to reducing impacts to historic structures under all alternatives. Likewise, the presence of and knowledge shared by resource experts during fire operations will help limit damage to cultural resources.

Cultural Resources Intensity of Effects Defined

Negligible: Impacts would be barely perceptible changes in significant characteristics of a historic property, archeological sites, and cultural landscapes.

Minor: Impacts would be perceptible and noticeable, but would remain localized and confined to a single element or significant characteristic of a historic property, archeological site, or cultural landscape (such as a single archeological site containing low data potential within a larger archeological district or a single contributing element of a larger historic district).

Moderate: Impacts would be sufficient to cause a noticeable but not substantial change in significant characteristics of a historic property, archeological sites, and cultural landscapes.

Major: Impacts would result in substantial and highly noticeable changes in significant characteristics of a historic property, archeological sites, and cultural landscapes.

Impairment: A major, adverse impact to a resource or value whose conservation is key to the cultural integrity of the park or identified as a goal in the park's general management plan or other relevant NPS planning documents.

Duration of impacts to cultural resources from fire activities is not usually considered under the National Historic Preservation Act. Most direct effects to resources are permanent.

Assessment Methodology
The cultural resources matrix (Appendix C) is the basis for the analysis. This matrix describes the resources, risks, and treatments to minimize impacts, and was developed by management, fire, natural resource, and cultural resource staff of Guadalupe Mountains National Park, the NPS Southern Arizona Office, and the NPS Western Archeological Conservation Center.

No Action

Impact Analysis
While suppressing fires helps reduce the risk of burning historic structures, suppression activities can significantly damage archeological sites. Impacts to cultural resources can be minimized by timing prescribed burns to avoid peak (late spring) fire danger when fires would burn hottest and may cause most damage. The impact duration is relevant in cases where fire clears vegetation formerly obscuring cultural resources. Time for vegetation recovery will vary with intensity of fire. Fire has a minor potential for short-term, direct, adverse impacts due to mitigation activities. There are possible greater direct effects of ground-disturbing suppression activities under this alternative than the "action" alternatives. Under this alternative with the most suppression, the indirect effects are minor impacts due to expected erosion and vegetation loss. Risk of adverse impacts from high-severity fire continues. For example, a high severity fire in upper North McKittrick Canyon could lead to the washout of Pratt Cabin due to a large flood.

Mitigation actions are to: Locate and identify sites vulnerable to fire effects; mechanically reduce hazardous fuel; construct fire breaks around sites; use minimum impact suppression techniques; and ensure the presence of resource experts during fire operations.

Cumulative Effects
Cumulative effects on cultural resources include concerns within the park only for No Action and Alternative A. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effects analysis finds:

- Past and future prescribed burns, wildland fire use, and non-fire treatments at the park may cause minor adverse effects, but surveys help minimize those effects.
- Ongoing weathering and exposure of archeological sites cause minor adverse effects.
- Line-digging for ongoing fire suppression activities can have a moderate adverse effect on cultural resources.
- Ongoing increases in woody plant cover increase fuels and make burns hotter which may cause minor adverse effects.
- Large, high severity fires in the Guadalupe Mountains that reach the park and ZOC may add moderate adverse effects.

Repeated backcountry fires have likely already compromised fire-intolerant artifacts. Other actions (road, utility, trail, and septic work) in the cumulative scenario require careful surveying and mitigation of cultural resources impacts. Minor to moderate cumulative effects on the totality of archeological resources are expected from repeated suppression actions.

Conclusion
Minor direct and indirect adverse impacts to cultural resources would occur, with no changes to the existing FMP direction. Minor to moderate cumulative impacts resulting from successive suppression actions are expected. Exposure of sites or artifacts through removal of concealing vegetation; cracking and flaking of stone or concrete foundations; alteration of landscapes; and burning of flammable resources, including structures, are examples of direct effect. Erosion and damage to integrity of resources on the ground after suppression-related disturbance is the main predicted indirect effect. This alternative holds the greatest potential, with its continued suppression over most of the park, for moderate adverse impacts to cultural resources in the long-term, particularly damage to flammable historic structures.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there would be no impairment of cultural resources under this alternative.

Alternative A

Impact Analysis
Alternative A is similar to the No Action Alternative with timing of wildland fire use for resource benefits an important factor in intensity. Duration and intensity are the same as the No Action Alternative. Minor direct effects are predicted because of mitigation measures that protect sites from flames and ground disturbance. Water drops and the potential for retardant drops could be expected, however, known sensitive cultural sites would be avoided except as the last resort to save the resource. There are long-term benefits to cultural resources from reduction in fuel loads in and around sites. Potential for adverse indirect effects (mostly erosion) decreases over time with reduction in fuel load.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
Cumulative effects are similar to the No Action Alternative, except fewer impacts from suppression activities. These activities allow fuel to build up, which threatens historic structures and archeological sites.

Conclusion
Minor direct and indirect adverse impacts to cultural resources would occur as described above, with long-term benefits to cultural resources from reduction in fuel loads in and around sensitive areas throughout the park. Potential for damage to wooden structures decreases, and cumulative impacts to cultural resources from repeated suppression activities would decrease in relation to the No Action alternative.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3)

identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there would be no impairment of cultural resources under this alternative.

Alternative B

Impact Analysis
Alternative B is similar to Alternative A with timing less important as fuels are reduced. The duration and intensity is the same as the No Action Alternative. The direct effects are similar to Alternative A with the smallest potential for disturbance as a result of suppression actions. Alternative B has the greatest potential for reduced suppression activities in the future. The indirect effects are similar to Alternative A with the greatest potential for fuel load reduction.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
The cumulative effects are similar to Alternative A, except Alternative B has the fewest impacts from suppression activities. The Zone of Cooperation is also included.

Conclusion
Minor direct and indirect adverse impacts to cultural resources would occur as described under No Action, with the greatest long-term benefits under Alternative B to cultural resources from the reduction in fuel loads in and around sensitive areas throughout the park and reduced suppression activity along the north boundary. Cumulative impacts to cultural resources from repeated suppression activities would decrease in relation to the No Action alternative.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there would be no impairment of cultural resources under this alternative.

Impact Topic 4 (Vegetation)

In the mid-1970s, awareness grew nationwide of negative effects of exclusion of fire in ecosystems. Gary Ahlstrand (1981) worked in the Guadalupe Mountains and concluded that 150 years of intense use by humans had increased densities of woody plants at the expense of grasses. Grazing from the late 1800s through the mid 1900s decreased grass cover that carried fire; direct fire suppression following cessation of grazing allowed grasses to increase while woody species persisted. Forest, woodland, shrubland, and grassland communities were all perceived as changed by grazing and fire suppression. Guadalupe Mountains National Park began a prescribed fire program in 1979 aimed at reducing fuel loads, restoring vegetation communities, and learning about the effects of fire.

Plant Communities

Rocky Mountain (Petran) Conifer Forest (122.3 in Brown 1994)
Fire effects on species: Table E-1 in Appendix E
Ahlstrand (1981) dated fire scars from 49 southwestern white pine stems. His data showed that fires occurred in the study area, all the high-country mixed-conifer forest in the park, during at least 71 of the years between 1496 and 1980. The mean fire return interval, considering all fires in the study area between 1554 and 1842, was 4.7 years. Ahlstrand suggests that a 5-15 year fire return interval in the mixed conifer forest would open up thickets of Douglas-fir and ponderosa pine. These thickets developed in the absence of fire for most of the 20th century, likely aided by seeds trampled down to mineral soil by the hooves of grazing livestock before the park was established. Higher frequency of fire would also favor ponderosa pine and southwestern white pine over Douglas-fir.

The IDT expects that fires should reduce the stocking density of Douglas-fir, reducing competition and dead and downed fuels. Wildland fires should burn at lower intensity than the 1990 Frijole fire. This vegetation type should move toward fuel models 2 and 9. Fires should also improve the federally listed Mexican spotted owl habitat. Cumulative effects of burning repeatedly should include restoring the mosaic of conifers and hardwoods and enhancing the resilience of the forest to ecosystem disturbances such as fire, drought, and insects.

Great Basin Conifer Woodland (122.4 in Brown)
Fire effects on species: Table E-2 in Appendix E
Great Basin, or pinyon-juniper woodland, shifts between woodland or grassland dominance depending on fire frequency, moisture conditions, grazing, competition, and insect infestations that reduce vigor. At Guadalupe Mountains, it is likely this formation is grassier in the absence of grazing. With grassiness comes more frequent lightning fires and vice versa, as woody species are knocked back. A vegetation type conversion to Plains and Great Basin Grassland (Brown 1994—142.1) might result with continuing short fire return intervals. Mean fire interval in the Sacramento Mountains in pinyon-juniper habitat was 28 years with a range of 10-49 (Kaufmann et al. 1998). Models for southwestern Colorado and northern Arizona estimate 300 years from stand-replacing fire (leaving bare ground and skeleton forest) to mature pinyon-juniper woodland; observations in Utah found junipers well developed 85-90 years post-fire (Paysen et al. 2000).

At the park, the dominant junipers—one-seed and alligator—respond differently to fire, with the former a non-sprouter that is highly susceptible, and the latter a sprouter that is difficult to kill with fire. However, once mature, it takes years for alligator juniper to regain previous coverage and grasses are able to compete in the meantime.

The IDT expects fires to result in less tree cover and more grass. The fuel model is not expected to change. The cumulative effects of burning repeatedly should result in vigorous, healthy vegetation being maintained and the juniper overstory remaining at a natural level.

Madrean Evergreen Woodland (123.3 in Brown)
Fire effects on species: Table E-3 in Appendix E
Oaks dominate this woodland type. Although the subject of few fire ecology studies, Madrean oak woodlands are thought to be shaped by fire (Caprio and Zwolinski 1995; Ffolliott and Bennett 1996; Abbott 1998). A woodland-grassland dynamic potentially exists in these systems, as in the pinyon-juniper woodland. As the canopies of woody species grow denser, herbaceous production decreases and with it the fuel to carry fire. More open canopies allow more understory growth, more fine fuels buildup, and more frequent fire. Abbott (1998) suggests minimal return interval of 10-30 years for southeastern Arizona oak woodlands based on conservative estimates of fire frequency for neighboring coniferous forest and grasslands.

Ffolliott and Bennett (1996) examined oaks after the 1988 Peak fire in Sonora, Mexico and neighboring Coronado National Memorial in southeastern Arizona. While Abbott (1998) cautions against generalizing from single-fire studies, Ffolliett and Bennett's work showed that fire intensity had everything to do with the post-fire response of individual trees. Fifty percent of oak trees on the low-intensity site showed no visible damage, while over 80% of oaks in the high-intensity area were root-killed.

Texas madrone is sensitive to fire, though fire-scarred individuals are visible in the park. Frequent low-intensity fire keeps trees pruned and out of reach of browsers. While it seems to survive and re-sprout after higher-intensity fires, wildlife ruthlessly browse new growth. Beautiful madrone trees are part of the park's charm, and their loss via fire would be noticed, a local long-term adverse impact.

The IDT expects fires to reduce the chance of mature overstory mortality and maintain high plant diversity and health, while reducing understory (shrub) density and increasing grass cover. The result should be a fuel model mosaic with more 2, less 6. This area would be managed with a longer burn interval than other vegetation types. The cumulative effects of burning repeatedly should keep redberry juniper at low levels and further reduce overstory mortality.

Interior Chaparral (133.3 in Brown)
Fire effects on species: Table E-4 in Appendix E
Chaparral vegetation experiences stand-replacing fires at intervals measured in decades (Wright 1990; Paysen et al. 2000). The buildup of litter and dry conditions promote fire, vegetation recovery takes at least 10 to 15 years, and the next fire follows when litter and dryness once again team up (Wright 1990). While chaparral tends to replace chaparral after fire, species composition can change depending on post-fire seedbank composition.

The IDT expects fire to reduce fuel load, reduce shrub stature (but not shrub composition), and possibly slightly increase grass cover. However, if fires occur too frequently, there will be less shrub cover than desired and invasive species can invade.

Chihuahuan Semi-desert Grassland (143.1 in Brown)
Fire effects on species: Table E-5 in Appendix E
Most researchers conclude that grazing and lack of fire in semi-desert grasslands encourage shrubs at the expense of grass (Wright and Bailey 1982). Paysen et al. (2000) caution that while

fire can be used to accomplish objectives in grassy desert shrublands, it may also contribute to loss of desirable species. Ahlstrand (1982), working in "mountain shrub" vegetation at Carlsbad Caverns (that greatly overlaps in species composition with this type for Guadalupe Mountains National Park), suggested burning in this community every 10-15 years would shift it towards grasslands; absence of fire would shift it towards shrublands.

The IDT expects that fires will improve habitat for black-tailed prairie dogs, pronghorn, and burrowing owls while improving grass health. Fires should move this vegetation class to condition class I by reducing woody plants and promoting grass. The fuel model will not change. The cumulative effects of burning repeatedly should keep redberry junipers small and improve grassland bird diversity.

Chihuahuan Desertscrub (153.2 in Brown)
Fire effects on species: Table E-6 in Appendix E
Chihuahuan desertscrub occupies the lowlands of the park. Nicknamed the "asbestos formation" by park fire staff, stands of widely spaced, small-leaved shrubs on bajadas and flats have difficulty carrying fire. Dunes and bolsons host some fire-tolerant species. While these areas may have been grassier before grazing, it is not a goal of the park to reverse the trend, nor is there evidence that fire could do so. However, invading grasses may someday change the present no-fire regime.

The IDT does not expect this vegetation type to burn.

Interior Deciduous Forest and Woodland (no number assigned by Brown 1994)
Fire effects on species: Table E-7 in Appendix E
Fires occur in this wet type when conditions are right for them to move from neighboring communities. At the park, fires have been observed to jump springs. Fire return might synchronize with adjacent grassy communities (see Kaib 1996), but the natural breaks present in wetter, rockier canyon bottoms would limit the extent of fires. McKittrick Canyon is the key representative of this community type; a major fire through McKittrick would dramatically alter its character.

The IDT expects fires to reduce understory, shrub cover, and dead and downed fuels. The cumulative effects of burning repeatedly could potentially improve habitat for seed-eating birds and increase habitat diversity for wildlife generally. Repeated fires should also have a beneficial effect on protecting cultural resources (i.e., historic structures) and contribute to reducing transmission of shelf fungus between deciduous trees.

Landscape Effects

Concern about larger-scale vegetation patterns on the landscape comes from a mixture of sources. Visitors and other stakeholders expect the park to look a certain way, based on what they have seen in person or even in photographs. Such expectations lead to the desire for the landscape to remain static. There may be constituencies that desire park landscapes to look like they did during important historical events, yet returning fire as an ecosystem maintenance agent is desirable.

The fire program at Guadalupe Mountains National Park intends to have landscape-level effects on vegetation while maintaining mosaics. Opening up high country woodlands is a priority. Lack of fire in the system is allowing Douglas-fir to form dense thickets at the expense of ponderosa pine and southwestern white pine. Closure of the canopy and buildup of fuels with this shift increases the likelihood of high-severity fires. Education is needed to ease objections of visitors used to "deep woods." Fire becomes an interpretive opportunity. Wildland fire use (under pre-determined conditions) and prescribed burning helps the park bring desired change in stages—maintaining mosaics and avoiding large-scale, high-intensity events.

Beetle kills are happening on a landscape-level scale; drought makes trees susceptible in overstocked areas. Regular fire helps prevent outbreaks, since thinner stands are less stressed, but wildland fire also spreads easily in killed areas. Beetle kills are taking place in ponderosa pine on the Dog Canyon side of McKittrick and in Douglas-fir on north-facing slopes of South McKittrick above Hunter Line Cabin and the top of McKittrick Ridge near McKittrick Campground. Mistletoe also spreads more easily in dense stands.

