United States Department of the Interior
National Park Service

Big Bend National Park
Texas

Big Bend National Park

Final General Management Plan/ Environmental Impact Statement

Final
General Management Plan / Environmental Impact Statement

BIG BEND NATIONAL PARK

Brewster County, Texas
May 2004

This *General Management Plan / Environmental Impact Statement* describes and analyzes three alternatives for managing Big Bend National Park. The approved plan will help managers make decisions about managing natural and cultural resources, visitation, and development for the next 15 to 20 years. Some issues to be addressed are protection of natural and cultural resources; the strain on scarce water resources; employee housing, offices, and other development located in flash flood hazard areas; limited orientation and interpretation, and inadequate office space and storage for park staff. A separate management plan is being developed concurrently for the Rio Grande Wild and Scenic River.

Alternative A, the no-action or status quo alternative, reflects ongoing actions at the park and serves as a basis for comparing the other alternatives and knowing why certain changes may be advisable. Natural and cultural resources would be managed as they are now guided by laws, policies and guidelines. Issues would be resolved as they emerged and not as the result of a comprehensive plan. There would be limited if any changes in interpretation and visitor services would remain limited. Coordination with agencies and other groups would continue. There would be very little change in visitor facilities. The park would be operated and maintained as before with no new park management facilities except one new building to provide storage and office space for fire management and two new duplex units that will provide eight concession employee bedrooms at Panther Junction. The eight bedrooms will replace very old facilities (trailers) with modern housing. Staffing and funding levels would remain at or near current levels. Any development that is not tied to an approved plan would be designed to be temporary and reversible.

The two "action" alternatives describe various approaches to managing the park's resources and visitation. **Alternative B — Preferred Alternative — Enhanced and Adequate Natural Resource Stewardship and Enhanced Visitor Facilities —** would create a more sustainable park and provide better protection for the park's natural and cultural resources than the no-action alternative while offering an enhanced experience for visitors. Some facilities would be upgraded, and a new visitor center would be built at Panther Junction. **Alternative C — Maximize Natural Resource Stewardship and Preservation by Providing a More Resource-Oriented Visitor Experience —** would better protect the park's natural resources than the no-action alternative and alternative B while providing for visitor use. All facilities except the main road, a trailhead with parking, and a restroom would be removed from Chisos Basin and Rio Grande Village. These and other actions would be taken to make the park more sustainable, greatly reduce water use, and promote ecological restoration.

For questions about this document, write Superintendent, Big Bend National Park, P.O. Box 129, Big Bend National Park, TX 79834-0129, call (915) 477-2251, or Email: www.nps.gov/bibe. Please note that the NPS practice is to make comments, including names and addresses of respondents, available for public review. After a 30-day no-action period, a course of action will be approved through the issuance of a record of decision.

SUMMARY

The purpose of this *General Management Plan / Environmental Impact Statement* is to define a direction for the management of Big Bend National Park for the next 15 to 20 years. The approved plan will provide a framework for making decisions about managing the natural and cultural resources, visitor use, development, and park operations so that future opportunities and problems can be addressed effectively. The plan will prescribe the resource conditions and visitor experiences to be achieved over time according to law, policy, regulations, public expectations, and the park's purpose, significance, and special mandates.

An updated plan is needed to address current issues related to water quantity at some developed areas, park facilities in floodplains, endangered species, degradation of natural systems, conflicts among various user groups, and the lack of adequate space for interpretive activities, park housing, storage, and staff offices.

ISSUES TO BE ADDRESSED

Natural resource issues that must be addressed are management of water quantity at some developed areas, floodplains, threatened and endangered species, and degradation of natural systems.

Water resources at Chisos Basin are overcommitted. Overnight visitors and park and concessioner employees compete with wetland plants and wildlife for water. At certain times of the year, nearly all of the water from Oak Spring is diverted for human use. At times when the total output of the spring is not sufficient for needs of the developed area, conservation measures must be implemented.

Visitors' understanding of the significance of Big Bend National Park is limited by a lack of adequate orientation and interpretation. Additional interpretive emphasis is needed to foster visitor awareness of the park's principal stories.

The Panther Junction visitor center, a section of the "Mission 66" period (1960s) headquarters building, cannot accommodate the current level of visitation or provide all the information and interpretation of park stories needed by visitors. Space in the visitor center used by park staff and the cooperating association is inadequate, as is storage space. At Panther Junction, there is a lack of adequate office and storage space for park staff.

ALTERNATIVES

To achieve the desired conditions at Big Bend National Park, the planning team developed a "no-action" alternative (continuing present management) and two "action" alternatives for managing the resources and visitor uses of Big Bend National Park. Each action alternative would assign various areas of the park to different management prescriptions (zones). The management prescriptions identify how different areas could be managed to achieve a variety of resource conditions and visitor experiences. In each action alternative, the five management zones — wilderness, backcountry nonwilderness, cultural, visitor services, and operations — would each specify a particular combination of resource, social, and management conditions.

Alternative A — The No-action or Status Quo Alternative, reflects ongoing actions at the park and serves as a basis for comparing the other alternatives and knowing why certain changes might be advisable. Current laws, policies, and guidelines would guide natural and cultural resource management actions. Interpretation and visitor services would remain limited, and any development that is not tied to an approved plan would be designed to be temporary and reversible. All the visitor facilities available for visitor use, such as the Chisos Basin development, Rio Grande Village, and Cottonwood campgrounds, would be available under this alternative. There would be limited, if any, changes in the management of the park. Coordination with agencies and other groups would continue.

One already approved building would be constructed in Panther Junction, outside the most dangerous portion of the maximum

estimated floodplain. It would contain storage and office space for fire management. Some campsites at Rio Grande Village would be relocated to provide greater protection for the endangered fish, Big Bend gambusia. An alternative water source would be sought for human use to further protect the endangered fish. At Rio Grande Village and Cottonwood campgrounds and Panther Junction early warning systems and evacuation plans would be developed and implemented to protect visitors and staff occupying the floodplain. Failing utility (water and waste water) systems would be upgraded as funds become available. The park would be operated and maintained as before. Staffing and funding levels would remain at or near current levels.

Alternative B — Preferred Alternative — Enhanced and Adequate Natural Resource Stewardship and Enhanced Visitor Facilities would offer enhanced experiences for visitors while creating a more sustainable park and providing better protection for park resources. It is the National Park Service's preferred alternative. A new visitor center would be built at Panther Junction to provide room for interpretive media to adequately interpret key aspects of the park's stories and to help visitors plan their stays. The space in the headquarters building vacated by the visitor center function would be redesigned for staff offices. A storage warehouse, bunkhouse, and employee residence would also be built at Panther Junction. The natural resources and collection management building (described in the cumulative impact scenario) should adequately provide for the collection storage needs for the duration of this plan. In case additional collection storage space were necessary, the other new storage areas would be evaluated to accommodate this need. One employee residence and one employee bunkhouse would be removed from Chisos Basin to reduce human water use at that area.

At Rio Grande Village the RV campground would be enlarged by about 40% in area with no more than 30 total sites. Cottonwood Campground campsites would be relocated away from bank cave-in areas, and a new egress road would be constructed. Fifteen percent of park personnel and functions would be moved to gateway communities where offices and residences would be built or leased.

Alternative C — Maximize Natural Resource Stewardship and Preservation by Providing a More Resource-Oriented Visitor Experience would better protect the park's natural resources than alternative A (no-action) and alternative B while providing for visitor use. Development would be removed from Chisos Basin and Rio Grande Village except for the main roads. A trailhead with parking and a restroom would be constructed at each area. The visitor center function would expand within the headquarters building, and a new administrative building would be built at Panther Junction. A storage warehouse would also be constructed at Panther Junction. The natural resources and collection management building (described in the cumulative impact scenario) should adequately provide for the collection storage needs for the duration of this plan. In case additional collection storage space was necessary, the other new storage areas would be evaluated to accommodate this need. Fifteen percent of park personnel and functions would be moved to gateway communities where offices and residences would be built or leased.

ENVIRONMENTAL CONSEQUENCES

The planning team evaluated the potential consequences that the actions of each alternative could have on natural resources, cultural resources, the visitor experience, and the socioeconomic environment. The beneficial or adverse effects were categorized as either short term or long term, and their intensity was rated as negligible, minor, moderate, or major. The impacts of the various alternatives are compared in table 5.

For **alternative A, the no-action or status quo alternative,** during periods of extended drought as well as at certain very limited times when it is not raining during normal years, continued use of nearly all the water at Oak Spring for human use would cause negligible, intermittent, long-term, adverse impacts on the quantity of water in Oak Spring and the wetland there. The irrigation of shade trees and lawns at the campgrounds at Rio Grande Village and Cottonwood using water from the river would continue to cause the growth of unnaturally lush vegetation and allow exotic species to flourish — an ongoing, moderate, long-term adverse impact. Improving

Big Bend gambusia habitat by eliminating competition for spring water and relocating campsites would have a minor to moderate, long-term, beneficial impact on the endangered fish. The natural and beneficial values of floodplain areas would continue to be compromised by the presence of campgrounds at Rio Grande Village, and the developments in the flash flood hazard area at Panther Junction. This continuing long-term adverse impact on natural processes would be moderate. Although severe flooding has been infrequent and risks are minor to moderate, flooding at Panther Junction could result in major adverse impacts on visitors or employees involved. Even though the risk is not great, loss of infrastructure at Panther Junction from flooding could cause a major, long-term adverse impact on operations and require the park to find temporary housing and offices outside the park.

Ongoing identification and protection of archeological resources would have a minor to moderate beneficial impact on these resources. Research, documentation, identification, evaluation, and preservation of ethnographic resources would result in long-term, negligible to moderate beneficial impacts on ethnographic resources.

Alternative A would result in continuing degradation of the visitor experience from noise, congestion, and visitor frustration at not finding adequate interpretive and education facilities. This alternative would result in a continuing long-term adverse impact on visitors coming to the park at peak times. Visitors would have many opportunities to travel around the park at their own pace — a long-term, major beneficial impact. Retaining the campgrounds, picnic areas, and lodge would have an ongoing, moderate, long-range beneficial impact on the visitor experience.

The existing benefits of the park to the local and regional economy would continue. In addition, there would be minor, short-term, beneficial impacts on temporary employment opportunities and revenues during restoration and construction activities.

Under **alternative B** restoring soils on 61.5 acres to natural contours, rerouting runoff to natural drainages, and revegetating an area greater than 20 acres would have a major, long-term, beneficial impact on soils, vegetation, and smaller animals. Reducing human use of water from Oak Spring by removing some facilities at Chisos Basin would result in a 3% reduction in annual water use there — a minor long-term beneficial impact on plants and a moderate long-term beneficial impact on wildlife that use water from the spring. Withdrawal of 50% of the irrigation water from about 14 acres of exotic vegetation at Rio Grande Village would allow native vegetation to return — a moderate to major long-term beneficial impact on native vegetation.

Finding a separate source of drinking water for visitors and employees at Rio Grande Village would have a major, long-term, beneficial impact on the pond water system water quantity and a minor to moderate, long-term beneficial impact on the endangered Big Bend gambusia. Although a report finds that the risk is not great, flooding at Panther Junction could cause major adverse impacts on the visitors and employees involved. Flooding at Panther Junction could cause major adverse impacts on operations and could require the park to find temporary offices and housing outside the park.

Preservation actions taken under this alternative would have a long-term, moderate beneficial impact on some park historic structures. Water conservation measures at Rio Grande Village could change the vegetation characteristic of this potential cultural landscape — a long-term, moderate adverse impact. There would be a long-term, major, beneficial impact on artifacts and collections at Panther Junction.

Provision of adequate space for interpreting the park's primary themes, conducting interpretive and educational programs, and ensuring that visitors receive enough information to plan their stay effectively by constructing a new visitor center at Panther Junction would have a major long-term beneficial impact on most park visitors.

There would be increases in temporary and permanent employment opportunities and revenues as planned upgrades of facilities and programs are implemented.

Under **alternative C**, removing development, restoring natural contours, and revegetating 700

acres at Chisos Basin, Rio Grande Village, and the Maverick entrance station would have long-term, beneficial impacts. Impacts on soils would be major, on vegetation and wildlife moderate, and on black-capped vireo moderate to major. Impacts on water quantity at Oak Spring, plants that use water from Oak Spring, and wetlands at Oak Spring would be major. Impacts on animals that use water from Oak Spring would be moderate, and impacts on natural and beneficial floodplain values at Rio Grande Village would be major. Withdrawal of irrigation water from about 638 acres of exotic vegetation at Rio Grande Village would allow native vegetation to return — a major, long-term beneficial impact on native vegetation and a moderate long-term beneficial impact on water quantity in the Rio Grande.

Removing all human use from the spring at Rio Grande Village would be a major, long-term beneficial impact on wetlands and on water quantity in the pond system used by Big Bend gambusia. Along with the additional water available in the pond system where it lives, restoration of Rio Grande Village to more natural conditions through revegetation, and potentially doubling the available habitat through wetland restoration, would be expected to have a minor to moderate long-term beneficial impact on the fish. Although a report finds that the risk is not great, flooding at Panther Junction could cause major adverse impacts on the visitors and employees involved. Flooding at Panther Junction could cause major adverse impacts on operations and could require the park to find temporary offices and housing outside the park.

Demolition of some historic structures would result in a long-term minor to major, adverse impact on historic structures. Loss of some potential cultural landscapes would be a potential long-term, major, adverse impact on these landscapes. There would be long-term, moderate adverse impacts on ethnographic resources, and long-term, major beneficial impacts on the park collections.

Removal of overnight facilities at Chisos Basin and Rio Grande Village would have a major, long-term beneficial impact on the visitor experience of natural and cultural resources. A rehabilitated visitor center at Panther Junction would have a moderate, long-term benefit for most park visitors. Removing lodging and camping facilities would result in the loss of overnight experiences for some visitors, and removing interpretive centers at Chisos Basin and Rio Grande Village would eliminate opportunities for visitors to learn about key themes and resource management issues. Together, the loss of these facilities would b e a major long-term adverse impact on the visitor experience. Retaining the Cottonwood Campground and picnic areas would constitute a moderate long-term beneficial impact on visitors, and moving some campsites further from the river would lessen the potential from flooding.

There would be increases in temporary and permanent employment opportunities and revenues as planned upgrades of facilities and programs were implemented.

COMMENTS ON THE DRAFT PLAN

The *Draft General Management Plan / Environmental Impact Statement* for Big Bend National Park was sent out for public review and comment. During the review period, public meetings were held; after the review period comments were analyzed and changes were made, as appropriate, to the draft document. In response to public comment, the proposal to remove a 12-room motel unit from Chisos Basin is no longer in the preferred alternative. The "Purpose of and Need for the Plan" section and some impact discussions have been modified in response to comments. Comments and responses are in the "Consultation and Coordination" chapter. The final plan includes agency letters and all organization and individual letters with substantive comments. Following release of the *Final General Management Plan / Environmental Impact Statement* and a 30-day no-action period, a record of decision identifying the selected alternative (the approved plan) will be issued.

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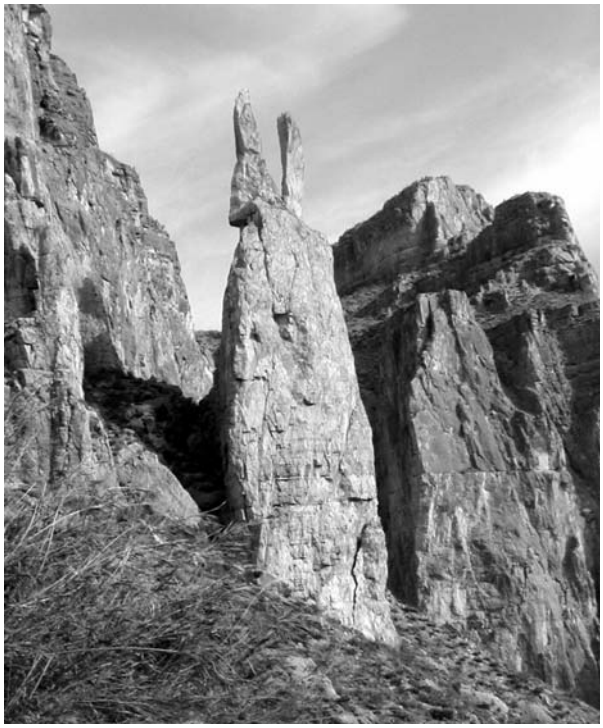

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PURPOSE, NEED, AND SCOPING

INTRODUCTION

This *Draft General Management Plan/ Environmental Impact Statement* presents and analyzes three alternative future directions for the management and use of Big Bend National Park. One of the alternatives, alternative B, has been identified as the National Park Service's (NPS) preferred future direction. The potential environmental impacts of all alternatives have been identified and assessed.

General management plans are intended to be long-term documents that establish and articulate a management philosophy and framework for decision making and problem solving in the parks. General management plans usually provide guidance during a 15- to 20-year period.

Actions directed by general management plans or in subsequent implementation plans are accomplished over time. Budget restrictions, requirements for additional data or regulatory compliance, and competing national park system priorities prevent immediate implementation of many actions. Major or especially costly actions could be implemented 10 or more years into the future.

BRIEF DESCRIPTION OF THE PARK

The park was established on June 20, 1935, by an act of Congress (see appendix A). Big Bend National Park is in south Brewster County in southwest Texas in a sparsely populated area of the country (see Park Area map). Brewster County has 6,204 square miles and a population of approximately 13,000 people. Most of the population resides in two towns, Marathon and Alpine, which lie 69 and 100 miles respectively to the north and northwest of park headquarters. The western gateway communities of Study Butte/Terlingua, and Lajitas have grown in recent years but remain less populated than Marathon and Alpine.

The maps in this document are for illustration purposes only and are not drawn perfectly to scale.

Big Bend National Park encompasses more than 801,000 acres. For more than 1,000 miles, the Rio Grande forms the international boundary between Mexico and the United States; Big Bend National Park administers approximately 25% of that boundary. Within the 118 twisting miles that define the park's southern boundary, the river's southeasterly flow changes abruptly to the northeast and forms the "big bend" of the Rio Grande. (The park also administers 125 miles of the Rio Grande Wild and Scenic River, which is outside the Big Bend National Park boundary.) South of the border, people call the Rio Grande by its Spanish name, Rio Bravo del Norte.

Because the Rio Grande serves as an international boundary, the park faces unusual constraints when administering and enforcing park rules, regulations, and policies. The park has jurisdiction only to the center of the deepest river channel; the rest of the river lies within the Republic of Mexico. South of the river lie the Mexican states of Chihuahua and Coahuila and their protected areas for flora and fauna known as the Maderas del Carmen and the Cañon de Santa Elena.

Big Bend National Park has national significance as the largest protected area of Chihuahuan Desert topography and ecology in the United States. Along with the Maderas del Carmen and Cañon de Santa Elena, Big Bend is part of one of the largest trans-boundary protected areas in North America. More than 2 million acres of Chihuahuan Desert resources, along with more than 200 miles of river, are under the national protection of the United States and Mexico. Few areas exceed the park's value for the protection and study of geologic and paleontologic resources. Cretaceous and Tertiary fossil organisms exist in variety and abundance. Archeologists have discovered artifacts that are estimated to be 9,000 years old, and historic

buildings and landscapes illustrate life along the international border at the turn of the century.

The park exhibits dramatic contrasts. Its climate may be characterized as one of extremes. Dry, hot late spring and early summer days often exceed 100°F in the lower elevations. Winters are normally mild throughout the park, but subfreezing temperatures occasionally occur. Because the altitude ranges from about 1,800 feet along the river to 7,800 feet in the Chisos Mountains, a wide variation in moisture and temperature exists throughout the park. These variations contribute to an exceptional diversity in plant and animal habitats.

The 118 river miles that form the southern park boundary include the spectacular canyons of Santa Elena, Mariscal, and Boquillas. The meandering Rio Grande in this portion of the Chihuahuan Desert has cut deep canyons with nearly vertical walls through three uplifts comprised primarily of limestone. Throughout the open desert areas, the highly productive Rio Grande riparian zone includes various plant and animal species and significant cultural resources. The vegetation extends into the desert along creeks and arroyos.

Cultural resources in the park range from the Paleo-Indian period 10,500 years ago through the historic period (mid 1500s to the present) represented by American Indian groups, such as the Chisos, Mescalero Apache, and Comanche. More recently, Spanish, Mexican, and American settlers farmed, ranched, and mined in the area.

Throughout the prehistoric period, humans found shelter and camped throughout the park. The archeological record reveals an Archaic-period desert culture whose inhabitants developed a nomadic hunting and gathering lifestyle that remained virtually unchanged for several thousand years.

In more recent times the park has been used for various subsistence or commercial land uses. The riparian and tributary environments were used for subsistence and irrigation farming. Transportation networks, irrigation structures, simple domestic residences and outbuildings, and planed and terraced farmlands lining the streambanks characterize these landscapes.

Annual visitation to the park has averaged 300,000 in recent years. The 1992 Visitor Services Project determined that most visitors were 41 years of age or older. Most visitors came to the park in family groups. Visitors from foreign countries comprised 10% of park visitation, with 48% of the international visitors coming from Germany. Americans came from Texas (65%), with smaller numbers from other states. The average length of stay, three days, is higher than most other national park system areas.

PURPOSE OF THE PLAN

The purpose of this *General Management Plan / Environmental Impact Statement* is to clearly define a direction for resource preservation and visitor experience at Big Bend National Park.

The approved plan will provide a framework for proactive decision making, including decisions on visitor use and on managing natural and cultural resources and development. This will allow managers to address future opportunities and problems effectively.

This plan will prescribe the resource conditions and visitor experiences that are to be achieved and maintained in the national park over time. Management decisions that must be made where law, policy, or regulations do not provide clear guidance or limits will be based on the park's purposes, the range of public expectations and concerns, resource analysis, and the evaluation of the natural, cultural, economic, and social impacts of alternative courses of action, including long-term costs to the park.

This document will not describe how particular programs or projects will be implemented or prioritized. Those decisions will be deferred to more detailed implementation planning, which will follow the broad, comprehensive decision making presented in this document.

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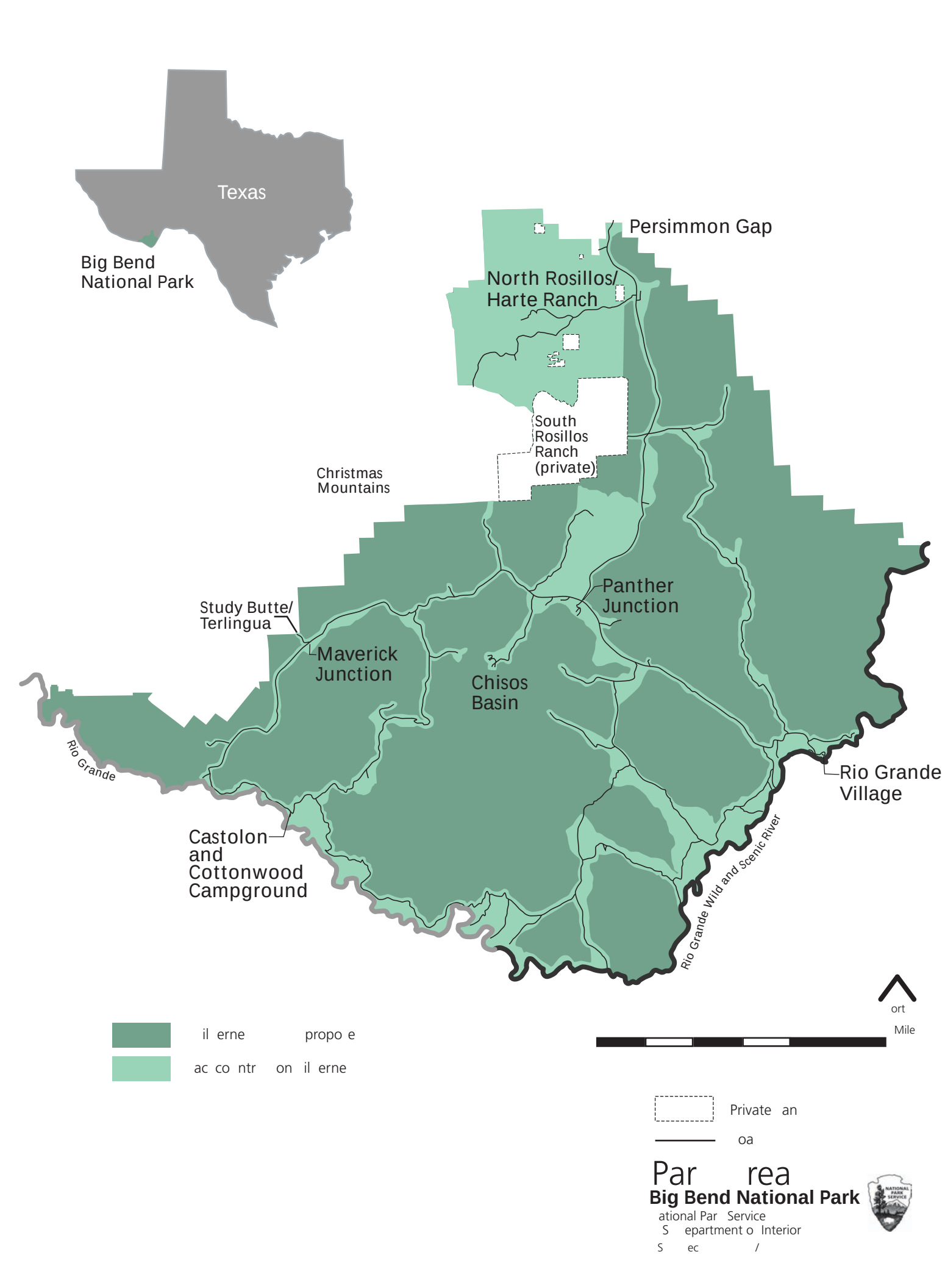
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National Park
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NEED FOR THE PLAN

The previous *General Management Plan* for Big Bend was approved in 1980. It needs to be updated. While the *Draft General Management Plan* is being finalized, the park managers will continue to follow applicable laws, policies, and guidelines as part of its standard operating procedures. They include the National Environmental Policy Act of 1969 (NEPA), section 106 of the National Historic Preservation Act of 1966 (16 USC 470 et seq. as amended), and NPS *Management Policies*.

Each unit in the national park system is guided by agencywide and park-specific laws, regulations, and policies. Understanding this guidance and how it affects each unit's mission is fundamental to planning for the future. This section highlights the park's missions (expressed as purpose, significance, and mission goals) and the legal and policy mandates that guide the management of Big Bend National Park. These mission and mandate statements define the parameters within which all management actions and alternatives must fall.

MISSION AND GOALS

Big Bend National Park was authorized by Congress in 1935 to preserve and protect a representative area of the Chihuahuan Desert along the Rio Grande for the benefit and enjoyment of present and future generations. The park includes rich biological and geological diversity, cultural history, recreational resources, and outstanding opportunities for bi-national protection of shared resources.

Park Purpose

Big Bend National Park's purpose is threefold:

- Preserve and protect all natural and national-register-eligible cultural resources and values.
- Provide educational opportunities to foster understanding and appreciation of the natural and human history of the region.
- Provide recreational opportunities for diverse groups that are compatible with the protection and appreciation of park resources.

Park Significance

The park is significant because it contains the most representative example of the Chihuahuan Desert ecosystem in the United States. The park's river, desert, and mountain environments support an extraordinary richness of biological diversity, including endemic plants and animals, and provide unparalleled recreation opportunities. The geologic features and Cretaceous and Tertiary fossils in Big Bend National Park furnish opportunities to study the sedimentary and igneous processes. Archeological and historic resources provide examples of cultural interaction in the Big Bend Region and varied ways humans adapted to the desert and river environments. The Rio Grande is life-sustaining for plants, animals, and human inhabitants beyond its banks. Along with the two Mexican protected areas for flora and fauna, Maderas del Carmen and Cañon de Santa Elena, Big Bend is now part of one of the largest transboundary protected areas in North America. More than two million acres of Chihuahuan Desert resources, along with more than 200 miles of river, are now under the national protection of the United States and Mexico.

Primary Interpretive Themes

The Park Service explains the park's natural, cultural, and historical resources to visitors through interpretation – so that visitors have an understanding of why the park was set aside by Congress. An integral part of providing for visitor enjoyment of national parks is offering them opportunities to forge their own intellectual and emotional connections to the ideas and meanings inherent in the resources of parks. Interpretive themes are ideas, concepts, or stories that are central to the park's purpose, significance, identity, and visitor experience.

The primary interpretive themes define concepts that every visitor should have the opportunity to learn. Primary themes also provide the framework for the park's interpretation and

educational programs, influence the visitor experience, and provide direction for planners and designers of the park's exhibits, publications, and audiovisual programs. Below are the primary interpretive themes (see appendix D for the subthemes and visitor experience goals).

1. Big Bend National Park's varied ecosystems – mountain, desert, and river – support an extraordinarily rich biological diversity.
2. Major resource threats, such as air and water pollution, intrusive sounds, and the presence of exotic plant and animal species as well as vandalism, graffiti, and the illegal collection of plants and animals, negatively impact both the resources of the park and the visitor experience.
3. Though rarely seen, water constitutes the most important resource in the Chihuahuan Desert environment. Water is the architect of the desert, and its presence or absence affects the desert's appearance, plant and animal life, and the ways that humans can use it.
4. The evidence left behind by different cultural groups over several thousand years, including American Indians, Mexicans, Mexican-Americans, and Anglo-American settlers, gives us clues to the past and helps us imagine what life was like for these early inhabitants of Big Bend.
5. The Maderas del Carmen Protected Area in Coahuila and the Cañon de Santa Elena Protected Area in Chihuahua are two Mexican federally protected areas adjacent to Big Bend National Park and Big Bend Ranch State Park. Together with Black Gap Wildlife Management Area, these five areas preserve millions of acres of important habitat, protect biological corridors for wildlife migration, and provide unique opportunities for the United States and Mexico to work together to preserve a common ecosystem.
6. Big Bend National Park provides an excellent outdoor laboratory for researchers to study the natural world, the interactions that occur within, and the impacts of both natural events and human activity.
7. The legacy of human impacts (adverse and beneficial) on Big Bend National Park's varied environments exhibits changes from past to present, including soil erosion, watershed impairment, grasslands decline, and species reduction as well as conservation.

THE SCOPING PROCESS – NOTICES, NEWSLETTERS, AND MEETINGS

The notice of intent (NOI) to prepare an environmental impact statement was published in the *Federal Register* May 3, 2000, with an amended NOI published on April 9, 2001. The first opportunity for the public to become involved in the development of this plan came in May 2000. A series of four public meetings were held in Study Butte/Terlingua, Alpine, Sanderson, and Austin. Sixty-three people attended these meetings. In addition to these meetings, at the end of July, three public meetings were held in Boquillas del Carmen, Santa Elena, and San Vicente. Several comments responding to the meetings and newsletter (spring 2000) were received. A number of these comments were incorporated into the issues for this general management plan. Comments were received in the general areas of natural and cultural resource protection, wilderness, interpretation and orientation, park boundary, and development.

A second newsletter, containing draft alternative concepts for the park, was distributed to the public in summer 2001. About 120 electronic and written comments were received. The two most commonly expressed thoughts were to leave things as they are now, alternative A, or to make most of the modest changes suggested in alternative B with the exception of the relocation of facilities at Rio Grande Village. There was no support for newsletter alternative C and very little for newsletter alternative D. (Note: alternative C from the newsletter was dismissed. Newsletter alternative D was modified and is called alternative C in this draft.)

Objections to second newsletter alternatives C and D focused on the idea that the alternatives would exclude many people, including the elderly and young children, from enjoying the park as they have up to now. Many of those submitting comments suggested a mix of alternatives, primarily A and B. One person

suggested a mix of C and D. Many commenters did not express a preference for any alternative. Rather they expressed negative views about certain proposed actions, primarily closing concessions facilities and campgrounds. Of these commenters, the largest number was against closing facilities in Chisos Basin. About two-thirds as many were against closing facilities in Rio Grande Village. Leaving things basically as they are now was mentioned more than any other issue.

American Indian consultation occurred throughout the planning process. Tribes identified as being affiliated with the park were sent a letter inviting them to participate in the planning process and all newsletters.

For information on how the preferred alternative was developed see appendix B.

ISSUES

Several issues were raised by park staff and the public in meetings, newsletter responses, and discussions with staff from other agencies and organizations.

Issues to be Addressed

The following issues will be addressed in the planning process.

Water quantity. Upstream impoundments and diversions, compounded by additional development and cultivated lands along the Mexican Rio Conchos, and the Rio Grande and their tributaries severely reduce river flows reaching the park. These conditions, exacerbated by recurring droughts, have effectively eliminated river recreation for parts of the year from 1994 through 2002.

The park's previous management plan refers to river recreation, but the river's minimum flow to sustain riparian and aquatic habitat and river recreation has yet to be determined.

Water is a limiting factor for development and use. Water sources at Chisos Basin and Panther Junction at times produce inadequate amounts of water for current development and use.

Floodplains. Flood control structures and heavy use on the Rio Grande outside the park have severely damaged the riparian woodland system. The problem affects all the low elevation flatlands along the parks southern border including Rio Grande Village and Cottonwood Campground. Floodplain values are further compromised by the presence of some development in the 100-year floodplain. Irrigation at Rio Grande Village causes vegetation to be unnaturally lush, facilitates the growth of exotic plants, and creates unnatural wildlife habitat.

Aesthetics. Aboveground powerlines obstruct scenic views in Big Bend National Park. Park developments and night lighting affect views from key resource areas such as Chisos Basin, Panther Junction, roads, and trails.

Visitor Facilities. At Panther Junction, the visitor center space is inadequate. The building is often crowded. There is insufficient space for exhibits to introduce aspects of the primary interpretive themes and to provide adequate information for visiting sites in the park. The bookstore has grown into the lobby space, which aggravates the overcrowding. Also, the visitor center has no theater for showing audio-visual programs to further highlight elements of the interpretive themes, depict the park at different times of the year, show geological and other natural processes, or re-create scenes and events from the past.

Development. Despite the shortage of park housing and the need for improved visitor and staff facilities, additional development is of concern because of water quality and quantity issues and the importance of scenic views.

The park's aging infrastructure, including deteriorating water and wastewater systems, unimproved sections of road, and overcrowded campgrounds and parking lots, no longer are sufficient to support park operations and visitor use. In some cases, inadequate infrastructure threatens to degrade park resources.

Inadequate Staff Facilities. Overcrowding has extended to the administrative and operations of the Panther Junction headquarters facility. Since the facility was constructed, the park staff has grown, increasing both office and storage needs. The growth of the cooperating association staff and the volume of sales items also have created the need for more office and stock storage space.

The park does not have adequate housing for its employees. The problem is compounded by the limited amount of land that is suitable for housing development within the park. The remoteness of the area makes commutes from the gateway communities prohibitively long.

Issues beyond the Scope of this Plan

The following issues are beyond the scope of this general plan because they are not under NPS control. However, park staff is continuing to work with others to improve conditions related to these topics.

Air Quality. Big Bend National Park, a Class I area under the Clean Air Act, at times has the dirtiest air in terms of visibility impairment of any western national park. The scenic vistas that historically encompassed more than 150 miles are disappearing. Increased acid deposition from sulfur dioxide emissions from coal-fired, electricity-generating plants southeast of the park could damage natural and cultural resources and seriously impact public health.

Water Quality. The Texas Commission on Environmental Quality has notified the park that drinking water at some locations in the park is not in compliance with state standards.

Riparian (River) Vegetation. Despite years of education and enforcement efforts, many Mexican livestock graze in the park each day. These impacts are evidenced by the lack of native riparian tree species reproduction, areas of vegetation trampling, areas where grass has been grazed, stock trails, eroded riverbanks, and the spread of exotics through fecal material.

Exotic Species. Many species of invasive exotic plants and animals have become established throughout much of the park and threaten native species. In time, these aggressive exotic plants and animals can greatly expand their populations, alter forest and wildlife habitats, and change scenery by smothering and displacing native species. These effects, which are already occurring in some areas of the park, will worsen substantially if left untreated. A sustained effort is needed to control these internal threats to the native species and their natural habitats.

IMPACT TOPICS (RESOURCES AND VALUES AT STAKE IN THE PLANNING PROCESS)

Specific impact topics were developed for discussion focus and to allow comparison of the environmental consequences of each alternative. These impact topics were identified on the basis of federal laws, regulations, and executive orders; the 2001 NPS *Management Policies*; project issues identified during scoping, and NPS knowledge of limited or easily impacted resources.

Natural Resource Topics

The planning team selected seven natural resource impact topics. The selection was based on the major values or issues the team identified early in the planning process, as well as on applicable laws and executive orders (for example, the Endangered Species Act of 1973, as amended, Executive Order 11988, "Floodplain Management," and Executive Order 11990, "Protection of Wetlands"). The following aspects of the natural environment will be impact topics because actions of the alternatives may affect them: soils; vegetation; wildlife; water quantity; threatened, endangered, and candidate species (black-capped vireo and Big Bend gambusia); wetlands; and floodplains.

Cultural Resource Topics

Cultural resource impact topics were selected on the basis of major values identified in the park's enabling legislation, values identified in the scoping process, and applicable laws and executive orders pertaining to cultural resources

(e.g., the 1966 National Historic Preservation Act and the National Environmental Policy Act). The topics are archeological resources, ethnographic resources, historic structures, cultural landscapes, and collections.

Visitor Experience Topics

The planning team identified visitor experience as an important issue that could be appreciably affected under the alternatives. Impact topics in this category are visitors' experiences of the park resources, orientation and interpretive information, and visitor safety.

Socioeconomic Environment Topics

Analyzing the local and regional economic impacts would show the possible impacts on the local and regional area that could result from implementation of the alternatives. In addition, the national park has neighbors that could be affected by plan alternatives. The topics discussed are businesses and park neighbors, recreation spending, commercial river runners and hotel/motel operators, and the local and regional economy.

IMPACT TOPICS CONSIDERED AND DISMISSED FROM FURTHER CONSIDERATION

Threatened, Endangered, and Proposed Species

Two federally endangered species, Big Bend gambusia (fish) and black-capped vireo (bird) are analyzed as impact topics. However, the following species have been dismissed from consideration.

The following species listed by the U.S. Fish and Wildlife Service in their July 2000 letter as occurring in Brewster or Terrell Counties, Texas (see appendix C), have been dismissed because they are not known to occur in the park. Neither are any actions proposed by this plan likely to impact them. In the following lists, (E) stands for endangered, (T) for threatened, (C) for candidate and (SOC) for species of concern.

Edwards Aquifer species:
- Comal Springs riffle beetle (E)
- Comal Springs dryopid beetle (E)
- Fountain darter (E)
- Peck's cave amphipod (E)
- San Marcos gambusia (E)
- Texas wild-rice (E)
- Texas blind salamander (E)
- San Marcos salamander (T)

Migratory species common to many or all counties:
- Least tern (E)
- Whooping crane (E)
- Piping plover (T)
- White-faced ibis (SOC)

Brewster County:
- Golden-cheeked warbler (E)
- Northern aplomado falcon (E)
- Southwestern willow flycatcher (E)
- Davis' green pitaya (E)
- Nellie cory cactus (E)
- Terlingua Creek cats-eye (E)
- Hinckley's oak (T)
- Mountain plover (T)

The bald eagle, a threatened species, does not nest at Big Bend. It is occasionally seen in the park along the Rio Grande. As a result of its only occasional presence in the park, it is very unlikely to be affected by any action taken to implement any alternative of the *General Management Plan*. Therefore impacts on the bald eagle will not be analyzed in this document.

Impacts on the following species were not analyzed because, although found in the park, they are not in any of the areas that would be affected by actions of any alternative of the *General Management Plan*. Management actions described in the "Servicewide Laws and Policies, Species of Special Concern" section, and in the mitigation listed near the end of this chapter, would ensure that these special species are inventoried and monitored and that mitigating measures would be taken as appropriate.

Bunched cory cactus (also known as Big Bend cory cactus) (T)
Chisos Mountain hedgehog cactus (T)
Lloyd's Mariposa cactus (T)
Tall paintbrush (C)
Guadalupe fescue (C)
Loggerhead shrike (SOC)
Mexican long-nosed bat (E)

The Texas Parks and Wildlife Department, Endangered Resource Branch, provided a Special Species List for Brewster County (see appendix C). Some species from the state list, other than those already described, occur in the general area. However, they are all unlikely to be affected because they are not known to occur in the immediate vicinity of alternative actions. Management actions described in the "Service-wide Laws and Policies, Species of Special Concern" section and mitigation measures listed at the end of the "Alternatives Including the Preferred Alternative" chapter would ensure that these special species are inventoried and monitored and that mitigating measures are taken as appropriate. This would make it very unlikely that these species would be impacted. Therefore, these species have been dismissed from further consideration.

Prime and Unique Farmland

In August 1980 the Council on Environmental Quality (CEQ) directed that federal agencies must assess the effects of their actions on farmland soils classified as prime or unique by the Natural Resource Conservation Service, U.S. Department of Agriculture. Prime or unique farmland is defined as soil that produces general crops such as common foods, forage, fiber, and oil seed. Unique farmland produces specialty crops such as fruits, vegetables, and nuts. According to the Natural Resource Conservation Service, Texas State office (pers. comm. 8/7/01), there are no prime or unique farmlands in Big Bend National Park; therefore, the topic of prime and unique farmland has been dismissed as an impact topic in this document.

Air Quality

Big Bend National Park is designated as a mandatory Class I air quality area under the National Clean Air Act of 1977. This most stringent air quality classification protects national parks and wilderness areas from air quality degradation. The Clean Air Act gives federal land mangers the responsibility for protecting air quality and related values, including visibility, plants, animals, soils, water quality, cultural resources, and public health from adverse air pollution impacts.

The monitoring of air quality at Big Bend began in 1982. The most significant air-quality-related value for the park is visibility. Air quality parameters are currently monitored through the use of the following instruments: automated camera; solar-powered satellite downloaded transmissometer; ozone monitoring module package; national atmospheric deposition program (NADP) sampler (wet side only) along with a rainfall event recorder; the IMPROVE particulate sampling system, and a digital camera at Panther Junction pointed toward a prominent landmark in Mexico.

Research since 1978 has shown that the park is among the NPS units having the most severely degraded air quality and visibility in the western United States. Threats to visibility and air quality include windblown dust, natural aerosols, and long-range transport of sulfates. Air quality is often degraded due to emissions of air pollutants transported from industrial and urban Texas Gulf Coast centers, heavy industries (e.g., smelters and steel mills) and power plants in northeastern Mexico.

The most current threat to increased visibility degradation is the construction of coal-fired electrical power plants near Piedras Negras, Mexico. These large power plants are designed to use a relatively high sulfur, high ash coal. Little or no technological engineering design to reduce fine particulates has been incorporated into the facilities. Negotiations with Mexico are currently underway in an attempt to mitigate this problem.

Although the park manages sources of air pollution in the park, works cooperatively with the Texas Commission on Environmental Quality regarding park visibility conditions, participates with the Air Resources division of the National Park Service to address regional haze issues in the central United States, and cooperates with the U.S. Environmental Protection Agency to monitor air quality, it has very little direct control over air quality in the air shed encompassing the park.

There are no general management plan proposals that, when considered along with required mitigation, would further impact air quality. Therefore, alternatives for this topic have not been developed and there would be no impacts on air quality from implementing any of the actions in the alternatives of this general management plan.

Water Quality in the Rio Grande

Most factors affecting water quality at Big Bend originate outside the park, (USDI, U.S.- Mexico Border Field Coordinating Committee in "Water Resources Issues in the Rio Grande–Rio Conchos to Amistad Reservoir Subarea, Fact Sheet 3,"April 1998). Many of them require coordination with regional or international groups. Park staff and others have developed a *Water Resources Management Plan* (NPS1996) that describes strategies the park will employ to address, among other issues, water quality. The water resources plan provides comprehensive treatment of this issue and is reaffirmed in the "Special Mandates and Administrative Commitments," section of the "Purpose, Need and Scoping," chapter of this document. Alternatives of the general management plan might impact water quality in the Rio Grande by raising fuel storage tanks above the level of the 500-year floodplain or protecting them from the 500-year flood. This would reduce the chances that fuel would enter floodwaters. Removing most development from Rio Grande Village in alternative C would reduce the number of vehicles in the area thereby reducing hydrocarbons that might drip from vehicles and find their way into the river. Therefore, water quality is not an impact topic in this document.

Traffic

Visitation to the park principally affects traffic on U.S. 385 from Marathon, Texas, to the main park road and traffic on Texas Route 118 from Alpine, Texas, to the main park road. There is very little traffic on either of these roads. None of the alternatives described would appreciably alter traffic on U.S. 385 and Texas 118, so there would be no impact on traffic. Therefore, the topic of traffic has been considered and dismissed.

Indian Trust Resources

President Clinton's April 29, 1994, "Memorandum for the Heads of Executive Departments and Agencies" directs that:

> Each executive department and agency shall assess the impact of federal government plans, projects, programs, and activities on tribal trust resources and assure that tribal government rights and concerns are considered during the development of such plans, projects, programs, and activities.

Also, order 3175 (Secretary of the Interior, November 8, 1993) states:

> The heads of bureaus and offices are responsible for being aware of the impact of their plans, projects, programs or activities on Indian trust resources. Bureaus and offices when engaged in the planning of any proposed project or action will ensure that any anticipated effects on Indian trust resources are explicitly addressed in the planning, decision and operational documents. These documents should clearly state the rationale for the recommended decision and explain how the decision will be consistent with the Department's trust responsibilities.

One definition of tribal trust resources (subsection B, section 3, Secretarial Order 3206, Babbitt 6/5/1997) is

> those natural resources, either on or off Indian lands, retained by, or reserved by or for Indian tribes through treaties, statutes, judicial decisions, and executive orders,

> which are protected by a fiduciary [trust] obligation on the part of the United States

None of the lands in Big Bend are trust resources according to this definition. Therefore, this topic has not been analyzed.

Environmental Justice

Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. No alternative would have health or environmental effects on minorities (including American Indian tribes) or low-income populations or communities as defined in the Environmental Protection Agency's *Environmental Justice Guidance* (1998). Environmental justice has been dismissed as an impact topic in this document.

LAWS, POLICIES, AND MANDATES

SPECIAL MANDATES AND ADMINISTRATIVE COMMITMENTS

This section identifies what must be done at Big Bend National Park to comply with federal laws and NPS policies. Many park management directives are specified in these mandates and are therefore not subject to alternative approaches. Big Bend has many other current plans and ongoing planning efforts. Those most directly related to the general management plan or potentially affected by it are listed below.

Letter of Intent Between The Department of the Interior (DOI) of the United States and The Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP) of the United Mexican States for Joint Work in Natural Protected Areas on the United States-Mexico Border

Under this agreement, the two agencies plan to expand cooperative activities in the conservation of contiguous natural protected areas in the border zone and to consider new opportunities for cooperation in the protection of natural protected areas on the United States-Mexico border. Among the listed areas are the wildlife protection areas in Mexico of Maderas del Carmen in Coahuila and Cañon de Santa Elena in Chihuahua, and the adjacent protected area in the United States, Big Bend National Park in Texas. Nothing in this *General Management Plan* would conflict with this letter of intent.

Wildfire Prevention Agreement with Mexico

An agreement with Mexico on the prevention of wildfires was signed in 1999. None of the actions proposed in this draft *General Management Plan* will conflict with the agreement.

Proposed Wilderness Classification

In 1984, as required by the Wilderness Act of 1964 (PL 88-577), the National Park Service published a *Final Environmental Impact Statement, Proposed Wilderness Classification, Big Bend National Park, Texas*. It proposed that 533,900 acres of the park be designated as wilderness and that an additional 25,700 acres be designated as potential wilderness addition. Until Congress acts on this proposal, the National Park Service will manage those lands as wilderness.

Water Resources Management Plan, Wildland Fire Management Plan, Backcountry Management Plan, Castolon Long-Range Interpretive Plan, Drought Contingency Plan, Water Conservation Plan

The "Water Resources Management Plan" was published in February 1995, the "Wildland Fire Management Plan" was approved in 1994, the "Backcountry Management Plan" was published in 1995, and the "Castolon Long Range Interpretive Plan" in 1997. A "Drought Contingency Plan" and a "Water Conservation Plan" are in draft form in summer 2002.This *General Management Plan* reaffirms these plans. No alternative of this plan suggests revisions.

Rio Grande Wild and Scenic River Management Plan

A segment of the Rio Grande was designated a national wild and scenic river in 1978 under the Wild and Scenic Rivers Act (16 USC 28 page 1274), making it a unit of the national park system. The unit is administered by Big Bend National Park. The National Park Service wrote a general management plan/development concept plan for the river in 1981, however, it was never approved. A river management plan is in progress for the Rio Grande Wild and Scenic River. Among other things, the plan evaluates segments that are not part of the wild and scenic

river for designation. A draft plan / environmental impact statement for the river is expected to go on public review in 2003. The GMP proposes no actions that could adversely affect the values that qualify the Rio Grande River for the national wild and scenic river system. None of the actions proposed in this draft *General Management Plan* conflict with the draft river management plan.

Wilderness Suitability Assessment

A Draft "Wilderness Suitability Assessment of North Rosillos/Harte Ranch in Big Bend National Park" was conducted by the National Park Service in December 2001 (see appendix E. This is the first required step in determining if all or part of this land is suitable for inclusion in the congressionally designated national wilderness preservation system. NPS regulations require the assessment of all national park system lands for wilderness suitability. Most of Big Bend National Park has already been studied for wilderness suitability, but the land in question was acquired in 1987 after the original park wilderness study was completed.

When the "Wilderness Suitability Assessment" has been approved by the Director of the National Park Service in Washington, D.C., the final determination of the area's suitability or nonsuitability as wilderness will be published in the *Federal Register*. If the area, or parts of the area, are determined suitable, a wilderness study will be conducted.

SERVICEWIDE LAWS AND POLICIES

As with all units of the national park system, the management of Big Bend National Park is guided by the 1916 Organic Act (which created the National Park Service), the General Authorities Act of 1970, the act of March 27, 1978, relating to the management of the national park system, and other applicable federal laws and regulations, such as the Endangered Species Act and the National Historic Preservation Act. Actions are also guided by the National Park Service's *Management Policies* (NPS 2001a). Also see "Appendix A: Legislation."

Many resource conditions and some aspects of visitor experience are prescribed by these legal mandates and NPS policies. This plan is not needed to decide, for instance, whether or not it is appropriate to protect endangered species, control exotic species, protect archeological sites, provide access for visitors with disabilities, or conserve artifacts. The plan will not explore alternatives because these things must be done. Although attaining some of these conditions set forth in these laws and policies has been temporarily deferred in the park because of funding or staffing limitations, the National Park Service will continue to strive to implement these requirements with or without a new general management plan.

The conditions prescribed by laws, regulations, and policies most pertinent to the planning and management of the park are summarized in this chapter.

Natural Resource Management Requirements

SOILS Current laws and policies require that the following conditions be achieved in the park:	
Desired Condition	**Source**
The Service will actively seek to understand and preserve the soil resources of parks, and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources.	NPS *Management Policies*
Management action will be taken by superintendents to prevent – or if that is not possible, to minimize – adverse, potentially irreversible impacts on soils. Soil conservation and soil amendment practices may be implemented to reduce impacts. Importation of offsite soil or soil amendments may be used to restore damaged sites. Offsite soil normally will be salvaged soil, not soil removed from pristine sites, unless the use of pristine site soil can be achieved without causing any overall ecosystem impairment. Before using any offsite materials, parks must develop a prescription, and select the materials that will be needed to restore the physical, chemical, and biological characteristics of original native soils without introducing any exotic species.	NPS *Management Policies*
When soil excavation is an unavoidable part of an approved facility development project, the Park Service will minimize soil excavation, erosion, and offsite soil migration during and after the development activity.	NPS *Management Policies*
When use of a soil fertilizer or other soil amendment is an unavoidable part of restoring a natural landscape or maintaining an altered plant community, the use will be guided by a written prescription. The prescription will be designed to ensure that such use of soil fertilizer or soil amendment does not unacceptably alter the physical, chemical, or biological characteristics of the soil, biological community, or surface or ground waters.	NPS *Management Policies*
Compliance Actions The National Park Service will take the following kinds of actions to meet legal and policy requirements related to soils:	
• Update soils map of the park in digital format that can be used in the park's geographic information system (GIS). • Whenever possible, park staff would educate visitors about soils.	

WATER RESOURCES

Current laws and policies require that the conditions delineated below be achieved in the park:

Desired Condition	Source
Surface water and groundwater will be restored or enhanced.	Clean Water Act; Executive Order (EO) 11514; NPS *Management Policies*
NPS and NPS-permitted programs and facilities will be maintained and operated to avoid pollution of surface water and groundwater.	Clean Water Act; EO 12088; Rivers and Harbors Act; NPS *Management Policies*

Compliance Actions

The National Park Service will take the following kinds of actions (listed in priority order) to meet legal and policy requirements related to water resources:

- Determine which methods can be used to ensure minimum flows under state and federal law and/or international efforts.
- Determine minimum flow needs to sustain aquatic life and provide recreational boating opportunities.
- Investigate and monitor water quality including salinity and trace elements. Study the effects of the water quality on aquatic life.
- Determine methods to restore the Rio Grande to a sustainable river ecosystem with a native riparian vegetation community and natural river geomorphology.
- Promote water conservation by the Park Service, concessioner, visitors, and park neighbors.
- Apply best management practices to all pollution-generating activities and facilities in the park, such as NPS maintenance and storage facilities and parking areas; minimize the use of pesticides, fertilizers, and other chemicals and manage them in keeping with NPS policy and federal regulations.
- Continue to monitor water flows and quality and to participate in the Texas Watch program.
- Continue to work with the Rio Grande Compact Commission, the International Boundary and Water Commission, the U.S. Geological Survey, the Bureau of Reclamation, and the Texas Commission on Environmental Quality to explore long-term strategies to ensure minimum flow levels and treaty compliance.
- Work with other entities to determine the impact on local aquifers of Big Bend National Park, Big Bend Ranch State Park, Black Gap Wildlife Management Area, and gateway communities.
- Work through or with other entities to ameliorate known water quality problems.
- Promote, with the assistance of other agencies, the development of pretreatment programs for existing and new maquiladora facilities along the Rio Grande and Rio Conchos.
- Press for continued and expanded monitoring to fulfill the database requirement and thus reveal any unknown water quality problems.
- Continue to follow the recommendations of the 1996 *Water Resources Management Plan for Big Bend National Park* (National Park Service).
- Work with interested groups along the border to achieve cooperative ecosystem management of the Rio Grande corridor through a long-term, comprehensive plan for conservation and use.

THREATENED AND ENDANGERED SPECIES Current laws and policies require that the following conditions be achieved in the park:	
Desired Condition	**Source**
Federally listed and state-listed threatened and endangered species and their habitats will be sustained.	Endangered Species Act; NPS *Management Policies*
The management of populations of exotic plant and animal species, up to and including eradication, will be undertaken wherever such species threaten park resources or public health and when control is prudent and feasible.	NPS *Management Policies*; EO 13112, "Invasive Species"
Native species populations that have been severely reduced in or extirpated from the park will be restored where feasible and sustainable.	NPS *Management Policies*

Compliance Actions

The National Park Service will take the following kinds of actions (listed in priority order) to meet legal and policy requirements related to species of special concern:

- Complete an inventory of plants and animals in the park and regularly monitor the distribution and condition (e.g., health, disease) of selected species that are (a) indicators of ecosystem condition and diversity, (b) rare or protected species, (c) invasive exotics, (d) native species capable of creating resource problems (e.g., habitat decline due to overpopulation).
- Develop a long-term program for reversing the destructive effects of exotic species.
- Study the environmental and ecological effects of exotic species invasion to assess threats and prioritize management actions.
- Undertake research to assess the methods by which new species become established and spread into native plant communities so that strategies for preventing introduction and establishment can be developed and implemented.
- Develop methods to restore native grasslands and stabilize eroding areas.
- Research soil properties including nutrients, microorganisms and soil crusts to learn how to restore native plant communities.
- Determine source of soil nutrients and the effects of atmospheric pollution on soils and soil biological crusts.
- Develop and institute annual mountain lion and bear population monitoring strategies.
- Develop and institute a food source monitoring strategy to identify periods when insufficient food is available.
- Determine the frequency and extent of human-caused lion mortality in the park lion population due to administrative actions.
- Determine genetic integrity and viability of the mountain lion population through DNA analysis (already done for bears). Establish and implement bear and lion genetic monitoring strategies for cyclic implementation.
- Monitor bighorn population movements, habitat use, reproduction and predation. Determine threats to population growth and recolonization of park habitat.

FLOODPLAINS Current laws and policies require that the conditions delineated below be achieved in the park:	
Desired Condition	**Source**
Natural floodplain values will be preserved or restored.	EO 11988; Rivers and Harbors Act; NPS *Management Policies;* Special Directive 93-4
Long-term and short-term environmental effects associated with the occupancy and modification of floodplains will be avoided. When it is not practicable to locate or relocate development or inappropriate human activities to a site outside the floodplain or where the floodplain will not be affected, the National Park Service will • Prepare and approve a statement of findings in accordance with DO 77-2. • Use nonstructural measures as much as practicable to reduce hazards to human life and property while minimizing impacts on the natural resources of floodplains. • Ensure that structures and facilities are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR 60). • Avoid direct or indirect support of new construction in wetlands unless there are no reasonable alternatives and the preferred alternative includes all practicable measures to minimize harm to wetlands. • Compensate for remaining unavoidable adverse impacts on wetlands by restoring wetlands that have been previously destroyed or degraded.	DO 77-2, "Floodplain Management"; National Flood Insurance Program (44 CFR 60); NPS *Management Policies*
Compliance Actions The National Park Service will take the following kinds of actions to meet legal and policy requirements related to floodplains:	
• Continue to follow the recommendations of the 1996 *Water Resources Management Plan for Big Bend National Park* (National Park Service). • Prepare a quantitative analysis of flood depth to allow park staff to develop appropriate mitigation measures for the flash flood prone area at Panther Junction. • Remove from the 500-year floodplain or protect from the 500-year flood the diesel, gasoline, and propane storage tanks that are marginally within the 100-year floodplain at Rio Grande Village, or protect them as required by NPS policy. Should an alternative such as constructing an embankment be chosen, a statement of findings would be prepared and approved. • Establish a flood awareness, preparedness and warning system to evacuate the most flood and erosion prone structures at Panther Junction, Rio Grande Village, and Cottonwood Campground at times of imminent danger. • Any future construction on the Panther Junction alluvial fan would be accompanied by a statement of findings describing the need to develop within the maximum estimated flood (Q_{me}), the flood hazard associated with the proposed development site, and the plans for mitigation of this flood hazard. • Visitors including those hiking, parking and picnicking in or near small channels, would be made aware of hazards associated with flash flooding and informed of what to do when water is flowing in low-water road crossings. • The camping area at Terlingua Abaja, an area susceptible to flash flooding, will be relocated a few hundred feet away on higher ground, and/or visitor instructions will be provided describing necessary action in the case of extreme flooding. • At Castolon, unstable bank areas will be clearly marked in order to reduce risk to visitors.	

WETLANDS Current laws and policies require that the conditions delineated below be achieved in the park:	
Desired Condition	**Source**
The natural and beneficial values of wetlands will be preserved and enhanced.	Clean Water Act; EO 11990; NPS *Management Policies;* DO 77-1, "Wetland Protection"; Rivers and Harbors Act
The National Park Service will implement a "no net loss of wetlands" policy and strive to achieve a longer-term goal of net gain of wetlands across the national park system through the restoration of previously degraded or destroyed wetlands.	DO 77-1, "Wetland Protection"; EO 11514
Compliance Actions The National Park Service will take the following kinds of actions to meet legal and policy requirements related to wetland resources:	
• Determine methods to restore the Rio Grande to a sustainable river ecosystem with a native riparian vegetation community and natural river geomorphology. • Continue to follow the recommendations of the 1996 *Water Resources Management Plan for Big Bend National Park* (National Park Service). • All facilities would be located to avoid wetlands if feasible. If avoiding wetlands was not feasible, other actions would be taken to comply with Executive Order 11990 ("Protection of Wetlands"), the Clean Water Act, and Director's Order 77-1 ("Wetland Protection"). • A statement of findings for wetlands will be prepared if the selected alternative would result in adverse impacts on wetlands. The statement of findings would include an analysis of the alternatives, delineation of the wetland, a wetland restoration plan to identify mitigation, and a wetland functional analysis of the impact site and restoration site.	

WILDERNESS	
The National Park Service will manage wilderness areas including those proposed for wilderness designation for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness.	
Desired Condition	**Source**
Each park containing wilderness resources will develop and maintain a wilderness management plan or equivalent planning document to guide the preservation, management and use of these resources. The wilderness management plan will identify desired future conditions, as well as establish indicators, standards, conditions, and thresholds beyond which management actions will be taken to reduce human impacts to wilderness resources.	NPS *Management Policies,* DO 41 "Wilderness Preservation and Management"
If new areas of 5,000 acres or more are added to a park, a wilderness suitability assessment will be undertaken.	
Compliance Actions	
The National Park Service will take the following kinds of actions (listed in priority order) to comply with the policies mentioned above.	
• A wilderness suitability assessment of the North Rosillos/Harte Ranch will be undertaken and included in Appendix E of this *General Management Plan*. • Managers contemplating the use of aircraft or other motorized equipment or mechanical transportation within wilderness must consider impacts to the character, aesthetics, and traditions of wilderness before considering the costs and efficiency of the equipment. • In evaluating environmental impacts, the National Park Service will take into account wilderness characteristics and values, including the primeval character and influence of the wilderness; the preservation of natural conditions (including the lack of man-made noise); and assurances that there will be outstanding opportunities for solitude, that the public will be provided with a primitive and unconfined type of recreational experience, and that wilderness will be preserved and used in an unimpaired condition. Managers will be expected to appropriately address cultural resources management considerations in the development and review of environmental compliance documents for actions that might impact wilderness resources. • Scientific activities will be encouraged and permitted when consistent with NPS responsibilities to preserve and manage wilderness.	

AIR QUALITY

The park is a class I air quality area. Current laws and policies require that the following conditions be achieved in the parks.

Desired Condition	Source
Inventory the air quality-related values associated with each park. Monitor and document the condition of air quality and related values. Evaluate air pollution impacts and identify causes. Minimize air quality pollution emissions associated with park operations, including the use of prescribed fire and visitor use activities. Ensure healthful indoor air quality at NPS facilities.	Clean Air Act, NPS *Management Policies*

Compliance Actions

The National Park Service will take the following kinds of actions (listed in priority order) to meet legal and policy requirements related to air quality.

Although the National Park Service has very little direct control over air quality in the air shed encompassing the park, park managers will continue to cooperate with the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency to monitor air quality and ensure that air quality is not impaired.

- Research effects of atmospheric deposition on plants, soils and wetlands in Big Bend National Park.
- Determine changes in ecosystem function caused by atmospheric deposition and assess the resistance and resilience of native ecosystems in the face of these external perturbations.
- Participate in federal, regional, and local air pollution control plans and drafting of regulations and review permit applications for major new air pollution sources
- Conduct operations in compliance with federal, state, and local air quality regulations.
- Maintain constant dialogue with the Texas Commission on Environmental Quality regarding visibility conditions at the park.
- Participate with the Air Resources Division on the regional planning group that includes TNRCC that was formed to address regional haze issues in the central United States.

GEOLOGIC RESOURCES Current laws and policies require that the following conditions be achieved in the park:	
Desired Condition	**Source**
Preserve and protect geologic resources as integral components of park natural systems. The Park Service will (1) assess the impacts of natural processes and human-related events on geologic resources (2) maintain and restore the integrity of existing geologic resources; (3) integrate geologic resource management into Service operations and planning; and (4) interpret geologic resources for park visitors.	NPS *Management Policies*
Paleontological resources, including both organic and mineralized remains in body or trace form, will be protected, preserved and managed for public education, interpretation, and scientific research. Superintendents will establish programs to inventory paleontological resources and systematically monitor for newly exposed fossils, especially in areas of rapid erosion.	NPS *Management Policies*
The Park Service will manage caves in accordance with approved cave management plans to perpetuate the natural systems associated with the caves.	NPS *Management Policies*
Compliance Actions The National Park Service will take the following kinds of actions (listed in priority order) to meet legal and policy requirements related to geologic resources:	
• Update geologic map of the park in digital format that can be used in the park's geographic information system (GIS). • Update geologic history of the park, using modern theory and techniques. • Update geologic interpretations of localities that are the subject of interpretive stops or displays. • Prepare a geologic inventory, including the identification of the significant geologic processes that shape park ecosystems and the identification of the human influences on those geologic processes (i.e., "geoindicators"); identification of geologic hazards; inventory of type sections or type localities within the park; inventory of "textbook" localities that provide particularly good or well-exposed examples of geologic features or events, and that may warrant special protection or interpretive efforts; and, identification of interpretive themes or other opportunities for interpreting the significant geologic events or processes that are preserved, exposed, or occur in the park. • Prepare a cave survey, including maps, locations, and assessments of park caves, using NPS protocols. • Prepare a cave management plan. • Undertake a paleontological inventory and survey, including information on paleontological research that has already been performed in the park, lists of fossil species found in the park, maps of high probability areas expected to produce fossils, recommendations for future research, identification of threats to fossil resources, and strategies for their protection. • Prepare a paleontology site layer for the park's GIS (i.e., database of fossil localities that have been excavated or are known to contain fossils).	

NATURAL SOUNDS

An important part of the NPS mission is to preserve or restore the natural soundscapes associated with national parks. The sounds of nature are among the intrinsic elements that combine to form the environment of our national parks. Current laws and policies require that the following conditions be achieved in the park:

Desired Condition	Source
The National Park Service will preserve the natural ambient soundscapes, restore degraded soundscapes to the natural ambient condition wherever possible, and protect natural soundscapes from degradation due to human-caused noise. Disruptions from recreational uses will be managed to provide a high-quality visitor experience in an effort to preserve or restore the natural quiet and natural sounds.	NPS *Management Policies,* DO 47,"Sound Preservation and Noise Management"
Noise sources are managed to preserve or restore the natural soundscape.	Executive memorandum signed by President Clinton on April 22, 1996

Compliance Actions

The National Park Service will take the following kinds of actions (listed in priority order) to comply with the policies mentioned above.

- Actions will be taken to prevent or minimize unnatural sounds that adversely affect park resources or values or visitors' enjoyment of them.
- The National Park Service will work with the Federal Aviation Administration (FAA), tour operators, commercial businesses, and general aviation interests to encourage aircraft to fly outside the park, especially for flights where the presence of the park is incidental to the purpose of the flight (i.e., transit between two points). Actions that might be considered to encourage pilots to fly outside the park include identifying the park on route maps as a noise-sensitive area, educating pilots about the reasons for keeping a distance from the park, and encouraging pilots to comply with FAA regulations and advisory guidance, in a manner that will minimize noise and other impacts.
- The park staff will continue to require tour bus companies to comply with regulations designed to reduce noise levels (e.g., turning off engines when buses are parked).
- Noise generated by NPS management activities will be minimized by strictly regulating administrative functions such as the use of motorized equipment. Noise will be a consideration in the procurement and use of equipment by the park staff.

NIGHT SKY

The park's night sky is a feature that contributes to visitors' experiences. Current laws and policies require that the following conditions be achieved in the park:

Desired Condition	Source
The National Park Service will cooperate with park neighbors and local government agencies to find ways to minimize the intrusion of artificial light into the night scene in the park. In natural areas, artificial outdoor lighting will be limited to basic safety requirements and will be shielded when possible.	NPS *Management Policies*

Compliance Actions

The National Park Service will take the following kinds of actions to comply with the policy mentioned above:

- The park staff will work with local communities and other agencies to encourage the protection of the night sky.
- The park staff will evaluate the impacts on the night sky caused by park facilities. If light sources in the park are affecting night skies, the staff will study alternatives such as shielding lights, changing lamp types, or eliminating unnecessary sources.
- A new Brewster County ordinance protects the night skies and the park will work with the county to reduce or eliminate the impacts of artificial outdoor lighting.

WILDLAND FIRE	
Current laws and policies require that the following conditions be achieved in the park:	
Desired Condition	**Source**
Park fire management programs will be designed to meet resource management objectives prescribed for the various areas of the park and to ensure that the safety of firefighters and the public are not compromised.	NPS *Management Policies;* DO 41, "Wilderness Preservation and Management"
All fires burning in natural or landscaped vegetation will be classified as either wildland fires or prescribed fires. All wildland fires will be effectively managed, considering resource values to be protected and firefighter and public safety, using the full range of strategic and tactical operations as described in an approved fire management plan. Prescribed fires are those fires ignited by managers to achieve resource objectives. To provide information on whether specified objectives are met, monitoring programs will be instituted for such fires to record fire behavior, smoke behavior, fire decisions, and fire effects.	NPS *Management Policies*
Compliance Actions	
The National Park Service will take the following kinds of actions to meet legal and policy requirements related to management of wildland fire:	
Periodically revise the "Fire Management Plan" to reflect changes in wildland fire policy, fire use applications, and the body of knowledge on fire effects within the park's vegetation types.	

WILD AND SCENIC RIVERS	
Current laws and policies require that the conditions delineated below be achieved in the park:	
Desired Condition	**Source**
The values that qualify the river for designation under the act will be preserved.	Wild and Scenic Rivers Act; NPS *Management Policies*
Compliance Actions	
The National Park Service will take the following kinds of actions to meet legal and policy requirements related to wild and scenic rivers:	
• The park will ensure that no management actions are undertaken that could adversely affect the values that qualify the Rio Grande for inclusion in the National Wild and Scenic Rivers System.	

BACKCOUNTRY	
The National Park Service will manage backcountry areas for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment.	
Desired Condition	**Source**
Backcountry use will be managed in accordance with a backcountry management plan (or other plan addressing backcountry uses) that is designed to avoid unacceptable impacts on park resources or adverse affects on visitor enjoyment of appropriate recreational experiences. The Park Service will seek to identify acceptable limits of impacts, monitor backcountry use levels and resource conditions, and take prompt corrective action when unacceptable impacts occur.	NPS *Management Policies*
Compliance Actions	
The National Park Service will take the following kinds of actions to comply with the policies mentioned above.	
• The park's backcountry management plan will be updated to avoid unacceptable impacts on park resources or adverse affects on visitor enjoyment of appropriate recreational experiences. • Special attention will be paid to occupancy limits in primitive road sites and the zone areas.	

LAND PROTECTION	
The National Park Service will manage for protection of park lands.	
Desired Condition	**Source**
Land protection plans should be prepared to determine and publicly document what lands or interests in land need to be in public ownership, and what means of protection are available to achieve the purposes for which the unit was created.	NPS *Management Policies*
Compliance Actions	
The National Park Service will take the following kinds of actions to comply with the policies mentioned above.	
• Prepare a land protection plan for the park.	

