



Environmental Assessment

For the Comprehensive Trail Management Plan
2007



Contents

1	Introduction	1
1.1	Background and Purpose	1
1.2	Need	3
1.3	Scoping	3
1.4	Relationship to Other Plans, Policies, and Regulations	4
1.5	Legal Description of Federal Lands Involved	5
2	Proposed Alternatives and Identification of the Environmentally Preferred Alternative	6
2.1	Proposed Alternatives	6
2.1.1	Alternative Number 1	6
2.1.2	Alternative Number 2	7
2.1.3	Alternative Number 3	8
2.1.4	Alternative Number 4	10
2.1.5	Alternative Number 5	11
2.2	Trail Management Program Implementation	13
2.2.1	Maintenance Issues	14
2.2.2	Administration Issues	15
2.3	Identification of the Environmentally Preferred Alternative	17
2.4	Alternatives Identified But Removed from Further Consideration	18
3	Affected Environment	19
3.1	General Setting	19
3.2	Climate and Air Quality	19
3.2.1	Climate	19
3.2.2	Air Quality	19
3.3	Soils, Geology, and Minerals	19
3.3.1	Soils	19
3.3.2	Geology and Mineral Resources	20
3.4	Hydrology Resources, Wetlands, and Floodplains	20
3.4.1	Surface and Sub-Surface Ground Water	20
3.4.2	Wetlands and Floodplains	21
3.5	Terrestrial and Aquatic Resources and Migratory Birds	21
3.5.1	Migratory Birds	21
3.6	Vegetation Resources	21
3.7	Threatened, Endangered, and Sensitive Species	22
3.8	Cultural Resources	22
3.9	Native American Religious Concerns	22



3.10	Environmental Justice	22
3.11	Aesthetics, Visual, and Recreation Resources	22
3.11.1	Visual	22
3.11.2	Recreation	22
3.12	Paleontology Resources	23
3.13	Noise	23
3.14	Solid or Hazardous Waste	23
3.15	Socio-Economic Conditions	23
3.16	Land Use	23
3.17	Public Health and Safety	23
4	Anticipated Environmental Consequences	23
4.1	Introduction	23
4.1.1	Methodology	23
4.1.2	Type of Effect, and Direct versus Indirect Impacts	23
4.1.3	Intensity	24
4.1.4	Duration	24
4.2	Impacts	24
4.2.1	Climate and Air Quality	24
4.2.2	Geology, Soils, and Minerals	25
4.2.3	Hydrology Resources, Wetlands, and Floodplains	25
4.2.4	Terrestrial and Aquatic Resources and Migratory Birds	25
4.2.5	Vegetation Resources	25
4.2.6	Threatened, Endangered, and Sensitive Species	25
4.2.7	Cultural Resources	26
4.2.8	Native American Religious Concerns	26
4.2.9	Environmental Justice	26
4.2.10	Aesthetics, Visual, and Recreation Resources	26
4.2.11	Paleontology Resources	26
4.2.12	Noise	27
4.2.13	Hazardous or Solid Waste	27
4.2.14	Socio-economic Conditions	27
4.2.15	Land Use	27
4.2.16	Public Health and Safety	27
4.3	Intensity of Impacts	27
4.3.1	Climate and Air Quality	27
4.3.2	Geology, Soils, and Minerals	27
4.3.3	Hydrology Resources, Wetlands, and Floodplains	28
4.3.4	Terrestrial and Aquatic Resources and Migratory Birds	28
4.3.5	Vegetation Resources	28
4.3.6	Threatened, Endangered, and Sensitive Species	29
4.3.7	Cultural Resources	29
4.3.8	Aesthetics, Visual, and Recreation Resources	29
4.3.9	Socio Economic Conditions	30
4.3.10	Public Health and Safety	30
4.4	Impact Assessment, Natural Resources	30
4.4.1	Air Quality	30
4.4.2	Geology, Soils, and Minerals	30



4.4.3	<i>Hydrology, Wetlands, and Floodplains</i>	31
4.4.4	<i>Terrestrial and Aquatic Resources and Migratory Birds</i>	31
4.4.5	<i>Vegetation Resources</i>	32
4.4.6	<i>Threatened, Endangered, and Sensitive Species</i>	33
4.4.7	<i>Cultural Resources</i>	33
4.4.8	<i>Aesthetics, Visual Resources</i>	34
4.4.9	<i>Recreation Resources</i>	34
4.4.10	<i>Socio-economic Resources</i>	35
4.4.11	<i>Public Health and Safety</i>	36
4.5	Cumulative Impacts	36
4.5.1	<i>Air Quality</i>	37
4.5.2	<i>Geology, Soils, and Minerals</i>	37
4.5.3	<i>Hydrology Resources, Wetlands, and Floodplains</i>	38
4.5.4	<i>Terrestrial and Aquatic Resources and Migratory Birds</i>	38
4.5.5	<i>Vegetation Resources</i>	38
4.5.6	<i>Threatened, Endangered, and Sensitive Species</i>	39
4.5.7	<i>Cultural Resources</i>	40
4.5.8	<i>Aesthetics, Visual, and Recreation Resources</i>	40
4.5.9	<i>Socio-economic Resources</i>	41
4.5.10	<i>Public Health and Safety</i>	41
5	Mitigation and Monitoring	42
6	Consultation and Coordination	43
6.1	List of Preparers	43
6.2	Agencies, Companies, or Individuals Consulted	43
	Endnotes	44





Yellow Trout Lily
Erythronium americanum

1 Introduction

1.1 Background and Purpose

During early 2006, the Superintendent of Mammoth Cave National Park (Park) initiated the development of a Comprehensive Trail Management Plan (Plan) relating to the hiking, biking, and equestrian trails within the park to thoughtfully and strategically plan for future management of the trail system. This Environmental Assessment (EA) is done in conjunction with the Plan to further guide management decisions.

The sustainability of Park trails is at a critical point. The Plan is needed as a strategic tool to plot the course of trail management in the coming years. Its broad purpose is to identify management objectives and strategies to guide the protection, management, and use of the trails within Mammoth Cave National Park over the next 10 years.

When the Park was established, the intention was to provide for use and enjoyment of the surface area in addition to the cave below. One of the purposes for creating the Park was to:

“...insure a great recreational ground...where... thousands of our people may find...the most delightful outdoor recreation in...traversing the picturesque and rugged hills and valleys and great forests of the region included in the proposed park area.”¹

Shortly after the Park was designated, improvements around the Mammoth Cave Hotel and Historic cave entrance began, including the development of several short trails in the vicinity of the hotel and cave entrance. Over the years, these were improved and expanded into a series of loops which now comprise the first 6.5 miles of the frontcountry trail system in general proximity of the Visitor Center and Green River nearby. A series of other trails, including trails at Sloans Pond, Turnhole Bend, Sand Cave, and Cedar Sink were also developed which provided additional opportunities for short hikes. The longest of these is the Cedar Sink Trail, which is slightly less than a mile in length. All of these trails are located along the entrance roads on the south side of the Green River, which are high-use areas within the Park.

In the early 1970's, the Park planned and opened a series of trails in the 20,000+ acres of backcountry area on the north side of the Green River. In 1974, these trails were officially opened to hiking and horseback riding. The core arteries of this 55+ mile trail system followed old and pre-existing dirt roads, with the remaining trails built as connections between these roads by making paths or following other old roads through the hollows and across the ridges. These connecting trails tied the system together to create numerous loops of up to several miles through the backcountry. Most of these trails were essentially dirt roads or paths, being constructed prior to the advent of widespread sustainable trail design, but First Creek Trail and portions of McCoy Hollow Trail were laid out by a National Park Service (NPS) landscape architect. Throughout the 1980s and 1990s, the backcountry trails received occasional Park maintenance, and saw some limited improvements including the addition of some bridges, water bars, and minor trail relocations. However, shrinking budgets and staffs eventually led to a lack of significant regular maintenance, and by the late 90s the condition of several segments of the backcountry trails had deteriorated significantly.

Since inception, the trail system has become a popular destination for hikers, backpackers, and horseback riders. Throughout the 1990s and early 2000s, yearly recreational visits to the trails, including overnight stays in the backcountry, were reported in the 3,000-6,000 range. (These figures were obtained through voluntary registration at trailheads and by the issuance of official backcountry camping permits.) Over the last 10 to 15 years, a growing interest in bike usage in the Park has also been observed. In 1999, Park management was approached by the Bowling Green League of Bicyclists, a local biking club, about the possibility of permitting bicycling on one or more trails in the Park. After some discussions and consideration, approximately 13 miles of trails were opened to bicycling on an experimental basis, while continuing to allow the traditional hiking and horseback riding on the same trails. These trails included all of Sal Hollow and Buffalo Trails, and part of Turnhole Bend Trail. From 1999-2004, maintenance on Sal Hollow trail was performed by volunteers from the Bowling Green League of Bicyclists. Their work included some reroutes of this trail. During most of this period, the hikers, horseback



riders, and bicyclists shared the trails. In 2004, the bicyclists reported that portions of the work they had completed were being impacted during wet periods by horse traffic; as a result Sal Hollow Trail was temporarily closed to horses. Sal Hollow remains closed to horseback riding in 2007; all of Buffalo Trail and Turnhole Bend Trail, which is open to bicycles, also remains open to horses and hikers.

The Sal Hollow Trail closure resulted in considerable visitor feedback, including positive comments from hikers and bikers, and negative comments from the equestrian community.

In 2005, Park management invited each of the three primary backcountry user groups (the Mammoth Cave Equestrian Trail Riders Association, the Bowling Green League of Bicyclists, and the Mammoth Cave Chapter of the Sierra Club) to form a single coalition, the Mammoth Cave Backcountry Summit Council, in order to facilitate communication and exchange information directly with each other and the Park regarding backcountry issues. This group has since met periodically, and has found common ground on a number of issues, including enhancing resource protection and supporting the maintenance and sustainability of all trails in the Park. This Summit Council has also participated in several backcountry trail workdays, where members from all groups worked together with the Park on a variety of trail projects. During Fiscal Years 2005 and 2006, members from this Council donated a total of 549 hours of volunteer labor in support of projects, with workdays continuing into 2007, and hopefully beyond.

In 2005, the Park announced the possibility of opening some administrative roads to bikes under a new NPS-wide agreement between the NPS and the International Mountain Bike Association. During a public comment period for this proposal, the horseback riding community submitted approximately 700 comments in opposition to opening any administrative roads which would be shared by horses and bikes, citing safety concerns posed by sharing trails. The biking community submitted less than a dozen responses in favor of the proposal during this period. The Park's action on this matter was to open four administrative roads to bicycles on the south side of the river, where horse use is not permitted (about 5 miles total), but none on the north side, pending the completion of a Com-

prehensive Trail Management Plan. Currently, the Park has a total of approximately 85 miles of trails open to various user groups, including the Administrative roads. All trails are open to hiking, approximately 50 miles are open to horses, and approximately 28 miles are open to bikes.

In 2005-2007, the nine-mile Mammoth Cave Railroad Bike and Hike Trail (a wide, graveled trail) was completed using sustainable design and technology. It follows the general route of a historic railroad bed leading from the Visitor Center to the boundary at Park City. This new trail is receiving significant use by both hikers and bikers, with numerous visitors being seen on the trail daily. The trail will connect to historic Bell's Tavern upon completion of Park City's bike trail. There is interest from the communities of Cave City and Brownsville to construct similar bike trails that would connect with the Mammoth Cave Railroad Bike and Hike Trail.

Since 2003, the Park has also completed or initiated a number of projects aimed at improving overall conditions of the backcountry trails, decreasing recreational impacts, and increasing user satisfaction on trails. In 2005 Collie Ridge Trail, the most heavily used trail in the backcountry, underwent a major, sustainably-designed restoration, including gravelling and trail rehabilitation. Several trail re-routes and improvements using sustainable design are underway. Those already completed (originally planned in 1999) include: portions of Raymer Hollow Trail, Wet Prong Trail, and Blair Springs Branch Trail. Eight stream crossings have been reinforced by installing Armor-lock block, an erosion-control technology which stabilizes stream banks and crossings. The Park has installed new bulletin boards at trailheads; produced a new, up-to-date backcountry map and brochure; installed a number of hitching posts for horses; installed reflective trail markers on all backcountry trails; and installed 40 new reflective trail signs at various trailheads and key intersections. The Maple Springs road and trailhead parking area have been redesigned, widened, and paved. Picnic tables and restrooms were also added at this trailhead parking area.

The Superintendent initiated this Comprehensive Trail Management Plan in the spring of 2006 to plan for future management of the trail system in Park.



1.2 Need

An Environmental Assessment (EA) provides decision-makers with necessary information and analysis for planning implementation of management strategies.

In addition to determining the environmental consequences of the preferred action and other alternatives, National Park Service Management Policies (2006) and Director's Order 12 require analysis of potential effects to determine whether or not actions would impair park resources.

Impairment is defined as an impact that, in the judgment of the National Park Service manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. A significant impact to any Park resource may be determined to constitute impairment.

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 park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of the park, provided the impact does not constitute impairment of the affected resources and values. Although Congress gave managers the discretion to allow certain impact within parks, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise.

This Environmental Assessment analyzes potential effects of the alternatives presented to determine if the alternatives would result in an impairment of park resources. Adverse impacts determined to have moderate or below (i.e., no impact, negligible, minor) intensities are not analyzed further relative to the impairment standard because of their relatively low magnitude.

The NPS is required to comply with the provisions of the National Park Organic Act of 1916, the National Environmental Policy Act of 1969

(NEPA), the National Historic Preservation Act of 1966, the Archeological Resources Protection Act of 1979, the National Park Service Director's Order 12, and Reference Manual 53 Special Park Uses, and various other related administrative and legislative requirements.

1.3 Scoping

Scoping is a process intended to identify the resources that may be affected by a proposed action, and to explore possible alternative ways of achieving the objectives of a proposed action while minimizing adverse impacts. The Park conducted both internal scoping with appropriate NPS staff and external scoping with the public and other agencies in relation to the Plan.

Internal scoping was conducted with an interdisciplinary team during a series of meetings in early 2006 to discuss the purpose and need for the project, develop preliminary ideas, assess the general environmental impacts which might be associated with the project, and to outline the basic goals of the project.

External scoping was initiated through a Public Scoping Meeting, which was held in the park on June 29, 2006. At this meeting, Park managers presented the basic goals and scope of the project to the public and solicited comments. A total of 110 people attended. An open comment period was also announced at the meeting, which was held from June 29-July 14, 2006, during which time written comments were received.

A total of 94 written comments were received – 59 from the horseback-riding community, 15 from the bicycling community, and 20 from hikers/backpackers. These individual responses essentially were a reflection of the writer's orientation. The horseback riders stated they wanted all existing trails on the north side of the river, including Sal Hollow, open to horses and to be adequately maintained. They were also opposed to sharing trails with bicycles, and prefer to see bicycles restricted to the south side of the river. The bicyclists stated they wanted to keep Sal Hollow, Buffalo Trail, and the portions of Turnhole Bend Trail open to biking, would like to see Sal Hollow Trail remain closed to horses, and have additional single-track trails be considered on the south side of the river. The hikers generally stated the importance of continuing to



provide opportunities for hikers and backpackers, and stressed the importance of maintaining existing trails and protecting the park as a natural area. A common theme among the comments was an emphasis on seeing the existing trails and facilities adequately maintained.

After analyzing the public comments, park staff input, and governing management documents, four key issues were identified as the scope of primary issues regarding trails and related facilities at Mammoth Cave National Park. Questions related to the scope are listed here; the complete Project Scope Statement is attached as Appendix 1. Funding, labor, and trail design/management are major considerations for each issue.

1. Visitor Use Issues

- Do existing trails meet the needs and desires of the public?
- Which user group(s) should use which trails?

2. Facilities Issues (trails, parking lots, restrooms, etc.)

- Are existing trails adequate, in terms of length and type?
- What, if any, new trails would be desirable?
- Are existing trailheads/parking lots adequate? What are future needs? Should new lots be considered; should existing lots be expanded/improved?

- Are other trail-related facilities adequate?
- How should the Maple Springs complex, and related parking lot and trailheads be connected by trails?

3. Maintenance Issues

- What is the best approach for maintaining existing park trails?
- If any new trails are recommended, what is the best approach for their maintenance?

4. Administrative Issues

- How do we keep track of numbers of visitors; what extent of accounting is adequate; what do we need and want?
- How can communications between the NPS and visitors regarding safety and resource protection be most efficiently achieved? How do we maximize compliance with regulations?
- Should we consider restricting trail use during extended periods of weather?
- To what extent, if any, should the park service address the possible future need and feasibility of implementing a fee and/or permit system regarding trail use?

While comprehensive, the Plan is not all-inclusive. The 31 river-miles (Green and Nolin) are not included as part of this Plan, nor are back-country campsites. The Plan addresses most current trail management issues; however, Park management recognizes the need to review and probably update the Plan in out years.

1.4 Relationship to Other Plans, Policies, and Regulations

Under both the Federal Land Planning and Management Act and NEPA, the NPS is required to evaluate proposed actions relative to compliance with existing land management decisions and to determine whether or not the actions would result in unnecessary or undue degradation of the potentially affected federal lands. This EA provides the necessary information to allow the NPS to make the required determinations on the potential environmental impacts of implementing the Plan.

