



# Foundation Document Mammoth Cave National Park

Kentucky

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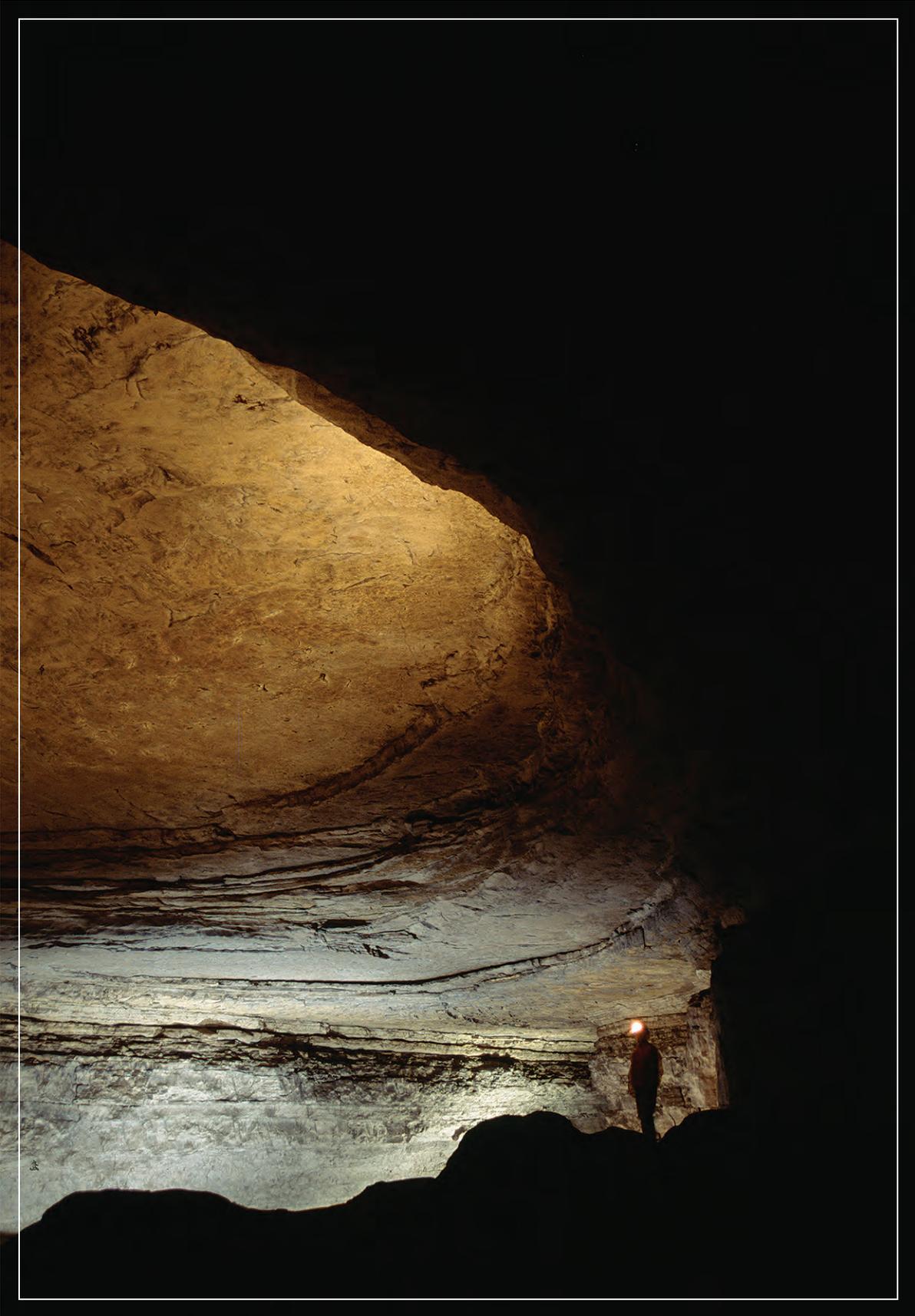
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## Mission of the National Park Service

The National Park Service (NPS) preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The National Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.

The NPS core values are a framework in which the National Park Service accomplishes its mission. They express the manner in which, both individually and collectively, the National Park Service pursues its mission. The NPS core values are:

- **Shared stewardship:** We share a commitment to resource stewardship with the global preservation community.
- **Excellence:** We strive continually to learn and improve so that we may achieve the highest ideals of public service.
- **Integrity:** We deal honestly and fairly with the public and one another.
- **Tradition:** We are proud of it; we learn from it; we are not bound by it.
- **Respect:** We embrace each other's differences so that we may enrich the well-being of everyone.

The National Park Service is a bureau within the Department of the Interior. While numerous national park system units were created prior to 1916, it was not until August 25, 1916, that President Woodrow Wilson signed the National Park Service Organic Act formally establishing the National Park Service.

The national park system continues to grow and comprises 401 park units covering more than 84 million acres in every state, the District of Columbia, American Samoa, Guam, Puerto Rico, and the Virgin Islands. These units include, but are not limited to, national parks, monuments, battlefields, military parks, historical parks, historic sites, lakeshores, seashores, recreation areas, scenic rivers and trails, and the White House. The variety and diversity of park units throughout the nation require a strong commitment to resource stewardship and management to ensure both the protection and enjoyment of these resources for future generations.



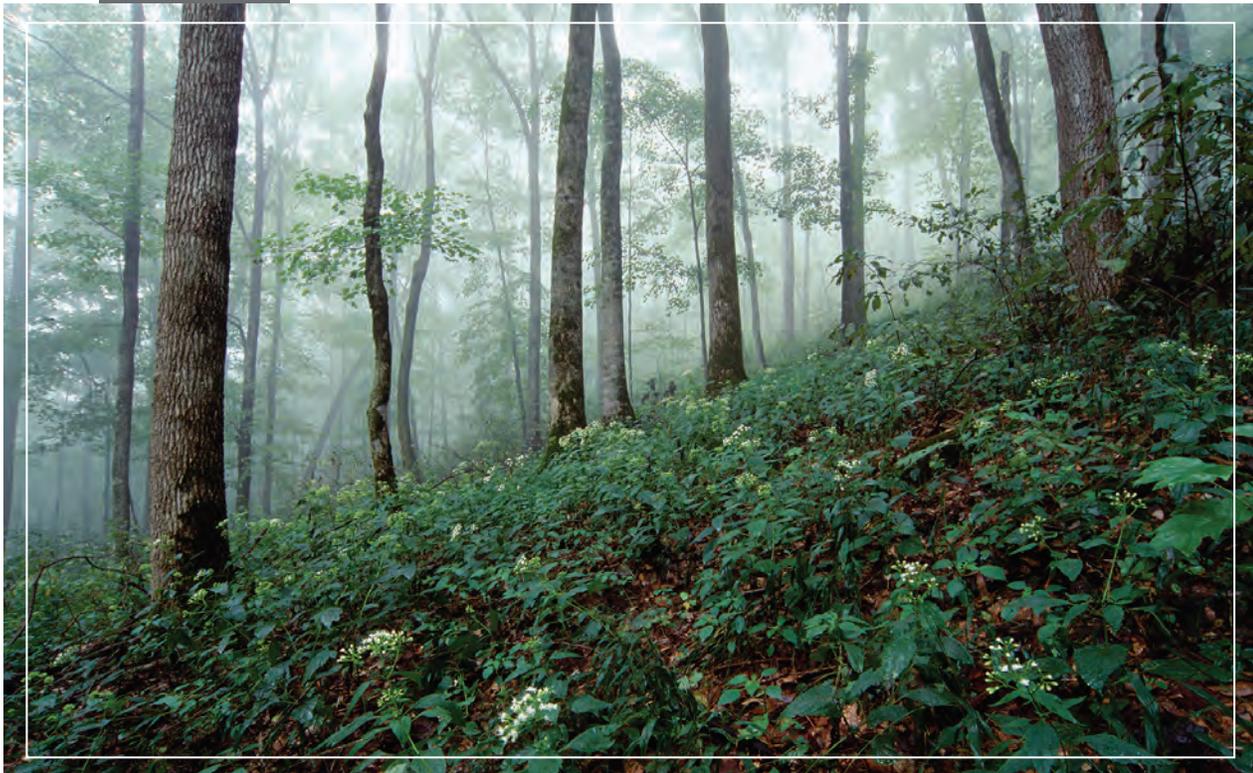
*The arrowhead was authorized as the official National Park Service emblem by the Secretary of the Interior on July 20, 1951. The sequoia tree and bison represent vegetation and wildlife, the mountains and water represent scenic and recreational values, and the arrowhead represents historical and archeological values.*

## Introduction

Every unit of the national park system needs a foundational document to provide basic guidance for planning and management decisions—a foundation for planning and management. The core components of a foundation document include a brief description of the park as well as the park’s purpose, significance, fundamental resources and values, and interpretive themes. The foundation document also includes special mandates and administrative commitments, an assessment of planning and data needs that identifies planning issues, planning products to be developed, and the associated studies and data required for park planning. Along with the core components, the assessment provides a focus for park planning activities and establishes a baseline from which planning documents are developed.

A primary benefit of developing a foundation document is the opportunity to integrate and coordinate all kinds and levels of planning from a single, shared understanding of what is most important about the park. The process of developing a foundation document begins with gathering and integrating information about the park. Next, this information is refined and focused to determine the most important attributes of the park. The process of preparing a foundation document aids park managers, staff, and the public in identifying and clearly stating in one document the essential information that is necessary for park management to consider when determining future planning efforts, outlining key planning issues, and protecting resources and values that are integral to park purpose and identity.

While not included in this document, a park atlas is also part of a foundation project. The atlas is a series of maps compiled from available geographic information system (GIS) data on natural and cultural resources, visitor use patterns, facilities, and other topics. It serves as a GIS-based support tool for planning and park operations. The atlas is published as a (hard copy) paper product and as geospatial data for use in a web mapping environment. The park atlas for Mammoth Cave National Park can be accessed online at: <http://insideparkatlas.nps.gov/>.



## Part 1: Core Components

The core components of a foundation document include a brief description of the park, park purpose, significance statements, fundamental resources and values, and interpretive themes. These components are core because they typically do not change over time. Core components are expected to be used in future planning and management efforts.