Cultural Resource Management Requirements

ARCHEOLOGICAL RESOURCES Current laws and policies require that the following conditions be achieved in the parks:	
Desired Condition	**Source**
Archeological sites will be identified and inventoried and their significance determined and documented. Archeological sites will be protected in an undisturbed condition unless it is determined through formal processes that disturbance or natural deterioration is unavoidable. When disturbance or deterioration is unavoidable, the site will be professionally documented and excavated and the resulting artifacts, materials, and records curated and conserved in consultation with the Texas Historical Commission (state historic preservation office) and American Indian tribes. Some archeological sites that could be adequately protected might be interpreted to the visitor.	National Historic Preservation Act; EO 11593; Archeological Resources Protection Act; the *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation;* programmatic memorandum of agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); NPS *Management Policies*, DO 28 "Cultural Resource Management Guideline"
Compliance Actions The National Park Service will take the following kinds of actions (listed in priority order) to meet legal and policy requirements related to archeological sites:	
• Conduct a parkwide cultural resource inventory. • Identify and inventory archeological sites park wide, determine and document their significance. The most critical area for study is park land where development or visitor activity is planned. • Determine which archeological sites should be added to the Archeological Sites Management Information System (ASMIS) and the National Register of Historic Places. • Educate visitors on regulations governing archeological resources and their removal and transport. • Monitor archeological sites. • Treat all archeological resources as eligible for listing on the National Register of Historic Places pending a formal determination by the National Park Service and the Texas Historical Commission (state historic preservation office) as to their significance. • Protect all archeological resources eligible for listing or listed on the national register; if disturbance to such resources is unavoidable, conduct formal consultation with the Advisory Council on Historic Preservation, as appropriate, and the Texas Historical Commission (state historic preservation office) and Indian tribes in accordance with the National Historic Preservation Act and implementing regulations.	

ETHNOGRAPHIC RESOURCES Certain contemporary American Indian and other communities are permitted by law, regulation, or policy to pursue customary religious, subsistence, and other cultural uses of NPS resources with which they are traditionally associated. Recognizing that its resource protection mandate affects this human use and cultural context of park resources, the National Park Service plans and executes programs in ways to safeguard cultural and natural resources while reflecting informed concern for contemporary peoples and cultures traditionally associated with them.	
Desired Condition	**Source**
Appropriate cultural anthropological research will be conducted in cooperation with groups associated with the park.	National Historic Preservation Act; Advisory Council for Historic Preservation implementing regulations; NPS *Management Policies*, DO 28 "Cultural Resource Management Guideline"
All agencies, including the National Park Service, are required to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of these sacred sites.	EO 13007 on American Indian Sacred Sites; American Indian Religious Freedom Act
NPS general regulations on access to and use of natural and cultural resources in parks will to the extent practicable, permitted by law, and not clearly inconsistent with agency functions be applied in an informed and balanced manner consistent with park purposes. Also, the Park Service will not unreasonably interfere with any American Indian use of traditional areas or sacred resources that does not result in the degradation of resources. Consumptive use of sacred resources is permitted only to the extent authorized by 36 CFR subsections 2.1(c) and 2.1(d).	EO 13007 on American Indian Sacred Sites; American Indian Religious Freedom Act; NPS *Management Policies*
Other federal agencies, state and local governments, potentially affected American Indian and other communities, interested groups, the state historic preservation officer, and the Advisory Council on Historic Preservation will to the greatest extent practicable, and to the extent permitted by law, be given opportunities to become informed about and comment on anticipated NPS actions at the earliest practicable time.	National Historic Preservation Act; programmatic memorandum of agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); EO 11593; American Indian Religious Freedom Act; Native American Graves Protection and Repatriation Act; EO 13007 on American Indian Sacred Sites, Presidential memorandum of April 29, 1994, on government-to-government relations with tribal governments; NPS *Management Policies*
All agencies are required to consult with tribal governments before taking actions that affect federally recognized tribal governments. These consultations are to be open and candid so that all interested parties may evaluate for themselves the potential impact of relevant proposals. Parks (including Big Bend National Park) must regularly consult with traditionally associated American Indians regarding planning, management, and operational decisions that affect subsistence activities, sacred materials or places, or other ethnographic resources with which they are historically associated.	American Indian Religious Freedom Act; Presidential memorandum of April 29, 1994, on government-to-government relations with tribal governments; National Historic Preservation Act; Advisory Council for Historic Preservation implementing regulations

ETHNOGRAPHIC RESOURCES (cont.)	
The identities of community consultants and information about sacred and other culturally sensitive places and practices will be kept confidential when research agreements or other circumstances warrant.	National Historic Preservation Act; NPS *Management Policies*
Desired Condition	**Source**
American Indians and other individuals and groups linked by ties of kinship or culture to ethnically identifiable human remains, sacred objects, objects of cultural patrimony, and associated funerary objects will be consulted when such items may be disturbed or are encountered on park lands.	NPS *Management Policies;* Native American Graves Protection and Repatriation Act

Compliance Actions

To accomplish the above goals, the National Park Service will do the following (listed in priority order):

- Prepare a cultural affiliation study to determine which tribes should be consulted for actions at Big Bend.
- Prepare an ethnographic overview and assessment.
- Continue to provide access to sacred sites and park resources by American Indians when the use is consistent with park purposes and the protection of resources.
- Survey and inventory ethnographic resources and document their significance.
- Treat all ethnographic resources as eligible for listing on the National Register of Historic Places pending a formal determination by the National Park Service and the state historic preservation officer as to their significance.
- Protect all ethnographic resources determined eligible for listing or listed on the national register. If disturbance of such resources is unavoidable, conduct formal consultation with the Advisory Council for Historic Preservation, as appropriate, with the state historic preservation officer, and with American Indian tribes. This consultation will be in accordance with the National Historic Preservation Act and the Advisory Council for Historic Preservation implementing regulations and programmatic agreement.
- Conduct regular consultations with affiliated tribes to continue to improve communications and resolve any problems or misunderstandings that occur.
- Continue to encourage the employment of American Indians on the park staff to improve communications and working relationships and encourage cultural diversity in the workplace.

HISTORIC BUILDINGS/STRUCTURES

Current laws and policies require that the following conditions be achieved for historic properties (e.g., buildings, structures, roads, trails, or cultural landscapes):

Desired Condition	Source
Historic structures and cultural landscapes will be inventoried and their significance and integrity evaluated under National Register of Historic Places criteria. The qualities that contribute to the listing or eligibility for listing of historic properties on the national register will be protected in accordance with the *Secretary of the Interior's Standards* (unless it is determined through a formal process that disturbance or natural deterioration is unavoidable).	National Historic Preservation Act; EO 11593; Archeological and Historic Preservation Act; the *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; Secretary of the Interior's Standards for the Treatment of Historic Properties, with Guidelines for the Treatment of Cultural Landscapes;* programmatic memorandum of agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); NPS *Management Policies,* DO 28 "Cultural Resource Management Guideline."

Compliance Actions

The National Park Service will take the following kinds of actions (listed in priority order) to meet legal and policy requirements related to historic properties:

- Update and certify the list of classified structures (LCS) and complete the Level 2 cultural landscape inventory.
- Determine the appropriate level of preservation for each historic property formally determined to be eligible for listing or listed on the National Register of Historic Places (subject to the *Secretary of the Interior's Standards*).
- Implement and maintain the appropriate level of preservation for such properties.
- Analyze the design elements (e.g., materials, colors, shape, massing, scale, architectural details, and site details) of historic structures and cultural landscapes in the park (e.g., intersections, curbing, signs, and roads and trails) to guide the rehabilitation and maintenance of sites and structures.
- Before modifying any historic properties on the National Register of Historic Places, such as Barker Lodge at Rio Grande Village or the Castolon Historic District, the Park Service will consult with the state historic preservation officer and the Advisory Council for Historic Preservation, as appropriate.
- Before modifying any structures associated with "Mission 66," the structures would be evaluated for listing on the national register in consultation with the state historic preservation office.

COLLECTIONS

Current laws and policies require that the following conditions be achieved in the park for museum collections:

Desired Condition	Source
All museum objects and manuscripts will be identified and inventoried, catalogued, documented, preserved, protected, and provision made for their access to and use for exhibits, research, and interpretation. The qualities that contribute to the significance of collections will be protected in accordance with established standards.	National Historic Preservation Act; American Religious Freedom Act; Archeological and Historic Preservation Act; Archeological Resources Protection Act; Native American Graves Protection and Repatriation Act; NPS *Management Policies*, DO 28 "Cultural Resource Management Guideline"

Compliance Actions

To accomplish the above goals, the National Park Service will do the following (listed in priority order):

- Inventory and catalog all park museum collections in accordance with standards in the NPS *Museum Handbook.*
- Develop and implement a collection management program according to NPS standards to guide the protection, conservation, and use of museum objects.
- Remove collections from the floodplain at Panther Junction or protect them against flooding as required by NPS policy.

VISITOR UNDERSTANDING AND PARK USE REQUIREMENTS Current laws, regulations, and policies leave considerable room for judgment about the best mix of types and levels of visitor use activities, programs, and facilities. For this reason, most decisions related to visitor experience and use are addressed in the section "What Might Be Achieved," below, and in the alternatives. However, the authority to charge fees is dictated by law and is therefore the same for all alternatives.	
Desired Condition	**Source**
Visitor and employee safety and health will be protected.	NPS *Management Policies*
Visitors will understand and appreciate park values and resources and have the information necessary to adapt to the park's environments; visitors will have opportunities to enjoy the national park in ways that leave the resources unimpaired for future generations.	NPS Organic Act; NPS *Management Policies;* DO 22, "Fee Collection"
Recreational uses will be promoted and regulated, and basic visitor needs will be met in keeping with park purposes.	NPS Organic Act; Title 36 of the Code of Federal Regulations (CFR); NPS *Management Policies.*
All reasonable efforts will be made to make buildings and facilities of the NPS accessible to and usable by all people including those with disabilities.	Architectural Barriers Act of 1968; Americans with Disabilities Act of 1990; 28 CFR Part 36 on Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities (ADAAG – ADA Accessibility Guidelines for Buildings and Facilities); Uniform Federal Accessibility Standards of 1984 (UFAS); US Access Board Draft Accessibility Guidelines for Outdoor Developed Areas of 1999; NPS Management Policies; DO 42 – Director's Orders: Accessibility for Visitors with Disabilities in NPS Programs, Facilities, and Services
All reasonable efforts will be made to make programs and services of the NPS accessible to and usable by all people including those with disabilities.	Rehabilitation Act of 1973; Secretary of the Interior's regulation 43 CFR 17 – Enforcement on the Basis of Disability in the Interior Programs; NPS Management Policies; DO 42 – Director's Orders: Accessibility for Visitors with Disabilities in NPS Programs, Facilities, and Services
Visitors who use federal facilities and services for outdoor recreation may be required to pay a greater share of the cost of providing those opportunities than the population as a whole.	NPS *Management Policies;* 1998 Executive Summary to Congress; Recreational Fee Demonstration Program, *Progress Report to Congress,* vol. 1*: Overview and Summary* (U.S. Department of the Interior, National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management; U.S. Department of Agriculture, Forest Service)
The park will identify implementation commitments for visitor carrying capacities for all areas of the unit.	1978 National Parks and Recreation Act (PL 95-625), NPS *Management Policies*
Compliance Actions The National Park Service will take the following kinds of actions to meet legal and policy requirements related to visitor understanding and use of the national park unit:	

- Give visitors the opportunity to understand, appreciate, and enjoy the park (management directions within this broad policy are discussed in the alternatives).
- Continue to enforce the regulations governing visitor use and behavior in Title 36 of the *Code of Federal Regulations* (36 CFR).
- **Architectural and Site Access.** The National Park Service would develop strategies to ensure that all new and renovated buildings and facilities, including those provided by concessioners are designed and constructed in conformance with applicable rules, regulations and standards. Existing buildings and facilities would be evaluated to determine the degree to which they are currently accessible to and usable by people with disabilities, and to identify barriers that limit access. Action plans would be developed identifying how barriers would be removed. Action plan elements and funding strategies would be included within annual and strategic (5-year) plans.
- **Programmatic Access.** The National Park Service would develop strategies to ensure that all services and programs, including those offered by concessioners, volunteers, cooperating associations, and interpreters, are designed and implemented in conformance with applicable rules, regulations and standards. Existing programs, activities, and services (including interpretation, telecommunications, media, and web pages) would be evaluated to determine the degree to which they are currently accessible to and usable by people with disabilities, and to identify barriers to access. Action plans would be developed identifying how barriers would be removed. Action plan elements and funding strategies would be included within annual and strategic (5-year) plans.
- The park will continue to monitor visitor comments on issues such as crowding, encounters with other visitors in the backcountry, availability of campsites at busy times of the year, availability of parking and visitor encounters with bears. Should bear encounters increase to a level unacceptable to the park, actions such as seasonal closures, moving trails, reduction of visitor numbers in the area and increased education would be taken. Should any of the trends increase to levels unacceptable to park management, the National Park Service will undertake detailed planning to establish visitor carrying capacity strategies and monitoring programs. Studies will determine what levels of visitation will be consistent with the experiences that visitors desire and preservation of park resources.

SUSTAINABLE DESIGN/DEVELOPMENT

Sustainability can be described as the result achieved by managing units of the national park system in ways that do not compromise the environment or its capacity to provide for present and future generations. Sustainable practices minimize the short- and long-term environmental impacts of developments and other activities through resource conservation, recycling, waste minimization, and the use of energy-efficient and ecologically responsible materials and techniques.

Desired Condition	Source
NPS and concessioner visitor management facilities will be harmonious with park resources, compatible with natural processes, aesthetically pleasing, functional, as accessible as possible to all segments of the population, energy-efficient, and cost-effective.	NPS *Management Policies*; EO 13123, "Greening the Government through Efficient Energy Management"; EO 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition"; NPS *Guiding Principles of Sustainable Design;* DO 13, "Environmental Leadership"; DO 90, "Value Analysis."

Compliance Actions

The NPS *Guiding Principles of Sustainable Design* (1993b) directs NPS management philosophy. It provides a basis for achieving sustainability in facility planning and design, emphasizes the importance of biodiversity, and encourages responsible decisions. The guidebook articulates principles to be used in the design and management of tourist facilities that emphasize environmental sensitivity in construction, the use of nontoxic materials, resource conservation, recycling, and integrating visitors with natural and cultural settings. Sustainability principles have been developed and are followed for interpretation, natural resources, cultural resources, site design, building design, energy management, water supply, waste prevention, and facility maintenance and operations. The Park Service also reduces energy costs, eliminates waste, and conserves energy resources by using energy-efficient and cost-effective technology. Energy efficiency is incorporated into the decision-making process during the design and acquisition of buildings, facilities, and transportation systems emphasizing the use of renewable energy sources.

In addition to following these principles, the following also will be accomplished:

- The staff of the national park will work with appropriate experts to make park facilities and programs sustainable. Value analysis and value engineering, including life cycle cost analysis, will be performed to examine the energy, environmental, and economic implications of proposed developments.
- The park staff will support and encourage suppliers, permittees, and contractors to follow sustainable practices.
- Interpretive programs at the national park will address sustainable practices within and outside of the national park unit.

RIGHTS-OF-WAY AND TELECOMMUNICATION INFRASTRUCTURE Current laws and policies require that the following conditions be achieved in the national park:	
Desired Condition	**Source**
Park resources or public enjoyment of the park will not be denigrated by nonconforming uses. Telecommunication structures will be permitted in the park to the extent that they do not jeopardize the park's mission and resources. No new nonconforming use or rights-of-way will be permitted through the park without specific statutory authority and approval by the director of the National Park Service or his representative, and will be permitted only if there is no practicable alternative to such use of NPS lands.	Telecommunications Act; 16 USC 79; 23 USC 317; 36 CFR 14; NPS *Management Policies;* DO 53A, "Wireless Telecommunications"; Reference Manual 53, "Special Park Uses."
Compliance Actions	
The Telecommunications Act of 1996 directs all federal agencies to assist in the national goal of achieving a seamless telecommunications system throughout the United States by accommodating requests by telecommunication companies for the use of property, rights-of-way, and easements to the extent allowable under each agency's mission. The National Park Service is legally obligated to permit telecommunication infrastructure in the parks if such facilities can be structured to avoid interference with park purposes. The management of Big Bend National Park has determined that because of the scenic and ethnographic significance of the park's resources, there are no appropriate locations for telecommunication infrastructure in Big Bend National Park.	

ALTERNATIVES, INCLUDING THE PREFERRED ALTERNATIVE

K. Newton

Tom Vandenberg

Karl Tipple

Phil Nichols

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INTRODUCTION TO THE ALTERNATIVES

This chapter contains descriptions of the three alternatives. Alternative A, the "no-action" or status quo alternative, which is described first, reflects existing conditions and serves as a basis for comparing and evaluating the other alternatives. Then the two "action" alternatives (B and C) that propose the future direction for Big Bend National Park are described.

Alternative B is the National Park Service's preferred alternative. In the process used to select the preferred alternative, the planning team found that alternative B would safeguard the resources, scenic values, and current visitor experience of Big Bend National Park.

Before the action alternatives were developed, information was gathered about the resources in the park. Information about the issues and scope of the project was solicited from the public, other agencies, special interest groups, and park staff through newsletters, meetings, and personal contacts. This helped with the development of the action alternatives. All the alternatives were intended to support the park's mission, purpose, and significance and to address issues; avoid unacceptable resource impacts; and respond to public desires and concerns. A number of the actions proposed in the alternatives would require additional compliance steps before implementation. These steps would include identification, evaluation, and consultation. The detail for these requirements can be found elsewhere in this document.

DECISION POINTS

Based on public comments and NPS concerns, decisions must be made in this *General Management Plan* about several major points. Alternatives have been developed to explore these decision points.

- Considering opportunities available outside the park, what kind of opportunities for experiences do we want visitors to have in various areas of the park while preserving the biodiversity of Chihuahuan desert ecosystem and the integrity of the park's cultural resources?

- What is the best way to protect the viewshed from within the park and the resources of the Christmas Mountains?

RELATIONSHIPS TO OTHER AGENCIES' PLANS

Possible conflicts between the alternatives and county, state, tribal, or federal land use plans and policies must be considered.

Big Bend is in southern Brewster County, Texas. Properties surrounding the park are primarily privately owned residential and agricultural lands. There are a few commercial and state-owned parcels. There are no tribal lands nearby.

Texas Outdoor Recreation Plan Assessment and Policy Plan (TORP)

This plan lists one goal and six objectives.

> Goal: "Increase and improve the quality of outdoor recreation opportunities in Texas."

The objectives most relevant to the general management plan are as follows:

- Provide recommended actions to address the top priority recreation issues in Texas.
- Encourage the appropriate utilization of resources for outdoor recreation in concert with the protection of cultural and natural resources and private property rights.
- Encourage public and private cooperation and input in addressing the outdoor recreation issues facing Texas.

The TORP lists 10 actions for meeting recreational open space needs. Those not dealing primarily with funding follow:

- Educate public, business sector, and officials on the importance of parks and

open space to the quality of life and economic development.
- Use floodplains and other nondevelopable lands for open space, greenbelts, and recreational areas, and to provide linkages of trails with parks, historical sites, and open space.
- Create linkages with parks, recreational facilities, historical sites, business districts, and open space by way of trails and greenways.
- Develop, coordinate, and implement open space master plans on local, regional, and state levels.
- Develop open space (new state parks) closer to population centers.
- Measure local needs rather than setting standards.
- Encourage city/school or public/private programs for open space.

Big Bend National Park provides opportunities to pursue 10 of the 20 outdoor recreational activities most important to the citizens of Texas.

Rank	Activity	Percent of Total Frequency
1	Camping	12
2	Fishing	11.5
3	Swimming	6.9
4	Hiking	5.3
7	Walking	3.6
9	Boating	3.0
10	Bicycling	2.9
11	Picnicking	2.7
19	Sightseeing	1.2
20	Jogging/Running	0.9

The state plan lists "Roles for the National Park Service to consider:"
- Continue to acquire and manage resources of national significance. Evaluate and address any adverse effects on local taxpayers and adjacent landowners.
- Continue to provide environmental education and information to the public.
- Complete the authorized acquisition of the Big Thicket National Preserve as funding allows.
- Increase funding and technical assistance for trails and waterways programs.

Black Gap Wildlife Management Area

This management area, administered by the state of Texas, is about 55 miles south of Marathon. "It is bordered by the Rio Grande on the east, by Big Bend National Park on the west and south, and by Texas General Land Office (GLO) and privately owned tracts to the north," (Black Gap Wildlife Management Area 1996). It is comprised of almost 83,000 acres. The primary goals of the wildlife management area as stated in its 1996 draft *Management Plan* are:

- To develop and manage wildlife habitats and populations of indigenous wildlife species.
- To provide a site where research of wildlife populations and habitats can be conducted under controlled conditions.
- To provide public hunting and appreciative use of wildlife in a manner compatible with the resource.
- To protect populations of endangered, threatened, and migratory wildlife and protected plant species and related habitats.
- To provide natural environments for use by educational groups, naturalists, and other professional biological investigators.
- To provide areas to demonstrate habitat development and wildlife management practices to landowners and other interested groups.
- To preserve unique natural sites and relict vegetation communities.

Big Bend Ranch State Park

This area is administered by the Texas State Parks and Wildlife Department. According to its 1994 *Management Plan*, this nature area is just west of Big Bend National Park and it includes the Solitario and Bofecillos Mountains. The area covers about 300,000 acres and has about 25 miles of Rio Grande frontage between the towns of Presidio and Lajitas. Marfa and Alpine are about an hour's drive to the north. Some proposals of the *Management Plan* are:

- Opportunities for expanded public use will occur in the Rio Grande Corridor, the Fresno/Contrabando Lowlands, the Bofecillos Highlands, and in the Solitario. This will include camping, hiking, mountain biking, and equestrian use that will be managed through a permit system.
- Levels of public use will be established that will be within the limits of prudent resource and visitor protection services. The Department will strive to maintain the primitive character of the state park.
- Interpretive and educational programs will be developed to foster an understanding and appreciation of the diverse natural and cultural resources of the Big Bend region including the proposed Santa Elena/Sierra del Carmen Biosphere Reserve in Mexico.
- An emphasis will be placed on repairing and rehabilitating existing facilities, such as the historic structures at Sauceda, improving visitor facilities at Fort Leaton and the Warnock Center, and stabilizing existing roads and trails that have been designated for public use.
- Big Bend Ranch, Fort Leaton, and the Barton Warnock Environmental Education Center will be managed by the Superintendent of Big Bend Ranch State Park. An administrative headquarters is located near Presidio, adjacent to Fort Leaton.

Brewster County

Brewster County does not have a master plan guiding management of natural resources and private and public land use (office of the Brewster County judge, pers. comm. 9/27/01). The county has regulations designed to prevent high density development in southern Brewster County including the area near the park. Counties in Texas do not have authority to zone. (See the "Affected Environment" chapter, "Socioeconomic Environment" section, "Land Use" subsection).

Brewster County has been informed of and involved in the development of this plan through informal and formal discussions with county staff (more details are available in the "Public Involvement" section of the "Consultation and Coordination" chapter). The "Environmental Consequences" chapter contains analyses of the impacts of concern to the county. The county favors Big Bend National Park continuing to focus on what they have rather than on land acquisition, keeping park management close to it current level, and making as much of the park as possible accessible to visitors.

Maderas del Carmen

This protected area in Mexico preserves 208,381 hectares (84,365 acres) of the Chihuahuan Desert south of Big Bend in the state of Coahuila, Mexico. The Management Program for the protected Area for Flora and Fauna, Maderas del Carmen, proposes to:

- assure the permanence of the natural resources
- guarantee preservation of biological diversity of the area
- rely on necessary technical information about the area's resources to facilitate and make its protection and management more efficient
- protect the natural resources of the area by rationally using them, which coincides with the general objectives and conservation of the area
- promote the participation and collaboration of the proprietors, users of the area, and the general public in the conservation and management programs for the area
- administer, coordinate, and supervise the financial, human, and material resources on which the protected area relies, as well as the actions that are undertaken within it

Cañon de Santa Elena

This protected area in Mexico preserves 277,209 hectares (112,230 acres) of mountains and valleys south of Big Bend in the state of Chihuahua, Mexico. Its objective is to preserve the natural habitats and ecosystems of the region, assuring the balance and continuity of the evolutionary and ecological processes; preserve existing biological diversity; and achieve the rational and controlled use of

natural resources. The Management Program for the protected Area for Flora and Fauna, Cañon de Santa Elena, Chihuahua, Mexico, proposes to:

- preserve the genetic and biological diversity of the area
- establish specific mechanisms for the conservation of protected flora and fauna to ensure their continued existence and foster their increase in number
- implement programs for the use of resources according to the characteristics and potential of each ecosystem
- promote actions to avoid the deterioration of the habitats and ecosystems and to discourage nonregulated activities
- promote conscientiousness of the local populace so that they contribute to preservation of natural resources, including paleontological and cultural resources
- establish efficient administrative systems that preserve, protect, and allow sustainable use of resources
- promote both productive and ecotourism-related activities that allow the improvement of the quality of life of the local population

Any changes brought about by any of the alternatives would not conflict with any of the approved plans of other jurisdictions.

MANAGEMENT PRESCRIPTIONS
(Management Zones)

An important tool in planning and management is the establishment of management prescriptions for various areas in the park. Management prescriptions (zones) identify how different areas could be managed to achieve a variety of resource conditions and visitor experiences. Each prescription specifies a particular combination of resource, social, and management conditions. The National Park Service would take different actions in different zones with regard to the types and levels of uses and facilities. The following five management prescriptions have been described for Big Bend. Alternatives for future conditions and management have been developed by placing these prescriptions in different configurations.

TABLE 1: MANAGEMENT PRESCRIPTIONS, BIG BEND NATIONAL PARK

Management Prescription	RESOURCE CONDITIONS	VISITOR EXPERIENCES	FACILTIES AND ACTIVITIES
Wilderness	These areas will be managed to ensure that their use and enjoyment would leave them unimpaired for future use and enjoyment as wilderness, provide for the protection of the areas as wilderness, and provide for the preservation of wilderness character. Archeological resources, if discovered, would generally be left intact unless threatened by loss due to erosion. Historic period ruins would generally be preserved unless they posed a threat to life, health, and safety.	Wilderness management would be coordinated with the backcountry nonwilderness prescription and similar experiences would be provided. However, management strategies and options would be more restrictive than under the nonwilderness prescription. Visitors would use these areas for day and overnight use. On the more popular trails, there would be a moderate probability of encountering others, particularly at campsites and other points of interest. Visitors would be influenced less by other human activities than they would in the nonwilderness prescription area. Travel would be along a range of routes from delineated trails to trail-less backcountry requiring a high degree of outdoor skills and self-reliance. Management actions would comply with NPS policies regarding wilderness.	Facilities could include maintained trails, foot bridges, directional signs, and primitive campsites. If campsites were designated, they might contain toilets and food storage lockers.
Backcountry Nonwilderness	Natural conditions would be mostly undisturbed, but evidence of visitor and administrative use might be apparent. Resource impacts would be restricted to hiking and stock use, campsites, and approved administrative facilities and activities. Past impacts would be reversible, although areas might require intensive effort and long periods to recover. Cultural resources would be protected and preserved. Resource conditions might be modified for necessary visitor and operational needs, but in a manner that would minimize visual and resource impacts.	Backcountry nonwilderness management would be coordinated with the wilderness prescription, and similar experiences would be provided. However, management strategies and options would be less restrictive than under the wilderness prescription. Visitors would use these areas for day and overnight use. On the more popular trails, there would be a moderate probability of encountering others, particularly at campsites and points of interest. Visitors would be influenced by other human activities more than they would in the wilderness prescription area. Travel would be along a range of routes from well-maintained trails to trail-less backcountry requiring a high degree of outdoor skills and self-reliance. Use levels might vary. There would be limits on the number of campers. There might be established campsites, food storage containers, and toilets in some locations. Hiking, camping, and stock use would be permitted.	Facilities might include maintained trails, unpaved backcountry roads, foot bridges, interpretive and directional signs, primitive campsites, administrative roads, and administrative equipment (such as wells or radio repeaters). If campsites were designated, they might contain facilities such as toilets and food storage lockers.

Management Prescription	RESOURCE CONDITIONS	VISITOR EXPERIENCES	FACILTIES AND ACTIVITIES
Cultural	Intensive management of identified and evaluated cultural landscapes highlighting the historical period would occur. Structure exteriors would be preserved; interiors would be preserved for interpretation or adaptively used for park and visitor support needs. Preservation strategies would be developed for each resource in this prescription. Archeological and ethnographic resources would be protected and preserved.	Visitors would be immersed in a cultural setting that reflects a historical period with minimal exposure to modern intrusions, both visible and audible. Visitors could explore sites on their own or participate in ranger-conducted programs. Recreational activities would be managed to support the area's historic character. Some areas may be closed to visitors to protect resources and resource values.	Interpretive exhibits, programs, demonstrations, and tours could take place in these areas. Historic structures and settings would be key features. There would be limited visitor amenities through adaptive use of historic structures (sales, restrooms, water fountains, etc.) and limited administrative support (staff offices, storage, housing, etc.)
Visitor Services	To the greatest degree practical in this management prescription, facilities would be models of best management practices and sustainable development. This prescription would be where there are limited or no significant resources or in areas that were previously disturbed by development. The natural environment could be modified for park operations, but it would still harmonize with the surrounding environment. Although the environment could be highly modified within the area, pollutants and other disturbances (e.g., stormwater runoff and dust from construction) would be contained and mitigated before affecting adjoining areas. The physical footprint of structures and stored material in this area would be minimized. Archeological resources would be avoided or adverse effects on the resources would be mitigated if necessary.	The visitor experience in this area would be highly social and focused on interpretation, education, orientation, visitor comfort, and safety. This structured environment would be highly accessible and ranger-led, and contacts with park staff and other visitors would be common; overcrowding would be avoided. Visitors would have an opportunity to get an overview of park resources in a short time with a minimum of physical exertion. An opportunity to learn about the park's significance and compelling stories through the interpretation of themes would be an important element. Visitors would have an opportunity to purchase materials related to the park. Necessary food and lodging would be available here.	Sightseeing, learning about the park through interpretive media and self-guided and ranger-led tours, short walks, and programs could be common activities. The area, also, would serve as a staging area for more extended tours. Orientation and interpretation facilities such as a visitor center, kiosk, wayside exhibits, and other interpretive media would be appropriate. Support facilities such as fee collection, restrooms, running water, first-aid areas, and hardened circulation areas and trails could be present. Recreation facilities such as developed campgrounds might be available. Space could be available for research, collections, classroom activities, and libraries. Utilities would include water, electricity, telephones, and computer access.

Management Prescription	RESOURCE CONDITIONS	VISITOR EXPERIENCES	FACILTIES AND ACTIVITIES
Operations	To the greatest degree practical, facilities in this management prescription would be models of best management practices and sustainable development. This prescription would be where there are limited or no significant resources or in areas that were previously disturbed by development. The natural environment could be modified for park operations, but facilities would still harmonize with the surrounding environment. Although the environment could be highly modified in this area, pollutants and other disturbances (e.g., storm-water runoff and dust from construction) would be contained and mitigated before affecting adjoining areas. Facilities and operations in the area would be buffered to avoid visitors seeing them or being disturbed by associated noise. The physical footprint of structures and stored material in this area would be minimized. Archeological resources would be avoided or adverse effects on the resources would be mitigated if necessary.	This area is not intended for visitors; however, limited incidental visitor use would be permitted. Most visitors would be only slightly aware of the facilities in this area during their visits.	The area could include structures and grounds used for administration and operations, such as offices, maintenance shops, collection areas, storage areas, warehouses, garages, research facilities, conference/meeting/ training facilities, housing, boat and equipment storage, vehicle maintenance, and outdoor storage. Facilities for park utilities and communication needs would be located in this area. Facilities would provide a safe, efficient, comfortable, and aesthetic work environment for park staff. Hardened circulation and parking areas would be appropriate in this area as well as service roads for operations activities. Housing would have sufficient space for family activities.

ALTERNATIVE A – NO-ACTION (STATUS QUO)

CONCEPT

Under this alternative the park would continue current management direction, and there would be no significant change in interpretation and management of the park. This alternative is presented as a basis for comparing the two "action" alternatives. Examining the no-action alternative is also useful in understanding why the National Park Service or the public may believe that certain changes are necessary or advisable. The two action alternatives (B and C) present ways of exploring those changes.

Actions that are already funded have been included in the no-action alternative. Other future actions planned for implementation by the park that have not been funded are included in the "Environmental Consequences" under "Methods for Analyzing Impacts" under the subheading "Projects That Make Up the Cumulative Impact Scenario, Current and Future Actions." The impacts of these actions are analyzed as part of the cumulative impact analysis.

THROUGHOUT THE PARK

The park staff would continue to protect and maintain known cultural and natural resources as time and funding allow. Cultural and natural resource inventory work and monitoring would continue and be expanded if possible. Park staff would continue to encourage and seek funding for the research that is needed to fill the gaps in knowledge about resources (following the park's strategic plan).

Park staff would continue to manage existing proposed and potential wilderness areas from 1984 *Final Environmental Impact Statement, Proposed Wilderness Classification (NPS 1984)* as wilderness, as required by NPS policy.

There would be little change in visitor facilities (see Alternative A maps). The only changes in operations would be construction of an already approved and funded fire management building at Panther Junction.

> The maps in this document are for illustration purposes only and are not drawn perfectly to scale.

The park has instituted a program of conservation and visitor education on the need to limit water use and the role of water in a desert environment.

The park would upgrade the water treatment system at Castolon.

Fire suppression systems would be upgraded at residences and the historic district at Castolon, 45 housings at Panther Junction and Rio Grande Village, headquarters at Panther Junction, and two single-story apartment buildings and a dorm at Chisos Basin.

The National Park Service proposes to reconstruct a 0.5-mile segment of Park Route 12 at mile marker 14. Park Route 12 is the paved route from Panther Junction to Rio Grande Village, within the park. The proposal calls for vertical realignment of the road between miles 14 and 14.5 to allow greater sight distance and increased highway safety. To accomplish the realignment, low water crossings would be replaced with culverts at two sites. An *Environmental Assessment* was released for public review in January 2002.

Housing would continue to be scattered throughout the park and in short supply. Adequate office and storage space for park staff would continue to be lacking and sometimes in facilities that are not suitable for efficient park operation.

Coordination would continue with agencies and other groups regarding water quality and quantity in the Rio Grande, air quality, threatened and endangered species, wildlife management, and law enforcement. The park's water rights would continue to be maintained at current levels.

The significant cultural properties would continue to be preserved and interpreted as time and funding permit. All national register sites and/or districts currently receive preservation maintenance and interpretation as time and funding allow. This would continue.

Park staff would continue to work with Mexican protected areas' staff and with Mexican villages that border the park. Park interpretive programs beyond park boundaries would continue.

There would be no change in the electrical lines that are in the viewshed of the road into Chisos Basin.

CHISOS BASIN

The visitor center, campgrounds, lodge, and employee housing would continue to be available to visitors and employees. The fire suppression and water systems would be upgraded.

PANTHER JUNCTION

The park is developing an early warning system and evacuation plan for all of Panther Junction, which is in the maximum estimated floodplain (see appendix F).

Facilities at Panther Junction would continue to increase slowly over the coming years to meet park needs. A few temporary housing and storage units would be placed in the Panther Junction area. The fire suppression system would be upgraded.

RIO GRANDE VILLAGE

The park is developing an early warning system and evacuation plan for all of Rio Grande Village, which is in the 100-year floodplain.

Facilities would continue to increase slowly over the coming years to meet park needs.

Fuel storage tanks would be raised above the level of or protected from the 500-year flood.

Irrigation of shade trees and lawns at the campground would continue to use 25.6 million gallons per month.

Efforts to locate a separate water source for visitors and staff would continue.

Campsites close to the Big Bend gambusia pond would be relocated to eliminate some potential impacts.

The fire suppression system at four residences would be upgraded.

The hydrologic patterns would remain altered.

The Barker Lodge ,NPS housing units, and the 25-site campground at Rio Grande Village would continue to be used.

CASTOLON

The store would continue operations. Employee and concessioner housing would remain in their current locations. The fire suppression system and water treatment and delivery systems would be upgraded.

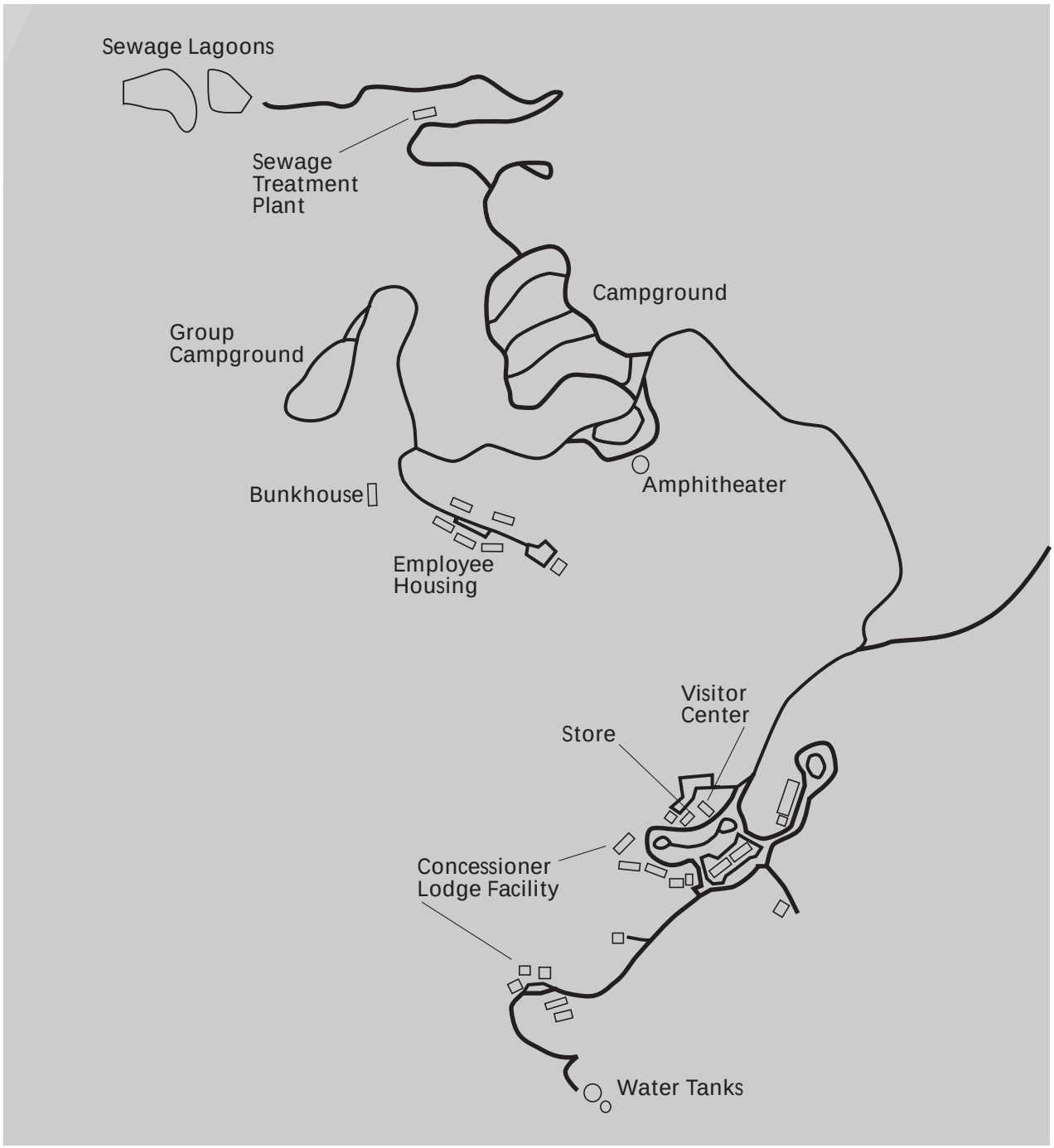
COTTONWOOD CAMPGROUND

The park is developing an early warning system and evacuation plan for Cottonwood Campground, which is in the 100-year floodplain. The campground and amphitheater would continue current operations. The single egress road would continue to be used. Irrigation of shade trees at the Cottonwood Campground would continue to use about 125,000 gallons per month.

NORTH ROSILLOS/HARTE RANCH

Ongoing work to restore natural hydrologic and soil conditions would continue as funds permit. Inventories would continue to identify the cultural and natural resources in this area

A small-scale experimental restoration treatment to determine how best to restore natural grasslands would be undertaken, and successful treatments would be used elsewhere in the park.



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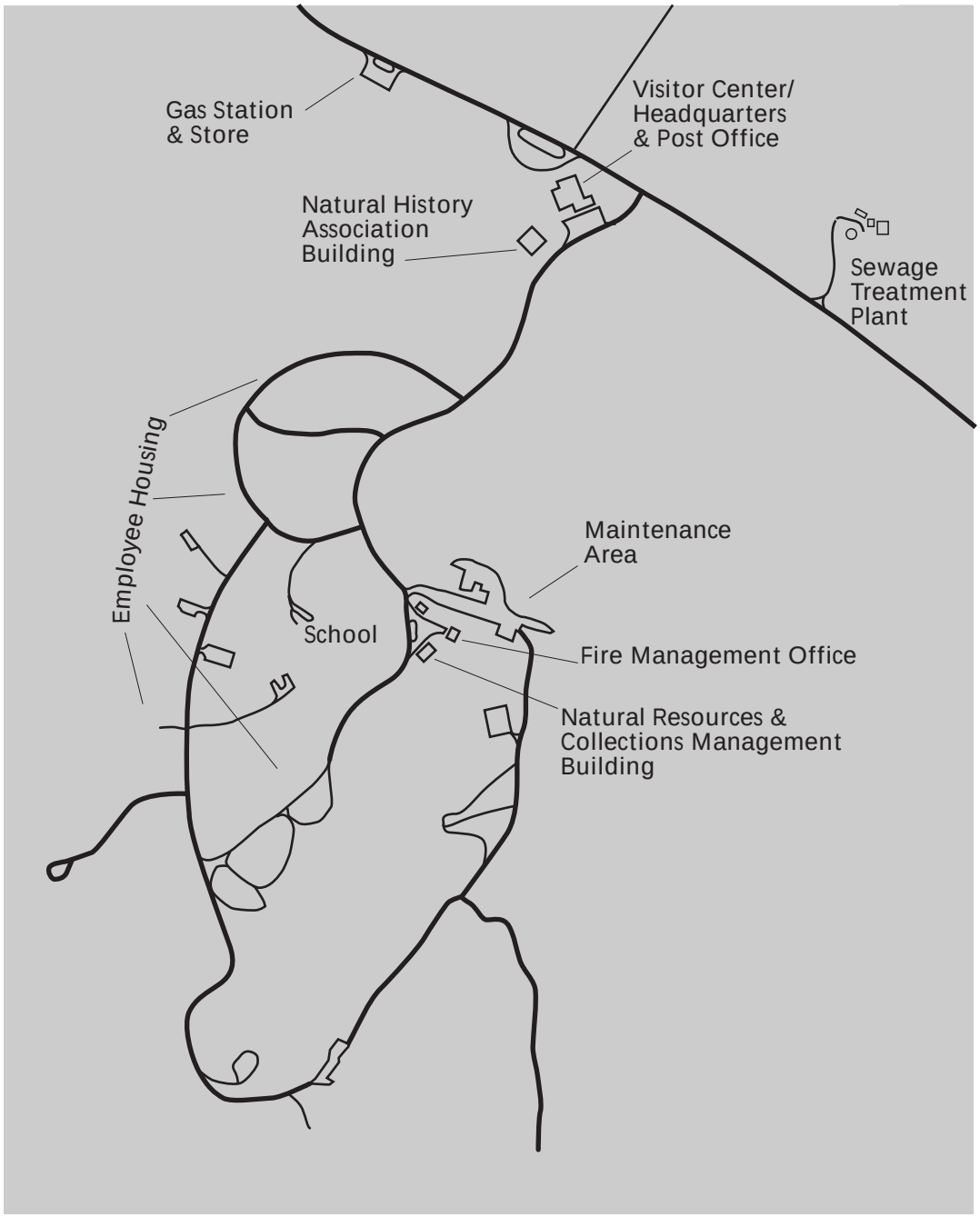

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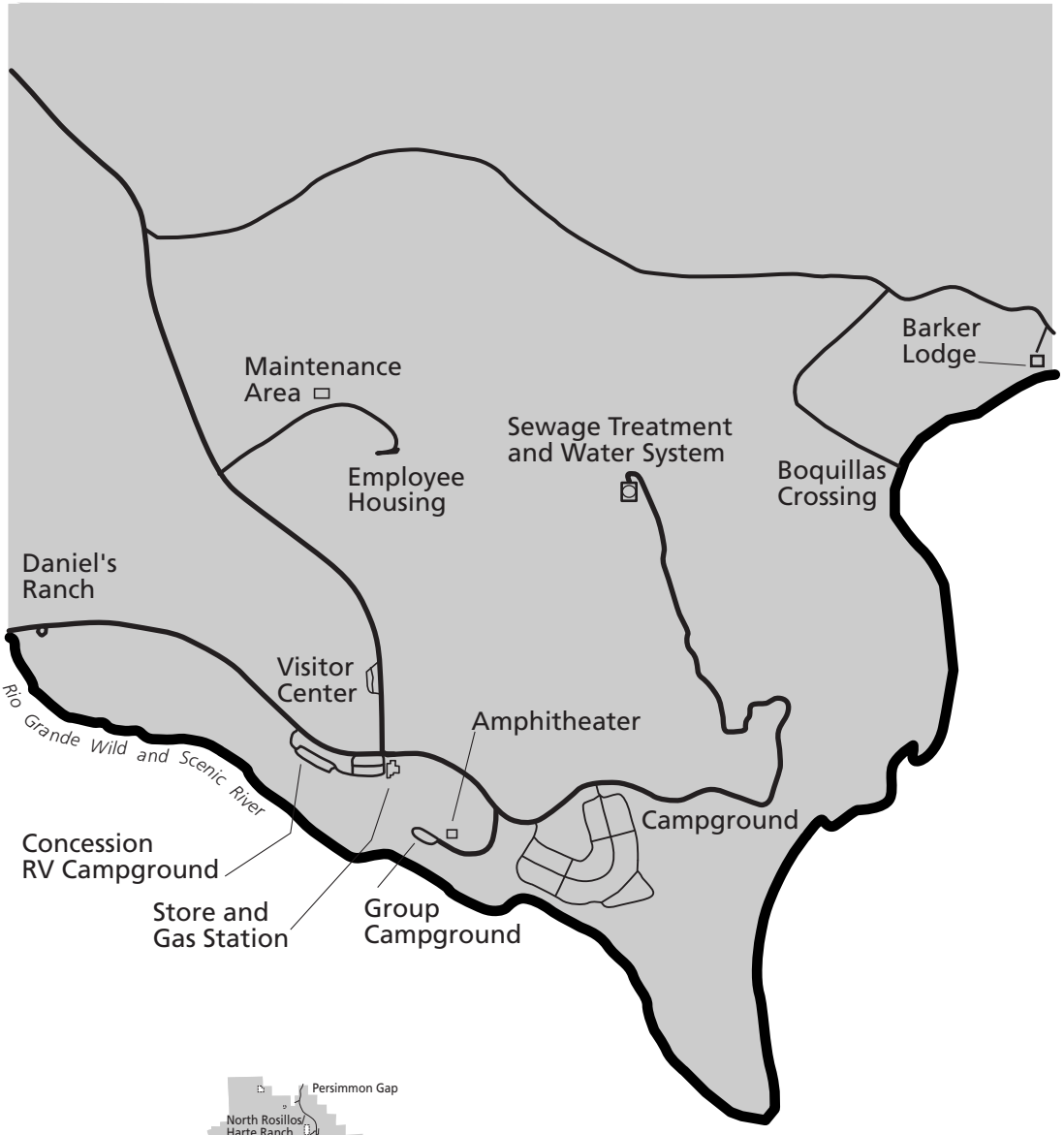

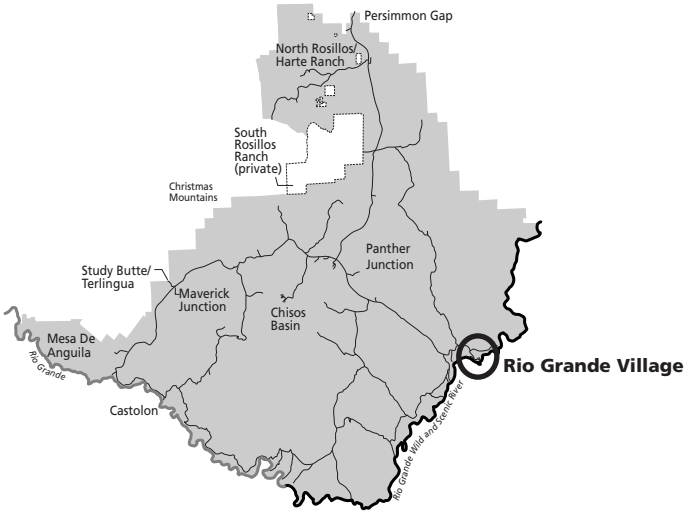

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Alternative A
No Action (Status Quo)
Rio Grande Village

Big Bend National Park

National Park Service
U.S. Department of Interior

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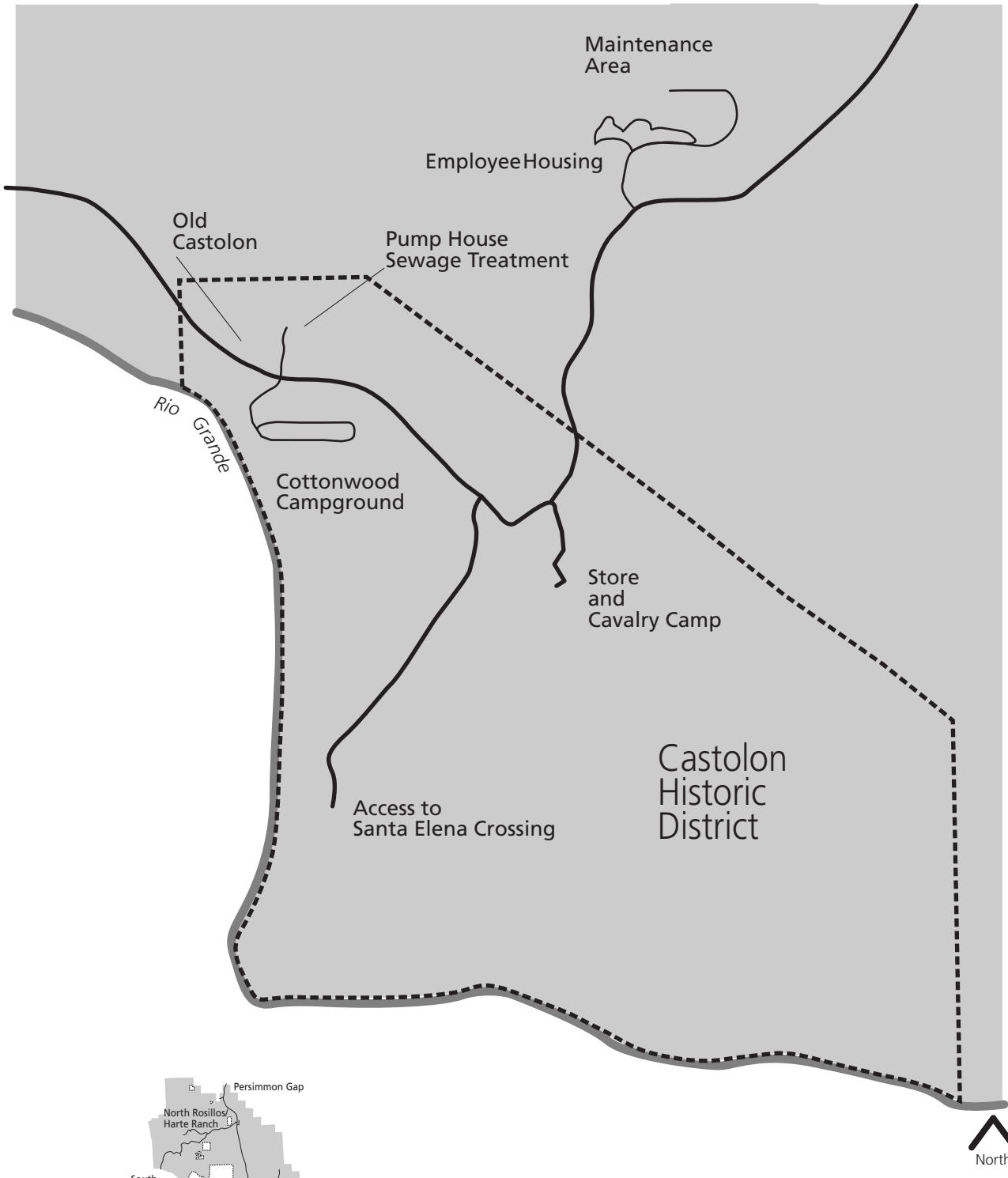

Alternative A
No Action (Status Quo)
Castolon

Big Bend National Park

National Park Service
U.S. Department of Interior

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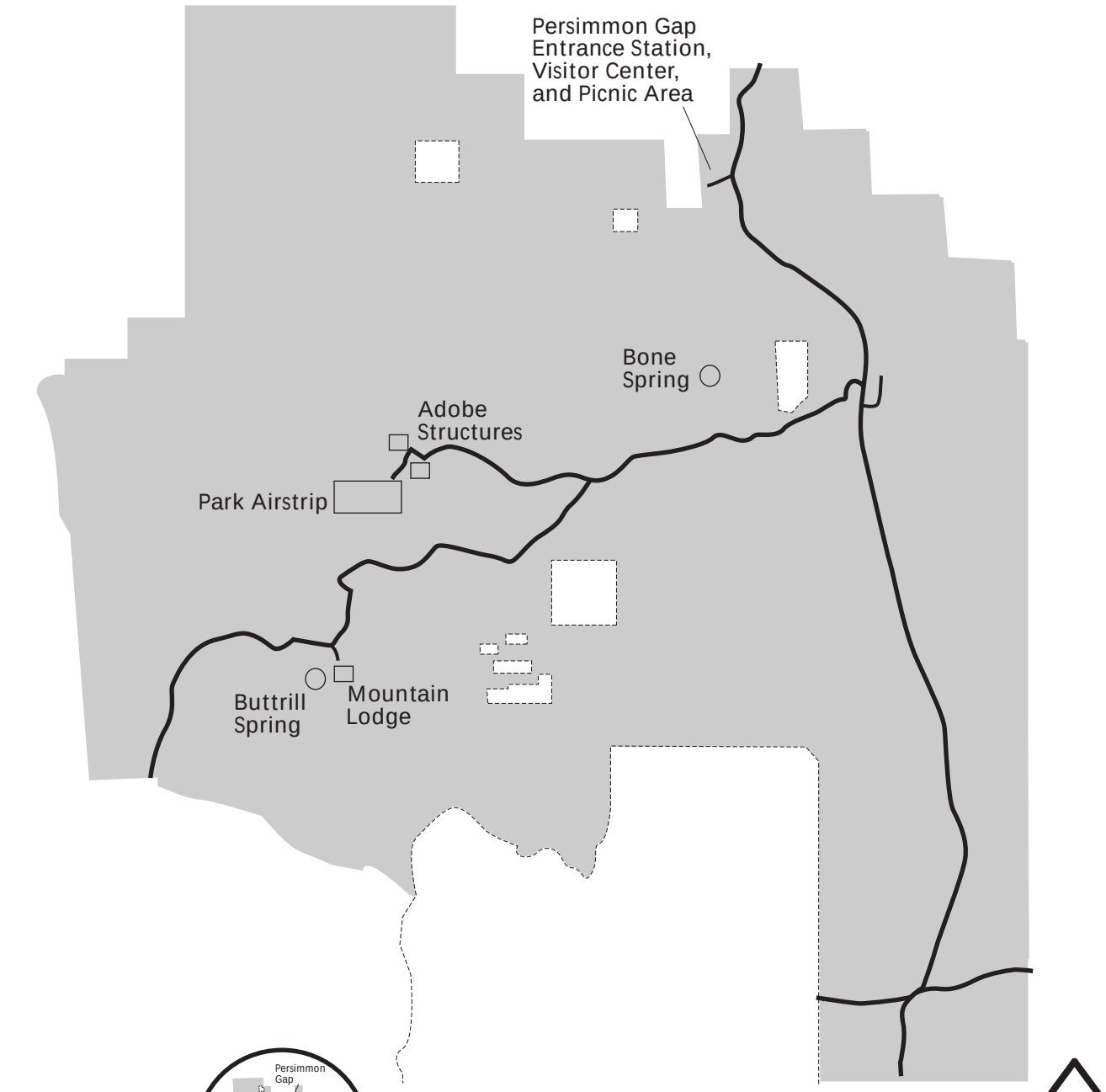

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PERSIMMON GAP, MAVERICK, AND GATEWAY COMMUNITIES

The housing unit at Persimmon Gap and the entrance station at Maverick would continue to be used. No facilities would be provided in gateway communities.

PARK BOUNDARY

No change in the park boundary is proposed under this alternative.

ESTIMATED COSTS

All costs are in year 2002 dollars. Alternative A would retain the current base staff of 100 full-time-equivalent (FTE) positions at a cost of $4.3 million per year.

The construction, rehabilitation, and restoration costs for alternative A would be $5.7 to $7.7 million. The estimate is general and should be used only for comparing the alternatives.

ALTERNATIVE B – (PREFERRED ALTERNATIVE) – ENHANCED AND ADEQUATE NATURAL RESOURCE STEWARDSHIP AND ENHANCED VISITOR FACILITIES

CONCEPT

This alternative would offer an enhanced experience for visitors while creating a more sustainable park and providing better protection for park resources.

A new visitor center would be developed that would include an auditorium, an expanded exhibit area, and possibly an outdoor exhibit area. Interpretation would be developed for the Buttrill Spring area. A number of actions such as reducing irrigation water used at Rio Grande Village by 50%, phasing out plants that are heavy water users at Rio Grande Village and Cottonwood Campground, relocating personnel to gateway communities, and removing some development from Chisos Basin would result in reduced water use. All these actions would provide for a better visitor experience and make the park more sustainable.

DETAILED DESCRIPTION

The description of this alternative, like descriptions of the other action alternative, is organized by management prescriptions. The various kinds of prescriptions are described at the beginning of this chapter. Also see the Alternative B maps for various areas within the park.

> The maps in this document are for illustration purposes only and are not drawn perfectly to scale.

Wilderness Prescription

(See Park Area map)

Most of the land that comprises the park has been determined either as "proposed" wilderness or "potential" wilderness. These recommendations have been transmitted to Congress by the president, but have not been acted on by Congress. The National Park Service is required to manage these lands to preserve their wilderness values until Congress acts. To accomplish this requirement, these lands would be managed under the wilderness prescription. This prescription would preserve vast desert and mountain landscapes that are unaltered by human hands. These areas contain dramatic contrasts, from lofty wooded peaks to canyons carved by the Rio Grande, all dominated by the great expanse of the Chihuahuan Desert. The visitor would have the opportunity for a primitive experience with chances to see the magnificent scenery that is unique within the United States as well as to sense the solitude and quietness that typifies the area.

Some of the notable features in the prescription are the Mesa de Anguila and the north side of the Santa Elena Canyon, the area east of the Santa Elena Canyon containing the creosotebush plant community, the lava capped Burro Mesa, the Chisos Mountains, and portions of the Chisos Basin. Most of the area around Mariscal Mountain, Talley Mountain, and Chilicotal Mountain would be in this prescription, as well as portions of Tornillo Creek, McKinney Hills, Boquillas Canyon on the Rio Grande, and the Sierra del Carmen Mountains. All of the cliffs in the three major canyons of the Rio Grande would be managed under the wilderness prescription.

The North Rosillos/Harte Ranch section of the park contains lands that are being evaluated by park staff to determine their suitability or nonsuitability for further study and possible recommendation for wilderness designation. See "Appendix E: Draft Wilderness Suitability Assessment," and the "Purpose, Need, and Scoping" chapter. If lands are found suitable for further study and possibly recommended for wilderness designation, these lands would

be managed as wilderness at least until the wilderness study was completed.

Backcountry Nonwilderness Prescription

(Much of Chisos Basin, Panther Junction, Rio Grande Village, Castolon [outside the historic district], and North Rosillos/Harte Ranch)

The following portions of the park have been excluded from the wilderness proposal: (1) areas along the Rio Grande and south of the River Road that are less than 5,000 acres and are impacted by citizens of Mexico and fishermen, (2) corridors along the roadways, and (3) areas that contain pole-mounted telephone, powerlines, or the soil and moisture study area. However, many of the areas contain values similar to those found in wilderness areas. In alternative B these lands would be in the backcountry nonwilderness prescription. In the North Rosillos/Harte Ranch area, the park would develop an interpretive trail at Buttrill Spring and might develop a Rosillos trail.

The Mariscal Mine, Luna's Jacal, Homer Wilson Ranch, and Sam Nail Ranch (not a national register site) are cultural resources found in areas covered by this prescription. A high priority for preservation work would be given for all sites eligible for listing on the National Register of Historic Places, such as the structures at Mariscal Mine and Luna's Jacal. The Homer Wilson and Sam Nail Ranches would be preserved and interpret both natural and cultural resource topics related to West Texas ranching.

Cultural Prescription

(Daniel's Ranch, Barker Lodge, Castolon Historic District, Bone and Buttrill Springs, and the adobe structures near the airstrip in North Rosillos/Harte Ranch area)

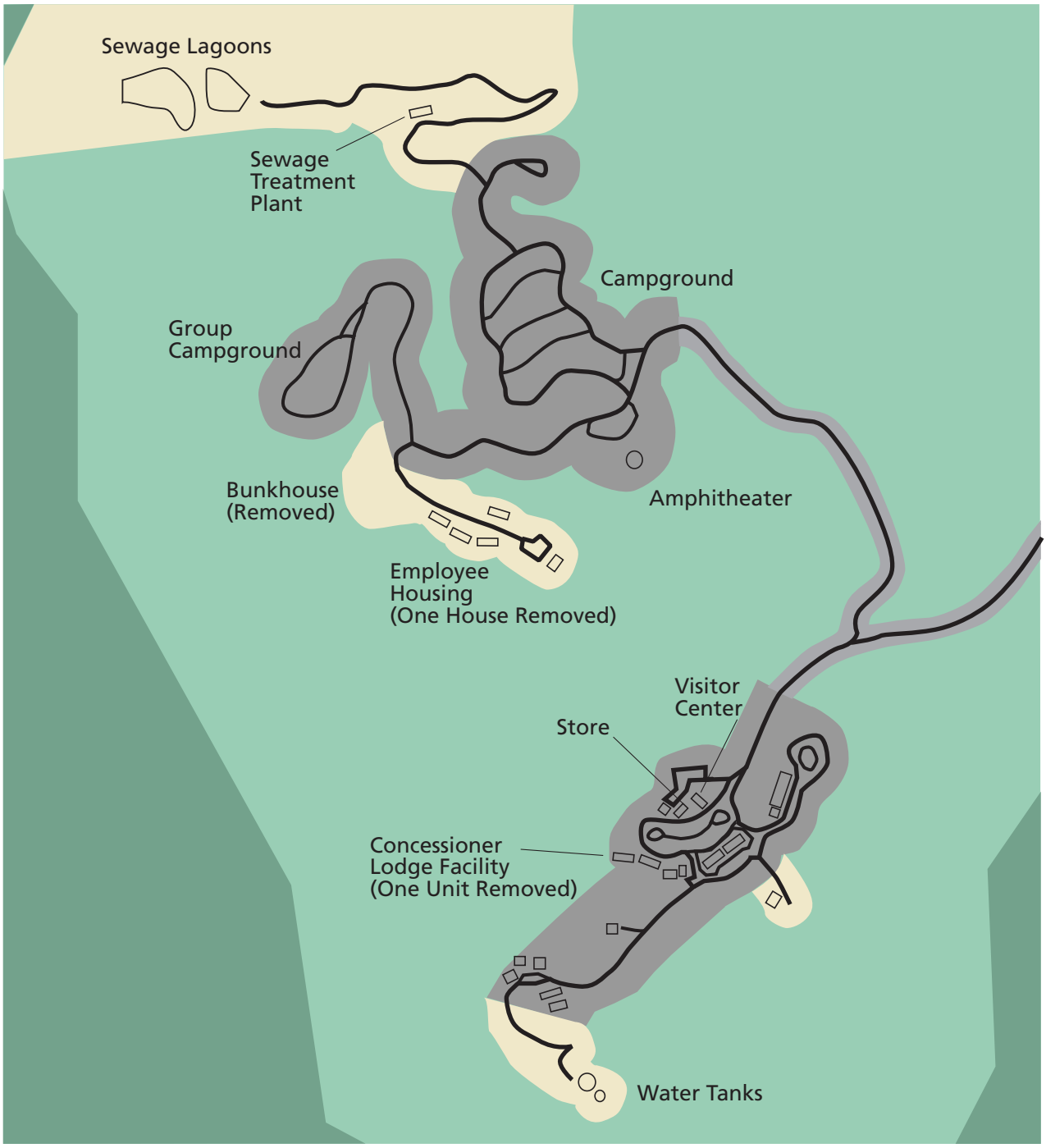
The cultural prescription would include Daniel's Ranch and Barker Lodge in the Rio Grande Village area, and the Castolon Historic District. Barker Lodge would be adaptively used for housing for researchers. The preservation and interpretive activities at the Daniel's Ranch and Castolon Historic District would continue.

In the North Rosillos/Harte Ranch area, Bone Spring and Buttrill Spring have been placed in this prescription, and the park would develop preservation strategies for each of these features. The various sites around Buttrill Spring and Bone Spring would be evaluated for their potential to be listed on the National Register of Historic Places – possibly as part of a cultural landscape. Features around Buttrill Spring would be preserved for their historic and interpretive significance. An interpretive trail would be developed in the area of Buttrill Spring.

Visitor Services Prescription

(Chisos Basin - campground, group campground, and amphitheater area and the visitor center, store, and lodge area
Panther Junction - area along the main park road from the visitor center/headquarters to the gas station and store
Rio Grande Village - visitor center, campground, group campground, store, gas station, concession RV campground, and surrounding area
Cottonwood Campground
Persimmon Gap - area surrounding entrance station, visitor center, and picnic area;
the new site for the Maverick entrance station)
many of the roads in the park)

At Chisos Basin, electrical lines would be placed underground to decrease their impact on park scenic values. To promote the Basin's sustainability and decrease the human impact on the Basin, especially water use, the National Park Service would remove one NPS employee residence and the NPS "bunkhouse," which is used for seasonal housing, after replacement housing is built at Panther Junction. If additional park housing were needed, it would be developed elsewhere in the park or in gateway communities. The park staff would work with the concessioner to remove lodge unit A (12 rooms) from the Basin.