The NPS hierarchy requiring plans was modified in 1998, in part, to integrate the requirements of the Government Performance and Results Act of 1993. That hierarchy now includes four

Virginia Creeper
Parthenocissus quinquefolia

Christmas Fern
Polystichum acrostichoides



basic types of plans: General Management Plans, Strategic Plans, Implementation Plans, and Annual Performance Plans including annual performance reports.

General Management Plans focus on why the park was established and what resource conditions and visitor experiences should be achieved and maintained over time. They cover an indefinite time frame. Strategic Plans focus on setting and meeting mission-oriented goals for periods of five years. Implementation Plans focus on how to implement an activity or project in order to achieve a long-term goal. Implementation Plans usually include a level of detail and analysis that would be inappropriate for General Management Plans and Strategic Plans. Implementation Plans often require formal analysis of alternatives in compliance with the NEPA and other legislative requirements. Annual Performance Plans consist primarily of annual goals and work plans followed by annual performance reports.

This Comprehensive Trail Management Plan is an Implementation Plan. Specific requirements for backcountry recreation management and planning are contained in

Chapter 3 of the NPS Guideline NPS-77 – Natural Resources Management, and in Chapter 8 of the National Park Service Management Policies.

NPS Management Policies and guidelines provide additional guidance for backcountry management. Following are excerpts relevant to trail management.

The NPS will encourage recreational activities that are consistent with applicable legislation, that promote visitor enjoyment of park resources through a direct association or relation to those resources, that are also consistent with the protection of resources, and that are compatible with other visitor uses.²

The NPS may permit commercial services that are not in derogation of park purposes or values and that provide recreational opportunities for visitors, contribute to visitor enjoyment of park resources, and support or achieve applicable

management objectives.³ Any restrictions [on visitor use] will be based on a determination by the superintendent that such measures are consistent with the park's enabling legislation and are needed either to prevent derogation of the values and purposes for which the park was established or to minimize visitor use conflicts.⁴

NPS Management Policies recognize that all parks are complex mixtures of values and resources, each with its own unique qualities and purposes, each requiring specific treatment in the development and implementation of management strategies and operational plans.⁵

NPS policy recognizes that providing for visitor recreational use has been a fundamental purpose of NPS areas since the establishment of Yellowstone National Park in 1872.⁶

Congress has established general regulations to provide for the proper use, management, government, and protection of persons, property and natural and cultural resources under areas within the jurisdiction of the National Park Service. These regulations are codified as Title 36, Code of Federal Regulations.

1.5 Legal Description of Federal Lands Involved

All lands involved in the proposed action lie completely and entirely within the boundaries of Mammoth Cave National Park, located in Edmonson, Hart, and Barren counties, Kentucky.

According to 16USC, Section 404-4045, the Park was established "...to preserve the cave system, including Mammoth Cave, the scenic river valleys of the Green and Nolin rivers, and a section of the hilly country of south central Kentucky." The Park is home to the longest recorded cave system in the world, with more than 350 miles explored and mapped and is an area of exclusive jurisdiction.. (Authorized May 25, 1926; established July 1, 1941. Boundary changes: May 14, 1934; August 28, 1937; December 3, 1940; June 5, 1942. Designated a World Heritage Site October 27, 1981. Designated a Biosphere Reserve 1990. Acreage—52,830.19)



White-Tailed Deer fawn
Odocoileus virginianus

2 Proposed Alternatives and Identification of the Environmentally Preferred Alternative

2.1 Proposed Alternatives

During the scoping phase of the development of this Plan, four key issues were identified as primary areas to be addressed. As described in Appendix 1, the four key issues in the Plan are: 1) Visitor Use Issues; 2) Facility Issues; 3) Maintenance Issues; and 4) Administrative Issues.

Alternatives were identified to determine how to best address these four primary scoping issues along with providing a wide range of potential actions. As a result of this process, five distinct alternatives emerged and are described below in detail. Alternatives identified but removed from further consideration are described in section 2.4.

Regarding the scoping issues of “Visitor Use Issues” and “Facility Issues,” each of the five alternatives has significant differences. These differences are outlined in the narratives under each alternative. While differences exist, there are a number of proposed actions relating to “Visitor Use Issues” and “Facility Issues” that are common to all alternatives (except the No Action Alternative). These proposed actions are noted as being common to alternatives 2, 3, 4, and 5.

Regarding the scoping issues relating to “Maintenance Issues” and “Administrative Issues,” the plan proposes a number of actions that are common to all alternatives (except the no action alternative). All of these proposed actions are identified in section 2.2 “Trail Management Program Implementation”

2.1.1 Alternative Number 1

No Action

Under the No Action Alternative, the trails, authorized uses, and facilities addressed in this Plan would remain as they currently exist.

Visitor Use Issues:

- Under this alternative, **visitor uses of the Sal Hollow Trail, the Buffalo Trail, and portions of Turnhole Bend Trail would remain as they are currently authorized.** The Sal Hollow Trail would be open only to hikers and bicycles year-round. Horse use would continue to be disallowed on the Sal Hollow Trail, but would continue to be allowed on the Buffalo Trail and the Turnhole Bend Trail.
- **No additional administrative roads**, such as the White Oak Trail, would be authorized for bicycle use.
- **All other visitor uses** of the park trail system would remain the same -- as they are currently authorized.
- **Existing parking and trailhead facilities at Maple Springs Trailhead** would remain as is and with no alterations. (Maple Springs currently has parking for six passenger vehicles and eight horse trailers.)
- **No connector trail in the Maple Springs complex would be constructed.** Horse use would continue on a portion of the Maple Springs Loop Road and the Good Spring Church Road.
- **Existing trailhead and parking facilities at the Good Spring United Baptist Church** would remain as is with no alterations. Trail access would continue from the church yard. Good Spring Trailhead currently has parking for 6 passenger vehicles. This trailhead does not have parking for vehicles with horse trailers.
- **The short connector trail between Lincoln Trailhead and Collie Ridge Trail** would remain as is. Presently, this trail is too narrow to accommodate the level of traffic it now receives. This connector trail is deeply rutted and eroded, and is in need of improvement.



- **No improvements would be made to the existing trailhead parking area at Lincoln**, which presently has 10 parking stalls both for horse trailers and passenger vehicles.
- **No improvements would be made to the existing trailhead parking area at the First Creek Trailhead**, which presently has 10 parking stalls used both for horse trailers and passenger vehicles.
- **No improvements would be made to the existing trailhead parking area at the Temple Hill Trailhead**, which is used both for horse trailers and passenger vehicles.
- **Small parking areas would not be constructed** at three locations: the start of Crystal Cave Road, the start of the Great Onyx Road, and at the White Oak Trailhead.
- Under this alternative, **the Park will not study the potential of other trail proposals** such as the extension of the Mammoth Cave Railroad Bike and Hike Trail to adjacent communities.

2.1.2 Alternative Number 2

Estimated Cost: \$225,150

(See Appendix IV)

Visitor Use Issues – Proposed Actions:

- **Allow horseback riders, bicyclists, and hikers to use Sal Hollow Trail, Buffalo Trail, and a portion of Turnhole Bend Trail all year.** Under this alternative, Sal Hollow, Buffalo, and portions of Turnhole Bend trail would be open to bicycle use year-round; these trails and all other northside trails would be open to horse use and hikers year-round. Bicycle use would also be authorized on the proposed connector trail from the Maple Springs Trailhead to the Maple Springs Group Campground and to the Mammoth Cave International Center for Science and Learning. A special regulation would be developed to authorize bicycle use on these trails. ■
- **Authorize mountain bike use on the White Oak Trail.** The White Oak Trail consists of an administrative road located in the northeast section of the park and separate from the main trail system. This 2.4 mile road/trail is currently open to hiking and horseback riding, but receives comparatively little traffic by any users. The road ends at a backcountry campsite on the Green River. This road is wide, reasonably level, and is appropriate for multiple use. White Oak Trail would remain open to hikers and horseback use, and would also be opened to bicycles under this proposed action. ■
- **All other visitor uses** of the park trail system would remain the same, as they are currently authorized. ■

Facility Issues – Proposed Actions:

- **Expand the footprint of trailhead parking area at Maple Springs Trailhead** and implement additional improvements to the existing parking area to better accommodate public use. Recent parking area improvements at Maple Springs resulted in fewer parking spaces, and additional spaces are needed to accommodate the expected increase in public use. (Maple Springs currently has parking for six passenger vehicles and eight horse trailers.) Under this alternative, the trailhead parking area at Maple Springs would be increased to provide parking for 15 passenger vehicles and 15 horse trailers. ■
- **Construct a connector trail** (approximately 1.5 miles) in the Maple Springs complex (Figure 5). This connector trail would improve access to the trail system and provide needed trail linkages among four existing facilities: the Maple Springs Trailhead, the Raymer Hollow trail, the Maple Springs Group Campground, and the Mammoth Cave International Center for Science and Learning. In addition to providing improved trail linkages, this connector trail would eliminate the safety issue related to the current use of the Maple Springs Loop Road to access the Raymer Hollow trail. This connector trail would be designed as a hard-ened-gravel trail to facilitate heavy use and two-way traffic. ■
- **Eliminate trailhead and trail access from the Good Spring United Baptist Church yard.** Under this alternative the trailhead and trails access leaving from the church will be eliminated. This alternative would include the development of connector trails that would replace the trail access eliminated at the church. Road access to the church and cemetery would remain. Trail access to Raymer

■ Proposal is unique to this alternative.

■ Proposal is common to alternatives 2, 3, and 5.

■ Proposal is common to alternatives 2, 4, and 5.

■ Proposal is common to alternatives 3, 4 and 5.

■ Proposal is common to alternatives 2, 3, 4 and 5.

Hollow Trail would be continued by use of a new connector trail from the Maple Springs Trailhead. Trail access to the Good Spring Trail would continue by use of the Buffalo Trail from the Maple Springs Trailhead. Good Spring United Baptist Church and Cemetery are a cultural resource of the Park's heritage; existing conditions (trail user impacts, vehicles parking in the church yard, and horses, bikes and hikers traveling through the church yard to access the trail system) do not adequately protect this valuable Park resource. ■

- **Improve the short connector trail between Lincoln Trailhead and Collie Ridge Trail.** The existing short connector trail is narrow, deeply rutted, and eroded. Therefore, it is proposed that this trail be widened to sustainable standards to accommodate the level of traffic it now receives. ■
- **Implement modest improvements to the existing trailhead parking area at Lincoln** within the existing footprint. Currently, there are ten horse trailer parking spaces at the Lincoln Trailhead. These parking spaces are used primarily by horse users, but occasionally are used by hikers. Under this alternative, the existing parking area/trailhead at Lincoln would be improved on its existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Implement modest improvements to the existing trailhead parking area at the First Creek Trailhead** within the existing footprint. Currently, there are ten horse trailer parking spaces at the First Creek Trailhead. Under this alternative, the parking area for this trailhead would be redesigned on the existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Implement modest improvements to the existing trailhead parking area at the Temple Hill Trailhead** within the existing footprint. Currently, there are ten horse trailer parking spaces at the Temple Hill Trailhead. Under this alternative, the parking area for this trailhead would be redesigned on the existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Construct small parking areas** at three locations: the start of Crystal Cave Road,

the start of the Great Onyx Road, and at the White Oak Trailhead. Under this alternative, simple, crushed aggregate parking areas would be built to provide parking for two to three cars at each site. This alternative would involve a minimal amount of clearing/leveling to prepare the sites. ■

- **Study the potential of other trail proposals** such as the extension of the Mammoth Cave Railroad Bike and Hike Trail that balance visitor use interests with resource protection, and are in accordance with the park's enabling legislation. There is interest from the communities of Cave City and Brownsville in constructing similar bike trails that may connect with the Mammoth Cave Railroad Bike and Hike Trail. ■

2.1.3 Alternative Number 3

Estimated Cost: \$255,750

(See Appendix IV)

Visitor Use Issues – Proposed Actions:

- **Permit horse use on Sal Hollow Trail from June through October.** Under this alternative, horse use on the Sal Hollow Trail would be permitted from June 1 through October 31 (during the driest months of the year); except for this restriction, horses are allowed on all other northside trails. As in all five Alternatives, hikers are permitted on all park trails year-round. Sal Hollow, Buffalo, and portions of Turnhole Bend trails would be open to bicycle use all year, and bicycle use would be authorized on the proposed connector trail from the Maple Springs Trailhead to the Maple Springs Group Campground and to the Mammoth Cave International Center for Science and Learning. A special regulation would be developed to authorize bicycle use on these trails. ■
- **Authorize mountain bike use on the White Oak Trail.** The White Oak Trail consists of an administrative road located in the northeast section of the park and separate from the main trail system. This 2.4 mile road/trail is currently open to hiking and horseback riding, but gets comparatively little traffic by



any users. The road ends at a backcountry campsite on the Green River. This road is wide, comparatively level, and is appropriate for multiple use. White Oak Trail would remain open to hikers and horseback use, and would also be opened to bicycles under this proposed action. ■

- **All other visitor uses** of the park trail system would remain the same -- as they are currently authorized. ■

Facility Issues – Proposed Actions:

- **Expand and improve the trailhead parking area at Lincoln Trailhead.** Currently, there are ten horse trailer parking spaces at the Lincoln Trailhead. Under this alternative, the footprint of this trailhead parking area would be expanded to provide parking for a total of 20 horse trailers and five passenger vehicles. This alternative would also include limited restroom facilities at the site, similar to those at the Maple Springs Trailhead. ■
- **Increase parking at Maple Springs Trailhead** within the existing footprint. When road improvements were made to the Maple Springs Road in 2003, the parking area was improved, but overall parking spaces were reduced. (Maple Springs currently has parking for six passenger vehicles and eight horse-trailers.) Adequate space is available between existing spaces to accommodate this expansion. Under this alternative, the existing parking area/trailhead would be improved on its existing footprint to provide 12 parking spaces for horse trailers and 10 parking spaces for passenger vehicles. ■
- **Construct a connector trail** (approximately 1.5 miles) in the Maple Springs complex (Figure 5.) This connector trail would improve access to the trail system and provide needed trail linkages among four existing facilities: the Maple Springs Trailhead, the Raymer Hollow trail, the Maple Springs Group Campground, and the Mammoth Cave International Center for Science and Learning. In addition to providing improved trail linkages, this connector trail would eliminate the safety issue related to the current use of the Maple Springs Loop Road to access the Raymer Hollow trail. This connector trail would be designed as a hardened-gravel trail to facilitate heavy use and two-way traffic. ■
- **Eliminate trailhead and trail access from the Good Spring United Baptist Church yard.** Under this alternative the trailhead and trails access leaving from the church will be eliminated. This alternative would include the development of connector trails that would replace the trail access eliminated at the church. Road access to the church and cemetery would remain. Trail access to Raymer Hollow Trail would be continued by use of a new connector trail from the Maple Springs Trailhead. Trail access to the Good Spring Trail would continue by use of the Buffalo Trail from the Maple Springs Trailhead. Good Spring United Baptist Church and Cemetery are a cultural resource of the Park's heritage; existing conditions (trail user impacts, vehicles parking in the church yard, and horses, bikes and hikers traveling through the church yard to access the trail system) do not adequately protect this valuable Park resource. ■
- **Improve the short connector trail between Lincoln Trailhead and Collie Ridge Trail.** The existing short connector trail is narrow, deeply rutted, and eroded. Therefore, it is proposed that this trail be widened to sustainable standards to accommodate the level of traffic it now receives. ■
- **Implement modest improvements to the existing trailhead parking area at the First Creek Trailhead** within the existing footprint. Currently, there are 10 horse trailer parking spaces at the First Creek Trailhead. Under this alternative, the parking area for this trailhead would be redesigned on the existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Implement modest improvements to the existing trailhead parking area at the Temple Hill Trailhead** within the existing footprint. Currently, there are 10 horse trailer parking spaces at the Temple Hill Trailhead. Under this alternative, the parking area for this trailhead would be redesigned on the existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Construct small parking areas** at three locations: the start of Crystal Cave Road, the start of the Great Onyx Road, and at the

■ *Proposal is unique to this alternative.*

■ *Proposal is common to alternatives 2, 3, and 5.*

■ *Proposal is common to alternatives 2, 4, and 5.*

■ *Proposal is common to alternatives 3, 4 and 5.*

■ *Proposal is common to alternatives 2, 3, 4 and 5.*



White Oak Trailhead. Under this alternative simple, basic crushed aggregate parking areas would be built to provide providing parking for 2-3 cars at each site. This alternative would involve a minimal amount of clearing/leveling to prepare the sites. ■

- **Study the potential of other trail proposals** such as the extension of the Mammoth Cave Railroad Bike and Hike Trail that balance visitor use interests with resource protection, and are in accordance with the park's enabling legislation. There is interest from the communities of Cave City and Brownsville in constructing similar bike trails that may connect with the Mammoth Cave Railroad Bike and Hike Trail. ■

2.1.4 Alternative Number 4

Estimated Cost: \$832,750

(See Appendix IV)

Visitor Use Issues – Proposed Actions:

- **Permit bicycle use and hiking on a proposed new six-mile loop trail** beginning at a new parking area and trailhead with access off of Green River Ferry Road-North. Horses would not be permitted on this trail. Under this alternative, bicycles would not be permitted on the Sal Hollow Trail, the Buffalo Trail, or portions of the Turnhole Bend Trail. These trails would revert to hiking and horse use only. Bicycle use and hiking would be permitted on the new six-mile, single-track loop trail which would be constructed east of the Green River Ferry Road-North and on the ridge west of Big Hollow. Bicycle use would also be authorized on the proposed connector trail from this new trailhead to the Maple Springs Group Campground and to the Mammoth Cave International Center for Science and Learning. A special regulation would be developed to authorize bicycle use on these trails. ■
- **Authorize mountain bike use on the White Oak Trail.** The White Oak Trail consists of an Administrative Road located in the northeast section of the park and separate from the main trail system. This 2.4 mile road/trail is currently open to hiking and horseback

riding, but gets comparatively little traffic by any users. The road ends at a backcountry campsite on the Green River. This road is wide, comparatively level, and is appropriate for multiple use. White Oak Trail would remain open to hikers and horseback use, and would also be opened to bicycles under this proposed action. ■

- **All other visitor uses** of the park trail system would remain the same – as they are currently authorized. ■

Facility Issues – Proposed Actions:

- **Construct a new multi-use trailhead parking area with access off of Green River Ferry Road-North.** Under this alternative, a new multi-use parking area would be constructed approximately halfway between the Maple Springs entrance roads, with direct access off of Green River Ferry Road-North. This lot would provide parking for 20 passenger vehicles as well as parking for 15 horse trailers. This proposed trailhead parking area could be located on either the east or west side of Green River Ferry Road-North; or it could be split into two lots, one on the west side for hiking and horse use and one on the east side for hiking and bicycle use. This alternative would include an option for developing limited restroom facilities, similar to those at the Maple Springs Trailhead. ■
- **Increase parking at Maple Springs Trailhead** within the existing footprint. When road improvements were made to the Maple Springs Road in 2003, the parking area was improved, but overall parking spaces were reduced. (Maple Springs currently has parking for six passenger vehicles and eight horse-trailers.) Adequate space is available between existing spaces to accommodate this expansion. Under this alternative, the existing parking area/trailhead would be improved on its existing footprint to provide 12 parking spaces for horse trailers and 10 parking spaces for passenger vehicles. ■
- **Construct a connector trail** (approximately 1.5 miles) in the Maple Springs complex (Figure 5.) This connector trail would improve access to the trail system and provide needed trail linkages among four existing facilities: the Maple Springs Trailhead; the Raymer Hollow trail; the Maple Springs Group Campground; and the Mammoth Cave International Center



for Science and Learning, as well as the new trailhead on Green River Ferry Road-North. In addition to providing improved trail linkages, this connector trail would eliminate the safety issue related to the current use of the Maple Springs Loop Road to access the Raymer Hollow trail. This connector trail would be designed as a hardened-gravel trail to facilitate heavy use and two-way traffic. ■

- **Eliminate trailhead and trail access from the Good Spring United Baptist Church yard.** Under this alternative the trailhead and trails access leaving from the church will be eliminated. This alternative would include the development of connector trails that would replace the trail access eliminated at the church. Road access to the church and cemetery would remain. Trail access to Raymer Hollow Trail would be continued by use of a new connector trail from the Maple Springs Trailhead. Trail access to the Good Spring Trail would continue by use of the Buffalo Trail from the Maple Springs Trailhead. Good Spring United Baptist Church and Cemetery are a cultural resource of the Park's heritage; existing conditions (trail user impacts, vehicles parking in the church yard, and horses, bikes and hikers traveling through the church yard to access the trail system) do not adequately protect this valuable Park resource. ■
- **Improve the short connector trail between Lincoln Trailhead and Collie Ridge Trail.** The existing short connector trail is narrow, deeply rutted, and eroded. Therefore, it is proposed that this trail be widened to sustainable standards to accommodate the level of traffic it now receives. ■
- **Implement modest improvements to the existing trailhead parking area at Lincoln** within the existing footprint. Currently, there are ten horse trailer parking spaces at the Lincoln Trailhead. These parking spaces are used primarily by horse users, but occasionally are used by hikers. Under this alternative, the existing parking area/trailhead at Lincoln would be improved on its existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Implement modest improvements to the existing trailhead parking area at the First Creek Trailhead** within the existing footprint. Currently, there are ten horse trailer

parking spaces at the First Creek Trailhead. Under this alternative, the parking area for this trailhead would be redesigned on the existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■

- **Implement modest improvements to the existing trailhead parking area at the Temple Hill Trailhead** within the existing footprint. Currently, there are ten horse trailer parking spaces at the Temple Hill Trailhead. Under this alternative, the parking area for this trailhead would be redesigned on the existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Construct small parking areas** at three locations: the start of Crystal Cave Road, the start of the Great Onyx Road, and at the White Oak Trailhead. Under this alternative, simple, crushed aggregate parking areas would be built to provide parking for two to three cars at each site. This alternative would involve a minimal amount of clearing/leveling to prepare the sites. ■
- **Study the potential of other trail proposals** such as the extension of the Mammoth Cave Railroad Bike and Hike Trail that balance visitor use interests with resource protection, and are in accordance with the park's enabling legislation. There is interest from the communities of Cave City and Brownsville in constructing similar bike trails that may connect with the Mammoth Cave Railroad Bike and Hike Trail. ■

■ *Proposal is unique to this alternative.*

■ *Proposal is common to alternatives 2, 3, and 5.*

■ *Proposal is common to alternatives 2, 4, and 5.*

■ *Proposal is common to alternatives 3, 4 and 5.*

■ *Proposal is common to alternatives 2, 3, 4 and 5.*

2.1.5 Alternative Number 5 Preferred Alternative

Estimated Cost: \$287,250

(See Appendix IV)

Visitor Use Issues – Proposed Actions:

- **Permit bicycle use on First Creek Trail, and close Sal Hollow, Turnhole Bend, and Buffalo Trails to bicycles** Under this alternative, First Creek Trail would be closed to horses, and the Sal Hollow Trail would be opened to horses. A special regulation would





be developed to authorize bicycle use on First Creek Trail. ■

- **Authorize mountain bike use on the White Oak Trail.** The White Oak Trail consists of an administrative road located in the northeast section of the park and separate from the main trail system. This 2.4 mile road/trail is currently open to hiking and horseback riding, but receives comparatively little traffic by any users. The road ends at a backcountry campsite on the Green River. This road is wide, reasonably level, and is appropriate for multiple use. White Oak Trail would remain open to hikers and horseback use, and would also be opened to bicycles under this proposed action. ■
- **All other visitor uses** of the park trail system would remain the same, as they are currently authorized. ■

Facility Issues – Proposed Actions:

- **Construct approximately one mile of re-routed trail on the First Creek Trail** (from the Temple Hill Trailhead to First Creek Lake). This work would achieve a more gradual change in elevation for this trail segment. ■
- **Increase parking at Maple Springs Trailhead** within the existing footprint. When road improvements were made to the Maple Springs Road in 2003, the parking area was improved, but overall parking spaces were reduced. (Maple Springs currently has parking for six passenger vehicles and eight horse trailers.) Adequate space is available between existing spaces to accommodate this expansion. Under this alternative, the existing parking area/trailhead would be improved on its existing footprint to provide 12 parking spaces for horse trailers and 10 parking spaces for passenger vehicles. ■
- **Construct a connector trail** (approximately 1.5 miles) in the Maple Springs complex (Figure 5.) This connector trail would improve access to the trail system and provide needed trail linkages among four existing facilities: the Maple Springs Trailhead, the Raymer Hollow trail, the Maple Springs Group Campground, and the Mammoth Cave International Center



for Science and Learning. In addition to providing improved trail linkages, this connector trail would eliminate the safety issue related to the current use of the Maple Springs Loop Road to access the Raymer Hollow trail. This connector trail would be designed as a hardened-gravel trail to facilitate heavy use and two-way traffic. ■

- **Eliminate trailhead and trail access from the Good Spring United Baptist Church yard.** Under this alternative the trailhead and trails access leaving from the church will be eliminated. This alternative would include the development of connector trails that would replace the trail access eliminated at the church. Road access to the church and cemetery would remain. Trail access to Raymer Hollow Trail would be continued by use of a new connector trail from the Maple Springs Trailhead. Trail access to the Good Spring Trail would continue by use of the Buffalo Trail from the Maple Springs Trailhead. Good Spring United Baptist Church and Cemetery are a cultural resource of the Park's heritage; existing conditions (trail user impacts, vehicles parking in the church yard, and horses, bikes and hikers traveling through the church yard to access the trail system) do not adequately protect this valuable Park resource. ■
- **Improve the short connector trail** between Lincoln Trailhead and Collie Ridge Trail. The existing short connector trail is narrow, deeply rutted, and eroded. Therefore, it is proposed that this trail be widened to sustainable standards to accommodate the level of traffic it now receives. ■
- **Implement modest improvements to the existing trailhead parking area at Lincoln** within the existing footprint. Currently, there are 10 horse trailer parking spaces at the Lincoln Trailhead. These parking spaces are used primarily by horse users, but occasionally are used by hikers. Under this alternative, the existing parking area/trailhead at Lincoln would be improved on its existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Implement modest improvements to the existing trailhead parking area at the First Creek Trailhead** within the existing footprint. Currently, there are ten horse trailer parking spaces at the First Creek Trailhead.

Under this alternative, the parking area for this trailhead would be redesigned on the existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■

- **Implement modest improvements to the existing trailhead parking area at the Temple Hill Trailhead** within the existing footprint. Currently, there are ten horse trailer parking spaces at the Temple Hill Trailhead. Under this alternative, the parking area for this trailhead would be redesigned on the existing footprint to provide a total of 15 parking spaces for use by both horse trailers and passenger vehicles. ■
- **Construct small parking areas** at three locations: the start of Crystal Cave Road, the start of the Great Onyx Road, and at the White Oak Trailhead. Under this alternative, simple, crushed aggregate parking areas would be built to provide parking for two to three cars at each site. This alternative would involve a minimal amount of clearing/leveling to prepare the sites. ■
- **Study the potential of other trail proposals** such as the extension of the Mammoth Cave Railroad Bike and Hike Trail that balance visitor use interests with resource protection, and are in accordance with the park's enabling legislation. There is interest from the communities of Cave City and Brownsville in constructing similar bike trails that may connect with the Mammoth Cave Railroad Bike and Hike Trail. ■

■ *Proposal is unique to this alternative.*

■ *Proposal is common to alternatives 2, 3, and 5.*

■ *Proposal is common to alternatives 2, 4, and 5.*

■ *Proposal is common to alternatives 3, 4 and 5.*

■ *Proposal is common to alternatives 2, 3, 4 and 5.*

2.2 Trail Management Program Implementation

(common to alternatives 2, 3, 4 & 5):

The Scope of this plan also includes "Maintenance" and "Administrative" issues. All proposed actions related to "Maintenance" and "Administrative" issues are programmatic in nature and are common to all alternatives considered in the previous section. These proposed actions are more appropriately described in relation to the park's ongoing implementation efforts relating to trail program management. Recommended actions relating to "Maintenance" and "Administrative" issues are described below.





Round-Leaf Tick-Trefoil
Desmodium rotundifolium

2.2.1. Maintenance Issues

Sustainable Design

One of the management objectives of this Plan is to update project descriptions and cost estimates for all trail-related project funding requests. Funding for trail-related project work becomes available intermittently as prioritized by the Southeast Regional Office of the National Park Service. In short, Mammoth Cave National Park competes with other parks in the Southeast Region to obtain project funding for trail work.

As funding for trail work is approved, there is an ongoing need to incorporate sustainable design, methods, and materials. Most of the trails in Mammoth Cave National Park were established prior to the advent of modern sustainable trail design techniques. As a result, there is a substantial backlog of deferred trail maintenance in the park. Under this Plan, sustainable construction and trail maintenance practices would be utilized on all future trail management activities (including both trail-related project work and regular trail maintenance). The use of sustainable design will create important long-term benefits, principally a reduced need for regular maintenance and repairs in the future.

Some common components of Sustainable Design include: designing trail grades within certain limits, using drainage structures such as waterbars and drainage dips, and following natural contours. Old roadbeds should be avoided except where they meet these design goals. Trail treads should be built up to cross perennially wet areas (i.e., seeps), using materials and techniques that permit the continued seepage of water underneath the tread such as interlocking trail-block and filter fabric structures. Bridges are an appropriate option when improvements are needed for crossing water courses. The desirable tread width in most areas is approximately 48 inches. Trail design should avoid obvious switchbacks in order to limit the opportunity for shortcutting and chronically wet areas such as seeps, bogs, and entrenched roadbeds.

Some segments of the existing park trails do not yet meet the standards described above. Where this is the case, a higher level of maintenance is required to keep the trail tread in reasonably good condition while minimizing impacts on park resources. Several techniques described in the guidelines above are appropriate options for

these areas, including installation of water bars, grade reversals, drainage dips, bridges, and hardened treads using gravel, interlocking blocks, and geotextile materials.

Water bars, grade reversals, and drainage dips are used to channel stormwater runoff out of the tread. At many locations, the existing trail grades will require the installation of several of these structures to prevent erosion. Landscape timbers are typically used for water bars, which are anchored with steel rebar pins; other designs can be utilized if approved. At some locations, gravel is also used to improve stability. A built up tread, consisting of layers of stone and geotextiles can be used to traverse boggy areas. Bridges may be constructed to cross stream courses, including wet weather streams.

In the process of reconfiguring existing trails to sustainable standards, some locations may be abandoned. The primary objective for abandonment is to ensure that erosion does not continue. Allowing the tread to be covered by leaf litter in the fall season would prevent further erosion, and it has proven to be an effective treatment in the Park.

The level at which to improve individual administrative roads should be decided on a case by case basis, but all should be regularly maintained. Administrative roads are the roads that have been retained to provide vehicular access for a number of management purposes including wildland fire management, trail and campsite maintenance, and emergency operations including search and rescue activities. These roads would be rehabilitated in place to mitigate existing erosion problems. A comprehensive rehabilitation of Collie Ridge Road was completed in 2005, including graveling.

Signs

Trail signs must provide adequate and accurate information and way-finding assistance to visitors. Many users do not possess adequate map reading and way-finding skills to proceed without some level of guidance and reinforcement provided by signs. In 2005, the NPS entered and cataloged every sign associated with Park trails into its database system to be maintained on a cyclic basis. These signs will continue to be the primary signage on the trail system. A variety of materials and designs may be used for signs, but all should meet the following minimum requirements:



- Signs are located at each trailhead and campsite to identify that location by name.
- Directional signs direct users to destinations such as campsites, specific features, and trailheads.
- All trails are marked with reflective trail markers.
- Bulletin boards at trailheads convey seasonal information, advisory information, and notification of trail or facility changes. Trailheads also will provide information related to resource protection and visitor safety and security.

In 2005, the Park began installing single-post directional signs at trailheads, trail intersections, and other key locations on the trail system. These have proven effective and economical, and are consistent with those being used in many other NPS areas with great success. These signs are used to supplement other signs on park trails as mentioned above.

Horse Hitch-Posts

Hitching posts are needed because riders are not allowed to tie horses to trees or other vegetation. As part of this Plan, hitching posts will be installed at various locations along trails at known and/or logical stopping points. These are usually installed in groups of three to four. No posts are to be installed in sensitive resource areas.

Staffing and Work Coordination

The Park does not presently have sufficient base funding to perform all of the work required for maintaining and operating 85 miles of trail. The Park has limited funding for Volunteer coordination and for overseeing trail project work by volunteers. The Park also commits to periodic employee work days to focus on critical trail maintenance needs. As stated in the management objectives, the Park plans to seek funding to re-establish a park trail maintenance crew (at least on a seasonal basis) to provide continuity of operations in performing a basic level of trail maintenance work.

Role of Volunteers

Volunteers play an integral role in meeting Park needs to conduct regular and preventive maintenance activities on trails. Volunteers assist the park by donating time and labor to construct trails, conduct preventive maintenance, assist

with monitoring of use, and in educating other users in sustainable practices. Most who volunteer to assist with trail issues are also trail users. Contributions may also be in-kind services.

Successful volunteer programs possess some common elements. The volunteer work must be meaningful for the volunteers. Volunteers want to produce something of value and to see that their work is valued by the agency and others who receive the benefit of their efforts. Volunteer programs work best when agreements are in writing and clearly specify the essential elements of the partnership and what the partners can expect from each other.

Mammoth Cave National Park has Memorandums of Understanding in place with the Bowling Green League of Bicyclists and the Mammoth Cave Group of the Cumberland Chapter of the Sierra Club in regard to trail use and trail work. The park also has a current Volunteer Group agreement with the Mammoth Cave Equine Trail Riders Association to participate in trail projects.

Collectively, these groups comprise the Mammoth Cave Backcountry Summit Council, which was formed to foster better communication between user groups, to promote responsible trail use, and to assist the Park with trail maintenance. Since 2005, these groups have worked with the Park during several group workdays, and have performed a significant amount of trail work (Figure 9). Volunteers from the Backcountry Summit Council contributed over 240 hours of trail work during 2006.