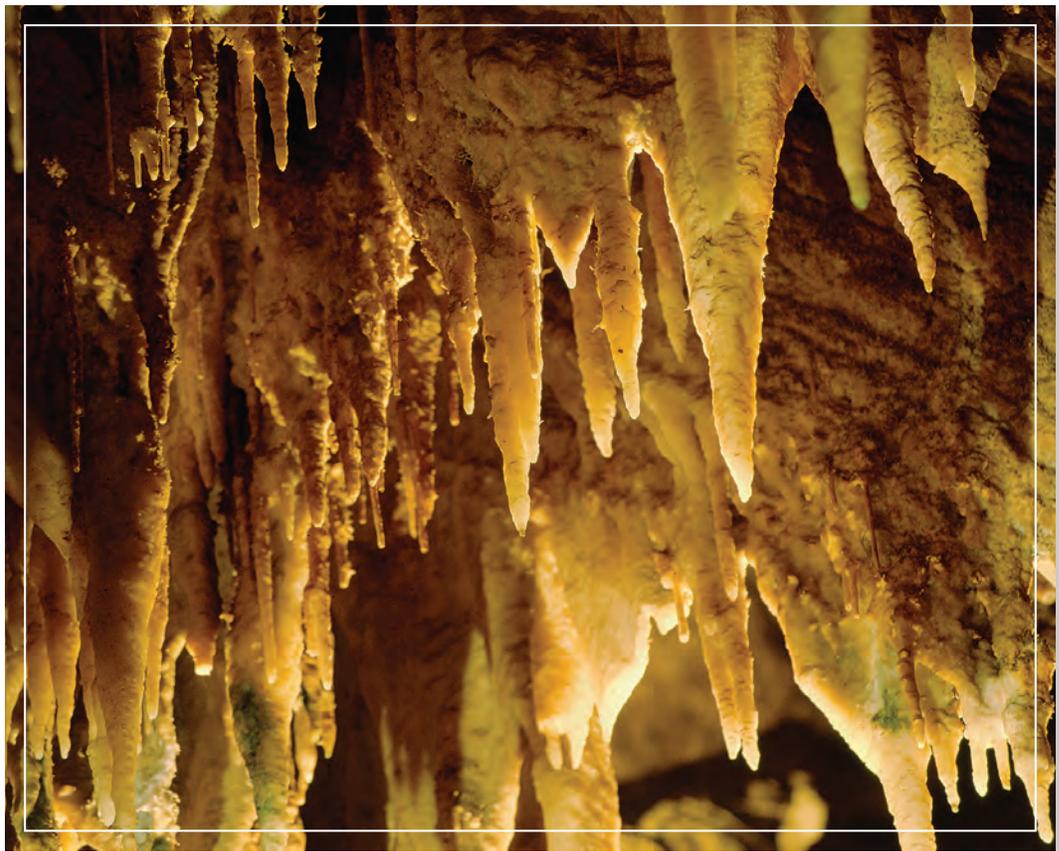
### Brief Description of the Park

Mammoth Cave has represented the challenge of the unknown for millennia, from the time the first American Indian explorers ventured inside some 5,000 years ago to the cave's rediscovery by European settlers at the turn of the 19th century, and still today as explorers, scientists, and visitors from the United States and around the world brave its shadowed chambers in search of wonder and new knowledge. Named for the enormity of its "mammoth" subterranean vaults and the unparalleled extent of its passages, Mammoth Cave is the longest known cave system in the world with 400 miles surveyed to date.

In 1941, Mammoth Cave's superlative qualities led the Southern Appalachian National Park Commission to recommend that the cave be made into a national park along with other national treasures such as Great Smoky Mountains and Shenandoah. The Mammoth Cave National Park Association and the Kentucky National Park Commission began the necessary, and unprecedented, 15-year process to convert settled areas into parklands, and once congressional requirements were met, Mammoth Cave National Park entered the national park system.

Today, Mammoth Cave National Park (the park) comprises approximately 52,830 acres in Edmonson, Hart, and Barren counties in the Commonwealth of Kentucky. Visitors are drawn to the park by its caves, scenic river valleys, bluffs, forests, and abundant wildlife. The park offers ranger-led cave tours and surface walks, camping, hiking, horseback riding, bicycling, scenic drives, canoeing and kayaking, fishing, accessible trails, and picnicking. This breadth of activities is available because Mammoth Cave National Park is a park on two levels—reclaimed hardwood forest and winding riverways above, and complex cave systems below.





For good reason, Mammoth Cave’s cavernous limestone or “karst” features draw the most interest. In karst terrain, everything that happens on the surface affects the caves below—surface and subsurface are intricately bound together and water is the binding thread through all aspects of the park. Rainwater enters the underground river system through cracks, crevices and thousands of sinkholes, some up to 10 miles outside the park boundary, and eventually emerges through springs into the Green River. Over millions of years, water has slowly cut and dissolved its way deeper into the landscape, leaving upper levels of dry cave behind; underground rivers at the water table are still carving new passages today. Myriad related geologic processes contribute to the formation not only of the extensive Mammoth Cave / Flint Ridge / Roppel Cave system, but to hundreds of smaller caves in the park, as well as numerous other karst features. Within the subterranean spaces, the interplay of water and mineral has produced remarkable formations in stone, some of them breathtaking in their beauty and fragility.

The mosaic of habitats and diversity of forests types, grasslands, and caves supports more than 1,300 plant species and is home to more than 70 threatened, endangered, or state-listed species. Mammoth Cave is recognized as having one of the most diverse karst biota in the world, including more than 40 species that spend their entire life in the cave and almost 100 others that can readily be found in the caves. Thirty-six species of animals have been described from park caves.

Yet even without the world’s longest cave system, the land within Mammoth Cave National Park would merit national park status simply for its extraordinary density and diversity of plant and animal life. The park has one of the most biologically diverse river systems in the nation. Historically, more than 70 mussel species inhabited Green River, where today that number has been reduced by approximately 20 species and many of those remaining are imperiled. Even so, Green River still holds one of the most diverse populations of mussels in the eastern United States. Approximately 150 species of freshwater fish are known from the entire extent of the Green River.

In addition to extensive natural resources, the park offers a rich cultural history. Archeologists believe prehistoric people entered the cave approximately 5,000 years ago and the cave's stable atmosphere and protection from disturbance preserved their discarded torches, sandals, and gourd bowls. After the cave's rediscovery by European settlers, the cave saw several uses, but quickly became a magnet for tourists from the United States and abroad, beginning its first commercial tours in 1816. Some of the early cave guides were slaves, including Stephen Bishop, Mat Bransford, and Nick Bransford, who discovered many of its famous passages. The park also contains nationally significant historic structures, including 1812-era mining works for saltpeter (an ingredient for gunpowder that influenced the history of the nation during that period), churches built in the 19th century, and structures built by the Civilian Conservation Corps (CCC) in the 1930s.

The cultural and natural resources protected within this national park are national treasures. In recognition of these world-class resources, the park has received two international designations. In 1981, the United Nations Educational, Scientific and Cultural Organization (UNESCO) designated Mammoth Cave as a World Heritage Site. In 1990, the Mammoth Cave Area International Biosphere Reserve was designated (with all park acreage included in a core 112,800-acre area) and it was expanded to 909,328 acres in 1996.

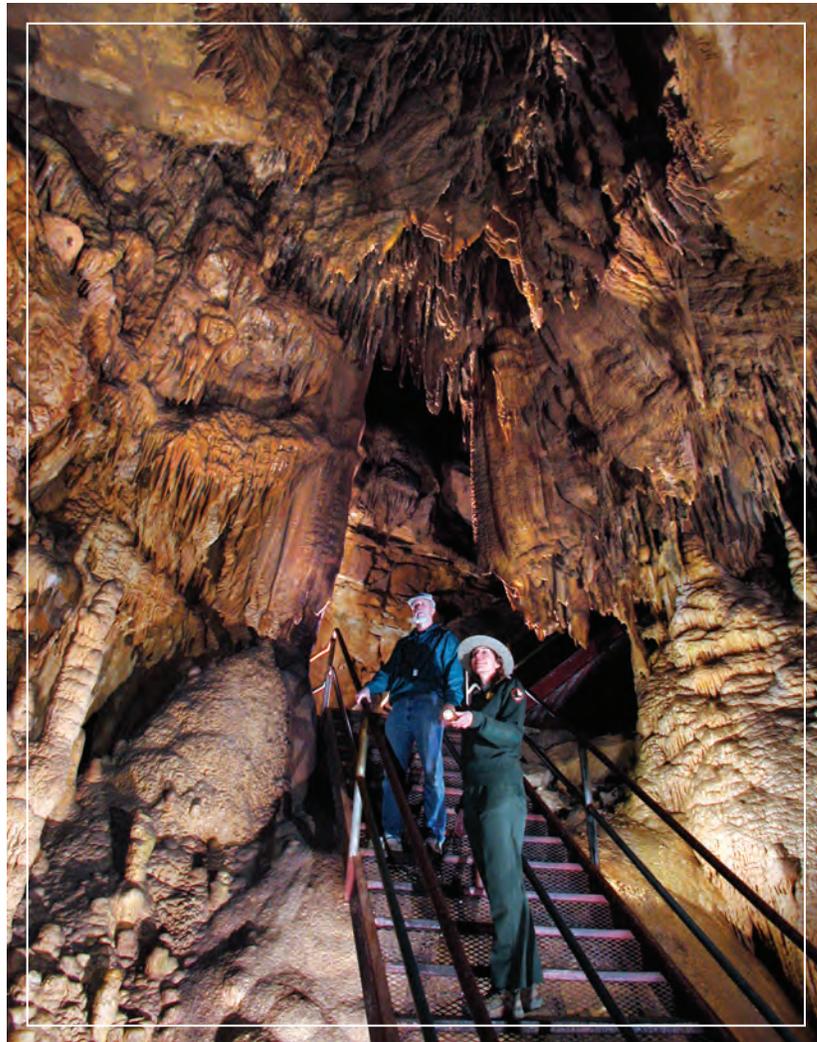
Explorers continue to discover the secrets of Mammoth Cave, and visitors to this national park continue to be drawn to its diversity, its beauty, and its mystery, as they have been since prehistory.



## Park Purpose

The purpose statement identifies the specific reason(s) for establishment of a particular park. The purpose statement for Mammoth Cave National Park was drafted through a careful analysis of its enabling legislation and the legislative history that influenced its development. The park was established when the enabling legislation adopted by Congress was signed into law on July 1, 1941 (see appendix A for enabling legislation and subsequent amendments). The purpose statement lays the foundation for understanding what is most important about the park.

*The purpose of MAMMOTH CAVE NATIONAL PARK is to preserve, protect, interpret, and study the internationally recognized biological and geologic features and processes associated with the longest known cave system in the world, the park's diverse forested, karst landscape, the Green and Nolin rivers, and extensive evidence of human history; and to provide and promote public enjoyment, recreation, and understanding.*



## Park Significance

Significance statements express why a park's resources and values are important enough to merit designation as a unit of the national park system. These statements are linked to the purpose of Mammoth Cave National Park, and are supported by data, research, and consensus. Statements of significance describe the distinctive nature of the park and why an area is important within a global, national, regional, and systemwide context. They focus on the most important resources and values that will assist in park planning and management.

The following significance statements have been identified for Mammoth Cave National Park. (Please note that the sequence of the statements does not reflect the level of significance.)