North

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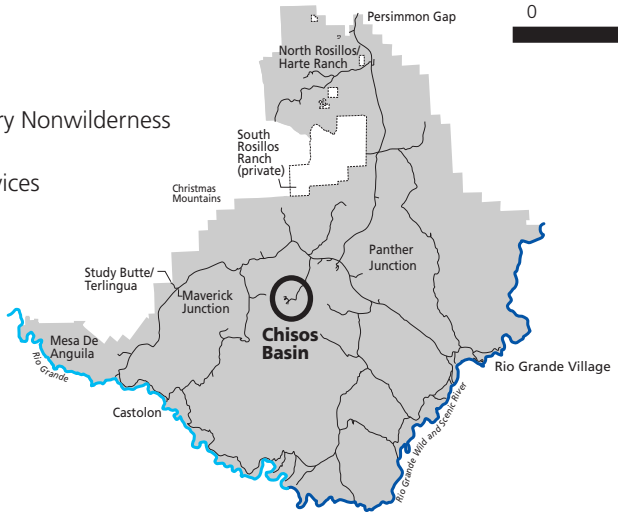
Wilderness

Backcountry Nonwilderness

Visitor Services

Operations



ROADS

Alternative B Chisos Basin

Big Bend National Park

National Park Service
U.S. Department of Interior

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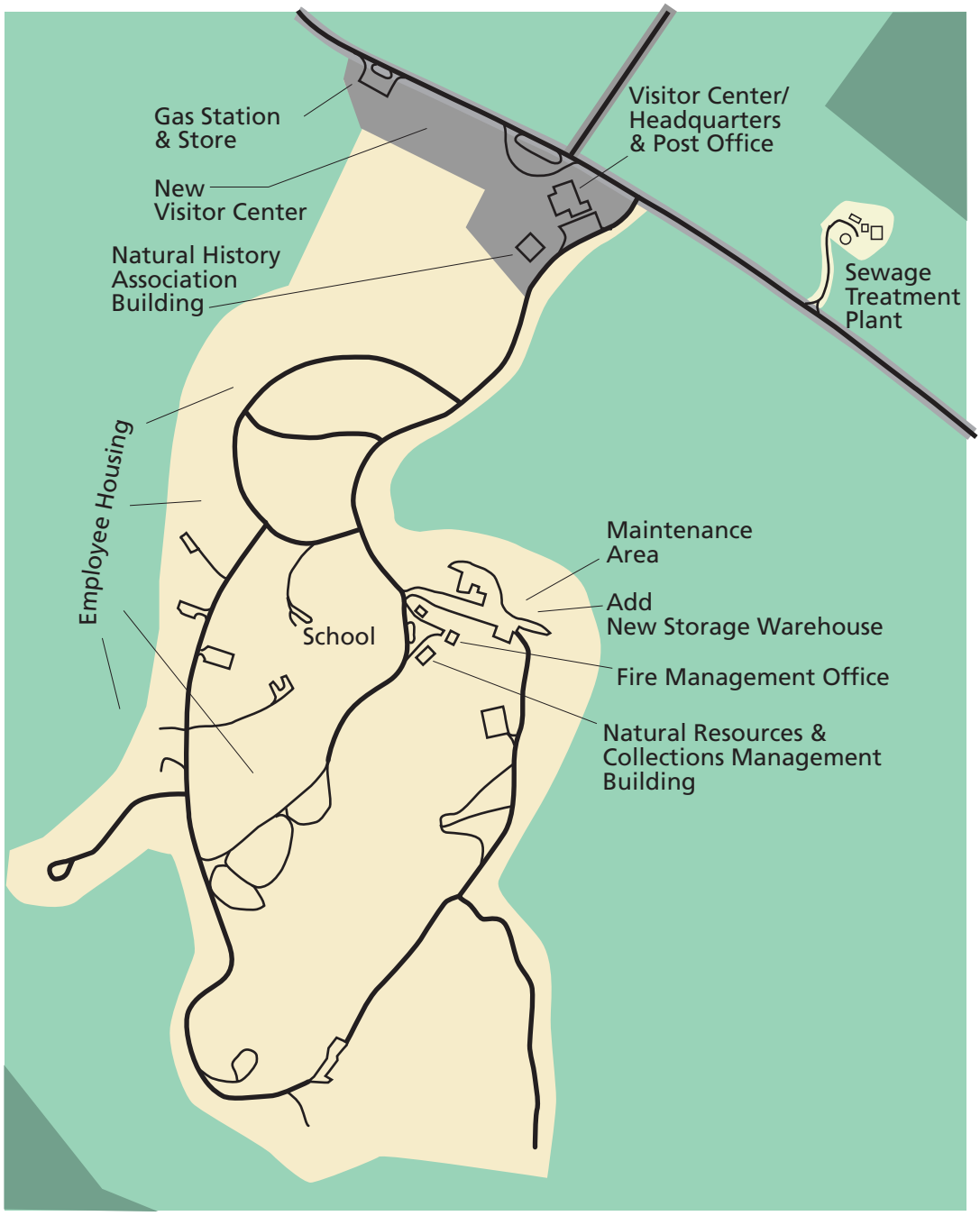

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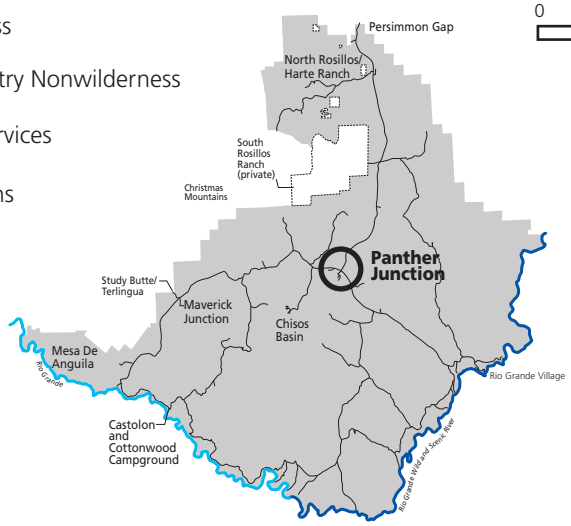

Alternative B
Panther Junction

Big Bend National Park

National Park Service
U.S. Department of Interior

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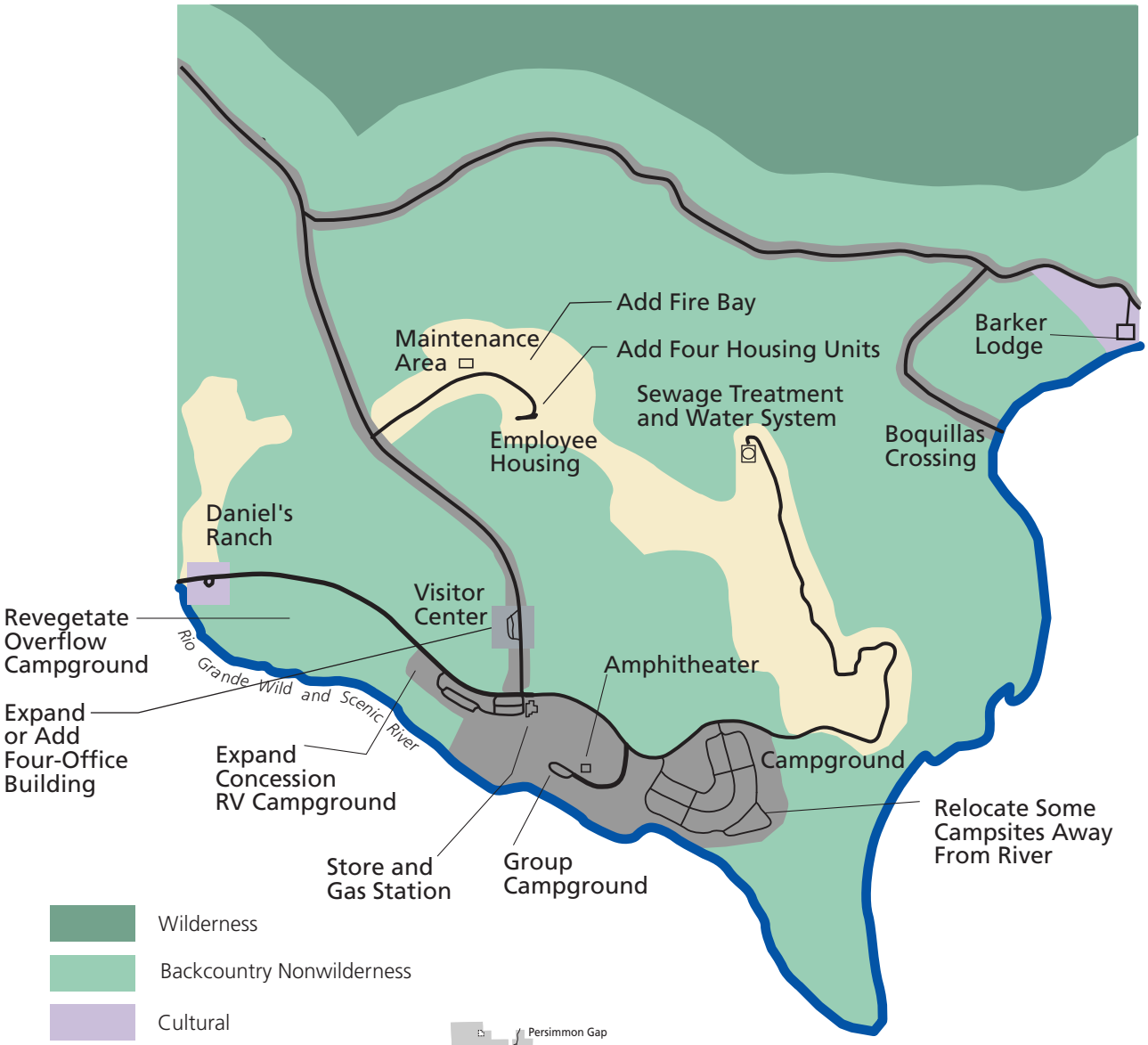

Alternative B
Rio Grande Village

Big Bend National Park

National Park Service
U.S. Department of Interior
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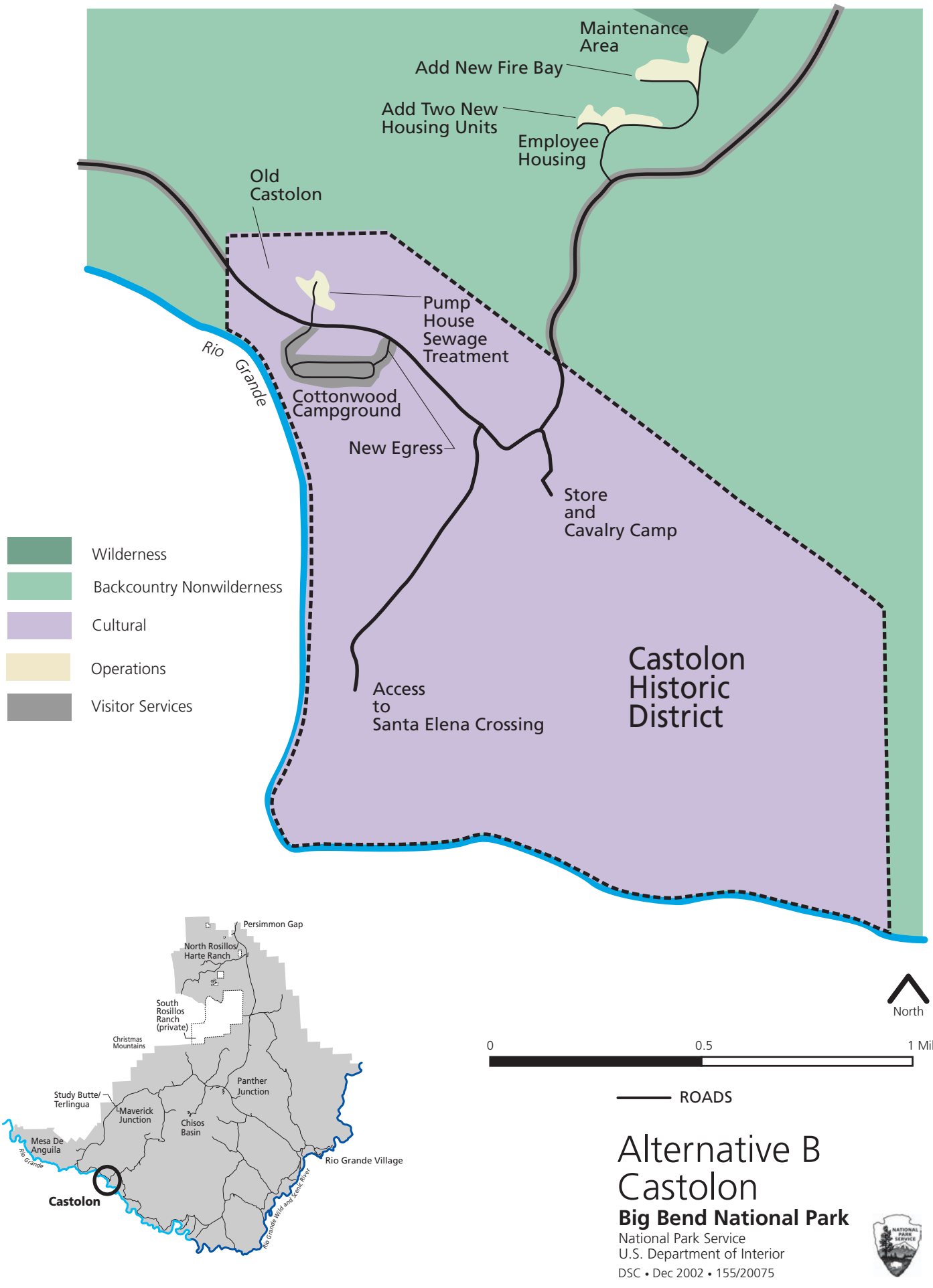

Alternative B Castolon

Big Bend National Park

National Park Service
U.S. Department of Interior
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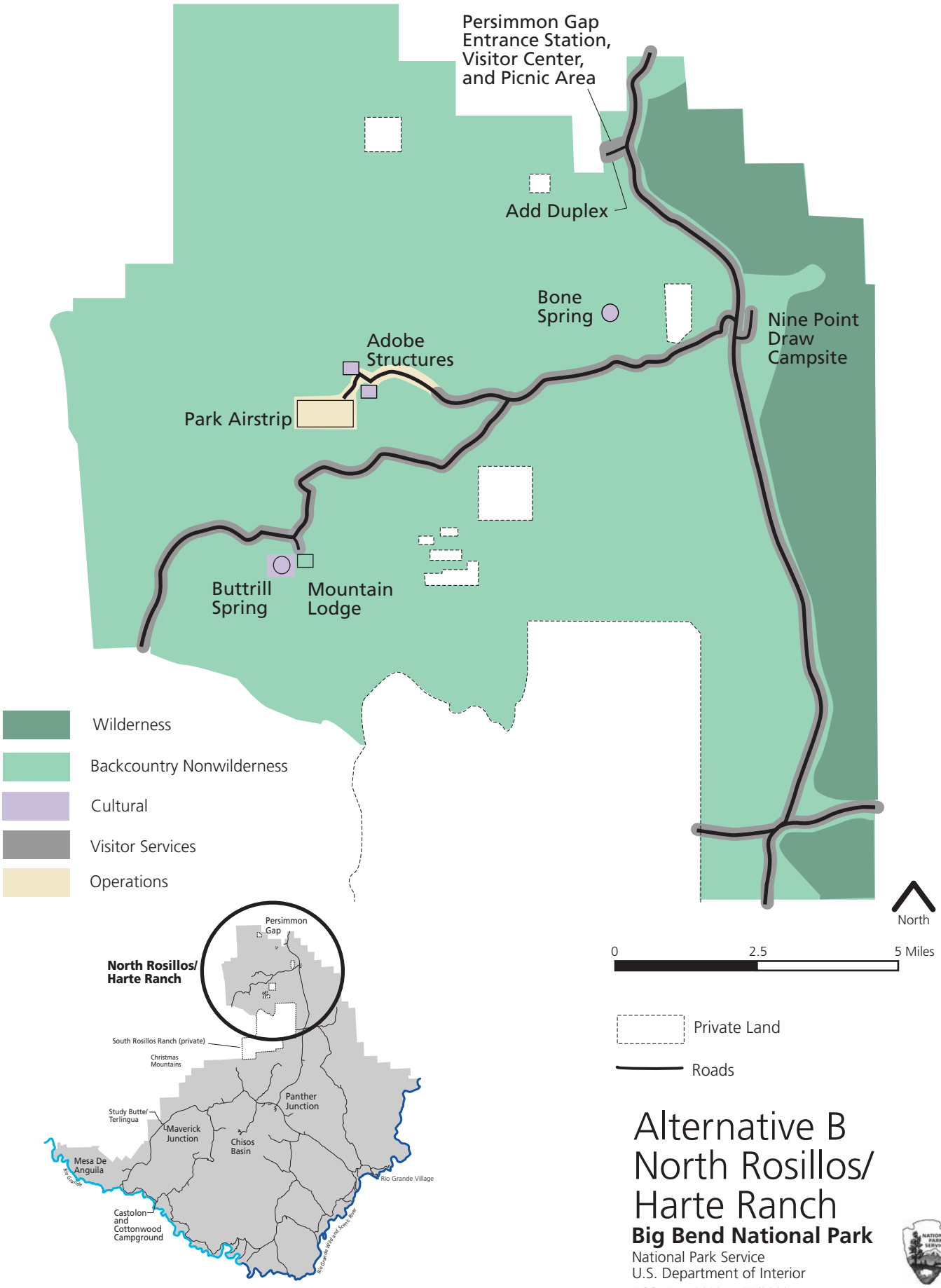

Alternative B North Rosillos/ Harte Ranch

Big Bend National Park

National Park Service
U.S. Department of Interior
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At Panther Junction, a new visitor center would be built to provide comprehensive interpretation of the park's interpretive themes. A new visitor center is the most effective and efficient way to address numerous shortcomings in the current facility, which serves not only as the main park visitor center but also as the park operational headquarters building. This results in conflicts between strictly park administrative activities and the need to provide a full range of visitor services. The current building was constructed in 1961 and designed to accommodate a smaller park staff and a park annual visitation of slightly more than 90,000 people. Forty years later, the park staff has grown and park annual visitation averages between 300,000 and 340,000 (and has been as high as 474,000). Because of the geography and layout of the park road system, nearly every visitor goes by the visitor center. During peak periods of use, the interior space becomes very congested with staff and visitor activities.

The visitor center lacks sufficient indoor spaces for such basic interpretive functions as interpretive programs, films, and other multi-media presentations. The visitor center's original auditorium, many years ago, was converted into a park community/meeting/ training room for park functions (such as administrative activities such as permitting for park activities) or for potlucks, Girl Scout meetings, religious services, and other community activities – purposes never anticipated in the original design. It has become the center for these activities because it is one of the very few public facilities within a 100-mile area that is large enough to accommodate numbers of people. (A small year-round visitor center in the Chisos Basin is geared to those visitors planning activities in the Basin. The two other visitor contact stations in the park at Rio Grande Village and Persimmon Gap operate only seasonally. None of these sites have the geographic advantage of Panther Junction.) The visitor center cannot accommodate all these activities and still be an effective visitor center. During peak periods, it can be difficult to even get into the building much less gain any understanding or appreciation of the various exhibits, displays, and literature available on the park.

In addition, it is critical to provide visitors with safety information to enable visitors to safely enjoy the park's beauty and not have their visit marred by accident or injury. Currently, the visitors can with effort gain the necessary information, but a new facility would provide a more efficient and effective mechanism for both distributing materials and face-to-face contact with visitors.

The new visitor center would include an auditorium for orientation and interpretive programs, expanded exhibit areas, and the main Big Bend Natural History Association bookstore. The center would take advantage of the desert climate by using outdoor exhibit space as much as possible for such items as paleontological exhibits and other appropriate interpretive themes. The new building would consolidate offices for the interpretive division. It would contain enough space to adequately provide interpretation of the park's interpretive themes and fully address the complexities of this huge park. Rather than having one large and very expensive structure, a number of the exhibits would be incorporated into the building area so that they could be protected from the elements but remain open to the outside even when the building was closed. In this way, exhibit space would be increased for minimal cost.

The new building would allow for the conversion of the old structure into much needed office space for current and future park staff. This conversion would be undertaken only after this Mission 66 structure was evaluated to determine its national register eligibility. If it was found eligible, the rehabilitation would be done in a manner that would preserve its character-defining features. This would consolidate offices that currently are in various locations around Panther Junction and make administrative operations more efficient.

The natural resources and collection management building (described in the cumulative impact scenario) should adequately provide for the collection storage needs for the

duration of this plan. In case additional collection storage space were necessary, the other new storage areas would be evaluated to accommodate this need.

At Rio Grande Village, some campsites would be relocated to reduce impacts on the endangered Big Bend gambusia. To give further protection to the Big Bend gambusia, the park staff would seek to find a separate water source so that the fish and people would no longer be sharing the same source. The former overflow camping area would be returned to natural conditions. The concessioner-operated RV campground would be enlarged by about 40% in area, but would not exceed 30 total sites. The current visitor center building would be expanded to provide office space for four park rangers, or a separate building would be constructed for this purpose depending on which would be more cost-effective.

At Cottonwood Campground, some of the campsites would be relocated away from the river because the riverbank in that area tends to slough off. An additional egress road from the campground would be constructed.

To eliminate visitor and employee safety issues at the Maverick entrance station and to remove it from its prominent place in the viewshed, the entrance station would be removed and a new one would be constructed closer to the park's western boundary.

Operations Prescription

(Chisos Basin - sewage lagoons/sewage treatment plant area, employee housing, water tanks, and NPS operational area near the lodge
Panther Junction - all the developed area south of the visitor center/ headquarters, the sewage treatment plant, and the road to this plant
Rio Grande Village - the area north of Daniel's Ranch, the maintenance area, the employee housing area, the sewage treatment and water system area, and the roads to these areas
Castolon - maintenance area, employee housing, and pump house/sewage treatment area
North Rosillos/Harte Ranch - park airstrip and a portion of the road leading to the airstrip)

The water system at Castolon would be upgraded to meet state standards. Up to 15% of the park's personnel and functions would be moved to gateway communities. This would require the park to construct or lease offices and /or residences in the gateway communities. Some employees might rent or buy their own residences. This action would increase the park's sustainability.

A new storage warehouse would be built at Panther Junction to consolidate this scattered function into one building specifically designed for storage. New housing inside the park would be located in Rio Grande Village, Castolon, and Persimmon Gap if water sources can be found. A total of eight new housing units would be constructed to provide for better resource protection, visitor safety, and interpretation. Fire bays would be built at Rio Grande Village and Castolon to achieve greater resource protection.

PARTNERSHIPS, PROGRAMS, AND ACTIVITIES

Water is critical to understanding and preserving the Big Bend ecosystem. This alternative proposes a number of actions to meet this critical need. In Rio Grande Village the amount of land irrigated by water from the Rio Grande would be reduced by about 50% to about 12.6 million gallons per month. Priority for irrigation would be given to shade trees in campgrounds and picnic areas. As cottonwoods die, they would be replaced by more drought-tolerant native species. Overall, plants that are heavy water users would be phased out to reduce the amount of irrigation. In the Rio Grande Village area, a study would be made on how best to restore natural hydrology consistent with maintaining cultural landscapes. The park staff would explore the feasibility of acquiring additional water rights for the entire

length of the Rio Grande in the park for the purpose of increasing flows in the river.

In the North Rosillos/Harte Ranch area, small-scale experimental restoration treatments would be undertaken to determine how best to restore the natural grasslands. Successful treatments would then be used in other areas of the park.

The park staff would continue to seek ways to strengthen connections with the Mexican protected areas bordering the park. This would include working with the staff in the Mexican protected areas to better protect and provide an understanding of the areas' natural and cultural resources. In addition, the park staff would continue to seek ways to work with the Mexican villages that border the park. This would include, but not be limited to, more interpretive programs.

Park interpretive programs that extend beyond park boundaries would be expanded, including external curriculum-based environmental education and use of technology to develop distance learning opportunities.

PARK BOUNDARY

No major changes in the park boundary would be proposed under this alternative.

ESTIMATED COSTS

In 2001 Big Bend National Park, in a unique partnership with the National Parks Conservation Association and a consortium of philanthropic organizations led by the Kendall Foundation, developed a business plan to identify the financial and personnel shortfalls at this park (NPS and NPCA 2001). This plan analyzed how many full-time equivalent employees (FTEs) would be necessary for the park to meet resource protection, management, administrative, maintenance, visitor experience, and facility operational standards. The additional FTE requirements below are based on that analysis.

There would be a transition period between when this plan is approved and when the park could become fully staffed. During this transition period, the park would seek to increase its efforts in the areas of grant and fund raising, developing partnerships, and doing cost-benefit analysis on park activities to increase park efficiency to cover the shortfall and meet minimal operational standards. These are at best temporary solutions.

All costs are in year 2002 dollars. All alternatives retain the current base staff of 100 full-time-equivalent (FTE) positions and show the number of additional FTEs required to implement the alternative. The additional positions would be in resource protection, interpretation, maintenance, and administrative support. A total of 31 additional FTEs at a cost of $1.4 to $2.0 million per year would eventually be required to implement this alternative. Added to current staffing costs of $4.3 million per year, the total would be $5.7 to $6.3 million per year.

The construction, rehabilitation, and restoration costs for alternative B would be about $ 18.3 to $25.0 million. The estimate is general and should be used only for comparing the alternatives in this plan.

ALTERNATIVE C – MAXIMIZE NATURAL RESOURCE STEWARDSHIP AND PRESERVATION BY PROVIDING A MORE RESOURCE-ORIENTED VISITOR EXPERIENCE

CONCEPT

This alternative would provide for the enduring protection and preservation of the park's natural resources. Actions would be undertaken to give greater resource protection while allowing for visitor use.

This alternative would result in the construction of a new park administrative headquarters while rehabilitating the existing facilities to better serve visitors. Removal of all development except for main roads at Chisos Basin and Rio Grande Village would be undertaken to provide greater protection for natural resources. Trailheads would be developed in these areas for visitor access. The private sector would be encouraged to develop lodging for visitors outside of the park.

DETAILED DESCRIPTION

The description of this alternative, like the description of alternative B, is organized by management prescriptions. The various prescriptions are described at the beginning of this chapter. Also see the Alternative C maps for placement of management prescriptions on areas within the park.

The maps in this document are for illustration purposes only and are not drawn perfectly to scale.

Wilderness Prescription

(See Park Area map)

Most of the land that comprises the park has been determined either as "proposed" wilderness or "potential" wilderness. These recommendations have been transmitted to Congress by the president, but have not been acted on by Congress. The National Park Service is required to manage these lands to preserve their wilderness values until Congress acts. To accomplish this requirement, these lands would be managed under the Wilderness Prescription that would preserve vast desert and mountain landscapes that are unaltered by the hand of man. These areas contain dramatic contrasts, from lofty wooded peaks to canyons carved by the Rio Grande, all dominated by the great expanse of the Chihuahuan Desert. The visitor would have the opportunity for a primitive experience with chances to see the magnificent scenery that is unique within the United States as well as to sense the solitude and quietness that typifies the area.

Some of the notable features in the prescription would be the Mesa de Anguila and the north side of Santa Elena Canyon, the area east of Santa Elena Canyon containing the creosotebush plant community, the lava-capped Burro Mesa, the Chisos Mountains, and portions of the Chisos Basin. Most of the area around Mariscal Mountain, Talley Mountain, and Chilicotal Mountain would also be in this prescription, as well as portions of Tornillo Creek, McKinney Hills, Boquillas Canyon on the Rio Grande, and the Sierra del Carmen Mountains. All the cliffs in the three major river canyons of the Rio Grande would be managed under the wilderness prescription. The Hot Spring trail would be extended to a new trailhead and nature trail to Boquillas Crossing.

The North Rosillos/Harte Ranch section of the park contains lands that are being evaluated to determine their suitability or nonsuitability for further study and possible recommendation for wilderness designation. See "Appendix E: Draft Wilderness Suitability Assessment," and the "Purpose, Need, and Scoping" chapter. If lands are found suitable for further study and possibly recommended for wilderness designation, these lands would be managed as wilderness at least until the wilderness study was completed.

Backcountry Nonwilderness Prescription

(Chisos Basin - most of Basin
Panther Junction - most of area excluding developed areas
Rio Grande Village - most of area
Castolon most of area north and west of historic district
North Rosillos/Harte Ranch - most of area excluding roads and development)

Portions of the park excluded from the 1984 wilderness proposal are: (1) areas along the Rio Grande and south of the River Road that are less than 5,000 acres and are impacted by citizens of Mexico and fishermen, (2) corridors along the roadways, (3) areas that contain pole-mounted telephone and power lines, and (4) the soil and moisture study area. However, many of the excluded areas contain values similar to those found in proposed or potential wilderness. Alternative C has placed these lands in the Backcountry Nonwilderness prescription.

In the North Rosillos/Harte Ranch area, the park may develop a Rosillos trail. All concession and park facilities in the Chisos Basin and Rio Grande Village would be removed, except the main road, and the area would be restored to natural contours and revegetated. A trailhead and parking area and restrooms would be provided. These areas would be managed following the Backcountry Nonwilderness prescription. No concessions lodging would be allowed in the park, but the private sector would be encouraged to develop lodging facilities outside the park boundaries.

The Mariscal Mine, Luna's Jacal, Homer Ranch, and Sam Nail Ranch (not a national register site) are cultural resources found in areas covered by this prescription. All sites eligible for listing on the national register would be preserved. These resources would continue to be preserved, and over time the interpretation of these sites would be upgraded as time and funding permit. This prescription would result in these areas being managed to either continue the natural conditions or to reduce past impacts on resources.

Cultural Prescription

(Daniel's Ranch, Barker Lodge area, Castolon Historic District, the two springs, and the adobe structures near the airport)

The park would consult with the Texas Historic Preservation Office to determine if the non-character-defining features of Barker Lodge could be documented and allowed to deteriorate. If this was not feasible, then Barker Lodge would be preserved in the most cost effective manner. The current preservation and interpretive activities at the Daniel's Ranch and Castolon Historic District would continue. The water and fire suppression system would be upgraded to provide for better protection of the historic district.

In the North Rosillos/Harte Ranch area, Bone Spring and Buttrill Spring would be placed in this prescription, and the park staff would develop preservation strategies for each of these features. The various sites around Buttrill Spring and Bone Spring would be evaluated for their potential to be listed on the National Register of Historic Places – possibly as part of a cultural landscape. Features around Buttrill Spring would be preserved for their historic and interpretive significance. An interpretive trail would be developed in the area of Buttrill Spring.

Visitor Services Prescription

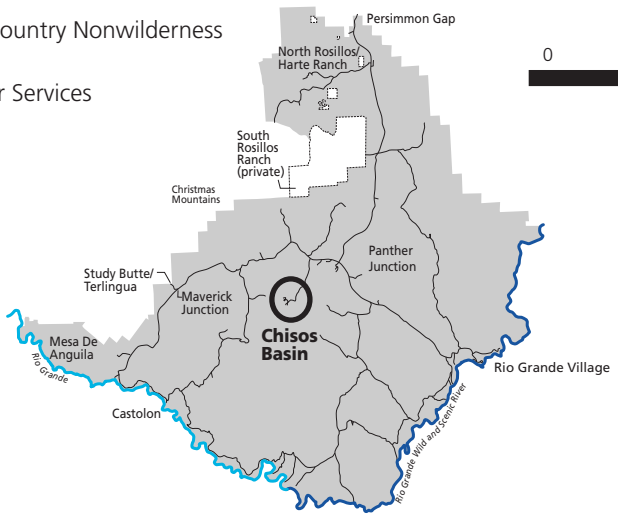
(Panther Junction - area along the main park road from the visitor center/headquarters to the gas station and store
Cottonwood Campground
Persimmon Gap - area around the entrance station, visitor center, and picnic area
Maverick - the new site for the entrance station)

At Chisos Basin, electrical lines would be placed underground to decrease their impact on park scenic values. At Panther Junction, the visitor center/ headquarters would be rehabilitated to better serve as a visitor center, consolidate offices for the interpretive division, and provide space for collections. This would be undertaken only after this Mission 66 structure was evaluated to determine its

Trailhead to Backcountry/ Parking Area/ Restroom

Backcountry Nonwilderness

Visitor Services



North

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ROADS

Alternative C Chisos Basin

Big Bend National Park

National Park Service
U.S. Department of Interior

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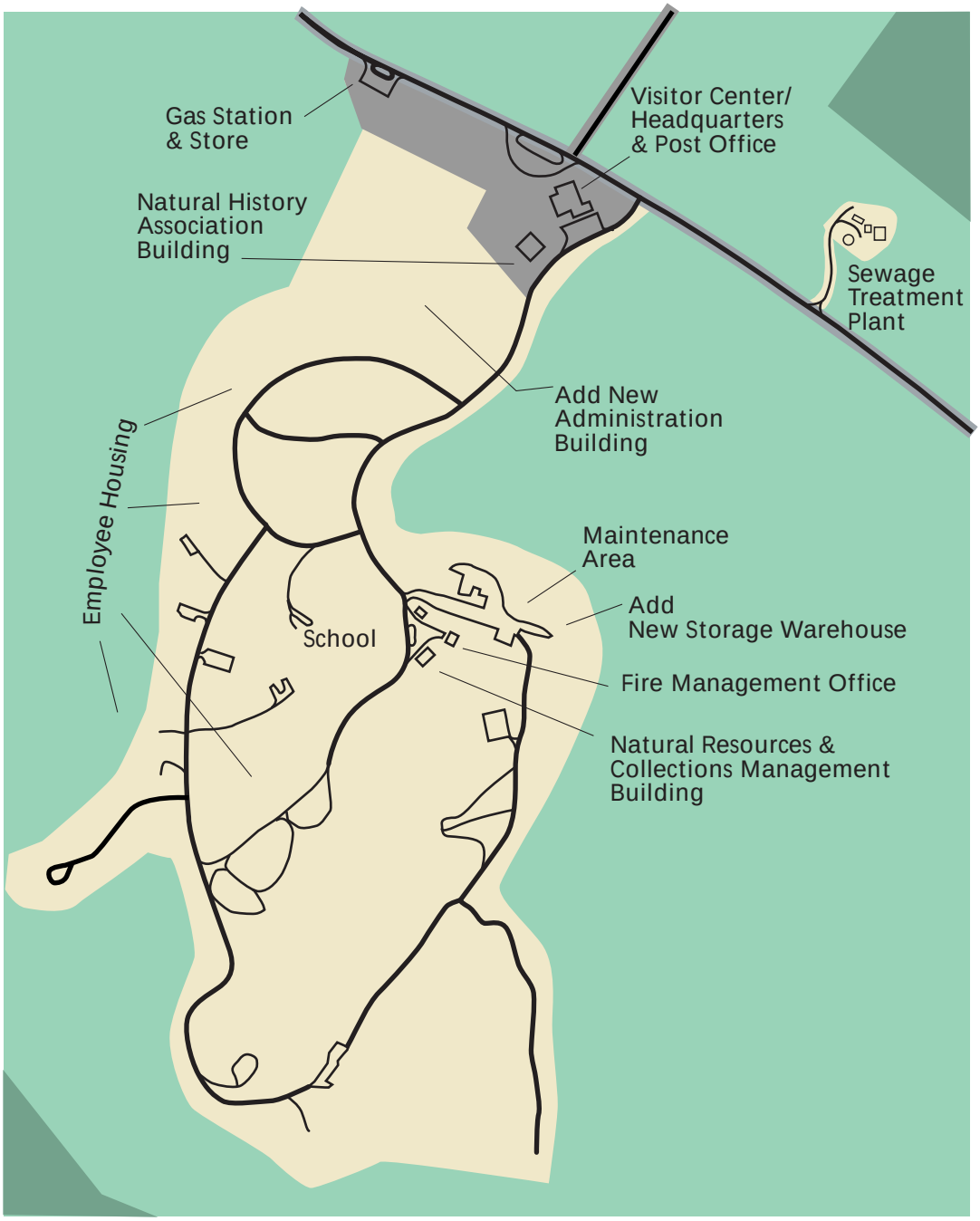

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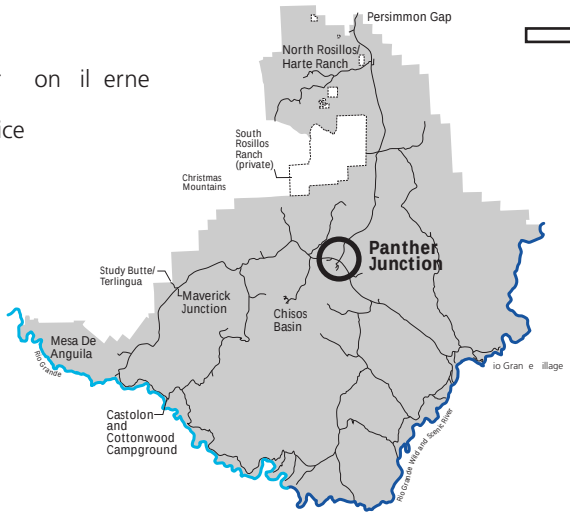

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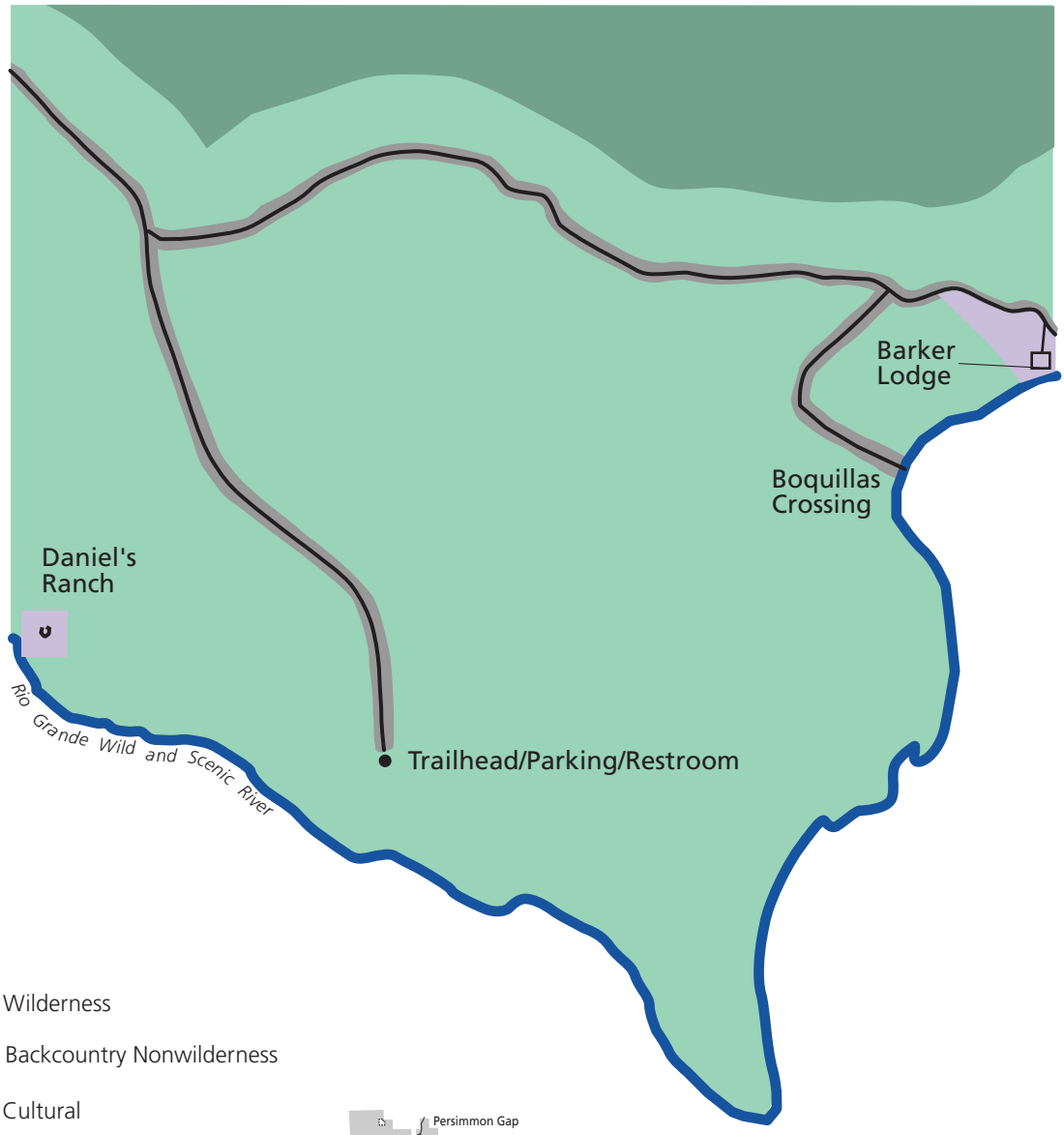
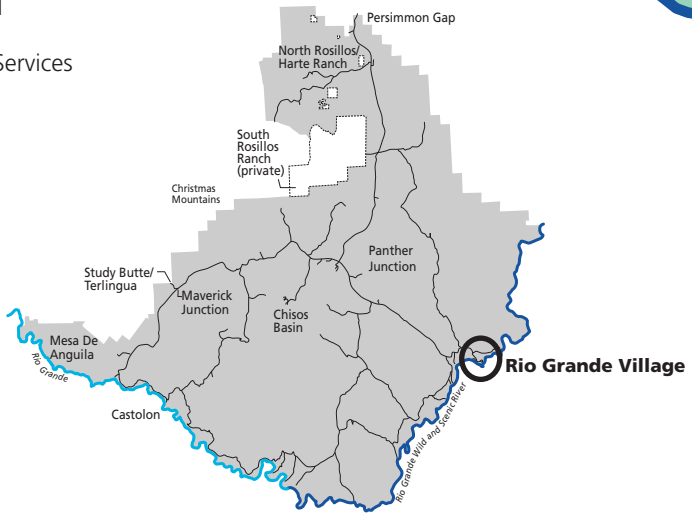


Wilderness

Backcountry Nonwilderness

Cultural

Visitor Services



North

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ROADS

Alternative C
Rio Grande Village

Big Bend National Park

National Park Service
U.S. Department of Interior

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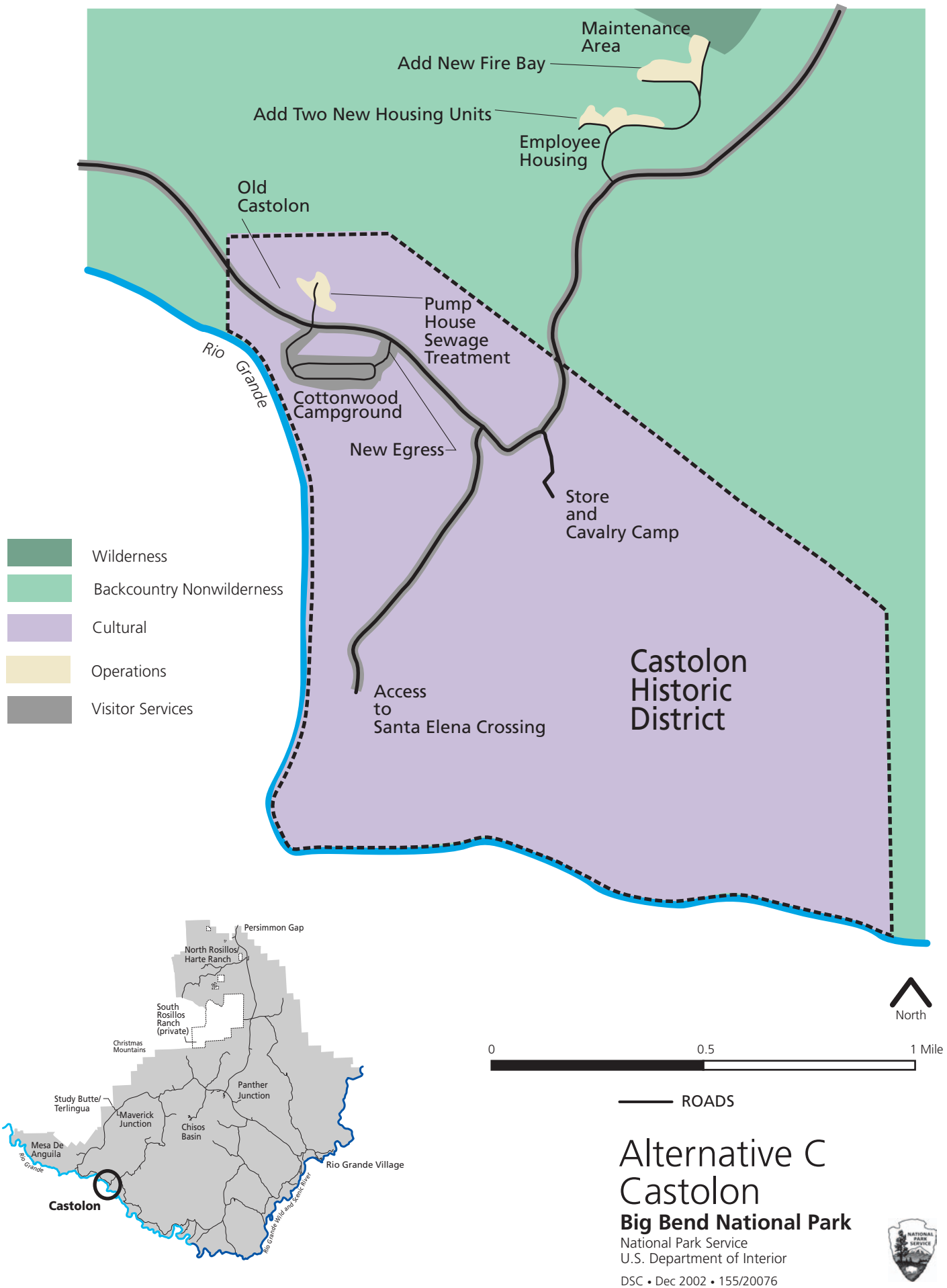

Alternative C Castolon

Big Bend National Park

National Park Service
U.S. Department of Interior

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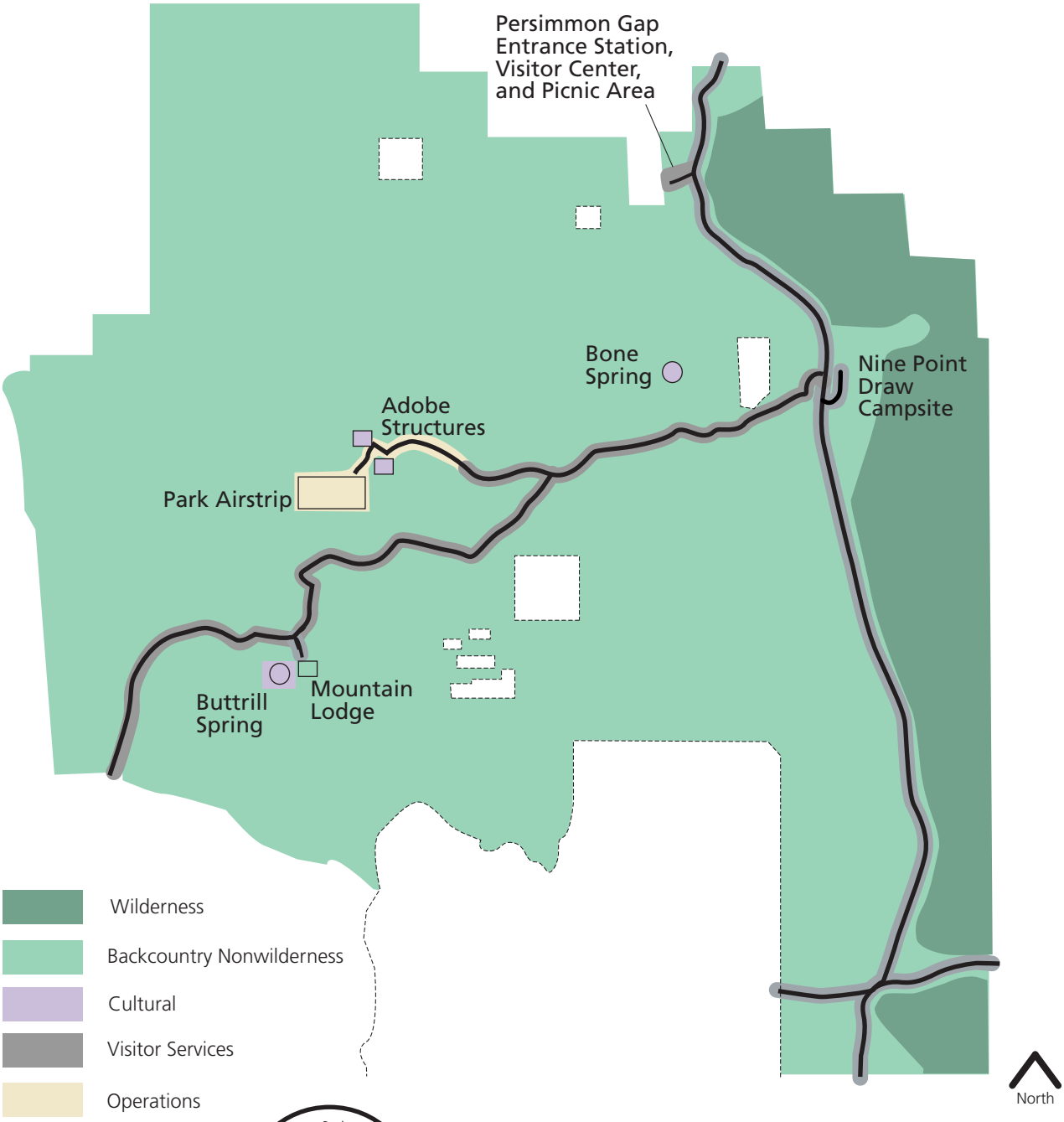

Alternative C
North Rosillos/ Harte Ranch

Big Bend National Park

National Park Service
U.S. Department of Interior

DSC • Dec 2002 • 155/20082

eligibility for listing on the national register. If it is found eligible, the rehabilitation would be done in a manner that would preserve its character-defining features.

At Cottonwood Campground, some of the campsites would be relocated away from the river, and a new egress road would be constructed from the campground.

To provide better visitor orientation and eliminate visitor and employee safety hazards at the Maverick entrance station, it would be removed; a new entrance station constructed on a site closer to the park's western boundary.

Operations Prescription

(Panther Junction – all the developed area south of the visitor center/ headquarters and the sewage treatment plant
Castolon - maintenance area, employee housing, and pump house/ sewage treatment area
North Rosillos/Harte Ranch - park airstrip and a portion of the road leading to the airstrip)

The water system at Panther Junction would be upgraded to meet state standards. Up to 15% of the park's personnel and functions would be moved to gateway communities. This would require the park to construct or lease offices and /or residences in the gateway communities. Some employees may rent or buy their own residences. This action would increase the park's sustainability.

A new administrative building would be built at Panther Junction so that all administrative offices there would be in one building. A new storage warehouse would be built at Panther Junction to consolidate this scattered function into one building specifically designed for storage. A fire bay would be built at Castolon to achieve greater resource protection. The natural resources and collection management building (described in the cumulative impact scenario) should adequately provide for the collection storage needs for the duration of this plan. In case additional collection storage space were necessary, the other new storage areas would be evaluated to accommodate this need.

PARTNERSHIPS PROGRAMS, AND ACTIVITIES

Water is critical to the understanding and preserving the Big Bend ecosystem. When development is removed from Rio Grande Village and Chisos Basin, the existing vegetation would be replaced with drought-tolerant species. Overall, plants that are heavy water users would be phased out and irrigation discontinued in Rio Grande Village. In the Rio Grande Village area, a study would be made on how best to restore natural hydrology consistent with maintaining cultural landscapes. The park staff would explore the feasibility of acquiring additional water rights for the entire length of the Rio Grande in the park for the purpose of increasing flow in the river.

In the North Rosillos/Harte Ranch area, small-scale experimental restoration treatments would be undertaken to determine how best to restore natural grasslands. Successful treatments would be used in other areas of the park.

The park would continue to seek ways to strengthen connections with the Mexican protected areas bordering the park. This would include working with staff in the Mexican protected areas to better protect and provide an understanding of the areas' natural and cultural resources. In addition, the park staff would continue to seek ways to work with the Mexican villages that border the park. This would include, but not be limited to, more interpretive programs.

The park's interpretive program would be expanded in a variety of ways to extend beyond park boundaries. This would include expanded, external, curriculum-based environmental education and using technology to develop distance learning opportunities.

PARK BOUNDARY

No change in the park boundary would be proposed under this alternative.

ESTIMATED COSTS

In 2001 Big Bend National Park, in a unique partnership with the National Parks Conservation Association and a consortium of philanthropic organizations led by the Kendall Foundation, developed a business plan to identify the financial and personnel shortfalls at this park (NPS and NPCA 2001). This plan analyzed how many full-time equivalent employees (FTEs) would be necessary for the park to meet resource protection, management, administrative, maintenance, visitor experience, and facility operational standards. The additional FTE requirements below are based on that analysis.

There would be a transition period between when this plan is approved and when the park could become fully staffed. During this transition period, the park would seek to increase its efforts in the areas of grant and fund raising, developing partnerships, and doing cost-benefit analysis on park activities to increase park efficiency to cover the shortfall and meet minimal operational standards. These are at best temporary solutions.

All costs are in year 2002 dollars. All alternatives retain the current base staff of 100 FTE positions and show what additional FTEs would be required to implement the alternative. The staffing figures represent additional positions that would be needed to carry out this alternative. The additional positions would be in the resource, protection, interpretation, maintenance, and administrative divisions. A total of 11.5 additional FTEs at a cost of $625,000 to $846,000 per year would eventually be required to implement this alternative. Added to the current staff cost of $4.3 million per year, total costs would be $4.9 to $5.1 million per year.

The construction, rehabilitation, and restoration costs for alternative C are estimated to range from $16 to $18.4 million. The estimate is general and should be used only for comparing the alternatives in this plan.

ALTERNATIVES ELIMINATED FROM FUTHER CONSIDERATION

SUMMARY

One alternative previously under consideration was eliminated from this draft plan due primarily to a lack of public support. The principal focus of this alternative was the relocation of most facilities in the Chisos Basin, Rio Grande Village, and Castolon. Most comments received on this proposal pointed out that simply moving facilities would result in impacts in the areas where facilities were removed and in areas to which these facilities were moved – many new areas of the park. The bullets indicate elements that were not included in another alternative.

Chisos Basin

- Remove all concession and park facilities from Chisos Basin except for campground and two residences for law enforcement and maintenance.
- Relocate the lodge and concession operations to an area between Basin Junction and Panther Junction. If this action were not feasible, permit no concession lodging in the park.

Panther Junction

- Expand visitor center to best interpret the park's natural and cultural material.

Castolon

- Develop new campground and amphitheater in mesquite flat or southeast along the river; remove current campground and amphitheater.
- Relocate concessions housing out of historic district.

Rio Grande Village

- Relocate campsite facilities and certain park support facilities such as visitor center and housing outside the 100-year floodplain.
- Relocate the gas station, store, and park support facilities such as maintenance outside the 500-year floodplain, possibly at the junction of the road to Boquillas.
- Reduce park facilities to a total of five residences (three for maintenance and two for law enforcement).
- If sufficient space can be identified, develop additional campsites.
- Reduce concessions facilities to two residences.

North Rosillos/Harte Ranch

- Designate a substantial portion of North Rosillos/Harte Ranch area for a wilderness study and manage it following the wilderness prescription. Exclude the county road, landing strip with surrounding buildings, and mountain lodge from this study.
- Allow the remaining structures to deteriorate in place; if necessary for visitor safety, remove them.
- Manage most land in the North Rosillos/Harte Ranch area following the wilderness prescription.

Parkwide

- Develop in situ display of paleontological resources and improve fossil bone exhibit

Christmas Mountains

- Encourage the Texas General Land Office to find a buyer for the land who would manage it to be compatible with park purposes.

IDEAS SUGGESTED AND ELIMINATED FROM FURTHER CONSIDERATION

During the planning process, the public suggested two ideas that were dropped from further consideration. These ideas are discussed below.

Museum of Paleontology. The new visitor center would have paleontological exhibit space, and an appropriate location in the park would be identified for an in situ display of paleontological resources including fossils.

Christmas Mountains. The Christmas Mountains are owned by the Texas State Land Office. The lands are protected by a strict conservation easement, and that easement remains in place regardless of ownership. The easement will protect the park viewshed and the Christmas Mountains from any development. Because of this, it was decided that the focus of this management plan should be on the lands owned by the park within the current boundary.

THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is the alternative that will promote the national environmental policy as expressed in section 101 of the National Environmental Policy Act. In the National Park Service, the environmentally preferred alternative is identified by (1) determining how each alternative would meet the criteria set forth in section 101(b) and (2) considering any inconsistencies between the alternatives analyzed and other environmental laws and policies (Director's Order 12, 2.7.E.).

The preferred alternative, alternative B, is the environmentally preferred alternative based on the following criteria provided in the National Environmental Policy Act:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure safe, healthful, productive, and esthetically and culturally pleasing surroundings for all Americans.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and a variety of individual choices.
- Achieve a balance between population and resource use and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Alternative B, which rated high in all categories, would enhance the park's ability to carry out its mission through developmental and programmatic activities while limiting the amount of new environmental impacts from the development. This would be accomplished through, in the main, limiting development to previously developed areas. Alternatives A and C lack the range of diversity and variety of individual choices found in B. Alternative B best balances the need to protect the park's resources while allowing visitors to enjoy the widest range of activities. Alternative B fulfills the responsibility of protecting resources for future generations by taking actions to reduce water use in the park and provide for additional measures to protect endangered species. Alternative C provides similar protection, but reduces opportunities for all visitors to fully enjoy the park and its resources. Therefore, the preferred alternative is the environmentally preferred alternative.

MITIGATION AND ADDITIONAL STUDIES

GROUND DISTURBANCE/SOILS

Where possible, new development would be built on previously disturbed sites. During design and construction, park natural resource staff would identify areas to be avoided.

Best management practices for controlling soil erosion, such as the placement of silt fencing, retention and replacement of topsoil, revegetation of sites with native species, and selective scheduling of construction activities, would be taken to reduce runoff and soil loss from construction sites. Salvaged vegetation, rather than new planting or seeding, would be used to the extent possible. Workers also would be required to control dust, and all construction machinery would be required to meet air emission standards. Restoration efforts would be scheduled to minimize impacts on downstream water users.

VEGETATION

Park staff would survey proposed development sites for sensitive species and would relocate new development if sensitive species populations were present. Similarly, trails, roads, campsites, and picnic sites would be located to avoid impacts on sensitive species.

To the extent possible, help minimize the spread of nonnative plants, park managers would allow only the use of weed-free materials and equipment for park operations and visitor use activities.

WATER RESOURCES

Best management practices such as the use of silt fences, would be implemented to ensure that construction-related effects were minimal and to prevent long-term impacts on water quality, wetlands, and aquatic species from displacement of soils.

A statement of findings for floodplains would be prepared if the selected alternative included retaining a campground in the 100-year floodplain or any development in the flash flood prone area at Panther Junction. The statement of findings would include an emergency preparedness plan for evacuating people in the event of a flood. More detail is available in the "Affected Environment" chapter, under "Natural Resources."

Any new facilities proposed in the floodplain (except trails, roads, and picnic facilities) would be designed to manage flood conditions, and a statement of findings for floodplains would be prepared.

Increased caution would be exercised to protect wetlands from damage caused by construction equipment, erosion, siltation, and other activities with the potential to affect wetlands.

Construction materials would be kept in work areas, especially if the construction took place near streams or natural drainages.

Wetlands would be delineated by qualified NPS staff or certified wetland specialists, and they would be marked before construction.

AIR QUALITY

The best available clean fuel technology would be applied (as it becomes available) to the extent feasible.

Measures to reduce air pollution would be taken.

Dust abatement measures would be employed.

CULTURAL RESOURCES

In accordance with NPS policies and procedures, the protection of cultural resources would continue. The disturbance of significant resources would be avoided wherever possible.

Where avoidance or preservation could not be achieved, appropriate mitigation would be carried out according to the procedures of the Advisory Council on Historic Preservation (36 CFR 800).

"Stop work" provisions and other protective measures would be included in project documents implementing the approved plan. (A stop work order would only be used in an extreme situation. Projects would be designed to identify and protect resources well before development plans were finalized.) Construction would be restricted to the immediate vicinity of the projects, and new disturbance would not be permitted outside the designated project area.

If previously unknown and significant archeological resources were unearthed during construction, or if human remains were discovered, work in the discovery area would be stopped immediately, and the park superintendent and the contracting officer would be notified immediately. Measures would be instituted to protect the remains, sacred objects, associated funerary objects, and objects of cultural patrimony. The superintendent would notify the state historic preservation officer. Any artifacts found in association with the remains, funerary objects, sacred objects, and objects of cultural patrimony, would be left in place. If the remains were determined to be of American Indian origin, the park superintendent would notify associated tribes according to the Native American Graves Protection and Repatriation Act and its implementing regulations.

A number of park landscapes and structures at Panther Junction, Rio Grande Village, Chisos Basin, and Castolon are potentially eligible for inclusion on the National Register of Historic Places as part of the National Park Service's Mission 66 work. Before taking any actions that would affect these sites, the sites would be evaluated in consultation with the Texas Historic Preservation Office. If these sites were determined eligible, then a strategy would be developed for their preservation or documentation.

Studies would be undertaken to determine:

- What is the archeological site distribution throughout the park, how do the sites relate to the various environmental zones, and what does this tell us about prehistoric populations and their adaptations to a changing environment?
- What cultural sites are located in areas of development and visitor use where the potential for adverse impacts from those activities are greatest?
- What native American tribes are affiliated with Big Bend and Rio Grande Wild and Scenic River?
- What ethnographic resources can be found in the park (Native American, Hispanic, others)?
- What are past and present Hispanic influences on Big Bend and the Rio Grande?
- What cultural landscapes in the park are eligible for nomination to the National Register of Historic Places?
- What is the best way to provide treatment for identified and evaluated cultural landscapes and historic structures?
- What archeological resources would be impacted in areas where development or visitor activity is planned?
- What is the best way to record and preserve the 450 buildings, structures, and ruins scattered throughout the park?
- What was the Hispanic settlement that took place in the area of the park in the 18th and 19th centuries?
- What native plants and animals were used by the Hispanic populace?
- What was the effect of mining on the park environment?
- What is the best way to document and preserve the 40 gravesites and 300 graves scattered throughout the park?

Also, a scope of collections needs to be prepared and a cadastral survey of all disputed sections of boundary needs to be conducted, especially in recent additions in the northwest section of the park.

TABLE 2: COMPARISON OF ALTERNATIVES

	Alternative A	Alternative B (Preferred)	Alternative C
Concept	No significant change in current interpretation or park management direction.	Offer enhanced experience for visitors while creating a more sustainable park and providing better protection for park resources. A new visitor center would be developed that would include an auditorium, an expanded exhibit area, and possibly an outdoor exhibit area. Interpretation would be developed for the Buttrill Spring area. A number of actions such as reducing irrigation water used at Rio Grande Village by 50%, phasing out plants that are heavy water users at Rio Grande Village and Cottonwood Campground, re-locating personnel to gateway communities, and removing some development from Chisos Basin would result in reduced water use. All these actions would provide for a better visitor experience and make the park more sustainable.	Provide for the enduring protection and preservation of the park's natural resources. Give greater resource protection while providing for visitor use. This alternative would result in the construction of a new park administrative headquarters while rehabilitating the existing facilities to better serve visitors. Removal of all development except for main roads at Chisos Basin and Rio Grande Village would be undertaken to provide greater protection for natural resources. Trailheads would be developed in these areas for visitor access. The private sector would be encouraged to develop lodging for visitors outside of the park.
Wilderness	Manage existing proposed and potential wilderness areas from 1984 *Final Environmental Impact Statement, Proposed Wilderness Classification (NPS 1984)* as wilderness as required by NPS policy.	Same as alternative A. If wilderness suitability assessment for North Rosillos/Harte Ranch area finds lands suitable for further study and possible recommendation for wilderness designation, manage these lands as wilderness at least until the wilderness study was completed.	Same as alternative B.
Throughout the Park	Continue to provide all park offices and housing in the park boundary.	Move up to 15% of park personnel and functions to gateway communities; construct or lease offices and/or residences in gateway communities.	Same as alternative B.
	Maintain park water rights at current levels.	Acquire additional water rights to increase flows in the river.	Same as alternative B.
	Continue to work with Mexican protected areas' staff.	Seek ways to strengthen connections with the Mexican protected areas.	Same as alternative B.
	Continue to work with Mexican villages that border the park.	Seek additional ways to work with the Mexican villages that border the park, possibly including more interpretive programs.	Same as alternative B.

	Alternative A	Alternative B (Preferred)	Alternative C
Throughout the Park (cont.)	Continue interpretive programs beyond park boundaries.	Expand interpretive programs that extend beyond park boundaries, including environmental education and the use of technology. Develop *in situ* paleontological exhibit.	Same as alternative B.
Chisos Basin	Retain visitor center, campgrounds, lodge, and NPS housing.	Relocate one NPS employee residence and NPS bunkhouse to Panther Junction; work with concessioner to remove lodge unit A (12 rooms).	Remove all development from Basin except main road; restore to natural conditions with drought-tolerant species. Provide trailhead, restroom, and parking area at trailhead. Encourage private sector to develop lodging outside the park.
	Do not change electrical lines, which are in the viewshed of the road into Chisos Basin.	Place electrical lines underground (to decrease visual impacts).	Same as alternative B. Remove electric lines when remove development.
Panther Junction	Construct new fire management building.	Same as alternative A	Same as alternative A.
	Develop early warning system and evacuation plan.	Same as alternative A.	Same as alternative A.
	Retain visitor center and administrative functions in headquarters building.	Construct new visitor center, including auditorium, bookstore, and expanded exhibit area. Determine feasibility of developing outdoor exhibits for large items (casts of paleontological resources).	Construct new administrative building.
		Provide and consolidate space for storage. and office space for interpretive division. Rehabilitate former visitor center area of headquarters to consolidate administrative offices. Provide NPS employee residence and bunkhouse to replace those removed from Chisos Basin.	Rehabilitate visitor center/headquarters to better serve as a visitor center, storage, and consolidated offices of the interpretive division.
	Add a few temporary housing and storage units as needed.	Construct storage warehouse. Replace housing (as described in the cumulative impact scenario).	Same as alternative B.
	Upgrade fire suppression system	Same as A.	Same as A.

	Alternative A	Alternative B (Preferred)	Alternative C
Rio Grande Village	Maintain visitor center building at current site.	Expand current visitor center building to provide offices for four park rangers or build a separate building for this purpose – whichever is most cost-effective.	Remove all development (except main road) from village, including visitor center; restore to natural conditions with drought-tolerant species. Provide trailhead, restroom, and parking. Extend Hot Spring trail to new trail-head and nature trail to Boquillas Crossing.
	Develop early warning system and evacuation plan for floodplain.	Same as alternative A.	Remove all development except main road and cultural resources from floodplain.
	Raise fuel storage tanks above 500-year flood level.	Same as alternative A.	Remove fuel tanks.
	Continue to irrigate shade trees and lawns.	Reduce irrigation water used by 50% (to 12.6 million gallons per month); give priority to shade trees in campgrounds and picnic areas. When they die, replace cottonwoods with more drought-tolerant species. Phase out plants that are heavy water users.	Phase out plants that are heavy water users. Continue irrigation only until area is restored.
	Retain altered hydrologic patterns.	Study how best to restore natural hydrology consistent with maintaining cultural landscapes.	Same as alternative B.
	Continue efforts to locate a separate water source for visitors and staff.	Same as alternative A.	Remove all visitor, staff, and concessioner facilities, therefore no alternative water source would be needed.
	Relocate some campsites away from Big Bend gambusia pond.	Same as alternative A.	Remove all development, including campgrounds.
	Use Barker Lodge for housing.	Use Barker Lodge for housing for researchers	Consult with state historic preservation office to see if non-character-defining portions of the lodge could be documented and left to deteriorate; if that was not feasible, preserve lodge in most cost-effective manner.
		Return overflow camping area to natural conditions.	Remove all development except main road, including campgrounds.
	Retain 25-site RV campground.	Concessioner would enlarge RV campground by about 40% with a total of no more than 30 sites.	Remove all development except main road, including campgrounds.
	Retain nine housing units (plus Barker Lodge).	Construct four new NPS housing units if a water source is found.	Remove all development except main road.
		Construct fire bay.	Remove all development except main road.
Castolon	Retain 11 housing units	Construct two new NPS housing units if water source is found.	Same as alternative A.
	Upgrade water and fire suppression systems.	Same as A.	Same as A.
		Construct fire bay.	Same as alternative B.

	Alternative A	Alternative B (Preferred)	Alternative C
Cottonwood Campground	Develop early warning system and evacuation plan for the floodplain.	Same as alternative A.	Same as alternative A.
	Continue to irrigate shade trees and other vegetation.	When cottonwoods die, replace them with more drought-tolerant species. Phase out plants that are heavy water users.	Same as alternative B.
	Continue to have campsites in areas where riverbank caves in.	Relocate some campsites away from river.	Same as alternative B.
	Retain single egress road.	Construct additional egress road from campground.	Same as alternative B.
North Rosillos/ Harte Ranch	Continue work to restore natural hydrologic and soil conditions and inventory cultural and natural resources as funds permit. Undertake small-scale experimental restoration treatments to determine how best to restore natural grasslands; use successful treatments elsewhere in the park.	Same as alternative A.	Same as alternative A.
	Retain existing conditions, with no trails.	Develop an interpretive trail at Buttrill Spring and possibly develop a Rosillos trail.	Same as alternative B.
		Develop preservation strategies for Bone Spring and Buttrill Spring. Preserve features around Buttrill Spring for historic and interpretive significance.	Same as alternative B.
		Evaluate features around Buttrill Spring and Bone Spring for potential to be listed on national register	Same as alternative B.
Persimmon Gap	Retain one housing unit.	Construct NPS duplex unit if a reliable water source is found.	Same as alternative A.
Maverick Entrance	Retain current station.	Remove current station; construct new one closer to western park boundary.	Same as alternative B
Gateway Communities	Maintain no facilities in gateway communities.	Construct or lease residences and offices.	Same as alternative B.
Boundary Adjustments	Propose no changes.	Same as alternative A.	Same as alternative A.
Costs	100 FTEs at about $4.3 million/year Construction, rehabilitation, and restoration costs $5.7 – $7.7 million	131 FTEs at about $5.7 –$6.3 million/year Construction, rehabilitation, and restoration costs $18.3 – $25 million	111.5 FTEs at about $4.9 – $5.1 million/year Construction, rehabilitation, and restoration costs $16 – $18.4 million

TABLE 3: COMPARISON OF IMPACTS

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
Soils		
Soil disturbance from ongoing maintenance, repair of buildings, upgrading one water system, and removing or protecting fuel storage tanks from the 500-year flood would be minor, adverse, and long term. Soil erosion by wind and water, and soil nutrient transport from foot traffic, would be minor, long term, and adverse. Impacts of development such as eliminating inflow of water, diverting precipitation from natural drainages, and compaction would be long term, adverse, and minor.	Construction on about 10 acres within the park and up to 2.5 acres outside would disturb soils by increasing wind and water erosion. Because relatively small areas would be affected and mitigating measures would be employed, these adverse impacts would be minor and long term. Soil erosion by wind and water and soil nutrient transport from trail building on an acre or more and trail rehabilitation as needed would have a minor, long-term, adverse impact. Restoring soils on 62 acres to natural contours, rerouting runoff to natural drainages and revegetating an area greater than 20 acres would have a major, long-term, beneficial impact on soils. Removing some structures and constructing others on small sites within developed areas could require regrading that would result in the loss of some of the natural soil profile – a minor, long-term, adverse impact.	Soil disturbance from actions proposed would be restricted to the minimum required. Construction in alternative C would disturb approximately 4 acres of soil inside the park and 2.5 acres outside. All of the soils in the park that would be disturbed by construction are in developed (disturbed) areas except the Maverick entrance station; consequently, soil erosion by wind and water and soil nutrient transport would result in minor, long-term, adverse impacts. (Soil characteristics for sites outside the park are unknown because no site has been selected.) Removing development, restoring natural contours, and revegetating 700 acres at Chisos Basin, Rio Grande Village, and Maverick entrance station would have a major, long-term beneficial impact on soils.

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
	Vegetation	
Maintenance and ongoing visitor use would affect vegetation by leading to changes in the relative abundance of species, the death of some plants from the exposure of root systems, the trampling and death of some plants, and the resultant changes in species composition. These would be negligible to minor long-term adverse effects. The irrigation of shade trees and lawns at the campgrounds at Rio Grande Village and Cottonwood would continue to cause the growth of unnaturally lush vegetation and allow exotic species to flourish, an ongoing, moderate, long-term adverse impact.	Construction activities would disturb 10 acres of already disturbed vegetation inside the park and 2.5 acres outside, a minor long-term adverse impact. Revegetation would be attempted, but arid conditions make revegetation difficult. Restoring natural contours and revegetating 62 acres would have a moderate long-term beneficial impact on vegetation. The removal of motel building A, the bunkhouse, and one NPS staff residence at Chisos Basin would result in a 13% decrease in annual water use of Oak Spring – a minor to moderate intermittent long-term beneficial impact on plants that use water from Oak Spring. Withdrawal of 50% of the irrigation water from about 14 acres of exotic vegetation at Rio Grande Village would allow native vegetation to return – a moderate to major long-term beneficial impact on native vegetation.	Construction activities would disturb about 4 acres of already disturbed vegetation inside the park and 2.5 acres outside, a minor long-term adverse impact. Revegetation would be attempted, but arid conditions make revegetation difficult. Restoring natural contours and revegetating about 700 acres would have a moderate, long-term, beneficial impact on vegetation. The removal of all development except a trailhead, parking, and restroom at Chisos Basin would result in a cessation in human use of 4 million gallons per year from Oak Spring – a long-term major beneficial impact on plants that use water from the spring. Withdrawal of irrigation water from about 638 acres of exotic vegetation at Rio Grande Village would allow native vegetation to return – a major, long-term beneficial impact on native vegetation.
	Wildlife	
Overall, the fragmentation of wildlife habitat, the alteration of wildlife movement, and vehicular collisions with wildlife from this alternative would continue to have a long-term minor adverse impact.	Reducing human use of water at Oak Spring by 13% would restore a permanent (year-round) water source for wildlife, a long-term, moderate, beneficial impact on wildlife using the spring. Restoration of natural contours and vegetation on about 30 acres at Rio Grande Village would increase wildlife habitat, a moderate long-term beneficial impact on smaller animals.	Stopping withdrawal of water from Oak Spring for human use would be expected to have a long-term, moderate, beneficial impact on wildlife using Oak Spring. Restoration of natural contours and vegetation on about 700 acres at Chisos Basin, Rio Grande Village, and the Maverick entrance station would increase wildlife habitat, a moderate, long-term, beneficial impact on wildlife.