Under this Plan, the NPS intends to continue support of group workdays by scheduling periodic trail workdays during both the spring and fall of each year. The Park also intends to foster support and develop relationships with other groups such as the Boy Scouts of America, the American Hiking Society, the Student Conservation Association, and other similar groups who may wish to participate in trail projects.

2.2.2 Administrative Issues

Monitoring Visitor Use and Environmental Impacts

Informed decisions can only be made concerning impacts from visitor use when there is adequate information available to identify cause



and effect relationships. Monitoring visitor use, visitor satisfaction, and the impacts associated with visitor use is crucial to providing needed information to park managers.

Prior to 2006, the park obtained official figures for trail usage primarily from voluntary registration at trailheads. During 2006, the park implemented a new, more accurate system for recording and monitoring visitor use on trails. Counts are now determined by using a combination of methods, including electronic monitoring devices at trailheads. The official numbers of trail users reported henceforth will be obtained by this new counting method. Trailhead registers will continue to be provided to obtain collateral information about trail users, as a service to visitors, and for visitor safety in case of a search and rescue. In 2006, a total of 35,617 trail users were reported, which included 24,004 hikers, 9,459 horseback riders, and 2,154 bicyclists.

Impacts on trails can be measured through a variety of repeatable condition assessment methods. Trail width and depth can be monitored; water quality, siltation, and runoff can be measured; and photographic point-monitoring can

be used to assess the extent of impacts to trails and resources. These methods can be tailored to identify specific trail segments that are sustaining their integrity as well as trail segments that need additional work.

Monitoring is the key element in providing park managers with the information necessary to make decisions in a systematic way. Under this Plan, it is recommended that a viable resource monitoring program be developed and implemented in 2008 and then sustained into future years. This is in conformance with NPS Management Policies 2006, which states:

“Superintendents will also identify ways to monitor for and address unacceptable impacts on park resources and visitor experiences.”⁷

User Education

The physical condition of trails can be improved by sustainable trail design and proper maintenance, but changing user behaviors is essential to resolving some of the persistent problems associated with many types of resource impacts, such as shortcutting, tying horses to trees, littering,

Table 2.3 Selection of the Environmentally-Preferred Alternative

<i>National Environmental Policy Act Goals</i>	<i>No Action Alternative</i>	<i>Alternative 2</i>	<i>Alternative 3</i>	<i>Alternative 4</i>	<i>Alternative 5 (Preferred)</i>
Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.	X	++	++	+	+++
Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.	X	X	+	+++	+++
Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.		O	O	+	++
Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, whenever possible, an environment which supports diversity, and variety of individual choice.	O	+	+	+	++
Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.	+	+	+	+	+
Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.		O	O	O	O

Legend: Contributes substantially toward meeting the goal = + Neither contributes much nor detracts much from meeting the goal = Interferes with achieving the goal = X



and creating new unauthorized trails. Communicating effectively with users can reduce these impacts significantly. Many of the existing common practices that produce damaging impacts are produced by lack of understanding rather than negative intent. The park utilizes several forms of communication to convey messages that promote sustainable practices, and this Plan recommends continuing these efforts. These include:

- Printed information distributed in response to inquiries and backcountry camping permits.
- Informational signs and brochures at trail-heads.
- Inclusion of information about sustainable practices such as “Leave No Trace” in appropriate park publications and web pages.

These efforts will be enhanced with continuing support from park user groups, volunteer groups, and other organizations that are encouraged to keep incorporating these messages into their own websites, newsletters, and other communications.

Permits and Fees

The only trail-related permits Mammoth Cave National Park currently requires are free permits for backcountry camping. This requirement is primarily used to regulate and assign backcountry campsites. This Plan does not recommend any additions or changes to the current permit system at this time.

The use of permits and fees as a management option for a variety of activities is a common and accepted practice on federal lands. A permit system allows agencies to determine a highly accurate record of the numbers of individuals engaging in a particular activity, or utilizing a particular facility or area. Issuance of permits also allows an opportunity to provide direct contact with permittees in regard to regulatory requirements, safety, and conservation. The public is not generally opposed to paying nominal fees for engaging in special activities on federal lands, particularly if proceeds are used to improve or maintain those special uses. However, implementation of either system requires an ability to efficiently manage and operate the programs in such a manner that is practical, economical, and enforceable. There is no such program feasible for implementation in the Park at this time.

2.3 Identification of the Environmentally Preferred Alternative

As stated in Section 2.7 (D) of the NPS DO-12 Handbook, “The environmentally preferred alternative is the alternative that will best promote the national environmental policy expressed in NEPA (Section 101(b)).” In determining the environmentally preferred alternative, the national goal statements need to be incorporated into this determination via a qualitative comparison rating of the alternatives under consideration. Each alternative assessed in this EA was rated as to how well it contributes to meeting each of the six NEPA goals. Given the very general nature of the goal statements, with no specific measurable parameters identified, precise, quantitative ratings are not feasible. Therefore, three general qualitative levels were established to rate alternatives as to how well they contribute to meeting each goal: 1) the alternative contributes substantially to meeting that goal (denoted by a “plus” sign); 2) the alternative neither much contributes toward nor detracts from meeting that goal (denoted by a circle); and 3) the alternative interferes with that goal achievement (denoted by an “X”). Each rating was judgmentally based on an alternative’s predicted impacts on the relevant environmental resources. For example, an alternative that adversely affects historic, cultural, and natural resources would get a low rating for NEPA goal #4. Although more than one alternative may contribute substantially towards meeting a goal, one may contribute to a greater extent than another. In these cases, the use of multiple check marks denotes the difference between alternatives, with the larger number of check marks indicating the greater level of goal achievement.

A summary of this process for each alternative is presented in Table 2.3. Identification of the environmentally preferred alternative involved comparing the entire set of ratings for each alternative. In the absence of any indication of Congressional intent otherwise, each of the six NEPA goal statements was considered equally important.

The above chart indicates that Alternative 5 is the Environmentally Preferred Alternative. Alternative 5 eliminates horse impacts (water quality, tread wear, and exotic species) within the First Creek drainage, including impacts on the trail and on the campsites along this trail. Alternative



5 requires only a small amount of additional trail construction/re-routing work, and Alternative 5 only requires modest improvements of existing parking areas, almost exclusively on the footprint of existing parking areas. For these reasons, Alternative 5 is considered to be the environmentally-preferred alternative.

2.4 Alternatives Identified But Removed from Consideration

A number of possible alternatives were considered by the Park during the early planning stages of this Plan, but were eliminated for various reasons and not considered further. These alternatives and the reasoning for their elimination are described below.

Constructing new multi-use trails south of Green River. This possible alternative was considered but rejected primarily for issues relating to the protection of the Mammoth Cave System and the associated cave resources. The Mammoth Cave System is located entirely on the south side of the Green River, and the hydrology and ecology of the cave is closely related to surface topography and drainage. Impacts arising from the use of horses and backcountry overnight camping are not considered appropriate south of the Green River and are currently limited to areas on the north side of the river. Also, from the visitor management, patrol, and administrative perspectives, it is more efficient to maintain this separation of uses.

No bicycle use on backcountry trails. This possible alternative was considered but rejected because of the public interest in backcountry bicycle use identified during the scoping process. Backcountry bicycle use has been ongoing in the park for eight years on an experimental basis with acceptable results. Since the opening of the Sal Hollow Trail to bike use, along with the Buffalo Trail and portions of the Turnhole Bend Trail, there has been a consistent level of bicycle use. Bicyclists are one of the three user groups represented in the Mammoth Cave Backcountry Summit Council.

Permit bicycling, horseback riding, and hiking on all backcountry trails. This possibility was considered but rejected because of the strong response received during the Scoping process and in previous communications with all three user groups. Each of these groups have expressed a preference for separate trails, particularly between horse users and hikers, and between horse users and bicyclists. In addition, a perceived safety concern has been expressed by the horseback-riding community regarding sharing trails with bicyclists.

Leaving the trail system “as is,” with no changes to current trails, related facilities, and current designated uses. This alternative (Alternative #1) is the “No Action” alternative and was considered unacceptable for several reasons. Mainly, public comments received during the Scoping process were emphatic in their dissatisfaction with the current status of permitted visitor uses on some park trails. In particular, there was substantial concern expressed about the existing visitor use designations made on the Sal Hollow Trail, the Buffalo Trail, and portions of the Turnhole Bend Trail. Similarly, it is unacceptable that various facility needs would remain unresolved.



3. Affected Environment

A discussion of the affected environment with focus on the following critical resources or issues is presented in this section:

- Climate and Air Quality
- Geology, Soils, and Minerals
- Hydrology Resources, Wetlands, and Floodplains
- Terrestrial and Aquatic Resources and Migratory Birds
- Vegetation Resources
- Threatened, Endangered, and Sensitive Species
- Cultural Resources
- Native American Religious Concerns
- Environmental Justice
- Aesthetics, Visual and Recreation Resources
- Paleontology Resources
- Noise
- Hazardous or Solid Waste
- Socio-economic Resources
- Land Use
- Public Health and Safety

3.1 General Setting

Mammoth Cave National Park is located in south-central Kentucky, in the counties of Edmonson, Barren, and Hart. The park is within the Second Congressional District. The Park encompasses 52,830 acres. Mammoth Cave National Park contains the world's longest known cave system and offers internationally renowned examples of karst topography, and one of the most diverse cave ecosystems in the world. Approximately 130 species of fauna use the cave on a regular basis.

In addition to the world renowned cave system, the Park is noted for its outstanding scenic rivers, valleys, bluffs, forests, and abundant wildlife. The park includes 25 miles of the Green River and six miles of the Nolin River. The Green River supports a diverse freshwater mussel population including seven federally listed endangered species. It is also the master stream controlling the geologic development of Mammoth Cave and its unique ecosystem.

3.2 Climate and Air Quality

3.2.1 Climate

Western Kentucky has a moderate climate, characterized by warm, yet moist conditions. Summers are usually warm, and winters cool. Annual temperature averages about 54 degrees. Kentucky's weather patterns are influenced by the Gulf of Mexico, especially during summer. Much of Mammoth Cave's average 52 inches of precipitation a year falls in spring, the rainiest season. Kentucky is located in a path several storm systems tend to follow. Storms happen year-round; most storms, however, occur between March and September.

3.2.2. Air Quality

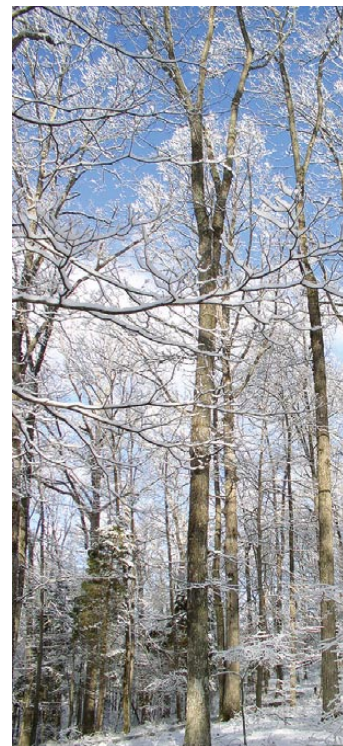
Mammoth Cave National Park is a Class I Airshed Area under the Clean Air Act. Based on data collected from 1991-1999, Mammoth Cave National Park is among the most polluted national parks in the United States. The measures used in developing the ranking were visibility, ozone, and acid precipitation.

Mammoth Cave NP currently monitors ozone, sulfur dioxide, carbon monoxide, nitric oxide, total reacted nitrogen, particulate matter (PM_{2.5} and PM₁₀), visibility (aerosol and optical), wet deposition, and volatile organic compounds. The EPA designated Edmonson County, Kentucky, as a non-attainment area for ozone in 1990 after recording six violations of the 1-hour ozone National Ambient Air Quality Standard (NAAQS) from 1987 to 1989. Edmonson County, Kentucky, was re-designated as attaining the ozone NAAQS in 1995, following six years of measurements below the ozone NAAQS. The worst air quality days typically occur in winter because of low boundary layer conditions, and during the summer due to stagnant air masses. Air quality will be considered to be the same for all alternatives.

3.3 Soils, Geology, and Minerals

3.3.1 Soils

In September, 1994, the USDA Soil Conservation Service issued a report on a soil survey conducted within the park that year.⁸ The information below is based upon that report.



The park's climate is humid and temperate. Because the soils are not dry or frozen for long periods, soil formation has continued uninterrupted; many soluble bases and clay minerals have leached to lower horizons, and in some instances, out of the soil. As a result, many of the soils in the Park are acid, have a loam surface layer, and a subsoil that has accumulated clay from upper horizons.

Most soils in the Park have formed in residuum from sedimentary rocks. Other kinds of parent material include loess, alluvium, and colluvium.

Soils formed under the predominantly hardwood forest are acid. Historically and prehistorically, man has influenced soil formation by clearing, tilling and in some cases, burning the vegetation. In places, accelerated erosion has removed most of the original surface layer and exposed the subsoil.

On steep slopes, soils are generally not as deep and less developed as soils in gently sloping areas; water erosion is increased.

Soils in the Park range from young to old; the youngest are on alluvial positions, with indistinct soil horizons and little evidence of profile development. Some soils that formed on stream terraces, are older and exhibit a more-mature horizon of development. The oldest, most mature soils in the Park formed in stable landscape position in a variety of residual materials. They are deeply weathered and have developed argillic (clay) horizons.

3.3.2 Geology and Mineral Resources

Geological resources of Mammoth Cave National Park are primarily sedimentary deposits of Mississippian and Pennsylvanian age typical of the region. Limestone and sandstone outcrops, bluffs, and flats are common. The area is typified by karst geology associated with the formation of numerous caves and underground streams as described in section 3.4.1.

3.4 Hydrology Resources, Wetlands, and Floodplains

3.4.1 Surface and Sub-Surface Groundwater

Mammoth Cave National Park is located in the heart of the south central Kentucky karst, which is an integrated set of subterranean drainage basins covering more than 400 square miles. Mammoth Cave is the longest of over 200 caves within the Park which are part of the longest system or associated with local drainage features. The primary surface waters are the Green and Nolin Rivers. The Park is bisected east to west by the Green River, which defines the hydrologic base level and divides the region into two distinct physiographic areas. North of the river, an alternating series of limestone and insoluble rocks are exposed with the main limestone strata accessible only near the river and in the bottom of a few deeply incised valleys. This has resulted in rugged topography with streams that alternately flow on insoluble rocks, over waterfalls, enter caves in limestone, and resurge at springs perched on the next lower stratum of insoluble rock. The caves are numerous, but are relatively smaller with smaller drainage basins when compared to Mammoth Cave.

South of the Green River the surface and sub-surface is defined by the Mammoth Cave karst aquifer, a component of which is the Mammoth Cave System. The Mammoth Cave karst aquifer owes the majority of its recharge to areas outside the park boundary. This recharge enters the aquifer through numerous sinking streams and countless sinkholes. Any practices that may have an adverse impact to water quality within the recharge area of the park can directly affect the water quality of the park.

The Mammoth Cave karst aquifer exhibits convergent flow, much like the convergent flow patterns of a dendritic surface stream system. While other aquifers may possess diffuse flow, the convergent flow of the Mammoth Cave karst aquifer channels waters toward a common trunk conduit or spring. Flow through the Mammoth Cave aquifer can be very rapid, on the order of 1,000's to 10,000's of feet per day. The aquifer is very dynamic, that is, it responds nearly instantaneously to rainfall. Chemical and bacteriological properties of the groundwater can also change dramatically following rainfall events. These stage rises can activate high-level overflow routes



between groundwater basins and thus direct flow in different directions depending upon aquifer conditions.

Large portions of the upper Green River watershed and the groundwater basins affecting Mammoth Cave National Park lie outside Park boundaries, and greatly influence water quality within the park. The primary activities that influence the park's water quality include: disposal of domestic, municipal, and industrial sewage; solid waste disposal; agricultural and forestry management practices; oil and gas exploration and production, urban land-use; and recreational activities.

3.4.2 Wetlands and Floodplains

Both the Green and Nolin River have floodplains which lie within Mammoth Cave National Park. Wetlands in the Park include First Creek Lake and numerous small ponds and streams. Existing trails in the Park pass through floodplains at various locations. Portions of First Creek Trail circle First Creek Lake, and lie within the Nolin River floodplain. Portions of Echo River Trail, Green River Bluffs Trail, and River Styx Spring Trail pass through higher areas of the Green River Floodplain. Existing trails cross permanent and intermittent streams.

3.5 Terrestrial and Aquatic Resources and Migratory Birds

The terrestrial ecosystem of the Park is predominantly that of a typical mixed deciduous forest. The Park supports populations of all regionally common biota. Threatened and endangered species are listed in Section 3.7. Vegetation resources are described in Section 3.6. The terrestrial cave ecosystem is dependent upon the forest ecosystem for its food base. The importation of food is mostly accomplished by cave crickets, bats, packrats, and other small mammals which feed outside, and use caves for refuge, where their droppings accumulate.