1. Mammoth Cave National Park is both a UNESCO World Heritage Site and the core of an International Biosphere Reserve, primarily due to its globally significant karst resources. The park protects the world's longest known cave and more than 400 other caves that contain features that are superlative examples of their types. The park has one of the highest diversities of cave-adapted organisms in the world. The park's interrelated cave and surface karst features are superb, with textbook examples of the karst process including drainage systems, vast recharge areas, sinkholes, and complex networks of conduits and springs. For more than 200 years, the cave system has been a laboratory for multiple disciplines and has served to explain fundamental principles of speleology, hydrology, cave biology, and cave archeology.
2. Mammoth Cave National Park's range of topography and location at the juncture of the Shawnee Hills / Western Kentucky Coal Fields and Mississippian Plateau (which includes the Dripping Springs Escarpment) regions, dissected by the Green and Nolin rivers, creates an interrelationship of the surface and subsurface ecosystems with exceptional diversity of landforms, habitats, life forms, and functions. The diversity of habitats protected in the park provides sanctuary for a wide variety of flora and fauna communities; some of these communities are endangered and of international significance. Abundant flora and fauna provide opportunities for valuable scientific research, including one of the most studied cave biota in the world.
3. Mammoth Cave National Park contains well-preserved cultural resources, both in the caves and above ground, spanning the last 12,000 years. These include evidence of cave exploration; American Indian early plant domestication; prehistoric and early historic mineral mining; pioneer settlements; sites related to early American wars; and engineering and design related to 200 years of tourism and park development. The remarkable integrity of cultural resources in Mammoth Cave National Park has and continues to inspire exploration, educational outreach, and scientific research.
4. The Green River is the master stream controlling the geologic development of Mammoth Cave and its world-class karst ecosystem. Springs along the Green River provide opportunities to experience the intersection between the surface and subsurface environments. Within the park, the Green River bisects two physiographic regions and supports one of the most biodiverse aquatic communities in North America. The scenic Green and Nolin rivers provide significant opportunities for scientific study and recreation within the forested karst landscape.
5. Mammoth Cave National Park has been an internationally known destination for more than 200 years. The park, located within a day's drive of half of the U.S. population, offers a wide range of recreational and educational opportunities amidst the diverse cave system, outstanding scenic rivers, hilly country, and abundant wildlife. On ranger-led tours, visitors learn of the connection between the park's surface and subsurface and hear stories of the people who lived here for thousands of years. Generation after generation of park visitors return time and again to rekindle emotional and personal connections with the rich cultural and natural history of the park.

## Fundamental Resources and Values

Fundamental resources and values (FRVs) are those features, systems, processes, experiences, stories, scenes, sounds, smells, or other attributes determined to warrant primary consideration during planning and management processes because they are essential to achieving the purpose of the park and maintaining its significance. Fundamental resources and values are closely related to a park's legislative purpose and are more specific than significance statements.

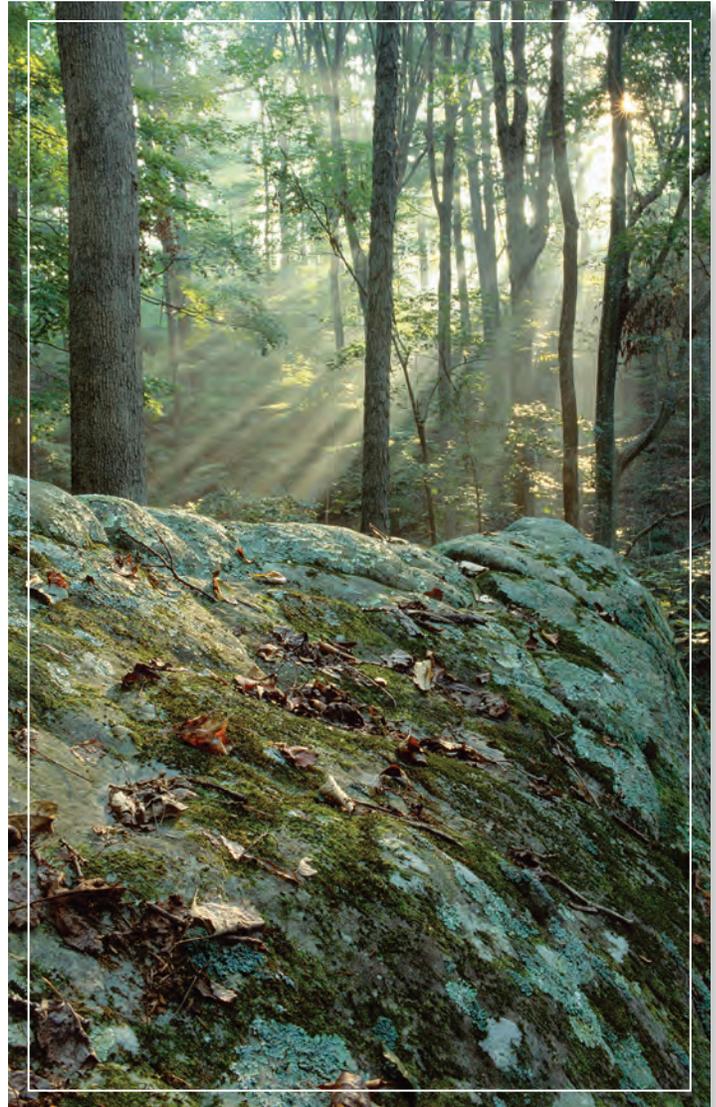
Fundamental resources and values help focus planning and management efforts on what is truly significant about the park. One of the most important responsibilities of NPS managers is to ensure the conservation and public enjoyment of those qualities that are essential (fundamental) to achieving the purpose of the park and maintaining its significance. If fundamental resources and values are allowed to deteriorate, the park purpose and/or significance could be jeopardized.

The following fundamental resources and values have been identified for Mammoth Cave National Park:

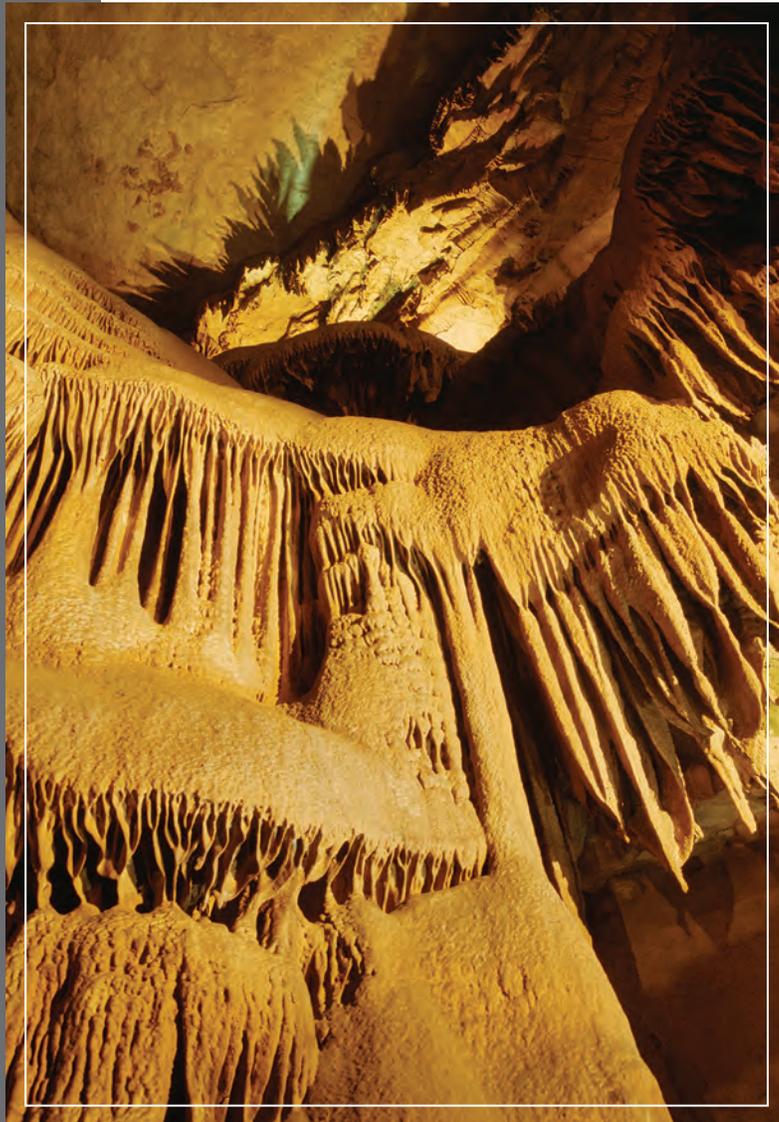
- **World-class Karst.** Mammoth Cave's karst landscape is internationally renowned. It showcases the geologic and hydrologic processes linking the surface and subsurface environments. The park contains an incredible density of extensive caves, including the world's longest at over 400 miles, 10 others more than one mile long, and more than 400 smaller caves. The cave contains large passages, vertical shafts, stalagmites, stalactites, splendid gypsum flowers, delicate gypsum needles, rare mirabilite flowers, and other natural features. Many of these are superlative examples of their type. The cave's environment preserves fossilized remains, traces of past human uses, and protects one of the highest biodiversity of cave-adapted organisms in the world.
- **Scientific Exploration and Discovery.** The park is the core of one of the most studied karst areas of the world. More than 5,000 years of exploration has led to present understanding of the complexity of the park's caves. Since the early 1800s, Mammoth Cave has served as an important destination for scientific discovery. Survey and mapping efforts have documented more than 400 miles of interconnected cave passages. Past and ongoing research at the park has been conducted in a wide range of disciplines from history, archeology, and social sciences to the physical and biological sciences. Thirty-six species of animals were first discovered and scientifically described from park caves. Ground-breaking research has shaped the fundamental principles of speleology, hydrology, cave biology, and cave archeology. The more than 1,200,000 objects in the park's museum and archival collections record Mammoth Cave's natural and cultural history. This ongoing tradition of inquiry dynamically shapes park education, interpretation, and outreach.



- Underground Time Capsule.** The caves in Mammoth Cave National Park are an exceptional time capsule due to specific environmental conditions and limited disturbance, which have preserved fragile, perishable materials within a distinctive cultural landscape. The cave preserves the footprints and evidence of American Indian exploration beginning about 5,000 years ago, extensive mineral mining beginning around 3,000 years ago, and evidence of early plant domestication. Saltpeter mining was a major industry during the War of 1812, leaving behind one of the best-preserved saltpeter works from that era. Evidence from 200 years of economic endeavors and tourism includes historic signatures, structures, monuments, and construction for visitor access at a number of caves in the park.
- Twelve Thousand Years of Human Interaction with the Land.** Mammoth Cave National Park preserves cultural resources, objects, and landscapes, above and below ground, that remain important touchstones of cultural identity and heritage. An array of archeological sites, including rock shelters, burials, and early agricultural sites document American Indian presence in the area beginning 12,000 years ago. Many contemporary area families maintain direct ties to the rural communities that existed prior to park establishment through the remaining churches, cemeteries, home sites, objects, and cultural landscapes associated with historic settlement. The park also preserves extensive cultural resources related to 200 years of cave tourism, transportation, and park development.
- Water Shapes the Landscape.** The flowing water of the Green River is the most dominant force shaping the regional landscape characterized by deep valleys and well-incised meanders cutting through the geologic sequence. The Green and Nolin rivers are ancient channels, predating the earliest cave development. Ultimately, caves drain to the Green River creating important springs. The cave streams in the park are designated Outstanding National Resource Waters, and the park's underground drainage basins are designated as Outstanding State Resource Waters, extending outside of the park's boundary. The Green River is designated as an Outstanding State Resource Water and a state Wild River, providing significant scenic and recreational opportunities. The Green and Nolin rivers support one of the most diverse fish and invertebrate faunas in North America.
- Opportunities for Connection to the Resources.** The very nature of Mammoth Cave allows visitors to personally interact with interpretive rangers who provide the necessary protection to cave resources and the visitors themselves. Park visitors choose from a wide range of educational and interpretive opportunities, such as ranger-led cave tours or relaxing campfire programs. Visitors enjoy a wide range of recreational opportunities such as hiking, biking, horseback riding, or floating, canoeing, kayaking, and fishing the rivers. Visitors, volunteers, and researchers explore and discover the park's natural and human history and in turn explore their own physical abilities and mental, emotional, and spiritual interests.