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
	Water Quantity	
Continued use of nearly all the water at Oak Spring for human use at Chisos Basin during certain times of the year would be a moderate, intermittent, long-term, adverse impact. Overall, impacts on the quantity of water in the Rio Grande would be minor, long term, and adverse.	Reduction of human use of water from Oak Spring by about 13% would be a minor, intermittent, long-term, and beneficial impact on water quantity. Reduction of park use of river water for irrigation by 12.8 million gallons per month, a small amount compared to the flow in the river, would have a minor, long-term, beneficial impact on water quantity in the river. Finding a separate source of drinking water for visitors and employees at Rio Grande Village would leave an additional 2.9 million gallons in the pond system – a major, long-term beneficial impact on pond system water quantity. However, depending on the alternative water source, an adverse impact on that source might occur from park use.	Removing all human use of water from Oak Spring, 4 million gallons per year, would be a long-term, major, beneficial impact. At Rio Grande Village, eliminating the use of irrigation water – 25.6 million gallons per month – from the Rio Grande would be a moderate, long-term, beneficial impact. Removing all human use of the spring at Rio Grande Village, 2.9 million gallons per year, would be a major, long-term, beneficial impact.
	Threatened, Endangered, and Candidate Species	
Overall, the continued presence of development in the Chisos Basin, continued clearing of the road edges, browsing by herbivores, and human disturbance would have a negligible, long-term adverse impact on the black-capped vireo. Improving Big Bend gambusia habitat by eliminating competition for spring water and relocating campsites would have a minor to moderate long-term beneficial impact on the fish.	Changes at the Chisos Basin would not impact the black-capped vireo. Improving Big Bend gambusia habitat by eliminating competition for spring water and relocating campsites would have a minor to moderate, long-term beneficial impact on the fish.	Overall, decreased traffic on the Chisos Basin road would have a beneficial, minor and long-term impact on the black-capped vireo by reducing human disturbance. Restoring about 60 acres of vegetation in the Basin might have a moderate to major long-term beneficial impact on the bird by increasing habitat. The availability of about 2.9 million additional gallons of water to the pond system where Big Bend gambusia live, restoring more natural conditions in the area through revegetation, and potentially doubling the available habitat through wetland restoration would be expected to have a minor to moderate, long-term, beneficial impact on the fish.

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
	Floodplains	
The natural and beneficial values of floodplain areas would continue to be compromised by the presence of campgrounds at Rio Grande Village and Cottonwood, other development at Rio Grande Village, and the development in the flash flood hazard area at Panther Junction. This continuing long-term adverse impact on natural processes would be moderate.	The natural and beneficial values of floodplain areas would be enhanced at Rio Grande Village by the reduction of the likelihood of fuel spilling into flood waters and the restoration of more natural vegetation. This impact would be minor, beneficial, and long term.	Removal of about 638 acres of development from Rio Grande Village and revegetation of the area would have a long-term, major, beneficial impact on the natural floodplain values.
Although severe flooding has been infrequent and risks are minor to moderate, flooding at Rio Grande Village, Cottonwood Campground, or Panther Junction could result in major adverse impacts on the visitors or employees involved.	Same as A.	Same as A.
Even though the risk of flooding is not great at Panther Junction, damage or loss of 60% of the museum collection would be a major, long-term adverse impact on the collection, and loss of infrastructure would be a major, long-term adverse impact on operations. Loss of infrastructure would require the park to find temporary offices and housing outside the park.	Same as A.	Same as A.

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
	Wetlands	
Maintaining use of nearly all the water from Oak Spring during certain times of the year, continuing use of the camp-grounds at Rio Grande Village and Cottonwood, continuing use of other development at Rio Grande Village, and irrigation at both campgrounds would continue a moderate long-term adverse effect on wetlands.	Reducing use of water from Oak Spring by 532,000 gallons per year (13%) would be a minor long-term beneficial impact on the wetland at the spring.	Removing all human water use from Chisos Basin would mean that about 4 million additional gallons per year would be available to wetland vegetation, a long-term, major, beneficial impact on wetlands associated with Oak Spring. Removing most visitor use, discontinuing irrigation, eliminating use of spring water for humans, and restoring about 638 acres to more natural conditions would have a major, long-term beneficial impact on wetland processes at Rio Grande Village.
	Archeological Resources	
There would be long-term, moderate, adverse impacts from construction at Panther Junction. There would be no or negligible effects on archeological resources from the addition to the lodge in Chisos Basin. The ongoing efforts to identify and protect archeological resources would have a long-term minor to moderate beneficial impact on archeological resources; limited staff and funding for such work would keep these impacts at minor to moderate levels.	The development that would occur under the implementation of this alternative would not impact known archeological resources in the park; in those areas where there are possible unknown archeological resources there is sufficient space to avoid impacting these resources. Some excavation work might be required to complete compliance for some construction and removal activities. There would be no direct or indirect impacts on archeological resources, and no change to existing conditions. This would result in a long-term, negligible beneficial impact on these resources.	Overall, alternative C would result in leaving large portions of the park in a natural condition, which would have a long-term, minor, beneficial impact on archeological resources.

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
	Historic Buildings/Structures	
Research and resource documentation is improving the park's ability to make informed management decisions. The ongoing efforts to identify and preserve structures coupled with the park's efforts to improve structures so that more structures are in good condition would benefit these resources. The overall result would be a long-term negligible to minor beneficial effect on the park's historic structures. The upgraded fire suppression and water systems at Castolon would be a long-term, minor to moderate beneficial impact for these structures.	The preservation actions taken in the preferred alternative would have an overall long-term, moderate, beneficial impact on the park's historic structures.	Overall, alternative C would result in the demolition of some historic structures while other structures would be preserved. This would result in a long-term moderate to major, adverse impact on historic structures.
	Cultural Landscapes	
Research and resource documentation is improving the park's ability to make informed management decisions. The ongoing efforts to identify and evaluate landscapes would result in actions to preserve these landscapes. The overall result would be a long-term, minor, beneficial effect on the park's cultural landscapes.	Identifying those features at Buttrill Spring that contribute to this potential cultural landscape and preserving these features would have a long-term, minor, beneficial effect. Water conservation measures in the Rio Grande Village could change the vegetation characteristic of this landscape, which could have a long-term, moderate adverse impact on this potential cultural landscape. Placing more than 90% of the park in either the wilderness or backcountry nonwilderness prescription and less than 10% in management prescriptions that would allow for development would have a long-term negligible, beneficial impact on the park's cultural landscapes.	Overall, alternative C would result in the loss of some potential cultural landscapes. This would result in a long-term, major, adverse impact on these resources. Application of the management prescriptions would have a long-term negligible, beneficial impact on the park's cultural landscapes.

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
	Ethnographic Resources	
Research and resource documentation is improving the park's ability to make informed management decisions. The ongoing efforts to identify and to evaluate ethnographic resources and park programs to meet the needs of various groups would result in actions to preserve these resources. The overall result would be a long-term, negligible to moderate, beneficial effect on the park's ethnographic resources.	The actions in the preferred alternative would result in a long-term, negligible, beneficial impact on the park's ethnographic resources.	The overall result of alternative C would be long-term, moderate adverse impacts on ethnographic resources.
	Museum Collections	
Alternative A would result in only slight improvement in the condition and care of park collections. A new natural resources and collections management building to be constructed at Panther Junction (described in the cumulative impact scenario) that would better protect and preserve the collections would be offset by the limited ability to display, curate, and access the collections. This alternative would result in a long-term, minor, beneficial impact on park collections.	There would be a long-term major, beneficial, impact to artifacts and collections at Panther Junction. Overall, there would be a long-term, minor beneficial effect on park collections in that the collections would be better preserved and interpreted.	The overall effect of this alternative would be to have a long-term, major beneficial impact on park collections in that the collections would be better preserved and interpreted.

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
	Visitor Understanding	
Alternative A would result in continuing degradation of the visitor experience because of noise, congestion, and visitor frustration at not finding adequate interpretive and education facilities and easy access to safety information. This alternative would result in a continuing long-term adverse impact on visitors coming to the park at peak times. Visitors would have many opportunities to travel around the park at their own pace. This would continue to be a long-term major benefit for visitors. The campgrounds, picnic areas, and lodge offer mostly pleasant experiences that users value highly. Retaining these facilities would constitute an ongoing, moderate, long-range beneficial effect for visitors. Although the above effects would continue over time, none of the impacts are anticipated to increase or decrease appreciably.	Over the long term, most visitors at Chisos Basin would benefit from a reduction in congestion and noise brought about by alternative B; this would be a moderate beneficial effect on visitors' experiences during the peak season. Less congestion and noise would result in a long-term benefit for visitors coming to the park at peak and nonpeak times. A new visitor center would provide adequate space for interpreting the park's primary themes, conducting interpretive and educational programs, and ensuring that visitors received sufficient information to effectively plan for a safe and enjoyable stay. This would provide a major long-term benefit for most park visitors. Moving some of the campsites farther from the river would lessen the potential danger to visitors from flooding.	Over the long term, day use visitors at Chisos Basin and Rio Grande Village would benefit from removing overnight facilities. This would be a major long-term beneficial impact on visitor experience of natural and cultural resources. A rehabbed visitor center at Panther Junction would provide additional space for interpreting the park's primary themes, conducting interpretive and educational programs, and ensuring that visitors received sufficient information to effectively plan for a safe and enjoyable stay. This would provide a moderate long-term benefit for the majority of park visitors. Removing lodging and camping facilities would result in the loss of overnight experiences for some visitors. Removing the interpretive centers at Chisos Basin and Rio Grande Village would eliminate opportunities for visitors to learn, through exhibits and other indoor media, some of the key themes and resource management issues of these sections of the park. The loss of these facilities would be a major long-term adverse impact on the overnight and interpretive visitor experiences in these areas. Retaining the Cottonwood Campground and picnic areas would constitute a moderate long-range beneficial effect for visitors, and moving some of the campsites further from the river would lessen the potential danger from flooding.

Alternative A (No Action)	Alternative B (Preferred)	Alternative C
	Socioeconomic Environment	
The existing benefits of the park to the local and regional economy would continue, with minor improvements in temporary employment opportunities and revenues as the planned restoration and upgrade construction activities took place. There would be both direct and indirect, long-term, minor beneficial effects of continuing existing practices at the park.	The existing economic and socioeconomic benefits that the park brings to the local and regional economy would continue. There would be minor to moderate direct short-term and long-term improvements in both permanent and temporary federal and private sector employment opportunities from implementing alternative B, which would generate about 600 jobs. There would also be minor to moderate indirect improvements in overall socioeconomic activity and tax revenues as the planned upgrades of facilities and programs are implemented. These economic benefits would be due to increased payrolls and visitor spending, providing about $20.1 million in additional sales and $1.9 million in additional tax revenues. These benefits would be both local and regional in nature, with the minor to moderate improvements to employment benefiting the relatively isolated and sparsely populated southwest Texas counties of Brewster, Presidio, and Terrell. There would also be international economic stimulation with enhanced employment opportunities for Mexican communities along the border. There might be beneficial cumulative socioeconomic impacts in the Mexican villages that border the park, and at the Big Bend Ranch State Park, Black Gap Wildlife Management Area, and the Rio Grand Wild and Scenic River from enhanced recreational activity.	The existing economic and socioeconomic benefits that the park brings to the local and regional economy would continue, and there would be moderate to major direct short-term and long-term benefits in both permanent and temporary federal and private sector employment opportunities with alternative C, which would generate about 2,505 jobs. There would also be a moderate to major indirect long-term, beneficial impact in overall socioeconomic activity and tax revenues as the planned upgrades of facilities and programs are implemented. This beneficial effect would result from increased payrolls and visitor spending providing about $85 million in additional sales and $8.3 million in additional tax revenues. These benefits would be both local and regional in nature, with the moderate to major improvements to employment benefiting the relatively isolated and sparsely populated southwest Texas counties of Brewster, Presidio, and Terrell. There would also be international economic stimulation with enhanced employment opportunities for Mexican communities along the border.

AFFECTED ENVIRONMENT

Phil Nichols

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NATURAL RESOURCES

SETTING

Big Bend National Park comprises 801,000 acres in southern Brewster County in southwestern Texas in the northernmost portion of the Chihuahuan Desert. The Chihuahuan is the largest of North America's four deserts. The name Big Bend is applied to the area that is bordered on three sides by the Rio Grande. The park is only a part of this area. The elevation ranges from about 1,700 feet at the point where the Rio Grande leaves the park to 7,825 feet on top of Emory Peak. Big Bend National Park is known for its scenic beauty, which ranges from stark seemingly barren wastelands to majestic forested mountains to gigantic canyons. Visitors also come to observe the flora and fauna, much of which is typical of the Chihuahuan Desert.

Although water resources dot the landscape and flash floods occur after heavy rains, the Rio Grande provides the park's most prominent source of water (http://www.nps.gov/bibe/riogrand.htm 8/20/01).

The Rio Grande defines the park's southern boundary for 118 miles. A 196-mile portion of the Rio Grande, designated as part of the Wild and Scenic River system, is administered by the park. Only 69 miles of the Wild and Scenic River are within the park boundary. The remaining 127 miles are downstream of the park.

Big Bend National Park is a UNESCO-designated Man and the Biosphere (MAB) Reserve representing the Chihuahuan Desert.

SOILS

The following discussion describes the soils in the areas that would be affected by implementing actions proposed in the alternatives of this general management plan. All of the information regarding soil resources came from the *Soil Survey of Big Bend National Park, Part of Brewster County, Texas* (U.S. Soil Conservation Service 1985).

The soils in Big Bend National Park occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. These soils are delineated on soil survey maps and depicted as soil map units. For each soil map unit the soil survey provides specific information regarding a wide variety of uses and management issues.

Topsoil in the park is virtually nonexistent. Instead, subsoils, containing higher concentrations of calcium carbonate and sodium, are exposed. This is an important factor in efforts to revegetate disturbed areas, especially in the extremely arid conditions at the park.

In the following descriptions of limitations of soils at specific locations in the park, only those limitations that apply to actions in one or more alternatives are discussed. For example, because no campground is considered in any alternative for Panther Junction, no soil limitations for campgrounds are described for Panther Junction. However, because buildings are proposed for Panther Junction in one or more alternatives, limitations for building foundations are described.

Chisos Basin

According to the soil survey, one soil map unit occurs within the developed area: LMF Liv-Mainstay-Rock Outcrop Complex, steep.

The Liv-Mainstay-Rock Outcrop Complex, steep, covers all of the developed area except the route of the road to the Basin; it consists of shallow and deep, very cobbly, and very gravelly soils with areas of exposed rock outcrop on igneous hills and mountains. Slopes are steep, generally ranging from 20% to 45%, although they can range from 8% to vertical rock walls. Elevation of this soil ranges from 5,000 to about 6,200 feet. Stones and large boulders that have fallen from igneous rock ledges are scattered across the surface of these areas. The soils are well drained. Surface runoff is rapid. Water

erosion is a severe hazard because of steep slopes. Slopes, stones, and depth to bedrock make excavating for foundations, septic systems, and underground utilities difficult.

Panther Junction

At this area near the base of the Chisos Mountains, soils are CMD-Chilicotal-Monterosa association, rolling. They consist of deep, shallow and very shallow, very gravelly and cobbly soils on rolling uplands. They are on ballenas, or rounded ridges, partial ballenas, and piedmont slopes of 3% to 8% . The landscape is incised with frequent drainage ways that have side slopes of mostly 8% to 20%. The soil surface has a desert pavement of igneous gravel.

Chilicotal soils make up about 60% of the map unit, and occur on concave side slopes of drainageways and the concave and more sloping parts of ridges. Monterosa soils, located on convex ridgetops, make up about 20% of the unit. The remaining 20% of the soil map unit is Pantera and Tornillo soils in drainage ways; reddish colored shales and clays along side slopes of larger drainageways; sandstone outcrops along drains; and igneous rock dikes and outcrops.

Chilocotal soils are well drained. Surface runoff is medium. Wind and water erosion are only slight hazards because of gravel on the surface. Limitations for excavating for foundations are moderate because of slope; for septic systems slight. No data is provided for limitations for underground utilities.

Monterosa soils are well drained. Surface runoff is medium. Because of the gravel and cobbles on the surface, wind and water erosion are only slight hazards. The cemented pan of the Monterosa soils presents some problems in excavating for foundations, septic systems, and underground utilities. The short, steep slopes present problems in leveling areas for building sites.

Rio Grande Village

There are two soil map units that might be affected at Rio Grande Village: GHA-Glendale-Harkey and TOA-Tornillo loam, occasionally flooded.

Glendale-Harkey soils are deep, well drained, and located on the floodplain of the Rio Grande, along the southern border of the park. Slopes range from 0% to 2%. Heavy rains on the Rio Conchos in Mexico and other watersheds cause the Rio Grande, to overflow its banks and flood areas with these soils with 1 to 10 feet of water. Flooding occurs about once every three to five years. Inundation usually lasts from 2 to 20 days. Thin layers of fresh alluvium are deposited during each flood. The mapped areas are long and narrow. The ranger station and campground are located in this soil type.

Both Glendale and Harkey soils are well drained with slow to medium surface runoff and moderate wind erosion hazard. Occasional flooding is the major limitation for campsites and picnic areas. The soils are highly erodible if used for paths and trails. The major limitation for building sites is the hazard of flooding, which is difficult to overcome.

Tornillo loam, occasionally flooded, consists of a deep, nearly level and gently sloping soil on broad alluvial flats on valley floors. Slopes range from 0% to 3%.

Tornillo soil is well drained. Surface runoff is slow to medium. This soil receives runoff from areas higher on the landscape, and during high intensity rainstorms it is flooded by sheet water as much as several inches deep. This brief flash flooding occurs about once every three to eight years. The surface of the soil crusts and seals over so that most of the rainfall runs off and water enters the soil very slowly. This soil is very erosive and has narrow, deep arroyos in many areas. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The possibility of flash flooding precludes the use of these areas for building sites. Dirt roads that cross arroyos are difficult to maintain.

Flooding makes limitations for camping areas severe and slight for picnic areas, paths, and trails.

Limitations for shallow excavations are slight. Limitations for dwellings and small buildings are severe because of flooding.

The picnic area, visitor center, gas station, maintenance area, employee housing, and sewage lagoons at Rio Grande Village are in this soil type.

Since the 1985 soils survey, several dams have been constructed on the Rio Conchos in Mexico. Because the Rio Conchos is the source of most of the water in the Rio Grande at Big Bend National Park, these dams make the danger of flooding at Rio Grande Village and Cottonwood Campground much smaller than it was at the time of preparation of the soil survey.

Castolon

The soil map unit is CHD-Chamberino very gravelly loam. Most areas are between the Chisos Mountains and the Rio Grande on fan piedmonts, or broad alluvial fans that have many shallow drainageways from 3 to 10 feet deep and 10 to 60 feet wide. Slopes are dominantly 1% to-4% and several hundred feet long. Short slopes along drainageways are as much as 8%.

The Chamberino soil is well drained. Surface runoff is medium. Wind and water erosion are only slight hazards because of the cobbles and gravel on the surface.

The existing employee housing and historic district are in this soil type. Limitations for shallow excavations and dwellings without basements are moderate because of slope.

Cottonwood Campground

The soil map unit at Cottonwood Campground is GHA-Glendale-Harkey (floodplain). For a discussion of this soil type, including flood hazard, see "Soils, Rio Grande Village" above.

North Rosillos/Harte Ranch

This area, added to the park since 1985, was not mapped as part of the park soil survey. It is, however, being mapped by the 2002 soil mapping project.

Persimmon Gap

The visitor contact station at Persimmon gap is in the PAA – Pajarito-Agustin map unit, gently sloping, and the trailer is in the UNC – Upton-Nickel map unit.

The Pajarito-Agustin association consists of deep, well-drained soils on uplands. No dependable water sources are available. Paharito soils make up 40% of this soil map unit, Agustin 40%, and other types 20%. Paharito and Agustin soils are well drained. Surface runoff is very slow in Paharito and slow in Agustin. Water erosion is moderate in Paharito and slight in Agustin. Wind erosion is a moderate hazard in both types. These soils have few or no limitations for building sites. Seepage can be a problem for septic systems in some areas.

The Upton-Nickel map unit, undulating, consists of deep, shallow, and very shallow, gravelly and very gravelly soils on broad dissected piedmont slopes. Slopes are mostly 1%-6%. Upton and similar soils make up about 80% of the map unit, Nickel about 15%, and other types about 5%. Upton soils are on gently sloping piedmont ridges. Nickel soils are along the gently sloping to strongly sloping drainageways. Both soils are well drained, and surface runoff is medium. For both Upton and Nickel, wind and water erosion are only slight hazards because of gravel on the surface.

The major limitations for building sites are the small stones and the cemented caliche layer at a shallow depth in the Upton soils, which makes excavating for foundations, septic systems, and underground utilities difficult.

Maverick and Potential Site for New Entrance Station

Soil here is in the VBD–Vieja-Badland, rolling map unit. These soils are very shallow and shallow, very gravelly clayey soils and badland in areas where geologic materials are exposed. They are on uplands and in valleys. Slopes are mostly 2%-15% but are as much as 35%. Vieja soils make up about 65% of this map unit, Badland about 15%, and other types about 20%.

Vieja soils are well drained. Surface runoff is rapid. Wind and water erosion are moderate hazards.

Badland soils consist of barren, eroding geologic exposures. Surface runoff is very rapid, and little or no water enters the soil. Wind erosion is a slight hazard. Water erosion is a severe hazard. Badland soils produce much sediment.

Limitations for small commercial buildings are severe for Vieja soils because of slope and severe for Badland soils because of slope and depth to rock. Limitations for dwellings without basements are moderate for Vieja soils because of slope and depth to rock and severe for Badland soils because of slope and depth to rock. Limitations for septic tank absorption fields are severe for both soil types because of depth to rock. In Badland soils limitations are also severe because of slope.

VEGETATION

Chisos Basin

The Chisos Basin is an intermountain basin with woodland-grassland vegetation. Many endemic and unusual species of trees, such as the drooping juniper, grow here. Vegetation on Liv-Mainstay-Rock Outcrop Complex soils includes pinyon pine, gray oak, Graves oak, Emory oak, Chisos red oak, drooping juniper, oneseed juniper, alligator juniper, Texas madrone, green agave, sotol, lechuguilla, pricklypear, skeletonleaf goldeneye, whitethorn acacia, sideoats grama, cane bluestem, buffalograss, green sprangletop, dropseeds, and tridens.

On Hurd soils, the vegetation includes Mexican pinyon pine, redberry juniper, Gambel oak, catclaw, foothill basketgrass, Mexican sagewort, wolftail, deer muhly, bracken fern, little bluestem, hairy grama, and cane bluestem. There are a few of the scarce Texas madrone trees. Trees and other mixed prairie-type vegetation make this one of the most beautiful and scenic units in the park.

Panther Junction

Vegetation in the Panther Junction area is brush grassland. Sotol and ceniza are the major brush species. Chino grama is the dominant grass. Other vegetation is lechuguilla, ocotillo, whitethorn acacia, mariola, pricklypear, ephedra, skeletonleaf goldeneye, guayacan, red grama, and sideoats grama.

Rio Grande Village

At Rio Grande Village on Glendale-Harkey soils vegetation includes saltcedar, mesquite, cottonwood, willow, tree tobacco, whitebrush, spiny aster, Bermudagrass, and common and giant reed. The vegetation is dense in most areas.

At Rio Grande Village, Tornillo soils cover broad, gently sloping areas that are mostly bare except for creosotebush. Some of the low, nearly level areas, where water stands after rains, support pockets of grass. Vegetation includes creosotebush, mesquite, lechuguilla, mariola, fourwing saltbrush, and tasajillo. The brush is scattered and much of the surface is bare. Grasses are scattered tobosa, burrograss, fluffgrass, threeawns, and sixweeks grama. There are small coppice dunes around the bases of the brushy plants.

Castolon

On Chamberino-Chilocotal-Upton soils at Castolon, much of the surface is bare. Creosotebush, generally small and stunted, is the dominant vegetation. Clumps of dog cacti and patches of lechuguilla are scattered across the surface. This soil supports a sparse stand of

vegetation. The woody vegetation includes lechuguilla, dog cacti, creosote bush, leatherstem, prickleypear, and range ratany. Grasses are chino grama, threeawns, fluffgrass, and slim tridens. The lack of available seed sources, the dominance of creosotebush, and high ground temperatures during the summer make reestablishment of grasses difficult.

Cottonwood Campground

For a description of vegetation in this area, see "Vegetation at Rio Grande Village on Glendale-Harkey Soils" above.

North Rosillos/Harte Ranch

The following description comes from the "Draft Wilderness Suitability Assessment, Appendix E.

Three vegetation communities dominate the area – desert shrublands, remnant grasslands, and degraded former-grasslands. Much of the area consists of shallow, rocky soils that support native Chihuahuan Desert shrublands dominated by creosote bush (*Larrea tridentata)*, with varying amounts of interspersed grama (*Bouteloua* spp.) grass. Small patches of intact Tornillo loam flatlands support native grasslands dominated by tobosa (*Hilaria mutica*), *Chloris*, and bluestem *(Bouteloa* spp.) grasses. Over large areas, the organic horizon of Tornillo loam soil has been lost to erosion and vegetation is sparse or absent.

In gully systems and associated man-made diversions and water catchment structures, exotic johnsongrass (*Sorghum halapense*) is prevalent.

Well-developed native riparian plant communities can be found at several natural springs in the North Rosillos area, most notably at the Buttrill Spring complex. These riparian islands are important for maintaining landscape-level biodiversity in the area.

Persimmon Gap

The Pajarito-Agustin association, gently sloping soil type (visitor contact station) is dominated by shrub vegetation, mostly creosotebush. Other vegetation is lechuguilla, tasajillo, prickleypear, dog cacti, and mariola and some scattered chino grama and threeawns.

The dominant plant on the Upton-Nickel soil association (trailer) is creosote bush. The sparse vegetation also includes lechuguilla, mariola, ceniza, candelilla, dog cacti, pricklypear, and ephedra, as well as grasses such as chino grama, threeawn, fluffgrass, slim tridens, and sixweeks grama.

Maverick and Potential Site for New Entrance Station

The Vieja soils have sparse vegetation of stunted creosotebush, fluffgrass, dog cacti, and sixweek grama. Various fast-growing, short-lived annuals appear after rainstorms in some areas. Badland soils are mostly barren of vegetation.

WILDLIFE

The following describes wildlife at areas that may be impacted by actions of alternatives in this general management plan.

Chisos Basin

Areas with Liv-Mainstay-Rock Outcrop Complex soils are used by the endemic Carmen Mountains whitetail deer for food and shelter. Javelina make limited use of areas along drainages. Mountain lions use some areas for hunting and dens. Fox, ringtails, and rock squirrels den in the area. Raptors use the high mountains for food, cover, lookout points, and nesting. Peregrine falcons sometimes nest on the high rocky cliffs. Perching (passerine) birds, including the black-capped vireo, use portions of the Chisos Basin for food, cover, and nesting.

On Hurd soils, mule deer range at lower elevations and Carmen Mountains whitetail deer at

higher ones. There is a good variety and quantity of forage for deer. Mountain lions hunt here, and many perching birds nest and feed in the area.

A few springs in the Chisos Basin provide water for wildlife. On the Hurd soil type there are no springs.

Panther Junction

Mule deer and javelina use the Panther Junction area as home ranges. The lechuguilla and other shrubs provide a good variety and quantity of food. Coyote and fox use the area for hunting and dens. Rodents, snakes, and lizards also den here. Perching birds use the area for food, cover, and nesting.

Springs in at various places throughout the Panther Junction area provide water for wildlife.

Rio Grande Village

On the Glendale-Harkey soils map unit, the Rio Grande, which forms one boundary of the Rio Grande Village, provides ample water for wildlife. A few mule deer and javelina use the areas of these soils at Rio Grande Village for food and shelter. Mexican beaver burrow in the riverbank and feed on willows and other trees. Coyotes hunt and make dens. Rodents, snakes, and lizards den here. Many perching birds use the soils map unit for food, shelter, and nesting.

Where there are Tornillo soils, there are no springs or other permanent water sources, causing the area to have limited use by most wildlife. Mule deer and javelina occasionally cross areas of Tornillo soils, but do not use them for home ranges. Rodents, snakes, and lizards use the area for dens. A few perching birds use the area for food and nesting.

Castolon

Use by wildlife is limited. A few mule deer and javelina feed on lechuguilla and woody shrubs, but do not make these areas their normal home range. Rodents, snakes, and lizards use these desert areas for food and shelter, and a few passerine birds use this area for food, shelter, and nesting sites.

There are no springs or other permanent water sources for wildlife.

Cottonwood Campground

For a description of wildlife in this area, see "Wildlife, Rio Grande Village on Glendale-Harkey soils" above.

North Rosillos/Harte Ranch

The following description comes from the "Draft Wilderness Suitability Assessment" (appendix E).

Desert and mountain transition zones of the area provide suitable habitat for a suite of Chihuahuan desert wildlife, including desert mule deer, Carmen white-tail deer, mountain lion, bobcat, coyote, fox, occasional black bear, and numerous other mammals. Higher elevations of the Rosillos Mountains contain one of the few small populations of Carmen white-tailed deer, and the area is expected to host an expanding population of desert bighorn sheep being reintroduced to the nearby Black Gap Wildlife Management Area.

The lowland Tornillo soils are habitat for the park's greatest diversity of amphibian species. At least six species are adapted to reproducing in the area's intermittent pools and surviving long dry periods underground. Three additional species associate with permanent springs and rocky habitats of the Rosillos Mountains.

Habitat diversity of the North Rosillos area makes reptiles the most abundant terrestrial vertebrate group. The 37 documented reptile species include 17 lizards, 19 snakes, and one turtle. Included in this group is the rare Texas horned lizard.

Numerous resident and migratory birds find necessary desert scrub and grassland habitat on

the North Rosillos. Typical desert species such as cactus wren, mockingbird, scaled quail, turkey vulture, and black-throated sparrow are common.

Persimmon Gap

Mule deer and javelina sometimes travel across areas of Pajarito-Agustin soils (visitor contact station) but do not use them for home ranges. Rodents, snakes and lizards use the areas for shelter, food, and nesting.

On the Upton-Nickel soils map unit, mule deer and javelina use the lechuguilla and other woody shrubs for food. Shrubs and woody vegetation along drainageways provide shelter and travelways. Rodents, snakes, and lizards use this unit for food and dens. Coyotes and foxes hunt across the soil map unit and passerine birds use it for food and nesting.

Maverick and Potential Site for New Entrance Station

Lizards and rodents are about the only wildlife in this area. Mule deer and javelina occasionally cross areas of this soil type, but because there is little food and cover, they do not use areas with this soil type as home ranges.

WATER QUANTITY

Water – its presence or absence – affects every aspect of Big Bend National Park. It sculpts the landscape and controls vegetation and wildlife. It affects visitor use and places severe restrictions on development. Water conservation measures are required throughout the park. At times, the park has come close to not having enough water available for resource protection, and park visitor and staff use.

Water for Chisos Basin is pumped from the perennial Oak Spring about 2 miles west of the Basin. During the high visitor use season, the quantity of water available from the spring is barely adequate to meet the needs of visitors and staff. Little, if any water is left for vegetation and wildlife at the spring.

At Panther Junction, an extensive water system contains six water wells (three on standby), four observation wells, two water reservoirs, pumps and 7 miles of water lines.

At Rio Grande Village water for human use comes from a spring. The endangered Big Bend gambusia also depends on this spring. Water from the Rio Grande is used to water lawns and trees in the developed area, providing very unnatural conditions in this desert environment.

Water for Persimmon Gap is trucked from Panther Junction and stored in a 5,000-gallon holding tank. Water supplies appear to be sufficient for the present but could not accommodate a significant increase in visitation (NPS 1986).

Upstream impoundments and diversions, compounded by additional development and cultivated lands along the Mexican Rio Conchos, and the Rio Grande and their tributaries severely reduce river flows reaching the park. These conditions, exacerbated by recurring droughts, have effectively eliminated river recreation for parts of the year from 1994 through 2002.

The park's previous management plan refers to river recreation, but the river's minimum flow to sustain riparian and aquatic habitat and river recreation has yet to be determined.

THREATENED, ENDANGERED, AND CANDIDATE SPECIES

Although the U.S. Fish and Wildlife Service has listed multiple species as occurring in Brewster County and potentially occurring in the park, black-capped vireo and Big Bend gambusia are the only ones of those species occurring in the park that would be potentially impacted by actions proposed in the alternatives in this general management plan. These species are listed as endangered (see "Impacts Considered But Dismissed" and appendix C).

The black-capped vireo *(Vireo atricapillus)* can be found in mountain habitats and mid elevation drainages from the Chisos Mountains. The Chisos Basin is a very important part of their habitat. The vireo lives in areas with scattered trees and numerous dense clumps of shrubs growing to ground level, interspersed with open areas of bare ground, rock, grasses, or forbs. Foliage that extends to ground level is the most important requirement for nesting. Most nests are well-screened by foliage. Territories can be on steep slopes, such as heads of ravines or along sides of arroyos. In such areas, the slow succession of the shallow soils and the microclimates provided by the rugged terrain perpetuates clumping of vegetation, thus sustaining an area suitable for the vireo. In west Texas, the vireo occurs in more stable shrub associations adapted to dry conditions consisting of littleleaf ash, mountain laurel, evergreen sumac, cacti, century plant, sotol, ocotillo, and beard grass, and is located primarily along steep canyons. Threats to and reasons for decline of the species are habitat loss to urbanization, browsing by herbivores, brush clearing, natural succession, brown-headed cowbird (*Molothrus ater*) brood parasitism, and human disturbance. A recovery plan was prepared by the U.S. Fish and Wildlife Service in 1991.

Big Bend gambusia *(Gambusia gaigei)* lives in spring-fed marshes with dense aquatic vegetation (submerged and emergent), primarily *Chara* and cat-tail. Presumably its habitat is clear, shallow water fed by warm springs. The Bid Bend gambusia is located in the wild at only one site – Rio Grande Village in the park. (There is a small population being maintained at the U.S. Fish and Wildlife Service fish hatchery in Dexter, New Mexico.) The Big Bend gambusia is threatened by habitat alteration, groundwater pumping, declining spring flows, and competition with introduced nonnative species such as the western mosquito fish *(G. affinis)*. A recovery plan was prepared for Big Bend gambusia by the U.S. Fish and Wildlife Service in 1984.

This fish has been threatened with extinction on several occasions. The refugium habitat (spring 1) at Rio Grande Village has experienced extreme variation in groundwater levels during the past decade, resulting in concerns for the well being of this population.

FLOODPLAINS

Dams on the Rio Grande upstream of the park are one factor regulating river flows. Water is released from various dams in response to irrigation and flood control needs. River regulation and heavy use have severely damaged the riparian woodland system and geomorphological processes in the park. The National Park Service does not possess water rights for maintaining minimum flows in the river.

Floodplains in areas that might be affected by actions in the alternatives in this plan are those at Panther Junction and the Rio Grande at Rio Grande Village and Cottonwood Campground.

Panther Junction

Information in this section is mainly from two documents prepared by the NPS Water Resources Division: a memorandum, "Summary of Panther Junction flood hazard," dated April 2000, and "Estimation of Flood and Geomorphic Hazard in the Panther Canyon Area of Big Bend National Park, Texas" dated 1995.

The main park housing area is about 0.25 mile southwest of park headquarters. The housing facility contains more than 40 residence structures, an elementary school, and a resource management building. Most structures are between the Panther Canyon drainage and the Mouse Canyon drainage on the upper end of an alluvial fan. The structure used for storing museum artifacts is adjacent to the Panther Canyon drainage.

Panther Canyon drains a watershed of just over 2 square miles, and Mouse Canyon drains about 0.65 square mile. Both watersheds are underlain by bedrock composed of Chisos limestone in the lower portion of the catchment and Panther laccolith rhyolite in the upper catchment. The upper canyons are steep with a large proportion of exposed bedrock and therefore have high runoff

capabilities. The lower canyons have a more gentle slope, where relatively thick deposits of alluvium have accumulated. The drainages themselves are intermittent streams, supporting flow only in response to rainfall. No base flow exists between runoff periods. Because of the physical characteristics of the watersheds and the possibility of intense summer thunderstorms, it is likely that these drainages are capable of producing flash floods.

All of the structures at Panther Junction are on the uppermost end of an extensive bajada, or a series of coalescing alluvial fans. There are three specific flood-related hazards associated with this location: bank loss from erosion, inundation from floodwaters, and destruction from debris flows. Additionally, an overriding hazard exists in the long periods between devastating events, which may create the illusion of inactivity. Lastly, hazardous flood events, when they do take place, may occur in a very short time period due to the relatively small and steep watershed, allowing little opportunity for warning or evacuation. Consequently, this area is considered flash flood prone, and the resulting regulatory floodplain is the maximum estimated flood (Q_{me}).

Bank loss in the housing area during times of moderate to high flows may pose a serious threat to structures near the channel. The fan deposit where the development is located is composed of unconsolidated material underlain by bedrock at a shallow depth. Consequently, downward incision is inhibited and lateral migration of the channel is occurring. Examination of the cross-section surveyed in 1995 through the area of greatest bank loss indicates that the cross-channel gradient is toward the housing area. This general tilt of the channel, coupled with the shallow bedrock, strongly indicates that bank loss will be an ongoing problem without mitigating measures. Structures near the incised channel have the highest degree of risk from bank collapse. Any site farther from the channel is less likely to suffer foundation collapse due to erosion, but for long time periods all structures on the fan are potentially at some risk, as the primary channel may be expected to migrate. During the early 1990s, during large discharge events, large portions of one bank were lost through erosion, and several park residences were threatened.

High magnitude, clearwater flows pose a risk, primarily to structures near the major, active channel where it is not deeply incised, specifically in the area of the museum storage and resources building. Other structures on the lower portion of the fan are at moderate risk because flooding of the many distributary channels is likely during a high magnitude event. However, flow on the lower fan would likely spread out, resulting in shallow depths and modest velocities. The incised channel in the upper portion of the fan is capable of containing high magnitude flows up to and including the estimated 500-year flood. The regulatory flood (the Q_{me}), however, will overtop channel banks and likely inundate the entire housing area. The flood hazard of different portions of the fan may be quantified in terms of depth by comparing land elevation with the floodplain elevation depicted on the floodplain map. A quantitative analysis of flood depth will allow park staff to develop appropriate mitigation measures.

A detailed reconnaissance of the upper watershed was conducted to determine whether a debris flow threat exists. Despite large amounts of alluvium and colluvium in Bovarc Canyon upstream of the confluence of Panther and Bovarc Canyons, given the low channel gradient and the relatively great distance, it is unlikely that a destructive debris flow could travel to the Panther Junction housing area. However, the large amount of available material could be transported downstream in moderate to high magnitude floods, aggrading the incised channel and reducing flood conveyance capacity. Aggradation of the incised channel in the Panther Junction area would increase the flood hazard.

Rio Grande Village

The NPS Water Resources Division, during a reconnaissance in 1992, found the Rio Grande to be functioning in a manner normal for a large river in a fairly natural setting. There was abundant evidence of erosion on the outside of bends, apparently caused by two fairly large floods in 1991-1992. Channel instability of this type is a natural process and should not necessarily be considered a man-caused problem. Placement of riprap or other structural

stabilization techniques were not recommended because they would make the Rio Grande function less naturally and might cause problems in other locations.

Developments at Big Bend in the greater floodplain of the Rio Grande will experience flooding only in extremely large (and rare) events. Furthermore, flow velocities can be expected to be very low because of hydraulic conditions along the river. The gradient of the Rio Grande is low, about 5 feet per mile, and the floodplain is very wide. These factors make rapid and dangerous flooding in the areas of visitor and concession use almost impossible. The largest floods that occur in the Rio Grande originate from precipitation over a large area and can usually be observed upstream, well in advance of arrival at Big Bend. Even a very large tributary flood will result in a much smaller relative event in the main river. For these reasons, flash flooding on the main river is not a great concern.

Cottonwood Campground

Park developments along the Rio Grande, though within the 100-year floodplain according to flood insurance rate maps, are well located from a flood hazard perspective. Bank failure will continue to occur and may eventually lead to the need to relocate certain facilities at Cottonwood Campground. However, if unstable bank areas are clearly marked, they are of little risk to visitors. Bank stabilization, such as placement of riprap, is not recommended because it would make the Rio Grande less natural and may cause problems at other locations.

WETLANDS

Wetlands at the park have not been inventoried by the U.S. Fish and Wildlife Service or other agencies, and there is no wetlands map. There is a map of springs. Two areas with wetlands that might be impacted by plan alternatives are Oak Spring and Rio Grande Village.

The water supply for development at Chisos Basin comes from Oak Spring. During periods of low spring flow much of the water from the spring is collected and used at the Basin. This leaves little water for the wetland plants at the spring.

Before establishment of the park, farm development destroyed Big Bend's most extensive wetlands at Rio Grande Village. These wetlands were created by four warm springs emanating within 0.5 mile of the Rio Grande near what is now Rio Grande Village. Pre-park agricultural development resulted in containment of springs, diversion into irrigation systems, and virtual removal of beaver populations. When Rio Grande Village campground, roads, and maintenance facilities were established, they were placed in areas cleared by decades of agricultural use.

Five decades of protection have allowed some natural establishment of wetlands in the area. However, a paved 0.75-mile service road to an abandoned NPS maintenance facility, a powerline corridor, an unpaved water reservoir access road, and a water pipeline across sections of the recovering wetland prevent the Park Service from allowing or fostering recovery of half the approximately 10-acre potential wetland.

The warm springs supply two artificial ponds with water to support the only habitat of the endangered *Gambusia gaigei* (Big Bend mosquitofish). The artificial ponds also displace potential natural wetlands, although *Gambusia gaigei* exists in the warm springs and associated beaver ponds. Restoration of the wetlands displaced by nonessential NPS facilities would approximately double the available habitat of *Gambusia gaigei*.

The riparian zone along the Rio Grande is heavily impacted by grazing as evidenced by the lack of typical riparian tree species reproduction, areas of vegetation trampling, stock trails, and the spread of exotics through fecal material.

CULTURAL RESOURCES

INTRODUCTION

Big Bend National Park is a land of borders. Situated on the boundary with Mexico along the Rio Grande, it is a place where countries and cultures meet. It is also a place that merges natural environments, from desert to mountains. It is a place where south meets north and east meets west, creating a great diversity of plants and animals. The park covers more than 801,000 acres of west Texas in the place where the Rio Grande makes a sharp turn – the Big Bend.

ARCHEOLOGICAL AND HISTORICAL RESOURCES

Although Big Bend is famous for its natural resources and recreational opportunities, the park is rich in cultural history. Native peoples lived in and/or passed through this area for thousands of years. Pictographs and archeological sites evidence their presence. In more recent history (the last 500 years), six different nations – Spain, France, Mexico, the Republic of Texas, the Confederate States of America, and the United States of America have claimed Texas.

The pre- and proto-historic indigenous people of Big Bend were culturally related to other Uto-Aztecan cultures of northern Mexico. Throughout the prehistoric period, humans found shelter and maintained open campsites throughout the present-day park. The archeological record reveals an Archaic desert culture whose inhabitants developed a nomadic hunting and gathering lifestyle that remained virtually unchanged for several thousand years. Archeological discoveries indicate an Archaic period occupation in the high Chisos Mountains. Past human inhabitants used all portions of the park but were particularly attracted to the river corridor during the most recent prehistory due to the increasing climatic aridity and the need for more moist conditions in which to practice horticulture and agriculture.

One chronological sequence proposed for the park is based on archeological studies from surrounding cultural regions. Many chronological schemes have been suggested that attempt to organize the existing archeological data into meaningful temporal sequences. Although these chronological sequences often conflict, four broad categories are most commonly accepted:

Late Paleo-Indian (ca. 8000 - 6500 B.C.)
Archaic (ca. 6500 B.C. – A.D. 1000)
Late Prehistoric (ca. A.D. 1000 – 1535)
Historic (ca. A.D. 1500 – present)

The duration of each period and time of transition from one period to the next remains speculative.

Late Paleo-Indian Period (ca. 8000 - 6500 B.C.)

At the end of the last ice age, the climate was much cooler and wetter, and woodlands covered much of the Big Bend. Since about 9000 B.C. the climate has gradually become warmer and drier, and there has been a gradual influx of heat- and drought-adapted plants. Evidence of Paleo-Indian presence has been recorded in the park, but no studies have been done that explain local human adaptation during this period. The earliest inhabitants lived a nomadic hunting and gathering lifestyle that was adapted to the cooler and wetter climate that prevailed in that age. Throughout the Paleo-Indian period, people hunted large game animals as their primary source of materials for food, clothing, and shelter.

Archaic Period (ca. 6500 B.C. - A.D. 1000)

After the last glacial episode, woodlands gave way to arid-adapted plant communities at lower elevations. The slowly changing climate caused a decline in the numbers of large game animals, primarily bison. American Indian groups of the Archaic period adapted to the changing climate

by developing a hunting and gathering lifestyle so successful that it remained virtually unchanged for about 7,500 years. The Archaic Period people hunted smaller game with a spear that was propelled by a spear-thrower called an atlatl. A strong dependence on plant foods, and a more structured social organization characterize this period. People learned skillful ways to exploit the environment and developed a rich material culture that involved the intensive use of plants and animals. A higher density of late Archaic sites indicates a more efficient adaptation and larger, denser population. An expansion of the Jornada Mogollon culture from southeastern New Mexico into extreme West Texas occurred at the close of the Archaic period.

Late Prehistoric Period (ca. A.D. 1000 - 1535)

By 1000 A.D. the native people of the Big Bend had come under the influence of the Jornada Mogollon, with its ceramics, agriculture, and sedentary lifestyle. During the Late Prehistoric, American Indians of the Big Bend began using the bow and arrow, and groups northwest of the area were producing pottery. Agricultural villages existed near present-day Presidio, Texas, and Indian groups in the area that is now the park practiced horticulture or simple agriculture. In most areas to the east, the Late Archaic hunting and gathering lifeway persisted into the Historic Period. The period is characterized by increased interregional trading.

The Historic Period (1535 A.D. - present)

During the early Historic Period several Indian groups were recorded as inhabiting the Big Bend. The Chisos Indians were a loosely organized group of nomadic hunters and gatherers who probably practiced limited agriculture. The name Chiso (Chizo) originally referred to one band (also known as the Cauitaome or Taquitatome), but the Spaniards extended it to include at least six closely associated bands. Their origin is not known, but they were associated with the Concho speaking Indians of northeastern Chihuahua and northwestern Coahuila. Their language group is a variation of Uto-Aztecan, a language whose speakers ranged from central Mexico to the Great Basin of the United States and includes the Aztec, Toltec, and the modern Hopi. The Jumano were a nomadic people who traveled and traded throughout western Texas and southeastern New Mexico, but some historic records indicate they were enemies of the Chisos. Around the beginning of the 18th century (1700 A.D.), the Mescalero Apaches began to invade the Big Bend region, eventually displacing or absorbing the Chisos Indians. The last aboriginal group to use the Big Bend was the Comanche who passed through along the Great Comanche Trail on their way to and from periodic raids into the Mexican interior. These raids continued until the mid-1800s.

In roughly 1535 A.D. the first Spanish explorations came into this portion of North America. The expedition of Alvar Nunez Cabeza de Vaca passed near the Big Bend, and was followed by other expeditions in the search for gold and silver, farm and ranch land, and Indian slaves. In an attempt to protect the northern frontier of Mexico, a line of "presidios," or forts, was established along the Rio Grande in the late 1700s. The Presidio de San Vicente was built near present-day San Vicente, Coahuila, and the Presidio de San Carlos was built near present-day Manuel Benavides, Chihuahua, both in Mexico. These presidios were soon abandoned, however, because of financial difficulties and because they could not effectively stop Indian intrusions into Mexico.

Very little study has been made of the Mexican occupation of the Big Bend following the abandonment of the presidios. In 1805 the Mexican settlement called Altares existed 30 miles south of the Rio Grande. Mexican families lived in the Big Bend area when Anglo settlers began moving in during the latter half of the 1800s. Following the war between Mexico and the United States, which ended in 1849, military surveys were made of the uncharted land of the Big Bend. Military forts and outposts were established across West Texas to protect migrating settlers from the Indians. Around 1870 ranchers began to migrate into the Big Bend, and by 1900 sheep, goat, and cattle ranches occupied the Big Bend area. The

delicate desert environment, however, was soon overgrazed.

In the early 1900s, the discovery of valuable mineral deposits brought more settlers who worked in the mines or supported the mines by farming or by cutting timber for use in the mines and smelters. Communities sprang up around the mines; development of Boquillas and Terlingua directly resulted from mining operations. During this period, farmers settled the Rio Grande floodplain. Settlements developed with names like Terlingua Abajo, San Vicente, Coyote, and Castolon. These were often no more than clusters of families living and farming in the same area, and they were successful only to the degree that the land was able to support them.

From about 1915 to 1920, revolution raged in Mexico. Many Mexican families moved north of the river to avoid the bloodshed and bandit raids. The raids, including the Glenn Springs raid in 1916, brought the U.S. military to defend the border. The National Guard established camps at Glenn Springs, La Noria (northeast of Rio Grande Village), Lajitas (west of the park), and Castolon (Camp Santa Helena). In response to a later revolution (the Escobar Rebellion of 1929), the Air Corps established a landing field at nearby Johnson's Ranch.

Camp Santa Helena, established in 1916, used troops from the 5th, 6th, and 8th cavalries. The men lived in tents and the construction of a permanent post began in 1919. By the time the buildings were completed in 1920, the Revolution was over and the men were ordered to roll up their tents and take new assignments elsewhere. The soldiers probably never occupied the new buildings. They included an enlisted men's barrack, officers' and non-commissioned officers' quarters, a latrine, a granary and tack shed, and a stable (which burned sometime before 1933).

In the 1930s many people who loved the Big Bend country saw that it was a land of unique contrast and beauty that was worth preserving for future generations. The state of Texas passed legislation to acquire land in the area that was to become the Texas Canyons State Park. In 1935, the federal government passed legislation that would enable the acquisition of the land for a national park. The state deeded the land that they had acquired to the federal government, and on June 12, 1944, Big Bend National Park became a reality.

ARCHEOLOGICAL RESOURCES

There still is much to learn about the prehistory and history of Big Bend National Park. A complete understanding of people's past depends on the scientific study of the sites and artifacts that have survived the ravages of time. Archeological research in Big Bend National Park is scanty with only 3% of the park surveyed. Two early archeological surveys (1936-37 and 1966-67) sampled only a portion of the park. However, the two surveys recorded 628 sites, and the latter survey revealed that the park probably contains more than 26,000 archeological sites. Extant data suggest that the park contains more than 26,000 archeological sites, and that an estimated 10%-15% would be eligible for listing on the national register. More than 1,500 sites have been recorded that date from the Late Paleo-Indian to Late Prehistoric periods. These sites contain more than 200 prehistoric to proto-historic structures and more than 400 historic period structures. Only three archeological properties have been through the national register review. Park archeological studies have been adding more than 100 new sites a year. At Big Bend National Park, only two prehistoric archeological sites are currently considered "public" – the Hot Spring pictograph site and the Chimneys. As research is completed on other archeological sites, they may be opened to the public.

The park staff continues to update inventories of archeological sites into the Archeological Sites Management Information System. In 1995 the park began a multiyear archeological survey to sample 12%-15% of the park, which will ultimately enable management to predict where archeological sites may occur. The project heavily involves the park Geographic Information System (GIS) for spatial analysis of the survey field data. Already the survey has added significantly to the cultural resources inventory

and data is being used for assisting with the park's fire management program.

Two of the archeological sites and one archeological district (Burro Mesa) are listed on the National Register of Historic Places. The Glenn Spring Cavalry Outpost and an individual archeological site are in the process of nomination to the national register. Other archeological sites consisting of prehistoric sites might be nominated pending further survey and evaluation.

Fifteen sites on the North Rosillos Ranch addition are currently Texas State Archeological Landmarks.

HISTORIC STRUCTURES

There are eight National Register of Historic Places sites or districts containing structures in Big Bend National Park. They are Burro Mesa Archeological District, Castolon Historic District, Hot Springs Historic District, the Mariscal Mining District, the Homer Wilson Blue Creek Ranch Site, Rancho Estelle, Daniel's Farmhouse, and Luna's Jacal. The park contains 76 historic structures. When properly studied, these sites and structures can provide valuable information about past lifeways. The Barker Lodge, Neville Spring, and Glenn Spring Cavalry Outpost are in the process of being nominated to the national register. Additional sites that may be nominated pending further survey and evaluation are Terlingua Abaja, Johnson Ranch, ore tramway, McKinney Spring Ranch, La Noria, and Indian Head Mountain. The park contains structures associated with Mission 66 work that need to be identified and evaluated.

The park continues to evaluate structures in various areas to determine their national register eligibility. Currently, the park has listed 69 structures in Big Bend National Park on the List of Classified Structures . Of the 69 structures, 26 were considered in good condition. The category of good condition is defined as a level at which the structure and significant features need no repair, but only routine or cyclic maintenance. The park's goal is to increase the number of structures in good condition to 50% of those listed. This action would result in a long-term, minor, beneficial impact. In addition, the park is revising the list, which could result in the evaluation and possible listing of more park structures.

The structures at Mariscal Mine, Luna's Jacal, Homer Wilson Ranch, Sam Nail Ranch (a site that does not meet national register criteria), Daniel's Ranch, and Barker Lodge receive preservation treatment as staff time and funding permit.

CULTURAL LANDSCAPES

Big Bend has many cultural landscapes, relating to various classic themes of the West (Indian use, Spanish colonial military/exploration, Mexican settlement, U.S. exploration/military, ranching, floodplain agriculture, mining, and the development of tourism) and time periods from prehistory to the 20th century.

Big Bend's cultural landscapes are under threat by the usual culprits such as erosion and weathering, vandalism, collectors, flooding, collapse, and benign neglect due to insufficient funding and personnel. In addition, there are other threats like the collapse of stone and adobe structures due to constant heavy truck traffic routed to nearby roads during construction. All management decisions having potential to affect a cultural landscape must be made in consultation with appropriate cultural resource specialists (historic landscape architects, historians, archeologists, historical architects, etc.) and through concurrent review and agreement by the Texas state historic preservation office.

No cultural landscapes have been officially identified and designated for Big Bend National Park, but a Level 0 reconnaissance cultural landscape inventory has identified a number of potential cultural landscapes. (A cultural landscape inventory Level 0 reconnaissance study identifies cultural landscape needs, information requirements, and immediate threats, and establishes priorities for Level 1 and 2 inventories.) Most cultural landscapes in the park would either be considered as historic vernacular landscapes or associated with historic

sites. Many areas of the park have a record of repeated use by many groups of people over 10,000 years, and each group leaves its layers of effects. Some locations exhibit numerous layers of reuse during the prehistoric period, with subsequent use during the Historic Period. Park facilities create an additional cultural overlay. The park is preparing to undertake a landscape reconnaissance survey that would identify what is known about a specific cultural landscape, identify information needs, and establish priorities for a Level 2 inventory. The Level 2 inventory would result in establishing the character-defining landscape features and evaluate the landscapes for eligibility to the National Register of Historic Places.

In 1999, a "Cultural Landscape Inventory Level 0 Reconnaissance Study" of 11 major cultural landscapes (or component landscapes) was conducted (see following list). It appears that these cultural landscapes have the potential for eligibility to the National Register of Historic Places as cultural landscapes (districts). These should be within the first cut for more in-depth cultural landscape inventory work and possibly cultural landscape reports.

Castolon Valley

Themes: U.S. Military, Trade, Floodplain agriculture, and Mexican-U.S. relations
Historic properties: Castolon Historic District, El Ojito, Old Castolon, La Coyota, Rancho Estelle (Sublett-Dorgan farm), and perhaps up Alamo Creek to Luna's Jacal
Boundaries: Cañon de Santa Elena to El Ojito to Cerro Castellan to the Rio Grande and Santa Elena Crossing
Contributing adjacent lands: Santa Elena, Mexico

Terlingua Abajo

Themes: Floodplain agriculture, mining trade, and Mexican-U.S. relations
Historic properties: Terlingua Abajo, Molinar, and vicinity (perhaps to Luna's Jacal)
Boundaries: South and East to Cañon de Santa Elena, north along Terlingua Creek to park boundary, west to base of Mesa Anguila
Contributing adjacent lands: Terlingua

Boquillas Valley

Themes: Native American occupation (Hot Springs), floodplain agriculture, mining, Mexican-U.S. relations/conflicts
Historic properties: Ore tramway, Barker Lodge, Boquillas community (with Sada home and restaurant site), Daniel's farm, Deemer store site, Rio Grande Village Mission 66 area, Hot Springs Historic District
Boundaries: Boquillas Canyon to Boquillas Hot Springs, Boquillas Crossing to Lower Tornillo, Rio Grande Overlook and northern tramway terminus
Contributing adjacent lands: Boquillas, Mexico and the Puerto Rico Mine

San Vicente
Themes: Floodplain agriculture, Mexican-U.S. relations, and Spanish period
Historic properties: San Vicente site, Comptons, San Vicente Crossing and vicinity. Outliers may include Solis, Rooneys, and Casa de Piedra
Boundaries: The immediate vicinity/viewshed of San Vicente
Contributing adjacent lands: San Vicente, Mexico, notably Presidio de San Vicente

Chisos Basin

Themes: Native American occupation, CCC development and the Park
Historic properties: CCC-built road, trails, and cottages, CCC-related features, Chisos Basin site, the historic viewshed (ex: the Window)
Boundaries: Viewshed to the surrounding peaks that define the Basin, including Panther Pass and Green Gulch road
Contributing adjacent lands: None (Chisos Mountains NPS-managed)

Mariscal Mining District

Themes: Mining
Historic Properties: Mariscal Mine, prospects, surrounding settlement, brick kiln, red-light district

Boundaries: To base of Talley Mountain, up to cessation of prospects on Mariscal Mountain, to back portion of mining area (area of brick kiln and dwellings)
Contributing adjacent lands: None (vicinity NPS-managed)

Comanche Trail (Linear Landscape)

Themes: Native American occupation, military
Historic Properties: Persimmon Gap, Comanche Trail, La Noria, Glenn Spring, Paso de Chisos (there were several branches; more research needed)
Boundaries: Linear landscape, viewshed/ occupation sites along trail
Contributing adjacent lands: From beyond Marathon and Fort Stockton, south to the trail as it crosses through Lajitas and Paso de Chisos into Coahuila and Chihuahua, Mexico

Cottonwood Creek Valley

Themes: Native American occupation, ranching
Historic Properties: Prehistoric Native American archaeological landscape, with lithic quarries, campsites, springs, and trails. Also includes far corner of G-4 Ranch, with Gano Ranch site at Gano Spring, the first ranch in this valley. Finally, includes Homer Wilson Blue Creek Ranch (headquarters at base of Chisos Window) and Line Camp, and Sam Nail Ranch.
Boundaries: From Chisos Mountains to Burro Mesa, from the head of Cottonwood Creek to the canyon.
Contributing adjacent lands: None (vicinity NPS-managed)

Glenn Spring

Themes: Native American occupation, U.S. military and Mexican conflict, candelilla processing
Historic properties: Glenn Spring campsite (Indian site), Glenn Spring village (military camp/battlefield, candelilla wax plant, about five jacals, ranch)
Boundaries: Up to divide and Indian campsite, to clay canyon draining the springs, village defined by surrounding, close hills
Contributing adjacent lands: None (vicinity NPS-managed)

Neville Spring

Theme: U.S. Military
Historic properties: Neville Spring Cavalry Outpost (including oldest datable structure in park)

Johnson Ranch

Themes: Ranching, U.S. military
Historic properties: sloping plain south of Punta de la Sierra on Rio Grande was used as farm and landing field. Farm begun in 1924 by Graddy and Williams; started trading post; Johnsons bought it in 1928 – post good but the cotton and goats not profitable. In 1929, U.S. Army dedicated landing field, which was used for training and lookout/checkpoint on international boundary. Training included flying between the Mule Ear Peaks

The reconnaissance identified the following eight landscapes as having good potential according to the literature, park files, and staff, but further investigation is needed to develop boundaries and interrelationships with other elements.

Dugout Wells

Themes: Ranching
Historic properties: Dugout Well, W. A. Green ranch and school, garden, fruit trees, flowers (palms, oleanders survive); important overnight campout on Marathon-Boquillas road
Boundaries: Immediate vicinity of Dugout Well or legal boundaries of Green ranch
Contributing adjacent lands: None (vicinity NPS-managed)

Indian Head Mountain

Theme: Native American occupation

La Noria ("The Well")

Historic properties: Army camp and "Old Boquillas." Nearby road led to Hannold's store (1930s trading post)

McKinney Spring

Historic properties: McKinney Spring Ranch and village, candelilla wax processing plant (one of two largest in park)

Government Spring (Burnham) Ranch

Historic properties: Government surveyor camp, Government Spring (Burnham) Ranch

Hannold Ranch

Historic properties: Hannold Ranch, Hannold grave, Hannold store, site (landscape scar) of Texas Highway Department's Big Bend-Marathon road building/maintenance (1936-39)

K-Bar Ranch

Theme: Ranching

Tornillo Flat

Themes: Native American occupation, ranching, overgrazing
Historic Properties: Now a wasteland, previously (before 1918-20) covered by tobosa grass (named for Tobosa Indians). Was good antelope range and probably used as hunting grounds. Sandstone ridges (*cuestas*) were good for ambush, and some, especially with shelters, have archaeological sites. Hornfels quarry at Banta Shut-In near south end of the flat. Grass cut by early settlers for hay, and there were parts of old mowing machine. Grass was killed by drought and overgrazing; excellent potential for interpreting overgrazing.

There are other potential cultural landscapes, notably the many small ranching operations throughout the park (perhaps two thematic landscapes might be developed, one on ranching and one on Native American occupation). Forty-eight landscapes or landscape-related elements were noted in the literature but were not investigated in the 1999 reconnaissance due to time limitations. This list can be found in appendix G.

After the Second World War, the National Park Service undertook a building program to accommodate the growing demand for better visitor facilities and to update park infrastructure neglected during the war. This program was known as Mission 66, and its period of significance was from after World War II until 1967. In this period a substantial amount of development occurred in the park. On April 27, 1998, the NPS Director of the Intermountain Region sent a memorandum to all superintendents of the Intermountain Region imposing a moratorium on development effecting Mission 66 structures and stipulating that "any construction, repair, or rehabilitation activity that may effect any structure built after World War II to 1967 be subject to provisions of Section 106 of the National Historic Preservation Act. To comply with this directive, park staff has made a preliminary determination of which structures and landscapes associated with the Mission 66 era could potentially be eligible for listing on the National Register of Historic Place. This list does not represent a formal or complete identification of all structures and landscapes associated with Mission 66 in the park. The park staff has determined the following structures and landscapes as potentially eligible:

- Chisos Basin – structures (housing) and landscapes (upper Basin parking layout, campground layout, infrastructure, and some road)
- Panther Junction – structures (the existing visitor center and some housing) and

landscapes (street layout and views of the visitor center)
- Rio Grande Village – structures (housing) and landscapes (road system, some parts of the irrigation system to the camping areas and roadsides, reflection pond in the group campground, and infrastructure for the campgrounds and restroom) area

Some work may have occurred in the Castolon area in the Cottonwood Campground, but additional research is needed to make this determination.

The Comanche Trail is a Historic Period cultural landscape that is being interpreted through a park brochure. This trail is known from written documents and historic maps, but has been mostly obliterated from the landscape by natural erosion. It is physically evident at only a few locations in the park.

One landscape that is actively interpreted at Big Bend is an undesirable landscape of human misuse – the alteration of natural vegetation communities by overgrazing between the 1850s and the 1940s. Fifty years of land dormancy since park establishment has allowed the grassland to recover to its approximate pre-1850s level in the higher, more moist elevations.

ETHNOGRAPHIC RESOURCES

Historical documents by the Spanish in the 1600s reveal that a variety of ethnic groups used or occupied the Big Bend National Park region. These accounts indicate an early indigenous occupation of the Chisos Mountains and surroundings by the Chizo (Chisos) Indians during the 17th century, reaching back through an unknown span of time. This group was apparently linked with cultures in northern Mexico. Linguistically, the Chisos spoke the Concho dialect of the Uto-Aztecan language. Their material culture, evident from comparative archeological studies in the early 20th century, is very similar to that of cave and desert dwellers of northern Chihuahua and northwestern Coahuila. The final status and location of the Chisos Indians is unknown. Neighboring bands fled the intrusion of Apache invaders, escaping southward to security within their cultural kindred. The same is probably true of the Chisos.

Some historians suggest that the Lipan Apache occupied the Big Bend, but most reliable sources point out that the Lipan occupied land east of the Pecos River. There is documented use of the Big Bend area by Apache groups, primarily the Mescalero, during the 18th century. Spanish accounts mention raids by small bands of Apache, who wandered throughout New Mexico, Arizona, Texas, and northern Mexico. These were essentially nomadic transients who lived off of plunder taken during their wanderings. Some accounts describe renegade Apache bands escaping pursuit by Spanish soldiers, fleeing to the safety of the mountainous regions of west Texas and northern Chihuahua, Mexico. The Comanche and possibly the Kiowa passed through the Big Bend during their annual raiding forays into northern Mexico during the 19th century.

Hispanic communities or *rancherias* arose in the northern states of Coahuila and Chihuahua, Mexico, during the 18th and 19th centuries. Hispanic sites of 18th and early 19th century may exist in the park, but archeological research is needed to identify sites specifically attributable to any particular Indian, Hispanic, or Anglo ethnic group.

Hispanic and Anglo ranches and farmers were forced out of the area when land was being acquired for Big Bend National Park. There may be traditional ties of these affected people with the communities, cemeteries, and farms and homesteads that they were forced to abandon.

Ethnographic resources may include subsistence items such as plant materials used in healing or ceremonial activities. The only tribal group to request specific use of such resources was the Crow Chapter of the Native American Church, who asked for permission to hunt for and gather peyote cactus for ritual use.

At Big Bend National Park, American Indian consultation has been conducted with tribal representatives from the Comanche, Cheyenne, and Blackfeet. The Blackfeet have expressed an

affiliation with the park. The park consults with local American Indian tribes and councils to update park inventories.

COLLECTIONS

Park collections inventory lists almost 121,500 items, including archeological, historical, archival, biological, paleontological, and geological items. About 46,087 of those items have not yet been catalogued. Although about 60% of the collection remains in the park, many objects relating to the park have been placed in various repositories outside the park, including the University of Arizona, the Lajitas Museum, the Barton Warnock Environmental Education Center, Texas Tech University, and Texas A & M University. The park collection is valuable for the information for research and interpretation that it provides about processes, events, and interactions among cultures, individuals, and the environment. The collection contains diagnostic and site-specific artifacts, NAGPRA-related objects, threatened and endangered species specimens, voucher specimens, administrative reports, historic maps, papers, photographs, and one-of–a-kind items.

VISITOR UNDERSTANDING – EXPERIENCING THE RESOURCES

During the 1980s the average annual recreation visits to Big Bend National Park was about 180,400 people. In the 1990s the average rose to 305,400 recreation visits per year, representing an increase of about 70%. Figure 1 shows the total annual recreation visits from 1980-2000.

On a monthly basis (see figure 2) most visitation occurs from September through April, with November, February, and March receiving the highest number of visitors. Due to the high heat, summer is the least visited season of the year.

In April 1992 the University of Idaho Cooperative Park Studies Unit (CPSU) conducted a survey of park visitors. The purpose of the study was to get a better understanding of park visitors, and to learn more about what experiences visitors looked for and attained. Information was gathered about demographics, the activities visitors engaged in, their opinions about the quality and adequacy of facilities, etc.

The results of this survey of visitors to Big Bend National Park showed that:

- Visitors were often families (62%) and in groups of two (60%). Forty-four percent of visitors were 56-70 years old; 20% were aged 41-55. Most (60%) were first-time visitors.
- Visitors from foreign countries comprised 10% of the visitation, with 48% of the international visitors from Germany.
- Most visitors (76%) spent one or two nights at Big Bend. This is further illustrated in figure 3, which shows the relationship of overnight stays to the total annual recreational visits.
- In assessing the types of activities engaged in, most visitors saw the scenery (985), visited the visitor center(s) (88%), and went on day hikes (53%). Panther Junction Visitor Center was the most visited park site (87%), followed by the Chisos Basin (80%), Cañon de Santa Elena (68%), and Rio Grande Village (62%).
- Highway directional signs and restrooms were rated as the most important maintenance services/facilities. Directional signs along trails received the highest quality ratings.
- A number of visitors expressed the need for more overnight accommodations, although others felt there should be no additional overnight facilities in the park.

A number of conflicts exist between various recreational activities and efforts to protect park resources. These conflicts include camping near springs, off-road travel, and bear-human encounters.

Big Bend is a large park, 801,000 acres, with relatively low visitation. In the last 10 years visitation has fluctuated from a high of 340,806 in 1998 to a low of 264,684 in 2001. The park has not shown the ever-increasing numbers of visitors that are so common in other units of the national park system. This is due to a number of factors, the most important being geographical isolation. The park is in one of the most isolated, least populated areas in the continental United States. The nearest airport is a four-hour drive; the nearest town of any size is more than 100 miles away from park headquarters. The park is not "on the way" to anywhere else. Park roads dead-end at the Mexican border on the Rio Grande.

The park does have times when it is busy, but they are the same periods every year. Thanksgiving week, Christmas and New Years, and the busiest period of every year, two to three weeks of Spring Break in March and April. The rest of the time the park is not very busy, and during the summer months visitation drops dramatically due to the heat. Holiday weekends are busier than other times, but are not as busy as the periods mentioned above.