The Green River and its tributary, Nolin River, flow 25 and 6 miles respectively through the Park. These base-level streams possess one of the most diverse fish (82 species) and invertebrate faunas (51 species of mussels alone) in North America. An unused navigation dam (Lock and Dam 6) just beyond the downstream park boundary interrupts normal flow of 16

miles of the Green River and all of the Nolin River within the Park. Habitats for eight federally listed endangered species are seriously degraded through reduction of natural flow velocity and resultant siltation. The seven mussel species that are federally endangered are effectively excluded from the Lock and Dam 6 impoundment because the impounded waters do not meet their habitat requirements.

Cave streams are part of the river continuum since they are tributaries of base-level rivers via springs. These distinct but connected aquatic ecosystems are energetically supported by in-washed organic debris from the surface. Food transport is usually down gradient, but natural backflooding from the river ecosystem through springs into the lower cave streams is also important.

3.5.1 Migratory Birds

A number of migratory birds pass through the Park seasonally. The habitats found within Mammoth Cave National Park do not encourage concentrated use by migratory birds. Instead, the use by migratory birds is dispersed. Waterfowl and occasional raptors, including bald eagles, are periodically seen along river corridors and at First Creek Lake. A portion of one existing trail, First Creek Trail, circles First Creek Lake for a total of approximately 0.75 miles.

3.6 Vegetation Resources

Mammoth Cave National Park contains portions of both the Oak-Hickory Forest Region to the west, and the Mixed Mesophytic Forest Region to the east and north. With over 1,000 species of flowering plants, including 84 species of trees, the diversity within plant communities is high. Forest communities in the patchwork of karst terrain largely differentiate along moisture gradients governed by proximity to surface streams and ponds, which are largely determined by bed-rock geology and soil structure. Physiographic factors such as slope and aspect also govern the range of moisture extremes through the seasons. Cedar glades and barrens naturally occur on steep dry limestone slopes that face south and southwest, and also on disturbed sites. On moderately dry sites near ridgetops, chestnut oak and red maple are found. Under the mesic conditions found on lower slopes, in the bottoms of narrow karst valleys, and the relatively level terrain on top of plateau fragments, oaks, hickories,



Crayfish
Cambarus bartonii

American beech, tulip poplar, and maples sort according to local conditions. Juniper, Virginia pine, and blackjack oak largely dominate former farm fields. At the wettest end of the moisture spectrum, hemlock and umbrella magnolia occur in deep sandstone gorges, and on river flood-plains sycamore, box elder, and river birch occur. Most of the forest growth within the park is secondary, and very similar in size and age structure.

3.7 Threatened, Endangered, and Sensitive Species

The species considered in this document were identified by the U.S. Fish and Wildlife Service as known to occur or with the potential to occur within Mammoth Cave National Park. The Park is located in portions of Barren, Edmonson, and Hart Counties in Kentucky. Species contained in the list which have no known presence in the park are indicated by (NP) following the common name, and they are not considered in the analysis of environmental consequences.

3.8 Cultural Resources

The cultural timeline for the Park covers 10,000 years of human history and extends prehistorically from the Paleo-Indian Period to the Middle Mississippian Period. Archeological evidence indicates that Park caves and rock shelters were extensively utilized by prehistoric people from the Late Archaic through the Early Woodland Periods. The cave environment has preserved materials that would otherwise quickly decompose in above ground areas, and have provided important information about the life-ways of these early peoples. The historic period begins with Early Settlement 1774-1825, and continues through the Depression Era 1929-1941. Representing these periods are 1,084 archeological sites (prehistoric and/or historic), and 28 historic structures on the surface and in the cave. Most of the structures and some sites have been evaluated for their National Register eligibility and, of those evaluated, eligible structures and sites have been listed. National Register listings include the 28 historic structures, one archeological site, and one historic object (Engine #4 and Combine Coach). Additional resources, e.g. Concessions Warehouse, have been recently determined eligible, but have not as yet been nominated.

Important historic structures include stone tuberculin huts inside Mammoth Cave (circa 1842), steam engine number four and coach (circa 1900), and Civilian Conservation Corps structures (circa 1937), three churches (circa 1900) and the Floyd Collins House and Ticket Office (circa 1926). The majority of buildings and other facilities in the park have largely been evaluated and determined to be non-historic. Included are utility systems, the Visitor Center, Hotel, the Great Onyx Job Corps Center, and other administrative buildings. Most utilities are underground and within road corridors.

3.9 Native American Religious Concerns

The Division of Science and Resources Management at the Park maintains close communications with seven American Indian tribes. Numerous consultations have been carried out with these seven tribes on matters related to the Native American Graves Protection and Repatriation Act. During the course of these consultations, tribal representatives have not identified any Native American sacred or religious sites at the Park.

3.10 Environmental Justice

Environmental justice issues involve federal actions that disproportionately affect minorities or low income groups. There are no known issues relating to environmental justice associated with this Plan.

3.11 Aesthetics, Visual, and Recreation Resources

3.11.1 Visual

Visual resources common to the area include scenic woodlands, rivers, streams, waterfalls and cascades, rock outcrops, bluffs, scenic landscape and river vistas (particularly in winter), wildflowers, birds, and wildlife.

3.11.2 Recreation

Mammoth Cave National Park offers opportunities for a variety of recreational activities including cave tours, hiking, horseback riding, bicycling, camping, fishing, bird/wildlife watching, boating, motor-touring, and photography.



3.12 Paleontology Resources

Fossils are common in sedimentary rocks throughout the region. There are no non-typical paleontological resources known in the surface areas under consideration. Some significant paleontological resources occur inside several caves in the park, but are not impacted by this Plan.

3.13 Noise

Ambient noise levels within the Park generally originate from vehicles, farm machinery on adjacent lands, and occasional aircraft.

3.14 Solid or Hazardous Waste

No known solid or hazardous waste issues related to the proposed action have been identified.

3.15 Socioeconomic Conditions

The primary local profile is rural, with economies based on agriculture, local manufacturing, and tourism. Cave City, Park City, and Brownsville are the gateway communities at to the Park. Mammoth Cave has been a major tourist attraction in Kentucky for over 190 years. The Park generates a significant contribution to the economy of gateway communities, and is important on a statewide level. Accomplishment of the Park mission is an important social factor and includes protection and enhancement of habitat for threatened or endangered species.

3.16 Land Use

Land affected by the proposed action lies completely within Mammoth Cave National Park, and is currently used for activities related to the management purposes of the Park, as described in section 1.1, various scientific research, and recreational activities as described in section 3.

3.17 Public Health and Safety

Existing trails in the park contain some segments that are muddy or badly eroded areas which could present some safety hazards to backcountry users. The equestrian community has expressed safety concerns with sharing trails with bicycles.

4 Anticipated Environmental Consequences

4.1 Introduction

Implementation of the proposed action does not significantly alter current uses in Mammoth Cave National Park, and no significant new environmental consequences are anticipated. In fact, implementation of the Preferred Alternative of the Comprehensive Trail Management Plan should result in over all improvement of environmental conditions in the Park. The following sections describe and summarize the likely effects and or anticipated environmental consequences of implementing each of the alternatives presented in the Comprehensive Trail Management Plan. Table 4.1 summarizes the probable impacts of the alternatives related to the relevant resources or resource values that may be affected by the proposed plan.

4.1.1 Methodology

This section describes the methodology used for assessing impacts to natural resources, cultural resources, and other resources described in Section 3. Impacts were evaluated within a local context, i.e., within Mammoth Cave National Park.

4.1.2 Type of Effect, and Direct versus Indirect Impacts:

The alternatives were evaluated in terms of whether impacts would be beneficial or adverse to environmental resources. In some cases, an alternative could result in both adverse and beneficial effects to natural resources. Beneficial impacts would help preserve, enhance, and restore the natural functioning of ecological systems in the area. Adverse impacts would deplete or degrade natural resources.

Direct effects would be caused by an action and would occur at the same time and place as the action. Indirect effects would be caused by the action and would be reasonably foreseeable but would occur later in time, at another place, or to another resource.



Table 4.1 Threatened, Endangered and Sensitive Species

Common name	Species
Listed Endangered Species	
Indiana Bat	<i>Myotis sodalis</i>
Gray Bat	<i>Myotis grisescens</i>
Red-cockaded Woodpecker (NP)	<i>Picoides borealis</i>
Bachman's Warbler (NP)	<i>Vermivora bachmanii</i>
Kirtland's Warbler (NP)	<i>Dendroica kirtlandii</i>
Kentucky Cave Shrimp	<i>Palaemonias ganteri</i>
Rough Pigtoe Pearly Mussel	<i>Pleurobema plenum</i>
Clubshell	<i>Pleurobema clava</i>
Ring Pink	<i>Obovaria retusa</i>
Fanshell	<i>Cyprogenia stegaria</i>
Pink Mucket Pearly Mussel	<i>Lampsilis orbiculata</i>
Northern Riffleshell	<i>Epioblasma torulosa rangiana</i>
Orange-footed Pearly Mussel (NP)	<i>Plethobasus cooperianus</i>
Fat Pocketbook (NP)	<i>Potamilus capax</i>
Tuberculed-blossom Pearly Mussel(NP)	<i>Epioblasma torulosa torulosa</i>
Purple Cat's Paw Pearly Mussel	<i>Epioblasma sulcata sulcata</i>
Cracking Pearly Mussel (NP)	<i>Hemistena lata</i>
Short's bladderpod (NP)	<i>Lesquerella globosa</i>
Listed Threatened Species	
Price's Potato Bean (NP)	<i>Apios priceana</i>
Proposed Species	
Scaleshell (NP)	<i>Leptodea leptodon</i>
Candidate Species	
Surprising Cave Beetle	<i>Pseudanophthalmus inexpectatus</i>
Beaver Cave Beetle (NP)	<i>Pseudanophthalmus major</i>
Clifton Cave Beetle (NP)	<i>Pseudanophthalmus caecus</i>
Cumberland Johnny Darter (NP)	<i>Etheostoma nigrum ssp. Susanae</i>
Fluted Kidneyshell (NP)	<i>Ptychobranthus subtentum</i>
Greater Adams Cave Beetle (NP)	<i>Pseudanophthalmus pholeter</i>
Icebox Cave Beetle (NP)	<i>Pseudanophthalmus frigidus</i>
Lesser Adams Cave Beetle (NP)	<i>Pseudanophthalmus cataryctos</i>
Louisville Cave Beetle (NP)	<i>Pseudanophthalmus troglodytes</i>
Short's Bladderpod (NP)	<i>Lesquerella globosa</i>
Slabside Pearlymussel (NP)	<i>Lexingtonia dolabelloides</i>
Tatum Cave Beetle (NP)	<i>Pseudanophthalmus parvus</i>
White Fringeless Orchid (NP)	<i>Platanthera integrilabia</i>
Sheepnose Mussel	<i>Plethobasus cyphus</i>
Spectaclecase Mussel	<i>Cumberlandia monodonta</i>

4.1.3 Intensity

This evaluation used the approach for defining the intensity (or magnitude) of an impact presented in *Director's Order 12: Conservation Planning, Environmental Impact Analysis and Decision-making* (2001)⁹.

4.1.4 Duration

The planning horizon for this Plan is approximately 10 years. Within this time frame, impacts that would occur within five years or less were classified as short-term effects. Long-term effects would last for more than five years.

4.2 Impacts

The National Park Service is required to protect the natural abundance and diversity of all of the Park's naturally occurring resources and communities. NEPA calls for an examination of the likely impacts of the alternatives on all components of affected ecosystems. Proposed actions in this Plan were evaluated in terms of the type of effect, intensity, and duration of the impacts as defined in the following sections and whether the impacts were considered beneficial or adverse to the natural environment. Generally, the methodology for natural resource impact assessments follows direction provided in the Council on Environmental Quality Regulations for Implementing the National Environmental Policy Act, Parts 1502 and 1508.

The ability to do a quantitative analysis is limited due to the prescriptive nature of the alternatives. Qualitative analysis relies substantially on professional judgment to reach reasonable conclusions as to type of effect, intensity, and duration of potential impacts, and whether the impacts are considered to be beneficial or adverse. The planning team based the impact analysis and the conclusions in this part largely on a review of existing literature and park studies, information provided by experts within the National Park Service and other agencies, park staff insights, and professional judgment.

4.2.1 Climate and Air Quality

The air quality impact assessment involved the identification and qualitative description of the types of actions under the alternatives that could affect air quality.



4.2.2 Geology, Soils, and Minerals.

This analysis identified potential impacts to geologic and soil resources associated with the proposed actions in the alternatives. The analysis concentrated primarily on the impacts associated with continued trail use, rehabilitation of existing trails, and the limited construction of trails and parking areas described in the alternatives.

4.2.3 Hydrology Resources, Wetlands and Floodplains

The relationship of existing water quality to erosion, siltation, and runoff from trails and related facilities in the Park has not been sufficiently studied and modeled to quantitatively assess impacts. This limited amount of baseline information makes it difficult to detect changes in water quality associated with trails and trail use. Consequently, water quality impacts of the alternatives were assessed qualitatively.

Wetlands impacts were assessed by evaluating the alternatives in relation to known wetlands. The magnitude of the resulting impacts on wetlands was determined based on the potential for wetland acreage loss and the size, integrity, and continuity with other wetlands. Assessment for impacts to floodplains focused on natural river processes and aquatic habitats.

4.2.4 Terrestrial and Aquatic Resources and Migratory Birds

Impacts on migratory birds, terrestrial and aquatic animal life are closely related to the impacts on habitat. The evaluation considered whether the actions would be likely to displace some or all individuals of a species in the park or would result in loss or creation of habitat conditions needed for the viability of local or regional populations. Impacts associated with wildlife might include any change in roosting or foraging areas, food supply, protective cover, or distribution or abundance of species. Analysis was based on the assumptions listed below:

- The greater the size of a biotic community and the stronger its links to neighboring communities, the more valuable it is to the integrity and maintenance of biotic processes. Development limits the size of a community and fragments and disassociates communities from each other.

- The more developed areas become, the less valuable they are as wildlife habitat. New development would increase human presence and increase the potential for soil, vegetation, and wildlife disturbance. The potential for negative wildlife interactions increases as visitation increases.
- Development and activities near sensitive habitat may adversely affect adjacent natural communities
- Disturbance in or near hydrological features may reduce the productive capability associated with natural communities. Modifications that result in soil compactions, loss of riparian vegetation, and accelerated erosion and sediment transport influence important habitat characteristics such as substrate type, location, and cover. These physical aspects often determine the composition of vegetative and wildlife communities.
- Trails may form barriers for many types of wildlife and fragment habitat.

4.2.5 Vegetation Resources

This analysis identified potential impacts to plant populations and vegetation communities resulting from the proposed actions in the alternatives. The analysis concentrated on the impacts associated with the limited construction of trails and parking areas as described in the alternatives, and the rehabilitation of trail segments to be closed. The ability to do a quantitative analysis is limited due to the prescriptive nature of the alternatives. Qualitative analysis relies substantially on professional judgment to reach reasonable conclusions as to type of effect, intensity, and duration of potential impacts, and whether the impacts are considered to be beneficial or adverse to vegetation resources.

4.2.6 Threatened, Endangered and Sensitive Species

Through coordination with the U.S. Fish and Wildlife Service, species of special concern have been identified that are generally located in or near the Park. Professional judgment was used to reach reasonable conclusions as to type of effect, intensity, and duration of potential impacts to special status species, and whether the impacts would be likely to have an adverse effect on federally listed species within the meaning of Section 7 of the Endangered Species Act.



4.2.7 Cultural Resources

Impacts to archeological and cultural resources are generally identified and evaluated by: 1) identifying/evaluating historic properties within the area of potential effects; 2) assessing effects and applying the criteria of Effect and Adverse Effect in consultation with the Kentucky State Historic Preservation Office (KY SHPO); 3) consultation the KY SHPO, American Indian Tribal Historic Preservation Offices for seven tribes, and possibly the Advisory Council on Historic Preservation (ACHP); 4) ACHP Comment (if applicable); and 5) proceed with project, considering ways to avoid, minimize or mitigate adverse impacts.

Impacts to cultural resources are described in terms of the context, intensity, duration, and type of impacts. This approach is consistent with the regulations of the Council on Environmental Quality that implement the NEPA. These impact analyses are intended, however, to comply with the requirements of both NEPA and Section 106 of the National Historic Preservation Act (NHPA). Under regulations issued by the Advisory Council on Historic Preservation, 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 qualifies it for inclusion in 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 an alternative that would occur later in time, be farther removed 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 in the National Register.

All the alternatives were evaluated in terms of whether impacts would be beneficial or adverse to cultural resources. Beneficial impacts would help preserve and enhance those character-defining qualities that make a property significant under national register criteria. Adverse impacts would deplete or negatively alter these resources. Mitigation would tend to reduce the negative

impacts of a particular alternative. Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA 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.

4.2.8 Native American Religious Concerns

There are no issues regarding Native American Religious Concerns identified with the Plan. The assessment of any potential impacts to these concerns are thus None/Not Applicable and therefore this resource will not be discussed or considered further in this document.

4.2.9 Environmental Justice

No adverse impacts on minority or low-income groups that reside within the residual communities are expected. The assessment of any potential impacts to these concerns is thus None/Not Applicable and therefore this resource is dismissed from further discussion and consideration.

