

# ENVIRONMENTAL CONSEQUENCES



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## 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 be 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.

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*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

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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<sup>+</sup> 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 be 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 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 Blackfoot 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<sup>+</sup> 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, undergrounding 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 resources 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.

## ENVIRONMENTAL CONSEQUENCES

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<sup>+</sup> 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.