Some vegetation types at the park naturally experience stand-replacing fires. In a park managed for its scenic beauty, large-scale stand replacement is not desirable. With these events also come unpredictable amounts of flooding and erosion. Given fuel loads that may currently lie outside the natural range of variability in some areas, it is not clear what new equilibrium situations would look like. Thus it is desirable to control the application of fire in the interior chaparral areas (particularly slopes within McKittrick Canyon) to avoid large-scale stand replacement, while still allowing much needed burning to take place.

Park managers will also be taking care to prevent fire from taking out canyon-bottom riparian areas (Brown 1994—interior deciduous forest and woodland). These places are historically not particularly fire prone due to the presence of plentiful moisture, but drought conditions combined with adjacent slopes covered with chaparral overdue for fire, place such woodlands at risk. The noticeable loss of McKittrick Canyon trees, highly regarded throughout the region for their displays of fall color, would constitute a moderate impact.

The distribution of vegetation on the landscape naturally changes over time with gradual processes like erosion or climate change. Disturbance events, like fires and floods, also rearrange vegetation. Stand-replacing fires (such as occurs naturally in shrublands and grasslands and unnaturally in southwestern woodlands) can create dramatic changes in scenery. Large intense fires can remove vegetation from large expanses of landscape, potentially erasing mosaic patterns and causing conversions from one vegetation type to another (for example, from shrubland to grassland). Exceptionally heavy fuel accumulations in park high-country areas are currently capable of sustaining large, high-intensity and high-severity fires that cause landscape-level alteration. Alternatives A and B, which increase wildland fire use over No Action, would somewhat reduce the potential for landscape-altering events.

Vegetation Intensity and Duration of Effects Defined

Negligible: An action that could affect individuals of a species, with no measurable or perceptible change to populations. Impacts would be barely perceptible changes to landscape features.

Minor: An action that could cause a change to populations, but the change would be small and, if measurable, would be a small and localized effect and not decrease or increase the species diversity of the park. Impacts would remain localized and confined to a single element or significant characteristic of a landscape such as a particular plant community over a small area.

Moderate: An action that could cause a change to populations and communities that increases or decreases species diversity in the park. The change would be a localized effect and not be considered a threat to the long-term survivability of the species in question. Impacts would be sufficient to cause a noticeable but not substantial change in landscape features such as alteration of a particular plant community in several localized areas.

Major: An action that could decrease the species diversity of the park, be considered a threat to the long-term survivability of populations in question, and/or eliminate the population of a species that is locally endemic or considered key to the natural integrity of the park. Also, an action would be considered a threat if it would decrease species diversity or population numbers of particular species. Impacts would result in substantial and highly noticeable changes in landscape features, such as complete loss of vegetation over a widespread area.

Impairment: A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Short-term: A return to the pre-event range of variability in distribution and abundance of species and arrangement of vegetation on the landscape within the natural fire interval of the affected habitat.

Long-term: No return to pre-event range of variability in distribution and abundance of species and arrangement of vegetation on the landscape within the natural fire interval of the affected habitat.

Assessment Methodology

Impacts of the fire program on vegetation have been developed from research and monitoring results within the park, the literature, and the experiences of staff and outside experts.

No Action

Impact Analysis
The No Action Alternative would see spring and fall burns affecting vegetation with a prescribed fire program and limited fire use. In addition, there would be suppression actions during the traditional late-spring through summer fire season. Impacts on plants would be less severe in non-drought years. Actions would be restricted to the park. In regard to intensity and duration, the No Action Alternative could lead to high-severity fire with moderate, long-lasting landscape-level changes (vegetation type conversions) due to the potential for suppression and fuel buildup. Immediate direct effects are avoided with suppression in exchange for buildup of risk as fuels accumulate. Maximum suppression will minimize short-term adverse direct effects (death and injury) to plants, but suppression activities (ground disturbance) can locally affect vegetation. Prescribed fire mosaics preserve unburned areas as seed sources for plants. The No Action Alternative is the least effective at moving vegetation to a desired condition; only minor indirect benefits from wildland fire use and prescribed burning are predicted. The indirect effect of a high-severity wildland fire threat continues.

High-severity fire would cause moderate effects on the distribution of vegetation on the landscape. Prescriptions for wildland fire use and prescribed burns would be written to lessen direct landscape effects. The high-severity fire would cause moderate indirect effects on vegetation that in turn would affect wildlife. Erosion and sedimentation could follow high-intensity fires that remove significant amounts of vegetation.

Mitigation actions include prescribed burning and mechanical treatments that will render areas less susceptible to landscape-altering, high-severity fires. Prescribed burning helps preserve vegetation mosaics.

Cumulative Effects
Cumulative effects on vegetation include concerns within and beyond the park to areas that are sources of colonization for park plants. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effect analysis finds:

- Grazing on the Lincoln National Forest Zone of Cooperation may have minor adverse effects on the ability of wildland fire use and prescribed burns to meet vegetation goals under Alternative B
- Insect outbreaks may have moderate adverse effects on wildlife habitat
- Fire events in the same location at higher than historical frequency could shift plants to different habitats
- Ongoing increases in woody plant cover increase fuels, make burns hotter, increase fire tolerant species, and decrease fire-intolerant species, having moderate adverse effects on distribution of vegetation on the landscape
- Past and future prescribed burns, wildland fire use, and non-fire treatments at the park would cause moderate beneficial effects on landscape-scale vegetation patterns
- High severity fires in the Guadalupe Mountains that reach the park and ZOC may add moderate adverse effects
- Insect outbreaks may have moderate adverse effects on landscape-scale vegetation patterns

- Large-scale fires on neighboring lands could reduce available seed sources for recolonization after fires at the park deplete populations of plants
- Fire events in the same location at higher than historical frequency could shift plant communities towards non-historical states

The combination of the cumulative impacts listed above with suppression actions, prescribed burns, and wildland fire use events would have a moderate adverse effect on vegetation.

Conclusion
The park would continue to progress from a "natural" fire regime to "suppression" landscape with minimized adverse direct effects in the short-term. Lack of fire would continue to maintain shrublands where grasslands once occurred and create dense thickets out of historically open woodlands. Numerous factors could influence the outcome of prescribed or wildland fire in the park but overall fires are likely to burn hotter than they did historically because of increased fuels from more dead material, and from denser vegetation. Potential for moderate, long-term adverse impacts on vegetation exists due to continued suppression, particularly in the park high country.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there would be no impairment of vegetation under this alternative.

Alternative A

Impact Analysis
In regard to the timing and context, more wildland fire use would be expected to bring more fire during the natural fire season with actions restricted to the park. More wildland fire use would also treat more of the park and avert high-intensity events with moderate, long-term benefits. The increase in wildland fire use under Alternative A would be expected to result in minor to moderate short-term adverse direct effects instead of a major adverse effect of high-intensity fires caused by hazardous fuel buildups. In turn, an increase in shade tolerate species is expected. Alternative A would also have moderate indirect landscape effects.

The mitigation actions are the same as the No Action Alternative.

Cumulative Effects
The cumulative effects are the same as the No Action Alternative.

Conclusion
Greater wildland fire use under Alternative A reduces the likelihood of high-severity, landscape altering events. The existing fuel buildups in the high country will remain difficult to alleviate and adverse impacts may still occur but likely on a smaller scale, compared with the No Action Alternative. Overall, Alternative A has a moderate, beneficial impact in the long-term.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there would be no impairment of vegetation under this alternative.

Alternative B

Impact Analysis
More wildland fire use is expected to bring more fire during the natural fire season. As the upper North McKittrick landscape is treated by fire, the likelihood of fires spreading from the ZOC to the park decreases. Duration and intensity of effects is similar to Alternative A. The inclusion of wildland fire use and prescribed burning in upper North McKittrick averts effects and helps to avoid high-intensity, long-lasting effects throughout the watershed. Direct effects are similar to Alternative A. The likelihood of fires entering the park along the Forest Service boundary will lessen as more burning takes place in the Zone of Cooperation. The indirect effects are similar to Alternative A. The inclusion of the entire McKittrick Canyon watershed would be expected to bring moderate indirect effects to the upper canyon as well as the rest of the park.

The mitigation actions are the same as the No Action Alternative.

Cumulative Effects
The cumulative effects are the same as the No Action Alternative, but also include the Zone of Cooperation.

Conclusion
Alternative B potentially offers the greatest amount of fire meeting prescription over the park landscapes. Fires that may cross the north boundary would not have to be suppressed. Overall, Alternative B has a moderate, beneficial impact in the long-term.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there would be no impairment of vegetation under this alternative.

Impact Topic 5 (Wildlife)

It is known from the literature that most fires potentially injure or kill animals, and large, intense fires are certainly dangerous to animals caught in their path (Bendell 1974; Singer and Schullery 1989). However, direct mortality from fire is generally considered to be minor (Ganey, Block, and Boucher 1996), with season of burn having a significant impact on mortality levels (Kruse and Piehl 1986; Lehman and Allendorf 1989; Robbins and Myers 1992). For example, burning during nesting season appears to be the most detrimental to bird and small mammal populations (Erwin and Stasiak 1979).

Habitat effects can have more bearing on wildlife populations than direct mortality of individuals (Singer et al. 1989; Vales and Peek 1996). Fires influence animal species indirectly due to habitat modification, changes in food supply, or changes in abundance of competitors and/or predators (Rotenberry et al. 1995; Finch et al. 1997). A review by Finch et al. (1997) points out that reproductive success may be reduced in the first postfire year because of food reductions from spring fires. Thus, changes in vegetative structure and composition have interlinking effects on the related faunal species.

Fires can impact birds positively or negatively, depending on the season, patchiness, severity of burning, and the particular behavior strategy of the species involved (Kruse and Piehl 1986; Lehman and Allendorf 1989; Robbins and Myers 1992). However, direct mortality due to fire is considered minor for most bird species. Numerous studies have determined that burning during nesting season appears to be most detrimental to ground-nesting populations (Grange 1948; Erwin and Stasiak 1979; Kruse and Peihl 1986; Svedarsky et al. 1986). Nesting success was attributed in part to areas skipped by the fire as it burned in a mosaic pattern (Kruse and Piehl 1986). Patchy burns also favor species that require perches and cover above the ground (Bock and Bock 1990). In forested areas, fire effects on birds depend largely on fire severity. Species nesting in the canopy could be injured by intense surface fire and crown fire. At Guadalupe Mountains this kind of fire behavior might be expected just before the onset of the monsoon season around the first of July.

Fires favor raptors by reducing cover and exposing prey. Dodd (1988) noted that the northern harrier, American kestrel, red-tailed hawk, Cooper's hawk, and turkey and black vultures are attracted to fire and recent burns. When prey species increase in response to postfire increases in forage, raptors are also favored. Dodd (1988) describes beneficial effects from fire on populations of burrowing owl in desert grassland, sharp-shinned and Cooper's hawk in chaparral, and northern goshawk and sharp-shinned hawk in ponderosa pine forest.

Smith et al. (2001) studied the effects of prescribed fire on montane rattlesnakes during and after fire in the Peloncillo Mountains, in the southwest corner of the New Mexico Bootheel, on the Arizona-New Mexico state line. All nine individual snakes studied sought refuge from fire; one died. Simons (1989) reported similar mortality in general for reptiles in southern Arizona.

There is no question that fire events can directly harm plants and wildlife. At the species level there is variation in the sensitivity to fire. However, mobile animals are able to escape direct effects of fire, and many plants benefit from fire during some stage of their life cycle. Fire effects data for dominant species at the park (Appendix E) generally show tolerance of fire in the long term, either through resprouting of topkilled stems or fire-induced germination. At the ecosystem level, it can be argued that fire was historically present and benefits plant communities over the long term. Those benefits translate into habitat improvements for animals or habitat adjustments, where faunal composition has changed as a function of suppression-induced vegetation change. Alternative A brings more fire to the landscape, and Alternative B brings the most fire because of less need to suppress fires that might cross the northern boundary. Continued absence of fire, most likely under No Action, will increase fuel buildups that make future conflagrations more probable with the potential to impact entire habitats or populations.

Wildlife Intensity and Duration of Effects Defined

Negligible: An action that could affect individuals of a species, with no measurable or perceptible change to populations.

Minor: An action that could cause a change to populations, but the change would be small and, if measurable, would be a small and localized effect and not decrease or increase the species diversity of the park.

Moderate: An action that could cause a change to populations and communities such that the species diversity of the park is decreased or increased. The change would be a localized effect and not be considered a threat to the long-term survivability of species in question.

Major: An action that could decrease the species diversity of the park, be considered a threat to the long-term survivability of populations in question, and/or eliminate the population of a species that is locally endemic or considered key to the natural integrity of the park. Or an action that would increase species diversity or population numbers of particular species.

Impairment: A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Short-term: A return to the pre-event range of variability in distribution and abundance of species within the natural fire interval of the affected habitat.

Long-term: No return to pre-event range of variability in distribution and abundance of species within the natural fire interval of the affected habitat.

Assessment Methodology

Assessment of change in wildlife comes from past experience in the park's fire program, park staff expertise, and literature pertaining to fire in the Chihuahuan Desert region.

No Action

Impact Analysis

Natural-season fires that avoid breeding seasons should cause the fewest direct negative impacts on animals. This alternative dictates the most suppression, which would limit duration of low- to moderate-intensity fires and their direct effects. Effects of fire suppression—increasing risk of high-severity fires—would continue. Maximum suppression will minimize short-term adverse direct effects (death and injury) to animals. Suppression activities (ground disturbance, helicopter

overflight) can locally affect wildlife. Prescribed fire mosaics preserve unburned areas as refuges for animals. Under the No Action Alternative only minor indirect benefits from wildland fire use and prescribed burning are predicted. The indirect effects of habitat degradation and threat of high-severity wildland fire continue.

Mitigation actions are: mechanical hazardous fuel reduction; prescriptions that protect sensitive species' habitats; presence of resource experts during fire operations; post-fire monitoring to verify and improve prescriptions.

Cumulative Effects
Cumulative effects on wildlife include concerns within the park. Areas around the park that are sources of colonization for park animals, or places where park animals move, are also considered. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effect analysis finds:

- Ongoing increases in woody plant cover increase fuels, make burns hotter, increase fire tolerant species, and decrease fire-intolerant species, having moderate adverse effects on wildlife habitat.
- Past and future prescribed burns, wildland fire use, and non-fire treatments at the park would cause moderate beneficial effects on wildlife habitat.
- Large, high-severity fires in the Guadalupe Mountains that reach the park and ZOC may add moderate adverse effects.
- Insect outbreaks may have moderately adverse effects on wildlife habitat.
- Hunting on the Lincoln National Forest may have minor adverse effects on wildlife.
- Large-scale fires on neighboring lands could reduce available pools for recolonization after fires at the park deplete animal populations.
- Fire events in the same location at higher than historical frequency could shift plant and animals to different habitats.
- Rabies control activities add helicopter overflights that disturb wildlife.

The combination of the cumulative impacts listed above with suppression actions, prescribed burns, and wildland fire use events would have minor to moderate adverse effects on wildlife.

Conclusion
Continued suppression of most fires would result in minor, short-term, direct adverse impacts to wildlife. Prescribed fire, thinning, wildland fire, and suppression actions could cause small changes to populations through loss of individual animals but moderate, indirect effects in the long-term by renewing habitat. No Action is least effective at meeting long-term resource management objectives. There would be a potential for long-term moderate adverse impacts to particular species with continued habitat degradation and threats of high-severity fires during periods of severe fire conditions resulting from successive suppression actions. The park would continue its progress from a "natural" fire regime to a "suppression" landscape.

Because there should be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3)

identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there should be no impairment of wildlife under this alternative.

Alternative A

Impact Analysis
The timing and context of Alternative A is similar to No Action with future impacts reduced as more fires occur. There are more longer-duration impacts with less suppression, though the need to suppress along most of the boundary would shorten duration of direct effects. Increased wildland fire use for resource benefit would have moderate, short-term adverse direct effects on animals intolerant of fire. There is an indirect beneficial effect to native species from changes in vegetation structure and composition due to increased use of fire under Alternative A; post-fire increases in resource availability (light, nutrients, water) benefit plants and thus animals.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
The cumulative effects are the same as the No Action Alternative.