- **Biodiversity.** Mammoth Cave National Park is home to a diversity of habitats and life forms, including several threatened and endangered species. Of the more than 130 species of fauna within park caves, some are known to exist only within the Mammoth Cave area, such as the federally endangered Kentucky cave shrimp. There are 13 species of bats, including 3 federally endangered species. The Green and Nolin rivers possess one of the most diverse fish (82 species) and invertebrate faunas (51 species of mussels, including 7 federally endangered species) in North America. The combination of the topographic variety associated with the karst landscape and the temperate climate of the region provides a number of ecological niches that support an exceptionally diverse assemblage of more than 1,300 vascular flora species, including unusual communities.
- **Natural Resource Quality and Function.** Mammoth Cave National Park is designated as a World Heritage Site and International Biosphere Reserve because of the outstanding quality of resources. Designated as a Class I area under the Clean Air Act, as amended in 1977 and 1990, the park provides special protection for air quality, sensitive ecosystems, and clean, clear views. Green River is designated an Outstanding State Resource Water. The quality of air, water, vegetation, and wildlife resources are preserved and protected in an environment dominated by natural processes. The park backcountry provides wilderness character through opportunities to experience solitude and remoteness from civilization.



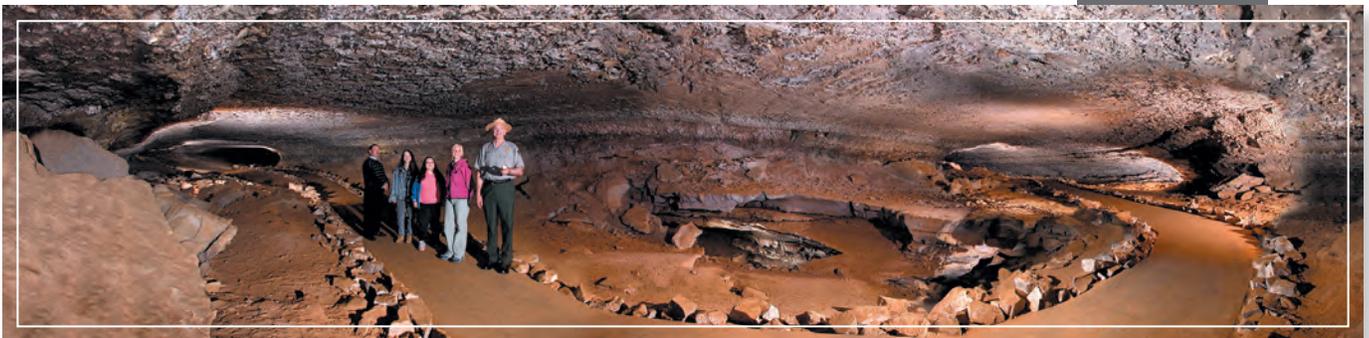
## Interpretive Themes

Interpretive themes are often described as the key stories or concepts that visitors should understand after visiting a park—they define the most important ideas or concepts communicated to visitors about a park unit. Themes are derived from, and should reflect, park purpose, significance, resources, and values. The set of interpretive themes is complete when it provides the structure necessary for park staff to develop opportunities for visitors to explore and relate to all park significance statements and fundamental resources and values.

Interpretive themes are an organizational tool that reveal and clarify meaning, concepts, contexts, and values represented by park resources. Sound themes are accurate and reflect current scholarship and science. They encourage exploration of the context in which events or natural processes occurred and the effects of those events and processes. Interpretive themes go beyond a mere description of the event or process to foster multiple opportunities to experience and consider the park and its resources. These themes help explain why a park story is relevant to people who may otherwise be unaware of connections they have to an event, time, or place associated with the park.

The following interpretive themes have been identified for Mammoth Cave National Park:

- The Mammoth Cave landscape shelters an underground labyrinth unmatched in size and complexity; the mysteries of this diverse natural laboratory have inspired human discovery for thousands of years.
- We share with our ancestors an avid curiosity and sense of wonder that guides us to experience adventure and excitement, create works of imagination, and explore the unknown.
- Knowledge from ongoing scientific endeavors in the Mammoth Cave area helps to alleviate threats to the park's resources, expand understanding of complex natural systems, and enrich the visitor experience.
- For more than 12,000 years people have interacted with the Mammoth Cave landscape using natural resources to ensure their survival and improve their quality of life.
- The ever-changing karst landscape of south central Kentucky exemplifies the power and persistence of water through time in creating the world's longest known cave system, Mammoth Cave.
- The diverse flora and fauna of Mammoth Cave National Park, some of international significance and endangered, is faced with external and internal challenges that not only affect visitor use and management of the park, but the very survival of those species.



## Part 2: Dynamic Components

The dynamic components of a foundation document include special mandates and administrative commitments and an assessment of planning and data needs. These components are dynamic because they will change over time. New special mandates can be established and new administrative commitments made. As conditions and trends of fundamental resources and values change over time, the analysis of planning and data needs will need to be revisited and revised, along with key issues. Therefore, this part of the foundation document will be updated accordingly.

### Special Mandates and Administrative Commitments

Many management decisions for a park unit are directed or influenced by special mandates and administrative commitments with other federal agencies, state and local governments, utility companies, partnering organizations, and other entities. Special mandates are requirements specific to a park that must be fulfilled. Mandates can be expressed in enabling legislation, in separate legislation following the establishment of the park, or through a judicial process. They may expand on park purpose or introduce elements unrelated to the purpose of the park. Administrative commitments are, in general, agreements that have been reached through formal, documented processes, often through memorandums of agreement. Examples include easements, rights-of-way, arrangements for emergency service responses, etc. Special mandates and administrative commitments can support, in many cases, a network of partnerships that help fulfill the objectives of the park and facilitate working relationships with other organizations. They are an essential component of managing and planning for Mammoth Cave National Park. Some parks have also received special designations that honor the exemplary resources and/or cultural heritage of the park.

For more information about the existing special mandates, special designations, and administrative commitments for Mammoth Cave National Park, please see appendix B.

### Assessment of Planning and Data Needs

Once the core components of part 1 of the foundation document have been identified, it is important to gather and evaluate existing information about the park's fundamental resources and values, and develop a full assessment of the park's planning and data needs. The assessment of planning and data needs section presents planning issues, the planning projects that will address these issues, and the associated information requirements for planning, such as resource inventories and data collection, including GIS data.

There are three sections in the assessment of planning and data needs:

- analysis of fundamental resources and values
- identification of key issues and associated planning and data needs
- identification of planning and data needs (including spatial mapping activities or GIS maps)

The analysis of fundamental resources and values and identification of key issues leads up to and supports the identification of planning and data collection needs.

### Analysis of Fundamental Resources and Values

The fundamental resource or value analysis table includes current conditions, potential threats and opportunities, planning and data needs, and selected laws and NPS policies related to management of the identified resource or value.

Fundamental Resource or Value	World-class Karst
Related Significance Statements	<ul style="list-style-type: none"> <li>• Significance statement #1</li> </ul>
Current Conditions and Trends	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• The karst system is generally in a good condition and stable.</li> <li>• The park contains more than 400 caves, including the world’s longest known cave. The Mammoth Cave / Flint Ridge / Roppel Cave system has more than 400 miles of mapped passages. Ten other long (greater than 1 mile long) caves are wholly or partially within the park boundaries.</li> <li>• Groundwater use is currently stable; recharge exceeds withdrawal.</li> <li>• Cave streams have generally good water quality; however, contamination issues occur during storm events.</li> <li>• Base level streams have unnatural ponding resulting from U.S. Army Corps of Engineers (USACE) Green River Lock and Dam #6, which has been decommissioned.</li> <li>• Cave features, including sediments, formations, and speleogens are generally in good condition, although areas with a longer history of tourism show damage from visitation and tour related infrastructure.</li> <li>• Some fragile organic and biological cave resources (including both archeological materials and paleontological materials) in some areas are deteriorating due to altered cave climates.</li> <li>• Cave biota and ecosystem are generally in good condition, although biota near some toured areas and cave bats face additional issues (see threats below).</li> <li>• Nonnative algae and cyanobacteria growth (lamp-flora) caused by cave lighting is widespread but localized in lighted tour areas of the cave. Lamp-flora threatens cave ecosystem, some cultural resources, and cave aesthetics.</li> <li>• Dust and lint from cave trails and tourists is widespread but localized in toured areas of the cave. Both dust and lint obscure and potentially threaten cave ecosystem, paleontological resources, and cultural resources. Dust and lint impact cave aesthetics in heavily toured areas.</li> <li>• Modification of cave entrances (mostly in the past, but also continuing to some extent) has altered, and in some cases restored, natural airflow patterns within the cave.</li> <li>• Corroding material from both current and previous tour infrastructure (including wire, fixtures, and old hand rails) mobilize metals that may harm cave biota. This impact occurs along both current and former toured areas in several caves in the park.</li> <li>• Park caves, including both the Mammoth Cave System and other caves in the park, are mostly in very good condition. Some local impacts occur, but they tend to be limited in scope of area and duration.</li> <li>• The majority of the park’s most sensitive caves with highly significant resources are gated; however, some park caves with important resources are not gated. Additionally, some cave gates need to be replaced due to age and condition.</li> <li>• All caves in the park are closed to visitation except via ranger led/attended tour or permit from the superintendent.</li> <li>• At least 31 karst groundwater basins drain through or within the park. At least 13 of these extend outside the park boundary.</li> </ul>

Fundamental Resource or Value	World-class Karst
<p><b>Current Conditions and Trends</b></p>	<p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• Natural surface and subsurface karst processes continue to develop the karst system and sustain cave ecosystems within and outside the park.</li> <li>• Groundwater use and recharge trends are poorly known but appear stable; however, potential hydraulic fracturing for hydrocarbons and climate change could negatively impact this stability.</li> <li>• Cave stream water quality has improved over the last 25 years, but storm events still bring contaminants into the cave. The park continues to work with state, local, and federal officials to reduce contamination entering the caves.</li> <li>• Base-level stream ponding due to USACE Green River Lock and Dam #6 will continue until the structure is removed or fails.</li> <li>• Cave resources, including formations, sediments, paleontological resources, and archeological materials, are generally well protected from damage and remain in good condition. Exceptions occur where visitation or local climate alteration are leading to deterioration of some resources.</li> <li>• Cave biota and ecosystem conditions appear stable. However, see significant data needs listed below.</li> <li>• Lamp-flora is widespread but localized in lighted tour areas of the cave. In some areas, particularly Mammoth Dome and parts of the New Entrance and Frozen Niagara, conditions seem to be improving with updated lighting. However, some areas still have major growth due to current lights, and legacy algae from previous lighting still exists.</li> <li>• Dust and lint is widespread but localized in toured areas of the cave. In some areas, particularly parts of Upper Historic and Frozen Niagara, cave trail modifications have reduced the amount of dust and lint migrating off trail. However major areas still have significant (and worsening) dust and lint problems. Legacy dust problems still exist in Upper Historic.</li> <li>• Additional caves continue to be identified in the park. Passages continue to be discovered and explored in caves. In addition, previously unrecorded significant cave resources continue to be identified in existing caves and passages.</li> <li>• Although National Speleological Society restoration camps and other volunteer groups continue to remove old, corroding infrastructure, much infrastructure remains that may locally impact cave areas.</li> <li>• New cave gates are installed as significant resources are identified. Some cave gates are reaching the end of their useful life and will need to be replaced.</li> </ul>