Visitor comments rarely, if ever, mention crowding. Visitors who seek solitude, and are familiar with the park's visitation patterns, simply visit when the park is not crowded. It is not at all unusual for hikers or river runners to not encounter another person on trips throughout much of the year.

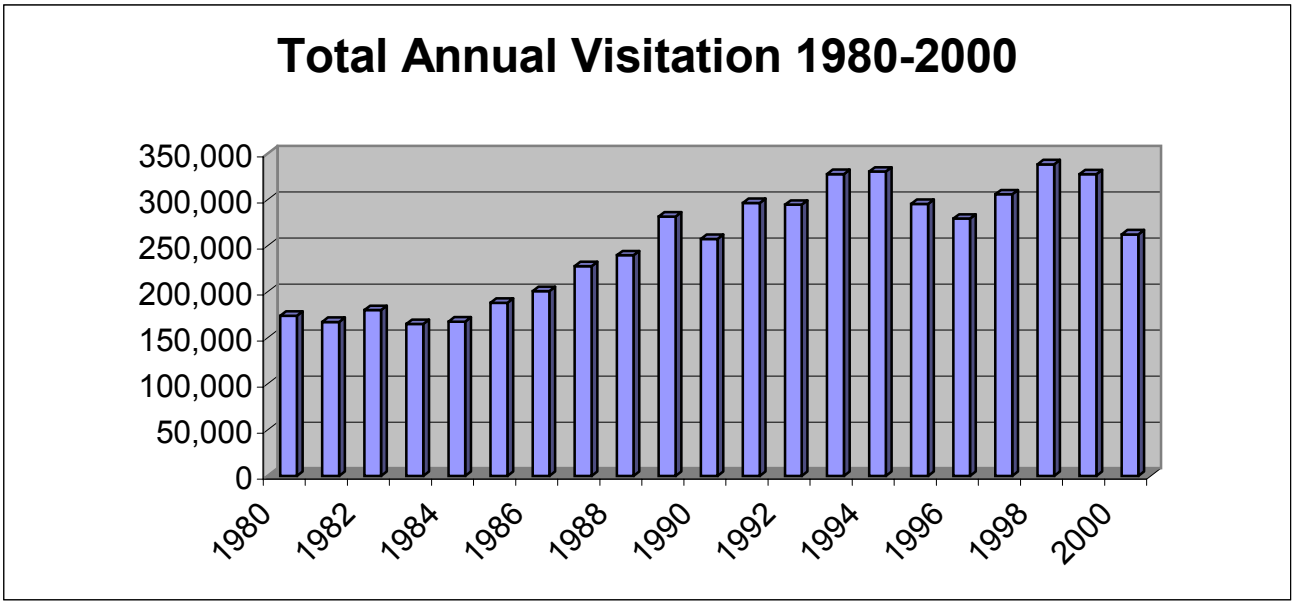


Figure 1. Total Annual Visitation, 1980-2000

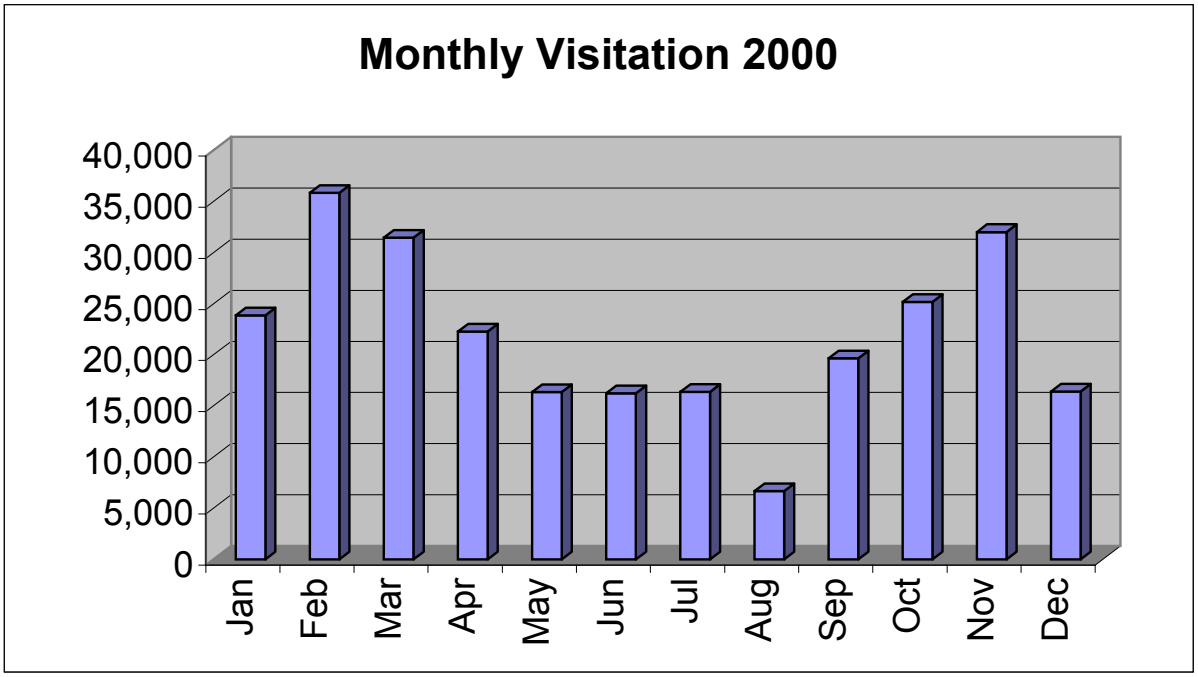


Figure 2. Monthly Visitation, 2000

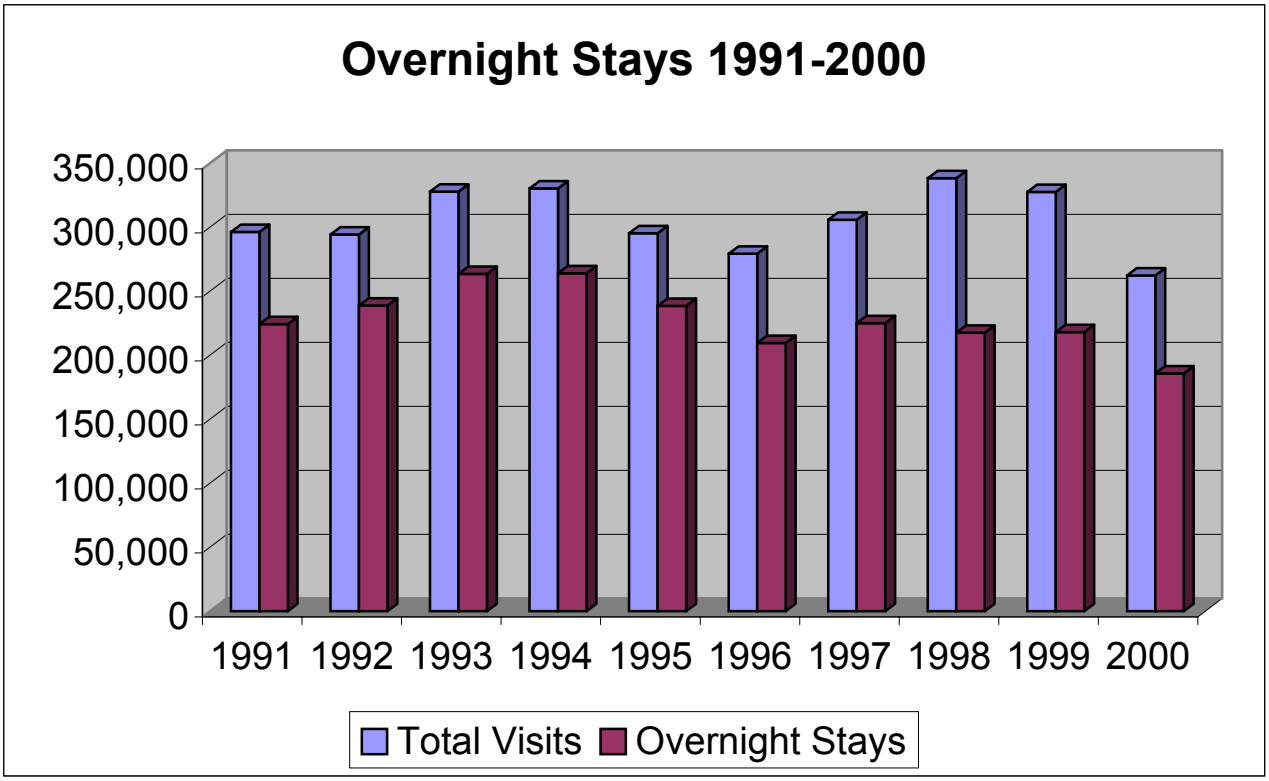


Figure 3. Overnight Stays 1991-2000

Visitor comments tend to focus on such issues as generator noise and the lack of campsites at very specific times of the year. Most of the time visitors can arrive at any time of the day and easily get a frontcountry or backcountry campsite. It is the same situation for river permits – a visitor can arrive, pick up a free permit, and get on the river within hours.

Parking can be a problem during the busy times of the year. It is adequate most of the year.

There are areas of concern. The park has seen a return of black bears primarily to the Chisos Mountains and surrounding areas, as well as the need to contain populations of mountain lions throughout the park. Incidents between humans and large mammals are infrequent but do occur. The park has been very proactive in terms of installing steel, bear-proof storage boxes in front- and backcountry campsites as well as at trailheads. Regulations in campgrounds concerning the proper storage of food and other mammal attractants are quite strict and enforced. Information about proper procedures and behavior are available at visitor centers, in park publications such as the park newspaper, on bulletin boards, and at trailheads.

As these large mammal populations grow, particularly black bears, there may be areas of the park where management changes may be necessary. The on-going drought has had severe impacts on the bear population, and it is unclear how many bears the park could support in years with normal precipitation. The bear population is being studied and monitored, which should provide the necessary information to make informed decisions on when, where, and what changes are appropriate.

ORIENTATION AND INTERPRETATION

In the 1992 visitor survey, visitors most used maps, advice from friends and relatives, and travel guides/tour books as sources of information about the park. Visitors came to the park for many reasons, but the most often identified was the scenic views and drives.

The most used visitor services were the park brochure/map and the visitor center personnel. The park brochure/map, visitor center personnel, and safety information brochures were listed as the most important services. Visitor center sales publications and ranger/volunteer-led programs received the highest quality ratings.

The Panther Junction Visitor Center is inadequate in size to serve visitors during peak periods. The visitor center also lacks sufficient space to adequately introduce the park's primary interpretive themes and provide trip-planning information. At peak periods, considerable congestion exists between visitors seeking to purchase items and those trying to see the exhibits.

The various informational and interpretive media and programs do not adequately address diverse visitor populations or the cultural diversity reflected in the park themes.

SAFETY

The campground, store, and gas station at Rio Grande Village are in the 100-year floodplain. This poses a potential hazard to visitors and employees in this area of the park.

Some of the buildings at Panther Junction are in a flash-flood-hazard area, posing a potential hazard to employees and employee families in this area of the park.

FACILITIES

Chisos Basin

The comparatively cool climate and dramatic scenery make the Chisos Mountains a primary destination for park visitors. The Chisos Basin, a bowl-shaped depression within the mountains, has long been a focal point. Facilities include a visitor center, the open-year-round Chisos Mountain Lodge (cottages and lodge units offering a total of 72 rooms as well as a restaurant, and gift shop), a 65-site campground operated on first-come-first serve basis, a group campground available by reservation for parties of 10 or more, a store, a visitor center, six employee housing units, two employee dorms, parking, and trails. Evening programs are offered in an amphitheater.

Panther Junction

Visitor facilities include a visitor center and bookstore, post office, and gasoline station. Park collections are in the floodplain, placing them at risk of damage or loss.

Rio Grande Village

This area has a visitor center, a 100-site NPS campground, a concessioner-operated 25-site RV full hook-up campground, a picnic area, a group campground, an amphitheater, a general store, a gasoline pump, and a self-guiding nature trail.

The area is open year-round. Campsites have a parking space, grill, picnic table, and access to sanitary facilities and potable water.

Castolon

Castolon contains a ranger station that is open intermittently. The Castolon Historic District contains housing for park staff (permanent and seasonal), researchers, and the concessioner. The historic La Harmonia Store in the Castolon Historic District is open daily and offers groceries and supplies. The Castolon Historic District contains structures that have interpretive exhibits and an amphitheater. Interpretive programs and guided walks are given from November to April.

Cottonwood Campground

The campground has 35 sites, operated on a first-come, first-served basis, and chemical toilets. Its sites are suitable for tents and RVs. Each site has a picnic table and grill. Group camping is available for groups of 10 or more by reservation. There is an amphitheater near the campground in which interpretive programs are

occasionally conducted from November to April. Nearby, at Castolon, are a general store and gasoline pump.

Persimmon Gap

A visitor center and entrance station are at Persimmon Gap.

Maverick

There is an entrance station and interpretive exhibit at Maverick.

SOCIOECONOMIC ENVIRONMENT

BUSINESSES AND PARK NEIGHBORS

The study area for this Big Bend National Park *General Management Plan / Environmental Impact Statement* has been defined as Brewster and Presidio Counties. In addition, the affected environment is also described for the Mexican states of Chihuahua and Coahuila (located across the international border and south of the Rio Grande). The "Affected Environment" section describes economic conditions throughout the study area with particular emphasis on park tourism. Rio Grande tourism is limited to the park and is not described for the lower canyons. The Lower Canyons refers to portions of the river below the Heath Canyon boat put-in area. This area is downstream and outside the park.

There are many businesses near the park's west entrance, including campgrounds, commercial river runners and outfitters, stores, restaurants, motels, gas stations, a bank, a post office, and gift shops. There is a privately owned campground and store near the park's north entrance. Most other adjacent lands are working ranches or small "ranchettes" on the Terlingua Ranch development.

Brewster County

The 2000 household population of Brewster County was 8,466. In 2000, about 43% of county residents were of Hispanic descent. County public school enrollment in 1995 was 1,520 students. The median household income was about $18,000 (U.S. Bureau of the Census 1998). The 1999 per capita income of $20,111 ranked Brewster County 148th in the state. This was 75% of the statewide average and 70% of the national average. Since 1989, the average annual growth rate in per capita income has been about 5.9% (by comparison, the statewide growth rate for per capita income was 5.1%).

The total earnings of persons employed in Brewster County were $176.8 million in 1999. During the preceding 10 years, earnings increased by 5.6% per year and about 22.7% of all residents had 1997 incomes below the poverty line. About 16% of all Hispanic individuals were below the poverty line (U.S. Bureau of the Census 1998 and 2000).

There were an average of 5,440 persons in the 2000 civilian labor force, and an average of 5,320 were employed (an unemployment rate of 2.2%). Most employment was associated with retail trade, and services. Alpine is the largest community in Brewster County, with a 2000 population of 5,672 persons. There were 2,772 persons of Hispanic origin in that year. Brewster County had total of 4,614 housing units in 2000, 3,669 of which were occupied. About 60% of the occupied units were owner occupied. The 1997 median rent in town was $294 per month, and the median home value was $46,900 (U.S. Bureau of the Census 1998 and 2000).

Presidio County

The 2000 population of Presidio County in households was 7,208. In 2000 about 84% of county residents were of Hispanic descent. County public school enrollment in 1995 totaled 1,650 students. About 1,700 persons over 25 years of age had completed less than the 9th grade in 1990 (U.S. Bureau of the Census 1990).

The 1999 per capita income of $10,739 is 40% of the statewide average and 38% of the national average. Since 1989 the average annual growth rate in per capita income has been 2.7% (by comparison, the statewide growth rate for per capita income was 5.1%). Total earnings of persons employed in Presidio County were $96.2 million in 1998 (Bureau of Economic Affairs 1999). Earnings increased by 6.1% per year compared to the previous 10 years. About 35.6% of all residents had 1997 incomes below the poverty line. In 1990 about 45% of all Hispanic individuals in Presidio County were below the poverty line (U.S. Bureau of the Census 1990 and 2000).

There was an average of 3,609 persons in the 2000 civilian labor force, and the average civilian unemployment rate was 25.6%. More than half of county employment was associated with wholesale or retail trade.

In 2000 Presidio County had a total of 2,530 housing units of which 1,778 (70%) were owner-occupied.

Presidio is the largest town in Presidio County. It has a mayor-alderman form of government and has a municipal planning commission. The town has three full-time firefighters but does not have police officers or ambulance services. Drinking water is obtained from wells, and the sewage treatment facility has a capacity of 7.7 million gallons per day. West Texas Utilities Company provides electric service. Table 4 summarizes demographic information for the communities of Alpine and Presidio.

The total 2000 study area population was 15,674 persons. This represents an increase of about 1,000 individuals compared to the 1950 level (U.S. Bureau of the Census 1950-2000). Decennial population changes during the period 1950-2000 are illustrated in table 5 and figure 4. The population of Brewster County increased by 16% over the 50-year period, while the population of Presidio County decreased by 2%. Figure 5 shows data on changes to Hispanic populations from 1980 to 2000. Data prior to 1980 were not used since data on Hispanic individuals were not tracked before then. The data show that since 1980 the number of Hispanic residents in Presidio County has increased by about 2.5% each year, while the growth rate for Hispanic persons in Brewster County has increased by about one-half percent each year.

STUDY AREA ECONOMIC CONDITIONS SINCE 1950

For this assessment, economic conditions in the study area are generally represented by the change in per capita income. Per capita income information is shown on Table 6 and Figure 6. Between 1960 and 1998 (the most recent year for which data are available), the per capita income for residents of Brewster County grew by an average of about 7% per year. Income for Presidio increased at a slower rate of 3% (U.S. Bureau of the Census 1960-1990 and 1998). The Census Bureau was unable to provide data for 1950. Although income has risen rapidly since 1990, the income for county residents is still considerably lower compared to the statewide average.

TABLE 4. SUMMARY OF SELECTED DEMOGRAPHIC CONDITIONS, TOWNS OF ALPINE AND PRESIDIO

Indicator	Alpine	Presidio
Population 2000	5,786	4,165
Households 2000	2,429	1,285
Median 1990 Household Income	$17,479	$9,148
Total Housing Units 2000	**2,852**	**1,541**
Average 1990 Monthly Rental	$294	$203

Source: U.S. Bureau of the Census 1990 and 2000

TABLE 5. STUDY AREA POPULATION TRENDS, 1950-2000

County	1950	1960	1970	1980	1990	2000	Change 1950-2000
Brewster	7,309	6,434	7,780	7,573	8,681	8,466	16%
Presidio	7,354	5,460	4,842	5,188	6,637	7,208	-2%
Total	14,663	11,894	12,622	12,761	15,318	15,674	7 %

Source: Bureau of the Census, 1950-2000.

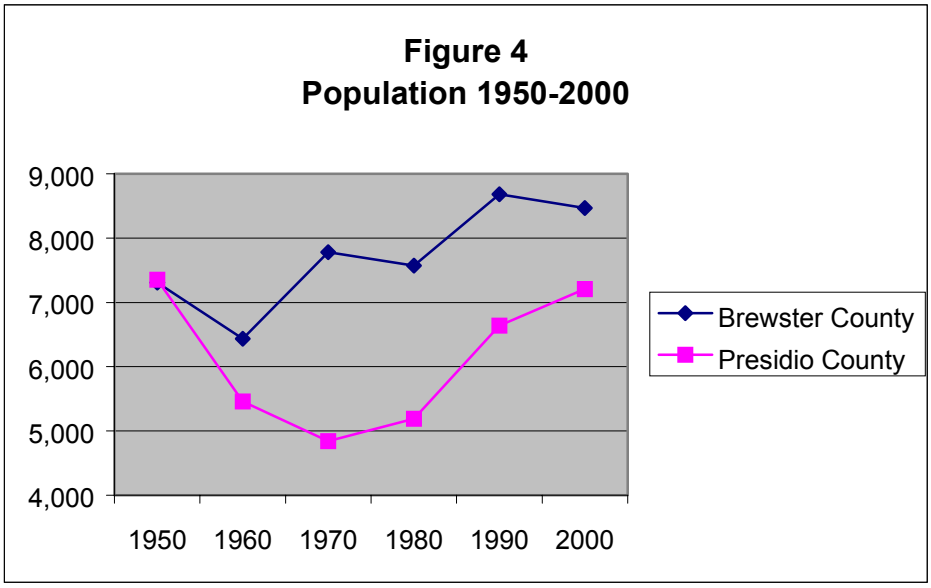


TABLE 6. STUDY AREA PER CAPITA INCOME, 1960-1998

County	1960	1970	1980	1990	1998	Change 1960-1998
Brewster	$5,035	$6,279	$8,105	$10,730	$18,729	272 %
Presidio	$4,854	$5,054	$6,285	$6,347	$10,296	112 %

Source: U.S. Bureau of the Census, 1960-1990 and 1998.

Figure 5
Persons of Hispanic Origin By County

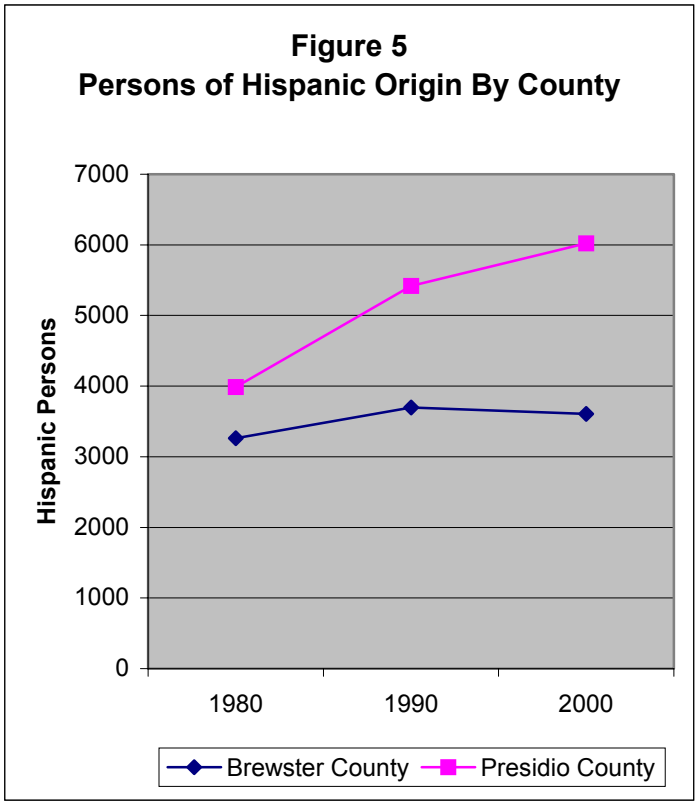
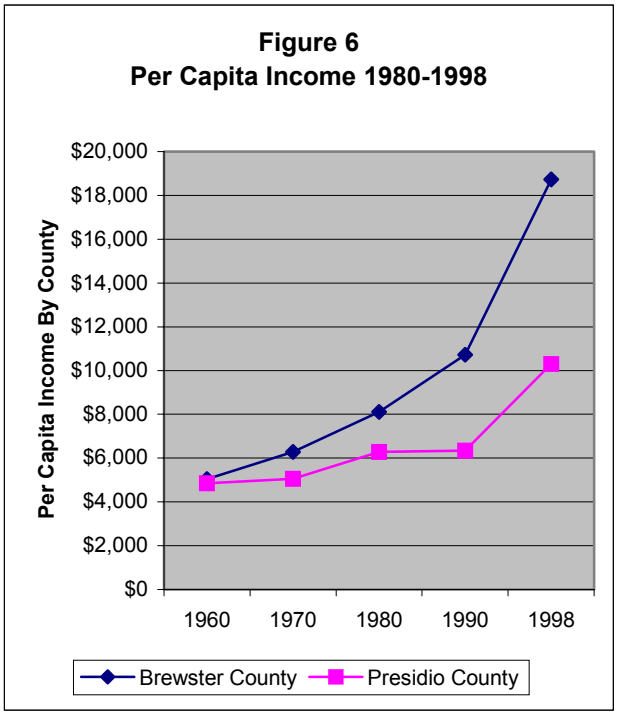


Figure 6
Per Capita Income 1980-1998



Recreation Use At Big Bend National Park

The Big Bend National Park was authorized on June 20, 1935, and was established in 1944. There were 264,864 total visitors in 2000. Park campgrounds include Chisos Basin, Cottonwood, Rio Grande Village, Rio Grande Village Trailer Park, and numerous backcountry sites with a total of 335 campground/backcountry sites. Major activities at the park include hiking/backpacking, rafting and canoeing, exploring, birding, and camping. Canyons in the park include Santa Elena (20 miles), Mariscal (10 miles) and Boquillas (33 miles in length) on the Rio Grande.

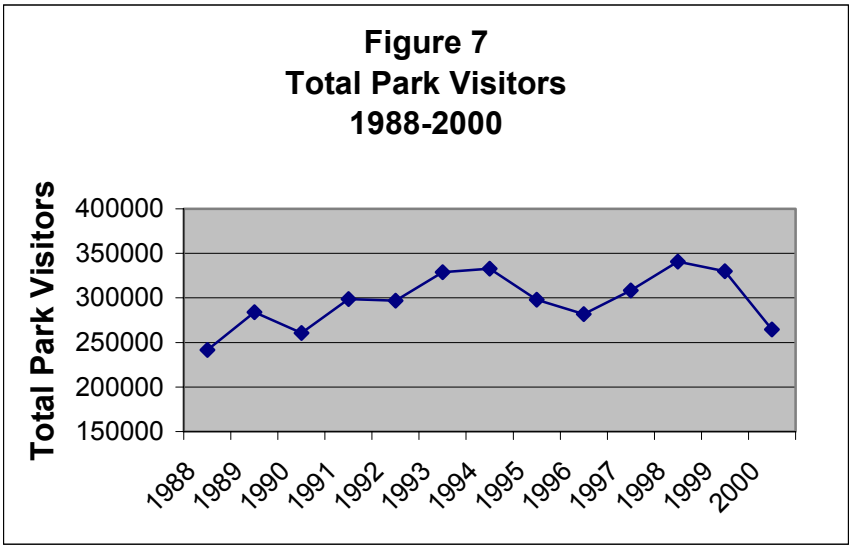
Since 1988, total park use has increased by 23,000 visitors, equivalent to a growth rate of about 1% per year for the 12-year period. However, park use showed a strong increase in the period 1989 through 1994 with an overall growth rate of 4% in that time frame. Park use then fell during 1995 and 1996, to rise again to a peak of 340,806 in 1998. Since then annual visits have fallen back to nearly 1988 levels, reflecting larger national and statewide economic trends. Annual park visitation for the period 1988-2000 is shown in figure 7.

A total of 44,627 visitors stayed in concessions lodging and 10,473 in the concessions campgrounds in 2000. The total number of overnight stays at the park in 2000 was 184,880.

Current Impact of Recreation Spending in Study Area

In 1996, the Big Bend National Park and the Rio Grande Wild and Scenic River generated more than $51 million to the economy of Brewster County (National Park Service, 1996). This was based on a 1996 tourism level of 279,952 individuals. This figure included the combined sales benefits associated with tourism (all purchases and expenditures), as well as Federal government expenditures (such as road construction). The combined job benefits from these expenditures totaled 1,789 positions.

Within the park, there are currently 72 rooms, which include the Chisos Mountains Lodge, the motel, the lodge unit, and the Stone Cottages. Park concessions staff indicated that there are 65 employees. The three motor inns and lodges contacted outside the park reported a combined number of about 160 rooms and a total number of about 130 employees. A survey of selected motel



Source: National Park Service, April 24, 2002.

operators in Brewster and Presidio Counties showed that there are at least 500 motel/hotel rooms with around 90 to 100 employees. Based on this representative facility survey (both inside and outside the Park in the study area), it is estimated that there are currently more than 200 employees of hotels, motels, or lodges. This is only an approximation, and the actual number could be higher if a 100% inventory of all facilities was conducted.

Conditions in Chihuahua and Coahuila

The Mexican states of Chihuahua and Coahuila are immediately south of the Big Bend National Park and the Rio Grande. The socioeconomic conditions in these states are briefly described in this document because they may benefit economically from proposed NPS management programs.

The current (year 2000) population of Chihuahua is estimated to be 3,047,867 individuals (XII Censo General De Poblacion Y Vivienda, Resultados Preliminares). This represents an increase of 606,000 persons compared to 1990 (a 25% increase). Also between 1990 and 2000, the population of Mexico grew by about 20%. The population of Chihuahua is evenly split between males and females. In 1998 there were 79,336 births and 15,753 deaths in the state. Table 7shows selected statistics for Chihuahua and the largest several towns or cities within the state.

The current population of Coahuila is 2,295,808, which represents an increase of 323,000 persons (16%) compared to the 1990 census figures. This was a somewhat slower growth rate relative to Chihuahua. In 1998 there were 57,541 births and 10,276 deaths in the state. Table 8 summarizes selected socioeconomic indicators for Coahuila.

TABLE 7. COMPARISON OF SELECTED ECONOMIC INDICATORS, STATE OF CHIHUAHUA

State or City	Population 2000 (a)	Total Employment 1998 (b)	Individuals per House 2000 (a)	Number Businesses 1998 (b)
State of Chihuahua	3,047,867	744,450	4.0	88,803
Juarez	1,217,818	393,867	4.1	32,068
Chihuahua	670,208	194,783	3.9	23,276
Cuauhtemoc	124,279	22,327	3.9	4,465
Delicias	116,132	29,778	3.9	5,219
Hidalgo	100,881	21,902	4.1	4,928
Nuevo Casas Grandes	54,226	13,100	3.9	2,300
Guadeloupe	48,226	630	5.3	122

Sources:
(a) Preliminary data are for year 2000 (XII Censo General De Poblacion Y Vivienda, Resultados Preliminares).
(b) Data are for 1998 (Aspectos Economicas de Chihuahua)

TABLE 8. COMPARISON OF SELECTED ECONOMIC INDICATORS, STATE OF COAHUILA

State or City	Population 2000 (a)	Total Employment 1998 (b)	Individuals per House 2000 (a)	Number Businesses 1998 (b)
State of Coahuila	2,295,808	535,617	4.2	74,321
Saltillo	577,352	144,687	4.3	19,538
Torreon	529,093	135,665	4.2	19,462
Monclova	193,657	54,711	4.0	7,153
Piedras Negras	127,898	36,036	4.1	4,114
Acuña	110,388	42,337	4.3	2,725
Matamoros	91,858	6,861	4.0	1,767
San Pedro	88,451	10,263	4.4	2,244

Sources:
(a) Preliminary data are for year 2000 (XII Censo General De Poblacion Y Vivienda, Resultados Preliminares).
(b) Data are for 1998 (Aspectos Economicas de Coahuila)

LOCAL AND REGIONAL ECONOMY / LAND USE

The economy in the Big Bend National Park area is based mainly on ranching and tourism. The nearest town, Study Butte/Terlingua just outside the park's southwestern boundary, has a motel and several small restaurants. There is residential development along the park boundary just north of Study Butte/Terlingua.

This section describes land use plans, policies, and controls for the area including those of local, county, and state governments in the vicinity of the park. There are tribal lands nearby.

Population growth and industrial development have occurred in recent years on both sides of the Rio Grande without adequate investment in the infrastructure to control resulting pollution. Growth is straining the ability of local entities to fund either pollution abatement or adequate water quality monitoring programs. The North American Free Trade Agreement promises to accelerate this growth, as does the shift from an agricultural to an industrial economic base in the border area (Texas Water Commission 1992).

At present there is no comprehensive state or regional planning activity taking place regarding land use in the Big Bend region. Texas conducts a statewide low-income housing program that is applicable to Brewster and Presidio counties. As of 2000, no federal and/or Section 8 vouchers were included in the program for the two counties.

Big Bend Ranch State Park (State of Texas)

The Texas State Parks and Wildlife Department administers the Big Bend Ranch State Park, a 299,345-acre facility adjacent to the national park in Presidio County. There is little existing or planned development in the park. Certain areas of the park have limited recreational use and vehicular access. Visitors must obtain user permits either at Fort Leaton State Historical Park or Barton Warnock Environmental Education Center prior to using the park. The park has two group and ten primitive camping areas and a system of hiking and riding trails. There are also boating and fishing areas along the river.

Texas Outdoor Recreation Plan (TORP)

This planning program seeks to improve recreational opportunities throughout the state. The plan's policies focus on local, state and private parks and open space. Although it does not address Big Bend National Park directly, it recognizes that Big Bend provides priority outdoor recreational opportunities in the state.

In addition, Texas has begun preparing the Texas Land and Water Conservation and Resources Plan to further address state, local and private open space, conservation, and recreation programs. The plan is scheduled for completion in October 2002.

Black Gap Wildlife Management Area (State of Texas)

The Black Gap has 25 campsites along the river that are used primarily for fishing and hunting. Two areas at Black Gap are available for launching rafts and canoes, Horse Canyon and Maravillas Canyon. To enter the wildlife management area one must acquire one of three kinds of permit. Hunters must have an annual hunting permit, fishermen a limited use permit, and non consumptive users, such as campers, bird watchers, hikers, and river users, a Texas Conservation Passport. No permits are sold in the wildlife management area, but they may be purchased at other locations before arrival at Black Gap.

Most of the wildlife management area is closed from March 1 to August 31 each year for road and habitat maintenance. The roads to Horse and Maravillas Canyons remain open. The entire Black Gap is closed October 7-11, 21-25; November 12 to December 12; December 26-29; and January 13-16. Those with special hunting permits may use the area during the closures.

Brewster County

Texas counties do not have zoning authority; however, they can promulgate various kinds of regulations that affect land use. These regulations serve some of the same purposes as a master plan for land use. The county has subdivision and platting regulations particularly along the border in southern Brewster County that would prevent dense subdivisions from being placed next to the park. They have regulations for permitting septic tanks. Manufactured homes and manufactured home rental communities are highly regulated in Brewster County. The county has shortages of both housing and office space. (County Judge, Val Beard, pers. comm. 9/28/01)

City of Alpine

The Texas Municipal Code grants home rule cities broad planning and zoning powers. The City of Alpine has a planning and zoning commission that oversees implementation of the city's zoning and subdivision ordinances. Alpine shares with Brewster County concerns about housing and office space shortages. (City of Alpine, pers. comm. 4/23/02).

Christmas Mountains

Adjacent to this privately owned area on the park's western boundary increased subdivision of land is occurring (primarily the Terlingua Ranch development). The issue of the park's viewshed has emerged as a prime concern. The owner of the Christmas Mountains has a long-term goal of preserving the area from the escalating subdivision. The owner would also like to preserve the viewshed from Big Bend National Park, and toward the park from the Christmas Mountains and Terlingua Ranch area.

Subsurface ownership is divided between the present owner and numerous prior owners who wholly or partially retain the mineral rights. As far as the Park Service knows, only fluorspar has been actively extracted from the Christmas Mountains in the past three decades. The success of the mineral extraction was influenced by three factors: fluctuating market prices; remoteness of the mineral source from paved roads and rail service; and richness of the mineral deposits. The mines stopped operation because these factors made mining costs prohibitive.

The Christmas Mountains property is bordered on three and one-half sides by the subdivided Terlingua Ranch development. The Terlingua Ranch headquarters, lodge, and landing strip are about 2.5 miles from the west boundary of the park. One mile of the Christmas Mountains boundary along the southeast side adjoins the

park near Christmas Spring, which is within the park.

Terlingua Ranch

The Terlingua Ranch development, about 220,000 acres in size, is primarily composed of 10-acre to 40-acre parcels that contain varying degrees of development. The rural and extremely remote nature of the area makes it impractical for working people to live in and commute to a limited job market. Most residents are either retired or are part-time residents. The Terlingua Ranch Lodge is a motel and restaurant resort that is at the end of a 16-mile dirt road, and it provides services to a limited clientele. It is estimated that about 400 residents live on about 220,000 acres of the Terlingua Ranch property (NPS 1989); more than half of them are full-time residents. The development has roughly 5,000 landowners.

Lajitas

In 2000, SRS Properties purchased the Lajitas Resort and 25,000 acres of surrounding land. Austin businessman Steve Smith is attempting to develop a world-class golf resort on the property. This will include two championship golf courses, 800 homes, an RV park, condominiums, an equestrian center, a private airport capable of landing large jets, a hotel and restaurants. Part of the development borders the park, and some of it may already infringe on park land. It will use enormous amounts of water – 700,000 gallons per day alone to water one of the golf courses. It blocks access to park trails on Mesa de Anguila. The park is very concerned about this development, particularly the water use; its location directly adjacent to the park, and the fact that the main put-in for Santa Elena Canyon river trips is also on the Smith property. The park will monitor the development closely and take appropriate action if the park and/or river are threatened or damaged in any way.

ENVIRONMENTAL CONSEQUENCES

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C. Glymph

B. Wall

METHODS FOR ANALYZING IMPACTS

The planning team based the impact analysis and the conclusions in this chapter largely on the review of existing literature and studies, information provided by experts in the National Park Service and other agencies, and Big Bend staff insights and professional judgment. The team's method of analyzing impacts is further explained below. It is important to remember that all the impacts include mitigating measures to minimize or avoid impacts. If mitigating measures described in the "Alternatives Including the Preferred Alternative" chapter were not applied, the potential for resource impacts and the magnitude of those impacts would increase.

Effects can be direct, indirect, or cumulative. Direct effects are caused by an action and occur at the same time and place as the action. Indirect effects are caused by the action and occur later or farther away, but are still reasonably foreseeable. Cumulative effects are the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time.

Impact intensity is the degree to which a resource would be beneficially or adversely affected. The criteria that were used to rate the intensity of the impacts for each resource topic are presented later in this section under each topic heading.

Impact duration refers to how long an impact would last. For the purposes of this document, the planning team used the following terms to describe the duration of the impacts:

Short term: The impact would last less than one year, normally during construction and recovery.

Long term: The impact would last more than one year, normally from operations.

PROJECTS THAT MAKE UP THE CUMULATIVE IMPACT SCENARIO

To determine potential cumulative impacts, projects in the area surrounding Big Bend were identified. The area included Study Butte/ Terlingua, the Christmas Mountains, adjacent Mexican villages that border the park, the Rio Grande Wild and Scenic River, and nearby lands administered by the state (Black Gap Wildlife Management Area and Big Bend Ranch State Park). Projects were determined by meetings and phone calls with county and town governments and state land managers. Potential projects identified as cumulative actions included any planning or development activity that was currently being implemented or that would be implemented in the reasonably foreseeable future. These include projects in the park that are not funded.

These cumulative actions are evaluated in the cumulative impact analysis in conjunction with the impacts of each alternative to determine if they would have any additive effects on a particular natural resource, cultural resource, visitor use, or the socioeconomic environment. Because most of these cumulative actions are in the early planning stages, the evaluation of cumulative effects was based on a general description of the project.

Past Actions

The following past actions could contribute to cumulative effects.

Agriculture and Ranching. Agriculture and ranching within and outside the park, while leaving a historical/cultural landscape, have greatly reduced native plants in favor of vegetation that cattle and sheep prefer for food. This in turn has led to the alteration of soil and the loss of soil through erosion. Fences have

been built in the park and elsewhere to limit the movement of animals, mainly cattle and sheep. Along with ranching has come the use of herbicides to kill unwanted plant species and the introduction of exotic species of plants. The park's use of herbicides to control exotics contributes to herbicide use in the area. In addition, natural hydrology and landforms have been modified to create dams and stock tanks to provide water for nonnative animals.

Upstream Use of the Rio Grande. Despite numerous treaties and agreements, both international and among parties in the United States, the water in the Rio Grande is so over-used that the riverbed between El Paso and Presidio, Texas, is frequently dry (NPS 1997a). This reduces opportunities for activities such as irrigation of crops and recreational use of the river. Even when there is water in the river, the water has a high salt and silt content that is unhealthy for irrigated plants and people.

Current and Future Actions

Current actions and those projected for the future also could contribute to cumulative effects.

Increased development of the gateway communities west of the park, the establishment and proposed joint activities with Big Bend Ranch State Park, and the continued operation of the state Black Gap Wildlife Management Area may be impacting local aquifers.

An ongoing restoration project at the North Rosillos/Harte Ranch area, the largest such project in the park, is restoring natural contours, hydrology, and vegetation as much as possible. It will continue as funding permits.

A curatorial and resource management office building (6,250 square feet with fire sprinkler system), walkways, and parking is scheduled for construction at the Panther Junction developed area. This building will be adjacent to the new fire management building.

Another major project scheduled for Big Bend is an approved trailer replacement project that will replace 19 bedrooms. Tentative plans call for the construction of four 2-bedroom duplex units and one 3-bedroom house.

The park would upgrade the water and wastewater treatment systems at Chisos Basin and water treatment systems at Panther Junction and Rio Grande Village that do not meet the Texas Commission on Environmental Quality's standards or are in a deteriorated condition.

IMPAIRMENT OF RESOURCES

In addition to determining the environmental consequences of the alternatives, NPS policy (NPS 2001a: *Management Policies*, section 1.4) requires that potential effects be analyzed to determine whether or not proposed actions would impair the resources or values of the park.

The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve resources and values. NPS managers must always seek ways to avoid or minimize, to the greatest degree practicable, adverse impacts on the resources and values. However, the laws do give the National Park Service the management discretion to allow impacts on the resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service this management discretion, that discretion is limited by the statutory requirement that the National Park Service must leave the resources and values unimpaired unless a particular law directly and specifically provides otherwise.

The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of the resources and values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact on any resource or value may constitute an impairment. An impact would be most likely to constitute an impairment if it affected a resource or value whose conservation would be

(a) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, (b) key to the natural or cultural integrity of the park or to opportunities to enjoy it, or (c) identified as a goal in the park's general management plan or other relevant NPS planning documents. Impairment might result from NPS activities in managing a park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park. In this document, a determination on impairment is made in the conclusion section for each impact topic in the "Environmental Consequences" chapter.

NATURAL RESOURCES

The impact topic of natural resources includes discussions of the effects on the integrity of natural systems, including soils; vegetation; wildlife; water quantity in the Rio Grande and Oak Spring; threatened, endangered, and sensitive species; and wetlands and floodplains. Threatened, endangered and sensitive species are those listed by the U. S. Fish and Wildlife Service as threatened, endangered, or proposed for listing under the Endangered Species Act. Sensitive species also include state-listed plants and animals; however, Texas does not maintain a list of sensitive species. Wetlands are "lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface" (USFWS 1979). Floodplains are defined by the NPS *Floodplain Management Guideline* (1993a) as "the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, and including, at a minimum, that area subject to temporary inundation by a regulatory flood."

Information on known resources was compiled. Where possible, map locations of sensitive resources were compared with the locations of proposed developments and modifications. Predictions about short-term and long-term site impacts were based on previous studies of visitor and facilities development impacts on natural resources. Sociological studies comparing the deterrent effects of signs versus ranger presence on sites were also considered in this analysis. The definitions below assume that mitigation would be implemented. For this document, the planning team qualitatively evaluated the impact intensity for natural resources.

The following categories were used to evaluate the potential impacts on soils:

Negligible: Soil would not be affected or the effects would be below or at the lower levels of detection. Any effects on soil productivity or fertility would be slight and no long-term effects on soils would occur.

Minor: Effects on soil would be detectable. Effects on soil productivity or fertility would be small, as would the area affected. If mitigation were needed to offset adverse effects, it would be relatively simple to implement and would likely be successful.

Moderate: The effect on soil productivity or fertility would e readily apparent, likely long-term, and result in a change to the soil character over a relatively wide area. Mitigating measures would probably be necessary to offset adverse effects and would likely be successful.

Major: The effect on soil productivity or fertility would be readily apparent, long-term, and substantially change the character of the soil over a large area in and out of the monument. Mitigating measures to offset adverse effects would be needed, extensive, and their success could not be guaranteed.

The following categories were used to evaluate the potential impacts on vegetation:

Negligible: The impact would result in no measurable or perceptible changes in plant community size, integrity or continuity.

Minor: Impacts are measurable or perceptible and localized within a relatively small area. The overall viability of the plant community would not be affected and, if left alone, would recover.

Moderate: Impacts would cause a change in the plant community (e.g. abundance, distribution, quantity, or quality); however, the impact would remain localized.

Major: Impacts on plant communities would be substantial, highly noticeable, and long term.

The following categories were used to evaluate the potential impacts on wildlife:

Negligible: Impacts on wildlife or their habitat would not be measurable or perceptible.

Minor: Impacts on wildlife and habitats would be detectable, although the effects would likely be short-term, localized, and would be of little consequence to the species' population.

Moderate: Impacts on wildlife and habitats would be readily detectable, long-term and localized, with consequences at the population level.

Major: Impacts on wildlife and habitats would be obvious, long-term, and would have substantial consequences on wildlife populations, in the region.

The following categories were used to evaluate the potential impacts on water quantity:

Negligible: Changes in water use would not be measurable.

Minor: Water use would be increased or reduced by up to 25 percent.

Moderate: Water use would be increased or reduced by 26 to 49 percent.

Major: Water use would be increased or reduced by 50 percent or more.

The following categories were used to evaluate the potential impacts on threatened, endangered, or proposed species:

Negligible: The action would result in a change to a population or individuals of a species that would be so small that it would not be of any measurable or perceptible consequence to the population or other changes that would be so small that they would not be measurable or perceptible.

Minor: The action would result in a change to a population or individuals of a species that, if measurable, would be small and localized, or other changes that would be slight but detectable.

Moderate: The action would result in a change to a population or individuals of a species that would be measurable but localized.

Major: The action would result in a change to a population or individuals of a species that would be measurable and have a permanent consequence to the population.

The following categories were used to evaluate the potential impacts on floodplains:

Negligible: Impacts on the ability of the floodplain to function normally would not be measurable or perceptible.

Minor: Impacts on the ability of the floodplain to function normally would be localized and slightly detectable.

Moderate: Impacts on the ability of the floodplain to function normally would be clearly detectable and could have an appreciable effect on natural processes.

Major: Impacts on the ability of the floodplain to function normally would be highly noticeable and would have a substantial influence on natural processes.

The following categories were used to evaluate the potential impacts on wetlands:

Negligible: Impacts on wetlands not be measurable or perceptible.

Minor: Impacts on wetlands would be localized and slightly detectable.

Moderate: Impacts on wetlands would be clearly detectable and could have an appreciable effect on natural processes.

Major: Impacts on wetlands would be highly noticeable and would have a substantial influence on natural processes.

CULTURAL RESOURCES

In this environmental impact statement, impacts on cultural resources (archeological resources, historic structures, the cultural landscape, ethnographic resources, and museum collections) are described in terms of type, context, duration, and intensity, which is consistent with the regulations of the Council on Environmental Quality (CEQ) that implement the National Environmental Policy Act (NEPA). Potential impacts are described in terms of type (are the effects beneficial or adverse?), context (are the effects site-specific, local, or even regional?), duration (are the effects short term, lasting less than one year, or long term, lasting more than one year?), and intensity (are the effects negligible, minor, moderate, or major). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic.

Impacts on Cultural Resources Included in or Eligible for Inclusion in the National Register of Historic Places and Section 106 of the National Historic Preservation Act

These impact analyses are intended, however, to comply with the requirements of both the National Environmental Policy Act and Section 106 of the National Historic Preservation Act (NHPA). In accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106 of the National Historic Preservation Act (36 CFR Part 800, *Protection of Historic Properties*), impacts to cultural resources were identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources in the area of potential effects that were either listed on or eligible to be listed on the National Register of Historic Places; (3) applying the criteria of adverse effect to affected cultural resources either listed on or eligible to be listed on the national register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the Advisory Council's regulations a determination of either *adverse effect* or *no adverse effect* must also be made for affected, national-register-eligible cultural resources. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualify it for inclusion on the national register, e.g., diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects caused by the actions proposed in the alternatives that would occur later in time, be farther in distance, or be cumulative (36 CFR Part 800.5, *Assessment of Adverse Effects*). A determination of *no adverse effect* means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion on the national register.

CEQ regulations and the NPS *Conservation Planning, Environmental Impact Analysis and Decision-making* (Director's Order #12) also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact, e.g., reducing the intensity of an impact from major to moderate or minor. Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under the National Environmental Policy Act only. It does not suggest that the level of effect as defined by Section 106 is similarly reduced. Although adverse effects under Section 106 may be mitigated, the effect remains adverse.

A Section 106 summary is included in the impact analysis sections for those cultural resources that are eligible for the National Register of Historic Places. The Section 106 summary is intended to meet the requirements of Section 106 and is an assessment of the effect of the undertaking (implementation of the alternative) on cultural resources, based upon the criterion of effect and criteria of adverse effect found in the Advisory Council's regulations.

Context. The affected area is the park and Brewster County. Cultural resources impacts should not extend beyond these areas.

Intensity Definitions for the National Environmental Policy Act and Section 106 Analysis of Cultural Resources

Archeological Resources. Certain important research questions about human history can only be answered by the actual physical material of cultural resources. Archeological resources can answer, in whole or in part, such research questions. An archeological site(s) can be eligible for listing on the National Register of Historic Places if the site(s) meets one or more of the following criteria: it is associated with events that have made a significant contribution to the broad patterns of our history; or it is associated with prehistory or with the lives of persons significant in our past, or it embodies the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or it has yielded, or may be likely to yield, information important in prehistory or history. For purposes of analyzing impacts on archeological resources, thresholds of change for the intensity of an impact are based upon the degree to which the site's(s') ability to meet the above criteria would be affected.

Negligible: There are no perceptible consequences to an archeological site's (s') potential to yield important information. For the purpose of Section 106, the determination of effect would be no adverse effect.

Minor: **Adverse impact** – disturbance of a site(s) is confined to a small area with little, if any, loss of important information potential. For the purpose of Section 106, the determination of effect would be no adverse effect. **Beneficial impact** – preservation of a site in its natural state. For the purpose of Section 106, the determination of effect would be no adverse effect.

Moderate: **Adverse impact** – disturbance of a site(s) would not result in a substantial loss of important information For the purpose of Section 106, the determination of effect would be an adverse effect. **Beneficial impact** – stabilization of the site. For the purpose of Section 106, the determination of effect would be no adverse effect.

Major: **Adverse impact** – disturbance of a site(s) is substantial and results in the loss of most or all of the site and its potential to yield important information. For the purpose of Section 106, the determination of effect would be an adverse effect. **Beneficial impact** – active intervention to preserve the site. For the purpose of Section 106, the determination of effect would be no adverse effect.

Historic Structures/Buildings. For a structure or building to be listed on the National Register of Historic Places, it must be associated with an important historic context, i.e., possess significance – the meaning or value ascribed to the structure or building, *and* have integrity of those features necessary to convey its significance, i.e., location, design, setting, workmanship, materials, feeling, and association (see *National Register Bulletin #15*, "How to Apply the National Register Criteria for Evaluation"). To analyze potential impacts on historic structures/ buildings, the thresholds of change for the intensity of an impact are defined as follows:

Negligible: Impact(s) is at the lowest levels of detection – barely perceptible and not measurable. For the purpose of Section 106, the determination of effect would be no adverse effect.

Minor: **Adverse impact** – impact would not affect the character-defining features of a National-Register-of-Historic-Places-eligible or listed structure or building. For purposes of Section 106, the determination of effect would be no adverse effect. **Beneficial impact** – stabilization/preservation of character-defining features in accordance with the *Secretary's of the Interior's Standards for the Treatment of Historic Properties,* to maintain existing integrity of a structure or building. For

the purpose of Section 106, the determination of effect would be no adverse effect.

Moderate: **Adverse impact** – impact would alter a character-defining feature(s) of a structure or building, but would not diminish the integrity of the resource to the extent that its national register eligibility is jeopardized. For purposes of Section 106, the determination of effect would be an adverse effect. **Beneficial impact** – rehabilitation of a structure or building in accordance with the *Secretary's of the Interior's Standards for the Treatment of Historic Properties* to make possible a compatible use of the property while preserving its character-defining features. For the purpose of Section 106, the determination of effect would be no adverse effect.

Major: **Adverse impact** – the impact would alter a character-defining feature(s) of the structure or building, diminishing the integrity of the resource to the extent that it is no longer eligible to be listed on the national register. For the purpose of Section 106, the determination of effect would be an adverse effect. **Beneficial *impact*** –-restoration in accordance with the *Secretary's of the Interior's Standards for the Treatment of Historic Properties* to accurately depict the form, features, and character of a structure or building as it appeared during its period of significance. For the purpose of Section 106, the determination of effect would be no adverse effect.

Cultural Landscapes. Cultural landscapes are the result of the long interaction between people and the land, the influence of human beliefs and actions over time upon the natural landscape. Shaped through time by historical land use and management practices, as well as politics and property laws, levels of technology, and economic conditions, cultural landscapes provide a living record of an area's past, a visual chronicle of its history. The dynamic nature of modern human life, however, contributes to the continual reshaping of cultural landscapes, making these landscapes a good source of information about specific times and places, but at the same time rendering their long-term preservation a challenge.

For a cultural landscape to be listed on the national register, it must possess significance (the meaning or value ascribed to the landscape) *and* have integrity of those features necessary to convey its significance. The character-defining features of a cultural landscape include spatial organization and land patterns; topography; vegetation; circulation patterns; water features; and structures/buildings, site furnishings and objects (see *The Secretary of the Interior's Standards for the Treatment of Historic Properties With Guidelines for the Treatment of Cultural Landscapes* 1996). For purposes of analyzing potential impacts on cultural landscapes, the thresholds of change for the intensity of an impact are defined as follows:

Negligible: Impact(s) is at the lowest levels of detection – barely perceptible and not measurable. For the purpose of Section 106, the determination of effect would be no adverse effect.

Minor: **Adverse impact** – impact would not affect the character-defining features of a National-Register-of-Historic-Places-eligible or listed cultural landscape. For purposes of Section 106, the determination of effect would be no adverse effect. **Beneficial impact** – preservation of character-defining features in accordance with the *Secretary's of the Interior's Standards* to maintain integrity of the cultural landscape. For the purpose of Section 106, the determination of effect would be no adverse effect.

Moderate: **Adverse impact** – impact would alter a character-defining feature(s) of the cultural landscape, but would not diminish the integrity of the landscape to the extent that its national register eligibility is jeopardized. For purposes of Section 106, the determination of effect would be an adverse effect. **Beneficial impact** – rehabilitation of a landscape or its features in accordance with the *Secretary's of the Interior's Standards* to make possible a compatible use of the landscape while preserving its character-defining features. For the purpose of Section 106, the determination of effect would be no adverse effect.

Major: **Adverse impact** – impact would alter a character-defining feature(s) of the cultural landscape, diminishing the integrity of the resource to the extent that it is no longer eligible to be listed on the national register. For the purpose of Section 106, the determination of effect would be an adverse effect. **Beneficial impact** – restoration in accordance with the *Secretary's of the Interior's Standards* to accurately depict the features and character of a landscape as it appeared during its period of significance. For the purpose of Section 106, the determination of effect would be no adverse effect.

Ethnographic Resources. Certain important questions about human culture and history can only be answered by gathering information about the cultural material of cultural resources. Ethnographic resources have the potential to address questions about contemporary peoples or groups, their identify, and heritage. To those for whom the resources hold cultural meaning, the ethnographic link is vested in specific places of traditional use. Ethnographic resources can be eligible for inclusion on the National Register of Historic Places if they meet national register criteria for traditional cultural properties. For purposes of analyzing potential impacts on ethnographic resources, the thresholds of change for the intensity of an impact are defined below.

Negligible: Impact(s) would be barely perceptible and would neither alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. There would be no change to a group's body of beliefs and practices. For the purpose of Section 106, the determination of effect on traditional cultural properties would be no adverse effect.

Minor: **Adverse impacts** – impact(s) would be slight but noticeable, and would neither alter the resource condition, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. **Beneficial impact** – would allow traditional access and/or facilitate a group's traditional practices or beliefs. For the purpose of Section 106, the determination of effect on traditional cultural properties would be no adverse effect.

Moderate: **Adverse impact** – impact(s) would be apparent and would alter resource conditions, such as traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices, but the group's belief and/or practices would survive. For the purpose of Section 106, the determination of effect on traditional cultural properties would be an adverse effect. **Beneficial impact** – would facilitate a group's beliefs and practices. For the purpose of Section 106, the determination of effect on traditional cultural properties would be no adverse effect.

Major: **Adverse impact** – impact(s) would alter resource conditions, such as traditional access, site preservation, or the relationship between the resource and the affiliated group's body of beliefs and practices, to the extent that the survival of a group's beliefs and/or practices would be jeopardized. For the purpose of Section 106, the determination of effect on traditional cultural properties would be an adverse effect. **Beneficial impact** – would encourage a group's beliefs or practices. For the purpose of Section 106, the determination of effect on traditional cultural properties would be no adverse effect.

Museum Collections. Museum collections (historic artifacts, natural specimens, and archival and manuscript material) may be threatened by fire, theft, vandalism, natural disasters, and careless acts. The preservation of museum collections is an ongoing process of preventative conservation, supplemented by conservation treatment when necessary. The primary goal is preservation of artifacts in as stable condition as possible to prevent damage and minimize deterioration. A beneficial impact would result in greater access, preservation, and protection of the park's collections. An adverse impact would result in less access, preservation, and protection of the park's collections. For purposes of analyzing potential impacts, the thresholds of change for the intensity of an impact are defined as follows:

Negligible: the impact is at the lowest levels of detection – barely perceptible and not measurable.

Minor: the impact is measurable and perceptible but affects only a few artifacts in the museum collection.

Moderate: the impact is measurable and perceptible and affects many artifacts in the museum collection.

Major: the impact is measurable and perceptible and affects the majority of artifacts in the museum collection.

VISITOR EXPERIENCE

The discussions of the visitor experience in this document cover the effects on: visitors' ability to experience the park's primary resources and their natural and cultural settings (including vistas, natural sounds and smells, and wildlife); overall visitor access to the park; and the freedom to experience the resources at one's own pace. Also discussed is visitor access to appropriate orientation and interpretive information and the effects of proposed actions on visitor safety.

Information gathered in a 1992 visitor survey was used, along with public input during the planning process, to evaluate the potential impacts of implementing each alternative on visitors.

Visitors have expressed interest in learning more about the park's natural and cultural resources and to park facilities and accommodations. Concern was also expressed regarding the need for greater interaction and partnership with Mexican neighbors.

Consultation with American Indian groups has revealed that these groups are concerned not only about the preservation of cultural resources and properties, but also about the need to interpret the Big Bend area from American Indian perspectives.

For analysis purposes, impact intensities for visitor experience impact topics have been defined as follows:

Negligible: The impact would be barely detectable, would not occur in primary resource areas, or would affect few visitors.

Minor: The impact would be slight but detectable, would not occur in primary resource areas, or would affect few visitors.

Moderate: The impact would be readily apparent, would occur in primary resource areas, or would affect many visitors.

Major: The effect would be severely adverse or exceptionally beneficial, would occur in primary resource areas, or would affect the majority of visitors.

SOCIOECONOMIC ENVIRONMENT

Socioeconomic impacts take place both over the short and long term. For purposes of this analysis, short-term impacts would take place during the construction phases for the expanded facilities and system upgrades considered under alternatives B and C – about one to two years. Long-term benefits would start after construction is completed and continue indefinitely, or until conditions in the park are changed.

Socioeconomic impacts vary in intensity, and the degree of impact is directly related to its context – the economic activity in the surrounding area. In this analysis, intensity is defined as:

Negligible: Economic and socioeconomic conditions would not be affected or the effects would not be measurable.

Minor: The effects on economic and socioeconomic conditions would be small but measurable and would affect a small proportion of the population, with few effects discernible outside Brewster and Presidio Counties.

Moderate: The effects on economic and socioeconomic conditions would be readily

apparent and widespread in the vicinity of Brewster and Presidio Counties.

Major: The effects on economic and socioeconomic conditions would be readily apparent and would substantially change the economic or social services within Brewster and Presidio Counties.

The socioeconomic impact data presented in the following analysis have been rounded to the nearest $100,000 for sales and tax revenues, and to the nearest 10 jobs for estimates of job creation.

IMPACTS OF IMPLEMENTING ALTERNATIVE A (NO ACTION)

NATURAL RESOURCES

Soil

There would be soil disturbance caused by ongoing maintenance such as road grading, revegetation, restoration, repair of buildings, upgrading a water system, and removing or protecting fuel storage tanks at the gas station and maintenance area at Rio Grande Village from the 500-year flood. These actions would be restricted to the minimum area required for rehabilitation. All the areas that would be affected have been previously disturbed. Sites with soil disturbance would undergo accelerated wind and water erosion, at least temporarily, until drainage structures were fully operational and vegetation had recovered in cleared areas. To conserve available organic matter, topsoil, where present, would be retained and replaced. (Soils at Big Bend have virtually no topsoil.) The work, occurring in disturbed areas, would result in minor adverse long-term impacts on soils.

Foot traffic would continue to compact soils, decrease permeability, alter soil moisture, and diminish water storage capacity, increasing erosion and changes in the natural composition of vegetation. Altered vegetative composition would create changes in soil chemistry. To minimize the soil erosion created by this activity, most visitor developments have been constructed where the slopes are less than 15%. Where heavy foot traffic was expected, trails have been paved and visitors are encouraged to stay on maintained trails. Trail rehabilitation would include special design methods in areas where the slope is high and soils are easily eroded by wind and water. These impacts have already occurred to some degree because all the areas involved have been disturbed; consequently, soil erosion by wind and water, and soil nutrient transport, would be minor, long-term adverse impacts.

Under the no-action alternative, about 1,341 acres of the 801,000 in the park would continue to be occupied by development. The soil survey for the park shows varying suitability for development. In areas that would be impacted by actions of any alternative, erosion hazard varies from slight to severe. Development has wholly or partially eliminated the direct inflow of water and diverted precipitation from some natural drainages. Soils have been compacted by foot traffic. Management actions such as visitor education on the impacts of off-trail use, site hardening/trail paving, placement of fences to direct visitor use, designated trails and campsites, and restoration of impacted sites as funding becomes available would assist in minimizing these adverse impacts. Most of these impacts have already occurred in the developed areas; consequently impacts such as eliminating inflow of water, diverting precipitation from natural drainages, and soil compaction would be minor long term and adverse.

Soils at Chisos Basin, Panther Junction, Rio Grande Village, Castolon, and Cottonwood Campground have moderate or severe limitations for the kinds of actions that might occur under this alternative. Further geotechnical investigation would be required to evaluate suitability and needed mitigation before designing the kinds of facilities listed. Tables in appendix H show, for each developed area, specific limitations of soil map units for actions of any alternative.

Cumulative Effect. Agriculture, including dryland farming and ranching, have led to the erosion of soils by removing native vegetation and replacing it with plants not necessarily suited to the desert environment. This, along with tilling the soil, has left soils exposed to erosion by wind and water.

The development of some private lands such as those in gateway communities west of the park or on state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses, and the construction of five structures in the park could increase runoff, wind erosion, and soil compaction and alter soil regimes.

If efforts to restore soils and natural hydrology at North Rosillos/Harte Ranch are successful, there would be long-term beneficial impacts on soils there. The intensity of the impact is uncertain because the size of the area that would be successfully restored is not known. If funding continues, the project would likely have major beneficial impacts on soils.

Impacts on soils from agriculture and ranching covered wide areas and were adverse. Impacts on soils of current and anticipated future actions inside and outside the park, in conjunction with the impacts of alternative A would be major and adverse because they would probably cover more than 20 acres. Most of the impacts would be the result of development outside the park that may or may not be mitigated. The actions of alternative A and ongoing restoration at North Rosillos/Harte Ranch would contribute a very small increment to the overall cumulative impact.

Conclusion. Soil disturbance from ongoing maintenance, repair of buildings, upgrading one water system, and removing or protecting fuel storage tanks from the 500-year flood would be minor, adverse, and long term. Soil erosion by wind and water, and soil nutrient transport from foot traffic would be minor, long term, and adverse.

Impacts of development such as eliminating inflow of water, diverting precipitation from natural drainages, and compaction would be long term, adverse, and minor.

The park's soil resources would not be impaired by actions proposed under this alternative.

Vegetation

Disturbance of vegetation would result from ongoing maintenance such as road grading, revegetation, upgrading the water system, building two new buildings at Panther Junction, and relocating campsites at Rio Grande Village. Raising fuel tanks above the 500-year floodplain would not be expected to impact vegetation. Because most of these activities would occur over small areas that have been previously disturbed, this would be a negligible long-term adverse impact.

Clearing some vegetation could increase the relative abundance of plant species that invade disturbed areas. Some of these could be exotics. Increased erosion at these areas could expose root systems and lead to the subsequent death of more mesic plants (those needing a moderate amount of water). Because clearing would occur over small areas that have already been disturbed, this would be a minor long-term adverse impact.

The irrigation of shade trees and lawns at the campgrounds at Rio Grande Village and Cottonwood would continue to cause the growth of unnaturally lush vegetation and allow exotic species to flourish. This is an ongoing, moderate, long-term adverse impact.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert plants. Plants have been affected by being displaced, and habitat has been lost through agricultural uses and introduction of nonnative plants.

The development of some private lands such as those in gateway communities west of the park or on state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses, and the construction of five structures in the park could increase runoff, wind erosion, and soil compaction and alter soil regimes.

If restoration efforts at North Rosillos/Harte Ranch are successful, there would be long-term beneficial impacts on soils and hydrology, which in turn would allow restoration of native plants.

Impacts of agriculture and ranching on vegetation covered wide areas and were adverse. Impacts of current and anticipated future actions outside the park, in conjunction with the impacts of alternative A would result in moderate, long-term adverse impacts on vegetation. Most of the impacts would be the result of development outside the park that might or might not be mitigated. The actions of alternative A and ongoing restoration at North

Rosillos/Harte Ranch would contribute a very small increment to the overall cumulative impact.

Conclusion. Maintenance and ongoing visitor use would affect vegetation by leading to changes in the relative abundance of species, the death of some plants from the exposure of root systems, the trampling and death of some plants, and the resultant changes in species composition. These would be negligible to minor long-term adverse effects. The irrigation of shade trees and lawns at the campgrounds at Rio Grande Village and Cottonwood would continue to cause the growth of unnaturally lush vegetation and allow exotic species to flourish, an ongoing, moderate, long-term adverse impact.

The park's vegetation resources would not be impaired by the actions proposed in this alternative.

Wildlife

Alternative A would result in wildlife disturbance caused by ongoing maintenance such as road grading, revegetation and restoration; and upgrading the water system at Castolon. Wildlife would probably not be disturbed by removing fuel tanks from the 500-year floodplain, but methods of protecting the tanks in place could displace wildlife.

There would be no change in the amount of wildlife habitat in the park under alternative 1. Development would continue to occupy less than 1% of the 801,000+ acres in the park.

Wildlife habitat would continue to be fragmented by roads, trails, and facilities, and wildlife habits and movement would continue to be altered by employees and visitors. People still would concentrate at Chisos Basin, Panther Junction, Rio Grande Village, Castolon, and Cottonwood Campground, disturbing wildlife and degrading habitat. These intermittent adverse impacts would be minor and long term.

Visitors to less-used sites, such as the North Rosillos/Harte Ranch area, Dugout Wells, and backcountry camping areas, would continue to cause intermittent minor disruption of wildlife. This intermittent adverse impact would be negligible and long term.

Vehicle traffic would continue to cause a relatively low incidence of collisions with wildlife – a negligible, intermittent, adverse impact.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert animals. Animals have been affected by being displaced and killed as vermin, and habitat has been lost through agricultural uses and introduction of nonnative animals. Wildlife continues to be disrupted by development and human activity.

The development of some private lands such as those in gateway communities west of the park or on state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses, and the construction of five structures in the park, could alter wildlife habitat and habits and cause loss of wildlife in some areas. Water use of these developments or for tourist-related or other uses could reduce water available for wildlife. Road kill of rodents, larger mammals, and birds would increase because more development probably would increase traffic.

The past impacts of agriculture and ranching on wildlife covered wide areas and were adverse. Past and continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on wildlife. Impacts on wildlife of current and anticipated future actions outside the park, in conjunction with the impacts of alternative A and restoration at North Rosillos/Harte Ranch would be moderate, long term, and adverse. Most of the impacts would be the result of development actions outside the park that might or might not be mitigated. The actions of alternative A would contribute a very small increment to the overall cumulative impact.

Conclusion. Overall, the fragmentation of wildlife habitat, the alteration of wildlife movement, and vehicular collisions with wildlife from

this alternative would continue to have a long-term minor adverse impact.

The park's wildlife resources would not be impaired by the actions proposed under this alternative.

Water Quantity

Chisos Basin/Oak Spring. The development at Chisos Basin would continue to use nearly all the water from Oak Spring at certain times of the year. Impacts are particularly noticeable when periods of heavy use are combined with prolonged drought. The Chisos Basin development used 4,015,400 gallons of water in 2001. This is a moderate, intermittent, long-term adverse impact on the water quantity at Oak Spring and the plants and animals that would otherwise use the water.

The Rio Grande. The park would continue to irrigate Rio Grande Village and the Cottonwood Campground using river water (25.6 million gallons per month would continue to be used at Rio Grande Village and 125,000 gallons per month at Cottonwood Campground). Because park use would continue to be small compared to the flow in the river, this would be a minor, long-term, adverse impact.

At Castolon, use of irrigation water would continue to be about 125,000 gallons per month.

Cumulative Effects. The presence of dams upstream and continued heavy use of the river would result in major long-term reductions in water quantity in the park and upstream and downstream of the park.

Agriculture, including dryland farming and ranching, and urban development have increased to the point that water in the Rio Grande water shed is overcommitted.

The development of some private lands, such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area, for residential, tourist-related, or other uses or construction of five structures in the park would increase ground or surface water use and decrease water availability for other uses in an area where water is already scarce. The exact impact of increased residential or tourist development in gateway communities west of the park, if any, is not known.

Past impacts of use of the Rio Grande for agriculture, ranching, and water supply were, and continue to be, major and adverse. Impacts on water quantity in the Rio Grande of current and anticipated future actions outside the park, in conjunction with the impacts of alternative A and restoration at North Rosillos/Harte Ranch are anticipated to be long term and adverse. Intensity of this impact is not known because it is not clear how increased development in the gateway communities west of the park and the state-managed areas would impact the Rio Grande or what the amount of any increased use would be. The actions of alternative A would contribute a very small increment to the overall cumulative impact.

There would be no cumulative impacts on water quantity in Oak Spring because the spring originates in the Chisos Mountains within the park.

Conclusion. Continued use of nearly all the water at Oak Spring for human use at Chisos Basin at certain times of the year would be a moderate, intermittent, long-term, adverse impact. Overall, impacts on the quantity of water in the Rio Grande would be minor, long term, and adverse.

The resources and values of Big Bend National Park would not be impaired because there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, water quantity would not be impaired as a result of implementing actions in alternative A.