4.2.10 Aesthetics, Visual and Recreation Resources

Aesthetics and recreation resources are directly associated with visitor use and experience. Evaluation of the impacts on these resources requires analysis of all the alternatives in relation to opportunities for visitors to experience the Park and learn about and appreciate its many resources. This analysis is conducted in terms of how the visitor experience might vary by applying the different management prescriptions in the alternatives. Analysis is qualitative rather than quantitative due to the conceptual nature of the alternatives. Consequently, professional judgment was used to reach reasonable conclusions as to the intensity and duration of potential impacts, as well as whether the impacts would be beneficial or adverse.

4.2.11 Paleontology Resources

No paleontological resources are known within surface areas considered under the plan. The alternative would have no impacts to paleontological resources and therefore this resource is dismissed from further discussion and consideration.



4.2.12 Noise

The alternatives would have no impacts to ambient noise levels. The assessment of any potential impacts in regards to this issue is thus None/Not Applicable and therefore this resource is dismissed from further discussion and consideration.

4.2.13 Hazardous or Solid Waste

There are no hazardous or solid waste implications of the alternatives. The assessment of any potential impacts in regards to this issue is thus None/Not Applicable and therefore this resource is dismissed from further discussion and consideration.

4.2.14 Socioeconomic Conditions

The impact analysis evaluated the effect that park operations, tourism and recreation, and commercial services (concessions) would have on the local and regional economy under the alternatives. The analysis of socioeconomic impacts was developed from a review of the local and regional conditions as they relate to the Park. The potential for future development and changes in visitor use patterns was considered. Precise quantitative analysis of potential effects on socioeconomic conditions was not feasible due to the prescriptive nature of the plan. However, it is possible to make some broad, general assumptions regarding the effect of possible future actions using current and expected future use trends. Visitation levels have fluctuated in recent years, but are generally increasing. No specific analyses were made for projecting future visitation. For the purpose of this assessment, it was assumed that each additional 1,000 visits would result in measurable benefits to the local and regional economies. Socioeconomic effects were recognized as beneficial if, for example, they would increase the employment base or enhance the experience of park visitors (such as by providing improved services). Adverse socioeconomic impacts would negatively alter social or economic conditions in the county or region.

4.2.15 Land Use

The proposed alternatives would not significantly change current uses, and impose no long-term impacts on land use. The assessment of any potential impacts in regards to this issue is thus None/Not Applicable and therefore this resource

is dismissed from further discussion and consideration.

4.2.16 Public Health and Safety

This analysis identified potential impacts to public health and safety resulting from the proposed actions in the alternatives. The analysis concentrated on the impacts associated with the construction of trails and parking areas as described in the plan, the implementation of sustainable design, and the utilization of sustainable trail maintenance practices to address problem areas. The ability to do a quantitative analysis is limited due to the prescriptive nature of the alternatives. Qualitative analysis relies substantially on professional judgment to reach reasonable conclusions as to context, intensity, and duration of potential impacts, and whether the impacts are considered to be beneficial or adverse to public health and safety.

4.3 Intensity of Impacts

This evaluation used the approach for defining the intensity (or magnitude) of an impact presented in Director's Order 12: Conservation Planning, Environmental Impact Analysis and Decision-making (NPS 2001)¹⁰. Each impact was identified as negligible, minor, moderate, or major. Intensities are expressed qualitatively. The specific definition of intensity varies by impact topic, as follows:

4.3.1 Climate and Air Quality

Intensity of the impact to climate and air quality resources is defined as follows:

Negligible – An alternative would have no measurable or detectable effect.

Minor – An alternative would have a slight effect, causing a change in air emissions or visibility.

Moderate – An impact would be clearly detectable and would cause an appreciable change in air emissions or visibility.

Major – An alternative would cause a substantial, highly noticeable change in air emissions or visibility.

4.3.2 Geology, Soils, and Minerals

Intensity of the impact to geology, soils, and minerals is defined as follows:





Fire Pink
Silene virginica

Negligible – The impact on soils and geological resources would not be measurable. Ecological processes would not be affected.

Minor – An alternative would change a soil's profile in a relatively small area, but it would not necessarily decrease or increase the area's overall biological productivity and would not increase the potential for erosion of additional soil. For geological resources, impacts would be slightly detectable, but would not be expected to have an overall effect.

Moderate – An alternative would result in a change in quantity or alteration of the topsoil, overall biological productivity in a small area, or the potential for erosion to remove small quantities of additional soil. For geological resources, impacts would be clearly detectable and could have an appreciable effect on resources.

Major – An alternative would result in a change in the potential for erosion to remove large quantities of additional soil or cause alterations to topsoil and overall biological productivity in a relatively large area. For geological resources, impacts would be substantial, highly noticeable influences on the resources.

4.3.3 Hydrology Resources, Wetlands, and Floodplains

Intensity of the impact to hydrology resources, wetlands, and floodplains is defined as follows:

Negligible – An alternative would have no measurable or detectable effect on water quality, wetland size or integrity, or the timing and intensity of flows. No measurable or perceptible change in the natural river processes or natural ecological processes of wetlands would occur.

Minor – An alternative would have measurable but slight effects on water quality or the timing or intensity of flows. Water quality and effects on wetlands could include increased or decreased loads of sediment, debris, chemical or toxic substances, or pathogenic organisms. A small change in size, integrity or continuity could occur due to short-term indirect effects such as storm water related runoff. Actions within the floodplain would potentially interfere with or improve river processes or aquatic habitat in a limited way or in a localized area. However, the overall viability of the resource would not be affected.

Moderate – An alternative would have clearly detectable effects on water quality or the timing or intensity of flows, small but measurable change in size of wetlands, and potentially would affect organisms or natural ecological processes in wetlands. Impact could be visible to visitors. Actions within the floodplain would interfere with or enhance river processes or aquatic habitat in a substantial way or in a large area.

Major – An alternative would have substantial effects on water quality or the timing or intensity of flows and potentially would affect organisms or natural ecological processes of wetlands. Impacts would likely be visible to visitors. An action would permanently alter natural aquatic processes or aquatic habitat.

4.3.4 Terrestrial and Aquatic Resources and Migratory Birds

Intensity of the impact to terrestrial and aquatic resources and migratory birds is defined as follows:

Negligible – The impact would not be measurable on individuals, and the local populations would not be affected.

Minor – An alternative would affect the abundance or distribution of individuals in a localized area but would not affect the viability of local or regional populations.

Moderate – An alternative would affect a local population sufficiently to cause a minor change in abundance or distribution but would not affect the viability of the regional population.

Major – An alternative would affect a regional or local population of a species sufficiently to cause a change in abundance or in distribution to the extent that the population would not be likely to return to its former level (adverse), or would return to a sustainable level (beneficial).

4.3.5 Vegetation Resources

Intensity of the impact to vegetation resources is defined as follows:

Negligible – The impact on vegetation (individuals or communities) would not be measurable. Ecological processes would not be affected.

Minor – The alternative would affect the abundance or distribution of individual in a localized



area but would not affect the viability of local or regional populations.

Moderate – The alternative would affect a local population sufficiently to cause a change in abundance or distribution, but it would not affect the viability of the regional population. Changes to localized ecological processes would be of limited extent.

Major – The alternative would affect a regional or local population of a species sufficiently to cause a change in abundance or in distribution to the extent that the population would not be likely to return to its former level (adverse), or would return to a sustainable level (beneficial). Important ecological processes would be altered, and landscape-level changes would be expected.

4.3.6 *Threatened, Endangered, and Sensitive Species*

For special status species, including federally listed species, the following impact intensities were used. These terms are used to comply with Section 7 of the Endangered Species Act.

None – The alternative would have no effect on the special status species, including listed species.

Not likely to adversely affect – The alternative would be expected to have an insignificant, discountable, or beneficial effect on the special status species, including listed species.

Likely to adversely affect – The alternative would be expected to directly or indirectly have an adverse effect on the special status species, including listed species. Actions that could be likely to adversely affect species would include direct or indirect mortality of individuals; the removal or damage of nesting, breeding, foraging, or roosting habitats; impacts on food sources; and disturbance of nests during the breeding season. For wildlife, removal of vegetation could adversely affect species if it increased their susceptibility to predation.

4.3.7 *Cultural Resources*

In consultation with the Kentucky State Historic Preservation Office and the seven American Indian Tribal Historic Preservation Offices, all identified cultural properties within the area of potential effect will be evaluated according to the National Register criteria. If after survey by qualified professionals, who meet the qualifica-

tions as required in the Secretary's Standards, and eligible properties are determined to be present within the area of potential effect, the criteria of effect and adverse effect (36 CFR 800.9) will be applied.

No Cultural Resource Present – Any ground disturbance outside of existing trails will be surveyed for archeological and structural resources. This determination applies if no properties are identified within the area of potential effects and the park, KY SHPO and the THPO's are in agreement.

No Effect – Any ground disturbance outside of existing trails will be surveyed for archeological and structural resources. This determination applies if there will be no effect to identified National Register eligible resources and the park, KY SHPO and the THPO's are in agreement..

No Adverse Effect – Any ground disturbance outside of existing trails will be surveyed for archeological and structural resources. This determination applies if there will be no adverse effect to identified National Register eligible resources and the park, KY SHPO and the THPO's are in agreement.

Adverse Effect – Any ground disturbance outside of existing trails will be surveyed for archeological and structural resources. All efforts will be made to route trails around and away from identified eligible archeological sites and historic structures. This determination applies only if there is determined to be an unavoidable adverse effect to identified National Register eligible resources and the KY SHPO and the THPO's are engaged to arrive at a mitigation strategy, e.g. recording and data recovery.

4.3.8 *Aesthetics, Visual, and Recreation Resources*

The intensity of the impact is based on whether the impact to visitor use and experience is negligible, minor, moderate, or major, as defined below:

Negligible – A negligible effect would be a change that would not be perceptible or would be barely perceptible by most visitors.

Minor – A slight change in a few visitors' experiences, which would be noticeable but which would result in little detracting or improvement in the quality of the experience.



Copperhead
Agkistrodon contortrix

Though startling to encounter on the trails, all snakes play a crucial role in the Mammoth Cave ecosystem, and are protected in the park.

Moderate – A moderate effect would be a change in a large number of visitors' experiences that would result in a noticeable decrease or improvement in the quality of the experience. This would be indicated by a change in frustration level or convenience/inconvenience for a period of time.

Major – A substantial improvement in many visitors' experience or a severe drop in the quality of many peoples' experience, such as the addition or elimination of a recreational opportunity or a permanent change in access to a high visitor use area.

4.3.9 Socio-economic Resources

Intensity of impact on the socioeconomic environment is defined as follows:

Negligible – The impact either would be undetectable or would have no discernable effect.

Minor – The impact would be slightly detectable but would not have an overall effect.

Moderate – The impact would be clearly detectable and could have an appreciable effect.

Major – The impact would be substantial and have a highly positive (beneficial) or severely negative (adverse) effect. Such impacts could permanently alter the socioeconomic environment.

4.3.10 Public Health and Safety

Intensity of impact on public health and safety is defined as follows:

Negligible – The impact either would be undetectable or would have no discernable effect.

Minor – The impact would be slightly detectable but would not have an overall effect.

Moderate – The impact would be clearly detectable and could have an appreciable effect.

Major – The impact would be substantial and have a highly positive (beneficial) or severely negative (adverse) effect.

4.4 Impact Assessment

4.4.1 Air Quality

Alternatives 1 (No Action), 2, 3, 4, & 5: The alternatives would have negligible, direct, short-term impacts on air quality associated with proposed construction activities. During any construction dust would be controlled if it became an issue.

4.4.2 Geology, Soils, and Minerals

Alternative 1 (No Action): No new impacts to geology, soils and minerals would take place under the No Action Alternative. Soils on all existing backcountry trails are currently heavily impacted by public use, primarily by horses. These direct effects of public use on existing trails would continue. Long-term, moderate, direct and indirect, adverse affects are anticipated to geology, soils and mineral resources.

Alternative 2: Soils on all existing backcountry trails are currently heavily impacted by public use, primarily by horses. Direct effects of public use on existing trails would impact soils; however incorporation of sustainable design methods and materials would mitigate these impacts and over time improve conditions. Soils would be impacted by trail construction and parking area improvement activities. Long-term, moderate, direct and indirect, beneficial and adverse affects are anticipated to geology, soils and mineral resources.

Alternative 3: Same as Alternative 2

Alternative 4: This alternative would have the highest level of impact to soil resources since it proposes the largest increase in development within the park. Soils would be impacted by trail construction and parking area improvement activities. Some increase in backcountry visitation would likely occur if Alternative 4 where implemented and trail conditions improved. Direct effects of public use on existing trails would impact soils; however incorporation of sustainable design methods and materials would mitigate these impacts and over time improve conditions. Soils would be impacted by trail construction and parking area improvement activities. Long-term, moderate, direct and indirect, beneficial and adverse affects are anticipated to geology, soils and mineral resources.



Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative): Implementing the Preferred Alternative would result in no new types of impacts to soils. Soils on all trails are currently heavily impacted by public use, primarily by horses. This alternative would redistribute horse traffic off First Creek Trail (seven miles) onto the other 49 miles of backcountry trails, including the 9-mile Sal Hollow Trail which will be re-opened to horses. Bicycles will be permitted on First Creek Trail. Soil conditions should improve on First Creek Trail due to the removal of horses and horse waste. Soils would be impacted by the construction of 1.5 miles of connector trails in the Maple Springs complex area, rerouting several segments of the First Creek Trail (less than one mile), widening and improving the Lincoln connector trail, improvement of the Maple Springs Trailhead parking lot, and limited improvements proposed at other trailheads and parking areas. Long-term, moderate, direct and indirect, beneficial and adverse affects are anticipated to soils. This alternative would have no identifiable impacts on geology and minerals.

4.4.3 Hydrology, Wetlands, and Floodplains

Alternative 1 (No Action): No new impacts to water resources are associated with the No Action Alternative which are not currently occurring. The effects are expected to be direct and indirect, adverse, long-term and minor to moderate.

Alternative 2: Implementation of sustainable trail design in the construction, rehabilitation and maintenance of all trails will improve the overall water quality within the Park. Minor temporary impacts to water resources may occur in association with trail construction, parking lot upgrades, expansions and development. This alternative does not include any new trail construction in wetlands or floodplains, or alter the location of existing trails which currently pass through floodplains, across streams, or near wetlands. Therefore, no new impacts to these resources are expected. Implementing this alternative should result in a reduction of impacts to these areas and an increase in water quality as sustainable designs are incorporated into trail maintenance. Storm water runoff during construction would be mitigated with silt fencing or other erosion control devices. The effects are expected to be direct and indirect, beneficial and adverse, long-term and minor to moderate.

Alternative 3: Same as Alternative 2.

Alternative 4: Same as Alternate 2 except that the intensity of the impact is expected to be minor.

Alternative 5: The Preferred Alternative would result in no new types of impacts to water resources which are not currently occurring. The overall water quality of First Creek drainage basin would improve due to the removal of horse use impacts and waste products from horses. The incorporation of sustainable trail design and the increase in maintenance and monitoring should result in a decrease in erosion, uncontrolled runoff, and siltation in streams in proximity to trails. Impacts to the water resources in the Maple Springs complex area may increase slightly due to the addition of approximately 1.5 miles of connector trails. Implementation of sustainable trail design in the construction, rehabilitation and maintenance of all trails will improve the overall water quality within the Park. Minor temporary impacts to water resources may occur in association with trail construction, parking lot upgrades, expansions and development. This alternative does not include any new trail construction in wetlands or floodplains, or alter the location of existing trails which currently pass through floodplains, across streams, or near wetlands. Therefore, no new impacts to these resources are expected. Implementing the Preferred Alternative should result in a reduction of impacts to these areas and improve water quality as sustainable designs are incorporated into trail maintenance. Storm water runoff during construction would be mitigated with silt fencing or other erosion control devices. The effects are expected to be direct and indirect, beneficial and adverse, long-term and minor.

4.4.4 Terrestrial and Aquatic Resources and Migratory Birds

Alternative 1 (No Action): This alternative would result in no new types of impacts to terrestrial and aquatic resources and migratory birds which are not currently occurring, and would have minimal affects on these resources. Impacts might include changes in roosting or foraging areas, food supply, protective cover, or distribution or abundance of species. This alternative will not alter existing visitor use patterns in relation to migratory birds. The effects are





Dogwood
Cornus florida

expected to be direct and indirect, adverse, long-term and minor.

Alternative 2: This alternative would be expected have minimal effects on terrestrial and aquatic resources, and migratory birds. Some individuals of a species in the Park may be displaced or there may be a loss or creation of habitat conditions for local populations in small limited areas. Impacts might include changes in roosting or foraging areas, food supply, protective cover, or distribution or abundance of species. Trails may, but are not expected to form barriers or fragment habitat for wildlife. Minimal impacts are expected from construction of the approximately 1.5 miles of connector trails at the Maple Springs complex area, the short (less than one mile) reroutes of First Creek Trail, improvements to the Lincoln connector trail and improvements to parking areas. This alternative will not significantly alter existing visitor use patterns in relation to migratory birds. The physical effects of current visitor use, if any, are not known, but would not be expected to change. The effects are expected to be direct and indirect, beneficial and adverse, long-term and minor.