Fundamental Resource or Value	World-class Karst
Threats and Opportunities	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Localized impacts from authorized and unauthorized off-trail use within the caves resulting in vandalism and degradation to associated cultural resources, cave biology, and cave mineral deposits.</li> <li>• Localized impacts from authorized and unauthorized off-trail use on the surface resulting in degradation to ecology and secondarily to karst systems.</li> <li>• Potential for exceeding carrying capacity on surface and subsurface trails leading to increased erosion, trail breakdown, invasive species, impacts on cave and surface ecosystems, and water quality.</li> <li>• Changes in climate through increased mean annual temperature and varied precipitation could alter cave conditions.</li> <li>• Oil and gas and other extractive developments near the park boundary resulting in impacts to groundwater quality.</li> <li>• Illegal dumping in sinkholes, disappearing streams, and other lands that have underground drainage into the park degrades water quality.</li> <li>• Water quality threats from sewer line breaks and individual septic systems.</li> <li>• Potential water quality issues from abandoned older park sewer system.</li> <li>• Accidental spills from transportation corridors, including Interstate 65 and the CSX Railroad. Increasing traffic and hazard materials transport on local roads and highways increases this problem.</li> <li>• Non-point source pollution from agricultural practices and other sources degrading water quality.</li> <li>• Changing land uses associated with residential, commercial, and industrial developments.</li> <li>• White-nose syndrome (WNS) endangering or eliminating bat populations and potential secondary effects on cave invertebrate populations and forest vegetation.</li> <li>• Air quality degradation (i.e., increased acid, particle, and mercury deposition) affect natural cave processes, features, and organisms.</li> <li>• Base level cave streams and the Green and Nolin rivers have unnatural ponding resulting from USACE Green River Lock and Dam #6, resulting in increased siltation and probable impacts on the endangered Kentucky cave shrimp, mussels, and fish dependent on free-flowing conditions.</li> <li>• Cave formations, sediments, speleogens, archeological, and paleontological materials are locally affected by cave trail use (including both tour and non-tour use) and local perturbation of cave climate.</li> <li>• Unnatural water inputs associated with past and modern cave infrastructure locally alter cave climate and locally threaten cave resources including archeological materials, mineral deposits, and biology.</li> <li>• Backflooding of cave streams during flood events subjects them to Green River pollution from upstream sources.</li> <li>• Nonnative and invasive species above and below ground threaten many habitats and species in the karst landscape.</li> <li>• Lamp-flora, lint, and dust threaten cave ecosystems and visitor experience in toured areas of caves.</li> <li>• Waste of electricity in the cave due to 1) issues in the design of the lighting system for tours that do not allow tours to use lights most efficiently and 2) poorly designed stair de-icing system. Lighting system problems result in lights being left on rather than turned off between tours due to inadequate overlap between light strings.</li> <li>• Social media, global positioning system (GPS) technology, and GIS are allowing sharing of information such as cave locations. This potentially leads to increased visitation to undeveloped areas and damage to park natural and cultural resources.</li> </ul>

Fundamental Resource or Value	World-class Karst
<p><b>Threats and Opportunities</b></p>	<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Research partnerships with academic institutions, state and federal agency partners, nongovernmental organizations (NGOs), and private individuals provide ongoing information for decision making and expand knowledge of karst systems.</li> <li>• Volunteer support, notably large efforts by the Cave Research Foundation and National Speleological Society, is invaluable to the park in mapping caves, documenting new caves and cave resources, supporting scientific efforts in caves, and restoring areas that have been impacted by past activities in the caves.</li> <li>• Partnerships with local organizations and government groups regarding tourism, farming practices, manufacturing, transportation, and infrastructure promote environmentally sensitive economic development, especially within the Mammoth Cave International Biosphere Reserve.</li> <li>• As a champion of environmental protection, the park works cooperatively with government agencies (local, state, and federal), the Barren River Area Development District, and numerous nongovernmental organizations to promote conservation, assist in emergency responses to incidents that may endanger environmental resources, develop and implement best management practices, and engage in environmental education and outreach via park programs and the Mammoth Cave International Center for Science and Learning (MCICSL).</li> <li>• Mammoth Cave’s world-class karst provides an educational showcase that is used by people of all ages. Classes (K–20+), professional groups from around the world, and individuals come to the area to improve their understanding of karst. The park’s interpreters, environmental educators, and the Mammoth Cave International Center for Science and Learning direct, coordinate, and assist in these efforts.</li> <li>• International Biosphere Reserve and World Heritage Site designations allow regional discussion and response to opportunities and threats.</li> <li>• Management direction that emphasizes cooperative conservation to protect air quality and resources sensitive to air pollution.</li> </ul>
<p><b>Existing Data and Plans Related to the FRV</b></p>	<ul style="list-style-type: none"> <li>• Extensive knowledge has been gained about the karst systems of the park; however, numerous questions remain (see data needs).</li> <li>• Cave surveys and inventories (ongoing).</li> <li>• “White-Nose Syndrome Response Plan: Mammoth Cave National Park” (2011).</li> <li>• “Water Resources Management Plan: Mammoth Cave National Park, Kentucky” (2006).</li> <li>• Cumberland Piedmont Network (I&amp;M) vital signs planning and inventories.</li> <li>• Lesser caves inventory (ongoing).</li> <li>• Cultural resource inventories (Earthwatch, national register documentation).</li> <li>• Geologic inventory.</li> <li>• Paleontological inventory of selected cave portions.</li> <li>• “Groundwater Hazard Map of the Turnhole Spring Karst Groundwater Basin” (1994–1995), needs updating (see below data and planning needs).</li> <li>• Grade and drain plan for Interstate 65.</li> <li>• Groundwater basin maps.</li> </ul>

Fundamental Resource or Value	World-class Karst
<p><b>Data and/or GIS Needs</b></p>	<ul style="list-style-type: none"> <li>• Better understanding of the relationship between surface and cave climates (baseline modeling). Associated with large-scale regional changes and localized effects on cave environments and infrastructure.</li> <li>• Mercury effects on cave organisms. Associated with air quality, water quality, and biology.</li> <li>• Surveys, resource inventories, and mapping of currently known and new caves including flooded passages. More-detailed mapping is needed of some previously surveyed cave areas and newly discovered caves and passages.</li> <li>• Landscape dynamics. Changes to land uses outside the park boundary.</li> <li>• Bat population trends.</li> <li>• Continued monitoring of cave organisms.</li> <li>• Cultural landscape inventories.</li> <li>• Paleontological inventories.</li> <li>• Cave archeological surveys, inventories, and condition assessments.</li> <li>• Complete survey, mapping, and inventory of park lesser caves and springs.</li> <li>• Surface and groundwater input and outflow balance inventory and monitoring.</li> <li>• Inventory borehole and wells (water).</li> <li>• Vegetation change monitoring (as part of vegetation mapping).</li> <li>• Inventory and monitoring of invasive nonnative species.</li> <li>• Expanded (spatial and temporal) water quality and quantity monitoring.</li> <li>• Updated park habitat model.</li> <li>• Cave impact mapping/monitoring (primarily) for toured areas.</li> <li>• Updated groundwater hazard map (converted to GIS format).</li> <li>• GIS data supporting staff response to catastrophic events.</li> <li>• Cultural landscape reports.</li> </ul>
<p><b>Planning Needs</b></p>	<ul style="list-style-type: none"> <li>• Cave and karst management plan. Comprehensive plan related to management of natural and cultural resources and visitor use.</li> <li>• Natural resource condition assessment (in progress).</li> <li>• Resource stewardship strategy.</li> <li>• State of the Park report.</li> <li>• Invasive species management plan.</li> <li>• Air resource management plan.</li> <li>• Updated groundwater hazard response plan.</li> <li>• Cave trails plan.</li> <li>• Climate change scenario planning.</li> </ul>

Fundamental Resource or Value	World-class Karst
<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b></p>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• Paleontological Resources Preservation Act of 2009</li> <li>• Clean Water Act of 1972</li> <li>• Clean Air Act (42 USC §7470[2])</li> <li>• 1988 Federal Cave Resources Protection Act</li> <li>• Endangered Species Act of 1973, as amended</li> <li>• National Environmental Policy Act</li> <li>• Native American Graves Protection and Repatriation Act of 1990</li> <li>• National Historic Preservation Act of 1966, as amended (16 USC 470)</li> <li>• National Park Service Organic Act</li> <li>• Archaeological Resources Protection Act of 1979</li> <li>• National Parks Omnibus Management Act of 1998</li> <li>• 36CFR – Title 36 – Parks, Forests, and Public Property</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006, and Director’s Orders, and Secretarial Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS Management Policies 2006 (§4.6.1, 4.6.2, 4.6.4 and 4.8.1.1)</li> <li>• NPS Natural Resource Management Reference Manual #77</li> <li>• NPS A Call to Action: Preparing for a Second Century of Stewardship and Engagement</li> <li>• Secretarial Order 3289, “Addressing the Impacts of Climate Change on America’s Water, Land, and Other Natural and Cultural Resources”</li> </ul>



Fundamental Resource or Value	Scientific Exploration and Discovery
Related Significance Statements	<ul style="list-style-type: none"> <li>All significance statements</li> </ul>
Current Conditions and Trends	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>Research is dynamic and ongoing in the park. Despite the Mammoth Cave region being an important hub for scientific exploration and discovery for more than 200 years, there is still much to learn about the park's natural and cultural resources.</li> <li>Research in the park is diverse, covering a wide range of surface and subsurface disciplines including (but not limited to) history, archeology, biology, geology, hydrology, meteorology, and education.</li> <li>Understanding how park resources respond to threats such as climate change, invasive species, and changes in surrounding land uses, and discovering potential ways to mitigate those threats, can only be accomplished through continued, in-depth, scientific research and discovery.</li> <li>A park-issued permit is required for research or collecting within the park.</li> <li>The museum collections and archives are in good condition. A large backlog of cataloging exists.</li> <li>Strong partnerships and volunteer efforts exist to support science and cave mapping.</li> <li>Citizen science efforts support several park research projects.</li> <li>Curatorial facility meets standards and guidelines for protection of museum collections, but building is not hardened against some weather threats (such as tornados) and lacks back-up generator.</li> <li>Sufficient contract partner curatorial staff levels exist. The park does not have an NPS curatorial position.</li> <li>Research facilitation and coordination is provided by the Mammoth Cave International Center for Science and Learning, a partnership between Mammoth Cave and Western Kentucky University.</li> <li>Park has limited housing and lab facilities available to support research.</li> <li>Park lacks several key disciplines on staff including, but not limited to, cave specialist, cultural resource specialist, archeologist, hydrologist, and botanist. Cumberland Piedmont Network Inventory and Monitoring program (CUPN) provides some support on key disciplines, as they are working with 13 other parks in the network.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>Research is increasing.</li> <li>Citizen science opportunities in the park are increasing.</li> <li>Improving technologies allow innovative mapping, condition assessments, and other scientific research and monitoring.</li> <li>Collections continue to expand due to Mammoth Cave National Park, CUPN, and researcher activities and due to new methods to collect and preserve materials. Consequently, the curation facility is running out of room.</li> <li>Housing requests for researchers, interns, and volunteers frequently exceed the current available housing.</li> <li>Funding through projects and external sources is becoming increasingly competitive; securing these funds is vital to the continuation of curatorial and MCICSL staff and programs.</li> </ul>