Threatened, Endangered, and Candidate Species

Black-capped vireo (endangered). The Chisos Basin, including the road corridor leading into it, is a very important part of this bird's habitat. Reasons for the bird's decline are habitat loss to urbanization, browsing by herbivores, brush clearing, natural succession, brown-headed cowbird brood parasitism, and human disturbance. The development in the Chisos Basin would remain in this alternative. Clearing of the road edges, browsing by herbivores, and human disturbance would continue. Impacts of these actions have probably already occurred and have been localized. The continuation of current trends would be a negligible long-term adverse impact.

Big Bend gambusia (endangered). This fish is found in the wild only at Rio Grande Village. It is threatened by habitat alteration, ground-water pumping, declining spring flows, and competition with introduced nonnative species. The spring that feeds the pond at Rio Grande Village where Big Bend gambusia live is also used for human consumption. In alternative A, to eliminate the competition for water, a separate source of water would be found for human use.

Relocating the campsites that are close to the pond would likely result in eliminating this source of impacts on the Big Bend gambusia. How these changes would impact the fish are not known. It is hoped that the improvements in its habitat would result in minor to moderate, long-term beneficial impacts.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert plants and animals including threatened and endangered species. The black-capped vireo has lost habitat to browsing by herbivores, brush-clearing, and human disturbance and urbanization. The Big Bend gambusia has lost habitat to habitat alteration, groundwater pumping, decreasing spring flows, and competition with introduced nonnative species such as the western mosquito fish.

The development of some private lands, such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area, for residential, tourist-related, or other uses and the construction of five structures in the park could impact black-capped vireo habitat or alter suitable habitat for Big Bend gambusia. Water use for the developments or for activities not requiring development could reduce water available for habitat for these species in an area where water is already scarce.

Past impacts on threatened and endangered species from agriculture, including dryland farming and ranching, dam building, urbanization, and over use of water from the Rio Grande have been major and adverse. Impacts on threatened and endangered species from current and anticipated future actions outside the park, in conjunction with the impacts of alternative A and restoration at Harte Ranch, are not known because the locations of species outside the park in areas that might be impacted are not known. Given the lack of information regarding impacts outside the park, it is not possible to assess the relative size of the impacts of alternative A compared to current and anticipated future actions outside the park.

Conclusion. Overall, the continued presence of development in the Chisos Basin, continued clearing of the road edges, browsing by herbivores, and human disturbance would have a negligible, long-term adverse impact on the black-capped vireo. Improving Big Bend gambusia habitat by eliminating competition for spring water and relocating campsites would have a minor to moderate long-term beneficial impact on the fish.

The park's threatened and endangered species would not be impaired by actions proposed under this alternative.

Floodplains

Natural and Beneficial Floodplain Values. The natural and beneficial values of floodplains would continue to be compromised by the presence of the 100-site campground at Rio

Grande Village, the 35-site campground at Cottonwood, and all the development at Panther Junction. Protecting fuel storage tanks at Rio Grande Village from the 500-year flood would reduce the risk of fuel spilling into floodwaters. However, the continuing adverse impact on natural processes would be moderate and long term.

Flooding. A flood hazard reconnaissance (NPS: 1991) stated that, "Because flooding occurs only in extremely large and rare events, and flood flow velocities are very small, the possibility that visitors could be injured or lose their lives in a flood at Rio Grande Village or Cottonwood Campground is very small." Under the no-action alternative the campground and all development at Rio Grande Village and the campground at Cottonwood would continue to occupy part of the 100-year floodplain. Even though early warning and evacuation plans would be developed, communications might not always be fully comprehended or acted upon. Although the possibility of loss of life is very small, campers, other visitors, and employees would remain in some danger. Severe flooding has been infrequent, and risks are minor to moderate, but the results of flooding could cause major adverse impacts on the visitors and employees involved.

The entire development at Panther Junction, located on a bajada or area of converging alluvial fans, is subject to flash flooding and debris flows and is geomorphologically unstable. In ideal circumstances, development at Panther Junction would be located outside the maximum estimated flood (Q_{me}) (see appendix F). Under alternative A, the fire management building would be constructed in a less dangerous portion of the flood-prone area.

According to "Estimation of Flood and Geomorphic Hazard in the Panther Canyon Area of Big Bend National Park, Texas" (NPS: 1995), all of the structures at Panther Junction are at "some risk." However, the report also seems to indicate that the risk is not great. Nevertheless, because the long period between events leads to a false sense of security and warning time would be short, there is the possibility of human injury or loss of life in the event of a large flood. Even though the report finds that the risk is not great, flooding at Panther Junction could have major adverse impacts on the visitors and employees involved.

In the event of a 500-year or maximum estimated flood (Q_{me}), up to 60 % of the parks museum collection, stored at Panther Junction, could be damaged or destroyed. This would be a major long-term adverse impact on the collection.

In addition, a large investment in infrastructure (including the visitor center, the park headquarters, school, and 76 housing units) could be lost if the 500-year or maximum estimated flood (Q_{me}) occurs at Panther Junction. Even though the risk of this event occurring is not great, loss of infrastructure from flooding at Panther Junction could have a major, long-term adverse impact on NPS operations and could require the park staff to find temporary offices and housing outside the park.

Cumulative Effects. The construction of dams upstream of the park and the heavy use of the Rio Grande upstream have greatly reduced the extent of the floodplain and the natural and beneficial values of floodplains in the park.

Cattle and sheep probably have been allowed to use some riparian areas in and near the park. This practice degrades natural and beneficial floodplain values in exchange for benefits to agricultural uses. NPS structures and visitor uses in floodplain areas contribute to the loss of natural and beneficial values.

The presence of dams upstream and heavy use of the river would continue to result in major long-term reductions in area and in beneficial values in floodplains in the park and upstream and downstream of the park.

Further development in floodplains and wetlands outside the park for residential, agricultural, or commercial uses would decrease the area in which natural and beneficial floodplain values would be preserved.

Even though the natural resources and collections management building would be constructed in a less flood-prone area (less likely

to be inundated by smaller floods), and the likelihood of them being damaged in smaller floods would be reduced, they would still be within the maximum estimated flood area at Panther Junction. If the maximum estimated flood occurs, the 60% of the park's museum collection that is stored at Panther Junction could be damaged or destroyed. This would be a major long-term adverse impact on the collection.

Under this alternative the natural and beneficial values of floodplain areas would continue to be compromised by development at Rio Grande Village, Cottonwood, and Panther Junction (including a new natural resources and collections management building at Panther Junction).

The past impacts of agriculture, ranching, urbanization, and dam construction on floodplains covered wide areas and were adverse. Continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on floodplains. Impacts on floodplains of current and anticipated future actions inside and outside the park, in conjunction with the impacts of alternative A and restoration at North Rosillos/ Harte Ranch would be moderate, long term, and adverse. Most of the impacts would be the result of development actions outside the park that might or might not be mitigated. The actions of alternative A would contribute a very small increment to the overall cumulative impact.

Conclusion. The natural and beneficial values of floodplain areas would continue to be compromised by the presence of campgrounds at Rio Grande Village and Cottonwood, other development at Rio Grande Village, and the development in the flash flood hazard area at Panther Junction. This continuing long-term adverse impact on natural processes would be moderate.

Although severe flooding has been infrequent and risks are minor to moderate, flooding at Rio Grande Village, Cottonwood Campground, or Panther Junction could result in major adverse impacts on the visitors or employees involved. Even though the risk of flooding is not great at Panther Junction, damage or loss of 60% of the museum collection would be a major, long-term adverse impact on the collection, and loss of infrastructure would be a major, long-term adverse impact on operations. Loss of infrastructure could require the park to find temporary offices and housing outside the park.

The resources and values of Big Bend National Park would not be impaired because there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, no floodplain resources would be impaired as a result of implementing alternative A.

Wetlands

In the no-action alternative all the water from Oak Spring would continue to be diverted for human use at Chisos Basin at certain times of the year. This deprives associated wetlands of water. At Rio Grande Village and Cottonwood Campground, riparian vegetation has been eliminated from some high visitation areas and would not be allowed to recover in this alternative. The natural functioning of these wetlands would continue to be compromised by visitor use and irrigation. Because changes in the areas involved would be clearly detectable and have an appreciable effect on natural processes, this continuing adverse impact on wetlands would be long term and moderate.

Cumulative Effects. Some wetlands within and outside the park, especially along the Rio Grande, have been filled to make more land available for growing crops. Cattle and sheep probably have been allowed to use some wetland and riparian areas in and near the park. These practices decrease wetland areas and degrade natural and beneficial wetland values in exchange for benefit to agricultural uses. NPS structures and visitor uses in wetland areas

contribute to the loss of natural and beneficial values.

The presence of dams upstream and continued heavy use of the river would continue to result in major long-term reductions in wetland area and in beneficial values of wetlands in the park and upstream and downstream of the park. Further development in wetlands outside the park for residential, agricultural, or commercial uses would decrease the area in which natural and beneficial wetland values would be preserved.

The past impacts of agriculture, ranching, urbanization, and dam construction on wetlands covered wide areas and were major and adverse. Continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on wetlands. Impacts on wetlands of current and anticipated future actions outside the park, in conjunction with the impacts of alternative A and restoration at North Rosillos/ Harte Ranch, would be moderate, long term, and adverse. Most of the impacts would be the result of development actions outside the park that might or might not be mitigated. The actions of alternative A would contribute a very small increment to the overall cumulative impact.

Conclusion. Maintaining use of nearly all the water from Oak Spring during certain times of the year, continuing use of the campgrounds at Rio Grande Village and Cottonwood, continuing use of other development at Rio Grande Village, and irrigation at both campgrounds would continue a moderate long-term adverse effect on wetlands.

The resources and values of Big Bend National Park would not be impaired because there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, no wetland resources would be impaired as a result of implementing alternative A.

CULTURAL RESOURCES

Archeological Resources

Analysis. Archeological resources have been identified in the Panther Junction development areas. There is the potential for more archeological sites to found in areas scheduled for development. New structures to house the resource management staff and collections, and for fire management purposes are planned, and also a few temporary housing and storage units would be placed in the Panther Junction area. The construction of these facilities would avoid archeological resources to the greatest extent possible. The construction of the fire and resource management facility would require excavation of an archeological site. This would result in a long-term, moderate, adverse effect on the site.

At Chisos Basin, an addition is being made to the main lodge building in an area that contains no archeological resources; the result of this action would be no or negligible adverse impacts on archeological resources.

Continuing survey work to identify the park's archeological resources and preserving archeological resources as time and funding permit would have a long-term minor to moderate beneficial impact on archeological resources.

Cumulative Effects. Archeological resources at Big Bend National Park are subject to damage from development, vandalism, illegal activities, and natural processes. Past development in the Rio Grande Village area, Castolon area, Chisos Basin, and Panther Junction has resulted in the loss of some archeological resources during excavation and construction activities. Many of the reasonably foreseeable future actions, such as construction of new employee housing and administrative, maintenance, and storage facilities could disturb archeological resources. If significant archeological resources could not be avoided, the data they possess regarding prehistoric and/or historic lifeways would be documented and recovered in accordance with the *Secretary of the Interior's Standards and Guidelines for Archeology and Historic*

Preservation (36 CFR part 800) and other archeological technical guidance. The minor to moderate beneficial impacts of this alternative, in conjunction with the adverse impacts of other reasonably foreseeable future actions, would result in negligible to minor adverse impacts on archeological resources, depending upon the significance of the site. However, the adverse impacts of the alternative would be a relatively minor component of the overall cumulative impact due to the limited scope of the action.

The Black Gap Wildlife Management Area and Big Bend Ranch State Park, along with Big Bend National Park, are required to identify and preserve archeological sites. This would result in better management and protection of these resources. In the past, archeological sites have been subject to vandalism and loss due to lack of identification and protective measures. These actions, added to NPS actions, could possibly have a long-term, negligible to minor, beneficial impact on archeological resources.

Conclusion. There would be long-term, moderate, adverse impacts from construction at Panther Junction. There would be no or negligible effects on archeological resources from the addition to the lodge in Chisos Basin. The ongoing efforts to identify and protect archeological resources would have a long-term minor to moderate beneficial impact on archeological resources; limited staff and funding for such work would keep these impacts at minor to moderate levels.

The resources and values of Big Bend National Park would not be impaired because there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, no archeological resources would be impaired as a result of implementing alternative A.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the survey work and continuing preservation work at the park under alternative A would have an effect that would not be adverse.

Historic Structures/Buildings

Analysis. The park's goal is to increase the number of structures on the List of Classified Structures (currently 69) in good condition (currently 38%) to 50% of those listed. This action would result in a long-term, minor, beneficial impact. In addition, the park is revising the list, which could result in the evaluation and possible listing of more park structures. This would result in a long-term, negligible, beneficial impact for additional structures listed because treatment would be identified for these structures.

All national register structures receive preservation treatment as staff time and funding permit. This is a long-term, negligible to minor beneficial impact on these structures.

The upgraded fire suppression and water systems at Castolon would improve the protection and preservation of the historic district. This would be a long-term, minor to moderate beneficial impact for this historic district.

Cumulative Effects. Historic structures/buildings at Big Bend National Park are subject to damage from development, vandalism, illegal activities, and natural processes. Past development in the Rio Grande Village area, Castolon area, Chisos Basin, and Panther Junction has resulted in the loss of some structural resources during construction activities as well as the removal of some structures for visitor safety and other park purposes. The reasonably foreseeable future actions, such as construction of new employee housing and administrative, maintenance, and storage facilities would not impact historic structures/buildings. The negligible to minor beneficial impacts of this alternative, in conjunction with the lack of adverse impacts of other reasonably foreseeable future actions, would result in negligible to minor beneficial

impacts on historic structures/buildings. However, the beneficial impacts would be a relatively minor component of the overall cumulative impact due to the limited scope of the action.

The Black Gap Wildlife Management Area and Big Bend Ranch State Park are required to identify and preserve historical structures. Before the passage of the 1966 Historic Preservation Act, the park removed structures on parklands that may have been eligible for listing on the National Register of Historic Places. Since the enactment of the 1966 Historic Preservation Act, the park has evaluated and preserved these structures in parklands. The park's actions of identification, evaluation, and preservation added to those of the state parks could result in long-term negligible beneficial effects on the area's historic structures.

Conclusion. Research and resource documentation is improving the park's ability to make informed management decisions. The ongoing efforts to identify and preserve structures coupled with the park's efforts to improve structures so that more structures are in good condition would benefit these resources. The overall result would be a long-term negligible to minor beneficial effect on the park's historic structures. The upgraded fire suppression and water systems at Castolon would have a long-term, minor to moderate beneficial impact on these structures.

The park's historical structures/buildings would not be impaired by actions proposed under this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the survey work and continuing preservation work at the park under alternative A would have an effect that would not be adverse.

Cultural Landscapes

Analysis. No cultural landscapes have been have been officially designated, but a Level 0 reconnaissance survey has identified a number of potential cultural landscapes. Park maintenance and development actions prior to the upcoming Level 2 inventory, to establish the character-defining landscape features and evaluate potential landscapes for eligibility to the National Register of Historic Places, might impact character-defining features of these cultural landscapes. This could result in a long-term, moderate, adverse impact on the park's cultural landscapes. The identification of cultural landscapes would also give them official recognition and allow management to develop a strategy for their preservation and treatment. This would have a long-term, minor to moderate beneficial impact.

Cumulative Effects. The Black Gap Wildlife Management Area and Big Bend Ranch State Park are required as part of the state's compliance with the National Historic Preservation Act to identify and preserve cultural landscapes. In the past, cultural landscapes in the area have been adversely affected due to lack of identification and evaluation of character-defining features. This resulted in long-term, moderate to major, adverse impacts on cultural landscapes. This problem is gradually lessening as the various agencies develop inventories and preservation strategies for cultural landscapes. The park's actions added to those of the state parks could result in long-term, minor, beneficial effects on the area's cultural landscapes.

Conclusion. Research and resource documentation is improving the park's ability to make informed management decisions. The ongoing efforts to identify and evaluate landscapes would result in actions to preserve these landscapes. The overall result would be a long-term, minor, beneficial effect on the park's cultural landscapes.

The park's cultural landscapes would not be impaired by actions proposed under this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the survey work and continuing preserva-

tion work at the park under alternative A would have an effect that would not be adverse.

Ethnographic Resources

Analysis. Consultation with Comanche, Cheyenne, and Blackfeet tribal representatives on one site in the park could increase access for the tribes to additional sites that are important to these tribes. This would have a long-term minor beneficial effect. Efforts to update park interpretation to better provide Indian and Hispanic viewpoints of the park and its resources would increase visitor and staff understanding of these viewpoints. Work with the two Mexican protected areas and villages on the park's boundaries to identify ethnographic resources in the park, develop an understanding of the needs of these communities, and develop strategies (that are compatible with the park's mission) to meet those needs would have negligible to moderate beneficial impacts.

Cumulative Effects. Ethnographic resources at Big Bend National Park are subject to damage from development, vandalism, illegal activities, and natural processes. Past development in the Rio Grande Village area, Castolon area, Chisos Basin, and Panther Junction has resulted in the loss of some ethnographic resources during excavation and construction activities. Many of the reasonably foreseeable future actions, such as the construction of new employee housing and administrative, maintenance, and storage facilities, could disturb ethnographic resources. The negligible to minor beneficial impacts of this alternative, in conjunction with the adverse impacts of other reasonably foreseeable future actions, would result in negligible to minor adverse impacts on historic structures/buildings depending upon the significance of the site. However, the adverse impacts would be a relatively minor component of the overall cumulative impact, due to the limited scope of the action.

The Black Gap Wildlife Management Area and Big Bend Ranch State Park have neither inventories nor evaluations of ethnographic resources in their parks. In the past, Big Bend National Park did not take into consideration the needs of Hispanic or other groups, but the park staff is constructively working on problems of mutual concern. The park's actions added to those of the state parks could result in long-term, negligible to minor, beneficial impacts on the area's ethnographic resources.

Conclusion. Research and resource documentation is improving the park's ability to make informed management decisions. The ongoing efforts to identify and to evaluate ethnographic resources and park programs to meet the needs of various groups would result in actions to preserve these resources. The overall result would be a long-term, negligible to moderate, beneficial effect on the park's ethnographic resources.

The park's ethnographic resources would not be impaired by actions proposed under this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the survey work and continuing programmatic work under alternative A would have an effect that would not be adverse.

Museum Collections

Analysis. Continued work on reducing the backlog of uncatalogued collections materials would be a long-term minor to moderate beneficial impact on the park's collections.

Continued use of the display cases at Panther Junction, with their lack of adequate environmental control system and location in the lobby area that is subject to ambient light and fluctuations in temperature and humidity, would be an adverse long-term impact of minor intensity (because of the small number of artifacts being affected).

The visitor contact stations at Persimmon Gap, Rio Grande Village, and Chisos Basin also lack environmental control systems. However, the very limited amount of display materials at these

locations results in a long-term, negligible to minor, adverse impact.

Cumulative Effects. Collections at Big Bend National Park are subject to damage and deterioration from vandalism, illegal activities, natural processes, and lack of storage facilities with adequate environmental controls and security. Past lack of adequate care and facilities has resulted in the loss of some collection materials. Many of the reasonably foreseeable future actions, such as the construction of a new building at Panther Junction for natural resources and collections management to provide additional space for park collections (currently housed inside and outside the park) would result in better care of the collections. The negligible to minor beneficial impacts of this alternative, in conjunction with the minor beneficial impact of other reasonably foreseeable future actions, would result in minor beneficial impacts on collections. However, this impact would be a relatively minor component of the overall cumulative impact due to the limited scope of the action.

The two Texas state parks and Sul Ross State University would continue to preserve and interpret cultural resources. This work could result in increased collection materials available to the public and researchers. This would be a long-term, minor to moderate beneficial effect. These actions, added to the limited ability of the park to care for collections, could result in long-term minor to moderate adverse impacts on collections in the region.

Conclusion. Alternative A would result in only slight improvement in the condition and care of park collections. A new natural resources and collections management building to be constructed at Panther Junction (described in the cumulative impact scenario) that would better protect and preserve the collections would be offset by the limited ability to display, curate, and access the collections. This alternative would result in a long-term, minor, beneficial impact on park collections.

The park's collections would not be impaired by actions proposed under this alternative.

VISITOR UNDERSTANDING

Visitors' Experiences of Park Resources

The visitor experience of Chisos Basin would continue to be degraded by congestion and noise during peak use times. The long-term impact would be major because most visitors would be affected and because Chisos Basin is a primary resource area. Fewer visitors would be affected in nonpeak times, so at those times the impacts would be long term and moderate.

Park visitors can stop at many sites throughout the park to see resources and hike/walk trails to interact with park resources. This interaction is considered an important element of most visitors' experiences; therefore, continuing to provide these opportunities would result in a continued long-term major beneficial effect for most visitors.

Camping, lodging, and picnicking facilities are important to many visitors. These valuable activities would continue to have a long-term moderate beneficial effect on visitors' experiences.

Lights at night from developments associated with the campgrounds, lodge, visitor centers, and park housing are visible from areas within the park. These visual intrusions degrade the natural setting. However, under the no-action alternative, these long-term adverse visual impacts would be minor because the developments are low key. Nonetheless, lights at night would continue to disrupt the experiences for small numbers of visitors.

The park offers many opportunities for quiet and solitude in natural and cultural settings. Although many areas are not heavily visited, these kinds of experiences are important to the visitors who go there. Continuing to have these opportunities available would result in an ongoing long-term major benefit for visitors seeking these kinds of experiences. However, the current beneficial effect is not expected to change over time.

Access to Orientation, Interpretation, and Education

Facility limitations and crowded conditions at the Panther Junction Visitor Center would continue to lead to visitor and education group frustration over being unable to get the important and adequate information, interpretation and education messages, programs, and media that they would like to have. Most visitors and education groups would be affected, and because of the high value they place on these services, continuing the current limitations would constitute an ongoing long-term moderate to major adverse impact. However, the adverse effect is not expected to worsen over time.

Visitor Safety

Safety information would continue to be available, although crowding at the visitor center would continue to sometimes make it difficult to gain a comprehensive understanding of safety factors. The retention of visitor facilities at Rio Grande Village and Cottonwood Campground would place some visitors at risk from flooding. Please see the previous section on floodplains and flooding for more detail.

Cumulative Effects

Although past actions have affected visitor experience, no ongoing or future actions would have a perceptible impact on the visitor experience. Consequently, there would be no cumulative impacts as a result of implementing the no-action alternative.

Conclusion

Alternative A would result in continuing degradation of the visitor experience because of noise, congestion, and visitor frustration at not finding adequate interpretive and education facilities and easy access to safety information. This alternative would result in a continuing long-term adverse impact on visitors coming to the park at peak times.

Visitors would have many opportunities to travel around the park at their own pace. This would continue to be a long-term major benefit for visitors.

The campgrounds, picnic areas, and lodge offer mostly pleasant experiences that users value highly. Retaining these facilities would constitute an ongoing, moderate, long-range beneficial effect for visitors.

Although the above effects would continue over time, none of the impacts are anticipated to increase or decrease appreciably.

SOCIOECONOMIC ENVIRONMENT

Analysis

Big Bend National Park is located in a relatively isolated area in southwest Texas, and with an existing staffing level of 100 FTE, it is an important employer and source of revenue in the region. The park is the major travel and tourist attraction in the region, drawing an average of about 300,000 yearly visitors. It is assumed that this general level of visitation will continue in the future. Most of the land in the park would continue to be managed as "proposed" or "potential" wilderness.

Total combined sales generated from recreation spending by tourists and expenditures by residents, and direct government expenditures in salaries, supplies, construction projects, etc. under this alternative totals about $71.6 million. Overall park concessions and related private sector operations (such as river operators and hotel/motel operators) and construction would generate about 2,150 jobs in direct and indirect employment. Total tax revenues (comprised of state and local sales taxes and corporate income taxes) generated by the park and related recreation and support operations, and construction projects, is about $7 million.

Because the no-action alternative would provide for a continuation of existing trends in the park, it is expected that the current "baseline" socioeconomic effects and benefits to the local and regional economy would continue. There

would be no change in direct park employment or in related private sector employment serving visitors or other service sectors. This alternative would also include funds for construction, rehabilitation, and restoration of park facilities to maintain the current programs and levels of service, and upgrade of selected facilities to current health and safety standards (such as improving water system at Castolon, and upgrading park buildings to meet current requirements). Those funds have been included in the baseline calculations. There would be both direct and indirect, long-term, minor beneficial effects of continuing existing practices at the park.

Cumulative Impacts

The park serves local and regional recreation users, along with a smaller but sizable number of visitors from elsewhere in the United States and some overseas travelers. Because there would be no material changes in the park's facilities or operations (aside from improvements to meet current requirements) under this alternative, there would be no cumulative impacts on the regional economy. Instead, the current economic benefits of park operations would continue to accrue to the local businesses and park neighbors. There would be no incremental changes from this alternative that would create a cumulative economic impact.

Conclusion

The existing benefits of the park to the local and regional economy would continue, with minor improvements in temporary employment opportunities and revenues as the planned restoration and upgrade construction activities took place. There would be both direct and indirect, long-term, minor beneficial effects of continuing existing practices at the park.

UNAVOIDABLE ADVERSE IMPACTS

The following paragraphs describe the more important (moderate and major intensity) adverse impacts that would result from implementing alternative A. These are residual impacts that would remain after mitigation was implemented. The negligible and minor impacts are described in the foregoing analysis.

Natural Resources

The development at the Chisos Basin would continue to use nearly all of the water from Oak Spring at certain times of the year, which would be an unavoidable, moderate, intermittent, long-term adverse impact on the water quantity at Oak Spring and the plants and animals that would otherwise use the water.

The natural and beneficial values of floodplain areas would continue to be compromised by the presence of campgrounds at Rio Grande Village and Cottonwood, other development at Rio Grande Village, and the development in the flash flood hazard area at Panther Junction. This continuing, unavoidable, long-term adverse impact on natural processes would be moderate.

Although severe flooding has been infrequent and risks are minor to moderate, flooding at Rio Grande Village, Cottonwood Campground, or Panther Junction could result in unavoidable major adverse impacts on the visitors or employees involved.

Even though the risk is not great, damage or loss of 60% of the museum collection could be a major long-term adverse impact on the collection and loss of infrastructure from flooding at Panther Junction could be a major, long-term adverse unavoidable impact on operations. Loss of infrastructure could require the park to find temporary offices and housing outside the park.

Visitor Understanding

The visitor experience of Chisos Basin would continue to be degraded by congestion and noise. Implementation of this alternative would result in a continuing long-term, major, unavoidable, adverse impact on visitation during peak use times. The impact would be major because most visitors would be affected and because

Chisos Basin is a primary resource area. Fewer visitors would be affected in non-peak times, so at those times the impacts would be moderate.

Facility limitations and crowded conditions at the Panther Junction Visitor Center would continue to lead to visitor and education group frustration over being unable to get the important and adequate information, interpretation and education messages, programs, and media that they would like to have. Most visitors and education groups would be affected, and because of the high value they place on these services, continuing the current limitations would constitute a long-term, moderate to major, unavoidable, adverse impact.

Although the above effects would continue over time, none of the impacts are anticipated to increase or decrease appreciably.

Socioeconomic Impacts

There would be no unavoidable adverse socioeconomic impacts under any of the three alternatives. No mitigation measures for adverse socioeconomic impacts would be required.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Severe flooding has been infrequent, and the risks are minor to moderate; however, flooding could result in major adverse impacts on the visitors and employees involved, museum collections, and park operations.

Under alternative A there would no change from the current level of salaries paid to employees because there would be no change in the total number employed. There would be an irreversible and irretrievable commitment of resources in terms of funds expended on facility rehabilitation and other improvements ranging from $5.7 to $7.7 million, with an average figure of $6.7 used in this analysis.

RELATIONSHIPS OF SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Continuing visitor activities would reduce the long-term productivity of the environment and consume scarce water resources. Human activities associated with ongoing visitor and administrative use of the park would prevent vegetation and wildlife populations from reaching their full potential in size and population density.

Occupation of the floodplains at Panther Junction, Rio Grande Village and Cottonwood Campground for the indefinite future causes long-term reduction in natural and beneficial values of the floodplains and prevents them from functioning naturally.

Continuing recreation use and visitor activities, and planned facility improvements under alternative A would continue and improve the long-term productivity of the socioeconomic environment over the both the short and long term.

ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Energy requirements would increase with the construction of new structures. Designing all structures to be energy-efficient could mitigate the additional energy requirements. Alternative A would require the most energy of all the alternatives because of the number and energy inefficient structures and systems in the park.

IMPACTS OF IMPLEMENTING ALTERNATIVE B (PREFERRED)

NATURAL RESOURCES

Soils

Actions specific to alternative B that would impact soils are:

- Chisos Basin: One 12-room motel building would be removed; a 12-bed bunkhouse, and a single family residence would be relocated to Panther Junction.
- Panther Junction: A visitor center and storage warehouse would be constructed. One single-family residence and one bunkhouse would be constructed to replace the ones removed from Chisos Basin.
- Rio Grande Village: Some campsites would be relocated, the former overflow camping area would be returned to more natural conditions, the concession campground would be enlarged by about 40% up to a total of 30 sites, four housing units and one fire bay would be constructed, and the visitor center would be expanded to add four offices or a building for four offices would be constructed.
- Castolon: Two housing units and one fire bay would be constructed.
- Cottonwood Campground: Some campsites would be relocated farther from the river and a new road would be constructed for egress.
- North Rosillos/Harte Ranch: An interpretive trail at Buttrill Spring and possibly at Rosillos would be constructed.
- Persimmon Gap: One duplex would be constructed if a water source can be found.
- Maverick: An entrance station would be constructed and the existing entrance station would be removed.
- Gateway communities: Residences and offices would either be constructed or leased.

Proposed actions of alternative B would disturb about 10 acres of soil inside the park and 2.5 acres outside. All the areas that would be affected have been previously disturbed. Sites with soil disturbance would undergo accelerated wind and water erosion, at least temporarily, until drainage structures were fully operational and vegetation had recovered in cleared areas. To conserve available organic matter, topsoil, where present, would be retained and replaced. (Soils at Big Bend have virtually no topsoil.) Relatively small areas would be affected, and mitigating measures such as prompt revegetation and silt fences would be employed. However, the aridness of the area would increase the time required for vegetation to become established (if it did become established), and the low resilience of the soil would mean these adverse impacts would be minor and long term.

Trail rehabilitation would include special design methods in areas where the slope is high and soils are easily eroded by wind and water. These impacts have already occurred to some degree because all the areas involved have been disturbed. However, the new Buttrill Spring trail would increase the area impacted by 0.5 to 1 acre. The possible length and alignment are not available for the potential Rosillos Trail, so the area of disturbance cannot be calculated. Soil erosion by wind and water, and soil nutrient transport, would result in minor, long-term adverse impacts.

In this alternative, there would be 62 acres where soils would be restored to natural contours, runoff would be routed to natural drainages, and soils would be revegetated – Chisos Basin motel building, bunkhouse, and residence removals; Rio Grande Village restoration of former overflow camping area; and Maverick entrance station removal/ replacement. Even though about 62 acres would be restored, some of the development to be removed would be replaced at other locations and only small portions of developed areas would be restored. Under alternative B, about 1,341 acres of the 801,000^{+} acres in the park would continue to be occupied by development. Restoring natural contours, routing runoff to natural drainages, and revegetating an area greater than 20 acres would be a major, long-term, beneficial impact on soils.

Removing some structures at Chisos Basin, constructing a visitor center, storage warehouse, single-family residence, and a bunkhouse at Panther Junction, adding four offices onto the visitor center or constructing a four-office building, moving fuel storage tanks out of the floodplain or protecting them from the 500-year flood, and adding a fire bay at Rio Grande Village, constructing two housing units and a fire bay at Castolon; constructing a new egress for Cottonwood Campground, constructing a Buttrill Spring and possibly a North Rosillos/ Harte Ranch trail, constructing a duplex at Persimmon Gap, constructing an entrance station at the park boundary and removing the entrance station at Maverick, and constructing residences and office building offsite could require regrading that would result in the loss of some of the natural soil profile. However, because all these sites except the new Maverick entrance station site, are in developed areas, the overall soil quality of these areas has probably already been changed substantially and might be permanently affected. Within the park, the changes from actions of this alternative would impact small areas within developed areas. (No site for development outside the park has been selected.) Therefore, these impacts would be minor, long term, and adverse.

Soils at Chisos Basin, Panther Junction, Rio Grande Village, Cottonwood Campground, and Castolon have moderate or severe limitations for the kinds of actions that are suggested in alternative B. Further geotechnical investigation would be required to evaluate suitability and needed mitigation before designing the facilities listed. Tables in appendix H show, for each developed area, the actions of the alternatives and specific limitations of soils.

Cumulative Effect. Agriculture, including dryland farming and ranching, have led to the erosion of soils by removing native vegetation and replacing it with plants not necessarily suited to the desert environment. This, along with tilling the soil, has left soils exposed to erosion by wind and water.

The development of some private lands such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses and construction of five structures in the park could increase runoff, wind erosion, and soil compaction and alter soil regimes.

If efforts to restore soils and natural hydrology at North Rosillos/Harte Ranch are successful, there would be long-term beneficial impacts on soils there. The intensity of the impact is uncertain because the size of the area that would be successfully restored is not known. If funding continues, the project would likely have major beneficial impacts on soils.

Impacts on soils from agriculture and ranching covered wide areas and were adverse. Impacts on soils of current and anticipated future actions outside the park, in conjunction with the impacts of alternative B would be major and adverse because they would probably cover more than 20 acres. Most of the impacts would be the result of development outside the park that might or might not be mitigated. The actions of alternative B and ongoing restoration at North Rosillos/Harte Ranch would contribute a very small increment to the overall cumulative impact.

Conclusion. Construction on about 10 acres within the park and up to 2.5 acres outside would disturb soils by increasing wind and water erosion. Because relatively small areas would be affected and mitigating measures would be employed, these adverse impacts would be minor and long term. Soil erosion by wind and water, soil nutrient transport from trail building on an acre or more, and trail rehabilitation as needed would have a minor, long-term, adverse impact. Restoring soils on 62 acres to natural contours, rerouting runoff to natural drainages, and revegetating an area greater than 20 acres would have a major, long-term, beneficial impact on soils. Removing some structures and constructing others on small sites within developed areas could require regrading that would result in the loss of some of the natural soil profile – a minor, long-term, adverse impact.

The park's soil resources would not be impaired by the impacts described under this alternative.

Vegetation

Construction activities in alternative B (see soils discussion above) would disturb about 10 acres of vegetation inside the park and 2.5 acres outside. Removing fuel tanks from the floodplain at Rio Grande Village would be in addition to this number because the extent of required changes is not known. Topsoil (if present) would be scraped off and saved for future use before construction began. To allow more rapid recovery of native vegetation and minimize the encroachment of invading species, the topsoil would subsequently be replaced and reseeded to the extent possible with seed of native species gathered in the park or seeds of native species gathered in the park and propagated elsewhere. During the recovery period, the artificially seeded or replanted native vegetation would not be identical in composition to vegetation prior to construction. A reduction in the organic content of the soil would cause a slight change in species composition for several years. Because the affected area is already disturbed and the described mitigating measures would be implemented, this adverse impact on previously disturbed vegetation would be minor and long term.

There would be 62 acres where soils would be restored to natural contours and revegetated – Chisos Basin motel building, bunkhouse and residence removals; Rio Grande Village restoration of former overflow camping area; and Maverick entrance station. Sixty of these acres would be at Rio Grande Village, where water for irrigation is available to help plants become established. This would be a moderate, long-term beneficial impact on vegetation.

Some vegetation would be trampled or destroyed by some off-trail use of areas such as the Buttrill Spring and Rosillos trails. This localized, intermittent impact, which would not affect the overall structure of any natural community would be minor, adverse, and long term.

At Chisos Basin, removal of motel building A, the bunkhouse, and one NPS staff residence would result in a 532,000-gallon decrease in annual water use of Oak Spring – a 13% decrease from existing conditions. Because removal of the development would be a large undertaking and would not be likely to be reversed, the impact would be long term. The plant communities growing next to Oak Spring would benefit from having a perennial water source. The beneficial impact would be expected to be clearly detectable and have an appreciable effect on the abundance of individuals of some or all species and on the composition of plant communities. Therefore, this long-term, beneficial impact would be of moderate intensity.

At Rio Grande Village, reduction of irrigation by 50% would be expected to kill 14 acres of exotic vegetation (lawns) and allow native vegetation to repopulate these areas. This would be a moderate to major long-term beneficial impact on native vegetation.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert plants. Plants have been affected by being displaced, and habitat has been lost through agricultural uses and introduction of nonnative plants.

The development of some private lands such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses and construction of five structures in the park could alter vegetative communities and cause loss of plants in some areas. Water use from these developments or uses could reduce water available for vegetation.

If restoration efforts at North Rosillos/Harte Ranch are successful, there would be long-term beneficial impacts on soils and hydrology, which in turn would allow restoration of native plants.

Impacts of agriculture and ranching on vegetation covered wide areas and were adverse. Impacts of current and anticipated future actions outside the park, in conjunction with the impacts of alternative B would result in moderate, long-term adverse impacts on vegetation. Most of the impacts would be the result of development outside the park that might or might not be mitigated. The actions of

alternative B and ongoing restoration at North Rosillos/Harte Ranch would contribute a very small increment to the overall cumulative impact.

Conclusion. Construction activities in alternative B would disturb 10 acres of already disturbed vegetation inside the park and 2.5 acres outside, a minor long-term adverse impact. Revegetation would be attempted, but arid conditions make revegetation difficult. Restoring natural contours and revegetating 62 acres would have a moderate long-term beneficial impact on vegetation.

The removal of motel building A, the bunkhouse, and one NPS staff residence at Chisos Basin would result in a 13% decrease in annual water use of Oak Spring – a minor to moderate intermittent long-term beneficial impact on plants that use water from Oak Spring.

Withdrawal of 50% of the irrigation water from about 14 acres of exotic vegetation at Rio Grande Village would allow native vegetation to return – a moderate to major long-term beneficial impact on native vegetation.

The park's vegetation would not be impaired by the impacts described under this alternative.

Wildlife

Construction on 10 acres of developed areas (except the Maverick entrance station) inside the park and 2.5 acres outside the park would disturb wildlife and degrade habitat to a small degree.

At Chisos Basin, removal of motel building A, the bunkhouse, and one NPS staff residence would result in a 532,000-gallon decrease in annual water use of Oak Spring – a 13% decrease from existing conditions. The reduction in withdrawal of water for human use from the perennial Oak Spring would restore a permanent (year-round) water source for wildlife – a beneficial impact in the arid environment of the Chisos Basin. This beneficial effect on habitat at Oak Spring would be expected to be readily detectable, and population size of wildlife species using the spring would be expected to increase. Composition of wildlife communities would be expected to change. Because removal of the development would be a large undertaking and would not be likely to be reversed, this would be a long-term impact on wildlife using Oak Spring. Therefore, this would be a moderate long-term beneficial impact on wildlife using Oak Spring.

The restoration of natural contours and vegetation on approximately 62 acres at Rio Grande Village might provide habitat for smaller animals, but its location adjacent to the concessioner RV campground would lessen its desirability. Restoration of 30 acres of wildlife habitat would be a moderate, long-term, beneficial impact on smaller animals.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert animals. Animals have been affected by being displaced and killed as vermin, and habitat has been lost through agricultural uses and introduction of nonnative animals. Wildlife continues to be disrupted by development and human activity.

The development of some private lands such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses and construction of five structures in the park could alter wildlife habitat and habits and cause loss of wildlife in some areas. Water used by developments or for tourists could reduce water available for wildlife. Road kill of rodents, larger mammals, and birds would increase because more development probably would increase traffic.

The past impacts from agriculture and ranching on wildlife covered wide areas and were adverse. Past and continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on wildlife. Impacts on wildlife of current and anticipated future actions outside the park, in conjunction with the impacts of alternative B and restoration at North Rosillos/Harte Ranch would be moderate, long term, and adverse. Most of the impacts would be the result

of development actions outside the park that might or might not be mitigated. The actions of alternative B would contribute a very small increment to the overall cumulative impact.

Conclusion. Reducing human use of water at Oak Spring by 13% would restore a permanent (year-round) water source for wildlife, a long-term, moderate, beneficial impact on wildlife using the spring. Restoration of natural contours and vegetation on about 30 acres at Rio Grande Village would increase wildlife habitat, a moderate long-term beneficial impact on smaller animals.

The park's wildlife would not be impaired by the actions proposed under this alternative.

Water Quantity

Chisos Basin/Oak Spring. Removing motel building A, the bunkhouse, and one NPS staff residence from Chisos Basin would result in a 532,000-gallon decrease in annual water use of Oak Spring – a 13% decrease from existing conditions. This would be a minor, intermittent, long-term, beneficial impact on the quantity of water available at Oak Spring.

Panther Junction. Moving 15% of personnel and functions out of Panther Junction would not be expected to decrease water use because additional employees are needed who would work and live at Panther Junction. There would probably be no net change in employees living at Panther Junction. Adding an administration building to the area would add a minimal amount of water use to the area. Incorporating water-saving features into the building would probably offset most of the increased use.

The Rio Grande. The park would continue to irrigate Rio Grande Village and the Cottonwood Campground using river water. However, at Rio Grande Village, use of irrigation water would be reduced from about 25.6 million gallons per month to about 12.8 million gallons per month by restricting its irrigation to the campgrounds, picnic areas, and areas undergoing revegetation. At Castolon, use of irrigation water would continue to be about 125,000 gallons per month. Because park use would remain small and intermittent compared to the flow in the river, this would be a minor, long-term, beneficial impact on water quantity.

Spring at Rio Grande Village. Finding a separate source of drinking water for visitors and employees would eliminate the use of the spring at Rio Grande Village that feeds three ponds in the area. The availability of about 2.9 million additional gallons per year of water to the pond system would be a major long-term beneficial impact on water quantity. However, the new source of water would be used at the rate of about 2.9 million gallons per year. This might be an adverse impact on that source, depending on the nature of the alternative source.

Castolon. Water use at Castolon would be expected to remain the same as alternative A – 2.6 million gallons per year of drinking water from wells and about 125,000 gallons per month of irrigation water from the Rio Grande. However, depending on the alternative water source, an adverse impact on that source might occur.

Persimmon Gap. Water use at Persimmon Gap would be expected to remain the same as in alternative A – 300,000 gallons per year.

Cumulative Effects. The presence of dams upstream and continued heavy use of the river would result in major long-term reductions in water quantity in the park and upstream and downstream of the park.

Agriculture, including dryland farming and ranching, and urban development have increased to the point that water in the Rio Grande water shed is overcommitted.

The development of some private lands, such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area, for residential, tourist-related, or other uses and the construction of five structures in the park would increase ground or surface water use and decrease water availability for other uses in an area where water is already scarce. The exact

impact of increased residential or tourist development in gateway communities west of the park, if any, is not known.

Past impacts of use of the Rio Grande for agriculture, ranching, and water supply were, and continue to be, major and adverse. Impacts on water quantity in the Rio Grande of current and anticipated future actions outside the park, in conjunction with the impacts of alternative B and restoration at North Rosillos/Harte Ranch are anticipated to be long term and adverse. Intensity of this impact is not known because it is not clear how increased development in the gateway communities west of the park and the state-managed areas would impact the Rio Grande or what the amount of any increased use would be. The actions of alternative B would contribute a very small increment to the overall cumulative impact.

There would be no cumulative impacts on water quantity in Oak Spring because the spring originates in the Chisos Mountains within the park.

Conclusion. Reduction of human use of water from Oak Spring by about 13% would be a minor, intermittent, long-term, and beneficial impact on water quantity. Reduction of park use of river water for irrigation by 12.8 million gallons per month, a small amount compared to the flow in the river, would have a minor, long-term, beneficial impact on water quantity in the river. Finding a separate source of drinking water for visitors and employees at Rio Grande Village would leave an additional 2.9 million gallons in the pond system – a major, long-term beneficial impact on pond system water quantity. However, depending on the alternative water source, an adverse impact on that source might occur from park use.

The park's water quantity would not be impaired by the actions proposed under this alternative.

Threatened, Endangered, and Candidate Species

Black-capped vireo (endangered). The Chisos Basin, including the corridor of the road leading into it, is a very important part of this bird's habitat. Reasons for the bird's decline are habitat loss to urbanization, browsing by herbivores, brush clearing, natural succession, brown – headed cowbird brood parasitism, and human disturbance. The proposed reductions in development at Chisos Basin and consequent reduction in traffic on the road leading into it would not be expected to be large enough to have an impact on black-capped vireo.

Big Bend gambusia (endangered). This fish, found in the wild only at Rio Grande Village, is threatened by habitat alteration, ground-water pumping, declining spring flows, and competition with introduced nonnative species. The spring that feeds the pond at Rio Grande Village where Big Bend gambusia live is also used for human consumption. Finding a separate source of water for human use would eliminate the competition for water, and relocating some of the campsites in the area that are close to the pond and the fish would likely result in eliminating this source of impacts on the gambusia. How these changes would impact the fish is not known. It is hoped that the improvements in its habitat would result in minor to moderate, long-term beneficial impacts.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert plants and animals including threatened and endangered species. The black-capped vireo has lost habitat to browsing by herbivores, brush-clearing, and human disturbance and urbanization. The Big Bend gambusia has lost habitat to habitat alteration, groundwater pumping, decreasing spring flows, and competition with introduced nonnative species such as the western mosquito fish.

The development of some private lands, such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area, for residential, tourist-related, or other uses and the

construction of five structures in the park could impact black-capped vireo habitat or alter suitable habitat for Big Bend gambusia. Water used by developments or for tourists could reduce water available for habitat for these species in an area where water is already scarce.

Past impacts on threatened and endangered species from agriculture, including dryland farming and ranching, dam building, urbanization, and over use of water from the Rio Grande have been major and adverse. Impacts on threatened and endangered species from current and anticipated future actions outside the park, in conjunction with the impacts of alternative B and restoration at Harte Ranch, are not known because the locations of species outside the park in areas that might be impacted are not known. Given the lack of information regarding impacts outside the park, it is not possible to assess the relative size of the impacts of alternative B compared to current and anticipated future actions outside the park.

Conclusion. Changes at Chisos Basin would not impact the black-capped vireo. Improving Big Bend gambusia habitat by eliminating competition for spring water and relocating campsites would have a minor to moderate, long-term beneficial impact on the fish.

The park's threatened and endangered species would not be impaired by the actions proposed under this alternative.

Floodplains

Natural and Beneficial Floodplain Values. The natural and beneficial values of the Rio Grande floodplain would be enhanced at Rio Grande Village by moving fuel storage tanks out of the 500-year floodplain or protecting them from the 500-year flood, restoring former overflow camping area to more natural conditions, relocating some campsites farther from the river, and reducing irrigation. The likelihood of fuel spilling into flood waters would be reduced, and vegetation in the floodplain at Rio Grande Village would more nearly approximate natural conditions. These impacts on the floodplain would be localized, minor, beneficial, and long term.

Flooding. A flood hazard reconnaissance (NPS: 1991) stated that, "Because flooding occurs only in extremely large and rare events, and flood flow velocities are very small, the possibility that visitors could be injured or lose their lives in a flood at Rio Grande Village or Cottonwood Campground is very small." As in the no-action alternative the campground and all development at Rio Grande Village and the campground at Cottonwood would continue to occupy part of the 100-year floodplain. In addition under alternative B four offices, four housing units, and a fire bay would be added within the floodplain. Even though early warning and evacuation plans would be developed, communications might not always be fully comprehended or acted upon. Although the possibility of loss of life is very small, campers, other visitors, and employees would remain in some danger. Severe flooding has been infrequent, and risks are minor to moderate, but the results of flooding could cause major adverse impacts on the visitors and employees involved.

The entire development at Panther Junction, located on a bajada or area of converging alluvial fans, is subject to flash flooding and debris flows and is geomorphologically unstable. In ideal circumstances, development at Panther Junction would be located outside the maximum estimated flood (Q_{me}) (see appendix F). As in alternative A, the fire management building would be constructed in a less dangerous portion of the flood-prone area. In alternative B, four additional structures would be constructed in the floodplain at Panther Junction – an employee residence, a bunkhouse, a visitor center, and a storage warehouse.

According to "Estimation of Flood and Geomorphic Hazard in the Panther Canyon Area of Big Bend National Park, Texas" (NPS 1995), all of the structures at Panther Junction are at "some risk." However, the report also seems to indicate that the risk is not great. Nevertheless, because the long period between events leads to a false sense of security and warning time would be short, there is the possibility of human injury or loss of life in the

event of a large flood. As in the no-action alternative, even though the report finds that the risk is not great, flooding at Panther Junction could cause major adverse impacts on the visitors and employees involved.

As in the no-action alternative, in the event of a 500-year or maximum estimated flood (Q_{me}), up to 60% of the park's museum collection, stored at Panther Junction, could be damaged or destroyed. This would be a major long-term adverse impact on the collection.

In addition, a large investment in infrastructure (including the visitor center, the park headquarters, school, and 76 housing units) could be lost if the 500-year or maximum estimated flood (Q_{me}) occurs at Panther Junction. Even though the risk of this event occurring is not great, loss of infrastructure from flooding at Panther Junction could have a major, long-term impact on NPS operations and could require the park staff to find temporary offices and housing outside the park.

Cumulative Effects. The construction of dams upstream of the park and the heavy use of the Rio Grande upstream have greatly reduced the extent of the floodplain and the natural and beneficial values of floodplains in the park.

Cattle and sheep probably have been allowed to use some riparian areas in and near the park. This practice degrades natural and beneficial floodplain values in exchange for benefits to agricultural uses. NPS structures and visitor uses in floodplain areas contribute to the loss of natural and beneficial values.

The presence of dams upstream and heavy use of the river would continue to result in major long-term reductions in area and in beneficial values in floodplains in the park and upstream and downstream of the park.

Further development in floodplains and wetlands outside the park for residential, agricultural, or commercial uses would decrease the area in which natural and beneficial floodplain values would be preserved.

Under this alternative the natural and beneficial values of floodplain areas would continue to be compromised by development at Rio Grande Village, Cottonwood, and Panther Junction.

Even though the natural resources and collections management building would be constructed in a less flood-prone area (less likely to be inundated by smaller floods), and the likelihood of them being damaged in smaller floods would be reduced, they would still be within the maximum estimated flood area at Panther Junction. If the maximum estimated flood occurs, the 60% of the park's museum collection that is stored at Panther Junction could be damaged or destroyed. This would be a major long-term adverse impact on the collection.

The past impacts of agriculture, ranching, urbanization, and dam construction on floodplains covered wide areas and were adverse. Continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on floodplains. Impacts on floodplains of current and anticipated future actions outside the park, in conjunction with the impacts of alternative B and restoration at North Rosillos/Harte Ranch would be moderate, long term, and adverse. Most of the impacts would be the result of development actions outside the park that might or might not be mitigated. The actions of alternative B would contribute a very small increment to the overall cumulative impact.

Conclusion. The natural and beneficial values of floodplain areas would be enhanced at Rio Grande Village by the reduction of the likelihood of fuel spilling into flood waters and the restoration of more natural vegetation. This impact would be minor, beneficial, and long term.

Although severe flooding has been infrequent and risks are minor to moderate, flooding at Rio Grande Village, Cottonwood Campground, or Panther Junction could result in major adverse impacts on the visitors or employees involved.

As in alternative A, even though the risk of flooding is not great at Panther Junction, damage

or loss of 60% of the museum collection would be a major, long-term adverse impact on the collection, and loss of infrastructure would be a major, long-term adverse impact on operations. Loss of infrastructure could require the park to find temporary offices and housing outside the park.

The resources and values of Big Bend National Park would not be impaired because there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, no floodplain resources or values would be impaired as a result of implementing this alternative.

Wetlands

In alternative B there would be a reduction of 532,000 gallons per year, 13%, in water use from Oak Spring at Chisos Basin. This would leave more water in the wetland area year-round for the benefit of wetland vegetation and associated wildlife. This would be a minor, long-term, beneficial impact on wetlands at Oak Spring.

Cumulative Effects. Some wetlands within and outside the park, especially along the Rio Grande, have been filled to make more land available for growing crops. Cattle and sheep probably have been allowed to use some wetland and riparian areas in and near the park. These practices decrease wetland areas and degrade natural and beneficial wetland values in exchange for benefit to agricultural uses. NPS structures and visitor uses in wetland areas contribute to the loss of natural and beneficial values.

The presence of dams upstream and continued heavy use of the river would continue to result in major long-term reductions in wetland area and in beneficial values of wetlands in the park and upstream and downstream of the park. Further development in wetlands outside the park for residential, agricultural, or commercial uses would decrease the area in which natural and beneficial wetland values would be preserved.

The past impacts of agriculture, ranching, urbanization, and dam construction on wetlands covered wide areas and were major and adverse. Continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on wetlands. Impacts on wetlands of current and anticipated future actions outside the park, in conjunction with the impacts of alternative B and restoration at North Rosillos/ Harte Ranch, would be moderate, long term, and adverse. Most of the impacts would be the result of development actions outside the park that might or might not be mitigated. The actions of alternative B would contribute a very small increment to the overall cumulative impact.

Conclusion. Reducing use of water from Oak Spring by 532,000 gallons per year (13%) would have a minor long-term beneficial impact on the wetland at the spring.

The park's wetlands would not be impaired by the actions proposed under this alternative.

CULTURAL RESOURCES

Archeological Resources

Analysis. The ground-disturbing activities of the preferred alternative would include removing structures in Chisos Basin, constructing a new visitor center and storage warehouse at Panther Junction, relocating campsites at Cottonwood Campground and Rio Grande Village, underground electrical lines, upgrading park water systems, constructing fire bays at Rio Grande Village and Castolon, relocating the Maverick entrance station, enlarging the campground at Rio Grande Village, and constructing new housing at Rio Grande Village, Castolon, and Persimmon Gap are mainly in previously disturbed areas. These actions could result in impacts on archeological resources. In those areas such as Panther Junction, Chisos Basin, and Rio Grande Village where archeological resources have been identified, Construction

would be done in a manner to avoid impacting resources. A small amount of the new development could occur in previously undisturbed areas such as the new location for the Maverick entrance station. This could result in the discovery of previously unknown archeological resources. Development would be so designed to avoid these resources. Therefore, there would be long-term negligible beneficial impacts on archeological resources.

The area around Buttrill Spring contains potentially eligible archeological and historic sites. Developing a trail could be done in a manner to avoid these resources; however the introduction of visitation to the area could result in resource degradation due to trampling of the ruins and prehistoric archeological components of the site. This could be partially mitigated through a visitor education program and would have a long-term, minor to moderate adverse impact.

The management prescriptions of the preferred alternative would place more than 90% of the park in either the Wilderness or Backcountry Nonwilderness prescriptions and less than 10% of the park in management prescriptions that would allow for development. This would result in little new disturbance of known archeological resources. The application of the management prescriptions would have a long-term, negligible, beneficial impact.

Cumulative Effects. Archeological resources at Big Bend National Park are subject to damage from development, vandalism, illegal activities, and natural processes. Past development in the Rio Grande Village area, Castolon area, Chisos Basin, and Panther Junction has resulted in the loss of some archeological resources during excavation and construction activities. Many of the reasonably foreseeable future actions, such as construction of new employee housing and administrative, maintenance, and storage facilities could disturb archeological resources. If significant archeological resources could not be avoided, the data they possess regarding prehistoric and/or historic lifeways would be documented and recovered, in accordance with the *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation* (36 CFR part 800) and other archeological technical guidance. The negligible impact of this alternative, in conjunction with the adverse impacts of other reasonably foreseeable future actions, would result in negligible to minor adverse impacts on archeological resources, depending upon the significance of the site. However, the adverse impacts of the alternative would be a relatively minor component of the overall cumulative impact due to the limited scope of the action.

The Black Gap Wildlife Management Area and Big Bend Ranch State Park are required to identify and preserve archeological resources. In the past, archeological resources have been lost due to neglect and lack of adequate protection measures. This situation is slowly being remedied as archeological resources are identified and protection measures are put in place. NPS actions added to those of the state parks could result in long-term, negligible, beneficial effects on the area's archeological resources.

Conclusion. The development that would occur under the implementation of this alternative would not impact known archeological resources in the park; in those areas where there are possible unknown archeological resources there is sufficient space to avoid impacting these resources. Some excavation work might be required to complete compliance for some construction and removal activities. There would be no direct or indirect impacts on archeological resources, and no change to existing conditions. This would result in a long-term, negligible beneficial impact on these resources.

The park's archeological resources would not be impaired by actions proposed under this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the development proposed under alternative B would have an effect that would not be adverse.

Historic Structures/Buildings

Analysis. The current visitor center dates from the Mission 66 period. A determination of eligibility needs to be completed to determine its significance and character-defining features. If the visitor center were determined eligible, then changes to the building would be done in such a manner as to not impact the character-defining features. Rehabilitation activities would have a long-term, negligible impact. The adaptive use of Barker Lodge for housing researchers could result in some loss of historic fabric, but overall would result in the preservation of this property. The preservation of this structure would result in a long-term, moderate beneficial impact.

Cumulative Effects. Historic structures/buildings at Big Bend National Park are subject to damage from development, vandalism, illegal activities, and natural processes. Past development in the Rio Grande Village area, Castolon area, Chisos Basin, and Panther Junction has resulted in the loss of some structural resources during construction activities as well as the removal of some structures for visitor safety and other park purposes. The reasonably foreseeable future actions, such as construction of new employee housing and administrative, maintenance, and storage facilities would not impact historic structures/buildings.

The Black Gap Wildlife Management Area and Big Bend Ranch State Park are developing inventories of historic structures in their parks to guide them in the preservation of these structures. In the past, Big Bend National Park has allowed some historic structures to deteriorate without a priority system of what to preserve. These actions had an adverse action on the preservation of structures. NPS actions in implementing the preferred alternative, in combination with those of the state parks, would have a long-term, minor, beneficial impact.

Conclusion. The preservation actions taken in the preferred alternative would have an overall long-term, moderate, beneficial impact on the park's historic structures.

No impairment of historic structures/buildings would result from implementing the preferred alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the development proposed under the preferred alternative would have an effect that would not be adverse.

Cultural Landscapes

Analysis. This alternative would evaluate Buttrill Spring and Bone Spring to identify those features that contribute to this potential cultural landscape. These features would be preserved and interpreted by the park. This would have a long-term, minor, beneficial effect.

Rio Grande Village and Cottonwood Campground contain a cultural landscape, resulting from the Mission 66 work in this area of the park, that is potentially eligible for listing on the National Register of Historic Places. The water conservation measures in the Rio Grande Village and Cottonwood Campground could result in changing the vegetation characteristic of this landscape, such as reducing the amount of green grass areas and phasing out heavy-water-using plants with more drought-tolerant native species. It needs to be determined if the current vegetation is a character-defining feature of this potential cultural landscape; this would help guide management in how to reduce heavy-water-using plants. These actions could have a long-term, moderate adverse impact on these potential cultural landscapes.

The management prescriptions of alternative B would place more than 90% of the park in either the Wilderness or Backcountry Nonwilderness prescription and less than 10% of the park in management prescriptions that would allow for development. The application of these management prescriptions would have a long-term negligible, beneficial impact on the park's cultural landscapes.

Cumulative Effects. The Black Gap Wildlife Management Area and Big Bend Ranch State Park are required to identify and preserve historic resources including cultural landscapes. In the past, cultural landscapes have been adversely affected due to lack of identification and protection measures. Over the years, some of the original character-defining vegetation types in the park's cultural landscapes have been lost or replaced with other species. This situation is slowly being remedied as cultural landscapes are being identified and preservation and protection measures are put in place. NPS actions added to those of the state parks could result in long-term, negligible, beneficial effects on the area's cultural landscapes.

Conclusion. Identifying those features at Buttrill Spring that contribute to this potential cultural landscape and preserving these features would have a long-term, minor, beneficial effect. Water conservation measures in the Rio Grande Village could change the vegetation characteristic of this landscape, which could have a long-term, moderate adverse impact on this potential cultural landscape.

Placing more than 90% of the park in either the wilderness or backcountry nonwilderness prescription and less than 10% in management prescriptions that would allow for development would have a long-term negligible, beneficial impact on the park's cultural landscapes.

The resources and values of Big Bend National Park would not be impaired because there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, no cultural landscapes would be impaired as a result of implementing this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the development proposed under the preferred alternative would have an effect that would not be adverse.

Ethnographic Resources

Analysis. None of the proposed actions in the preferred alternative would alter the relationship or practices of affiliated groups with park resources, nor would the actions facilitate access or be supportive of practices or beliefs. However, none of the actions would hinder current access and practices. The actions would be considered to have long-term, negligible, beneficial impact.

Cumulative Effects. The Black Gap Wildlife Management Area and Big Bend Ranch State Park have neither inventories nor evaluations of ethnographic resources in their parks. In the past, Big Bend National Park did not take into consideration the needs of Hispanic or other groups, but the park staff is constructively working on problems of mutual concern. The park's actions, added to those of the state parks, could result in long-term, negligible, beneficial impacts on the area's ethnographic resources.

Conclusion. The actions in the preferred alternative would result in a long-term, negligible, beneficial impact on the park's ethnographic resources.

The park's ethnographic resources would not be impaired by actions proposed under this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the development proposed under the preferred alternative would have an effect that would not be adverse.

Museum Collections

Analysis. The new visitor center at Panther Junction would contain space to display the park's collections, provide better access for

researchers, and provide adequate environmental control systems. The new structure would allow the park to consolidate the collections from various locations around the park and be placed in areas that have environmental control systems. The new visitor center would provide for greater display space for materials in the park's collection. Because these actions would affect most of the park's collections, these actions would result in a long-term, major, beneficial impact on the park's collections.

Cumulative Effects. The two Texas state parks and Sul Ross State University would continue to collect, preserve, and interpret cultural and natural collections. This work could result in increased collection materials available to the public and researchers if it was coordinated with the collection work being done by the park staff. Many of the reasonably foreseeable future actions, such as the construction of a new building at Panther Junction for natural resources and collections management to provide additional space for park collections (currently housed inside and outside the park) would result in better care of the collections. This would be a long-term minor to moderate beneficial effect. These actions, added to the limited but improved ability of the park to care for collections, could result in long-term minor to moderate beneficial impacts on collections in the region.

Conclusion. There would be a long-term major, beneficial impact to artifacts and collections at Panther Junction. Overall, there would be a long-term, minor beneficial effect on park collections in that the collections would be better preserved and interpreted.

The park's museum collection would not be impaired by actions proposed under this alternative.

VISITOR UNDERSTANDING

Visitors' Experience of Park Resources

The removal of one lodge unit and some employee housing would enhance the visitor experience at Chisos Basin by reducing congestion and noise during peak use times. The long-term impact would be moderate because only some visitors would be affected. Fewer visitors would be affected in nonpeak times, so at those times the long-term impacts would be minor.

Reducing the number of motel rooms by 12 would mean that fewer visitors would be able to stay in overnight lodging at Chisos Basin and create a long-term moderate adverse impact on those visitors who could not stay during peak use times. The impact would be moderate because only some visitors would be affected. At nonpeak times, fewer visitors would be affected and impacts would be long term and minor.

The visitor experience would be further enhanced by the addition of interpretive trails at Buttrill Spring and possibly at Rosillos Ranch. This would be a long-term beneficial and minor impact.

Lights at night from developments associated with the campgrounds, lodge, visitor centers, and park housing are visible from areas within the park. These visual intrusions degrade the natural setting. However, the reduction of the number of motel rooms at Chisos Basin (compared to the no-action alternative) would result in long-term, negligible to minor beneficial visual impacts because the developments are low key. Nonetheless, lights at night would continue to disrupt the experiences for small numbers of visitors.

Access to Orientation and Interpretation

Construction of a new visitor center at Panther Junction would help visitors and educational groups to get the important and adequate information, interpretation and education messages, programs, and media that they would like to have. Because most visitors and education groups would be affected, and because of the high value they place on these services, this would constitute a long-term moderate to major beneficial impact on the visitor experience.

Visitor Safety

The increased availability of access to visitor safety information through printed materials and personal contact at Panther Junction would provide for a better visitor experience. The retention of visitor facilities at Rio Grande Village, but moving some of the campsites at Cottonwood Campground farther from the river, would place fewer visitors at risk from flooding. Please see the previous section on floodplains and flooding for more details.

Cumulative Effects

Although past actions have affected visitor understanding, no other on-going or future actions would have a perceptible impact on visitor experiences. The actions of this alternative would not add appreciably to cumulative effects.

Conclusion

Over the long term, most visitors at Chisos Basin would benefit from a reduction in congestion and noise brought about by alternative B; this would be a moderate beneficial effect on visitors' experiences during the peak season. Less congestion and noise would result in a long-term benefit for visitors coming to the park at peak and nonpeak times.

A new visitor center would provide adequate space for interpreting the park's primary themes, conducting interpretive and educational programs, and ensuring that visitors received sufficient information to effectively plan for a safe and enjoyable stay. This would provide a major long-term benefit for most park visitors.

Moving some of the campsites farther from the river would lessen the potential danger to visitors from flooding.

SOCIOECONOMIC ENVIRONMENT

Analysis

Alternative B would enhance stewardship of natural resources while simultaneously expanding visitor facilities and opportunities for cultural resource understanding. Although most of the land in the park would continue to be managed as "proposed" or "potential" wilderness, this alternative would include construction of new and improved visitor and park employee facilities, campground improvements, upgrade of one water system to serve visitors and residents, restoration of native drought-resistant plant species, and strengthening of park interpretive and outreach programs. An additional 31 full-time equivalent employees would be needed to implement this alternative, increasing local employment opportunities and long-term economic benefits.

As stated in alternative A, the park would be expected to continue to serve about 300,000 visitors yearly. Total combined sales generated from recreation spending by tourists and expenditures by residents, and direct government expenditures in salaries, supplies, construction projects, etc. under this alternative would total about $91.7 million. Overall park and related private sector concessions and operations (such as river operators and hotel/ motel operators) and construction would generate about 2,750 jobs in direct and indirect employment. Total tax revenues (comprised of state and local sales taxes and corporate income taxes) generated by the park and related recreation and support operations and construction projects would be about $8.9 million. The loss of one 12-unit lodging unit from the concessioner's operation would reduce total sales from $91.7 million to $90.2 million, and total tax revenues from $8.9 million to $8.8 million. Employment generation would be reduced from 2,750 jobs to 2,705 jobs. Using a worst-case assumption that displaced overnight visitors would not find accommodations elsewhere and would therefore decide not to visit the park would reduce overall annual visitation from about 300,000 visitors per year to about 292,000 per year. These reductions would be considered long term, minor, adverse effects at the park level. However, such changes might

affect the concessioner's local management and operating decisions.

In comparison to the no-action alternative, alternative B would have a net increased benefit of about $20.1 million in total combined sales, $1.9 million in tax revenues, and 600 additional jobs. These additional short-term and long-term, minor to moderate beneficial effects would be the direct and indirect products of the increased spending on facility upgrades and improvements in programs, including increased park employment.

Cumulative Impacts

Big Bend National Park serves local and regional recreation users, along with a smaller but sizable number of visitors from elsewhere in the United States and some overseas travelers. There would be incremental enhancements to the park's facilities and operations, along with long-term, beneficial cumulative impacts on the regional economy from increased economic activity. Baseline park employment (100 full-time-equivalent employees) would continue, and an additional 31 employees would be added, many or most of whom may be drawn from the local labor pool. Therefore, it would be anticipated that most of the economic benefits would accrue to the private sector and to local and state agencies. In addition, there might be beneficial cumulative socioeconomic impacts in the adjacent Mexican villages that border the park resulting from increased employment opportunities, and for the Big Bend Ranch State Park, Black Gap Wildlife Management Area, and the Rio Grand Wild and Scenic River from enhanced recreational activity.

Conclusion

The existing economic and socioeconomic benefits that the park brings to the local and regional economy would continue. There would be minor to moderate direct short-term and long-term improvements in both permanent and temporary federal and private sector employment opportunities from implementing alternative B, which would generate about 600 jobs. There would also be minor to moderate indirect improvements in overall socioeconomic activity and tax revenues as the planned upgrades of facilities and programs are implemented. These economic benefits would be due to increased payrolls and visitor spending, providing about $20.1 million in additional sales and $1.9 million in additional tax revenues. These benefits would be both local and regional in nature, with the minor to moderate improvements to employment benefiting the relatively isolated and sparsely populated southwest Texas counties of Brewster, Presidio, and Terrell. There would also be international economic stimulation with enhanced employment opportunities for Mexican communities along the border. There might be beneficial cumulative socioeconomic impacts in the Mexican villages that border the park, and at the Big Bend Ranch State Park, Black Gap Wildlife Management Area, and the Rio Grand Wild and Scenic River from enhanced recreational activity.

UNAVOIDABLE ADVERSE IMPACTS

The following paragraphs describe the more important (moderate and major intensity) adverse impacts that would result from implementing alternative B. These are residual impacts that would remain after mitigation was implemented. The negligible and minor impacts are described in the previous analysis.

Natural Resources

All of the soils in the park (about 10 acres) and outside the park (about 2.5 acres) that would be disturbed by construction, except the Maverick entrance station, are in developed areas; consequently, soil erosion by wind and water, and soil nutrient transport would result in moderate, long-term, unavoidable, adverse impacts.

Although severe flooding has been infrequent and risks are minor to moderate, flooding at Rio Grande Village, Cottonwood Campground, or Panther Junction could result in major adverse impacts on the visitors or employees involved.

Although the risk of flooding at Panther Junction is not great, damage or loss of 60% of the museum collection could be a major long-term adverse impact on the collection, and loss of infrastructure could have a major long-term adverse impact on operations. Loss of infrastructure could require the park to find temporary offices and housing outside the park. Flooding at Panther Junction could also cause major adverse impacts on the visitors and employees involved.

New natural resource s and collections management building at Panther Junction constructed in a less flood-prone area (less likely to be inundated by smaller floods) would remain within the maximum estimated flood plain. As in no action, flooding at Panther Junction could have a major, long, term adverse impact on infrastructure and require the park to find temporary offices outside the park.

Cultural Resources

Rio Grande Village contains a cultural landscape, resulting from the Mission 66 work in this area of the park, that is potentially eligible for listing on the National Register of Historic Places. The water conservation measures in the Rio Grande Village could result in changing the vegetation characteristic of this landscape, such as reducing the amount of green grass areas and phasing out heavy-water-using plants with more drought-tolerant native species. These actions could have a long-term, moderate, adverse, unavoidable impact on this potential cultural landscape.

Socioeconomic Environment

There would be no unavoidable adverse socioeconomic impacts under any of the three alternatives. No mitigation measures for adverse socioeconomic impacts would be required.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Severe flooding has been infrequent, and the risks are minor to moderate; however, flooding could result in major adverse impacts on visitors or employees involved, museum collections, and park operations.