Conclusion
With more fire use, greater short-term, adverse impacts to individual animals are expected in relation to the No Action Alternative. Fires will consume stumps, logs, and snags that may be nesting and foraging sites for woodpeckers, small owls, and small mammals, but fire also creates more of such sites. Managing for burn mosaics keeps such impacts minor. Resprouting of shrubs after burns provides new forage for browsers. Short-term adverse impacts to particular species would be minor to moderate with appropriate protective measures. The long-term threat of high-severity fires would subside with park-wide application of prescribed fire and wildland fire use. Particular species would benefit as management objectives are met.

Because there should be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there would not be impairment of wildlife under this alternative.

Alternative B

Impact Analysis
The timing and context of Alternative B is similar to Alternative A. There is a further reduction of impacts as upper North McKittrick is treated by fire, which improves the entire watershed. As the upper North McKittrick landscape is treated, the likelihood of fires spreading from the ZOC to the park decreases. With NPS and USFS cooperating to avoid high-severity fires with moderate impacts in upper North McKittrick, erosion and downstream deposition that could alter habitat for aquatic animals would be reduced in intensity and duration. The direct effects are similar to Alternative A, except inclusion of upper North McKittrick would expand the area where moderate, short-term adverse effects on fire-intolerant species may occur. The indirect effects are

also similar to Alternative A, except inclusion of upper North McKittrick would expand the area where fire improves habitat conditions.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
Cumulative effects are the same as the No Action Alternative, but also include the Zone of Cooperation:

- Grazing on the Lincoln National Forest Zone of Cooperation may have minor adverse effects on the ability of wildland fire use and prescribed burns to meet vegetation goals under Alternative B.

Conclusion
The effects of Alternative B would be similar to Alternative A, and the effects to animals within the Zone of Cooperation would be similar to those experienced within the park. The long-term threat to the park's resources from high-severity fires will further decrease as management objectives for the Zone of Cooperation are met, reducing the opportunity for fire encroachment from neighboring Forest Service land. Allowing fires that meet prescriptions to burn the upper North McKittrick watershed decreases the likelihood of high-severity fires that can result in adverse indirect effects (erosion and sedimentation) on aquatic animals downstream.

Because there may be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan and/or other relevant NPS planning documents, there should be no impairment of wildlife under this alternative.

Impact Topic 6 (Unique Sites and Sensitive Species)

Fire could change the character of unique sites as well as positively or negatively change the abundance of species of particular interest to park visitors and managers.

The loss of unique sites and sensitive species would rob the park of key portions of its identity and undermine its purpose. At Guadalupe Mountains National Park, McKittrick Canyon is a geological-biological wonder beloved for its spectacular scenery. Its spring-fed, perennial stream supports deciduous riparian woodland. High-intensity fire through the canyon bottom would drastically change its character. The sensitive species of fish, invertebrates, and amphibians in the canyon would be impacted, not to mention the disappointment of the public that flocks to the site to see fall color displays. Meanwhile the chaparral-covered canyon slopes are overdue for a stand-replacing fire. The creek's delicate travertine ($CaCO_3$ precipitate) lining would be highly susceptible to damage from suppression activities. Thus, fire retardant should be avoided.

The park's springs are also places whose character is subject to change as a result of fire. These locations are always undergoing succession, and fire just resets the clock—opening up areas that will later fill in, and freeing up water that will later be consumed by new vegetation. Fire in

surrounding areas can result in erosion that can fill waterways with sediment. Again, fire retardant should be avoided in these areas.

Research Natural Areas [(1) Devil's Den Canyon, (2) Upper South McKittrick Canyon (above Hunter Line Cabin), and (3) The Middle Fork of North McKittrick Canyon] are set aside for study. Fire has not been a tool of researchers in these areas and deliberate manipulative activity such as experimental fire is not permitted within research natural areas under NPS management policy. Seeking to improve understanding of fire behavior in particular plant communities, however, suggests the need for fire research associated with conditions before, during and after wildland fire use. Fire retardant would not be used in these areas.

Middle Permian benchmark—Two out of three (Getaway Ledge and Stratotype Canyon) are fire-proof; third area (Nipple Hill) does not have particularly high fuel loads and digging line would cause more disturbance than burning.

Wilderness necessitates minimum impact management, including minimum tool analysis, and fire suppression in such areas relies on crews arriving on foot, using hand tools, and expecting no helicopter support. Superintendents can override these provisions under emergency conditions when threats to life and property supersede maintenance of wilderness values.

Plant species of concern are generally local endemics that occur in specialized habitats (see Chapter III, Table III-1).

Table III-1 lists the plants of concern to NPS, State of Texas, USFWS, and Lincoln National Forest relative to fire program activities. The park will manage for low-intensity fire in the vicinity of known populations of special status plants. For presribed burns the park will: check for known populations, conduct fuels assessments around known populations, mechanically reduce fuels, if needed, and survey populations at 1, 2, 5, and 10 years post-burn under fire effects monitoring protocol.

Sensitive plants, by vegetation type, are listed below:

- Rocky Mountain Coniferous Forest: biennial woolywhite, fiveflower rock daisy, Guadalupe pincushion cactus, Guadalupe rabbitbrush, Guadalupe valerian, Guadalupe violet, mat leastdaisy, McKittrick pennyroyal, and possibly McKittrick's snowberry
- Great Basin Conifer Woodland: Guadalupe mescal bean
- Madrean Evergreen Woodland: Chisos coralroot, Glass Mountain coralroot, Guadalupe milkwort, Guadalupe rabbitbrush, Guadalupe valerian, mat leastdaisy, and sparseflower jewelflower
- Interior Chaparral: Culberson County skullcap and possibly strong bladderpod
- Chihuahuan Semi-desert Grassland: Chisos agave, gypsum wild-buckwheat, paper spine, Payson's hiddenflower, and Trans Pecos beargrass
- Chihuahuan Desertscrub: Burgess' broomsage, gypsum milkvetch, Payson's hiddenflower, and Warnock's ragwort
- Interior Deciduous Forest and Woodland: cardinal penstemon, Chaplin's golden columbine, Guadalupe Mountains aster, and possibly Guadalupe fescue

Table III-2 is a list of sensitive animal species developed by NPS, State of Texas, USFWS, and Lincoln National Forest. Animals of concern tend to be widespread species that are hurting across their ranges. Discussion under Impact topic 5 (Wildlife) also applies to the sensitive wildlife.

Mexican spotted owl (MSO) is the species of greatest concern relative to fire at Guadalupe Mountains. The Biological Assessment (BA) and Biological Opinion (BO) contain background and guidelines for fire management. The following conservation measures are specified in the BA prepared for the USFWS:

> The park will identify occupied owl breeding locations, prioritize areas for protection, and locate access points for suppression, wildland fire use, and prescribed burning activities. This information will be communicated in advance (when feasible) to fire management personnel. Guadalupe Mountains National Park is a Class I airshed, and smoke will be managed to prevent air quality degradation according to state and local requirements. Both volume and density of smoke is usually greater for wildfires than for prescribed burns or wildland fire use; smoke dispersal is a factor in the decision for wildland fire use. Fire operations will proceed without helicopter flight over protected activity centers (PACs) during the breeding season (March 1 through August 31), except in emergency life-threatening situations.

Unique Sites and Sensitive Species Intensity of Effects Defined

Negligible: The impacts on unique sites or sensitive species are at the lowest levels of detection, barely perceptible and not measurable.

Minor: The impacts on the unique sites or sensitive species are measurable and perceptible, but slight and localized within a relatively small area or restricted to one or two species. The impacts do not affect the character-defining features of sites, have a permanent effect on sites' integrity, or threaten in any way continued persistence of species in the park.

Moderate: The impacts are measurable and perceptible. The impacts change one or more character-defining feature(s) of unique site(s) but do not affect the site to the extent that its integrity is jeopardized. More than two sensitive species are affected, and continued persistence in localized areas may be threatened.

Major: The impact is substantial, noticeable, and permanent. The impact is severe or of exceptional benefit. In the case of adverse effects on unique sites, the impact changes one or more character-defining feature(s) to the extent that integrity of the site(s) is jeopardized and the site(s) can no longer be considered suitable for special recognition. Continued persistence of sensitive species in the park is threatened.

Impairment: A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity

of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Short-term: A return of unique sites and distribution and abundance of sensitive species to pre-event range of variability within the natural fire interval of the affected habitat.

Long-term: No return of unique sites and distribution and abundance of sensitive species to pre-event range of variability within the natural fire interval of the affected habitat.

Assessment Methodology
The IDT produced the list of unique sites. Consultations with USFWS (Texas and New Mexico Ecological Services), Texas Parks and Wildlife, and New Mexico Game and Fish plus park biologists produced the sensitive species list. Park resource management staff made the determination of impacts based on experience with fuels reduction projects.

No Action Alternative

Impact Analysis
Fires during natural fire (monsoon) season minimize the threat of adverse effects to unique sites and sensitive species in the park. Mitigation measures reduce intensity and duration of impacts. Low- to moderate-intensity fires result in a minimal risk of adverse impact. Fire is part of the process for natural sites and effects subside with each post-fire season. Suppression could postpone direct effects of fire, but the potential exists for surface and subsurface disturbance during suppression activities. Continued suppression brings risk of high-intensity events that could cause moderate direct effects on unique sites. Fuel reduction treatments decrease likelihood of major direct effects. Unique natural sites and habitats of fire-adapted species likely benefit from fire. The No Action Alternative is least effective at lessening the threat of future high-severity wildland fire threats to these sites and habitats. Suppression actions may have the indirect effect of postponing the loss of vegetation, temporarily preventing secondary effects of erosion and silting up of unique aquatic sites.

Mitigation actions include: surveying known populations of sensitive species, fuel reduction around unique sites and in sensitive species habitats; prescribed burning of fire-tolerant sites and habitats; fire suppression in and around fire-intolerant sites and habitats; timing of fires to minimize intensity; minimum impact management techniques.

Cumulative Effects
Cumulative effects on unique sites and sensitive species include concerns within the park only, with the exception of Mexican spotted owl on the Lincoln National Forest for all alternatives. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effect analysis finds:

- Ongoing increases in woody plant cover increase fuels and make burns hotter, possibly having moderate adverse effects on the McKittrick Canyon riparian zone, Research Natural Areas, areas around springs, Mexican spotted owl habitat, and Guadalupe mescal bean and Guadalupe violet, two species whose entire known populations could be affected by high-intensity fire.

- Past and future prescribed burns, wildland fire use, and non-fire treatments at the park would cause moderate beneficial effects through reduction of fuels in the McKittrick Canyon riparian zone, areas adjacent to Research Natural Areas, areas around springs, Mexican spotted owl habitat, and the habitats of Guadalupe mescal bean and Guadalupe violet, two species whose entire known populations could be affected by high-intensity fire.
- High severity fires in the Guadalupe Mountains that reach the ZOC and park could have minor to moderate adverse effects on the McKittrick Canyon watershed, including Research Natural Areas and Mexican spotted owl habitat.
- Ongoing insect outbreaks may have long-term moderate adverse effects on Mexican spotted owl habitat and Research Natural Areas by killing trees.

Past effects that have led to increases in vegetation and dead and downed materials increase the potential for larger hotter fires. All proposed fire activities would lessen harmful effects over the long-term on sensitive species and special sites.

The combination of the cumulative impacts listed above with suppression actions, prescribed burns, and wildland fire use events would have moderate, adverse effects on unique sites and sensitive species.

Conclusion
Continued suppression of most fires would result in minor, short-term, direct adverse impacts to unique sites and sensitive species. Prescribed and wildland fire could result in increased sediment loads in streams and springs and small changes to populations of sensitive species through loss of individual plants and animals. Prescribed fire should lead to moderate, indirect beneficial effects in the long-term. The No Action is least effective at meeting long-range resource management objectives. The potential for long-term adverse impacts to fire-sensitive species with continued habitat degradation and threats of high-severity fires would be moderate. Moderate, adverse impacts resulting from successive suppression actions are expected. Potential exists for minor to moderate, adverse impacts to unique sites and sensitive species accrues as suppression continues.

Because there should not be major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there should not be impairment of unique sites and sensitive species under this alternative.

Alternative A

Impact Analysis
The timing, context, duration, and intensity of impacts are the same as the No Action Alternative. The direct effects are similar to the No Action Alternative, except the likelihood of minor direct effects increase and major direct effects decrease with increased prescribed burning and wildland fire use. Alternative A is indirectly effective at reducing long-term adverse impacts from high-severity wildland fire by improving historic scenes at these sites.

Mitigation measures are the same as the No Action Alternative.

Cumulative Effects
Cumulative effects are the same as the No Action Alternative.

Conclusion
With more fire use, greater short-term, adverse impacts to individual plants and animals are expected in relation to No Action. Fires will consume stumps, logs, and snags that may be nesting and foraging sites for woodpeckers, small owls, and small mammals, but fire also creates more of such sites. Managing for burn mosaics keeps such impacts minor. Resprouting of shrubs after burns provides new forage for browsers. Short-term adverse impacts to particular species would be minor with appropriate protective measures. The long-term threat of high-intensity fires would subside with park-wide application of prescribed fire and wildland fire use. Particular species would benefit as management objectives are met.

Because there should not be major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would not be impairment of unique sites and sensitive species under this alternative.

Alternative B

Impact Analysis
The timing and context of Alternative B is similar to the No Action Alternative. Inclusion of upper North McKittrick Canyon increases overall project areas and number of unique sites. The duration and intensity is the same as the No Action Alternative. Direct effects are similar to the No Action Alternative, except likelihood of fires entering the park along the Forest Service boundary will lessen as more burning takes place in upper North McKittrick. Likelihood of high-intensity fires that could harm unique sites in upper North McKittrick decreases with increased treatment. The indirect effects are similar to Alternative A with increased effectiveness at reducing long-term adverse impacts. In addition, the lower stocking levels in North McKittrick Canyon would increase the available water content of the area.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
Cumulative effects are the same as the No Action Alternative, but also include the Zone of Cooperation. This is the site of caves that are considered important to recreational users.

Conclusion
The effects of Alternative B would be similar to Alternative A, and the effects to plants and animals within the Zone of Cooperation would be similar to those experienced within the park. The long-term threat to the park's resources from high intensity fires will further decrease as

management objectives for the Zone of Cooperation are met, reducing the opportunity for fire encroachment from neighboring Forest Service land. Allowing fires that meet prescriptions to burn the upper North McKittrick watershed decreases the likelihood of high-severity fires that can result in adverse indirect effects (erosion and sedimentation) on plants and animals downstream. Benefits in the long-term are greater than Alternative A.

Because there should not be major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would not be impairment of unique sites and sensitive species under this alternative.

Impact Topic 7 (Non-indigenous Species)

Fire may aid invasion of non-indigenous species but may also prove to be a control tool. Non-indigenous species, particularly plants, threaten the integrity of many ecosystems. Fire raises three main concerns with respect to exotic plants. First, many species thrive in bare or disturbed areas, and fires and suppression activities can make more habitat prone for invasion. Second, many non-indigenous species can resprout after being topkilled by fire, and if they grow faster than natives, repeated fires can favor the non-indigenous species. Third, non-indigenous grasses are fine fuels bringing fire into systems either not tolerant of fire or not tolerant of the fire behavior produced by the invading species. While grasses appear on the list of exotics for Guadalupe Mountains National Park (see Table III-4), they do not at this time occur in densities that create fuel problems. Carefully applied fire can help with control of some invading plants, and further research will aid managers with matters of timing, frequency, and intensity of burns.

Non-indigenous animals are not viewed at this time as requiring consideration in the planning of fire program activities.

Of the non-indigenous plants described as priorities in Chapter III, the following are of concern or interest relative to fire program activities. Information comes from communications with park staff, Guertin and Halvorson's (2003) review, and the Fire Effects Information System (FEIS) managed by the Forest Service:

- African rue's tendency to thrive on degraded lands may mean it can spread into areas recently disturbed by fire intense enough to produce bare ground.