Alternative 3: Same as Alternative 2.

Alternative 4: This alternative would be expected have minor effects on terrestrial and aquatic resources. Some individuals of a species in the park may be displaced or there may be a loss or creation of habitat conditions for local populations in small limited areas associated with the proposed new developments. Impacts might include changes in roosting or foraging areas, food supply, protective cover, or distribution or abundance of species. The new trails may, but are not expect to form barriers or fragment habitat for wildlife. Minor impacts would be expected from construction of the approximately six miles of new trail for bicyclists and hikers, construction of 1.5 miles of new connector trails at the Maple Springs complex area, the short (less than one mile) reroutes of First Creek Trail, improvements to the Lincoln connector trail and improvements to parking areas. This alternative will alter existing visitor use patterns but is not expected to significantly alter available resources for migratory birds. The effects are expected to be direct and indirect, beneficial and adverse, long-term and minor.

Alternative 5: The Preferred Alternative would have no significant impacts to terrestrial and

aquatic resources and migratory birds which are not currently occurring. Minimal impacts from construction of the approximately 1.5 miles of new connector trails at the Maple Springs complex area, the short (less than one mile) reroutes of First Creek Trail, improvements to the Lincoln connector trail and improvements to parking areas. Water quality should improve, and erosion and runoff should decrease with the implementation of sustainable design and practices. The Preferred Alternative will not significantly alter existing visitor use patterns in relation to migratory birds. Occasional raptors, including bald eagles, and waterfowl are seen along the river corridors and First Creek Lake. The physical effects of current visitor use, if any, are not known, but would not be expected to change. The effects are expected to be direct and indirect, beneficial and adverse, long-term and minor.

4.4.5 Vegetation Resources

Alternative 1 (No Action): Vegetation that once grew directly in the path of the backcountry trails and parking areas has been obliterated by current uses. No new vegetation impacts would occur, however some impacts would occur when trail users leave the designated trail to avoid existing mud holes and problem areas. The effects are expected to be direct and indirect, adverse, long-term and minor to moderate.

Alternative 2: Vegetation that once grew directly in the path of the backcountry trails has been obliterated by current uses. The only new vegetation impacts that would result from this alternative would be removal of vegetation in construction of the approximately 1.5 mile connector trails at the Maple Springs complex area, improvements to the Lincoln connector trail, short (less than one mile) reroutes of First Creek Trail, and removal of several trees and brush for the proposed parking lot improvements. Implementation of sustainable design and practices would improve trail conditions and reduce travel off trail. The effects are expected to be direct and indirect, beneficial and adverse, long-term and minor.

Alternative 3: Same as Alternative 2.

Alternative 4: Vegetation that once grew directly in the path of the backcountry trails was obliterated by current uses. The only new vegetation impacts that would result from this alternative



would be removal of vegetation in construction of the approximately six miles of new trail for bicyclists and hikers, construction of 1.5 miles of new connector trails at the Maple Springs complex area, improvements to the Lincoln connector trail, short (less than one mile) reroutes of First Creek Trail, and removal of numerous trees and brush for proposed parking lot improvements. Implementation of sustainable design and practices would improve trail conditions and reduce travel off trail. The effects are expected to be direct and indirect, beneficial and adverse, long-term and minor to moderate.

Alternative 5: Same as Alternative 2.

4.4.6 Threatened, Endangered, and Sensitive Species

Alternative 1 (No Action): The No Action Alternative would result in no impacts to threatened, endangered, and sensitive species which are not currently occurring. The effects are expected to be “not likely to adversely affect”, direct and indirect, beneficial and adverse and long-term.

Alternative 2: Indiana and Gray bats likely forage above existing backcountry trails, and Indiana bats may roost in nearby trees. Both bats hibernate in park caves. Vegetation and tree removal identified in this alternative would be completed in accordance with the “Biological Opinion for the Effects of the Hazard Tree Removal and Vegetation Management Program to the Indiana Bat at Mammoth Cave National Park, Kentucky”¹¹ to ensure the activities would be considered “not likely to adversely affect” the species.

The Kentucky cave shrimp is currently known to inhabit two caves located north of the Green River. Drainage from the area of the backcountry trail system can be presumed to reach at least some portion of caves that may contain the cave shrimp. Minor changes in the types of visitor use on backcountry trails, construction of the approximately 1.5 miles of connector trails at the Maple Springs complex area, the short (less than one mile) reroutes of First Creek Trail, improvements to the Lincoln connector trail and improvements to parking areas and associated water quality impacts are expected to have a “not likely to adversely affect” on the Kentucky cave shrimp.

Six species of endangered mussels are known to be present in the Green River within the Park;

these mussel species have been found in the free-flowing segment upstream of the majority of the backcountry trail system. This alternative is expected to have no effect on these listed species.

A federal candidate species, the surprising cave beetle is found in a cave approximately ½ mile from the nearest backcountry trail. This alternative would have no effect on the surprising cave beetle.

The bald eagle is occasionally seen from existing backcountry trails along the river corridor and First Creek Lake area. Implementation of this alternative is expected to “not likely adversely affect” the bald eagle. The effects of implementing this alternative on threatened, endangered, and sensitive species within the park are expected to be “not likely to adversely affect”, direct and indirect, beneficial and adverse and long-term.

Alternative 3: Same as Alternative 2.

Alternative 4: Same as Alternative 2, except that the proposed larger development footprint of this alternative into areas previously not disturbed would slightly increase the potential for impacts to threatened, endangered, and sensitive species. The effects of implementing this alternative on threatened, endangered, and sensitive species within the park are expected to be “not likely to adversely affect”, direct and indirect, beneficial and adverse and long-term.

Alternative 5: Same as Alternative 2, except that minor changes in the types of visitor use on backcountry trails would occur under this alternative. Bicycling would be permitted on First Creek Trail; horseback riding would be prohibited. Occasionally bald eagles are seen along the river corridors and First Creek Lake. The physical effects of current visitor use on bald eagles, if any, are not known. The minor changes in the types of visitor use on backcountry associated with the implementation of this alternative would not be expected to affect Bald Eagles. The effects of implementing this alternative on threatened, endangered, and sensitive species within the park are expected to be “not likely to adversely affect”, direct and indirect, beneficial and adverse and long-term.

4.4.7 Cultural Resources

Alternative 1 (No Action): No new ground disturbance activities would be initiated under



Bats in Long Cave

the No Action Alternative. Existing trails would continue to impact a few archeological sites as visitor travel leaves the designated trails, and as existing trails erode. Minimal adverse effects are anticipated or likely to archeological resources. The effects are expected to be direct and indirect, adverse, long-term and minor to moderate.

Alternative 2: Minimal adverse effects are anticipated or likely on cultural resources. Current trails impact a few archeological sites as visitor travel leaves the designated trails, and as existing trails erode, the park will work to mitigate these impacts. The trailhead and trails emanating from Good Spring United Baptist Church will be eliminated when the connector trails are complete in the Maple Springs complex. Good Spring United Baptist Church and Cemetery are important cultural resources and existing conditions do not adequately protect or provide respectful solitude for these resources. As sustainable trail design and practices are implemented, erosion will be reduced; as the condition of the trail system improves the frequency of users traveling off designated trails will decrease. Some ground disturbance would take place, however, all new construction sites, trail routes and reroutes will be surveyed for archeological resources. Locations would be adjusted to avoid adverse impacts if any archeological materials or features were discovered. Archeological compliance would be approved prior to construction. The effects are expected to be direct and indirect, beneficial and adverse, long-term and minor to moderate.

Alternative 3: Same as Alternative 2.

Alternative 4: Same as Alternative 2, except that this alternative includes the proposed construction of approximately six miles of new bike/hike trails and a new parking area.

Alternative 5: Same as Alternative 2.

4.4.8 Aesthetic, Visual Resources

Alternative 1 (No Action): The No Action Alternative would result in no new impacts to aesthetic/visual resources which are not currently occurring. Visitors on the backcountry trails would continue to experience poor trail conditions in some locations. The effects are expected to be direct and indirect, beneficial and adverse, moderate and long-term.

Alternative 2: The potential impacts of this alternative will not result in a substantial change from current use. Improvements to and installation of parking areas, construction of new trails, trail reroutes and trails improvements are expected to have negligible effects overall on the aesthetic/visual resources. The implementation of sustainable design and practices are expected to improve trail conditions and have a beneficial effect on the aesthetic/visual resources. The effects are expected to be direct and indirect, beneficial and adverse, moderate and long-term.

Alternative 3: Same as Alternative 2, except that Sal Hollow Trail will be free from horse wastes and other visual impacts created by horses part of the year.

Alternative 4: Same as Alternative 2.

Alternative 5: The potential impacts of the Preferred Alternative will not result in a substantial change from current use. However, implementing the preferred alternative will result in improved visual experience for hikers and campers along six miles of First Creek Trail and three associated campsites, where the trail will be free from horse wastes and other visual impacts created by horses. Improvement to parking areas within their existing footprints and the installation of three small parking areas at Administrative Road are expected to have negligible effects. The effects are expected to be direct and indirect, beneficial and adverse, moderate and long-term.

4.4.9 Recreation Resources

Alternative 1 (No Action): The No Action Alternative would result in no new impacts to recreation resources which are not currently occurring. The effects are expected to be direct and indirect, beneficial and adverse, moderate and long-term.

Alternative 2: This alternative would provide some improvement in the recreational opportunities for the three main user groups of trails in the Park: hikers, horseback riders, and bicyclists. All trails on the northside of Green River would be open to hiking and horse use. Sal Hollow Trail, Buffalo Trail, and portions of Turnhole Bend Trail would be open to bicycles year-round. Bicycle use would also be authorized on the proposed connector trail from the Maple Springs Trailhead to the Maple Springs Group



Campground and to the Mammoth Cave International Center for Science and Learning. White Oak Trail would be open to hikers, bicycling, and horseback riding. Quality of the trails would be improved through implementing sustainable design, maintenance, and updated trail use monitoring programs. The overall capacity of trailheads and parking areas would be increased. Access around the Maple Springs complex would be improved through the design and installation of a trail connecting the parking area, trailhead, group campground, and the Mammoth Cave International Center for Science and Learning. Recreational experiences will also be enhanced through improved and updated signage and the installation of additional hitch-rails for horses at key areas on the trail system. The effects are expected to be direct and indirect, beneficial and adverse, moderate and long-term.

Alternative 3: Same as Alternative 2 except that Sal Hollow Trail would be closed to horse use seasonally (November 1 through May 31).

Alternative 4: This alternative would provide improvement in the recreational opportunities for the three main user groups of trails in the Park: hikers, horseback riders, and bicyclists. All trails would be designated as open to hikers. Bicycle use and hiking would be permitted on a proposed new six-mile loop trail beginning at a new parking area and trailhead with access off of Green River Ferry Road-North. Horses would not be permitted on this trail. Under this alternative, bicycles would not be permitted on the Sal Hollow Trail, the Buffalo Trail, and portions of the Turnhole Bend Trail. These trails would revert to hiking and horse use only. Bicycle use would also be authorized on the proposed connector trail from this new trailhead to the Maple Springs Group Campground and to the Mammoth Cave International Center for Science and Learning. Mountain bike use would also be authorized on the White Oak Trail. The White Oak Trail is an Administrative Road located in the northeast section of the park and separate from the main trail system. This alternative includes the construction of a new multi-use parking area located approximately halfway between the Maple Springs entrance roads, with direct access off of Green River Ferry Road-North, with an option for developing limited restroom facilities at the site. The effects are expected to be direct and indirect, beneficial and adverse, moderate and long-term.

Alternative 5: The Preferred Alternative would provide improved recreational opportunities for the three main user groups of trails in the Park: hikers, horseback riders, and bicyclists. All trails would be designated as open to hikers. All trails on the northside of Green River would be open to horseback riding except First Creek Trail, which would be open to hiking and bicycling only. First Creek Trail would provide hikers and bicyclers with 6.7 miles of trails (and three backcountry campsites) which are not utilized by horses, and are free from associated impacts such as horse waste. White Oak Trail would be open to hikers, bicycling, and horseback riding. Sal Hollow trail would be re-opened to horse use. This alternative will significantly reduce the interactions between horses and bicycles since shared use will only occur on the White Oak Trail. This will address the perceived safety concern expressed by the equestrian community. Quality of the trails would be improved through implementing sustainable design, maintenance, and updated trail use monitoring programs. The overall capacity of trailheads and parking areas would be increased. Access around the Maple Springs complex would be improved through the design and installation of a trail connecting the parking area, trailhead, group campground, and the Mammoth Cave International Center for Science and Learning. Recreational experiences will also be enhanced through improved and updated signage and the installation of additional hitch-rails for horses at key areas on the trail system. The effects are expected to be direct and indirect, beneficial and adverse, moderate and long-term.

4.4.10 Socio-economic Resources

Alternative 1 (No Action): The No Action Alternative would result in no new impacts to socio-economic resources which are not currently occurring. The effects are expected to be direct and indirect, beneficial, long-term and negligible to minor.

Alternative 2: The effects of implementing this alternative on socio-economic resources would involve the potential construction funds that might be paid to contractors for construction of improvements. The amount of potential construction funds would be minimal, and the effects would be minimal and short-term. Implementing this alternative would have some potential to increase recreational opportunities





Lichen

within the park. Significant changes in visitor use patterns that would effect park operations, tourism, recreation, and commercial services (concessions) would be unlikely. If increased recreational opportunities encouraged visitors to prolong their stay, surrounding communities might see a small increase in tourism dollars. No specific analyses were made for projecting future visitation. However, future visitation trends for the park are expected to slowly increase over the next ten years. For the purpose of this assessment, it was assumed that each additional 1,000 visits would result in measurable benefits to the local and regional economies. The effects are expected to be direct and indirect, beneficial, long term and negligible to minor.

Alternative 3: Same as Alternative 2.

Alternative 4: The effects of implementing this alternative on socio-economic resources would involve the potential construction funds that might be paid to contractors for construction of improvements. The amount of potential construction funds would be minimal, and therefore the effects would be minimal and short-term. Implementing this alternative has potential to increase recreational opportunities for all user groups. This could cause changes in visitor use patterns that would effect park operations, tourism, recreation, and commercial services (concessions) which would have an affect on the local and regional economy. If increased recreational opportunities encouraged visitors to prolong their stay, surrounding communities may see a small increase in tourism dollars. No specific analyses were made for projecting future visitation. However, future visitation trends for the park are expected to slowly increase over the next ten years. For the purpose of this assessment, it was assumed that each additional 1,000 visits would result in measurable benefits to the local and regional economies. The effects are expected to be direct and indirect, beneficial, long-term and negligible to minor.

Alternative 5: Same as Alternative 4, except that the potential increase in recreational opportunities would be somewhat lower due to the lower level of development proposed in this alternative. The effects are expected to be direct and indirect, beneficial, long-term and negligible to minor.

4.4.11 Public Health and Safety

Alternative 1 (No Action): The No Action Alternative would result in no new impacts to public health and safety resources which are not currently occurring. The existing trails in the Park contain some segments that are in poor condition with mud holes or badly eroded areas which could present some safety hazards to hikers or horseback riders. Under this alternative no significant improvement to these conditions would occur. The effects are expected to be direct and indirect, adverse, long-term and minor.

Alternative 2: Under this alternative the quality of the trails would be improved through implementing sustainable design in construction and maintenance practices, and through updated trail use monitoring programs which would reduce poor trail conditions and associated safety hazards. The overall capacity of trailheads and parking areas would be increased and access around the Maple Springs complex would be improved through the design and installation of a trail connecting the parking area, trailhead, group campground, and the Mammoth Cave International Center for Science and Learning providing general improvement to public health and safety. Updated signage and the installation of additional hitch-rails for horses at key areas on the trail system would also enhance conditions. The effects are expected to be direct and indirect, beneficial, long-term and minor.

Alternative 3: Same as Alternative 2.

Alternative 4: Same as Alternative 2, except that this alternative also includes the development of a new parking area with restroom facilities providing general improvement to public health and safety.

Alternative 5: Same as Alternative 2.

4.5 Cumulative Impacts

Cumulative effects are the additional actions by any entity that can reasonably be predicted to occur as a result of the proposed action. Cumulative impact is defined in the Council on Environmental Quality regulations at 40 CFR 1508.7 as follows:

Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regard-



less of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The effects Alternatives 1, 2, 3, and 4 on most resources values are similar, and numerous action items have been identified as being common/identical. Alternative 4 would have the most cumulative impacts because it would require the largest amount of new construction and development of previously undisturbed resources. The effects of the other three alternatives require comparable levels of construction at the same sites.

Implementation of the Preferred Alternative will represent a small increase in cumulative impacts from the incremental increase in land development within the Park as follows:

- Rerouting of approximately one mile of the First Creek Trail;
- Construction of approximately 1.5 miles of connector trails;
- Improvement of the short connector trail from Lincoln Trailhead to Collie Ridge; and
- Improvements to or installation of parking areas.

The Preferred Alternative includes incorporating improved maintenance actions and sustainable design into park trails, and developing and implementing resource and trail use monitoring programs during the next five years. Therefore, total cumulative impacts for some resources should be reduced over time.