Construction materials and energy used would be irretrievably lost.

Under alternative B, there would be irreversible and irretrievable commitments of resources in terms of funds expended on both labor and construction materials, and for labor for both facility and program construction and operation. These commitments would be about $1.7 yearly for the additional planned employees and an approximate average of $21.7 million (ranging from $18.3 to $25.0 million) for construction, rehabilitation, and restoration costs.

RELATIONSHIP OF SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Continuing visitor activities would reduce the long-term productivity of the environment and consume scarce water resources. Human activities associated with ongoing visitor and administrative use of the park would prevent vegetation and wildlife populations from reaching their full potential in size and population density.

The short-term disturbance of soils, vegetation, and wildlife habitat from constructing facilities and rehabilitating disturbed areas would be more than offset by the long-term restoration of vegetation and wildlife habitat and reductions in water use at Chisos Basin and Rio Grande Village.

Occupation of the floodplains at Panther Junction, Rio Grande Village, and Cottonwood Campground for the indefinite future would cause long-term reduction in natural and beneficial values of the floodplains.

Under alternatives B and C the development and construction of additional and improved visitor facilities, demolition of structures, and revegetation activities would result in short-term socioeconomic benefits. Once construction work was completed, long-term benefits would result from the enhanced facilities and programs. Alternative B would have the most favorable overall net socioeconomic benefits from increased employment and economic activity.

ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Energy requirements would increase with the construction of new structures. Designing all structures to be energy-efficient could mitigate the additional energy requirements. Alternative B would require slightly less energy than alternative A because three energy-inefficient structures would be removed at Chisos Basin and two of them would be replaced with energy-efficient structures. (The 12-room lodge unit would not be replaced.) Also, electricity required for pumping water would be reduced by 13% at Chisos Basin and 50% at Rio Grande Village.

IMPACTS OF IMPLEMENTING ALTERNATIVE C

NATURAL RESOURCES

Soils

Actions specific to alternative C that would impact soils are as follows:

- Chisos Basin: All development except the main road, 50-car parking area, and a restroom would be removed.
- Panther Junction: The visitor center/ headquarters would be rehabilitated to better serve as a visitor center, consolidate offices for the interpretive division, and provide space for collections. A new administration building and a new warehouse would be built.
- Rio Grande Village: All development would be removed except the main road, a trailhead and 50-car parking area, and a restroom. The trails to Hot Springs and Boquillas Crossing would be extended to the new trailhead.
- Castolon: One fire bay would be constructed.
- Cottonwood Campground: Some campsites would be relocated farther from the river, and a new road would be constructed for egress.
- North Rosillos/Harte Ranch: An interpretive trail would be constructed at Buttrill Spring and possibly at Rosillos.
- Persimmon Gap: No change.
- Maverick: An entrance station would be constructed and the existing entrance station would be removed.
- Gateway communities: Residences and offices would either be constructed or leased.

These actions would disturb approximately 4 acres of soil inside the park and 2.5 acres outside. Removing fuel tanks from the floodplain at Rio Grande Village would be in addition to this number because the extent of required changes is not known. All the areas that would be affected have been previously disturbed. Sites with soil disturbance would undergo accelerated wind and water erosion, at least temporarily, until drainage structures were fully operational and vegetation had recovered in cleared areas. To conserve available organic matter, topsoil, where present, would be retained and replaced. (Soils at Big Bend have virtually no topsoil.) Relatively small areas would be affected, and mitigating measures such as prompt revegetation and silt fences would be employed. However, the aridness of the area would increase the time required for vegetation to become established (if it did become established), and the low resilience of the soil would mean these adverse impacts would be minor and long term.

Trail rehabilitation would include special design methods in areas where the slope is high and soils are easily eroded by wind and water. These impacts have already occurred to some degree because all the areas involved have been disturbed. However, the trail extensions to Boquillas at Rio Grande Village, and new Buttrill Spring trail increase the area impacted by 0.7 to 1.2 acres. The possible length and alignment are not available for the potential Rosillos Trail, so the area of disturbance cannot be calculated. Soil erosion by wind and water, and soil nutrient transport, would result in minor, long-term, adverse impacts.

In this alternative, there would be 700 acres at Chisos Basin, Rio Grande Village, Cottonwood Campground, and the Maverick entrance station where soils would be restored to natural contours, runoff would be routed to natural drainages, and soils would be revegetated. Under alternative C, about 641 acres of the 801,000^{+} acres in the park would continue to be occupied by development. Restoring natural contours, routing runoff to natural drainages, and revegetating an area greater than 700 acres would have a major, long-term beneficial impact on soils.

Removing almost all structures at Chisos Basin, constructing an administration building and storage warehouse at Panther Junction, removing development at Rio Grande Village and extending the trail system, constructing a fire bay at Castolon; constructing a new egress road for Cottonwood Campground, constructing a Buttrill Spring trail and possibly a North

Rosillos/Harte Ranch trail, constructing an entrance station at the park boundary and removing the entrance station at Maverick, and possibly constructing residences and an office building offsite could require regrading that would result in loss of some of the natural soil profile. However, because all these sites except the ones for the new Maverick entrance station and development outside the park are in developed areas, the overall soil quality of these areas has probably already been changed significantly and possibly permanently affected. Within the park, the changes from actions of this alternative would impact small areas within developed areas. (No site for development outside the park has been selected.) Therefore, these impacts would be minor, long term, and adverse.

Soils at Chisos Basin, Panther Junction, Rio Grande Village, Cottonwood Campground, and Castolon have moderate or severe limitations for the kinds of actions that are suggested in alternative C. Further geotechnical investigation would be required to evaluate suitability and needed mitigation before designing the facilities listed. Tables in appendix H show, for each developed area, the actions of the alternatives and specific limitations of soils.

Cumulative Effect. Agriculture, including dryland farming and ranching, have led to the erosion of soils by removing native vegetation and replacing it with plants not necessarily suited to the desert environment. This, along with tilling the soil, has left soils exposed to erosion by wind and water.

The development of some private lands such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses, and construction of five structures in the park could increase runoff, wind erosion, and soil compaction and alter soil regimes.

If efforts to restore soils and natural hydrology at North Rosillos/Harte Ranch are successful, there would be long-term beneficial impacts on soils there. The intensity of the impact is uncertain because the size of the area that would be successfully restored is not known. If funding continues, the project would likely have major beneficial impacts on soils.

Impacts on soils from agriculture and ranching covered wide areas and were adverse. Impacts on soils of current and anticipated future actions outside the park, in conjunction with the impacts of alternative C would be major and adverse because they would probably cover more than 20 acres. Most of the impacts would be the result of development outside the park that might or might not be mitigated. The actions of alternative C and ongoing restoration at North Rosillos/Harte Ranch would contribute a very small increment to the overall cumulative impact.

Conclusion. Soil disturbance from actions proposed in alternative C would be restricted to the minimum required. Construction in alternative C would disturb approximately 4 acres of soil inside the park and 2.5 acres outside. All of the soils in the park that would be disturbed by construction are in developed (disturbed) areas except the Maverick entrance station; consequently, soil erosion by wind and water and soil nutrient transport would result in minor, long-term, adverse impacts. (Soil characteristics for sites outside the park are unknown because no site has been selected.) Removing development, restoring natural contours, and revegetating 700 acres at Chisos Basin, Rio Grande Village, and Maverick entrance station would have a major, long-term beneficial impact on soils.

The park's soil resources would not be impaired by the actions proposed under this alternative.

Vegetation

Construction activities in alternative C (see soils discussion above) would disturb about 4 acres of vegetation inside the park and 2.5 acres outside. Topsoil (if present) would be scraped off and saved for future use before construction began. To allow more rapid recovery of native vegetation and minimize the encroachment of invading species, the topsoil would

subsequently be replaced and reseeded to the extent possible with seed of native species gathered in the park or seeds of native species gathered in the park and propagated elsewhere. During the recovery period, the artificially seeded or replanted native vegetation would not be identical in composition to vegetation prior to construction. A reduction in the organic content of the soil would cause a slight change in species composition for several years. Because the affected area is already disturbed and the described mitigating measures would be implemented, this adverse impact on previously disturbed vegetation would be minor and long term.

At Chisos Basin, Rio Grande Village, Cottonwood Campground, and the Maverick entrance station, 700 acres of soils would be restored to natural contours and revegetated. About 638 of these acres would be at Rio Grande Village, a site where water for irrigation is available to help plants become established. Restoring the areas would have a moderate, long-term, beneficial impact on vegetation.

At Chisos Basin, all development would be removed except a trailhead for access to the backcountry, 50-car parking area, and a restroom. There would be no human use of Oak Spring – an annual reduction of about 4 million gallons of water. Because removal of the development would be a large undertaking and would not be likely to be reversed, the impact would be long term. The plants are growing next to Oak Spring because they are water-loving. Therefore, having wet conditions all year and having use of all the water from the spring except what is taken by wildlife (rather than having some of the water taken all year with periods when nearly all the water in the spring is taken for human use) would be beneficial to these plants. The beneficial impact would be expected to be highly noticeable and increase the abundance and health of individuals, groups of species and communities of plants at the spring. Therefore, this long-term, beneficial impact on plants that use Oak Spring would be major.

At Rio Grande Village, eliminating irrigation (reducing it from about 25.6 million gallons per month to 0) would be expected to kill about 638 acres of exotic vegetation (lawns) and allow native vegetation to repopulate the areas. This would be a major, long-term, beneficial impact on native vegetation.

Some vegetation would be trampled or destroyed by some off-trail use of areas such as the Buttrill Spring and Rosillos trails. This localized intermittent adverse impact would be minor and long term.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert plants. Plants have been affected by being displaced, and habitat has been lost through agricultural uses and introduction of nonnative plants.

The development of some private lands such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses and the construction of five structures in the park could alter vegetative communities and cause loss of plants in some areas. Water use from these developments or uses could reduce water available for vegetation.

If restoration efforts at North Rosillos/Harte Ranch are successful, there would be long-term beneficial impacts on soils and hydrology, which in turn would allow restoration of native plants.

Impacts of agriculture and ranching on vegetation covered wide areas and were adverse. Impacts of current and anticipated future actions outside the park, in conjunction with the impacts of alternative C would result in moderate, long-term adverse impacts on vegetation. Most of the impacts would be the result of development outside the park that might or might not be mitigated. The actions of alternative C and ongoing restoration at North Rosillos/Harte Ranch would contribute a very small increment to the overall cumulative impact.

Conclusion. Construction activities in alternative C would disturb about 4 acres of already disturbed vegetation inside the park and 2.5 acres outside, a minor long-term adverse impact. Revegetation would be attempted, but arid conditions make revegetation difficult. Restoring natural contours and revegetating about 700 acres would have a moderate, long-term, beneficial impact on vegetation.

The removal of all development except a trailhead, parking, and restroom at Chisos Basin would result in a cessation in human use of 4 million gallons per year from Oak Spring – a long-term major beneficial impact on plants that use water from the spring.

Withdrawal of irrigation water from about 638 acres of exotic vegetation at Rio Grande Village would allow native vegetation to return – a major, long-term beneficial impact on native vegetation.

The park's vegetation resources would not be impaired by the actions proposed under this alternative.

Wildlife

Alternative C would result in wildlife disturbance caused by ongoing maintenance such as road grading, revegetation and restoration; and upgrading the water system at Castolon.

Construction on 4 acres in developed areas (except the new Maverick entrance station) inside the park and 2.5 acres outside the park would disturb wildlife and degrade habitat to a small degree. These intermittent adverse impacts would be minor and long term.

At Chisos Basin, all development would be removed except a trailhead for access to the backcountry, 50-car parking area, and a restroom. There would be no human use of Oak Spring – an annual reduction of about 4 million gallons of water. Because removal of the development would be a large undertaking and would not be likely to be reversed, this would be a long-term impact on wildlife using Oak Spring. The cessation of withdrawal of water for human use from the perennial Oak Spring would restore a permanent (year-round) water source for wildlife and increase the amount of water available to wildlife – a beneficial impact in the arid environment of the Chisos Basin. This beneficial effect on habitat at Oak Spring would be expected to be readily detectable, and population size of wildlife species using the spring would be expected to increase. Composition of wildlife communities would be expected to change. Therefore, this would be a moderate, long-term, beneficial impact on wildlife using Oak Spring.

The restoration of natural contours and vegetation on about 700 acres at Chisos Basin, Rio Grande Village, and the Maverick entrance station would provide additional habitat for wildlife. It is anticipated that the restoration of habitat on 700 acres along with the large decrease in human activity there because of the removal of development would have a moderate, long-term, beneficial impact on wildlife.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert animals. Animals have been affected by being displaced and killed as vermin, and habitat has been lost through agricultural uses and introduction of nonnative animals. Wildlife continues to be disrupted by development and human activity.

The development of some private lands such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area for residential, tourist-related, or other uses and the construction of five structures in the park could alter wildlife habitat and habits and cause loss of wildlife in some areas. Water used by developments or for tourists could reduce water available for wildlife. Road kill of rodents, larger mammals, and birds would increase because more development probably would increase traffic.

The past impacts from agriculture and ranching on wildlife covered wide areas and

were adverse. Past and continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on wildlife. Impacts on wildlife of current and anticipated future actions outside the park, in conjunction with the impacts of alternative C and restoration at North Rosillos/Harte Ranch would be moderate, long term, and adverse. Most of the impacts would be the result of development actions outside the park that might or might not be mitigated. The actions of alternative C would contribute a very small increment to the overall cumulative impact.

Conclusion. Stopping withdrawal of water from Oak Spring for human use would be expected to have a long-term, moderate, beneficial impact on wildlife using Oak Spring. Restoration of natural contours and vegetation on about 700 acres at Chisos Basin, Rio Grande Village, and the Maverick entrance station would increase wildlife habitat, a moderate, long-term, beneficial impact on wildlife.

The park's wildlife resources would not be impaired by the actions proposed under this alternative.

Water Quantity

Chisos Basin/Oak Spring. Removing all park and concessioner personnel, functions and development except for a trailhead for access to the backcountry, a 50-car parking area, and a restroom would help conserve water in this arid environment; drinking water and flush toilets would not be provided. Removing all development from Chisos Basin except the main road, a trailhead, 50-car parking and a restroom (without flush toilets) would result in a decrease in water withdrawal from Oak Spring of about 4 million gallons per year. All water formerly used by the development, park and concessioner staff, and visitors would be available to the spring and associated vegetation and wildlife. Because removal of the development would be a large undertaking and would not be likely to be reversed, this would be a long-term, major, beneficial impact on water quantity in Oak Spring.

Panther Junction. Moving 15% of personnel and functions out of Panther Junction would not be expected to decrease water use because additional employees are needed who would work and live at Panther Junction. There would probably be no net change in employees living at Panther Junction. Adding an administration building to the area would add a minimal amount of water use to the area. Incorporating water-saving features into the building would be expected to offset most of the increased use.

Rio Grande Village. Removing all park concessioner personnel, functions and development at Rio Grande Village except a trailhead for access to the backcountry, 50-car parking area, and a restroom would conserve water in this arid environment; drinking water and flush toilets would not be provided. Removing development would reduce the use of water from the river for irrigation from about 25.6 million gallons per month to 0 gallons per month once all development (except cultural resources) is removed and revegetation of the area is complete. There is no data available on how much of the irrigation water evaporates and how much finds its way back into the Rio Grande, but it is thought that most of the water does flow back into the river. Because removal of the development would be a large undertaking and would not be likely to be reversed, this would be a long-term impact on water quantity. Leaving an additional 25.6 million gallons of water per month in the river rather than removing it for irrigation would be expected to be a moderate, long term, beneficial impact on water quantity in the Rio Grande.

Spring at Rio Grande Village. Removing development at Rio Grande Village and providing no water for human use there would mean that all the water formerly used by park and concessioner staff and visitors would be available to two of the three spring-fed ponds in the area. The availability of about 2.9 million additional gallons of water to the pond system would be a major long-term beneficial impact on water quantity.

Castolon. Water use at Castolon is expected to remain the same as alternative A – 2.6 million gallons per year of drinking water from wells and about 125,000 gallons per month of irrigation water from the Rio Grande.

Persimmon Gap. Water use at Persimmon Gap would be expected to remain the same as alternative A – about 300,000 gallons per year.

Cumulative Effects. The presence of dams upstream and continued heavy use of the river would result in major long-term reductions in water quantity in the park and upstream and downstream of the park.

Agriculture, including dryland farming and ranching, and urban development have increased to the point that water in the Rio Grande water shed is overcommitted.

The development of some private lands, such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area, for residential, tourist-related, or other uses would increase ground or surface water use and decrease water availability for other uses in an area where water is already scarce. The exact impact of increased residential or tourist development in gateway communities west of the park, if any, is not known.

Past impacts of use of the Rio Grande for agriculture, ranching, and water supply were, and continue to be, major and adverse. Impacts on water quantity in the Rio Grande of current and anticipated future actions outside the park, in conjunction with the impacts of alternative C and restoration at North Rosillos/Harte Ranch are anticipated to be long term and adverse. Intensity of this impact is not known because it is not clear how increased development in the gateway communities west of the park and the state-managed areas would impact the Rio Grande or what the amount of any increased use would be. The actions of alternative C would contribute a very small increment to the overall cumulative impact.

There would be no cumulative impacts on water quantity in Oak Spring because the spring originates in the Chisos Mountains within the park.

Conclusion. Removing all human use of water from Oak Spring, 4 million gallons per year, would be a long-term, major, beneficial impact. At Rio Grande Village, eliminating the use of irrigation water – 25.6 million gallons per month – from the Rio Grande would be a moderate, long-term, beneficial impact. Removing all human use of the springs at Rio Grande Village, 2.9 million gallons per year, would be a major, long-term, beneficial impact.

The park's water quantity would not be impaired by the actions proposed under this alternative.

Threatened, Endangered, and Candidate Species

Black-capped vireo (endangered). The Chisos Basin including the corridor of the road leading into it, is a very important part of this bird's habitat. Reasons for the bird's decline are habitat loss to urbanization, browsing by herbivores, brush clearing, natural succession, brown-headed cowbird brood parasitism, and human disturbance. Most development in the Chisos would be removed in this alternative. The main road into the Basin would remain and a trailhead and 50-car parking area would be constructed. During demolition and removal of structures, recontouring of the land and revegetation, visitor traffic would be replaced by fewer heavy equipment vehicles such as front-end loaders and dump trucks. Once the heavy equipment work was complete and the trailhead and parking in place, visitor traffic would resume at lower levels than before demolition. Impacts of human disturbance from current visitor use and from fewer heavy vehicles during construction would be expected to be about the same. However, when the only use of Chisos Basin is for backcountry use, human disturbance from a smaller number of visitor vehicles would be expected to be much less. Clearing of road edges would continue, but there would be

fewer roads. In addition, if restoration of vegetation on about 60 acres in the Basin was successful, there might be additional habitat for the black-capped vireo. The decreased traffic on the road would have a beneficial, minor, and long-term impact on the bird by reducing human disturbance. The restoration of about 60 acres of vegetation in the Basin might have a moderate to major long-term beneficial impact on the bird by increasing habitat.

Big Bend gambusia (endangered). This fish, found in the wild at only Rio Grande Village, is threatened by habitat alteration, ground-water pumping, declining spring flows, and competition with introduced nonnative species. The spring that feeds the pond at Rio Grande Village where Big Bend gambusia live is also used for human consumption. Removing development at Rio Grande Village and providing no water for human use there would mean that all the water formerly used by park and concessioner staff and visitors would be available to two of the three spring-fed ponds in the area. The availability of about 2.9 million additional gallons of water to the pond system would remove human competition for water and make it very unlikely that pond system would dry up. Whether this change would actually lead to increases in numbers of this endangered fish is not known. The impact would be expected to be minor to moderate, long term, and beneficial.

Removal of development and most human disturbance from Rio Grande Village would be expected to benefit Big Bend gambusia by reducing the likelihood of predators being introduced into the pond by visitors as when fishermen dispose of their catch. Introduction of predators might still occur when the river overflows into the pond. Restoration of a more natural system through revegetation of the area would provide a more natural area that might benefit the fish. Whether this change would actually lead to increases in numbers of this endangered fish is not known. The impact would be expected to be minor to moderate, long term, and beneficial.

If the potential 10-acre wetland is successfully restored at Rio Grande Village, it would approximately double the habitat of the Big Bend gambusia. Whether there would be a change in population is not known. The impact would be expected to be minor to moderate, long term, and beneficial.

Cumulative Effects. Agriculture, including dryland farming and ranching, have greatly reduced native desert plants and animals including threatened and endangered species. The black-capped vireo has lost habitat to browsing by herbivores, brush-clearing, and human disturbance and urbanization. The Big Bend gambusia has lost habitat to habitat alteration, groundwater pumping, decreasing spring flows, and competition with introduced nonnative species such as the western mosquito fish.

The development of some private lands, such as those in gateway communities west of the park or state lands such as Big Bend Ranch State Park and Black Gap Wildlife Management Area, for residential, tourist-related, or other uses could impact black-capped vireo habitat or alter suitable habitat for Big Bend gambusia. Water used by developments or for tourists could reduce water available for habitat for these species in an area where water is already scarce.

Past impacts on threatened and endangered species from agriculture, including dryland farming and ranching, dam building, urbanization, and over use of water from the Rio Grande have been major and adverse. Impacts on threatened and endangered species from current and anticipated future actions outside the park, in conjunction with the impacts of alternative C and restoration at Harte Ranch, are not known because the locations of species outside the park in areas that might be impacted are not known. Given the lack of information regarding impacts outside the park, it is not possible to assess the relative size of the impacts of alternative C compared to current and anticipated future actions outside the park.

Conclusion. Overall, decreased traffic on the Chisos Basin road would have a beneficial, minor and long-term impact on the black-capped vireo by reducing human disturbance. Restoring about 60 acres of vegetation in the Basin might have a moderate to major long-term beneficial impact on the bird by increasing habitat.

The availability of about 2.9 million additional gallons of water to the pond system where Big Bend gambusia live, restoring more natural conditions in the area through revegetation, and potentially doubling the available habitat through wetland restoration would be expected to have a minor to moderate, long-term, beneficial impact on the fish.

The park's threatened and endangered species would not be impaired by the actions proposed under this alternative.

Floodplains

Natural and Beneficial Floodplain Values. Removal of about 638 acres of development from Rio Grande Village and revegetation of the area would restore natural and beneficial floodplain values – a long-term, major beneficial impact on the floodplain.

Flooding. A flood hazard reconnaissance (NPS: 1991) stated that, "Because flooding occurs only in extremely large and rare events, and flood flow velocities are very small, the possibility that visitors could be injured or lose their lives in a flood at Rio Grande Village or Cottonwood Campground is very small." As in the no-action alternative, the campground at Cottonwood would continue to occupy part of the 100-year floodplain. Under alternative C all the development at Rio Grande Village except the main road would be removed and a parking area, trailhead, and restroom would be constructed. This would remove all overnight use in the area by visitors and employees. Day-use would be greatly reduced. Visitors, employees, and infrastructure at risk from flooding would be greatly reduced at Rio Grande Village. Even though early warning and evacuation plans would be developed, communications might not always be fully comprehended or acted upon. Although the possibility of loss of life is very small, and greatly reduced in alternative C, campers and employees at Cottonwood Campground and day users at Rio Grande Village would remain in some danger. As in the no-action alternative severe flooding has been infrequent, and risks are minor to moderate, but the results of flooding could cause major adverse impacts on the visitors and employees involved.

The entire development at Panther Junction, located on a bajada or area of converging alluvial fans, is subject to flash flooding and debris flows and is geomorphologically unstable. In ideal circumstances, development at Panther Junction would be located outside the maximum estimated flood (Q_{me}) (see appendix F). As in alternative A, the fire management building would be constructed in a less dangerous portion of the flood-prone area. In alternative C, two additional structures would be constructed in the floodplain at Panther Junction – an administration building and a storage warehouse.

According to "Estimation of Flood and Geomorphic Hazard in the Panther Canyon Area of Big Bend National Park, Texas" (NPS 1995), all of the structures at Panther Junction are at "some risk." However, the report also seems to indicate that the risk is not great. Nevertheless, because the long period between events leads to a false sense of security and warning time would be short, there is the possibility of human injury or loss of life in the event of a large flood. Even though the report finds that the risk is not great, flooding at Panther Junction could cause major adverse impacts on the visitors and employees involved.

As in the no-action alternative, in the event of a 500-year or maximum estimated flood (Q_{me}), up to 60% of the park's museum collection, stored at Panther Junction, could be damaged or destroyed. This would be a major long-term adverse impact on the collection.

In addition, a large investment in infrastructure (including the visitor center, the park

headquarters, school, and 76 housing units) could be lost if the 500-year or maximum estimated flood (Q_{me}) occurs at Panther Junction. Even though the risk of this event occurring is not great, loss of infrastructure from flooding at Panther Junction could have a major, long-term adverse impact on NPS operations and could require the park staff to find temporary offices and housing outside the park.

Cumulative Effects. The construction of dams upstream of the park and the heavy use of the Rio Grande upstream have greatly reduced the extent of the floodplain and the natural and beneficial values of floodplains in the park.

Cattle and sheep probably have been allowed to use some riparian areas in and near the park. This practice degrades natural and beneficial floodplain values in exchange for benefits to agricultural uses. NPS structures and visitor uses in floodplain areas contribute to the loss of natural and beneficial values.

The presence of dams upstream and heavy use of the river would continue to result in major long-term reductions in area and in beneficial values in floodplains in the park and upstream and downstream of the park.

Further development in floodplains and wetlands outside the park for residential, agricultural, or commercial uses would decrease the area in which natural and beneficial floodplain values would be preserved.

Even though the natural resources and collections management building would be constructed in a less flood-prone area (less likely to be inundated by smaller floods), and the likelihood of them being damaged in smaller floods would be reduced, they would still be within the maximum estimated flood area at Panther Junction. If the maximum estimated flood occurs, the 60% of the park's museum collection that is stored at Panther Junction could be damaged or destroyed. This would be a major long-term adverse impact on the collection.

Under this alternative the natural and beneficial values of the floodplain areas would continue to be compromised by development at Cottonwood and Panther Junction. This would include a new natural resources and collection management building at Panther Junction.

The past impacts of agriculture, ranching, urbanization, and dam construction on floodplains covered wide areas and were major and adverse. Continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on floodplains. Impacts on floodplains of current and anticipated future actions outside the park, in conjunction with the impacts of alternative C and restoration at North Rosillos/Harte Ranch, would be moderate, long term, and adverse. Most of the impacts would be the result of development actions outside the park that might or might not be mitigated. The actions of alternative C would contribute a very small increment to the overall cumulative impact.

Conclusion. Removal of about 638 acres of development from Rio Grande Village and revegetation of the area would have a long-term, major, beneficial impact on natural floodplain values.

Although the risk is not great, flooding at Panther Junction could cause major adverse impacts on the visitors and employees involved.

Even though the risk of flooding is not great at Panther Junction, damage or loss of 60% of the museum collection would be a major, long-term adverse impact on the collection, and loss of infrastructure would be a major, long-term adverse impact on operations. Loss of infrastructure could require the park to find temporary offices and housing outside the park.

The resources and values of Big Bend National Park would not be impaired because there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, no floodplain resources or values would be impaired as a result of implementing this alternative.

Wetlands

Removing all development from Chisos Basin except the main road, a trailhead, 50-car parking area, and a restroom (without drinking water or flush toilets) would result in a decrease in water withdrawal from Oak Spring of about 4 million gallons per year. All of the water formerly used by the development, park and concessioner staff, and visitors would be available to the spring and associated vegetation and wildlife. Because removal of the development would be a large undertaking and would not be likely to be reversed, this would be a long-term, major, beneficial impact on wetlands associated with Oak Spring.

At Rio Grande Village, riparian and other wetland vegetation has been eliminated from some high visitation areas and would be restored to more natural conditions in this alternative. The natural functioning of wetlands in this area would be enhanced by the removal of most visitor use, cessation of irrigation, and elimination of use of spring water for human drinking water. About 638 acres would be restored to more natural conditions. The area that would be occupied by wetlands after restoration is not known, but it is hoped that the potential 10-acre wetland could be restored. This would be a major, long-term, beneficial impact on wetland processes.

Cumulative Effects. Some wetlands within and outside the park, especially along the Rio Grande, have been filled to make more land available for growing crops. Cattle and sheep probably have been allowed to use some wetland and riparian areas in and near the park. These practices decrease wetland areas and degrade natural and beneficial wetland values in exchange for benefit to agricultural uses. NPS structures and visitor uses in wetland areas contribute to the loss of natural and beneficial values.

The presence of dams upstream and continued heavy use of the river would continue to result in major long-term reductions in wetland area and in beneficial values of wetlands in the park and upstream and downstream of the park. Further development in wetlands outside the park for residential, agricultural, or commercial uses would decrease the area in which natural and beneficial wetland values would be preserved.

The past impacts of agriculture, ranching, urbanization, and dam construction on wetlands covered wide areas and were major and adverse. Continuing overuse of water from the Rio Grande is a major contributor to adverse impacts on wetlands. Impacts on wetlands of current and anticipated future actions outside the park, in conjunction with the impacts of alternative C and restoration at North Rosillos/Harte Ranch, would be moderate, long term, and adverse. Most of the impacts would be the result of development actions outside the park that might or might not be mitigated. The actions of alternative C would contribute a very small increment to the overall cumulative impact.

Conclusion. Removing all human water use from Chisos Basin would mean that about 4 million additional gallons per year would be available to wetland vegetation, a long-term, major, beneficial impact on wetlands associated with Oak Spring.

Removing most visitor use, discontinuing irrigation, eliminating use of spring water for humans, and restoring about 638 acres to more natural conditions would have a major, long-term beneficial impact on wetland processes at Rio Grande Village.

The park's wetland resources would not be impaired by the actions proposed under this alternative.

CULTURAL RESOURCES

Archeological Resources

Analysis. The removal of structures and roads in the Rio Grande Village and Chisos Basin area and the restoration of the natural contours would result in extensive ground disturbance. Although there are archeological resources in these two areas, this action would only occur in previously disturbed areas.

The area around Buttrill Spring contains potentially eligible archeological and historic sites. Developing a trail could be done in a manner to avoid these resources; however the introduction of visitation to the area could result in resource degradation due to trampling of the ruins and prehistoric archeological components of the site. This could be partially mitigated through a visitor education program and would have a long-term, minor to moderate adverse impact.

Known archeological resources can be found in the Panther Junction area, but the construction of a new administrative center and warehouse would be done in a location to avoid these resources. No impact on archeological resources would result.

Archeological resources would be avoided in the location and construction of the trails in the North Rosillos/Harte Ranch area, the relocation of the Cottonwood Campground campsites, and relocation of the Maverick entrance station. There would be no impact on archeological resources in these areas.

The management prescriptions of alternative C would place more than 95% of the park in either the Wilderness or Backcountry Non-wilderness management prescription and less than 5% of the park in management prescriptions that would allow for development. This would not result in disturbance of known archeological resources. The application of the management prescriptions would have a long-term, minor, beneficial impact.

Cumulative Effects. The Black Gap Wildlife Management Area and Big Bend Ranch State Park are required to identify and preserve archeological resources. In the past, archeological resources have been lost due to neglect and lack of adequate protection measures. This situation is slowly being remedied as archeological resources are identified and protection measures are put in place. The park's actions added to those of the state parks could result in long-term; negligible, beneficial cumulative effects on the area's archeological resources.

Conclusion. Overall, alternative C would result in leaving large portions of the park in a natural condition, which would have a long-term, minor, beneficial impact on archeological resources.

The park's archeological resources would not be impaired by actions proposed under this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the development proposed under alternative C would have an effect that would not be adverse.

Historic Structures/Buildings

Analysis. No historic structures would be affected by the removal of development at Rio Grande Village. However, the removal of structures at Chisos Basin would include four small stone cottages that were constructed by the Civilian Conservation Corp and have been determined eligible for listing on the National Register of Historic Places. The demolition and removal of these cottages would result in a long-term, major, adverse impact on these resources. Allowing those portions of the Barker Lodge that are not character defining to deteriorate would have a long-term, negligible, adverse impact on this resource.

The current visitor center dates from the Mission 66 period. A determination of eligibility needs to be completed to determine its significance and character-defining features. If the visitor center were determined eligible,

then changes to the building would be done in such a manner as to not impact the character-defining features. Rehabilitation activities would have a long-term, negligible impact.

Placing more than 95% of the park in either the Wilderness or Backcountry Nonwilderness prescription and less than 5% of the park in management prescriptions that would allow for development would have a long-term negligible, beneficial impact. The reduction of park maintenance demands in this alternative could result in more funding and time for preserving the park's historic structures, which would also have a long-term negligible, beneficial impact.

Cumulative Effects. Historic structures/buildings at Big Bend National Park are subject to damage from development, vandalism, illegal activities, and natural processes. Past development in the Rio Grande Village area, Castolon area, Chisos Basin, and Panther Junction has resulted in the loss of some structures during construction activities as well as the removal of some structures for visitor safety and other park purposes. The reasonably foreseeable future actions, such as construction of new employee housing and administrative, maintenance, and storage facilities, would not impact historic structures/buildings. The minor to major adverse impacts of this alternative, in conjunction with the lack of adverse impacts of other reasonably foreseeable future actions, would result in minor to major adverse impacts on historic structures/buildings. However, the adverse impacts would be a relatively minor component of the overall cumulative impacts, due to the limited scope of the action.

The Black Gap Wildlife Management Area and Big Bend Ranch State Park are required to identify and preserve historic structures. In the past, historic structures have been lost due to neglect, lack of adequate protection measures, or even deliberate destruction. NPS actions added to those of the state parks could result in long-term, negligible to minor adverse effects on the area's historic structures.

Conclusion. Overall, alternative C would result in the demolition of some historic structures while other structures would be preserved. This would result in a long-term moderate to major, adverse impact on historic structures.

Although actions under this alternative would have a major adverse effect on the historic structures/buildings, there would be no major adverse impacts on a resource or value whose conservation is (a) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, (b) key to the natural or cultural integrity of the park or to opportunities to enjoy it, or (c) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the development proposed under alternative C would have an effect that would be adverse.

Cultural Landscapes

Analysis. The removal of man-made features and structures at Rio Grande Village and Chisos Basin would impact two potential cultural landscapes. One landscape represents a potential Mission 66 period and the other represents the "CCC" (Civilian Conservation Corps) period and a potential Mission 66 period at the park. At Rio Grande Village impacts would include the removal of man-made ponds and other features associated with the Mission 66 work there. At Chisos Basin, the action would result in the removal of CCC-era buildings and a road that was originally built by the CCC. It would result in the removal of housing, parking, and campground layouts associated with Mission 66. The demolition and removal of these features would result in a long-term, major, adverse impact.

The management prescriptions of alternative C would place more than 95% of the park in

either the Wilderness or Backcountry Nonwilderness prescription and less than 5% of the park in management prescriptions that would allow for development. The application of these management prescriptions would result in the removal of the two above-mentioned potential cultural landscapes; however, other park cultural landscapes, such as in the Castolon historic district, would be preserved under the management prescriptions. The management prescriptions would have a long-term negligible, beneficial impact on the park's cultural landscapes.

Cumulative Effects. The Black Gap Wildlife Management Area and Big Bend Ranch State Park are required to identify and preserve historic resources including cultural landscapes. In the past and continuing to the present, cultural landscapes have been lost due to lack of identification and protection measures. NPS actions added to those of the state parks would result in the loss of some potential cultural landscapes, which would be considered a long-term, moderate to major, adverse effect on the area's cultural landscapes.

Conclusion. Overall, alternative C would result in the loss of some potential cultural landscapes. This would result in a long-term, major, adverse impact on these resources. Application of the management prescriptions would have a long-term negligible, beneficial impact on the park's cultural landscapes.

Although actions under this alternative would have a major adverse effect on the cultural landscape, there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, no cultural landscapes would be impaired as a result of implementing this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the development proposed under alternative C would have an effect that would be adverse.

Ethnographic Resources

Analysis. The store in Rio Grande Village is a potential ethnographic resource for the Hispanic community. It is scheduled for removal in this alternative. This would result in a long-term, moderate, adverse effect. The removal of structures and the restoration of natural contours in Rio Grande Village and Chisos Basin would not impact or facilitate the beliefs and practices of American Indian groups associated with the park. Nor would the other actions proposed in alternative C impact or facilitate the beliefs and practices of these American Indian groups.

Cumulative Effects. The Black Gap Wildlife Management Area and Big Bend Ranch State Park have neither inventories nor evaluations of ethnographic resources in their parks. In the past, Big Bend National Park did not take into consideration the needs of Hispanic or other groups, but the park staff is constructively working on problems of mutual concern. The park's actions added to those of the state parks could result in long-term negligible beneficial impacts on the area's ethnographic resources.

Conclusion. The overall result of alternative C would be long-term, moderate, adverse impacts on ethnographic resources.

The resources and values of Big Bend National Park would not be impaired because there would be no major adverse impacts on a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend 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. Consequently, no ethnographic resources or values would be

impaired as a result of implementing this alternative.

Section 106 Summary. Under the regulations of the Advisory Council on Historic Preservation (36 CFR 800.5) addressing the criteria of effect and adverse effect, the National Park Service finds the development proposed under alternative C would have an effect that would be adverse.

Museum Collections

Analysis. The rehabilitation of the Panther Junction visitor center would provide more space for display of the park's collections. This would have a long-term, minor beneficial effect. Also a warehouse would be constructed at Panther Junction that would replace the various facilities around the park and the feasibility of storing collections in this structure would be studied. This consolidation of park storage facilities and placing the collections in a facility designed for their protection and preservation would have a long-term, major beneficial effect.

Cumulative Effects. The two Texas state parks and Sul Ross State University would continue to collect, preserve, and interpret cultural and natural materials. This work could result in increased collection materials available to the public and researchers if it was coordinated with the collection work being done by the park staff. Many of the reasonably foreseeable future actions, such as the construction of a new building at Panther Junction for natural resources and collections management to provide additional space for park collections (currently housed inside and outside the park) would result in better care of the collections. This would be a long-term minor to moderate beneficial effect. These actions, added to proposed actions of park staff to care for collections, could result in long-term minor to moderate beneficial impacts on collections in the region.

Conclusion. The overall effect of this alternative would be to have a long-term, major beneficial impact on park collections in that the collections would be better preserved and interpreted.

The park's museum collections would not be impaired by actions proposed in alternative C.

VISITOR UNDERSTANDING

Visitors' Experience of Park Resources

Removal of all facilities at Chisos Basin and Rio Grande Village (except for the main road, a trailhead with parking and restroom, and backcountry trails) would eliminate congestion and most noise from these primary resource areas of the park. Visitors would experience these areas as day-use sites and would have ample opportunities to seek solitude and interact with resources. This would be a major long-term beneficial impact on visitor experience of natural and cultural resources.

Removing the lodging at Chisos Basin and camping facilities at Rio Grande Village would result in the loss of overnight experiences for some visitors. Because of the coolness of Chisos Basin in the warmer months and the campground's proximity to the river at Rio Grande Village, these are prime areas for staying overnight; the loss of these facilities would be a major long-term adverse impact on the overnight visitor experience.

Park visitors can stop at many sites throughout the park to see the resources and hike/walk trails to interact with park resources. This interaction is considered an important element of most visitors' experiences; therefore, continuing to provide these opportunities would result in a continued major beneficial effect for most visitors. The visitor experience would be further enhanced by the addition of interpretive trails at Buttrill Spring and possibly at Rosillos Ranch.

Removing facilities at Chisos Basin and Rio Grande Village would significantly reduce the adverse impacts from lights at night. The natural setting would be enhanced, although lights in the Panther Junction area would continue to disrupt the experiences for small

numbers of visitors. Overall, removal of facilities at Chisos Basin and Rio Grande Village would have a major, long-term, beneficial impact on opportunities to see the night sky without light intrusions.

Access to Orientation and Interpretation

Rehabilitating the existing headquarters building at Panther Junction to accommodate offices, storage, and a visitor center would create some conflicts in use and space allocation. Although the space devoted to the visitor center might be enlarged from the current facility, it might not be sufficient or in the best configuration to best interpret park themes, provide information, and otherwise meet visitor needs. However, the result would be long term and moderately beneficial to the overall visitor experience.

Visitor Safety

The reduction of facilities at Chisos Basin would be partially offset by increased access to visitor safety information at Panther Junction. Removing visitor facilities at Rio Grande Village would virtually eliminate the danger to visitors from flooding there. Please see the previous section on floodplains and flooding for more details.

Conclusion

Over the long term, day use visitors at Chisos Basin and Rio Grande Village would benefit from the removal of overnight facilities brought about by alternative C. This would be a major long-term beneficial impact on visitor experience of natural and cultural resources.

A rehabbed visitor center at Panther Junction would provide additional space for interpreting the park's primary themes, conducting interpretive and educational programs, and ensuring that visitors receive sufficient information to effectively plan for a safe and enjoyable stay. This would provide a moderate long-term benefit for the majority of park visitors.

Removing lodging and camping facilities would result in the loss of overnight experiences for some visitors. Removing the interpretive centers at Chisos Basin and Rio Grande Village would eliminate opportunities for visitors to learn, through exhibits and other indoor media, some of the key themes and resource management issues of these sections of the park. The loss of these facilities would be a major long-term adverse impact on the overnight and interpretive visitor experiences in these areas.

Retaining the Cottonwood Campground and picnic areas would constitute a moderate long-range beneficial effect for visitors, and moving some of the campsites further from the river would lessen the potential danger from flooding.

Cumulative Effects

Although past actions have affected the visitor experience, no ongoing or future actions such as repaving the main road would have a perceptible impact on it. The actions of alternative C would not add appreciably to cumulative impacts.

SOCIOECONOMIC ENVIRONMENT

Analysis

Alternative C would maximize stewardship of natural resources and preservation of park resources, along with expanding opportunities for cultural resource understanding. Most of the land in the park would continue to be managed as "proposed" or "potential" wilderness. This alternative would also include some construction of new and improved visitor and park employee facilities, campground improvements, upgrade of one water system to serve visitors and residents, restoration of native drought-resistant plant species, and strengthening of park interpretive and outreach programs. An additional 11.5 full-

time-equivalent employees would be needed to implement this alternative, increasing local employment opportunities and economic benefits.

The park would be expected to continue serving about 300,000 visitors yearly. Total combined sales generated from recreation spending by tourists, expenditures by residents, and direct government expenditures in salaries, supplies, construction projects, etc. with this alternative would total about $85 million. Overall, park and related private sector operations and construction would generate about 2,550 jobs in direct and indirect employment. Total tax revenues (comprised of state and local sales taxes and corporate income taxes) generated by the park and related recreation and support operations and construction projects would be about $8.3 million. The loss of the concessioner's operation at Chisos Basin and Rio Grande Village would reduce total sales from $85.0 million to $83.5 million, and total tax revenues from $8.3 million to $8.1 million. Employment generation would be reduced from 2,550 jobs to 2,505 jobs. Using a worst-case assumption that displaced overnight visitors would not find accommodations elsewhere and would therefore decide not to visit the park would reduce overall annual visitation from about 300,000 visitors per year to about 292,000 per year. These reductions would be considered long term, minor, adverse effects at the park level. However, such changes might affect the concessioner's local management and operating decisions.

In comparison to the no-action alternative, alternative C would have a net increased benefit of about $13.4 million in total combined sales, $1.3 million in tax revenues, and 400 additional jobs. These additional short-term and long-term moderate to major beneficial impacts would be the direct and indirect products of the increased spending on facility upgrades and improvements in programs, including increased park employment.

Cumulative Impacts

Big Bend National Park serves local and regional recreation users, along with a smaller but sizable number of visitors from elsewhere in the United States and some overseas travelers. There would be enhanced natural resource preservation activities, incremental enhancements to the park's facilities and operations, and long-term beneficial cumulative impacts on the regional economy from increased economic activity. Baseline park employment (100 full-time-equivalent employees) would continue, and an additional 11.5 employees would be added, many or most of whom might be drawn from the local labor pool. Therefore, it would be anticipated that most of the economic benefits would accrue to the private sector and to local and state agencies. In addition, there might be beneficial cumulative socioeconomic impacts in the adjacent Mexican villages that border the park resulting from increased employment opportunities, and at the Big Bend Ranch State Park, Black Gap Wildlife Management Area, and the Rio Grand Wild and Scenic River from enhanced recreational activity.

Conclusion

The existing economic and socioeconomic benefits that the park brings to the local and regional economy would continue, and there would be moderate to major direct short-term and long-term benefits in both permanent and temporary federal and private sector employment opportunities with alternative C, which would generate about 2,505 jobs. There would also be a moderate to major indirect long-term, beneficial impact in overall socioeconomic activity and tax revenues as the planned upgrades of facilities and programs are implemented. This beneficial effect would result from increased payrolls and visitor spending providing about $85 million in additional sales and $8.3 million in additional tax revenues. These benefits would be both local and regional in nature, with the moderate to major improvements to employment benefiting the relatively isolated and sparsely populated southwest Texas counties of

Brewster, Presidio, and Terrell. There would also be international economic stimulation with enhanced employment opportunities for Mexican communities along the border.

UNAVOIDABLE ADVERSE IMPACTS

The following paragraphs describe the more important (moderate and major intensity) adverse impacts that would result from implementing alternative C. These are residual impacts that would remain after mitigation was implemented. The negligible and minor impacts are described in the foregoing analysis.

Natural Resources

The natural and beneficial values of floodplain areas would continue to be compromised by development in the flash-flood hazard area at Panther Junction. This continuing long-term adverse impact on natural processes would be unavoidable and moderate.

Although severe flooding has been infrequent and risks are minor to moderate, flooding at Rio Grande Village, or Panther Junction could result in major adverse impacts on the visitors or employees involved.

Even though the risk of flooding is not great at Panther Junction, damage or loss of 60% of the museum collection could be a major, long-term adverse impact on the collection, and loss of infrastructure could be a major, long-term adverse impact on operations. Loss of infrastructure could require the park to find temporary offices and housing outside the park.

Cultural Resources

The removal of structures at Chisos Basin (including four small CCC-era stone cottages that have been determined eligible for listing on the National Register of Historic Places) would result in a long-term, major, adverse impact on these resources.

Overall, alternative C would result in the demolition of some historic structures while other structures would be preserved. This would result in a long-term minor to major, adverse impact on historic structures.

The removal of man-made features and structures at Rio Grande Village (the removal of man-made ponds and other features associated with the Mission 66 work there) and Chisos Basin (the removal of CCC-era buildings and road) would impact these two potential cultural landscapes. These actions would result in a long-term, major, adverse, unavoidable impact on historic structures.

The store in Rio Grande Village is a potential ethnographic resource for the Hispanic community. It is scheduled for removal in this alternative. This would result in a long-term, major, unavoidable, adverse effect.

Visitor Understanding

Removing lodging and camping facilities in Chisos Basin and Rio Grande Village would result in the loss of overnight experiences for some visitors. Removing the visitor centers at Chisos Basin and Rio Grande Village would eliminate opportunities for visitors to learn, through exhibits and other indoor media, some of the key themes and resource management issues of these sections of the park. The loss of these facilities would be a major, long-term, unavoidable adverse impact on the overnight and interpretive visitor experiences in these areas.

Socioeconomic Environment

There would be no unavoidable adverse socioeconomic impacts under any of the three alternatives. No mitigation measures for adverse socioeconomic impacts would be required.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Severe flooding has been infrequent, and the risks are minor to moderate; however, flooding could result in major adverse impacts on visitors or employees involved, museum collections, and park operations.

Removal of four small, historic stone cottages constructed at Chisos Basin by the Civilian Conservation Corps would be irreversible.

Construction materials and energy used would be irretrievably lost.

There would be irreversible and irretrievable commitments of resources in terms of funds expended on both labor and construction materials, and for labor for both facility and program construction and operation. These commitments would be about $0.74 million yearly for the additional planned employees and an approximate average of $17.2 million (ranging from $16.0 to $18.4 million) for construction, rehabilitation, and restoration costs.

RELATIONSHIP OF SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Continuing visitor activities would reduce the long-term productivity of the environment and consume scarce water resources at Panther Junction, Castolon, and Cottonwood Campground. Human activities associated with ongoing visitor and administrative use of the park would prevent vegetation and wildlife populations from reaching their full potential in size and population density.

The short-term disturbance of soils, vegetation, and wildlife habitat from constructing facilities and rehabilitating disturbed areas would be more than offset by the long-term restoration of about 700 acres of vegetation and wildlife habitat and cessation in human use of water at Chisos Basin and Rio Grande Village.

Long-term reduction of human use of Rio Grande Village, restoration of about 630 acres to more natural conditions, and elimination of human use of the spring there might result in long-term improvement of the habitat of the endangered fish, Big Bend gambusia.

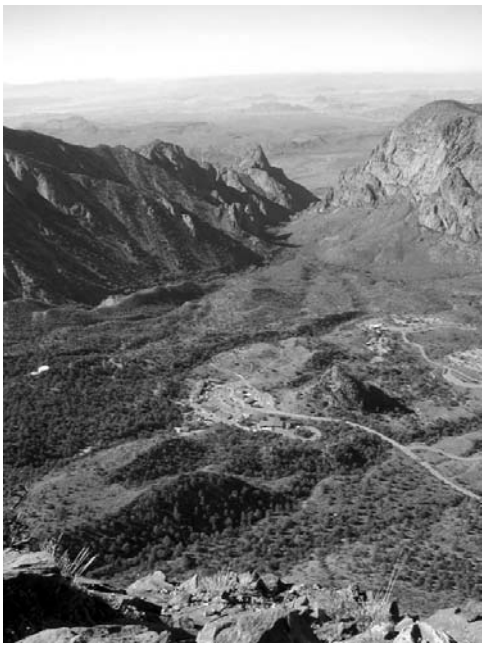
Occupation of the floodplains at Panther Junction and Cottonwood Campground for the indefinite future causes long-term reduction in natural and beneficial values of floodplains. Removal of development at Rio Grande Village would allow floodplain values to become reestablished over the long term at that location.

Under alternatives B and C the development and construction of additional and improved visitor facilities, demolition of structures, and revegetation activities would result in short-term socioeconomic benefits. Once construction work was completed, long-term benefits would result from the enhanced facilities and programs. Alternative B would have the most favorable overall net socioeconomic benefits from increased employment and economic activity.

ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Energy requirements would increase with the construction of new structures and be reduced by removing structures. Designing new structures to be energy-efficient could mitigate the additional energy requirements of new buildings. Alternative C would require much less energy than alternative A because all the structures at Chisos Basin and Rio Grande Village (except historic structures) would be removed.

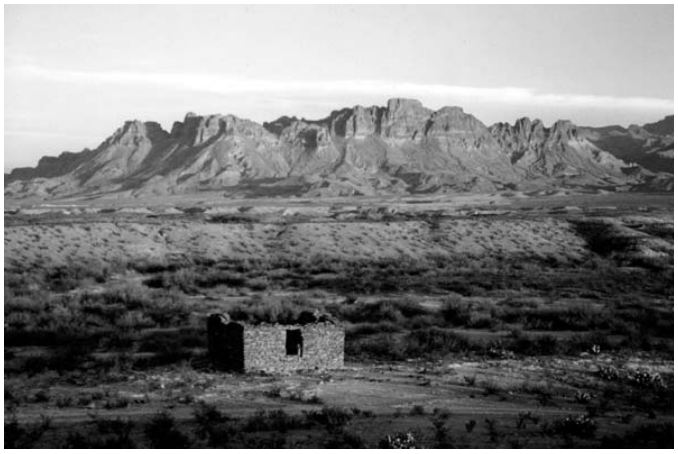
CONSULTATION & COORDINATION WITH OTHERS



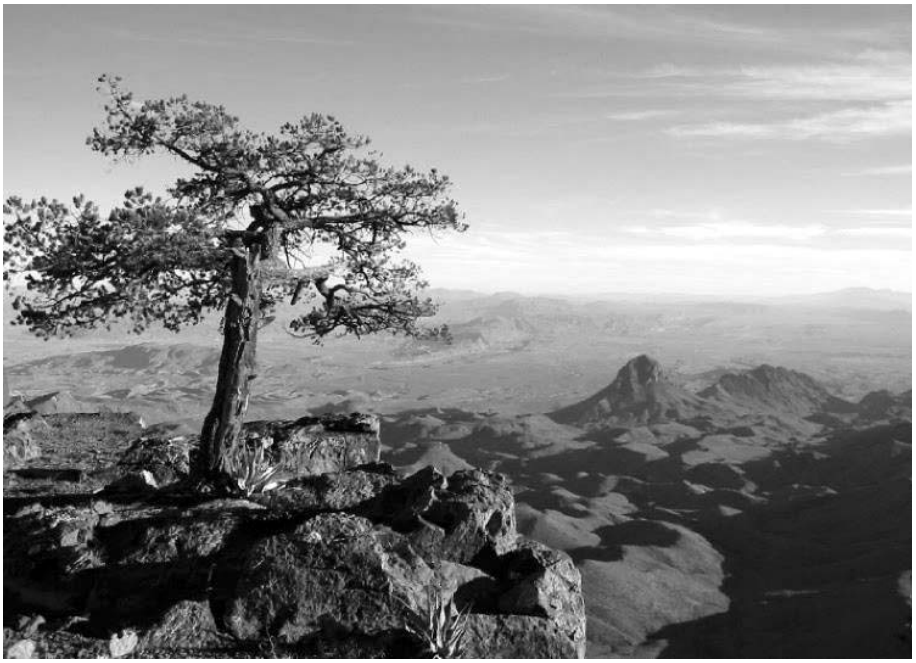
Brian Crocket

Jeff Blaylock

Andy Foster



Jeff Blaylock



Adam Smith

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PUBLIC INVOLVEMENT

The *Draft General Management Plan / Environmental Impact Statement* for Big Bend National Park represents thoughts presented by the National Park Service, Native American groups, and the public. Consultation and coordination among the agencies and the public were vitally important throughout the planning process. The public had two primary avenues by which it participated during the development of the plan: participation in public meetings and responses to newsletters.

PUBLIC MEETINGS AND NEWSLETTERS

Public meetings and newsletters were used to keep the public informed and involved in the planning process for Big Bend National Park. A mailing list was compiled that consisted of members of governmental agencies, nongovernmental groups, businesses, legislators, local governments, and interested citizens.

The notice of intent to prepare an environmental impact statement was published in the *Federal Register* on May 3, 2000. A newsletter issued in May 2000 described the planning effort. Public meetings were held during May 2000 in Study Butte/Terlingua, Alpine, Sanderson, and Austin and were attended by 63 people. A total of 80 electronic and mailed comments were received in response to that newsletter. The National Park Service also met with city, county, and state agencies. In July 2000 the park held meetings in Mexico at Santa Elena, San Vicente, and Boquillas del Carmen. These meetings were attended by nearly 40 people. The National Park Service received comments in the meetings and in the response to the newsletter, and these comments were incorporated into the issues for the plan.

A second newsletter distributed in June 2001 described the draft alternative concepts for managing the national park. A total of 120 electronic and mailed comments were received in response to that newsletter. A number of letters favored only minimal changes to the current management of the park. Other people favored more visitor amenities, such as more recreational vehicle camping areas, trails, etc., while others favored removal of park development from areas of the park like the Chisos Basin.

CONSULTATION

Section 106 Consultation

Agencies that have direct or indirect jurisdiction over historic properties are required by section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470, et seq.) to take into account the effect of any undertaking on properties eligible for the National Register of Historic Places. To meet the requirements of 36 CFR 800, the National Park Service sent letters to the Texas historic preservation office and the Advisory Council on Historic Preservation on May 15, 2000, inviting their participation in the planning process. Both offices were sent all the newsletters with a request for comments.

Under the terms of stipulation VI.E of the 1995 programmatic agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers, the National Park Service, "in consultation with the SHPO, will make a determination about which are programmatic exclusions under IV.A and B, and all other undertakings, potential effects on those resources to seek review and comment under 36 CFR 800.4-6 during the plan review process."

In the following table the specific undertakings are listed, along with the National Park Service's determination of how those individual undertakings relate to the 1995 Programmatic Agreement.

TABLE 9. ACTIONS THAT MIGHT AFFECT CULTURAL RESOURCES AND ASSOCIATED COMPLIANCE REQUIREMENTS

(Requirements of the Texas Historic Preservation Office and/or the Advisory Council on Historic Preservation)

Action	Compliance Requirement
Adaptively use Barker Lodge for housing	Further SHPO review may be necessary at the scoping, conceptual, and possibly at the design stage of the project.
Development at Buttrill Spring	No further SHPO review necessary unless it is determined that the spring and its features are eligible for the National Register of Historic Places or it is determined that visitation to the spring would impact archeological resources.
Removal of one NPS employee residence, NPS "bunkhouse", and one motel unit.	No further SHPO review necessary.
Construct new visitor center	No further SHPO review unless eligible National Register of Historic Places archeological sites are impacted by construction.
Relocation of campsites at Rio Grande Village and Cottonwood Campground	No further SHPO review unless eligible National Register of Historic Places archeological sites are impacted by construction or sites would impact cultural landscapes.
Construct new storage warehouse at Panther Junction	No further SHPO review unless eligible National Register of Historic Places archeological sites are impacted by construction.
Construct new employee housing at Rio Grande Village, Castolon, and Persimmon Gap	No further SHPO review unless eligible National Register of Historic Places archeological sites are impacted by construction or sites would impact cultural landscapes.
Construct fire bays at Rio Grande Village and Castolon	No further SHPO review unless eligible National Register of Historic Places archeological sites are impacted by construction.
Relocation of Maverick entrance station	No further SHPO review unless eligible National Register of Historic Places archeological sites are impacted by construction.
Rehabilitate visitor center	No further SHPO review necessary unless the building is determined eligible for the National Register of Historic Places or is a part of a cultural landscape. If so, further consultation would be necessary to protect the landscape and the character-defining features.
Identification and evaluation of potentially eligible cultural landscapes and resources.	Further SHPO review and consultation necessary to determine if any of the cultural landscapes or properties are potentially eligible for listing on the National Register of Historic Places.

Consultation with Native Americans

Letters were sent to the following Native American groups on May 15, 2000, to invite their participation in the planning process:

Fort Sill Apache Tribe of Oklahoma
Mescalero Apache Tribe
Apache Tribe of Oklahoma
Blackfeet Tribe
Caddo Indian Tribe of Oklahoma
Cheyenne-Arapaho Tribes of Oklahoma
Jicarilla Apache Tribe
Kiowa Indian Tribe of Oklahoma
Comanche Indian Tribe, Oklahoma
Kickapoo Traditional Tribe of Texas

The tribes were briefed on the scope of the planning project and the preliminary alternatives by newsletter and follow-up telephone calls soliciting comments. Oral comments by some tribes included recommendations to maintain the park as it is; other tribes had no comments at this time. The Mescalero Apache commented that traditional cultural properties be identified and protected and that interpretation takes in the Native American viewpoint. Conversations have been ongoing throughout the planning process to inform the tribes about the progress of the plan and identify how and to what extent they would like to be involved. The tribes will have an opportunity to review and comment on this draft plan.

AGENCIES AND ORGANIZATIONS TO WHICH THIS DOCUMENT WAS SENT

Federal Agencies

Federal Emergency Management Agency
U.S. Army Corps of Engineers
U.S. Department of Agriculture
    Natural Resources Conservation Service
    U.S. Forest Service
U.S. Department of the Interior
    Advisory Council on Historic Preservation
    National Park Service
        Amistad National Recreation Area
        Guadalupe National Park
        Organ Pipe Cactus National Park
        Rivers and Trails Program
    U.S. Fish and Wildlife Service
        Ecological Field Office
    U.S. Geological Survey
U.S. Environmental Protection Agency

Mexican State Agencies

Patricio Martinez
Palacio de Gobierno
Chihuahua, Chihuahua 25000
Mexico

Rogelio Montemayor
Palacio de Gobierno
Saltillo, Cohuila 25000
Mexico

Mexican Protected Areas

Maderas del Carmen
Julio Carrera
Apdo. Postal 486
Saltillo, Coahuila 2500
Mexico

Cañon de Santa Elena
Pablo Dominquez
Col. San Felipe
Chihuahua, Chihuahua 31240
Mexico

U.S. Senators and Representatives

Office of Senator John Cornyn
Office of Senator Kay Bailey Hutchison
U.S. Representative Henry Bonilla
U.S. Representative Gene Green
U.S. Representative Silvestre Reyes

State Agencies

Texas Commission on Environmental Quality
Texas Parks and Wildlife
    Big Bend Ranch State Park
    Black Gap Wildlife Management Area
    Davis Mountains State Park
    Endangered Species Branch
Texas Historical Commission (state historic preservation office)

State Officials

Texas Governor Rick Perry
Texas State Representative Pete Gallego
Texas State Senator Frank Madla

American Indian Tribes With Potential Cultural Affiliation to the Park

Fort Sill Apache Tribe of Oklahoma
Mescalero Apache Tribe
Apache Tribe of Oklahoma
Blackfeet Tribe
Caddo Indian Tribe of Oklahoma
Cheyenne-Arapaho Tribes of Oklahoma
Jicarilla Apache Tribe
Kiowa Indian Tribe of Oklahoma
Comanche Indian Tribe of Oklahoma
Kickapoo Traditional Tribe of Texas

Local, City, and County Governments

Amarillo, Texas, local governement
Brewster County
    Commission
    Judge, Val Beard
Brownsville, Texas, local government
Pecos, Texas, local government
San Vicente School District

Terrell County Commission
Judge Dudley Harrison

Organizations and Businesses

Abilene Reporter-News
Alpine Commerce
Alpine Observer
American Whitewater Association
Andy White Ranches
Associated Press
Audubon Texas
Austin American-Statesman
Balmorhea Commerce
Barton Warnock Center
Big Bend Motor Inn/Mission Lodge
Big Bend Natural History Association
Big Bend River Tours
Big Spring Commerce
Big Spring Herald
Borderline
Brownsville
Brownwood Bulletin
Bullis Gap Ranch and Paradise Valley Ranch
Center for Environmental Resource Management
Chevron USA
Chisos Mountain Lodge
Continental Divide Trail Society
Conservationists' Wild River Committee
Crane Chamber of Commerce
Dallas Morning News
Davis Mountains Trans Pecos Heritage Association
Del Rio Commerce
Del Rio News Herald
Desert Sports
Eagle Pass News-Guide
El Paso Times
Far Flung Adventures
Forever Resorts, LCC
Fort Davis Chamber of Commerce
Fort Stockton Commerce
Fort Stockton Pioneer
Fort Worth Newsletter
Fort Worth Star Telegram
Galveston Daily News
Houston Chronicle
Indian Creek Landowners Association
Isleta del Sur Pueblo
Jeff Davis County Mountain Dispatch
Judge Roy Bean Center
Kent State University
KFST Radio
KLKE and KDLK Radio
KMID-TV Channel 2
KVLF Radio
KOSA-TV
KVLF Radio
KWES-News West 9
KWES-TV
KWMC Radio
Lajitas Trading Post
Laredo Morning Times
Lubbock Avalanche-Journal
Marathon Commerce
Marfa Chamber of Commerce
Midland Commerce
Midland Reporter-Telegram
Mission Chamber of Commerce
National Parks and Conservation Association
National Park Concessions, Inc.
Northern Arizona University
Northwestern University
Odessa American
Odessa Convention & Visitors Bureau
Paradise Valley
Pecos Commerce
Pecos Enterprise
Pitcock Ranch
Presidio Commerce
Randolph Company
Rio Grande Adventures
Rio Grande Sun
Riskind Natural Resources
Rhodes Welding
San Angelo Commerce
San Angelo Standard-Times
San Antonio Express-News
Sanderson Commerce
San Marcos Record
Sanderson River Ranch
Santa Fe New Mexican
Sierra Club
Standard/Radio Post
Study Butte Store
Sul Ross University
Terlingua Moon
Terlingua Ranch Lodge
Terrell County News Leader
Terrell Visitor
Texas Audubon Society
Texas Explorers Club
Texas River Adventures

Texas Rivers Protection Association
Texas Tech University
The Alpine Avalanche
The Battalion
The Big Bend Sentinel
The Conservation Fund
The Conservationists' Wilderness and Wild River Committee
The Crane News
The Desert Candle Newspaper
The Gage Hotel
The International Presidio
The Lajitas Sun
The Sweetwater Reporter
The Van Horn Advocate
TOCNR
University of Northern Colorado
University of Texas-El Paso
Uvalde Commerce
Valley Star
Voyageur Outward Bound
Waco Tribune-Herald
World Wildlife Fund

APPENDIXES, BIBLIOGRAPHY, PREPARERS, & INDEX

Karl Tipple

Gareth Rowell

Dave Catalani

Bill Chambers

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APPENDIX A: LEGISLATION

2. Big Bend National Park

An Act To provide for the establishment of the Big Bend National Park in the State of Texas, and for other purposes, approved June 20, 1935 (49 Stat. 393)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That when title to such lands as may be determined by the Secretary of the Interior as necessary for recreational park purposes within the boundaries to be determined by him within the area of approximately one million five hundred thousand acres, in the counties of Brewster and Presidio, in the State of Texas, known as the "Big Bend" area, shall have been vested in the United States, such lands shall be, and are hereby, established, dedicated, and set apart as a public park for the benefit and enjoyment of the people and shall be known as the "Big Bend National Park": *Provided,* That the United States shall not purchase by appropriation of public moneys any land within the aforesaid area, but such lands shall be secured by the United States only by public and private donations. (16 U.S.C. sec. 156.)

Big Bend National Park, Texas.

Establishment.

Area, location, etc.

Proviso.

Lands secured by donation only.

SEC. 2. The Secretary of the Interior is hereby authorized, in his discretion and upon submission of evidence of title satisfactory to him, to accept, on behalf of the United States, title to the lands referred to in the previous section hereof as may be deemed by him necessary or desirable for national-park purposes: *Provided,* That no land for said park shall be accepted until exclusive jurisdiction over the entire area, in form satisfactory to the Secretary of the Interior, shall have been ceded by the State of Texas to the United States. (16 U.S.C. sec. 157.)

Acceptance of title.

Proviso.

Exclusive jurisdiction required.

SEC. 3. The administration, protection, and development of the aforesaid park shall be exercised under the direction of the Secretary of the Interior by the National Park Service, subject to the provisions of the Act of August 25, 1916 (39 Stat. 535), entitled "An Act to establish a National Park Service, and for other purposes", as amended: *Provided,* That the provisions of the Act of June 10, 1920, known as the "Federal Water Power Act", shall not apply to this park. (16 U.S.C. sec. 158.)

National Park Service to administer, etc.

Water Power Act not applicable. 41 Stat. 1063.

Excerpt from An Act of the Legislature of Texas, approved May 12, 1939, authorizing the cession to the United States of exclusive jurisdiction over lands conveyed to the United States for the Big Bend National Park. (Art. 6077e, Vernon's Annotated Revised Civil Statutes of the State of Texas)

The United States Government, through the Secretary of the Interior or any other Agency, is hereby authorized to

acquire title, to hold, occupy and possess the area herein defined as the Big Bend National Park and the Governor of the State of Texas is hereby authorized to execute a deed of conveyance to the United States Government covering the area acquired under the terms of this Act as the Big Bend National Park for the use of the public for recreational park purposes, in consideration of the United States Government agreeing to establish and maintain said area as a National Park under an Act of Congress, being Public— No. 157, enacted by the Seventy-fourth Congress of the United States and to cede to the United States jurisdiction over said lands in conformity with the provisions of Article 5247, of the Revised Civil Statutes of Texas, 1925; reserving, however, to the State of Texas, the right to retain concurrent jurisdiction with the United States over every portion of the lands so ceded, so far, that all process, civil or criminal, issuing under the authority of this State or any of the courts or judicial officers thereof, may be executed by the proper officers of the State, upon any person amenable to the same within the limits of the land so ceded as the area for the Big Bend National Park, in like manner and like effect as if no such cession had taken place; and, reserving further, to the State the right to levy and collect taxes on sales of products or commodities upon which a sales tax is levied in this State, and to tax persons and corporations, their franchises and properties, on land or lands deeded and conveyed under the terms of this Act; and reserving also, to persons residing in or on any of the land or lands deeded or conveyed under the terms of this Act to the United States Government the right to vote at all elections within the counties, in which said land or lands are located, upon like terms and conditions and to the same extent as they would be entitled to vote in such counties had not such lands been deeded or conveyed as aforesaid to the United States of America.

2. Big Bend National Park

An Act Providing for the appointment of a United States commissioner for the Big Bend National Park in the State of Texas, and for other purposes, approved May 15, 1947 (61 Stat. 91)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That upon the establishment of the Big Bend National Park in the State of Texas pursuant to the provisions of the Act of June 20, 1935 (49 Stat. 393), entitled "An Act to provide for the establishment of the Big Bend National Park in the State of Texas, and for other purposes," the United States District Court for the Western District of Texas shall appoint a commissioner for the said national park. The district court shall prescribe the rules of procedure and practice for the commissioner in the trial of cases and for appeal to the district court. The commissioner shall be paid an annual salary, as appropriated for by the Congress. (See 28 U.S.C. §§ 631, 634 notes.)

Big Bend National Park, Texas. Appointment of Commissioner. 16 U.S.C. §§ 156–158.

Salary.

SEC. 2. The commissioner shall have jurisdiction to issue process in the name of the United States for the arrest of any person charged with a violation of any of the rules and regulations made by the Secretary of the Interior in pursuance of law for the government and protection of the park, or with the commission within the park of a petty offense against the law, and to try the person so charged, who, if found guilty, shall be subject to the punishment prescribed by section 3 of the Act of August 25, 1916 (39 Stat. 535; U.S.C., title 16, sec. 3), as amended. For the purposes of this Act, the term "petty offense" shall be defined as in section 335 of the Criminal Code (U.S.C., title 18, sec. 541). In all cases of conviction an appeal shall lie from the judgment of said commissioner to the district court. (See 28 U.S.C. § 632 note.)

Jurisdiction of commissioner.

"Petty offense." 35 Stat. 1152.

SEC. 3. The commissioner shall have power to issue process in the name of the United States for the arrest of any person charged with the commission within said park of any criminal offense not covered by the provisions of section 2 of this Act, and to hear the evidence introduced. If he is of the opinion that probable cause is shown for holding the person so charged for trial, he

Criminal offense.

shall commit such person for further appropriate action, and shall certify a transcript of the record of his proceedings and the testimony in such case to the district court, which court shall have jurisdiction of the case. (*Ibid.*)

Fees, costs, expenses, etc.

SEC. 4. All fees, costs, and expenses arising in cases under this Act and properly chargeable to the United States shall be certified, approved, and paid as are like fees, costs, and expenses in the courts of the United States. All fines, fees, costs, and expenses imposed and collected shall be deposited by the commissioner, or by the marshal of the United States collecting the same, with the clerk of the United States District Court for the Western District of Texas. (See 28 U.S.C. § 634 note.)