- Malta starthistle grows in disturbed, mainly roadside, areas. Fire suppression activities could facilitate this plant's spread. Hot burning before seed set may kill seed.

- While horehound is known to move into eroded areas, and fire can lead to erosion, its occurrence at the park seems to be restricted to old home and ranch sites. In 1993 the Pine Fire burned hot and fast through the horehound field in the old horse pen at the Houser house site. The horehound has not returned.

- The places in the park inhabited by Johnson grass are too close to developed areas to be prescribed burning sites. Deep rhizomes have no trouble surviving fire, and spring burning may encourage Johnson grass growth. Prescribed fire may also serve to open dense stands of Johnson grass for more effective herbicide treatment and dispose of plants dead from other treatments.

- Tumbleweeds are present in an area that the park may want to burn, near the Butterfield stage stop ruins parking lot. Burning when succulent (late July and early August) may reduce densities but cannot prevent the arrival of seeds from off-site. Return of natives eventually can crowd them out. Piled up dry tumbleweeds can be a fire hazard; flaming plants have been known to roll and spread fire.

- Puncture vine likes bare areas and could germinate with summer rains after spring fires. It occurs near the housing area where burning might be desirable for fuel reduction.

- Woolly mullein occurs in areas of the park that are priorities for prescribed burning, particularly Dog Canyon. It colonizes bare areas and disturbance brings seeds to the surface.

- Cocklebur likes bare areas and could germinate with summer rains after spring fires. It occurs near the housing area where burning might be desirable for fuel reduction. Leafy plants would be killed by fire, but seeds, housed in a hefty bur, could likely survive fast-moving, low-intensity fires such as would move through grassland areas.

Park managers are actively eradicating the non-indigenous species viewed as threats. The fire program would work in concert with these efforts and actively plan activities in ways that prevent exotics from spreading. Minimization measures include (1) avoiding unnecessary ground disturbance, (2) avoiding transport of seed by people and vehicles, and (3) avoid burning exotics in a way that might encourage them to spread. Fire planners and crews can also help with detection of new problem areas and even removal of exotics as they find them.

Fire is not considered a significant contributor to the spread of exotic species on a park-wide scale. Most exotic species identified in the park are limited to specific locations; fire management actions in these areas can be tailored to reflect the specific management considerations for each species.

Non-indigenous Species Intensity of Effects Defined

Negligible: Impacts would be barely perceptible changes in number, distribution, and densities of non-indigenous species.

Minor: Impacts would be perceptible and noticeable, but would remain localized and confined to one or two species or places.

Moderate: Impacts would be sufficient to cause a noticeable but not substantial change in number, distribution, and densities of non-indigenous species.

Major: Impacts would result in substantial and highly noticeable changes in number, distribution, and densities of non-indigenous species.

Impairment: A major, adverse impact to a resource or value whose conservation is key to the integrity of the park or identified as a goal in the park's general management plan or other relevant NPS planning documents.

Short-term: A return to the pre-event range of variability in distribution and abundance of non-indigenous species within the natural fire interval of the affected habitat.

Long-term: No return to pre-event range of variability in distribution and abundance of non-indigenous species within the natural fire interval of the affected habitat.

Assessment Methodology
Impacts of the fire program on exotic species have been developed from the literature and the experiences of staff and outside experts.

No Action

Impact Analysis
Season and location of fire will affect impacts on non-indigenous species. Fuels treatments will reduce the threat of high-severity fires in affected areas. Prescribed burns can be timed to discourage propagation of non-indigenous species. Most areas of the park are not threatened by the spread of exotic species. High-severity fires that result in bare ground may exacerbate the spread of non-indigenous species. High-intensity fires may, on the other hand, kill seeds of Malta starthistle and permanently remove horehound. Low-intensity fires may favor native or non-indigenous species depending on time of year. Seeds of spiny cocklebur likely survive low-intensity fire. Duration of a fire should have negligible effects on particular sites; duration, as an indicator of overall fire size, affects amount of ground potentially disturbed. The direct effects are localized and both beneficial or adverse with the fewest fires under the No Action Alternative. Burning the shoots of sprouters stimulates growth (adverse effect) but high-intensity fires may kill seeds of sensitive non-indigenous species (beneficial effect). Indirect effects include post-fire erosion, the creation of new habitat by suppression-activity disturbances, and the clearing of areas by fire. The greater reliance on suppression under the No Action Alternative would lead to moderate long-term adverse effects.

Mitigation actions are: surveying for stand locations; non-indigenous species control programs; research programs; fuel reduction programs around areas containing target species; adjusting prescriptions to avoid spread of target species; maintaining vigilance about seed transport on vehicles; and education can help reduce effects of the fire program on the spread of non-indigenous species.

Cumulative Effects
Cumulative effects on spread of non-indigenous species include concerns within and beyond the park to areas that are sources of colonization. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effect analysis finds:

- Ongoing increases in woody plant cover increase fuels and make fires burn hotter, making more areas suitable for disturbance-loving non-indigenous species and having moderate adverse effects on ecosystem integrity.
- Ongoing education programs that teach people how to avoid spreading non-indigenous plants may have a negligible to minor beneficial effect.
- Ongoing non-indigenous plant management programs may have a minor beneficial effect by curbing target species.
- Past and future prescribed burns, wildland fire use, and non-fire treatments at the park may create disturbances having minor short-term adverse effects in the form of spread of non-indigenous species but also may result in minor long-term beneficial effects by averting high-intensity, high-severity wildland fires that cause greater disturbances.
- Past and future suppression activities at the park may cause disturbances that encourage spread of non-indigenous plants and minor, long-term adverse effects.
- Large, high severity fires in the Guadalupe Mountains that reach the park and ZOC may add moderate adverse effects by creating expanses of habitat in the region for invasive non-indigenous plants.

All planned and non-planned fire events may lead to the increase of exotics without mitigative measures. Educational efforts may result in minor benefits.

The combination of the cumulative impacts listed above with suppression actions, prescribed burns, and wildland fire use events would have minor, adverse effects on non-indigenous species prevalence and distribution.

Conclusion
The No Action Alternative results in the most suppression. Suppression disturbances potentially prepare more areas for colonization by exotics in the short-term; high-severity fires potentially prepare areas for colonization over the long-term, as fuels build up. This alternative also includes prescribed burns often conducted near developments where exotics are present. Because the occurrence of exotics is highly localized in the park and the mitigation measures described above would be applied in all instances where feasible, No Action is predicted to have minor short-term adverse effects. The greater reliance on suppression under the No Action Alternative would lead to moderate long-term adverse effects.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment from non-indigenous vegetation under this alternative.

Alternative A
Impact Analysis
The timing, context, duration, and intensity are similar to the No Action Alternative but more areas of the park will likely not experience high-severity fire due to allowing fire use and prescribed burns to cross the north boundary. Direct effects remain localized but with an increase in the number of fires. There is a moderately adverse indirect effect from the disturbance of

digging during suppression. This creates an opening for the spread of non-indigenous species. Nonetheless, indirect effects are expected to be less than the No Action Alternative because of the fewer suppressed fires.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
Cumulative effects are the same as the No Action Alternative.

Conclusion
Under Alternative A, the potential for exotic plant spread exists both from allowing fires to burn, thus clearing areas for colonization, and from disturbing the ground during suppression actions. Because the occurrence of exotics is highly localized in the park and mitigation measures would be applied in all instances where feasible, Alternative A is predicted to have minor to moderate short-term adverse effects. In addition, the lower reliance on suppression under Alternative A would lead to minor long-term adverse effects.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment from non-indigenous vegetation under this alternative.

Alternative B

Impact Analysis
Timing, context, duration and intensity of impacts are all similar to Alternative A except that the benefits of increased wildland fire use will extend beyond the north boundary into upper North McKittrick Canyon. Direct and indirect effects are also similar to Alternative A but with a lessening of adverse effects due to more wildland fire use. Minor adverse effects may occur from the increased clearing by fire, which increases the opportunity for the spread of exotics. Vigilant removal of exotics may be needed.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
Cumulative effects are the same as the No Action Alternative but also include the Zone of Cooperation.

Conclusion
Under Alternative B there should be less suppression disturbance, but more extensive wildland fire use and prescribed burns that cross the north boundary. Because the occurrence of exotics is highly localized in the park and the mitigation measures would be applied in all instances where feasible, Alternative B is predicted to have minor short-term adverse effects. Similar to Alternative A, the lower reliance on suppression would lead to minor long-term adverse effects.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment from non-indigenous vegetation under this alternative.

Impact Topic 8 (Geology and Geohazards)

Removal of vegetation by fire can contribute to erosion, flooding, and damage of fossils, while fire can also facilitate new discoveries; heat can cause exfoliation of rock surfaces.

The Guadalupe Mountains are a remnant of a marine fossil reef that formed about 250 million years ago as calcareous sponges, algae, and other lime-secreting marine organisms, along with lime, precipitated from the seawater. There are no living examples of this type of reef; modern reefs are mostly composed of corals. The geology of the range has been well studied due to its proximity to oil and natural gas fields. The international benchmark for the Middle Permian period also lies within the park.

The geology of the Guadalupe Mountains, from both scientific and scenic perspectives, is a significant resource bringing visitors to the park. A long history of fire on the landscape would seemingly have long ago reduced the number of fire-sensitive geological features. However, loss of vegetation as a result of fire increases erosion and rockfall, and heat can cause rock to explode.

The park recently hired a full-time geologist to determine fossil type localities and conduct surveys of significant resources. As new paleontological specimens are discovered and new type localities determined, there would be a need to mitigate localities where extreme fire conditions are possible.

Low erosion potential to begin with keeps predicted impacts minor; long-term impacts could be highest under No Action and lowest under Alternative B.

Geology and Geohazard Intensity of Effects Defined

Negligible: An action that would cause no perceptible alteration of features or change to existing rates of erosion, levels of seasonal floodwaters, or sediment load during flood events.

Minor: A slight but measurable and perceptible alteration to features or change to existing rates of erosion, levels of seasonal floodwaters, or sediment load during flood events.

Moderate: A measurable and perceptible alteration of features or change to existing rates of erosion, levels of seasonal floodwaters, or sediment load during flood events that would necessitate some rehabilitation, cleanup, or repair.

Major: A measurable and perceptible alteration of features or change to existing rates of erosion, levels of seasonal floodwaters, or sediment load during flood events that would necessitate major rehabilitation, cleanup, or repair and road or campground closures.

Impairment: A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Short-term: A return of erosion, seasonal flooding, or sedimentation to pre-event rates within 3-5 summer rainy seasons.

Long-term: No return of erosion, seasonal flooding, or sedimentation to pre-event rates within 3-5 summer rainy seasons.

Assessment Methodology
Assessment of geology and geohazard impacts comes from staff observations, discussions with experts, studies conducted in the park, and the literature.

No Action Alternative

Impact Analysis
In regard to context and timing, the likelihood and severity of impacts depend on (1) extent and intensity of fire and (2) timing of and amounts of rainfall following burns. The intensity and duration of impacts also relate directly to the intensity, pattern of burning, and extent of fire. There is the potential for the most direct adverse effects from high-severity wildland fire under the No Action Alternative. Nonetheless, rocky slopes moderate erosion potential. Suppression activities have the indirect effect of causing localized soil disturbance.

Mitigation actions are to minimize size and intensity of individual burns; plan for burning in a "mosaic"; construct erosion controls following fires; replant slopes; and "rezone" high risk areas temporarily.

Cumulative Effects
Cumulative effects on geology and geohazards include the entirety of the watersheds that occur in the park. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effect analysis finds:

- Past and future prescribed burns, wildland fire use, and non-fire treatments have a minor short-term beneficial effect by reducing the likelihood of future high-severity fires that remove vegetation, promote erosion, and damage fossils.
- Ongoing increase in cover and density of woody species increase the likelihood of high-severity fire events that remove vegetation, promote erosion, damage fossils, and have long-term moderate adverse effects.
- Ongoing suppression activities in the park may disturb soil and have minor adverse effects.

- Grazing on USFS land north of the park boundary may have negligible to minor adverse effects.
- Wildland and prescribed fire and thinning on USFS land in the Guadalupe Mountains over the tenure of the FMP and beyond have a minor beneficial effect by reducing the likelihood of future high-severity fires that remove vegetation, promote erosion, and cause moderately adverse effects.
- Other actions are not likely to cause significant erosion and debris flow. Trail improvement will lessen erosion potential on affected slopes.

Build up of fuels will lead to hotter fires removing vegetation and increasing the likelihood of erosion. Fire activities to lessen fuels will reduce the probability of high-severity fire but there could be minor cumulative adverse effects from suppression activities.

Conclusion
Fire management-related impacts to geology and geohazards would be adverse but short-term and minor to moderate in intensity with appropriate mitigation measures. No change to existing conditions is expected in the short-term. Potential continues for moderate, short-term, adverse impacts to soil stability and flood potential during periods of severe fire conditions followed by monsoon-like rainfall events. No other actions are identified as causing cumulative impacts to geology or generating geohazards. Potential in the long-term for moderate, adverse impacts to geology and from geohazards accrues as suppression continues, fuels build, and the likelihood of high-severity fire increases.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents; there would be no impairment of geologic resources under this alternative.

Alternative A

Impact Analysis
The timing and context is the same as the No Action Alternative. The intensity and duration of effects is similar to the No Action Alternative, except more wildland fire use will help establish mosaic patterns that moderate erosion and debris flow. The direct and indirect effects are also similar, but the potential for high-severity wildland fire is reduced with wildland fire use and suppression will play less of a role.

Mitigation actions are to minimize size and intensity of individual burns; construct erosion controls following fires; and replant slopes with short-lived annuals as a nurse crop and erosion control.

Cumulative Effects
Cumulative effects are the same as the No Action Alternative.

Conclusion

Alternative A would also result in minor to moderate short-term adverse effects. However, over the long-term soil stability becomes less threatened as the potential for future high-severity wildland fire is reduced. Greater wildland fire use would lessen the adverse effects of future wildland fires by reducing fuel loads and connectivity throughout the park and therefore reduce erosion of mineral soil potentially exposed by high-intensity fires.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of geologic resources under this alternative.

Alternative B

Impact Analysis
The timing, context, duration, and intensity is similar to the No Action Alternative, but burning in the Zone of Cooperation will help stop fire spread onto the park. Direct and indirect effects are also similar to the No Action Alternative, except the potential for high-severity wildland fire is reduced with wildland fire use and burning in the Zone of Cooperation. In addition, high-severity flooding in upper North McKittrick Canyon is a possible short-term moderate indirect effect.

Mitigation actions are to minimize size and intensity of individual burns; construct erosion controls following fires; and to replant slopes in upper North McKittrick Canyon.

Cumulative Effects
The cumulative effects are the same as the No Action Alternative, but also include the Zone of Cooperation.

Conclusion
Alternative B, which might see fires crossing from the park to Forest Service land in upper North McKittrick Canyon, also has the potential for minor to moderate short-term adverse effects. Fire management actions in the upper reaches of the watershed will affect downstream reaches in the short-term, but would further lessen the potential adverse effects of future wildland fire events on geological features and from geohazards in the long-term.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of geologic resources under this alternative.

Impact Topic 9 (Air Quality)

Smoke from fires can be unhealthy and temporarily impact visibility. A natural consequence of wildland fire is smoke-related air quality impacts. Prescribed fires used to meet resource and protection objectives have direct, adverse impacts on air quality, but such impacts are considered

short-term. The use of prescribed fire for fuel reduction and resource-related purposes will reduce the likelihood of high-severity wildland fire and thus the chance for severe air quality impacts in the future.

Smoke may actually benefit some park plants; over the last decade, researchers have confirmed that chemicals in smoke trigger germination in species from Australia, South Africa, and the California chaparral (Brown and van Staden 1997). Conversely, smoke also reduces the growth of parasitic plants that grow on native trees. In a summer 2004 press release, Yosemite National Park mentioned the eradication of dwarf mistletoe as an ecological benefit of smoke.