Fundamental Resource or Value	Scientific Exploration and Discovery
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Limited funding both internally and externally.</li> <li>• Loss/lack of personnel to conduct and coordinate research efforts.</li> <li>• Curatorial personnel are funded exclusively by projects and external funding, so a loss of personnel to maintain and oversee park collections is a real possibility.</li> <li>• Curation facility will soon reach capacity.</li> <li>• Curation facility is vulnerable to tornados and other extreme weather.</li> <li>• MCICSL staff is soft-funded and limited in capacity by low and unsure funding.</li> <li>• Lack of key disciplines on park staff.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Partnerships with academic institutions, state and federal agency partners, nongovernmental agencies, and private individuals provide opportunities to expand research efforts.</li> <li>• Citizen science provides opportunities to multiply research capacity, while providing additional educational and recreational opportunities.</li> <li>• Volunteer support and internships are invaluable to the park and provide additional opportunities for supporting scientific efforts on the surface and in the caves.</li> <li>• Strong, well-developed partnerships provide opportunities to obtain additional internal and external funding.</li> <li>• Increased research to improve understanding of park resources.</li> <li>• Increased research to improve understanding of park history.</li> <li>• Increased research using park collections and integrating new information with archival materials.</li> </ul>
<p><b>Existing Data and Plans Related to the FRV</b></p>	<ul style="list-style-type: none"> <li>• “Collections Management Plan: Mammoth Cave National Park” (2005).</li> <li>• Existing cave maps.</li> <li>• 1.2 million existing objects and archival documents.</li> <li>• Hundreds of scientific papers have been written about Mammoth Cave.</li> </ul>
<p><b>Data and/or GIS Needs</b></p>	<ul style="list-style-type: none"> <li>• Eliminate collections cataloging backlog.</li> <li>• Digitize museum and archival collections.</li> <li>• Copies of missing scientific reports and papers for park library.</li> <li>• Systematize transfer of cave maps and survey data.</li> <li>• Surveys, resource inventories, and mapping of currently known and new caves including flooded passages.</li> </ul>
<p><b>Planning Needs</b></p>	<ul style="list-style-type: none"> <li>• Scientific research strategy.</li> <li>• Cave and karst management plan.</li> <li>• Natural resource condition assessment (underway).</li> <li>• Resource stewardship strategy.</li> <li>• State of the Park report.</li> <li>• Cultural landscape reports.</li> <li>• Climate change scenario planning.</li> </ul>

Fundamental Resource or Value	Scientific Exploration and Discovery
<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b></p>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• 1998 National Parks Omnibus Act</li> <li>• National Historic Preservation Act of 1966, as amended (16 USC 470)</li> <li>• Antiquities Act of 1906</li> <li>• Archeological and Historic Preservation Act of 1974</li> <li>• Archaeological Resources Protection Act of 1979</li> <li>• American Indian Religious Freedom Act of 1978</li> <li>• Historic Sites, Buildings, and Antiquities Act of 1935</li> <li>• Museum Act of 1955, as amended</li> <li>• Native American Graves Protection and Repatriation Act of 1990</li> <li>• Paleontological Resources Preservation Act of 2009</li> <li>• 1988 Federal Cave Resources Protection Act</li> <li>• Endangered Species Act of 1973, as amended</li> <li>• National Invasive Species Act of 1996</li> <li>• Lacey Act of 1900, as amended</li> <li>• Clean Water Act of 1972</li> <li>• Clean Air Act (42 USC §7470[2])</li> <li>• Executive Order 13112, "Invasive Species"</li> <li>• Executive Order 11593, "Protection and Enhancement of the Cultural Environment"</li> <li>• Executive Order 13007, "American Indian Sacred Sites"</li> <li>• 36 CFR 79 "Curation of Federally Owned and Administered Archeological Collections"</li> <li>• 36 CFR 800 "Protection of Historic Properties"</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006, Director's Orders, and Secretarial Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS Management Policies 2006 (§2.3.1.4, 4.2, 5.1, 8.10, 1.6, 4.1, 4.1.4, 4.4.1, 4.7.2)</li> <li>• Director's Order 24: <i>Museum Collections</i> (2008)</li> <li>• Director's Order 28: <i>Cultural Resource Management</i> (1998)</li> <li>• Director's Order 28A: <i>Archeology</i> (2004)</li> <li>• Director's Order 77-2: <i>Floodplain Management</i> (2003)</li> <li>• NPS <i>Museum Handbook</i>, parts I, II, and III</li> <li>• NPS-75 <i>Natural Resources Inventory and Monitoring Guideline</i></li> <li>• NPS <i>Natural Resource Management Reference Manual #77</i></li> <li>• NPS <i>A Call to Action: Preparing for a Second Century of Stewardship and Engagement</i></li> <li>• Secretarial Order 3289, "Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources"</li> </ul>

Fundamental Resource or Value	Underground Time Capsule
<p><b>Related Significance Statements</b></p>	<ul style="list-style-type: none"> <li>• Significance statements #1, 3, 5</li> </ul>
<p><b>Current Conditions and Trends</b></p>	<p><b>Conditions</b></p> <p><b><i>American Indian Resources.</i></b></p> <ul style="list-style-type: none"> <li>• Resources include perishable materials such as plant remains, textiles, sandals, torches, fecal remains, and gourd containers. Also preserved are areas of mining showing tool marks, footprints, petroglyphs, and pictographs. Some human remains exist in the caves.</li> <li>• The park has good knowledge of the resources contained within the historic section of upper Mammoth Cave, from the Historic Entrance to the Violet City Entrance. This area has been systematically surveyed.</li> <li>• The rest of Mammoth Cave and other caves in the park have not been surveyed to this level of detail.</li> <li>• The resources are well-preserved due to the consistent environmental conditions in the cave.</li> <li>• Information concerning sensitive archeological resources is kept confidential. Sensitive archeological resources are protected under the Native American Graves Protection and Repatriation Act and not made accessible.</li> <li>• The caves preserve tens of thousands of significant resources.</li> </ul> <p><b><i>Saltpeter Mining.</i></b></p> <ul style="list-style-type: none"> <li>• Resources include extant mining apparatus from the 1812 period, including wooden vats, wooden pipelines, pump towers, tailing piles, ox cart trails, rock walls, and other features related to mining.</li> <li>• The cave surface features are fairly well documented.</li> <li>• Buried pipelines and other mining features in the vestibule and entrance are not well documented, as well as the furnace features located outside the cave.</li> <li>• Some caves still remain to be fully documented, such as Dixon, Long, Dennison, and Jim caves.</li> <li>• The resources are well preserved due to the conditions in the cave.</li> </ul> <p><b><i>Endeavor Related Development.</i></b></p> <ul style="list-style-type: none"> <li>• Resources include mushroom beds, tuberculosis huts, early elevator construction, and resources related to use for local social events and religious services.</li> <li>• Mushroom beds are in poor to fair condition.</li> <li>• Tuberculosis huts are in fair condition.</li> <li>• Tuberculosis huts were documented during surveys.</li> </ul> <p><b><i>Tourist Related Development.</i></b></p> <ul style="list-style-type: none"> <li>• Resources include rock monuments, historic signatures, historic trails, CCC and Mission 66 development and objects, such as carts and tools, passage modifications.</li> <li>• Condition of these resources varies.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• The cave conditions arrest the normal decay process for the most part, but not entirely; conditions of the resources may slowly deteriorate over time.</li> <li>• Areas of the cave in high public use, electric lights, and changes in air flow patterns from modifications to the cave continue to affect preservation of the resources.</li> </ul>

Fundamental Resource or Value	Underground Time Capsule
<b>Threats and Opportunities</b>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Vulnerability of the resources due to development efforts in the cave such as redesign of cave trails and potentially all off-trail travel.</li> <li>• Changes in climate both outside and in the cave, through increased temperature and varied precipitation and altered cave conditions, could cause impacts on the resources. Changes and scale of changes are unknown. The stable environment in the cave could become unstable.</li> <li>• Lack of an array of specialized cultural resources management staff at the park and constrained fiscal resources to protect cultural resources.</li> <li>• Some caves with significant cultural resources are not gated to regulate access.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Redesign of cave trails.</li> <li>• Airflow monitoring of cave conditions.</li> <li>• Application of new technologies over time, such as lighting technology to prevent algae growth.</li> <li>• Continue to record and conduct more-detailed documentation of resources and implementation of technology.</li> <li>• Increased security measures, such as gating, to protect resources.</li> <li>• Continue to identify and work with associated American Indian tribes related to resources.</li> <li>• Increased volunteerism to support inventory opportunities.</li> </ul>
<b>Existing Data and Plans Related to the FRV</b>	<ul style="list-style-type: none"> <li>• “Mammoth Cave National Park Resource Management Plan,” Appendix A: Cave Management Plan (1987).</li> <li>• Historic American Buildings Survey / Historic American Engineering Record (HABS/HAER) study for saltpeter works.</li> <li>• “Collections Management Plan: Mammoth Cave National Park” (2005).</li> <li>• Artifact and feature inventory for historic portions of Mammoth Cave.</li> <li>• Conservation assessment and treatment recommendation for saltpeter works (2013).</li> </ul>
<b>Data and/or GIS Needs</b>	<ul style="list-style-type: none"> <li>• Complete cultural resources inventory of historic Mammoth Cave – includes a GIS platform and databases for historic signatures and artifacts.</li> <li>• More-detailed surveys of the majority of caves and remaining portions of Mammoth Cave that contain cultural resources.</li> <li>• Complete cultural landscape inventories and/or cultural landscape reports for remaining areas identified by the NPS Cultural Resources Division (including Historic Mammoth Cave and Crystal Cave).</li> </ul>
<b>Planning Needs</b>	<ul style="list-style-type: none"> <li>• Update cave management plan, including all caves in the park.</li> <li>• Resource stewardship strategy.</li> <li>• Historic structure report for tuberculosis huts.</li> </ul>