An Act To authorize the addition of certain lands to the Big Bend National Park in the State of Texas, and for other purposes, approved August 30, 1949 (63 Stat. 679)

Big Bend National Park, Tex. Additional land.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Interior is authorized to acquire, in such manner as he shall consider to be in the public interest, any land or interests in land situated within sections 15, 22, 27, 34, block 234, Brewster County, Texas, which he shall consider to be suitable for addition to the Big Bend National Park: *Provided, however*, That the aggregate cost to the Federal Government of properties acquired hereafter and under the provisions hereof shall not exceed the sum of $10,000. Properties acquired pursuant to this Act shall become a part of the park upon acquisition of title thereto by the United States. (16 U.S.C. § 157a.)

An Act To authorize the acquisition by the United States of the remaining non-Federal lands within Big Bend National Park, and for other purposes, approved August 8, 1953 (67 Stat. 497)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, notwithstanding any other provisions of law, the Secretary of the Interior is hereby authorized to procure, in such manner as he may consider to be in the public interest, the remaining non-Federal land and interests in land within the boundaries of Big Bend National Park. (16 U.S.C. § 157b.)

2. Big Bend

Public Law 96-607
96th Congress

An Act

Dec. 28, 1980
[S. 2363]

To provide, with respect to the national park system for the establishment of new units; for adjustment in boundaries; for increases in appropriation authorizations for land acquisition and development; and for other purposes.

National Park System, amendment.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

* * * * * * *

TITLE IV

BIG BEND NATIONAL PARK

16 USC 157c.

SEC. 401. The boundary of the Big Bend National Park in the State of Texas as hereby revised to include the lands and interests therein within the area generally depicted on the map entitled "Big Bend National Park, Boundary Additions", numbered 155/80,019-A and dated June 1980 which shall be on file and available for public inspection in the local and Washington, District of Columbia, Offices of the National Park Service, Department of the Interior. The Secretary is authorized to acquire the lands and interests therein added to the park by this section by donation, purchase with donated or appropriated funds, or exchange, except that lands and interests therein owned by the State of Texas or any political subdivision thereof may be acquired only by donation or exchange. There are authorized to be appropriated such sums as may be necessary to carry out the provisions of this section, but not to exceed $1,500,000 for the acquisition of lands and interests therein.

94 STAT. 3540
Appropriation authorization.

* * * * * * *

94 STAT. 3549

Approved December 28, 1980.

LEGISLATIVE HISTORY:
HOUSE REPORTS: No. 96-1024 accompanying H.R. 3 (Comm. on Interior and Insular Affairs) and No. 96-1520 (Comm. of Conference).
SENATE REPORT No. 96-755 (Comm. on Energy and Natural Resources).
CONGRESSIONAL RECORD, Vol. 126 (1980):
May 20, H.R. 3 considered and passed House.
June 5, considered and passed Senate.
June 17, considered and passed House, amended.
Dec. 3, House and Senate agreed to conference report.

APPENDIX B: DEVELOPING THE PREFERRED ALTERNATIVE

To develop a preliminary preferred alternative, the planning team evaluated the four draft alternatives that had been reviewed by the public in newsletter 2. The planning team broke down the alternative concepts, modified them based on public comment and professional input, and developed the actions that would flow from each concept as guided by the policy, park mission, and park significance. After this was completed, it was determined that two of the alternatives were very similar and these were blended to form one alternative. The alternatives were tested against the decision points and issues identified by the public and park to determine their relative advantages.

"GIVENS" AND DESIRED CONDITONS

First, it is useful to consider the assumptions or "givens" that affected the analysis of the alternatives. These givens are based on the purpose and significance, laws and policies, and public concerns and comments. The givens are listed below in two categories, one representing conditions that must be met by the preferred alternative; the second representing conditions that would be desirable for the preferred alternative to meet.

The actions in the preferred alternative must accomplish the following:

- would not adversely impact threatened and endangered species in ways that could not be mitigated
- would result in no net loss of wetlands
- would meet clean air and water standards
- would allow no loss of cultural resources without complete documentation
- would allow public access
- would provide safe, sustainable, and efficient operations for resource protection and visitor use

The following actions would be desirable in the preferred alternative:

- would result in little or no adverse impact on plants, animals, or soils
- would preserve properties eligible for the National Register of Historic Places
- would allow maximum public access consistent with resource protection and visitor experience goals

- would result in minimum disruption of desired experiences for users

COMPARING THE ALTERNATIVES

The next step was to develop criteria that would be used to compare alternatives. Using the givens presented above and topics that were commonly mentioned by the public in commenting on the alternatives, the team identified four criteria to evaluate the alternatives.

- visitor understanding of the park's significance
- natural resource stewardship
- cultural resource stewardship
- efficiency of park operations

The team identified the benefits of each alternative for each of the criteria. Alternative B best enhanced the visitor's understanding of the park's significance because the increased opportunities and diversity of ways it provided for interpreting the park's significance to visitors. Alternative A maintains the current range of visitor activities that only provide a limited understanding of the park's significance. Alternative C reduces the number and types of visitor activities and in so doing reduces opportunities to understand the park's significance.

Alternative C best supports natural resource stewardship as it provides the greatest reduction in park water use and creates the most wildlife habitat. Alternative A maintains the current water use but upgrades utility systems. Alternative A does not measurably reduce the park water use or create wildlife habitat. Alternative B somewhat reduces water use and creates wildlife habitat.

Alternative B best provides for cultural resource stewardship in that it sets preservation priorities and provides a number of strategies for giving more protection to cultural resources. Alternative C results in the lost of some cultural landscapes and structures. Alternative A would result in limited protection for cultural resources.

Alternative B would best provide for more efficient park operations by creating more functional park facilities and reducing the number of park personnel in the park. Alternative C would provide for similar benefits, but the removal of park visitor amenities could make this alternative slightly less efficient. Alternative A would continue a number of inefficient activities such as collections and staff being house in various structures – some not suitable for these purposes.

APPENDIX C: LETTERS REGARDING THREATENED AND ENDANGERED SPECIES

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services Field Office
10711 Burnet Road, Suite 200
Austin, Texas 78758

JUL - 6 2000

2-15-00-I-868

Mary Magee (DSC-PDS-RP)
National Park Service, Denver Service Center
Box 25287
Denver, Colorado 80225

Dear Ms. Magee:

This responds to your June 5, 2000 letter, requesting a current list of federally listed or proposed threatened and endangered species and mapped locations of known populations and Critical Habitat that may occur in Terrell and Brewster counties, Texas. It is our understanding this information will assist in the development of a general management, river management planning, and wilderness study to prescribe resource conditions and visitor experiences to be achieved and maintained at Big Bend National Park and Rio Grande Wild and Scenic River over time.

Enclosed is the list of species you requested and a copy of "Threatened and Endangered Species of Texas (Revised June 1995)," a publication that contains general information about the life histories, habitats, and distribution of the federally listed species in Texas. No federally designated Critical Habitat currently exists in Terrell or Brewster counties and, although we are unable to provide you with mapped locations of known listed species' populations, we look forward to working with you to determine when species surveys would be appropriate in an effort to avoid adverse impacts to federally listed or proposed species and their habitats.

We appreciate the opportunity to comment on the proposed management plans and your concern for endangered species and fish and wildlife resources. We look forward to assisting you with this effort and reviewing the Draft Environmental Impact Statement. If we can be of further assistance, please contact Dianne Lee at 512/490-0057, extension 231.

Sincerely,

David C. Frederick
Supervisor

Enclosures

Federally Listed as Threatened and Endangered Species of Texas
March 28, 2000

DISCLAIMER

This County list is based on information available to the U.S. Fish and Wildlife Service at the time of preparation, date on page 1. This list is subject to change, without notice, as new biological information is gathered and should not be used as the sole source for identifying species that may be impacted by a project.

Edwards Aquifer species: (Edwards Aquifer County) refers to those six counties within the Edwards Aquifer region. The Edwards Aquifer underlies portions of Kinney, Uvalde, Medina, Bexar, Hays, and Comal Counties (Texas). The Service has expressed concern that the combined current level of water withdrawal for all consumers from the Edwards Aquifer adversely affects aquifer-dependent species located at Comal and San Marcos springs during low flows. Deterioration of water quality and/or water withdrawal from the Edwards Aquifer may adversely affect eight federally-listed species.

Comal Springs riffle beetle	(E)	*Heterelmis comalensis*
Comal Springs dryopid beetle	(E)	*Stygoparnus comalensis*
Fountain darter	(E w/CH)	*Etheostoma fonticola*
Peck's cave amphipod	(E)	*Stygobromus (=Stygonectes) pecki*
San Marcos gambusia	(E w/CH)	*Gambusia georgei*
Texas wild-rice	(E w/CH)	*Zizania texana*
Texas blind salamander	(E)	*Typhlomolge rathbuni*
San Marcos salamander	(T □w/CH)	*Eurycea nana*

* The Barton Springs salamander is found in Travis County but may be affected by activities within the Barton Springs Segment of the Edwards Aquifer, which includes portions of Northern Hays County.

Migratory Species Common to many or all Counties: Species listed specifically in a county have confirmed sightings. If a species is not listed they may occur as migrants in those counties.

Least tern	(E ˜)	*Sterna antillarum*
Whooping crane	(E w/CH)	*Grus americana*
Bald eagle	(T)	*Haliaeetus leucocephalus*
Piping plover	(T)	*Charadrius melodus*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
White-faced ibis	(SOC)	*Plegadis chihi*

Brewster County

Black-capped vireo	(E)	*Vireo atricapillus*
Golden-cheeked warbler	(E)	*Dendroica chrysoparia*
Northern aplomado falcon	(E)	*Falco femoralis septentrionalis*
Southwestern willow flycatcher	(E‡)	*Empidonax traillii extimus*
Whooping crane	(E w/CH)	*Grus americana*
Mexican long-nosed bat	(E)	*Leptonycteris nivalis*

Big Bend gambusia	(E)	*Gambusia gaigei*
Davis' green pitaya	(E)	*Echinocereus viridiflorus* var. *davisii (=E. davisii)*
Nellie cory cactus	(E)	*Coryphantha (=Escobaria =Mammillaria) minima*
Terlingua Creek cats-eye	(E)	*Cryptantha crassipes*
Bunched cory cactus	(T)	*Coryphantha ramillosa*
Chisos Mountain hedgehog cactus	(T)	*Echinocereus chisoensis* (=reichenbachii) var. *chisoensis*
Hinckley's oak	(T)	*Quercus hinckleyi*
Lloyd's Mariposa cactus	(T)	*Echinomastus(=Echinocactuss, =Sclerocacuts) mariposensis*
Mountain plover	(P/T)	*Charadrius montanus*
Tall paintbrush	(C)	*Castilleja elongata*
Guadalupe fescue	(C)	*Festuca ligulata*
Shinner's tickle-tongue	(C)	*Zanthoxylum parvum*
Leoncita false foxglove	(SOC)	*Agalinis calycina*
Texas false saltgrass	(SOC)	*Allolepsis texana*
Ferruginous hawk	(SOC)	*Buteo regalis*
Baird's sparrow	(SOC)	*Ammodramus bairdii*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
Northern goshawk	(SOC)	*Accipiter gentilis*
Northern gray hawk	(SOC)	*Buteo nitidus maximus*
Texas olive sparrow	(SOC)	*Arremonops rufivirgatus rufivirgatus*
Western burrowing owl	(SOC)	*Athene cunicularia hypugea*
White-faced ibis	(SOC)	*Plegadis chihi*
Davis Mountain cottontail rabbit	(SOC)	*Sylvilagus floridanus robustus*
Greater western mastiff bat	(SOC)	*Eumops perotis californicus*
Presidio mole	(SOC)	*Scalopus aquaticus texanus*
Spotted bat	(SOC)	*Euderma maculatum*
Texas horned lizard	(SOC)	*Phrynosoma cornutum*
Blotched gambusia	(SOC)	*Gambusia senilis*
Blue sucker	(SOC)	*Cycleptus elongatus*
Chihuahua shiner	(SOC)	*Notropis chihuahua*
Conchos pupfish	(SOC)	*Cyprinodon eximius*
Mexican stoneroller	(SOC)	*Campostoma ornatum*
Proserpine shiner	(SOC)	*Cyprinella proserpina*
Rio Grande darter	(SOC)	*Etheostoma grahami*
Rio Grande shiner	(SOC)	*Notropis jemezanus*
Blanchards' sphinx moth	(SOC)	*Adhemarius blanchardorum*
Bonita diving beetle	(SOC)	*Deronectes neomexicana*
Subtropical blue-black tiger beetle	(SOC)	*Cicindela nigrocoerula subtropica*
Big Bend (Desert Mts.) bluegrass	(SOC)	*Poa strictiramea*
Big Bend hop hornbeam	(SOC)	*Ostrya chisosensis*
Bigpod bonamia	(SOC)	*Bonamia ovalifolia*
Bush-pea	(SOC)	*Genistidium dumosum*
White column cory cactus	(SOC)	*Coryphantha albicolumnaria*
Bushy wild-buckwheat	(SOC)	*Eriogonum suffruticosum*
Chaffey's cory cactus	(SOC)	*Coryphantha chaffeyi*

Chisos agave	(SOC)	*Agave glomeruliflora*
Chisos coral-root	(SOC)	*Hexalectris revoluta*
Chisos pinweed	(SOC)	*Lechea mensalis*
Cliff bedstraw	(SOC)	*Galium correllii*
Cox's dalea	(SOC)	*Dalea bartonii*
Cutler's twistflower	(SOC)	*Streptanthus cutleri*
Dense cory cactus	(SOC)	*Coryphantha dasyacantha* var. *dasyacantha*
Desert night-blooming cereus	(SOC)	*Cereus greggii* var. *greggii*
Duncan's cory cactus	(SOC)	*Coryphantha duncanii*
Glass Mountain coral-root	(SOC)	*Hexalectris nitida*
Glass Mountain rock-daisy	(SOC)	*Perityle vitreomontana*
Golden-spine hedgehog cactus	(SOC)	*Echinocereus chloranthus* var. *neocapillus*
Golden-spined prickly-pear	(SOC)	*Opuntia aureispina*
Heather leaf-flower	(SOC)	*Phyllanthus ericoides*
Hester's cory cactus	(SOC)	*Coryphantha hesteri*
Hinckley's brickelbush	(SOC)	*Brickellia brachyphylla* var. *hinckleyi*
Lateleaf oak	(SOC)	*Quercus tardifolia*
Little-leaf brongniartia	(SOC)	*Brongniartia minutifolia*
Long spur columbine	(SOC)	*Aquilegia longissima*
Many-flowered unicorn plant	(SOC)	*Proboscidea spicata*
Maravillas milkwort	(SOC)	*Polygala maravillasensis*
Mary's bluet	(SOC)	*Hedyotis butterwickiae*
Old blue mock pennyroyal	(SOC)	*Hedeoma pilosum*
Pale phacelia	(SOC)	*Phacelia pallida*
Perennial caltrop	(SOC)	*Kallstroemia perennans*
Purple gay-mallow	(SOC)	*Batesimalva violacea*
Ripley's senna	(SOC)	*Senna ripleyana*
Robert's stonecrop	(SOC)	*Sedum robertsianum*
Silver cholla	(SOC)	*Opuntia imbricata* var. *argentea*
Slender oak	(SOC)	*Quercus graciliformis*
Sonora fleabane	(SOC)	*Erigeron mimegletes*
Stairstep two-bristle rock-daisy	(SOC)	*Perityle bisetosa* var. *scalaris*
Straw-spine glory of Texas	(SOC)	*Thelocactus bicolor* var. *flavidispinus*
Swallow spurge	(SOC)	*Chamaesyce golondrina*
Terlingua brickelbush	(SOC)	*Brickellia brachyphylla* var. *terlinguensis*
Texas milkvine	(SOC)	*Matelea texensis*
Texas wolfberry	(SOC)	*Lycium texanum*
Three-tongued spurge	(SOC)	*Chamaesyce chaetocalyx* var. *triligulata*
Trans-Pecos maidenbush	(SOC)	*Andrachne arida*
Two-bristle rock-daisy	(SOC)	*Perityle bisetosa* var. *bisetosa*
Texas purple spike	(SOC)	*Hexalectris warnockii*
Wilkinson's whitlow-wort	(SOC)	*Paronychia wilkinsonii*
Wright's water-willow	(SOC)	*Justicia wrightii*

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Statewide or areawide migrants are not included by county, except where they breed or occur in concentrations. The whooping crane is an exception; an attempt is made to include all confirmed sightings on this list.

E	=	Species in danger of extinction throughout all or a significant portion of its range.
T	=	Species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
C	=	Species for which the Service has on file enough substantial information to warrant listing as threatened or endangered.
CH	=	Critical Habitat (in Texas unless annotated ‡)
P/	=	Proposed ...
P/E	=	Species proposed to be listed as endangered.
P/T	=	Species proposed to be listed as threatened.
TSA	=	Threatened due to similarity of appearance.
SOC	=	Species for which there is some information showing evidence of vulnerability, but not enough data to support listing at this time.
□	=	with special rule
‡	=	CH designated (or proposed) outside Texas
˜	=	protection restricted to populations found in the "interior" of the United States. In Texas, the least tern receives full protection, except within 50 miles (80 km) of the Gulf Coast.

County Name Code Designations:

examples		
Anderson	=	Arlington Ecological Services (ES) office
(Bee)	=	Corpus Christi ES office
[Galveston]	=	Clear Lake ES office
Gillespie	=	Austin ES office

June 14, 2002

Mary Magee (DSC-PDS-RP)
Big Bend National Park, Denver Service Center
P.O. Box 25287
Denver, Colorado 80225

Dear Ms. Magee:

This letter is in response to your information request, dated June 5, **2000,** and our subsequent telephone conversation May 29, 2002, for potential rare, threatened, and endangered (T&E) species within or near the Big Bend National Park and the Rio Grande Wild and Scenic River. To this end, enclosed are the TPWD county lists of rare, threatened, and endangered species for Brewster and Terrell counties.

Given the small proportion of public versus private land in Texas, the TPWD Biological and Conservation Data System (BCD) does not include a representative inventory of rare resources in the state. Although it is based on the best data available to TPWD regarding rare species, the data from the BCD do not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features within your project area. These data cannot substitute for an on-site evaluation by your qualified biologists. The BCD information is intended to assist you in avoiding harm to species that may occur on your site.

Also, printouts of BCD occurrence records for Big Bend National Park and the Rio Grande Wild and Scenic River are included for your planning reference. **Please do not include species occurrence printouts in your draft or final documents. Because, as you are aware, some species are especially sensitive to collection or harassment, these records are for your reference only.**

TPWD would appreciate receiving updates to the enclosed BCD records and any additional records for rare species maintained for the park and river. Please send any new survey data to the attention of Sandy Birnbaum at TPWD, Diversity Program, 3000 South IH-35, Austin, TX 78704.

Please contact me if you have any questions or need additional assistance (512/912-7021).

Sincerely,

Celeste Brancel-Brown, Environmental Review Coordinator
Wildlife Habitat Assessment Program, Wildlife Division
Threatened and Endangered Species

Enclosures

Big Bend National Park
Texas Parks and Wildlife Department, Endangered Resource Branch
Special Species List, Brewster County

Scientific Name	Common Name	Federal Status	State Status	Found in Park	Found in Project Area (3)	Likelihood of being affected by GMP alternatives
Buteo albicaudatus	white-tailed hawk		T			
Buteo albonotatus	zone-tailed hawk		T			
Buteo nitidus	gray hawk		T	x		
Buteogallus anthracinus	common black-hawk		T	x		
Charadrius montanus	mountain plover	PT	SC	x		
Empidonax traillii extimus	southwestern willow flycatcher	E	E			
Falco peregrinus	peregrine falcon	E	E,T			
Falco peregrinus anatum	American peregrine falcon		E			
Falco peregrinus tundrius	arctic peregrine falcon		T			
Vireo atricapillus	black-capped vireo	E	E	x	x	unlikely
Campostoma ornatum	Mexican stoneroller		T			
Cycleptus elongatus	blue sucker		T			
Cyprinodon eximius	Conchos pupfish		T			
Gambusia gaigei	Big Bend gambusia	E	E	x		unlikely
Notropis chihuahua	Chihuahua shiner		T			
Amplypterus blanchardi	Blanchards' sphinx moth		SC			
Deronectes neomexicana	Bonita diving beetle		SC			
Canis lupus (extirpated)	gray wolf	E	E			
Cynomys ludovicianus arizonensis	black-tailed prairie dog		SC			
Euderma maculatum	spotted bat		T	x		
Eumops perotis californicus	greater western mastiff bat		SC	x		
Felis pardalis	Ocelot	E	E	x		
Leptonycteris nivalis	greater long-nosed bat	E	E	x		
Myotis ciliolabrum	western small-footed bat		SC			
Myotis thysanodes	fringed myotis bat		SC	x		
Myotis velifer	cave myotis bat		SC	x		
Myotis volans	Long-legged myotis bat		SC	x		
Myotis yumanensis	Yuma myotis bat		SC	x		
Nasua narica	White-nosed coati		T	x		
Sigmodon ochrognathus	Yellow-nosed cotton rat		SC			
Sylvilagus floridanus robustus	Davis Mountains cottontail		SC	x		
Ursus americanus	Black bear		T	x		
Humboldtiana chisosensis	Chisos Mountains threeband		SC			
Humboldtiana texaba	Stockton Plateau threeband		SC			
Coleonyx reticulatus	Reticulated gecko		T	x		
Gopherus berlandieri	Texas tortoise		T	x		
Kinosternon hirtipes	Chihuahuan mud turtle		T			
Phrynosoma cornutum	Texas horned lizard		T			

Scientific Name	Common Name	Federal Status	State Status	Found in Park	Found in Project Area (3)	Likelihood of being affected by GMP alternatives
Tantili rubra	Big Bend blackhead snake		T			
Trachemys gaigeae	Big Bend slider		SC			
Trimorphodon biscutatus	Texas lyre snake		T			
Acleisanthes wrightii	Wright's trumpets		SC			
Agalinis calycina	Leoncita false foxglove		SC			
Agave glomeruliflora	Chisos agave		SC	x	Chisos Basin	unlikely
Allolepis texana	Texas false saltgrass		SC	x(2)	Castolon, Cottonwood	unlikely
Andrachne arida	Trans-Pecos maidenbush		SC	*x*		
Batesimalva violacea	Purple gay-mallow		SC	x		
Bonamia ovalifolia	Bigpod bonamia		SC	x		
Bouteloua kayi	Kay's grama		SC			
Brickellia brachyphylla var *hinckleyi*	Hinckley's brickellbush		SC	not in park		
Brickellia brachyphylla var *terlinguensis*	Terlingua brickellbush		SC	x		
Brongniartia minutifolia	Little-leaf brongniartia		SC	*x*		
Cardamine macrocarpa var *texana*	Texas largeseed bittercress		SC	*x*		
Castilleja elongata	Tall paintbrush		SC	x(1)		
Peniocereus greggii var *greggii*	Desert night-blooming cereus		SC	x(2)		
Chamaesyce chaetocalyx var *triligulata*	Three-tongue spurge		SC	*x*		
Chamaesyce golondrina	Swallow spurge		SC	*x*		
Chamaesyce jejuna	Dwarf broomspurge		SC	not in park		
Coryphantha albicolumnaria	White column cactus		SC	x		
Coryphantha dasyacantha var *dasyacantha*	Dense cory cactus		SC	x		
Coryphantha duncanii	Duncan's cory cactus		SC	x		
Coryphantha hesteri	Hester's cory cactus		SC	not in park		
Coryphantha minima	Nellie cory cactus	E	E			
Coryphantha ramillosa	Bunched cory cactus a.k.a. Big Bend cory cactus	T	T	x		
Croton pottsii var *thermophilus*	Leatherweed croton		SC	x		
Cryptantha crassipes	Terlingua creek cat's-eye	E	E			
Dalea bartonii	Cox's dalea		SC	not in park		
Echinocereus chisoensis var *chisoensis*	Chisos Mountains hedgehog cactus	T	T	x		
Echinocereus chloranthus var *neocapillus*	Golden-spine hedgehog cactus		SC	not in park		

Scientific Name	Common Name	Federal Status	State Status	Found in Park	Found in Project Area (3)	Likelihood of being affected by GMP alternatives
Echinocereus viridiflorus correllii	Correll's green pitaya		SC	not in park		
Echinocereus viridiflorus var *davisii*	Davis'green pitaya	E	E			
Erigeron mimegletes	Sonora fleabane		SC	x(2)		
Eriogonum suffruticosum	Bushy wild-buckwheat		SC	not in park		
Escobaria chaffeyi	Chaffey's cory cactus		SC	x	Chisos Basin	unlikely
Festuca ligulata	Guadalupe Mountains fescue	C1	SC	x (1)		
Galium correllii	Cliff bedstraw		SC	not in park		
Gaura boquillensis	Boquillas lizardtail		SC	x		
Genistidium dumosum	Brush-pea		SC	not in park		
Hedeoma pilosum	Old blue pennyroyal		SC			
Hedyotis butterwickiae	Mary's bluet		SC			
Hedyotis pooleana	Jackie's bluet		SC			
Hexalectris revoluta	Chisos coral-root		SC	x		
Hexalectris warnockii	Warnock's coral-root		SC	x	Chisos Basin	unlikely
Justicia wrightii	Wright's water-willow		SC	x(2)	Castolon	unlikely
Kallstroemia perennans	Perennial caltrop		SC			
Lechea mensalis	Chisos pinweed		SC	x		
Lycium texanum	Texas wolf-berry		SC			
Matelea texensis	Texas milkvine		SC			
Neolloydia (Sclerocactus) mariposensis	Lloyd's mariposa cactus	T	T	x		
Nesaea longipes	Longstalk heimia		SC			
Opuntia aureispina	Golden-spine prickly-pear		SC	x		
Opuntia imbricata var *argentea*	Silver cholla		SC	x		
Ostrya chisosensis	Big Bend hop-hornbeam		SC	x		
Paronychia wilkinsonii	Wilkinson's whitlow-wort		SC			
Perityle bisetosa var *appressa*	Appressed two-bristle rock-daisy		SC	Not in park		
Perityle bisetosa var *bisetosa*	Two-bristle rock-daisy		SC	x(2)	Rio Grande Village	unlikely
Perityle bisetosa var *scalaris*	Stairstep two-bristle rock-daisy		SC			
Perityle dissecta	Slimlobe rock-daisy		SC	x	North Rosillos/ Harte Ranch, Chisos Basin	unlikely
Perityle vitreomontana	Glass Mountains rock-daisy		SC	not in park		
Phacelia pallida	Pale Phacelia		SC			
Phyllanthus ericoides	Heather leaf-flower		SC	not in park		
Poa strictiramea	Desert Mountains bluegrass		SC	x		
Polygala maravillasensis	Maravillas milkwort		SC			
Proboscidea spicata	Many-flowered unicorn-plant		SC			

Scientific Name	Common Name	Federal Status	State Status	Found in Park	Found in Project Area (3)	Likelihood of being affected by GMP alternatives
Prunus murrayana	Murray's plum		SC			
Quercus graciliformis	Chisos oak		SC	x	Chisos Basin	unlikely
Quercus robusta	Robust oak		SC	x		
Quercus tardifolia	Lateleaf oak		SC	x		
Rorippa ramosa	Durango yellow-cress		SC	x		
Sedum harvardii	Harvard's stonecrop		SC	x		
Sedum robertsianum	Roberts' stonecrop		SC			
Selaginella viridissima	Green spikemoss		SC	x		
Senna orcuttii	Orcutt's senna		SC			
Senna ripleyana	Ripley's senna		SC			
Streptanthus cutleri	Cutler's twistflower		SC	x		
Thelocactus bicolor var *flavidispinus*	Straw-spine glory-of Texas		SC			
Zanthoxylum parvum	Shinner's tickle-tongue	C1	SC			

1. Big Bend National Park and the U.S. Fish and Wildlife Service have entered into an Agreement in Lieu of Listing (Conservation Agreement) for these species.
2. Current presence in park uncertain.
3. Chisos Basin, Panther Junction, Rio Grande Village, Castolon, Cottonwood, North Rosillos/Harte Ranch

APPENDIX D: INTERPRETIVE THEMES AND SUBTHEMES AND VISITOR UNDERSTANDING GOALS

Interpretive Themes and Subthemes

1. Big Bend National Park's varied ecosystems – mountain, desert, and river – support an extraordinarily rich biological diversity.

    - Although it appears harsh and barren, the Chihuahuan Desert is home to many plants and animals (some found nowhere else in the world) that use ingenious physical adaptations and behavioral strategies to overcome heat and drought stress.
    - The park's location along a major biological corridor for bird migration on the US-Mexico border enable bird-watchers to see more varieties of bird species than in any other national park, as well as some Mexican species seldom seen anywhere else in the United States.
    - The Chisos Mountains, the only complete mountain range found in a national park, stand as a mountain island surrounded by a desert sea, providing cooler, wetter habitat for species unable to survive in the hotter, drier desert. Relict species found in the Chisos Mountains today indicate what the climate and landscape over a broader area were like thousands of years ago. Many species are not found elsewhere in the United States.
    - Big Bend National Park provides valuable habitat for several endangered and threatened species of plants and animals, and the park's protected status greatly aids in the preservation, study, and recovery of many of these species.
    - The periodic occurrence of fire is a natural process in several of the ecosystems of Big Bend and is a necessary element in maintaining the overall health of these systems.
    - Although they are seldom seen, the animals of the desert have become highly adapted and take full advantage of scarce available resources.
    - The rich plant life in Big Bend represents the diversity of the Chihuahuan Desert and provided food, medicine, clothing, textiles, and tools for people of many cultures who have lived here.
    - The outstanding fossils uncovered in Big Bend National Park make this one of the premier national parks for paleontological discoveries. These fossils continue to provide clues to the past climate, flora, and fauna of this region.

2. Major resource threats such as air and water pollution, intrusive sounds, and the presence of exotic plant and animal species as well as vandalism, graffiti, and the illegal collection of plants and animals, negatively impact both the resources of the park and the visitor experience.

    - Big Bend National Park provides visitors with incredibly clear views of the night sky, unobstructed by light pollution.
    - Through stargazing, visitors learn how early cultures relied on the night sky for critical survival information and about current air and light pollution issues.
    - Big Bend is a mandatory class I air quality area under the Clean Air Act, meaning that very little degradation of air quality is acceptable. Both particulate and visibility aspects of air quality have been monitored since 1978. Big Bend is part of a large-scale air resource protection program to determine the potential impact of local and distant pollutant sources on the area.
    - An important part of the NPS mission is to preserve and/or restore the natural resources of the parks, including the natural soundscapes associated with units of the national park system. Intrusive sounds are also a matter of concern to park visitors. Big Bend is relatively free of intrusive sounds and strives to preserve the natural soundscape.
    - Exotic plants and animals are extremely disruptive to park ecosystems. Efforts to

prevent the introduction of exotic species and to remove established exotic species are ongoing.

3. Though rarely seen, water constitutes the most important resource in the Chihuahuan Desert environment. Water is the architect of the desert, and its presence or absence affects the desert's appearance, plant and animal life, and the ways that humans can use it.
   - The ruins at Castolon and Rio Grande Village show evidence that the river has historically been a focal point of life in Big Bend.
   - The Rio Grande is a source of life-giving water for the inhabitants of the Big Bend region, but there are also serious threats to its water quality and quantity.
   - Big Bend is a land of limited water. Water conservation, alternatives to mitigate the historic effects of people on the flow regime, evaluation of flood hazards in developed or frequently visited areas, and monitoring and managing water quality for the health and safety of park visitors and ecosystems are underway.

4. The evidence left behind by different cultural groups over several thousand years, including American Indians, Mexicans, Mexican-Americans, and Anglo-American settlers, gives us clues to the past and helps us imagine what life was like for these early inhabitants of Big Bend.

   - Big Bend National Park contains many outstanding archeological and historical sites and provides visitors with the chance to see how early inhabitants and later settlers lived.
   - People engaged in a number of occupations, including farming, ranching, and mining, to make a living.
   - American troops were stationed at several locations at various times throughout what is now the park from the mid-19th century until the conclusion of the Mexican Border Conflict in 1920. These soldiers, including African American Buffalo Soldiers (1885-90), protected settlers from hostile Indians, border raids, and bandits.
   - How did these various groups adapt to the desert environment, what was their interaction and interdependence, and what was the cumulative effect of the human presence on the developing desert environment?

5. The Maderas del Carmen Protected Area in Coahuila and the Cañon de Santa Elena Protected Area in Chihuahua are two Mexican federally protected areas adjacent to Big Bend National Park, and Big Bend Ranch State Park. Together with Black Gap Wildlife Management Area, these four areas preserve millions of acres of important habitat, protect biological corridors for wildlife migration, and provide unique opportunities for the United States and Mexico to work together to preserve a common ecosystem.

6. Big Bend National Park provides an excellent outdoor laboratory for researchers to study the natural world, the interactions that occur within, and the impacts of both natural events and human activity.
   - In addition to the National Park Service, the state of Texas, its citizens, the Civilian Conservation Corps, and other entities were instrumental in the creation and development of Big Bend National Park and in preserving its resources.

7. The legacy of human impacts on Big Bend National Park's varied environments exhibits changes from past to present, including soil erosion, watershed impairment, grasslands decline, and species reduction.

Visitor Understanding Goals

These goals help establish the desired visitor experiences and serve as a guide for developing a range of management approaches. The National Park Service will provide opportunities for public to

- learn about Big Bend without physically visiting the park
- feel welcome, respected, and able to offer suggestions
- safely enjoy park resources
- experience clean and well-maintained facilities
- visit a park visitor center and talk to a knowledgeable ranger or volunteer
- interact with park employees and other visitors
- have access to differing points of view on issues affecting the park
- learn and practice low-impact uses in the park
- learn about the park by attending interpretive programs
- learn some of the complex natural processes that helped to shape Big Bend
- receive exceptional customer service
- experience solitude
- experience the natural world without the intrusions of modern life
- experience views as far as the eye can see without evidence of humans in the landscape
- see plants and animals in their natural settings
- experience the richness of biological diversity in the park
- visit a historic site and see how early inhabitants of this area lived
- make self-discoveries and establish a connection to park resources
- experience Mexican culture by visiting one of the border towns adjacent to the park
- contemplate their own roles and responsibilities in the stewardship of natural and cultural resources
- enjoy a variety of appropriate recreational opportunities that are compatible with the protection of park resources

APPENDIX E: DRAFT WILDERNESS SUITABILITY ASSESSMENT

DRAFT

L48-(ScRM)

September 14, 2002

MEMORANDUM

From: Regional Director, Intermountain Region

To: Director

Subject: Wilderness Suitability Assessment – North Rosillos area of Big Bend Bend National Park

The Intermountain Regional Office determines that the North Rosillos addition of Big Bend National Park contains roadless and undeveloped Federal lands of sufficient size to make their preservation as wilderness practicable and are therefore suitable as wilderness.

The Wilderness Act of 1964 (16 U.S.C. 1131 et seq.) defines wilderness as "…an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation which is protected and managed so as to preserve its natural conditions…." 16 U.S.C. 1131(c).

The Wilderness Act, regulations at 43 CFR 19, Secretarial Order 2920, and Management Policies of the NPS (2001) require that the National Park Service (NPS) review all areas within a park to determine if any meet the criteria laid out in the Wilderness Act and NPS Policies.

The determination applied the following Management Policies criteria:

> National Park Service lands will be considered suitable for wilderness if they are at least 5000 acres or of sufficient size to make practicable their preservation and use in an unimpaired condition, and if they possess the following characteristics (as identified in the Wilderness Act):

- The earth and its community of life are untrammeled by humans, where humans are visitors and do not remain;
- The area is undeveloped and retains its primeval character and influence, without permanent improvements or human habitation;
- The area generally appears to have been affected primarily by the forces of nature, with the imprint of humans' work substantially unnoticeable;
- The area is protected and managed so as to preserve its natural conditions, and
- The area offers outstanding opportunities for solitude or a primitive and unconfined type of recreation.

NPS Management Policies (2001) 6.2.1.1
Primary Suitability Criteria.

I determine that areas within the North Rosillos addition of Big Bend National Park meet the criteria and are, therefore, suitable for wilderness. Significant portions of the North Rosillos area generally appear to have been affected primarily by the forces of nature with minimal evidence of human activity. These areas of the North Rosillos area offer outstanding opportunities for solitude or for primitive and unconfined recreation.

The suitable area is divided into 2 units. The North Rosillos unit and the Nine Point unit fall on opposite sides of the 14 mile Terlingua Ranch road; a permanent, unpaved, county maintained road; and its 3 mile administrative access road leading to an NPS aircraft facility.

The North Rosillos unit contains approximately 23,300 suitable acres. This includes, as suitable for potential wilderness, a 135 acre powerline corridor and 475 acres in non-federal ownership.

The Nine Point unit contains approximately 39,400 suitable acres. The Nine Point unit also includes areas suitable for potential wilderness: 55 acres of powerline corridor, a four-mile unpaved access road to private land, and approximately 900 acres of NPS land in three triangular parcels that lie between the private land access road and NPS boundary corners.

Attached is a draft notice for publication in the Federal Register should you approve this memorandum as the NPS' final wilderness assessment suitability determination.

Sincerely,

APPENDIX F: STATEMENT OF FINDINGS FOR FLOODPLAINS

STATEMENT OF FINDINGS

FOR

EXECUTIVE ORDER 11988 FLOODPLAIN MANAGEMENT

Rio Grande Village Developed Area & Cottonwood Campground

General Management Plan/Environmental Impact Statement

Big Bend National Park

Recommended:_____
Superintendent, Big Bend National Park Date

Concurred:_____
Chief, Water Resources Division Date

Approved:_____
Director, Intermountain Region Date

In accordance with Executive Order 11988—Floodplain Management and National Park Service guidelines for implementing the order, the National Park Service (NPS) has evaluated flooding hazards for the development at Rio Grande Village and Cottonwood Campground and has prepared this statement of findings (SOF). As an integral part of the effort to develop a general management plan (GMP) for the park, the SOF describes the flood hazard, alternatives, impacts, mitigation, and informed decisions for the continued use of the two areas. Additional detail regarding the park, campground, and future plans may be found in the GMP.

USE OF THE FLOODPLAIN

Rio Grande Village is the site of ponds that are the refugium of the endangered fish, *gambusia*. Visitor facilities include a nature trail, visitor center, gas station, store, 100-site campground, and concessioner RV campground. Administrative development is comprised of offices in the orientation and interpretive center, sewage lagoons, six employee residences, and a maintenance area. The entire developed area, including fuel storage tanks at the gas station, maintenance area, and housing area is located within the 100-year floodplain as mapped on Flood Insurance Rate Maps. Also within the 100-year floodplain is an historic adobe house. In the vicinity of Boquillas Canyon are a hot spring that may be subject to inundation during high flows and the historic Barker Lodge that may be damaged by bank erosion.

Cottonwood Campground, 35 sites, is located upriver from Rio Grande Village in the Castolon historic district. This campground, within the 100-year floodplain according to Flood Insurance Rate Maps, is subject to bank loss.

At Rio Grande Village, the preferred alternative in the general management plan would protect fuel storage from the 500-year flood, revegetate 70 acres formerly used for overflow camping, enlarge the concessioner RV campground by up to 40% not to exceed 30 total sites, move some campsites to better protect the endangered fish, add four offices to the visitor center or construct a new building for four offices, construct one fire bay, preserve Barker Lodge for housing, and add four houses if water is available,

At Cottonwood Campground, the preferred alternative of the GMP would relocate 20 campsites away from the river (because of bank cave-ins), construct a new access road (1/2 mile long) further from the river, and add two new 2-stall Romtech vault toilets.

Use of the 100-year floodplain for a campgrounds, residences, and maintenance buildings is a class I action. Storage of toxic materials (gasoline and other fuels) in the floodplain are class II actions.

ALTERNATIVES CONSIDERED

The first alternative, presented to the public in a newsletter, was relocating the campgrounds out of the 100-year floodplain. Responses were that the park service should not impact a new area when the campground is already in place and that responders do not want to camp at a location away from the river. Being next to the river and the large cottonwoods in the riparian area is highly valued by campers.

Alternative C in the GMP would remove all development except the main road, a trailhead with parking and a restroom, and three trails from Rio Grande Village. (The alternative of removing Cottonwood Campground was not considered in any alternative.) This would restore the natural and beneficial values of the floodplain, protect campers and employees from the dangers of flood, and

remove the opportunity for visitors to camp and receive interpretation of park resources at Rio Grande Village. It would eliminate the need for housing staff and having a maintenance facility at Rio Grande Village, and inconvenience those who use the gas station and store.

FLOOD HAZARD FROM IMPLEMENTATION OF THE PREFERRED ALTERNATIVE WITHOUT MITIGATION

In November, 1991, Gary Smillie and Mike Martin of Water Resources Division, National Park Service conducted flood hazard reconnaissance for the major developments at Big Bend. The following information is from the report of that trip.

> In general we found the Rio Grande River [*sic*] to be functioning in a manner normal for a large river in a fairly natural setting. There is abundant evidence of erosion on the outside of bends, apparently caused most recently by two fairly large flood events in the past year. Channel instability of this type is a natural process and should not necessarily be considered a man-caused problem. Placement of riprap or other structural stabilization technique would make the Rio Grande function less naturally and may, in fact, cause problems in other locations.
>
> Many of the major developments we visited in BIBE are in the greater floodplain of the Rio Grande, however, they will experience flooding only in extremely large (and rare) events. Furthermore, flow velocities can be expected to be very low because of hydraulic conditions along the river. The gradient of the Rio Grande is low, about 5 feet per mile, and the floodplain is very wide. These factors make rapid and dangerous flooding in the areas of visitor and concession use almost impossible. The largest flood events that occur in the Rio Grande originate from precipitation over a large area and can usually be observed upstream, well in advance of arrival to BIBE. Even a very large tributary flood will result in a much smaller relative event in the main river. For these reasons, flash flooding on the main river is not a great concern.
>
> In conclusion, we believe that park developments located along the Rio Grande are well located from a flood hazard perspective. Bank failure will continue to occur and may eventually lead to the need to relocate certain facilities, for example, Cottonwood Campground. However, if unstable bank areas are clearly marked, they are of little risk to visitors. Bank stabilization such as placement of rip rap in eroding bends, is not recommended at this time. Development of a flood warning system based on upstream flow and weather information may be practical and provide sufficient time to evacuate visitor and concession areas…Additionally, signage and/or pamphlet material explaining flood-related hazards could be made available to visitors.

The fact that the Rio Grande is not subject to flash flooding means that the regulatory floodplain for development associated with Cottonwood Campground and Rio Grande Village would be the 100-year floodplain. The regulatory floodplain for fuel storage, a critical action, is the 500-year floodplain.

In summary, because flooding occurs only in extremely large and rare events, and flood flow velocities are very small, the possibility that visitors could be injured or lose their lives in a flood at Cottonwood Campground or Rio Grande Village is very small. The following section describes measures that will be taken to minimize this already very small risk.

THE PROPOSED ACTION

The National Park Service will continue to operate the campground and all other facilities at Rio Grande Village and the campground at Cottonwood. At Rio Grande Village, it would protect fuel storage tanks at the gas station, maintenance area and housing area from the 500-year flood, restore 76 acres formerly used for overflow camping to more natural conditions, enlarge the concessioner RV campground by up to 40% not to exceed 30 total sites, move some campsites to better protect the endangered fish, add four offices to the visitor center or construct a new building for four offices, construct one fire bay, preserve Barker Lodge for housing, and add four houses if water is available. All fuel storage tanks would be protected by constructing berms that reached above the level of the 500-year floodplain, and securing the fuel storage tanks to the berms. At Cottonwood Campground, the preferred alternative of the GMP would relocate 20 campsites away from the river (because of bank cave-ins), construct a new access road (1/2 mile long) further from the river, and add two 2-stall Romtech vault toilets.

The National Park Service will develop a campground operational plan for Cottonwood Campground and a campground and developed area plan for Rio Grande Village to address flooding threats. The plans would address the following points:

- A decision tree for park staff to minimize the threat to life by clear planning choices
- Closure conditions: seasonal, watershed saturation, and storm event priorities
- Notification protocols for park staff, visitors, and campers
- Training staff, campground hosts, and volunteers in the implementation of the plan
- Preparation of informational and warning signs, brochures
- Establishment of formal notification/warning procedures between the park and the National Weather Service
- Heightened awareness periods during monsoon rain months of June, July, August and September, especially when the watershed is saturated by previous rains
- Preemptive night camping closure of the campground using the decision tree
- Formalization of evacuation routes and mobilization sites for rescue
- Review and revision of the plan elements every two to three years.

Some of these points related to flows on the Rio Grande are already included in the 1996 *Water Resources Management Plan, Big Bend National Park, Texas:*

- Educate public on low-flow and flood hazards through information leaflet distribution and with posted warning signs at boat launch sites and popular recreation areas.
- Take nonstructural and low-cost structural measures to protect flood-prone high use areas.
- Monitor National Weather Service severe weather and flood warning broadcasts for Amistad Reservoir and use as an early warning system for the park.
- Train park personnel for flood contingency.
- Use U.S. Geological Survey National Water Information System data from telemetered stations upstream of the park (as far as the Rio Conchos) in conjunction with studies of flood wave propagation along the park boundary to correlate water levels and corresponding discharges at key gauging stations between Presidio and Rio Grande Village.

The proposed action does not represent a new impact upon natural resource, cultural resource, or park infrastructure floodplain values in the park. Because of the restoration of 76 acres to more natural conditions, even with the addition of four offices, four employee housing units, and a fire bay, it does not represent an expansion of impacts on natural resource or park infrastructure floodplain values. It does represent an informed decision concerning the continuation of risk to human life that is

minimized by the mitigation contained in the campground and developed area operation plans. The risk to human life in the campgrounds and developed area cannot be eliminated entirely.

If the campground is damaged by future flooding or, as additional camping facilities and are developed outside the park, the park staff will consider closing the campgrounds on a seasonal or year-round basis, or converting them to day use picnicking only.

SUMMARY

The National Park Service will continue to operate the 35-site campground at Cottonwood, and the 100-site campground and other development at Rio Grande Village. It will protect fuel storage at the gas station and maintenance area from the 500-year flood, return the 76-acre overflow camping area to more natural conditions, enlarge the concessioner RV campground up to a total of 30 sites, and build four offices, four employee residences and a fire bay. Selective closure options described in an operational plan (campground and developed area operation plan) would lower the threat to life and property within the campgrounds and developed area. The park will develop this plan, regularly educate staff and visitors in its detail, and periodically review it with any additional relevant weather or flooding information that becomes available.

REFERENCES

National Park Service

1992 "Trip Report for Travel to Petroglyph National Monument and Big Bend National Park on November 12-17, 1991," by Bill Jackson, Chief, Water Resources Division, Fort Collins, Colorado.

1993 Floodplain Management Guideline, Washington Office, Washington, D.C.

1996 *Water Resources Management Plan, Big Bend National Park, Texas*, Robert D. MacNish and Laurel J. Lacher, University of Arizona, Carl M. Fleming, Big Bend National Park, and Mark D. Flora, Water Resources Division.

STATEMENTS OF FINDINGS

FOR

EXECUTIVE ORDER 11988 FLOODPLAIN MANAGEMENT

Panther Junction Developed Area

General Management Plan/Environmental Impact Statement

Big Bend National Park

Recommended:_____
Superintendent, Big Bend National Park Date

Concurred:_____
Chief, Water Resources Division Date

Approved:_____
Director, Intermountain Region Date

In accordance with Executive Order 11988 – Floodplain Management and National Park Service guidelines for implementing the order, the National Park Service (NPS) has evaluated flooding hazards for the development at Panther Junction and has prepared this statement of findings (SOF). As an integral part of the effort to develop a general management plan (GMP) for the park, the SOF describes the flood hazard, alternatives, impacts, mitigation, and informed decisions for the continued use of this area. Additional detail regarding the park, flooding history, and future plans may be found in the GMP.

USE OF THE FLOODPLAIN

Panther Junction is the location of a visitor center, the principal administrative area for the park (headquarters, maintenance, resource office building, collections storage Bally building), gas station, store, post office, school and 76 housing units (22 of which are trailers). The entire development is in a flash flood prone area. Therefore, according to the NPS Floodplain Management Guideline, 1993, the regulatory floodplain is the Qme. This is an extremely large event with a very low probability of occurrence. It is used as the regulatory floodplain here to provide a high degree of safety from runoff events that may inundate an area in a very short time (NPS WRD 1995: "Estimation of Flood and Geomorphic Hazard in the Panther Canyon Area of Big Bend National Park Texas").

The preferred alternative in the GMP is to construct a new visitor center with 100-space parking area, construct a storage warehouse, rehabilitate the vacated visitor center area of headquarters for additional offices, and move up to 15%of park personnel and functions to gateway communities. A dormitory and three-bedroom house would be built to replace housing units removed from Chisos Basin.

ALTERNATIVES CONSIDERED

The alternative of moving all development out of Panther Junction was considered and rejected because of the very high fiscal and natural resource costs of redeveloping infrastructure at another location. In addition, Panther Junction is located at the intersection of the roads leading from the two park entrances making it the ideal location for the visitor center and administrative facilities for the park. The school and associated housing, owned by the San Vicente School District, can only be moved by that entity.

The Chisos Basin development, located in a unique montane ecosystem and experiencing even greater problems with water quantity than Panther Junction, was deemed to be a higher priority for structure removal. A 12-room motel unit, one employee house and the bunkhouse will be removed from Chisos Basin. The employee house and bunkhouse will be replaced at Panther Junction.

FLOOD RISK

According to a memorandum from Michael Martin, Hydrologist, Water Operations Branch, Water Resources Division, National Park Service to Superintendent, Big Bend National Park on the subject of "Summary of Panther Junction Flood Hazard," April 14, 2000:

> All of the structures at PJ are located on the uppermost end of an extensive bajada, or a series of coalescing alluvial fans. There are three specific flood related hazards associated with this location: bank loss due to erosion, inundation from floodwaters, and destruction from debris flows. Additionally, an overriding hazard exists in the long periods between devastating events, which may create the illusion of inactivity. Lastly, hazardous flood events, when they do take place, may occur in a very short time period due to the relatively small and steep watershed, allowing little opportunity for warning or evacuation. Consequently, this area is considered flash flood prone, and the resulting regulatory floodplain is the Maximum Estimated Flood (Qme).

The following information is from "Estimation of Flood and Geomorphic Hazard in the Panther Canyon Area of Big Bend National Park, Texas," (NPS: 1995).

> The calculated design flood discharges for Panther Canyon were 1500, 2895, and 17000 cubic feet per second (CFS), for the 100-year, 500-year, and Qme, respectively. Mouse Canyon, with its much smaller watershed, produced discharge estimates of 550, 920, and 6000 cfs, for the 100-year, 500-year, and Qme, respectively.
>
> Because Mouse Canyon drains a much smaller watershed and the channel itself is far more entrenched than Panther Canyon, it was determined that the flood risk associated with Panther Canyon is much greater than from Mouse. In fact, the Mouse Canyon channel was capable of containing all three design floods. Consequently, Panther Canyon was judged as the source of all flood hazard and the following results are restricted to that drainage.
>
> Estimations of flood stage indicate that the Panther Canyon channel, with its present morphology, is capable of containing the 100-year discharge. As a result, the residential structures, the school, and the administrative buildings are above the level of this design flood. The 500-year discharge is also contained by the upper channel with it's [sic] present morphology. The downstream channel, however, does not contain the 500-year flood and structures on the lower fan may be subject to some inundation from this flood. This includes the area in the lower fan proposed for future development. The building that contains curatorial storage is located adjacent to the channel at an elevation that is very close to that predicted for the 500-year flood. The Qme discharge in Panther Canyon would overtop the banks and inundate the existing site between both Panther and Mouse Canyons.
>
> The depths of these design floods in Panther drainage ranged from 3.5 feet for the 100-year flood, to 8.5 feet for the Qme (Table 1). Mean channel velocities associated with the three design floods ranged from 8 feet per second (fps) for the 100-year event to about 13 fps for the Qme. These reported depths and velocities are estimated from one-dimensional flow. Any overbank flow, especially on the lower fan, would likely resemble divergent sheetflow and have lower depths and velocities…
>
> Careful field examination was made of Panther Canyon and no indication of previous high magnitude flooding was observed….

Quoting again from a memorandum from Michael Martin, Hydrologist, Water Operations Branch, Water Resources Division, National Park Service to Superintendent, Big Bend National Park on the subject of "Summary of Panther Junction Flood Hazard," April 14, 2000:

Debris Flow Hazard

To substantiate whether a debris flow threat exists or not, a detailed reconnaissance of the upper watershed was conducted with the intent of identifying adverse structure (fractures parallel to slopes) and accumulation of material in potential debris flow source areas. We reconnoitered Panther Canyon for a distance of over a mile upstream of the housing area. At the confluence of Panther and Bovarc Canyons, we proceeded several hundred yards upstream. Above the mentioned confluence, we observed large amounts of alluvium and colluvium in Bovarc Canyon. However, given the low channel gradient and the relatively great distance, it is unlikely that a destructive debris flow could travel to the Panther Junction housing area. The large amount of available material, however, could be transported downstream in moderate to high magnitude floods, aggrading the incised channel and reducing flood conveyance capacity. Aggradation of the incised channel in the PJ area would increase the flood hazard.

Bank Loss Hazard

Bank loss in the housing area during times of moderate to high flows may pose a serious threat to structures located near the channel. The fan deposit where the development is located is composed of unconsolidated material underlain by bedrock at a shallow depth. Consequently, downward incision is inhibited and lateral migration of the channel is occurring. Examination of the cross-section surveyed in 1995 through the area of greatest bank loss indicates that the cross-channel gradient is towards the housing area. This general tilt of the channel, coupled with the shallow bedrock, strongly indicates that bank loss will be an ongoing problem without mitigative measures. Structures in close proximity to the incised channel have the highest degree of risk from bank collapse. Any site located farther from the channel is less likely to suffer foundation collapse due to erosion, but, for long time periods all structures located on the fan are potentially at some risk, as the primary channel may be expected to migrate.

The following information is from "Estimation of Flood and Geomorphic Hazard in the Panther Canyon Area of Big Bend National Park, Texas," (NPS: 1995).

Summary

In general, the fan is an undesirable place because it is geomorphically unstable, flood prone, and possibly debris prone. This is not to say the residents are at extreme risk. Processes are slow in this environment and the present configuration may persist for many years, so any time afforded through protection may translate into a long, safe occupancy. Another factor that somewhat reduces the risk of catastrophic clear-water floods is the small contributing area of the watershed, which limits the amount of runoff and results in moderate, low frequency floods. Additionally, no evidence of prior high magnitude flooding, the debris of which would likely be preserved for long periods of time in this desert environment, was observed in the channel area.

When viewed in the context of long-term occupancy, the entire development is likely at some risk. The channel is actively migrating and bank loss threatens several structures. Buildings

> constructed on the lower portion of the fan, including the curatorial storage building, are likely to experience inundation from high magnitude flows. Shifting of the active channel to a distribuary channel through aggradation would potentially flood portions of the fan far removed from the main channel, and the most extreme floods that could be expected from this size watershed could inundate the entire area. The hazard of debris flow is not certain, but, if possible, could be extremely destructive.

All of the structures at Panther Junction are at "some risk" according to the report. However, the report also seems to indicate that the risk is not great. Nevertheless, because the long period between events leads to a false sense of security and warning time would be short, there is the possibility of human injury or loss of life in the event of a large flood. In addition, a large investment in infrastructure could be lost if the 500-year Qme does occur.

The curatorial storage building mentioned in the report and the science and resource building that is not mentioned are scheduled for replacement in a less flood-prone area of Panther Junction (as described in the cumulative impact scenario) — an action outside the GMP.

PROPOSED ACTION

The National Park Service will continue to have its principal visitor center, headquarters, administrative offices, and housing at Panther Junction. It will construct a new visitor center, with 100-space parking, storage warehouse, 12-bed dormitory, and three bedroom house to replace housing units removed from Chisos Basin, rehabilitate the headquarters building for additional offices, and move up to 15% of park personnel and functions to gateway communities. Removing 15% of park personnel and functions out of the park will mean that fewer offices and residences will be needed at Panther Junction than if the trend to provide housing and offices for most personnel at Panther Junction continued.

The National Park Service will develop a developed area plan for Panther Junction to address flooding threats. The plan would address the following points:

- A decision tree for park staff to minimize the threat to life by clear planning choices.
- Closure conditions: seasonal, watershed saturation, and storm event priorities.
- Notification protocols for park staff, visitors, and others.
- Training staff, employee families, school children, and volunteers in the implementation of the plan.
- Preparation of informational and warning signs, and brochures.
- Establishment of formal notification/warning procedures between the park and the National Weather Service.
- Monitor National Weather Service severe thunderstorm warning broadcasts as an early warning system for the park. (Water Resources Management Plan language was modified for Panther Junction.)
- Heightened awareness periods during monsoon rain months of June, July, August and September, especially when the watershed is saturated by previous rains.
- Preemptive housing area closure using the decision tree.
- Formalization of evacuation routes and mobilization sites for rescue.
- Train park personnel for flood contingency.
- Review and revision of the plan elements every two to three years.

- Determine if fuel tanks at the maintenance area are out of the 500-year floodplain or protect them from the 500-year floodplain.

Because of removal of 15% of park personnel and functions from Panther Junction, the proposed action does not represent a new impact upon natural resource, cultural resource, or park infrastructure floodplain values in the park. It does represent an informed decision concerning the continuation of risk to human life that is minimized by the mitigation contained in developed area operation plan. The risk to human life in the Panther Junction developed area cannot be eliminated entirely.

If the developed area is damaged by flooding or, as additional facilities and are developed outside the park, the park staff will consider whether replacement facilities would best be sited at Panther Junction, other locations in the park, or outside the park.

SUMMARY

The National Park Service will continue to have its principal visitor center, headquarters, administrative, and housing area at Panther Junction. It will construct a new visitor center, with 100-space parking, storage warehouse, 12-bed dormitory, and three bedroom house to replace housing units removed from Chisos Basin, rehabilitate the headquarters building for additional offices, and move up to 15% of park personnel and functions to gateway communities. Removing 15% of park personnel and functions out of the park will mean that fewer offices and residences will be needed at Panther Junction than if the trend to provide housing and offices for most personnel at Panther Junction continued.

The park service will create a developed area warning and evacuation plan to ensure that employees, employee families, school children and visitors receive adequate warning so that they suffer no ill effects from flooding. It will protect fuel storage at the gas station and maintenance area from the 500-year flood. Preparation of the developed area warning and evacuation plan would lower the threat to life and property within Panther Junction. However, injury or loss of life from flooding could not be completely prevented. The park will develop the plan, regularly educate staff and visitors in its detail, and periodically review it with any additional relevant weather or flooding information that becomes available.

Note from floodplain guidelines:
If flood warning and evacuation are planned, both warning and evacuation times should be determined. In the event that risk to property of human life cannot be eliminated in high hazard areas, even by compliance with this guideline, a clear statement of this situation is required in the SOF.

REFERENCES

National Park Service

1994 Floodplain Management Guideline, Washington Office, Washington, D.C.

1995 “Estimation of Flood and Geomorphic Hazard in the Panther Canyon Area of Big Bend National Park, Texas,” by Mike Martin, Water Resources Division, Fort Collins, Colorado.

1996 *Water Resources Management Plan, Big Bend National Park, Texas*, Robert D. MacNish and Laurel J. Lacher, University of Arizona, Carl M. Fleming, Big Bend National Park, and Mark D. Flora, Water Resources Division.

2000 Memorandum from Michael Martin, Hydrologist, Water Operations Branch, Water Resources Division, National Park Service to Superintendent, Big Bend National Park on the subject of "Summary of Panther Junction Flood Hazard," April 14, 2000.

APPENDIX G: UNINVESTIGATED POSSIBLE CULTURAL LANDSCAPES

The following 48 landscapes or landscape-related elements were noted in the literature, but were not investigated further in the 1999 reconnaissance due to time limitations:

Sites scattered across the park:

Cartledge's No. 4 mill with candelilla wax processing plant
Chilicotal Spring with candelilla wax processing plant
Croton Spring
de la Ho's Spring with candelilla wax processing plant
Dodson Ranch/Spring/Dodson Trail/house(s)/Outer Mountain Loop/Del Dodson Spring with candelilla wax processing plant
Graham Ranch
Grapevine Spring/ranch
Dominguez Ranch
Ernst Basin
Ernst Tinaja
Fresno
Fossil bone exhibit
Grapevine Ranch
Gravel Pit and La Clocha
Harte Ranch/North Rosillos Addition
Juniper Canyon
Laguna Meadows Cabin
Marufo Vega Trail
Maverick Junction/old Maverick Road
Mule Ear spring/ranch/Mule Ears corral
Nine Point Draw
Nugent Mountain
Oak Springs Ranch
Paint Gap Ranch
Panther Junction: headquarters, visitors center, employee housing, school
Rice Place/cemetery/Ranch (includes the large stock tank)
Robbers Roost
Ross Maxwell Scenic Drive
San Jacinto Spring with Candelilla wax processing plant
Telephone Canyon
The route taken by Echols with his camel experimental expedition (ex: Dog Canyon)

Sites along Rio Grande between Castolon and Mariscal Canyon:

Buenos Aires
Smoky Creek
Black Dike
Sierra Chino
Cemetery (unnamed)
Reed
Jewels
Woodson's; also site of Paso de Chisos Crossing (see Comanche War Trail)
Pettit's site
Pantera site and cemetery
Talley Ranch with nearby Candelilla wax processing plant

Sites along Rio Grande between Mariscal Canyon and Hot Springs:

Solis Landing
Grave (unnamed)
Solis Ranch
Compton Place with Candelilla wax processing plant
Rooney's Place
Casa de Piedra

APPENDIX H: SOIL TYPES AND LIMITATIONS FOR DEVELOPMENT BY ALTERNATIVE

Information in this table comes from Soil Survey staff. 1985 "Soil Survey of Big Bend National Park, Part of Brewster County, Texas." U.S. Department of Agriculture, Soil Conservation Service.

Soils with Moderate or Severe Limitations for Actions in Alternative A

The following areas will require further geotechnical investigation to evaluate suitability and needed mitigation prior to design of the listed facilities.

Developed Area	Actions	Soil Type
Chisos Basin	•Upgrade water system •Place electrical lines underground	Liv-Mainstay-Rock Outcrop Complex, steep (LMF) Water erosion is a severe hazard because of steep slopes. Excavating for underground utilities is difficult. Limitations for shallow excavations – Liv severe: slope Mainstay, severe: depth to rock, slope Rock Outcrop, severe depth to rock, slope
Rio Grande Village	•Retain campsites, visitor center, housing and maintenance areas, store, and gas station.	Lozier-Rock outcrop complex, steep (LRF); Glendale-Harkey association, occasionally flooded (GHA); and Tornillo loam, occasionally flooded. Lozier-rock outcrop, the hazard of water erosion is severe because of steep slopes. Glendale-Harkey soils are located in the floodplain and occasional flooding is the major limitation for campsites, picnic areas and building sites. The picnic area and sewage lagoons at Rio Grande Village are in the Tornillo soil type. During high intensity rainstorms, this soil type is flooded by sheet water as much as several inches deep. This brief flash flooding occurs about once every 3 to 8 years. Water erosion is a severe hazard. Limitations on Glendale Harkey – shallow excavations – moderate: flooding small commercial buildings – severe: flooding dwellings without basements – severe: flooding campsites – severe: flooding
Castolon	•Upgrade water and fire system.	Chamberino very gravelly loam, rolling (CHD). Limitations for shallow excavations, moderate slope
Cottonwood Campground	•Retain campsites.	Glendale-Harkey association, occasionally flooded (GHA); These soils are located in the floodplain and occasional flooding is the major limitation for campsites and picnic areas.
North Rosillos/ Harte Ranch	No actions in alternative A.	Area not covered by 1985 soil survey.
Persimmon Gap	No actions in alternative A.	
Maverick	No actions in alternative A.	
Gateway communities	No actions in alternative A.	

Soils with Moderate or Severe Limitations for Actions in Alternative B

The following areas will require further geotechnical investigation to evaluate suitability and needed mitigation prior to design of the listed facilities.

Developed Area	Actions	Soil Type
Chisos Basin	•Remove one 12-room motel building, 1 employee residence and one 12-bed bunk house	Liv-Mainstay-Rock Outcrop Complex, steep (LMF)— Water erosion is severe because of steep slopes. Hurds very cobbly loam (HRF) – Water erosion is a severe hazard. Limitations for shallow excavations – Liv severe: slope Mainstay, severe: depth to rock, slope Rock Outcrop, severe depth to rock, slope
Panther Junction	•Construct visitor center •Construct storage warehouse •Rehabilitate headquarters for additional offices •Construct employee residence, and 12-bed bunkhouse •Move up to 15 percent of personnel and functions to gateway communities •Upgrade water system	Chilicotal-Monterosa association, rolling (CMD) Limitations for shallow excavations – Chilicotal: moderate: slope Monterosa: severe: cemented pan, small stones small commercial buildings – severe: slope & cemented pan
Rio Grande Village	•Relocate some campsites to reduce impacts on *Gambusia* •Find and develop an alternative water source so that endangered fish and people do not share the same source. •Return former overflow camping area to natural conditions •Enlarge concession campground (RV) by approximately 40% in area not to exceed 30 additional sites. Add islands. •Construct 4 housing units if a water source is found •Construct one fire bay •Expand visitor center to add 4 offices or build 4-office building •Upgrade water system	Lozier-Rock outcrop complex, steep (LRF); Glendale-Harkey association, occasionally flooded; and Tornillo loam, occasionally flooded. For Lozier-rock outcrop, the hazard of water erosion is severe because of steep slopes. Glendale-Harkey soils are located in the floodplain and occasional flooding is the major limitation for campsites, picnic areas and building sites. The picnic area and sewage lagoons at Rio Grande Village are in the Tornillo soil type. During high intensity rainstorms, this soil type is flooded by sheet water as much as several inches deep. This brief flash flooding occurs about once every 3 to 8 years. Water erosion is a severe hazard. Limitations on Glendale-Harkey – small commercial buildings – severe: flooding dwellings without basements – severe: flooding campsites – severe: flooding
Castolon	•Construct 2 housing units •Construct fire bay	Chamberino very gravelly loam (CHD) Limitations for shallow excavations and dwellings without basements – moderate, slope small commercial buildings – severe: slope

Developed Area	Actions	Soil Type
Cottonwood Campground	•Relocate some campsites farther from the river •Construct new egress road	Glendale-Harkey association (GHA), occasionally flooded; these soils are located in the floodplain Limitations for campsites – severe: flooding local roads – Glendale severe: flooding, low strength; Harkey, severe: flooding
North Rosillos/ Harte Ranch	•Preserve structures around Buttrill Spring •Construct interpretive trail at Buttrill Spring •Possibly construct a Rosillos trail	Area not covered by 1985 soil survey.
Persimmon Gap	•Construct duplex if a water source can be found	Paharito-Agustin (PAA) at visitor contact station Upton-Nickel at trailer site (duplex site) Limitations for Dwellings without basements – Upton moderate: cemented pan; Nickel slight Septic tank absorption fields – Upton severe: cemented pan; Nickel severe: percolates slowly
Maverick	•Construct entrance station at park boundary •Remove existing entrance station	Vieja-Badland complex, rolling (VBD). Limitations for Small commercial buildings – Upton, moderate: cemented pan; Nickel, moderate: slope Septic tank absorption fields – severe: depth to rock
Gateway communities	Construct or lease residences and offices (Some of the 15% of employees who would be moved would rent or buy their own residences.)	

Soils with Moderate or Severe Limitations for Actions in Alternative C

The following areas will require further geotechnical investigation to evaluate suitability and needed mitigation prior to design of the listed facilities.

Developed Area	Actions	Soil Type
Chisos Basin	•Remove all development except main road. •Construct trailhead and parking	Liv-Mainstay-Rock Outcrop Complex (LMF), steep (Water erosion is a severe hazard because of steep slopes. Excavating for underground utilities is difficult.) Hurds very cobbly loam (Water erosion is a severe hazard.) Limitations for paths and trails – Liv and Mainstay – severe: slope and small stones Rock outcrop – severe: slope

Developed Area	Actions	Soil Type
Panther Junction	•Construct administration building and warehouse, •Rehabilitate headquarters into a visitor center •Moving up to 15 percent of personnel and functions to gateway communities; •Upgrade water system	Chilicotal-Monterosa association, rolling (Wind and water erosion are only slight hazards for Chilicotal and Monterosa soils because of gravel on the surface.) Limitations for shallow excavations – Chilicotal: moderate: slope Monterosa: severe: slope and cemented pan, small stones Limitations for small commercial buildings – Monterosa: severe: slope and cemented pan
Rio Grande Village	•Remove all development except the main road to a day use trailhead •Extend Hot Springs trail to new trailhead, nature trail to Boquillas crossing	Lozier-Rock outcrop complex, steep; Glendale-Harkey association, occasionally flooded; and Tornillo loam, occasionally flooded. For Lozier-rock outcrop, the hazard of water erosion is severe because of steep slopes. Glendale-Harkey soils are located in the floodplain and occasional flooding is the major limitation for campsites, picnic areas and building sites. During high intensity rainstorms, this soil type is flooded by sheet water as much as several inches deep. This brief flash flooding occurs about once every 3 to 8 years. Water erosion is a severe hazard. Limitations for Paths and trails – Glendale-Harkey – severe: erodes easily
Castolon	•Construct one fire bay	Chamberino very gravelly loam, rolling Limitations for shallow excavations – moderate, slope small commercial buildings – severe: slope
Cottonwood Campground	•Relocate some campsites farther from the river •Construct new egress road	Glendale-Harkey association, occasionally flooded; These soils are located in the floodplain and occasional flooding is the major limitation for campsites, picnic areas and building sites. Limitations for – campsites – severe: flooding local roads – Glendale severe: flooding, low strength Harkey, severe: flooding
North Rosillos/ Harte Ranch	•Construct interpretive trail at Buttrill Spring •Possibly construct a Rosillos trail	Area not covered by 1985 soil survey.
Persimmon Gap	None	
Maverick	•Construct entrance station at park boundary •Remove existing entrance station	Vieja-Badland complex, rolling Limitations for Small commercial buildings – Upton, moderate: cemented pan; Nickel, moderate: slope Septic tank absorption fields – severe: depth to rock
Gateway communities	Construct or lease residences and offices (some of the 15% of employees who would be moved would rent or buy their own residences.)	

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