In the absence of large, high-intensity wildland fires, the three alternatives (including the agency-preferred alternative) would potentially have the same relative impacts to air quality, given the schedule of prescribed fires is similar for all. Depending on wind speed, direction, and mixing height, the effects to downstream smoke load and visibility may be a concern during prescribed burn actions. Under all alternatives, mitigation of adverse air impacts is mandatory.

Guadalupe Mountains National Park is designated a Class I airshed, which requires the strictest enforcement of air quality regulations. Park personnel have the duty, as defined by the Clean Air Act, to protect park resources from air pollution-related effects and damage. Burn prescriptions must comply with all federal, state, interstate, and local air pollution standards. The state has authority in establishing air quality standards and permitting requirements. A burn permit from the Texas Commission on Environmental Quality is required. A burn permit details predicted smoke and particulate emissions resulting from the prescribed fire.

Clear skies, both day and night, are a feature of the park that affects visitor enjoyment. Views towards and out from the mountains are a significant part of the visitor experience. Smoke will compromise these views and cloud the starry, night sky.

Air Quality Intensity of Effects Defined

Negligible: The impact is at the lowest levels of detection. A fire management action (other than a wildland fire) that is well within established Texas and New Mexico ambient air quality standards, including visibility.

Minor: The impact is slight, but detectable. An action that meets all established Texas and New Mexico ambient air quality standards, including visibility.

Moderate: The impact is readily apparent. An action that exceeds one or more established Texas and New Mexico ambient air quality and/or visibility standards if mitigation measures are not implemented.

Major: The impact is severely adverse. An action that exceeds one or more established Texas and New Mexico ambient air quality and/or visibility standards, if mitigation measures are not implemented.

Impairment: A major, adverse impact to air quality that negates or contradicts (1) specific purposes identified in the establishing legislation or proclamation of Guadalupe

Mountains National Park; (2) the natural or cultural integrity of the park; or (3) goals in the park's general management plan or other relevant NPS planning documents.

Short-term: Within the duration of a specific fire program activity (for example prescribed burn or suppression action).

Long-term: Beyond the duration of a specific fire program activity.

Assessment Methodology
Air quality measurements in the park have established clear sky norms. Experience with prescribed burns and wildland fires is the basis of the assessment.

No Action Alternative

Impact Analysis
The park is federally designated a Class I airshed, which sets the highest level of air quality regulations; any smoke causes degradation. Weather at the time of fire events will determine dispersal patterns. Health problems from smoke exposure might appear at a later time. Intensity and duration of wildland fire impacts vary with weather conditions, vegetation, and duration and intensity of fire. Prescribed fires and wildland fire use are required to meet air quality standards. Impacts to air quality would be short-term, minor, direct effects with the suppression of most fires. Visual values would also be affected by increased risk of wildland fire. In regard to indirect effects, the risk of high-severity wildland fires continues to cause significant air quality impacts with the least amount of wildland fire use under the No Action Alternative.

Mitigation for adverse air impacts is mandatory. Actions are to continue to integrate weather data before and during prescribed burns; time prescribed burns to minimize smoke production, size, and intensity; and coordinate burns with adjacent and nearby land managers to minimize cumulative impacts in the region.

Cumulative Effects
Cumulative effects on air quality include concerns within the park's airshed. Fire operations are conducted only under conditions stipulated by the Texas Commission on Environmental Quality. Based on the list of related activities appearing at the beginning of this chapter, the cumulative effect analysis finds:

- Past and future prescribed burns and wildland fire use at the park and on the surrounding Lincoln National Forest potentially cause minor short-term adverse effects on air quality if they exceed prescription but lower the likelihood of future degradation by wildland fire.
- Fire on the park would add to short-term airshed degradation caused by other fires and dust generated by ground-disturbing projects in the region.
- Past and future wildland fire at the park and on the surrounding Lincoln National Forest potentially causes minor short-term adverse effects on air quality.
- Ongoing increase in cover and density of woody species increases the need and likelihood for smoke-producing fire events.

- Ongoing insect outbreaks increase the likelihood of wildland fire and adverse short-term effects on air quality.

All fire reduces air quality over the short-term. Regular fires to meet management objectives reduce air quality more frequently but provide many resource benefits and reduce the likelihood of large fires and greater reduction in the quality of the airshed.

The combination of the cumulative impacts listed above with suppression actions, prescribed burns, and wildland fire use events would have minor, short-term, adverse effects on air quality.

Conclusion
No Action minimizes short-term, adverse impacts to air quality and visual values through the active suppression of most fires. Impacts to air quality during prescribed burns and wildland fire use would be minor in intensity with required mitigation to meet state air quality standards. Over the long-term, potential grows for moderate adverse impacts to air quality during severe fire conditions with increasing fuel loads. The park's use of fire as a tool for meeting resource objectives has a cumulative effect on the airshed in combination with all other activities in the region producing airborne particulates.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of air quality under this alternative.

Alternative A

Impact Analysis

The timing and duration are the same as the No Action Alternative while the intensity and effects are similar. Small smoke events become more frequent with more burning in the park and the potential for large events generating a lot of smoke decreases. More burning will generate more smoke. The short-term direct adverse effects are expected to be minor with required mitigations such as monitoring, notifications, and ventilation. There would be long-term benefits with reductions in fuels. Indirect effects are similar to the No Action Alternative, except with more burning in the park, potential for large events generating a lot of smoke decreases.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
Cumulative effects are the same as the No Action Alternative.

Conclusion
Under Alternative A the greater use of fire for resource management may result in more smoke being released for any given period and short-term minor adverse impacts. Fire prescriptions would be required to meet air quality standards. Over the long-term, air quality and visual values

benefit from reduced fuels and decreased potential for high-severity wildland fires that produce large quantities of smoke.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of air quality under this alternative.

Alternative B

Impact Analysis

The timing and context for Alternative B is the same as the No Action Alternative while duration, intensity, and effects are all similar. The exception is that burning in the Zone of Cooperation reduces the likelihood of fires escaping the park and growing into bigger smoke-generating events.

Mitigation actions are the same as the No Action Alternative.

Cumulative Effects
Cumulative effects are the same as the No Action Alternative.

Conclusion
Alternative B would have effects similar to Alternative A, with greater potential for short-term, minor, adverse impacts with more extensive wildland fire use and prescribed burning. Prescribed and wildland fire use actions in the Zone of Cooperation in the long-term increase the extent of reductions in fuels and fuel connectivity and thus reduce the likelihood that a fire will grow into a larger smoke-generating event.

Because there would be no major impacts to a resource or a value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Guadalupe Mountains National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of air quality under this alternative.

Chapter V: Consultation and Coordination

Preparers

Fred Armstrong, *Natural Resource Program Manager, Guadalupe Mountains National Park*—BS in Natural Resources Management from California Polytechnic State University, San Luis Obispo; 23 years with the NPS, 11 years at Guadalupe Mountains NP. Lead on compliance activities (for listed species and cultural resources) for the park.

Richard Gatewood, *Fire Ecologist, National Park Service, Chihuahuan Desert Ecoregion*. Ph.D. in Disturbance and Restoration Ecology, Colorado State University. Four years ecologist, State of Texas; Research Associate, USDA Forest Service Rocky Mountain Experiment Station; 4 years Ecologist, Bandelier National Monument. Lead on fire ecology and fire effects monitoring for the park.

Brooke S. Gebow, *Senior Research Specialist, University of Arizona School of Natural Resources*—MS in Ecology and Evolutionary Biology from University of Arizona, six years energy consulting, 12 years free-lance science writer, four years Tucson Botanical Gardens, five years project support for UA/USGS Sonoran Desert Research Station. Cooperator with the NPS to coordinate production of the Guadalupe Mountains NP FMP and associated compliance documents.

John V. Lujan, *Superintendent, Guadalupe Mountains National Park*—BA in History from Sul Ross State University in Alpine, Texas; 27 years with the NPS at eight park units representing cultural, natural, and recreational areas. Fire Management background to include fire fighting experiences across the west and southeast. Oversight of the development of the Interagency FMP between the NPS and the BLM.

Jim McMahill, *Fire Management Officer, Guadalupe Mountains and Carlsbad Caverns National Parks*—BS in Geography with a concentration in natural resources management from the University of Wyoming; 12 years of federal fire management service with the National Park Service and Bureau of Land Management.

Ellis Richard, *Former Superintendent, Guadalupe Mountains National Park*—BA in Anthropology from University of California, Berkeley, 31 years with the NPS including service at Grand Canyon, Lassen Volcanic and Grand Teton National Parks. Fire experience includes fire information officer, initial attack fire boss and fire fighter. Responsible for overall fire management planning process.

Timothy C. Stubbs *(now retired NPS)*—BS in Botany from San Diego State University, 24 years with NPS; FMO for both Carlsbad Caverns and Guadalupe Mountains National Parks 1990 to March 2003. He also worked at Great Smoky Mountains and Sequoia National Park where he began his career as a seasonal employee in 1969. Drafted preliminary sections for the current revision.

Dan Swanson, *former Lead Fire Effects Monitor, Guadalupe Mountains & Carlsbad Caverns National Parks*—MS in Forest Resources from University of Idaho; BA in Environmental,

Population, and Organismic Biology from University of Colorado; 2 ½ years at Guadalupe Mountains NP, 2 ½ years Assistant Nursery Manager at University of Idaho Research Nursery. Responsible for fire effects, burn unit delineation, and GIS maps.

Janice A. Wobbenhorst, *Chief, Resource Management & Visitor Protection, Guadalupe Mountains National Park*—MPA in Public and Environmental Affairs from Indiana University-NW, 34 years with the NPS. Responsible for overall review of fire operations, assisting with compliance, interagency coordination, and impact analysis review.

List of Recipients

The recipients of the EA include: federal agencies, Indian tribes, state and local agencies, organizations, and individuals. The list is available upon request.

Chronology

Date	Event	Notes
March 12-13, 2002	Internal scoping meeting	Tony Armijo, Roads & Trails Foreman; Ellis Richard, former Superintendent; Richard Gatewood, Fire Ecologist; Kathy Davis, SOAR Fire Ecologist; Tim Stubbs, retired FMO; Fred Armstrong, Resource Manager; Brooke Gebow, UA Cooperator; Jan Wobbenhorst, Chief of Resources and Visitor Protection; Chuck Barat, Chief of Science and Stewardship, Carlsbad Caverns NP; Eva Long, IMRO Compliance Specialist for Fire; Bruce Malloy, former District Ranger; Doug Buehler, Chief of Interpretation
October 10, 2002	NOI publication in Federal Register	
November 11, 2002	Mailing sent to public and tribes	
October 10 to December 31, 2002	Public scoping comment period	
November 18, 19, 20, 21, 2002	Public scoping meetings held jointly with Carlsbad Caverns National Park	Met with Jamie Kingsbury, USFS District Ranger; Stubbs, Richard, Wobbenhorst, Gebow, Gatewood
November 20, 2002	Initiated consultation with Lincoln National Forest	
September 18, 2003	Initiated consultation with USFWS	Letters- Gebow to Texas and New Mexico Ecological Services
September 18, 2003	Initiated consultation with Texas Parks and Wildlife	Letter- Gebow to Celeste Brancel
January 27, 2004	Sent Biological Assessment to USFWS	Letter- Armstrong to Joy Nicolopoulous, Albuquerque, New Mexico
February 26, 2004	Comments received from TPWD	Letter- Brancel to Gebow
February 13, 2004	Initiated consultation with New Mexico Game and Fish Department	Letter- Gebow to Jan Ward
May 27, 2004	Initiated consultation with Texas SHPO	Phone call- Armstrong/Gebow to Debra Beene
December 27, 2004	Cultural Resource Component submitted to Texas SHPO	Letter- Armstrong to F. Lawrence Oaks

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Appendix A: Glossary

Appropriate Management Response	AMR	Specific actions taken in response to a wildland fire to implement protection and fire use objectives.
Biological Assessment	BA	An assessment presented to USFWS of effects on federally listed species, proposed listed species, or critical habitats of proposed federal actions that are not major construction projects (in this particular case, implementing a new FMP is the proposed action).
Biological Opinion	BO	The opinion of the USFWS on whether or not a proposed federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.
Context		The geographical or temporal environment of a proposed action, such that a change in the action relative to space or time might alter impacts.
Cultural Landscape		Landscapes as affected by people through time— the definition of such captures overlapping occupancy by different groups of people.
Cultural Resources		Valued aspects of a cultural system that might be tangible (districts, sites, structures, objects).
Cultural Resources Component	CRC	Document analyzing effects of the proposed action on cultural resources for review by the State Historic Preservation Office.
Cumulative Effect		Effects of actions (those in the past, present, or reasonably foreseeable future) that have an additive impact on the resources affected by the proposed action.
Diameter at breast height	dbh	Diameter of tree trunk measured about 55 in (1.4m) from the ground.
Debris Flow		"Rivers" of earth, rock, and debris saturated with water.
Direct Effect		An impact that occurs as a result of the proposed action or alternative in the same place and at the same time as the action.
Duration		The length of time of effects of an action.
Ecoregion		A large-scale area with a common geological and biological history.
Exotic Species		Species not native to a particular ecosystem.
Fire Management	FMP	The plan that guides all fire-related activities at a park that is

Plan		consistent with land and resource management plans and follows NPS guidelines.
Fire Management Unit	FMU	A delineated area of the park that permits particular fire management strategies.
Fuel		Vegetation, both living and dead, capable of burning.
Fuel Moisture		Amount of moisture contained in vegetation and in standing and downed, dead wood. Expressed as a percentage relative to the dry weight of the fuel.
Impairment		Impacts on resources that negatively, significantly, and possibly irreversibly alter their character from the state that made them important to protect in a park.
Indirect Effect		An impact that occurs as a result of the proposed action, but removed in time and space from the action.
Intensity		Magnitude of effect, from low to high.
Inter-disciplinary team	IDT	Group of interdisciplinary specialists that identifies important issues, relationships, and alternatives for public scrutiny.
Lincoln National Forest	LNF	USFS jurisdiction north of the park in New Mexico.
Mechanical/manual Treatment		Removal of vegetation by mechanical or manual means (rather than by fire).
Minimum Tool Requirement		The lowest impact means of accomplishing a task, frequently considered with respect to wilderness.
Mitigation		Modification of an action that lessens intensity of its impacts on a particular resource.
National Environmental Policy Act	NEPA	The 1969 law that dictates the objective analysis and public scrutiny of the environmental as well as social and economic impacts of proposed federal actions and their alternatives prior to implementation.
Natural Resources		A feature of the natural (physical and biological) environment that has value to humans.
No Action		Under NEPA, No Action continues the current planning and operational direction and provides a baseline against which other alternatives can be measured.
Non-fire Treatments		Removal of vegetation without using fire, most commonly through mechanical/manual or herbicidal treatments.
Non-indigenous Species		Species not original to a particular ecosystem (used like “exotic”).

Non-native Species		Species not native to a particular ecosystem (used like "exotic").
Prescribed Fire		Fire ignited by management to meet specific objectives.
Prescription		Measurable environmental criteria, particularly temperature, relative humidity, wind speed and direction, and fuel moisture, that define the conditions under which a prescribed fire would be ignited or allow a wildland fire use fire to continue to burn, guide selection of appropriate management responses, and indicate other required actions. Safety, economic, public health, geographic, administrative, social, or legal considerations would also affect decision-making.
Protected Activity Center	PAC	Designated areas that are protected to benefit Mexican spotted owl by restricting certain management activities.
Resource Advisor		An expert in a particular resource area (such as an archeologist or botanist) who is brought on site to advise fire crews relative to protecting sensitive resources.
Scoping		Compilation of knowledge and opinions in order to properly develop and decide on alternative courses of action, both internally to the park and externally with the public.
Sensitive Species		Species sensitive to perturbation from the proposed action, frequently rare species that are federal or state-listed, proposed for listing, occurring in very few places, or particularly sensitive to the action's impacts.
Species Diversity		A measure of the number of species in an area (species richness) that also accounts for species abundance.
State Historic Preservation Office	SHPO	The state office overseeing protection of cultural resources.
Succession		The natural development of biotic communities over time following disturbance.
Suppression		All the work of extinguishing a fire beginning with its discovery, using confine, contain, and control actions.
Thinning		Reduction of density of vegetation, frequently using non-fire means.
Timing		How effects vary depending on when the action takes place.
U. S. Fish and Wildlife Service	USFWS	U.S. Department of Interior agency charged with overseeing protection of threatened and endangered species.
Unique Sites		Sites sufficiently uncommon such that their presence is a special feature of the park with intrinsic value and of interest to visitors.