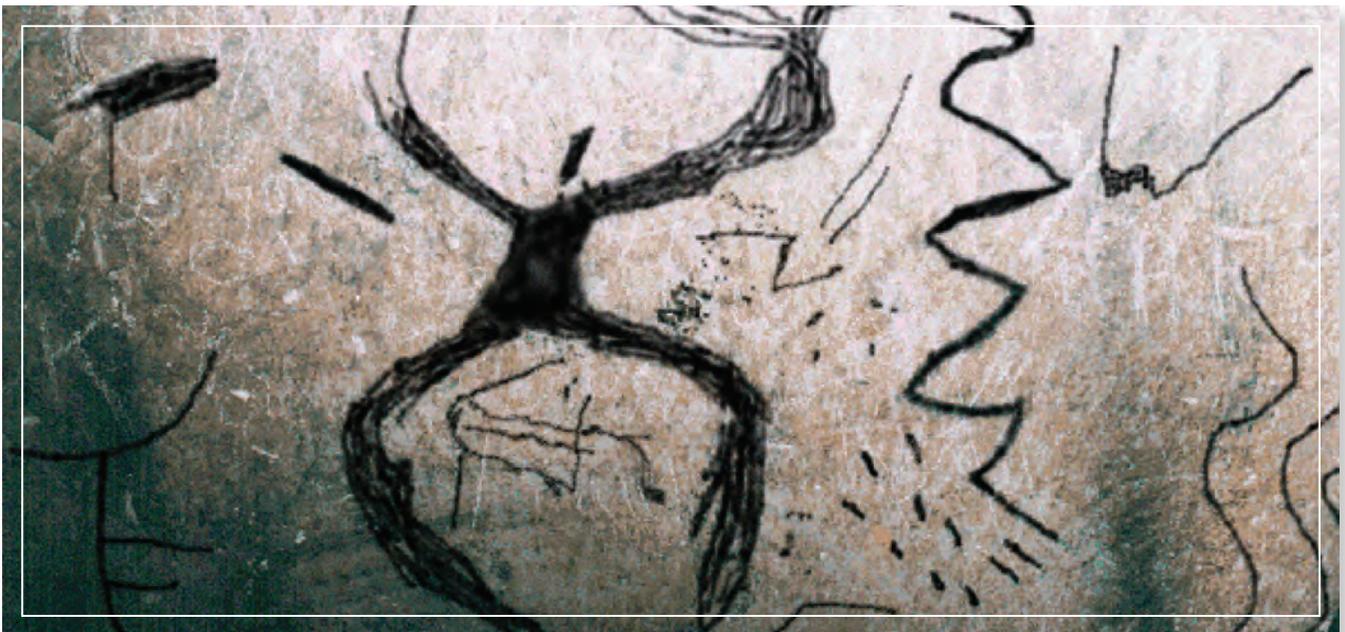
Fundamental Resource or Value	Underground Time Capsule
<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b></p>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• The Antiquities Act of 1906</li> <li>• Historic Sites, Buildings, and Antiquities Act of 1935</li> <li>• National Historic Preservation Act of 1966, as amended (16 USC 470)</li> <li>• American Indian Religious Freedom Act of 1978</li> <li>• Archeological and Historic Preservation Act of 1974</li> <li>• Archaeological Resources Protection Act of 1979</li> <li>• Native American Graves Protection and Repatriation Act of 1990</li> <li>• Executive Order 11593, "Protection and Enhancement of the Cultural Environment"</li> <li>• 1988 Federal Cave Resources Protection Act</li> <li>• Executive Order 13007, "Indian Sacred Sites"</li> <li>• Secretarial Order 3289, "Addressing the Impacts of Climate Change on America's Water, Land, and other Natural and Cultural Resources"</li> <li>• 36 CFR 79 "Curation of Archeological Collections"</li> <li>• 36 CFR 800 "Protection of Historic Properties"</li> <li>• Kentucky Revised Statutes Chapter 381.697–381.765 affect uncovering of remains or destruction of remains in cemeteries.</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS Management Policies 2006 (chapter 5)</li> <li>• Director's Order 28: Cultural Resource Management (1998)</li> <li>• Director's Order 28A: Archeology (2004)</li> </ul>



Fundamental Resource or Value	Twelve Thousand Years of Human Interaction with the Land
Related Significance Statements	<ul style="list-style-type: none"> <li>• Significance statements #1, 3, 4, 5</li> </ul>
Current Conditions and Trends	<p><b>Conditions</b></p> <p><b>Archeological Resources.</b></p> <ul style="list-style-type: none"> <li>• Resources include prehistoric rock shelter sites, isolated artifacts, upland ridge scatters, burial middens, sites of early agriculture, as well as numerous sites and objects related to historic pre-park settlement.</li> <li>• All known archeological sites are documented in the Archeological Site Management Information System (ASMIS); approximately 26% of the park has been surveyed for archeological sites at some level, and 13% has been surveyed to current regionwide Southeast Archeological Center survey program standards.</li> <li>• More than 1,000 archeological sites have been documented.</li> <li>• Current condition data exists for all known sites.</li> <li>• Condition varies for the sites. As of 2013, 93% of the park's known sites were recorded to be in Good condition. Of the remainder, 2% vary from Fair to Poor, 1% have been Destroyed, and 4% are of Unknown condition.</li> <li>• There is documentary evidence that a Civil War skirmish occurred within the boundaries of the park. Although preliminary work to locate the site has been undertaken correlating historic documentation with GIS data, there has been no systematic site survey or archeological investigation to confirm the specific location, and more documentary research is needed.</li> </ul> <p><b>Rural Communities.</b></p> <ul style="list-style-type: none"> <li>• Resources include a wide array of historic features including churches, cemeteries, road traces, house foundations, relic household items (i.e., various bottles, pots, pans, bowls, etc.), cellars, wells and cisterns, well-preserved farmed fields, fence rows, rock piles, discarded farm equipment, spring houses, and fish weirs.</li> <li>• Thousands of features from rural communities exist.</li> <li>• The vast majority of resources have been mapped at the feature level, but there are a few that haven't been fully documented.</li> <li>• Condition of cemeteries, in terms of documentation, is very good. Locations of every known grave have been mapped within the cemeteries. Headstones have been photographed.</li> <li>• Three churches are still extant.</li> <li>• Some cemeteries are still active.</li> </ul> <p><b>Tourism Related Development.</b></p> <ul style="list-style-type: none"> <li>• Resources include transportation items such as Engine #4 locomotive and the berm of the Mammoth Cave railroad, Collins-Crystal Cave Complex, road traces, historic entrances to caves, CCC-era development, remains of historic hotels (New Entrance Hotel), structural remains at the Great Onyx from the old country club site, and extant Mission 66 structures.</li> <li>• Majority of the surface features have been well documented.</li> <li>• Thousands of features from tourism-related development exist.</li> </ul> <p><b>Economic Enterprise Development.</b></p> <ul style="list-style-type: none"> <li>• The U.S. Army Corps of Engineers expects that Lock and Dam #6 will be determined eligible for inclusion in the National Register of Historic Places and will require additional research and documentation.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• Some resources are relatively stable such as Engine #4 and the Collins-Crystal Cave Complex, but visitor traffic and weathering continue to cause some negative impacts.</li> <li>• Impacts are more accelerated on the surface resources than those underground.</li> </ul>

Fundamental Resource or Value	Twelve Thousand Years of Human Interaction with the Land
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Visitor collection of artifacts, often unaware of regulations or rules.</li> <li>• Periodic looting of rock shelters.</li> <li>• Site visitation and varied modes of visitor use, including departure from established trails, may cause negative impacts on historic roads.</li> <li>• Insufficient information about location of resources may cause unintentional harm by park staff during routine park operations.</li> <li>• Lack of an array of specialized cultural resource management staff at the park and constrained fiscal resources to protect cultural resources.</li> <li>• Forty-three potential cultural landscapes and component landscapes are identified for the park that have not been documented with a cultural landscape inventory or cultural landscape report.</li> <li>• The 84 cemeteries are managed differently depending on location, and lack of accessibility could contribute to deterioration.</li> <li>• Changes in climate through increased mean annual temperature, varied precipitation, and extreme weather events could impact cultural resources.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Conduct an archeological survey of Civil War site.</li> <li>• Forty-three potential cultural landscapes and component landscapes are identified for the park that have not been documented with a cultural landscape inventory or cultural landscape report, and could be documented in the future.</li> <li>• Continue to make and update publically available cemetery information on the internet.</li> <li>• Continue systematic survey of the park’s cultural resources under section 110 of the National Historic Preservation Act (NHPA).</li> <li>• Increase data sharing and strengthen partnerships between NPS entities and regions and state governments.</li> <li>• Continue and increase archeological site stewardship program with Western Kentucky University.</li> <li>• Continue to identify and work with associated American Indian tribes related to resources.</li> </ul>
<p><b>Existing Data and Plans Related to the FRV</b></p>	<ul style="list-style-type: none"> <li>• Complete cultural landscape report for Core Visitor Center Area (expected 2014).</li> </ul>
<p><b>Data and/or GIS Needs</b></p>	<ul style="list-style-type: none"> <li>• Complete cultural landscape Inventories and/or cultural landscape reports for remaining areas identified by the NPS Cultural Resources Division (including Historic Mammoth Cave and Crystal Cave).</li> <li>• Archeological survey and GIS mapping of Civil War site.</li> <li>• GIS mapping for all cultural landscape features.</li> <li>• Historic structure reports: complete 27 needed as identified by the NPS Cultural Resources Division.</li> <li>• Complete systematic NHPA section 110 surveys of park cultural resources.</li> <li>• National register nominations: complete the 21 needed as identified by the NPS Cultural Resources Division, including updates, determinations of eligibility, and assessments.</li> <li>• Eliminate collections cataloging backlog.</li> <li>• Digitize museum and archival collections.</li> <li>• Administrative history of the park.</li> <li>• Historic resource study: identifies history of park usage including past property owners, etc.</li> </ul>

Fundamental Resource or Value	Twelve Thousand Years of Human Interaction with the Land
<p><b>Planning Needs</b></p>	<ul style="list-style-type: none"> <li>• Cemetery management plan.</li> <li>• Update archeological overview and assessment.</li> <li>• Ethnographic overview and assessment.</li> <li>• Resource stewardship strategy.</li> <li>• State of the Park report.</li> <li>• Climate change scenario planning.</li> </ul>
<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b></p>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• The Antiquities Act of 1906</li> <li>• Historic Sites, Buildings, and Antiquities Act of 1935</li> <li>• National Historic Preservation Act of 1966, as amended (16 USC 470)</li> <li>• American Indian Religious Freedom Act of 1978</li> <li>• Archeological and Historic Preservation Act of 1974</li> <li>• Archaeological Resources Protection Act of 1979</li> <li>• Native American Graves Protection and Repatriation Act of 1990</li> <li>• 1988 Federal Cave Resources Protection Act</li> <li>• Executive Order 11593, "Protection and Enhancement of the Cultural Environment"</li> <li>• Executive Order 13007, "Indian Sacred Sites"</li> <li>• Secretarial Order 3289. "Addressing the Impacts of Climate Change on America's Water, Land, and other Natural and Cultural Resources"</li> <li>• 36 CFR 79 "Curation of Archeological Collections"</li> <li>• 36 CFR 800 "Protection of Historic Properties"</li> <li>• Kentucky Revised Statutes Chapter 381.697–381.765 affect uncovering of remains or destruction of remains in cemeteries</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS Management Policies 2006 (chapter 5)</li> <li>• Director's Order 28: <i>Cultural Resource Management</i> (1998)</li> <li>• Director's Order 28A: <i>Archeology</i> (2004)</li> </ul>