4.5.1 Air Quality

Alternative 1, 2, 3, 4 & 5

Cumulative Impacts: The cumulative effects to air quality resources are expected to be negligible.

4.5.2 Geology, Soils, and Minerals

Alternative 1 (No Action)

Cumulative Impacts: Additional future impacts to soils resources would occur under the No Action Alternative. Erosion and visitors traveling off trail would continue adding to the past and existing impacts. No cumulative effects are anticipated to geology and mineral resources.

Alternative 2

Cumulative Impacts: Construction of new trails, rerouting trail segments and making improvements to parking facilities would increase the development footprint within the park and impact soils adding to the past and current impacts. Some increase in backcountry visitation would likely occur if Alternative 2 were implemented and trail conditions improved. The increased visitation would impact soils resources also adding to the past and current impacts, however incorporation of sustainable design, methods, and materials would mitigate these impacts and over time reduce cumulative impacts. The areas of impact would be negligible to minor in context of the Park as a whole. No cumulative effects are anticipated to geology and mineral resources.

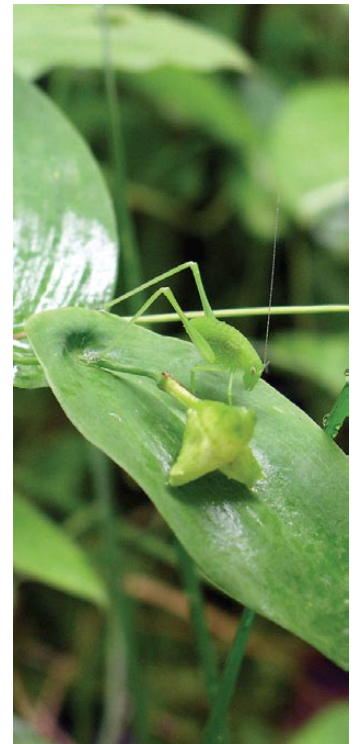
Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: Construction of six miles of new trails for bicyclists and hikers, construction of the new connector trail, rerouting and improving trail segments and making improvements to parking facilities would result in the largest increase in the development footprint within the Park and impact soils adding to the past and current impacts. Some increase in backcountry visitation would likely occur if Alternative 4 were implemented and trail conditions improved. The increased visitation would impact soil resources, also adding to the past and current impacts. However, the incorporation of sustainable design, methods, and materials would mitigate these impacts and over time reduce cumulative impacts. The areas of impact would be negligible to minor in context of the Park as a whole. No cumulative effects are anticipated to geology and mineral resources.

Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative) Cumulative Impacts: Construction of a segment of new connector trail, rerouting short trail segments, making improvements to trail segments and making improvements to parking facilities within their current footprint would result in a slight increase in the development footprint within the Park and impact soils, adding to the past development and current use impacts. Some increase in backcountry visitation would likely occur if Alterna-



Katydid nymph
Family Tettigoniidae

tive 5 where implemented and trail conditions improved. The increased visitation would impact soils resources also adding to the past and current impacts, however incorporation of sustainable design, methods, and materials would mitigate these impacts and over time reduce cumulative impacts. The areas of impact would be negligible to minor in context of the Park as a whole. No cumulative effects are anticipated to geology and mineral resources.

4.5.3 Hydrology Resources, Wetlands, and Floodplains

Alternative 1 (No Action)

Cumulative Impacts: Under the No Action Alternative the impacts associated with erosion and sedimentation that are currently occurring would continue. These impacts would add to the past impacts to hydrological resources. No cumulative impacts are expected to wetlands or floodplains.

Alternative 2

Cumulative Impacts: This alternative includes the implementation of sustainable trail design in the construction, rehabilitation and maintenance of all trails which will have a beneficial effect, improving the overall water quality within the Park and reducing cumulative impacts. Minor temporary impacts to water resources may occur in association with parking lot improvements, trail construction and other development activities. No cumulative impacts are expected to wetlands or floodplains.

Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: Same as Alternative 2, except that this alternative would include an additional six miles of new trail development for bicyclists and hikers, and construction of a new trailhead/parking facility in an area of the Park which currently has no development. Impacts associated with this development would add to the cumulative impacts of past development activities within the Park. The total area of impact of this alternative would be larger than the other alternatives. This alternative would have the greatest cumulative impact on hydrological resources. No cumulative impacts are expected to wetlands or floodplains.

Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative)

Cumulative Impacts: Same as Alternative 2, except that the overall water quality of the First Creek drainage basin would improve due to the removal of horse use impacts and waste products from horses.

4.5.4 Terrestrial and Aquatic Resources and Migratory Birds

Alternative 1 (No Action)

Cumulative Impacts: None

Alternative 2

Cumulative Impacts: This alternative would result in a small increase in the total development foot print within the park and add to the other development actions which occurred in the past. Some individuals of a species in the park may be displaced or there may be a loss or creation of habitat conditions for local populations in small limited areas. Impacts could include changes in roosting or foraging areas, food supply, protective cover, or distribution or abundance of species. Trails may, but are not expect to form barriers or fragment habitat for wildlife. The cumulative effects to terrestrial and aquatic resources are expected to be negligible.

Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: Same as Alternative 2, except that this alternative would involve the largest increase in the total development footprint within the Park and would therefore have the greatest cumulative impact.

Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative)

Cumulative Impacts: Same as Alternative 2.

4.5.5 Vegetation Resources

Alternative 1 (No Action)

Cumulative Impacts: Impacts to vegetation would continue to occur when trail users leave the designated trails to avoid existing mud holes and problem areas causing trail widening and braiding, adding to the impacts of past develop-



ment and visitor use actions. The cumulative effects are expected to be long-term and minor.

Alternative 2

Cumulative Impacts: Vegetation impacts, adding to the impacts of past development, vegetation management activities, and visitor use, would result from: the removal of vegetation in construction of the approximately 1.5 mile connector trails at the Maple Springs complex area; improvements to the Lincoln connector trail; short (less than one mile) reroutes of First Creek Trail; and removal of several trees (predominantly dead or dying pines and cedars) on existing footprints of proposed parking lot improvements. The areas of impact would be minor in context of the park as a whole. The cumulative effects are expected to be long-term and minor.

Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: Same as Alternative 2, except that the total area of impact would include an additional six miles of new trail development and construction of a new parking lot. This alternative would have significantly greater cumulative impacts on vegetation resources than the other alternatives. The cumulative effects are expected to be long-term and minor.

Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative)

Cumulative Impacts: Same as Alternative 2, except that the overall impacts on vegetation resources of the First Creek drainage basin would be reduced due to the removal of horse use impacts and waste products from horses. The cumulative effects to vegetation resources are expected to be minor and long-term.

4.5.6 Threatened, Endangered, and Sensitive Species

Alternative 1 (No Action)

Cumulative Impacts: None

Alternative 2

Cumulative Impacts: Indiana and gray bats likely forage above existing backcountry trails, and Indiana bats may roost in nearby trees. Both bats hibernate in Park caves. Vegetation and

tree removal identified in the Preferred Alternative would be completed in accordance with the "Biological Opinion for the Effects of the Hazard Tree Removal and Vegetation Management Program to the Indiana Bat at Mammoth Cave National Park, Kentucky"¹².

The Kentucky cave shrimp is currently known from two caves located north of the Green River. Drainage from the area of the backcountry trail system can be presumed to reach at least some portion of caves that may contain the cave shrimp. Minor changes in the types of visitor use on backcountry trails, construction of the approximately 1.5 miles of connector trails at the Maple Springs complex area, the short (less than one mile) reroutes of First Creek Trail, improvements to the Lincoln connector trail and parking area would have minimal impacts on water quality. However, these minor impacts to water quality would add to the cumulative impacts when considered with current and past activities. Implementation of sustainable design and practices is expected to have positive effect on water quality over time and therefore reduce the cumulative impacts to water quality which also effect cave shrimp.

Seven species of endangered mussels are known to be present in the Green River within the Park; most of these mussel species have been found in the free-flowing segment upstream of the majority of the backcountry trail system. There would be no cumulative effects on the endangered mussels in the Green River in the Park.

A federal candidate species, the surprising cave beetle is found in a cave located within ½ mile of a backcountry trail. This alternative would have no effect on the surprising cave beetle.

The bald eagle is occasionally seen from existing backcountry trails along the river corridor and First Creek Lake area. Minor changes in the types of visitor use on backcountry trails with the implementation of this alternative are not expected to have cumulative impacts on the bald eagle. The cumulative effects to threatened, endangered, and sensitive species are expected to be negligible and not likely to adversely affect.

Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: Same as Alternative 2.



Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative)

Cumulative Impacts: Same as Alternative 2.

4.5.7 Cultural/Archeological Resources

Alternative 1 (No Action)

Cumulative Impacts: Long-term cumulative impacts to archeological resources are likely from this alternative as existing trails continue to erode and as users continue to leave designated trails to avoid mud holes and other problem areas, adding to the impacts which occurred in the past. The cumulative effects to cultural/archeological resources could range from “no adverse effect” to “adverse effect.” Although there is potential for impact to presently unidentified cultural resources, the likelihood would be low.

Alternative 2

Cumulative Impacts: Current trails impact a few archeological sites as traffic leaves the designated trails and as existing trails erode adding to past impacts. The Park will work to mitigate these impacts. Sustainable trail design would be implemented to reduce erosion and as the condition of the trail system improves the frequency of users traveling off of the designated trails would decrease. Additional ground disturbance would take place under Alternative 2. However, archeological survey would be completed for all new trail routes, reroutes, and new parking areas prior to construction. Locations would be adjusted to avoid adverse impacts if any archeological materials or features were discovered. Therefore, this alternative would likely have no impacts on intact archeological resources and the likelihood of encountering buried, in situ prehistoric resources would be quite low. It is anticipated there will be “no adverse effect” to cultural/archeological resources.

Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: The development of several miles of new trails in the backcountry would bring park visitors closer to several identified archeological sites in a section of the park which does not currently contain trails. Existing trails impact a few archeological sites as traffic leaves the designated trails and as existing trails erode;

the Park will work to mitigate these impacts. Sustainable trail design would be implemented to reduce erosion and as the condition of the trail system improves, the frequency of users traveling off designated trails would decrease. Archeological survey would be completed for all new trail routes, reroutes, and new parking areas prior to construction. Locations would be adjusted to avoid adverse impacts if any archeological materials or features were discovered. It is anticipated there will be “no adverse effect” to cultural/archeological resources.

Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative)

Cumulative Impacts: Same as alternative 2. It is anticipated there will be “no adverse effect” to cultural/archeological resources.

Section 106 Summary: The application of the Advisory Council on Historic Preservation’s “criteria of adverse effects” (36 CFR Part 800.5, Assessment of Adverse Effects), will be completed in consultation with the Kentucky State Historic Preservation Office. A preliminary review by the Park Cultural Resource Specialist anticipates that implementation of the Preferred Alternative would have “no adverse effect” on the historic or cultural landscape resources eligible for or listed in the National Register of Historic Places.

4.5.8 Aesthetics, Visual, and Recreation Resources

Alternative 1 (No Action)

Cumulative Impacts: Under the No Action Alternative the existing impacts which are causing poor trail conditions would continue. These impacts would continue to add to the past impacts. The cumulative effects of this alternative to aesthetics and recreation resources are expected to be minor, adverse and long-term.

Alternative 2

Cumulative Impacts: This alternative would provide some improvement in the recreational opportunities for the three main user groups of trails in the Park: hikers, horseback riders, and bicyclists. The overall capacity of trailheads and parking areas would be increased and access around the Maple Springs complex would be improved. The implementation of sustainable design is expected to improve trail conditions. This



alternative would have minor beneficial cumulative effects on the aesthetic/visual resources.

Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: Same as Alternative 2, except that this alternative would provide a larger degree of improvement in the recreational opportunities for all backcountry visitors. The proposed new six-mile loop trail and new parking area/trailhead with restroom facilities would be additions to the existing Park facilities. The cumulative effects on aesthetics and recreation resources would be minor, beneficial and long-term.

Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative)

Cumulative Impacts: Same as Alternative 2, except that there would be additional beneficial impacts on aesthetic and recreation resources of First Creek Trail and the First Creek drainage basin due to the removal of horse use impacts and waste products from horses. The cumulative effects on aesthetics and recreation resources would be minor, beneficial and long-term.

4.5.9 Socio-Economic Resources

Alternative 1 (No Action)

Cumulative Impacts: None

Alternative 2

Cumulative Impacts: This alternative might provide some beneficial impact on socio-economic resources through potential construction funds that might be paid to contractors for construction of improvements. The amount of potential construction funds would be minimal, and the cumulative effects would be minimal and short-term. Visitation trends for the Park are expected

to slowly increase over the next ten years. This alternative includes study the potential of other trail proposals, such as the extension of the Mammoth Cave Railroad Bike and Hike Trail that balance visitor use interests with resource protection, and are in accordance with the park's enabling legislation. If increased recreational opportunities encourage visitors to prolong their stay, surrounding communities might see a small increase in tourism dollars. The overall cumulative effects would be minimal and long-term.

Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: Same as Alternative 2.

Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative)

Cumulative Impacts: Same as Alternative 2.

4.5.10 Public Health and Safety

Alternative 1 (No Action): None

Alternative 2

Cumulative Impacts: The actions of this alternative are expected to provide general improvements to the existing conditions and have beneficial cumulative effects. The overall cumulative effects would be direct and indirect, moderate and long-term.

Alternative 3

Cumulative Impacts: Same as Alternative 2.

Alternative 4

Cumulative Impacts: Same as Alternative 2.

Alternative 5 (Preferred Alternative & Environmentally Preferred Alternative)

Cumulative Impacts: Same as Alternative 2.



5. Mitigation and Monitoring

The Preferred Alternative is to implement a Comprehensive Trail Management Plan at Mammoth Cave National Park. All of the activities considered under the proposed action are already permitted in the Park, and no substantial changes in current use is proposed, and no significant impacts are anticipated which are likely to substantially affect the natural or cultural resources in the Park.

The following list contains the mitigating actions identified for the Preferred Alternative. These are important conditions that should be utilized to limit the potential for unexpected adverse consequences.

- Tree removal for the Preferred Alternative is expected to be minimal; any tree removal required will conform to the Park “Hazard Tree Management Plan”¹³. The Park completed formal consultation with the U.S. Fish & Wildlife Service before approval of that plan. The primary issue is protection of Indiana bats. Tree removal should be completed when Indiana bats are hibernating in caves (November 15th to March 31st) and therefore are unlikely to be roosting in trees.
- During any construction dust should be controlled if it becomes an issue to minimize air quality concerns.
- Erosion and sedimentation control measures should be placed to prevent movement of soils from construction sites into water resources and the cave system.
- Location of proposed facilities will be adjusted to avoid archeological resources if any are found. Mitigation actions will be undertaken within the current trail system to reduce the impacts of visitor travel off designated trails and trail erosion where there are identified impacts to archeological sites.
- Effective construction management and supervision should be provided to insure that public safety and other concerns related to construction are properly addressed, and that contractors perform as specified.
- The Preferred Alternative includes a management objective of developing and implementing a visitor use and trail resource impact and monitoring program within five years which should improve the Park’s ability to identify any potential future impacts and formulate effective management responses.



6. Consultation and Coordination

6.1 List of Preparers

United States Department of the Interior, National Park Service, Mammoth Cave NP

Bruce Powell, Deputy Superintendent

Robert H. Ward, Chief of Science & Resource Management Division and Cultural Resource Specialist

Larry W. Johnson, Park Ranger

Kenneth J. Kern, Management Assistant

Shannon Trimboli, Education Program Specialist

Vickie Carson, Public Information Officer

Lillian J. Scoggins, GIS Specialist

Gayle Giesecke, Superintendent's Secretary

Tres Seymour, Visual Information Specialist

6.2 Agencies, Companies, or Individuals Consulted

Rickard S. Toomey III, Ph.D., Director Mammoth Cave International Center for Science and Learning

United States Department of the Interior, Fish and Wildlife Service

State Historic Preservation Office, Commonwealth of Kentucky



Endnotes

- 1 Speech of Hon. Maurice H. Thatcher, 11. The same language appears in the Senate, Committee on Public Lands and Surveys, Report No. 823, May 10, 1926, and the House of Representatives, Committee on the Public Lands, Report No. 1178, May 12, 1926.
- 2 United States Department of the Interior, National Park Service, Management Policies, 2006.
- 3 Management Policies, 2006.
- 4 Ibid.
- 5 Ibid.
- 6 United States Department of the Interior, National Park Service, RM-77: Natural Resources Management Guideline, 3:72.
- 7 NPS Management Policies 2006, 8.2.1 Visitor Carrying Capacity, p. 100
- 8 United States Department of Agriculture Soil Conservation Service, Soil Survey of Mammoth Cave National Park Edmonson County, Kentucky, 1994, pp. 289-293.
- 9 NPS Director's Order 12, 2001.
- 10 Ibid.
- 11 Biological Opinion for the Effects of the Hazard Tree Removal and Vegetation Management Program to the Indiana Bat at Mammoth Cave National Park, Kentucky, James C. Widlak, June 2000.
- 12 Ibid.
- 13 Hazard Tree Management Plan, June 20, 2000.