Unique Stands		Patches of vegetation that are uncommon in an area that may be relicts from an earlier age.
USDA Forest Service	USFS	U.S. Department of Agriculture (USDA) agency overseeing national forests (same as USFS).
Watershed		Land above a given point in a drainage that potentially contributes water to the streamflow at that point.
Wilderness		Designated area managed to perpetuate natural processes and minimize human impacts.
Wildland Fire Use		Naturally (lightning) ignited fire managed to meet resource benefits under predetermined conditions.
Zone of Cooperation	ZOC	Under the preferred alternative, an area of USFS land immediately north of the park that is jointly managed for fire by NPS and USFS.

Appendix B: Issues related to fire management planning at Guadalupe Mountains National Park.

Possible Impact Area	Issues, Concerns, Opportunities
Visitor Experience	
safety	Fire can put visitors (and staff and firefighters) at risk. Fire use, prescribed fire, and thinning reduce hazard fuels.
mechanical noises	Equipment (chainsaws, hand tools, helicopters, aircraft, other vehicles) will make noise during burns and suppression.
traffic	Fire may force road closures within the park; planned highway closure, which could divert travelers from fire-related hazards, is not an option as alternate routes are not available. Vehicles to support prescribed burning or suppression efforts add to traffic in the park. Fire by-standers (rubber-neckers) may cause traffic hazards.
views	Sight of fire may frighten visitors. Smoke may reduce visibility. Burned landscape offends. Fires and thinning can open areas and enhance scenic views. Fire activities and post-fire scenes offer interpretive opportunities.
recreation opportunities	Fire may necessitate temporary closures of trails, vista points, and campgrounds.
visitation	Post-fire landscape may alter visitation.
Land Use	
property damage	Fire is a threat to park developments, structures and landscaping. Fire use, prescribed fire, and thinning reduce hazard fuels that threaten property.
neighbors	Fire may burn across boundary to neighboring property, especially along the north boundary with the Forest Service. Though sparse fuels currently reduce the risk of fire escaping onto neighboring private lands, ranchers' concerns persist about park fires spreading onto their property and burning grazing land and fence posts. Neighbors may be affected by increased erosion and flooding post-fire. Neighbors may benefit from fire's habitat-enhancing effects.

Possible Impact Area	Issues, Concerns, Opportunities
local economy	Local tourism could decline temporarily after a large, well-publicized fire. Local cafe business may increase when fire crews are present; restaurants and hotels in Carlsbad, NM (nearest sizable town) may also see increased business.
Cultural Resources	
archeological sites	Fire might damage/uncover exposed sites and artifacts on the surface.
pictographs and petroglyphs	Rock art sites are susceptible to smoke and heat damage.
structures	Fire might damage or destroy significant fire-susceptible structures listed on the National Register.
historic trout	Rainbow trout (stocked in McKittrick Canyon in 1929) could suffer from watershed alteration due to fire.
Vegetation	
composition	Fire-intolerant species may decline. Fire can stimulate growth and germination of some plants.
structure	Fires of high intensity can destroy entire stands of vegetation.
unique stands	Fire of high intensity may damage or eliminate unique stands of vegetation. Low- to moderate-intensity fire may renew unique stands of vegetation.
non-indigenous species	Fire facilitates invasion by undesirable Lehmann lovegrass, Malta starthistle, woolly mullein and other fire-loving species. Fire may prove to be a tool to control non-indigenous species.
Species of Special Concern	
plants	Effects of fire on numerous endemics and sensitive species are not well known. Endemics and sensitive species may suffer injury, death, or destruction of habitat by fire, thus require protection. Fire-adapted species may benefit from fire-reduced competition in vegetation stands; nutrient release may benefit plants. Aspens need fire to regenerate.
animals	Rare, protected, or listed animals may suffer injury, death, or destruction of habitat by fire. Effects of fire on sensitive species are not well known; species may benefit from fire-renewed habitat.

Possible Impact Area	Issues, Concerns, Opportunities
	Mexican spotted owl habitat benefits from low to moderate intensity fires.
Important Wildlife Considerations	
unusual species	Fire may kill, injure, or temporarily displace unusual species. Some species benefit from habitat-renewing, low intensity fire.
fire timing	Fire outside the fire season may disrupt animal cycles. Fire during bird breeding and nesting season will cause nesting failures and mortality.
Unique Sites	
ecoregions	Madrean ecoregion species (those with south-of-the-border affinities that are present in very few parks in the U.S.) may suffer injury, death or destruction of habitat by fire.
one-of-a-kind features	One-of-a-kind features may be altered by fire. Public concern about fire in beloved McKittrick Canyon (home of incredible fall color) and other riparian areas would be great; low-intensity prescribed burns and mechanical fuels treatment should lessen risk of stand-replacing, high intensity fires. Pockets of endemic plants on moist, north-facing cliffs may have difficulty regenerating after intense fires. Sand dunes on the west side should be protected from suppression activities; dune-adjacent landowner, the Hudspeth County Directive for Conservation, will require consultation on dune fire matters. Texas Champion Trees might incur fire damage or death.
scientific resources	Old trees containing significant data in tree rings and fire scars could be lost in major fire events. Non-vegetated international benchmark (geological “type locality”) for the Middle Permian period requires protection from suppression activities (retardant drops and ground disturbances). Loss of datable packrat middens and sloth dung in caves would be irreplaceable.
wilderness	Aircraft used in suppression activities bring noise and visual disturbances to wilderness areas. Suppression activities need to avoid compromising wilderness

Possible Impact Area	Issues, Concerns, Opportunities
	values.
Geological Resources	
paleontological specimens	Heat from fire may cause spalling (exfoliation) of rock surfaces and expose fossils. Heat may crack rocks. Fire may thin vegetation to reveal new sites. Fire may char specimens.
soils	Removal of vegetation by fire may create temporary hydrophobic conditions (decrease infiltration on exposed soils), increase erosion (especially on alluvial fans and in drainages), leading to deposition of sediments. Fire can increase soil moisture (due to less uptake by plants) and release nutrients to soil. Handlines may expose soil and increase erosion.
Geohazards	
mudflows	Increased potential for debris- and mudflows when intense storms hit fire-denuded slopes.
flooding	Potential for higher peak flow during intense storms, with increased risk of debris in floodflows after fires.
rockslides	Danger of rockslides increases after fire consumes vegetation on steep slopes.
seismic disturbances	Fire line explosives might dislodge rocks.
Water	
quantity	Runoff increases post-fire with lack of intercepting and water-consuming vegetation. Spring flows may be increased by fire thinning dense vegetation. Spring flows may be decreased by siltation and reduced shade after fires. Streamflows may increase then decrease post-fire.
quality	Runoff from fire-denuded slopes will contain increased particulate load. Retardant, lubricants, and fuels from suppression activities may wash into streams.
Floodplains/Wetlands	
hydrology	Potential for both positive and negative effects to hydrology from fire; flows may increase with thinning of overgrown

Possible Impact Area	Issues, Concerns, Opportunities
	vegetation, or decrease with siltation and reduced shade.
vegetation	Fire will cause damage to or loss of individual plants. Exclusion of fire and fuel accumulation makes habitat alteration due to intense fire more likely.
wildlife	Fire may favor certain species while deterring others. Fire may open thickets that ultimately dry up wet habitats. Bird nests are especially susceptible.
Air Quality	
smoke	Smoke may be a health hazard (especially to firefighters). Smoke may be an air-quality regulatory problem. Smoke may hamper visibility on roads. Smoke may slow spread of mistletoe if timing is such that it is present during pollination and seed set seasons. Smoke may trigger germination in plant species. Smoke is an attractant to some insects that damage forests.
Other Agency Policies	
federal agencies	Coordination with USFS needed to manage fire appropriately in watersheds crossing agency boundaries. NPS and other agency policies may not be compatible.
tribes	Consultation with tribes necessary to avoid fire impacts on significant landscapes and resources. Fire may have an impact on materials sought by tribes on park land.
states	New Mexico (over north boundary) has policies affecting wildland fire use.

Appendix C: Cultural Resource Matrix

The cultural resources analysis presented in Appendix C originated through discussion at an internal scoping meeting of park resource management, fire, and interpretive staff and University of Arizona cooperators in March 2002. Fred Armstrong (GUMO Cultural Resources Management Lead) led the cultural resources analysis efforts for this EA and the production of a Cultural Resources Component (CRC), a document summarizing concerns and solutions for submittal to the Texas Historical Commission (SHPO). The matrix appearing below was constructed with help from Dan Swanson, former park fire effects monitor. Dan made substantial progress on the analysis while attending a class on cultural resources and fire at the NPS Western Archeological Conservation Center in January 2003. The CRC was submitted to the Texas Historical Commission for review in December 2004.

Scope of the Cultural Resources Component

The entire area of Guadalupe Mountains National Park may be considered as a cultural landscape in a broad sense. Vegetation communities, patterns and elements attracted, and were important to, the people who lived here from the prehistoric past through the ranching settlement period. Tables C-1 through C-4 present a matrix of cultural resources, potential fire program effects, and treatments for Guadalupe Mountains National Park. Park resource management, fire, and interpretive staff began developing this matrix by defining historic contexts and a list of cultural resource types that included elements and values at risk from fire. This matrix considers historical, archeological, architectural, engineering, and cultural values and has been reviewed by NPS cultural resources professionals at the Western Archeological Conservation Center (WACC) in Tucson, Arizona. The cultural resources matrix is a working summary of resources and how the fire program should relate to them. It also specifies the particular aspects at risk, reviews what fire program activities create the risk, defines protection objectives for these resources, and suggests methods to minimize or mitigate impacts in order to achieve the objectives. It is a useful guide, both for planning and operations, to all who will be working with fire and cultural resources in the park.

The matrix lays out the cultural resource types pertaining to specific historic contexts within the park. Historic contexts are defined as patterns, themes, or trends in history by which a specific occurrence, property, or site is understood. These cultural resource types are further defined by elements, which are also found in the matrix.

Staff looked at risk conditions and/or activities that might occur in the presence of fire and potential effects on specific resource types given the elements of the resource, surrounding environment, and geographic location. Once the resource types and risk conditions or activities were defined, the resource and fire management personnel used this information to determine what the fire management objectives were and what treatments should be used to preserve identified resource values. In general, fire will be kept away from significant, combustible, non-renewable cultural resources. Pre-treatments of cultural resources for prescribed or wildland fires may include manual fuel removal/reduction, controlled black-lining to produce buffers from advancing fire, fire-repelling foam on combustible or thermally alterable features, or water sprayed by hand pump, pressurized hose, or aerial drops. As a rule, aerial tanker retardant drops

will not be used specifically to defend cultural resources because of the potential to stain and highlight sensitive resources for years to come. Potential impacts to known cultural resources will be considered whenever fire managers are confronted with making the decision to use aerial retardants as a last resort to defend life, property or significant park resources at risk of loss.

As future plans are made for prescribed burns in the park, we will conduct archeological inventories for those portions of the proposed burn area with known or high potential for cultural resources and where recent, thorough cultural resource inventory, condition assessments and management recommendations have not been accomplished by qualified cultural resource personnel. Burn plans will be reviewed for fire management strategies with regard to cultural resources, using the most up-to-date information available.

Currently, the park consults with the Mescalero Apache Tribe, Ysleta Del Sur Pueblo (Texas), Hopi Tribe, Pueblo of Isleta (New Mexico), Jicarilla Apache Nation, Pueblo of Zia, Commanche Nation, Kiowa Indian Tribe, San Carlos Apache Tribe, White Mountain Apache Tribe, Zuni Tribe, Apache Tribe of Oklahoma, and the Fort Sill Apache Tribe. Also consulted are relevant state and federal agencies, local governments, local businesses, non-government organizations, and private residents living adjacent to or near the park.

For this FMP, the park sent the public scoping newsletters to the mailing list that includes the parties listed above. Four public scoping meetings took place in November 2002, and the public scoping comment period extended from November 15 until December 31, 2002. Letters were sent to the Mescalero Apache tribal president, the Ysleta del Sur Pueblo, the Hopi tribe Office of the Chairman, and other groups who requested to be brought up to date on the planning progress at GUMO.

Definitions of terms:

Historic contexts are the historic and prehistoric themes under which various resources were created and used. Individual resources are best understood and evaluated by understanding the roles they played within specific historical frameworks. In the matrix, for example, ranching-mining-petroleum exploration context covers resources dating from the 1890s to 1970.

Resource types represent general function or morphology. The exact function may not be known, especially for prehistoric resources. In the matrix, historic districts are a specific resource type that are the setting for a number of different elements.

Elements are the specific physical characteristics of resource types. Identifying the elements allows us to define specific *elements or values at risk* from various fire management activities.

Risk conditions or activities are the specific environmental conditions and/or fire management activities that place particular resources at risk.

Fire management objectives guide actions in a way that protects the elements or values at risk. The matrix recommends reducing fuels and suppressing fires near historic structures.

Treatments or prescriptions are methods of attaining the objectives. In the matrix, pretreatment and line construction are necessary. Following are examples of other treatments or prescriptions:

- Reduce fuels in and around sites and artifacts using mechanical fuel reduction and/or prescribed fire, as appropriate.
- Manage the movement of fire into an identified sensitive cultural resource area only while taking safety and natural resource protection into consideration.
- Under certain circumstances, wildland fires and prescribed burns will be prevented from entering sensitive cultural resource areas.
- At fire-vulnerable sites such as corrals, other wooden structures or features, and hearths on archeological sites some form of documentation, sampling, or erecting protective barriers, etc. can mitigate adverse effects prior to fires.

Table C-1. Historic Context: Pre-ceramic period (paleo/archaic through AD 1000)

Resource Type	Elements	Elements or Values at Risk	Risk Conditions or Activities	Fire Management Objectives	Treatments or Prescriptions
camps and villages	hearths	feature integrity; radiocarbon date contamination	ground disturbance; carbon loading from fire; erosion	avoid disturbance; reduce fuels	pretreatment; line construction; use water where possible to suppress; photo documentation
	lithic scatter	radiocarbon date contamination; spatial arrangement	ground disturbance; loss of concealment; increased erosion	avoid disturbance; reduce fuels	pretreatment; use water where possible to suppress
	rock shelters	physical integrity	ground disturbance; rock flaking from heat; loss of concealment	avoid disturbance; reduce fuels; suppression	pretreatment; line construction
	rock art	radiocarbon date contamination; feature integrity; interpretive value	ground disturbance; loss of concealment; UV exposure; increased erosion; flaking from heat; retardant drop	avoid disturbance; suppression	line construction; pretreatment
	bedrock mortars	feature integrity	ground disturbance; up-gradient erosion (burial would also protect)	avoid disturbance	any suppression activities

Table C-2. Historic Context: Ceramic period to European/American contact (AD 1000 to 1850)

Resource Type	Elements	Elements or Values at Risk	Risk Conditions or Activities	Fire Management Objectives	Treatments or Prescriptions
camps and villages	hearths	feature integrity; radiocarbon date contamination	ground disturbance; carbon loading from fire; erosion	avoid disturbance; reduce fuels	pretreatment; line construction; use water where possible to suppress; photo documentation
	ceramics	feature integrity; security	ground disturbance; loss of concealment; increased erosion	avoid disturbance; reduce fuels	pretreatment; use water where possible to suppress
	rock ring middens (agave roasting pits)	feature integrity and arrangement, radiocarbon date contamination	ground disturbance	avoid disturbance; reduce heavy fuels	pretreatment; use water where possible to suppress
	rock shelters	feature integrity	ground disturbance; rock flaking from heat; loss of concealment	avoid disturbance; reduce fuels; suppression	pretreatment; line construction
	rock art	pigments; security	ground disturbance; loss of concealment; UV exposure; flaking from heat; retardant drop	suppression	black line pretreatment
cultural landscapes	sacred sites	interpretive value; aesthetics	ground disturbance; loss of key features in fire; increased erosion	suppression; avoid disturbance	pretreatment; line construction
	landscape arrangements	feature integrity and arrangement (fire also maintains historic scene)	ground disturbance; loss of key features in fire; erosion	avoid disturbance; reduce fuels	pretreatment; revegetation
	bark peels	feature integrity	loss of individual trees by stand-replacing fire	reduce fuels; suppression	pretreatment; line construction
	agaves	individual plants, a local traditional food	plant mortality; loss or damage	reduce fuels	pretreatment; timing of prescribed burn

Table C-3. Historic Context: Early Anglo-Military-Butterfield Stage (1850 to 1900)

(Note—most potentially flammable features are long gone)

Resource Type	Elements	Elements or Values at Risk	Risk Conditions or Activities	Fire Management Objectives	Treatments or Prescriptions
settlements; camps	houses	wooden features	loss or damage	divert fire from sites; suppression; minimize disturbance; maintain low intensity fuels	pretreatment; all suppression activities; photo documentation
	dugouts	wooden structural members	loss or damage; increased erosion	suppression; minimize disturbance	pretreatment; all suppression activities; photo documentation
	stone ruins	physical integrity	ground disturbance; increased erosion	avoid disturbance; reduce woody vegetation and root encroachment	any suppression activities
	military encampments	feature integrity and arrangement (fire also maintains historic scene)	ground disturbance; loss of landscape features; erosion	avoid disturbance	pretreatment; revegetation
roads	stage route/ emigrant trail	feature integrity	ground disturbance; erosion	minimize disturbance; maintain and stimulate grass cover	pretreatment; revegetation
historic sites	U.S. military-Indian engagement sites	feature integrity and arrangement (fire also maintains historic scene)	ground disturbance; loss of landscape features; erosion; fire could also help maintain cultural scene	minimize disturbance	pretreatment; revegetation
	signature trees	individual plants	plant mortality; loss or damage	suppression; avoid disturbance	pretreatment; any suppression activities

Table C-4. Historic Context: Ranching-Mining-Petroleum Exploration (1890s to 1970)

Resource Type	Elements	Elements or Values at Risk	Risk Conditions or Activities	Fire Management Objectives	Treatments or Prescriptions
ranch sites	metal tanks	not at risk			
	stone tanks	physical integrity	ground disturbance; erosion	divert fire from sites; minimize disturbance; reduce woody fuels	pretreatment; line construction; use water where possible to suppress; photo documentation
	earthen tanks	physical integrity	ground disturbance; erosion	avoid disturbance; reduce woody fuels	pretreatment; line construction
	concrete dams	physical integrity	heat	suppression; reduce woody fuels	any suppression activities
	cabins and houses	wooden features	loss or damage	suppression; reduce woody fuels	any suppression activities
ranching cultural landscapes	Landscape arrangements	feature integrity and arrangement (fire also maintains historic scene)	ground disturbance; loss of landscape features; erosion	minimize disturbance	pretreatment; revegetation
mining/oil exploration sites	well derricks (water/oil)	physical integrity	ground disturbance	minimize disturbance; suppression	pretreatment; line construction
	Pipelines	physical integrity	ground disturbance	minimize disturbance; suppression	pretreatment; line construction

List of Classified Structures

Guadalupe Mountains National Park has 34 entries on the List of Classified Structures (LCS, Table C-5). These structures include buildings, partial ruins, stone walls, water impoundments, water tanks, windmills, well equipment and a historic trail.

Desired Conditions for Historic Properties

Desired Conditions for historic properties at Guadalupe Mountains National Park have been identified in previous plans or reports. Moreover, the List of Classified Structures (1998) specifies the condition of historic structures in the park. Fire program activities are intended to maintain present condition and minimize impacts to cultural resources. Given sufficient funding, the park plans to bring all structures and archeological resources into a standing of good condition. In some cases fire may be beneficial to historic landscapes and archeological site preservation. An example is the use of low-intensity fire to remove encroaching shrubs in order to restore grasslands or prevent woody vegetation encroachment around historic structures.

Table C-5. List of Classified Structures

	Preferred Structure Name	Structure Number	LCS ID	Latest Condition	Latest Year Assessed
1.	Pinery	B-106	000520	Fair	1997
2.	Frijole Ranch House	B-200	005700	Good	1997
3.	Frijole Ranch Barn and Corral	B-205	005706	Good	1997
4.	Williams Ranch House	B-281	005707	Fair	1997
5.	Pratt Lodge	B-342	012077	Fair	1997
6.	Pratt Lodge Garage & Servant's Quarters	B-241	012078	Fair	1997
7.	Pratt Lodge Pumphouse	B-242	012079	Fair	1997
8.	Pratt Residence	B-341	012080	Fair	1997
9.	Pratt Residence Servant's Quarters	B-343	012081	Fair	1997
10.	Frijole Ranch Bunk House	B-207	012083	Good	1997
11.	Frijole Ranch Toilet and Shower	B-202	012084	Good	1997
12.	Frijole Ranch Pump House	B-204	012085	Good	1997
13.	Frijole Ranch Spring House	B-203	012086	Fair	1997
14.	Frijole Ranch Schoolhouse	B-201	012087	Fair	1997
15.	Grisham-Hunter Line Cabin	B-243	014400	Fair	1997
16.	Pratt Lodge Stone Fence	F-012	064390	Good	1997
17.	Frijole Ranch Water Tower	C-006	064394	Fair	1997
18.	Grisham-Hunter Tack Room	B-244	064401	Fair	1997
19.	Cabin in the Bowl	B-283	064402	Good	1997
20.	Cabin at Cox Tank	B-286	064403	Fair	1997
21.	Grisham-Hunter Line Cabin Stone Walls	B-246	064404	Fair	1997
22.	Metal Water Tanks	W-023-36	064405	Fair	1997
23.	Upper Pine Springs Pumping Operation	W-007	064406	Fair	1997
24.	Stone Water Tanks	W-023	064407	Good	1997
25.	Tack Building and Corral	B-142	064408	Fair	1997
26.	Stone Dam	D-001	064409	Good	1997
27.	Windmills with Metal Water Tanks	W-050-54	064410	Fair	1997
28.	Stone Dam	D-002	064411	Fair	1998
29.	Stone Dam	D-003	064412	Good	1998
30.	Stone Dam	D-004	064413	Good	1998
31.	Frijole Ranch Stone Fence	F-013	064414	Good	1997
32.	Butterfield Trail Segment	T-015	064415	Fair	1998

	Preferred Structure Name	Structure Number	LCS ID	Latest Condition	Latest Year Assessed
33.	Williams Ranch Corral	C-003	064416	Poor	1997
34.	Oil Well	W-201	064417	Fair	1997

Appendix D: Common and Scientific Names

African Rue (*Peganum harmala*)
Alkali Sacaton (*Sporobolus airoides*)
Alligator Juniper *(Juniperus deppeana)*
American Kestrel *(Falco sparverius)*
Ash (*Fraxinus* spp.)
Asian tumbleweed (*Salsola collina*)
Banana Yucca *(Yucca baccata)*
Bermuda Grass (*Cynodon dactylon*)
Big Bend Tree Lizard (*Urosaurus ornatus schmidti*)
Bigtooth Maple *(Acer grandidentatum)*
Black Bear (*Ursus americanus*)
Black Grama *(Bouteloua eriopoda)*
Black-tailed Jackrabbit (*Lepus californicus*)
Black-tailed Prairie Dog (*Cynomys ludovicianus*)
Black Vulture (*Coragyps atratus*)
Black Willow (*Salix nigra*)
Blue Grama *(Bouteloua gracilis)*
Bobcat (*Lynx rufus*)
Brazilian Free-tail Bat (*Tadarida brasiliensis*)
Burrowing Owl (*Athene cunicularia*)
Bush Muhly *(Muhlenbergia porteri)*
Cactus Wren (*Campylorhynchus brunneicapillus*)
Cane Bluestem (*Bothriochloa barbinodis*)
Canyon Towhee (*Pipilo fuscus*)
Catclaw Acacia *(Acacia constricta)*
Catclaw Mimosa *(Mimosa biuncifera)*
Chaplin's Columbine (*Aquilegia chaplinei*)
Chihuahuan Spotted Whiptail (*Aspidoscelis exsanguis*)
Chinkapin Oak *(Quercus muehlenbergii)*
Cholla (*Opuntia* spp.)
Colorado Pinyon Pine *(Pinus edulis)*
Cooper's Hawk *(Accipiter cooperii)*
Cottontop (*Digitaria californica*)
Couch's Spadefoot (*Scaphiopus couchii*)
Coyote (*Canis latrans*)
Creosotebush *(Larrea tridentata)*
Crucifixion Thorn (*Castela emoryi*)
Desert Buckbrush *(Ceanothus greggii)*
Desert Cottontail (*Sylvilagus audubonii*)
Douglas-fir *(Pseudotsuga menziesii)*
Dwarf mistletoe (*Arceuthobium* spp.*)*
Elk (*Cervus elaphus*)
Englemann Prickly-pear *(Opuntia phaecantha)*
Faxon Yucca (*Yucca faxoniana*)

Fluffgrass (*Erioneuron pulchellum*)
Fourwing Saltbush *(Atriplex canescens)*
French Tamarisk (*Tamarix gallica*)
Gambel Oak *(Quercus gambelii)*
Gray Fox (*Urocyon cinereoargenteus*)
Gray Oak *(Quercus grisea)*
Guadalupe Fescue (*Festuca ligulata*)
Hairy Grama *(Bouteloua hirsuta)*
Hairy Mountain-mahogany *(Cercocarpus montanus)*
Hairy Woodpecker (*Picoides villosus*)
Hernandez's Short-horned Lizard (*Phrynosoma hernandesi hernandesi*)
Honey Mesquite *(Prosopis glandulosa)*
Horehound (*Marrubium vulgare*)
Javelina Bush (*Condalia ericoides*)
Johnson Grass (*Sorghum halepsense*)
Juniper Titmouse (*Baeolophus ridgwayi*)
Kingcup Cactus *(Echinocereus triglochidiatus)*
Knowlton Hophornbeam *(Ostrya knowltonii)*
Lechuguilla *(Agave lechuguilla)*
Lehmann Lovegrass (*Eragrostis lehmanniana*)
Little Walnut *(Juglans microcarpa)*
Malta Starthistle (*Centaurea melitensis*)
Manzanita (*Arctostaphylos* spp.)
Mariola *(Parthenium incanum)*
Meadowlark (*Sturnella magna*)
Mescalero Gooseberry (*Ribes mescalerium*)
Mesquite (*Prosopis glandulosa*)
Mexican Spotted Owl (*Strix occidentalis lucida*)
Mexican Vole (*Microtus mexicanus*)
Mormon tea *(Ephedra* spp.)
Mountain Chickadee (*Poecile gambeli*)
Mountain Lion (*Felis concolor*)
Mountain Patch-nosed Snake (*Salvadora grahamiae grahamiae*)
Mule Deer (*Odocoileus hemionus*)
New Mexico Agave (*Agave neomexicana*)
Northern Harrier *(Circus cyaneus)*
Ocotillo *(Fouqueria splendens)*
One-seed Juniper (*Juniperus monosperma*)
Pallid Bat (*Antrozous pallidus*)
Plain Titmouse (*Parus inornatus*)
Ponderosa Pine *(Pinus ponderosa)*
Porcupine (*Erethizon dorsatum*)
Pronghorn (*Antilocapra americana*)
Puncture Vine (*Tribulus terrestris*)
Pygmy Nuthatch (*Sitta pygmaea*)
Quaking Aspen *(Populus tremuloides)*

Raccoon (*Procyon lotor*)
Range Ratany (*Krameria parvifolia*)
Redberry Juniper (*Juniperus pinchottii*)
Red-breasted Nuthatch (*Sitta canadensis*)
Red Crossbill (*Loxia curvirostra*)
Red Squirrel (*Tamiasciurus hudsonicus*)
Red-spotted Toad (*Bufo punctatus*)
Red-tailed Hawk *(Buteo jamaicensis)*
Ringtail (*Bassariscus astutus*)
Rio Grande Cottonwood *(Populus deltoides)*
Rio Grande Leopard Frog (*Rana berlandieri*)
Roadrunner (*Geococcyx californianus*)
Rock Squirrel (*Spermophil*us *variegates*)
Rocky Mountain Juniper *(Juniperus scopulorum)*
Rufous-crowned Sparrow (*Aimophila ruficeps*)
Russian Thistle (*Salsola kali*)
Saltcedar (*Tamarix ramosissima*)
Sand Dropseed *(Sporobolus cryptandrus)*
Sandpaper Oak (*Quercus pungens*)
Say's Phoebe (*Sayornis saya*)
Scaled Quail (*Callipepla squamata*)
Scott's Oriole (*Icterus parisorum*)
Scrub Oak *(Quercus mohriana)*
Sharp-shinned Hawk *(Accipiter striatus)*
Sideoats Grama *(Bouteloua curtipendula)*
Smallseed Sacahuista *(Nolina microcarpa)*
Soaptree Yucca *(Yucca elata)*
Sotol *(Dasylirion wheeleri)*
Southwestern Fence Lizard (*Sceloporus cowlesi*)
Southwestern White Pine (*Pinus strobiformis*)
Spanish Dagger *(Yucca torreyi)*
Spiny Cocklebur (*Xanthium spinosum*)
Steller's jay (*Cyanocitta stelleri*)
Striped Whipsnake (*Masticophis taeniatus*)
Tarbush *(Flourensia cernua)*
Texas Madrone *(Arbutus xalapensis)*
Three-awn (*Aristida* spp.)
Tobosagrass *(Pleuraphis mutica)*
Turkey (*Meleagris gallopavo*)
Turkey Vulture (*Cathartes aura*)
Utah Serviceberry *(Amalanchier utahensis)*
Velvet Ash *(Fraxinus velutina)*
Verdin (*Auriparus flaviceps*)
Viscid Acacia (*Acacia neovernicosa*)
Western Diamond-backed Rattlesnake (*Crotalus atrox)*
Western Scrub Jay (*Aphelocoma californica*)

Western Soapberry *(Sapindus saponaria)*
Western White Pine (*Pinus monticola*)
Whitethorn Acacia (*Acacia constricta*)
White-throated Swift (*Aeronautes saxatalis*)
Woolly Mullein (*Verbascum thapsus*)
Yucca (*Yucca* spp.)

Appendix E: Fire effects on dominant species in Guadalupe Mountains National Park vegetation types

Table E-1. Rocky Mountain (Petran) Conifer Forest: Fire Ecology of Species

FEIS is the Fire Effects Information System maintained by the Forest Service that contains literature reviews: http://www.fs.fed.us/database/feis/.

Species	Fire Ecology/Adaptations	Source
Acer grandidentatum	Bigtooth maple live in moist sites that tend to burn infrequently; following crown destruction by fire, some resprout from root crown, but not generally vigorously.	FEIS
Amalanchier utahensis	Utah serviceberry sprouts vigorously from root crowns after fire.	Ahlstrand 1981x
Ostrya knowltonii	Little is known about fire and Knowlton hophornbeam, but it probably sprouts in limited fashion post-fire as do congeners; may colonize burned sites via seed.	FEIS
Pinus edulis	Colorado pinyon is generally very susceptible to fire damage depending on stand structure and understory; it is absent from post-fire early successional stages. Seedlings establish primarily via the postburn food caches of birds and rodents; successful establishment requires a nurse plant.	FEIS
Pinus ponderosa var. *scopulorum*	Interior ponderosa pine can survive considerable scorching. Fire adaptations include: open crowns; self-pruning branches; thick, insulative, relatively unflammable bark; thick bud scales; tight needle bunches that open into a loose arrangement that does not favor combustion; high foliar moisture; and a deep rooting habit.	FEIS
Populus tremuloides	Much work on quaking aspen comes from the northern Rockies and eastern U.S.; the species is topkilled by fire, but sends up a "profusion" of stems for several years post-fire; new stands can develop within a decade; fire-scarred aspens in Utah showed 7- to 10-year fire frequency pre-1885; lack of young stands in the west may be due to absence of fire.	FEIS
Pseudotsuga menziesii	Mature Rocky Mountain Douglas-fir is generally more fire resistant than spruces and true firs and	FEIS

Species	Fire Ecology/Adaptations	Source
	equally or slightly less fire resistant than ponderosa pine. Mature trees can survive moderately severe ground fires because thick, corky bark insulates the cambium from heat damage. Where fire is frequent young trees don't survive. Low growing branches and flammable foliage make trees susceptible to crowning.	
Quercus gambelii	Gambel oak generally resprouts vigorously the first season post-fire; repeated fires weaken trees; Gambel oak understory can serve as ladder fuels; trees produce large amounts of litter; in Utah, fires were more frequent in ponderosa pine stands with Gambel oak understory than in oak-dominated stands.	FEIS
Q. muehlenbergii	Chinkapin oak often sprouts from stumps or rootcrowns after fire; reestablishment by seed is favored on mineral, post-fire seedbeds; sprouting ability appears to decrease as plants age.	FEIS

Table E-2. Great Basin Conifer Woodland: Fire Ecology of Species

FEIS is the Fire Effects Information System maintained by the Forest Service that contains literature reviews: http://www.fs.fed.us/database/feis/.

Species	Fire Ecology/Adaptations	Source
Bouteloua eriopoda	Black grama has the reputation of being fire-sensitive, recovering slowly after fire through vegetative growth; healthy stands recover more readily, given decent moisture; carries fire if cover is dense and conditions windy.	FEIS
B. gracilis	Blue grama is topkilled by fire, but fire generally increases occurrence, production, and cover; seed and seedstalk production may also be stimulated by fire; wet years post-fire increase yield.	FEIS
B. hirsuta	Hairy grama cover was positively correlated with fire frequency in Minnesota; most studies conclude it is undamaged by fire following a season or two of depressed production.	FEIS
Dasylirion leiophyllum	Young sotol with green leaves touching the ground are usually only slightly scorched; mature sotol with trunks sheathed in dead leaves makes them especially susceptible to fire; stalks attract lightning; plant tops spread fire by falling off and rolling downhill; plants occasionally resprout if lightly or moderately burned.	FEIS
Juniperus deppeana	Alligator juniper canopies are often high enough so that fires scorch but do not severely damage the crown. Bark also provides protection from fire. It is generally capable of prolific sprouting after aboveground vegetation is consumed by fire, particularly if the resprouting zone is covered by soil.	FEIS
Juniperus scopulorum	Rocky Mountain junipers up to about 20 years old are highly susceptible to fire; older trees have thicker bark and a more open crown that help them survive fire, though severe fires will damage or kill; fire causes less damage in habitats with sparse undergrowth.	FEIS
Nolina microcarpa	Sacahuista resprouts from the woody, underground caudex after fire; cool fires result in little or no mortality; hot fires kill many young	FEIS

Species	Fire Ecology/Adaptations	Source
	plants and some mature plants.	
Pinus edulis	Colorado pinyon is generally very susceptible to fire damage depending on stand structure and understory; it is absent from post-fire early successional stages. Seedlings establish primarily via the postburn food caches of birds and rodents; successful establishment requires a nurse plant.	FEIS
Quercus grisea	While the literature lacks fire data for Gray oak, oaks generally survive low-intensity, fast fires by resprouting after topkill.	FEIS
Sporobolus cryptandrus	Sand dropseed is usually killed or topkilled by fire; younger plants suffer less than older plants; postfire regeneration via seeds varies by site; water stress inhibits ability to withstand fire; conversely, wet conditions buffer effects of fire; positive responses to fire are associated with reduced competition.	FEIS

Table E-3. Madrean Evergreen Woodland: Fire Ecology of Species

FEIS is the Fire Effects Information System maintained by the Forest Service that contains literature reviews: http://www.fs.fed.us/database/feis/.

Species	Fire Ecology/Adaptations	Source
Arbutus xalapensis [texana]	Observation of fire scars on Texas madrone suggest some survival of fire; moist habitats generally protect from fire; post-fire sprouting at root collar has been observed by staff, even in severely topkilled trees; resprouts need protection from browsers to reestablish; bird-dispersed seed may establish on burns.	FEIS; GUMO staff observation
Bouteoua curtipendula	Sideoats grama response to fire depends on growth form, climatic conditions, season of burn, and severity of fire; reestablishment occurs through seed and/or rhizomes; recovery time is variable, but 2 to 3 years may be required.	FEIS
B. gracilis	Blue grama is topkilled by fire, but fire generally increases occurrence, production, and cover; seed and seedstalk production may also be stimulated by fire; wet years post-fire increase yield.	FEIS
B. hirsuta	Hairy grama cover was positively correlated with fire frequency in Minnesota; most studies conclude it is undamaged by fire following a season or two of depressed production.	FEIS
Juniperus deppeana	Alligator juniper canopies are often high enough so that fires scorch but do not severely damage the crown. Bark also provides protection from fire. It is generally capable of prolific sprouting after aboveground vegetation is consumed by fire, particularly if the resprouting zone is covered by soil.	FEIS
Mimosa aculeaticarpa var. *biuncifera [M. biuncifera]*	Fire topkills catclaw mimosa; plants are prolific post-fire sprouters; Ahlstrand's (1982) study showed greater frequency on burned versus unburned sites; plants themselves provide little fuel (open form and tiny leaves).	FEIS
Opuntia phaecantha	Response of Englemann prickly-pear to fire is extremely variable, depending on presence of fuels and fire intensity.	Cable 1973

Species	Fire Ecology/Adaptations	Source
Quercus grisea	While the literature lacks fire data for Gray oak, oaks generally survive low-intensity, fast fires by resprouting after topkill.	FEIS
Q. mohriana	The literature lacks fire effects data for Mohr shin oak, however, staff observed post-fire response after the 1993 Pine Fire showing that topkilled oaks vigorously resprouted.	GUMO staff observations
Q. muehlenbergii	Chinkapin oak often sprouts from stumps or rootcrowns after fire; reestablishment by seed is favored on mineral, post-fire seedbeds; sprouting ability appears to decrease as plants age.	FEIS
Q. undulata [Q. pungens]	Fire topkills sandpaper oaks; surviving plants are stimulated to sprout; unburied acorns are probably killed by fire.	FEIS

Table E-4. Interior Chaparral: Fire Ecology of Species

FEIS is the Fire Effects Information System maintained by the Forest Service that contains literature reviews: http://www.fs.fed.us/database/feis/.

Species	Fire Ecology/Adaptations	Source
B. gracilis	Blue grama is topkilled by fire, but fire generally increases occurrence, production, and cover; seed and seedstalk production may also be stimulated by fire; wet years post-fire increase yield.	FEIS
Ceanothus greggii	Fire generally kills desert ceanothus; seed remains viable for decades and is stimulated to germinate following fire; seedling abundance has been observed to increase with fire intensity; the plant is associated with stand-replacing fire frequencies of 20-30 years or more.	FEIS
Cercocarpus montanus	Fire generally topkills true mountain mahogany; plants resprout vigorously following fire; some seedlings may establish after fire.	FEIS; Ahlstrand 1981xx
Muhlenbergia porteri	Fire probably topkills bush muhly but the plant can probably resprout; recovery time probably depends on post-fire weather and competition; species is non-rhizomatous.	FEIS (probably)
Quercus grisea	While the literature lacks fire data for Gray oak, oaks generally survive low-intensity, fast fires by resprouting after topkill.	FEIS
Q. mohriana	The literature lacks fire effects data for Mohr shin oak, however, staff observed post-fire response after the 1993 Pine Fire showing that topkilled oaks vigorously resprouted.	GUMO staff observations
Sporobolus cryptandrus	Sand dropseed is usually killed or topkilled by fire; younger plants suffer less than older plants; postfire regeneration via seeds varies by site; water stress inhibits ability to withstand fire; conversely, wet conditions buffer effects of fire; positive responses to fire are associated with reduced competition.	FEIS

Table E-5. Chihuahuan Semidesert Grassland: Fire Ecology of Species

FEIS is the Fire Effects Information System maintained by the Forest Service that contains literature reviews: http://www.fs.fed.us/database/feis/.

Species	Fire Ecology/Adaptations	Source
Agave lechuguilla	Lechuguilla occurs in dense stands that can readily carry hot fire; mortality tends to be high; some plants survive and produce offsets; plants can escape fire by living in rocky microhabitats.	FEIS
Bouteloua eriopoda	Black grama has the reputation of being fire-sensitive, recovering slowly after fire through vegetative growth; healthy stands recover more readily, given decent moisture; carries fire if cover is dense and conditions windy.	FEIS
B. gracilis	Blue grama is topkilled by fire, but fire generally increases occurrence, production, and cover; seed and seedstalk production may also be stimulated by fire; wet years post-fire increase yield.	FEIS
B. hirsuta	Hairy grama cover was positively correlated with fire frequency in Minnesota; most studies conclude it is undamaged by fire following a season or two of depressed production.	FEIS
Dasylirion leiophyllum	Young sotol with green leaves touching the ground are usually only slightly scorched; mature sotol with trunks sheathed in dead leaves makes them especially susceptible to fire; stalks attract lightning; plant tops spread fire by falling off and rolling downhill; plants occasionally resprout if lightly or moderately burned.	FEIS
Digitaria californica	Arizona cottontop probably recovers completely from fire during the first growing season if it is a wet summer; a dry summer following fire extends recovery to two years; fire tolerance is due to growing points at or below the ground line.	FEIS
Ephedra spp.	Ephedras sprout post-fire; some seeding of disturbed sites has been observed.	FEIS
Fouqueria splendens	Waxy, resinous ocotillo bark burns readily; plants sprout after some fires; most ocotillo habitat carries fire only with sufficient grassy fuel buildup.	FEIS

Species	Fire Ecology/Adaptations	Source
Juniperus pinchottii	Frequent fire kills young Pinchot (redberry) juniper seedlings and saplings; where grasses are present, germination is suppressed; lack of fire and grazing have allowed encroachment into former grassland areas; trees sprout after fire; very hot fires under very dry conditions will kill plants.	FEIS
Prosopis glandulosa	Honey mesquite is an invader in some desert grassland communities; grazing reduced fuels and fire frequencies that kept plants in check; even very small plants survive fire by resprouting; frequent fire (7-10 yr intervals) may prevent honey mesquite establishment.	FEIS
Sporobolus airoides	Alkali sacaton is thought to be tolerant but not resistant to fire; recovery following fire has been reported as 2-4 years; fire is associated with this plant when its habitat has dried out or been invaded by mesquite or acacia.	FEIS
Yucca elata	Soaptree yucca can sprout from the stem after fire, even when some of the leaves are burnt; damage to apical meristem can lead to branching or death of above-ground plant and sprouting from rhizomes and root crown; the plant has been observed to increase in numbers in the absence of fire.	FEIS

Table E-6. Chihuahuan Desertscrub: Fire Ecology of Species

FEIS is the Fire Effects Information System maintained by the Forest Service that contains literature reviews: http://www.fs.fed.us/database/feis/.

Species	Fire Ecology/Adaptations	Source
Atriplex canescens	Fourwing saltbush is poorly adapted to frequent fire; some may resprout after topkill by light fire; leaves are somewhat fire resistant.	FEIS
Bouteloua eriopoda	Black grama has the reputation of being fire-sensitive, recovering slowly after fire through vegetative growth; healthy stands recover more readily, given decent moisture; carries fire if cover is dense and conditions windy.	FEIS
Echinocereus triglochidiatus	Spines may ignite; cactus body may scorch and blister. Staff observed external cylinders of large clones protected the central cylinders but individual or small clumps may not survive fire.	FEIS; GUMO staff observations
Flourensia cernua	Tarbush habitat generally does not carry fire; it is thought to colonize [burned areas] through seed from offsite.	FEIS
Fouqueria splendens	Waxy, resinous ocotillo bark burns readily; plants sprout after some fires; most ocotillo habitat carries fire only with sufficient grassy fuel buildup.	FEIS
Muhlenbergia porteri	Fire probably topkills bush muhly but the plant can probably resprout; recovery time probably depends on post-fire weather and competition; species is non-rhizomatous.	FEIS (probably)
Opuntia spp.	Prickly-pear and chollas survive fires depending on fuel buildup nearby; more fuel tends to accumulate under chollas; after cool fires, undamaged cholla joints on the ground may resprout.	Cable 1973
Prosopis glandulosa	Honey mesquite is an invader in some desert grassland communities; grazing reduced fuels and fire frequencies that kept plants in check; even very small plants survive fire by resprouting; frequent fire (7-10 yr intervals) may prevent honey mesquite establishment.	FEIS
Sporobolus airoides	Alkali sacaton is thought to be tolerant but not resistant to fire; recovery following fire has been	FEIS

Species	Fire Ecology/Adaptations	Source
	reported as 2-4 years; fire is associated with this plant when its habitat has dried out or been invaded by mesquite or acacia.	
Yucca baccata	Banana yucca is topkilled by fire; will resprout from rhizomes at 1-4 inch depth; some may resprout from base. Staff observations confirm this response.	FEIS; GUMO staff observations

Table E-7. Interior Deciduous Forest and Woodland (riparian): Fire Ecology of Species

FEIS is the Fire Effects Information System maintained by the Forest Service that contains literature reviews: http://www.fs.fed.us/database/feis/.

Species	Fire Ecology/Adaptations	Source
Acer grandidentatum	Bigtooth maple live in moist sites that tend to burn infrequently; following crown destruction by fire, some resprout from root crown, but not generally vigorously.	FEIS
Arbutus xalapensis [texana]	Observation of fire scars on Texas madrone suggest some survival of fire; moist habitats generally protect from fire; post-fire sprouting at root collar has been observed by staff, even in severely topkilled trees; resprouts need protection from browsers to reestablish; bird-dispersed seed may establish on burns.	FEIS; GUMO staff observation
Fraxinus velutina	Fire effects are not documented in the literature; other species of young ash are topkilled by fire and resprout or reproduce by seed; fire girdles thin bark on young trees; mature trees have thick protective bark	FEIS
Juglans microcarpa	Little walnut exhibits few adaptations for fire; presumably reestablishes through seed from offsite.	FEIS
Juniperus deppeana	Alligator juniper canopies are often high enough so that fires scorch but do not severely damage the crown. Bark also provides protection from fire. It is generally capable of prolific sprouting after aboveground vegetation is consumed by fire, particularly if the resprouting zone is covered by soil.	FEIS
Ostrya knowltonii	Little is known about fire and Knowlton hophornbeam, but it probably sprouts in limited fashion post-fire as do congeners; may colonize burned sites via seed.	FEIS
Pinus ponderosa var. *scopulorum*	Interior ponderosa pine can survive considerable scorching. Fire adaptations include: open crowns; self-pruning branches; thick, insulative, relatively unflammable bark; thick bud scales; tight needle bunches that open into a loose arrangement that does not favor combustion; high foliar moisture;	FEIS

Species	Fire Ecology/Adaptations	Source
	and a deep rooting habit.	
Populus deltoides var. *wislizenii*	*Populus deltoides* is a weak sprouter and generally killed by fire.	FEIS
Q. muehlenbergii	Chinkapin oak often sprouts from stumps or rootcrowns after fire; reestablishment by seed is favored on mineral, post-fire seedbeds; sprouting ability appears to decrease as plants age.	FEIS
Sapindus saponaria	Specific adaptations to fire have not been identified in western soapberry; plants may reoccupy a site through seed transported from adjacent unburned areas by birds; postfire sprouting from underground rhizomes is possible but has not been documented.	FEIS