Fundamental Resource or Value	Water Shapes the Landscape
Related Significance Statements	<ul style="list-style-type: none"> <li>• Significance statements #1, 2, 4, 5</li> </ul>
Current Conditions and Trends	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• The Green River within the park has been divided into three zones depending on the degree of, or lack of, influence from USACE Lock and Dam #6, located directly adjacent to the park’s downstream boundary. The Impounded Zone, with its deep pools, reaches for about 9.5 miles from this low-head obstruction to Sand Cave Island. The Transition Zone continues from Sand Cave Island to Cave Island, approximately five miles upstream. The remaining 10.5 miles is the Free-flowing Zone consisting of alternating riffles and pools.</li> <li>• Nolin River discharge is almost completely controlled by Nolin River Dam (USACE) and the entire seven miles of Nolin River in the park is impounded by USACE Green River Lock and Dam #6.</li> <li>• Green River is influenced by upstream discharges from the Green River Dam (USACE).</li> <li>• The mean annual discharge of the Green at Brownsville (immediately downstream of the park) is 123.7 m<sup>3</sup>/s (cubic meters per second), including the 26.6 m<sup>3</sup>/s from the Nolin River.</li> <li>• Mean annual flood stage is approximately 26 feet and mean 10-year flood stage is 49 feet.</li> <li>• The Green River in the park is not listed on the 2010 303(d) Impaired Water list. In 1998, The Green River in the park was listed as impaired due to pathogen levels. However, it was delisted in May 2005. The Green River from the upstream boundary of the park (mile 207.75) to mile 250.3 is listed on the 2010 303(d) Impaired Water list due to mercury in fish.</li> <li>• Green River is designated as an Outstanding State Resource Water, state Exceptional Water and a state Wild River.</li> <li>• Ultimately, surface waters drain through caves to the Green River creating important springs.</li> <li>• Sixteen groundwater basins on the north side of the Green River and at least 14 groundwater basins on the south side of the Green River discharge to springs along the Green River. One groundwater basin on the North Side discharges to a spring on the Nolin River.</li> <li>• River Styx Spring reverses its flow when the stage of the Green is between one-and-one-half and three meters above base, and the springs are discharging near base flow. Water from the Green enters River Styx’s spring run, into the cave for perhaps one kilometer (uncharted), mixes with the karst groundwater, and exits the cave (flowing for an additional kilometer) via Echo River Spring. This leads to mixing of surface Green River water with underground water in the cave. The condition is important for bringing nutrients (and contaminants) into parts of the cave.</li> <li>• The cave streams in the park are designated Outstanding National Resource Waters, and the park’s underground drainage basins are designated as Outstanding State Resource Waters, even outside of the park’s boundary.</li> <li>• Cave stream water quality has improved over the last 25 years, but storm events still bring contaminants into the cave. The park continues to work with state, local, and federal officials to reduce contamination entering the caves.</li> <li>• Perched karst aquifers in the Glen Dean and Haney formations pirate overland flow through caves forming upland springs where they contact impervious layers. These caves and cave streams are not directly tied to the Green River.</li> <li>• Primary contaminants that have been identified include domestic sewage, agricultural non-point source run-off, run-off from transportation and urban corridors, airborne contaminants (such as mercury, sulfur, and nitrogen), and endocrine disruptors.</li> </ul>

Fundamental Resource or Value	Water Shapes the Landscape
<p><b>Current Conditions and Trends</b></p>	<p><b>Conditions (continued)</b></p> <ul style="list-style-type: none"> <li>• Agricultural pollutants (animal waste, suspended sediments, and pesticides) and some urban pollutants (parking lot and road runoff) accumulate on the surface in virtual storage until they are washed into the karst aquifer during rainfall events. Each year, thousands of tons of sediments, animal wastes, nutrients, and pesticides are introduced into the streams of Mammoth Cave from these lands.</li> <li>• Traversing the cave's recharge basin are three major transportation corridors; Interstate 65, the Cumberland Parkway, and the CSX Railroad are drained by sinking creeks, dolines, and Class V injection wells. Any contaminant released along these routes is quickly washed into the Mammoth Cave karst aquifer. An average of four spills per year of hazardous materials has occurred along these routes within the park's groundwatersheds.</li> <li>• Base-level stream ponding due to USACE Green River Lock and Dam #6 will continue until the structure is removed or fails.</li> <li>• Invasion of Asian clam is increasing in park surface waters.</li> <li>• Heavy recreation use (e.g., canoes, kayaks) occurs on the free-flowing portions of the Green River.</li> <li>• Ridgetop ponds provide important amphibian breeding habitat. Many of the ponds are in advanced stages of eutrophication.</li> <li>• Atrazine has been found in rainwater in and around the park. In one study, 22% of samples exceeded U.S. Environmental Protection Agency (EPA) drinking water standards. Atrazine is also found in park surface and subsurface water despite the fact that atrazine is not used in the park. In one study 88% of samples showed detectable atrazine. Other agricultural pesticides have also been found in park waters.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• Annual discharge is variable, depending on annual rainfall. Climate change could change discharge and flood stage recurrence intervals.</li> <li>• While flow reversals in River Styx Spring no doubt occurred historically, it is believed that USACE Lock and Dam #6 (its pool extending to the Echo River Spring elevation) and the Green River Reservoir discharge (with sudden and long-duration increases in releases) have caused an increase in duration and frequency of these flow reversals.</li> <li>• Land use changes are occurring in many of the major groundwater basins; however, changes are in various directions. In general, development has increased in major basins that drain into the park. To a lesser extent, changes in forested areas and changes in extent and types of agriculture (row-crop versus pasture) have also occurred. However, further tracking of these changes is needed because existing data are not current.</li> <li>• Kentucky Division of Water<sup>1</sup> analysis of water quality trends in the Green River upstream of the park (at Munfordville) from 1979–2004 showed decreases in total chloride, total phosphorus, total Kjeldahl nitrogen. No trends were found in temperature, pH, specific conductance, dissolved oxygen, hardness, total suspended solids, total sulfate, total iron, total manganese, total nitrogen, total nitrite plus nitrate, or fecal coliform counts.</li> <li>• Water quality is generally below established state standards, except during flood pulses.</li> </ul>

1. Crain, A.S. and Martin, G.R., 2009, "Trends in Surface-Water Quality at Selected Ambient-Monitoring Network Stations in Kentucky, 1979–2004," USGS Scientific Investigations Report 2009–5027, 61pp.

Fundamental Resource or Value	Water Shapes the Landscape
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• The Green River drainage basin, including the Nolin, upstream of the western boundary of the park, (2,758 mi<sup>2</sup>) drains a wide range of ever-changing land-uses, including agricultural, silvicultural, urban, industrial, petroleum exploration, and transportation.</li> <li>• Any pollutant found on the surface within the recharge area, both in the sinking streams and the Sinkhole Plain, directly enters the cave streams in the form of unfiltered runoff during rainfall events. Flow through the aquifer can be quite rapid, on the order of 20 kilometers per day. Contaminants entering the karst aquifer can thus be rapidly transported, unaltered, through the cave streams and impact their dependent aquatic fauna.</li> <li>• Because the majority of the groundwater recharge area for Mammoth Cave lies beyond park boundaries, water quality is, and will remain, the most significant resource threat to the park’s water resources.</li> <li>• Individual domestic sewage systems (septic).</li> <li>• Agricultural non-point source runoff (reduced funding for Conservation Reserve Enhancement Program).</li> <li>• Airborne contaminant impacts by both dry and wet deposition.</li> <li>• Current nonnative aquatic species, such as rainbow trout, and common carp.</li> <li>• Zebra mussels have been found in the Lower Green River (up to river mile 74) and could soon invade the park.</li> <li>• Climate change on water resources.</li> <li>• Urban and transportation corridor impact.</li> <li>• Increased oil/gas extraction and mining pose a threat to cave and aquatic ecosystems.</li> <li>• River impoundments.</li> <li>• Modifications of flow of Haney Springs.</li> <li>• Congestion at Green River Ferry during busy periods of recreational river use along with vehicular traffic across the river.</li> <li>• Sensitive mussel beds impacted by increased use of the free-flowing section of the river during base flow conditions.</li> <li>• Horse use impacts on small streams.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Volunteer assistance for trash removal.</li> <li>• Visitor education on appropriate stewardship of water resources.</li> <li>• Restoration of river integrity.</li> <li>• Partnerships with local universities and state and federal agencies for evaluation and restoration of aquatic environments such as water quality monitoring and mussel propagation.</li> <li>• Removal or a natural breach of Lock and Dam #6 may result in improved river conditions and improved recreational use, and nonnative species management.</li> <li>• Nonnative species are removed from the park and future introduction of nonnatives is prevented.</li> <li>• There are ongoing opportunities through the regional haze and other air quality programs to work with state and federal air regulatory agencies and other stakeholders to address air quality impacts on water resources.</li> </ul>
<p><b>Existing Data and Plans Related to the FRV</b></p>	<ul style="list-style-type: none"> <li>• “Water Resources Management Plan: Mammoth Cave National Park, Kentucky” (2006).</li> <li>• “Mammoth Cave National Park: Rehabilitate Green River Crossing Environmental Assessment / Assessment of Effect” (2011).</li> <li>• Toxics release inventory (USEPA).</li> </ul>

Fundamental Resource or Value	Water Shapes the Landscape
Data and/or GIS Needs	<ul style="list-style-type: none"> <li>• Recreational carrying capacity study: define appropriate levels of recreational use under a range of river management scenarios.</li> <li>• Understanding fluvial geomorphology of the Green River.</li> <li>• Refine and improve recharge boundary definitions for basins that drain into and within the park.</li> <li>• Delineating vadose flow paths in park developed areas.</li> <li>• Ecological flow requirements for threatened and endangered species and habitat quality.</li> <li>• Inventory of point and non-point discharges (septic, agricultural, etc.).</li> <li>• Special studies to examine contaminant effects (e.g., pesticides) on sensitive biota.</li> <li>• Continued collection of data (weather, airborne contaminants, water quality).</li> <li>• Inventory and monitoring of invasive nonnative species.</li> <li>• Determine that water quantity is adequate to support natural geomorphic processes of fluvial and aquatic systems and to support native life.</li> <li>• Determine integrity of park waters so they are improved and maintained to support all native life.</li> <li>• Green River assessment by the U.S. Army Corps of Engineers.</li> <li>• Expanded water quality and water quantity monitoring.</li> </ul>
Planning Needs	<ul style="list-style-type: none"> <li>• Resource stewardship strategy.</li> <li>• Climate change scenario planning: climate change considerations in park management.</li> <li>• Natural resource condition assessment.</li> <li>• Invasive species management plan.</li> <li>• Planning for redevelopment for canoe facilities at Dennison Ferry.</li> <li>• Cave and karst management plan.</li> <li>• River use management plan.</li> </ul>
Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• Clean Water Act of 1972</li> <li>• Clean Air Act (42 USC §7470[2])</li> <li>• Water rights adjudication and law</li> <li>• Executive Order 11514, "Protection and Enhancement of Environmental Quality"</li> <li>• Executive Order 11988, "Floodplain Management"</li> <li>• Executive Order 11990, "Protection of Wetlands"</li> <li>• Executive Order 12088, "Federal Compliance with Pollution Control Standards"</li> <li>• Secretarial Order 3289, "Addressing the Impacts of Climate Change on America's Water, Land, and other Natural and Cultural Resources"</li> <li>• National Flood Insurance Program (44 CFR 60)</li> <li>• 401 KAR 10:026. Designation of uses of surface waters</li> <li>• 401 KAR 10:030. Antidegradation policy implementation methodology</li> <li>• 401 KAR 4:100. Wild rivers boundaries</li> <li>• 401 KAR 5:031. Outstanding Resource Water</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS <i>Management Policies 2006</i> (§4.6.1, 4.6.2, 4.6.4 and 4.8.1.1)</li> <li>• Director's Order 77-2: <i>Floodplain Management</i> (2003)</li> <li>• Special Directive 93-4 "Floodplain Management, Revised Guidelines for National Park Service Floodplain Compliance" (1993)</li> <li>• NPS <i>Natural Resource Management Reference Manual #77</i></li> </ul>

Fundamental Resource or Value	Opportunity for Connection to the Resources
<p><b>Related Significance Statements</b></p>	<ul style="list-style-type: none"> <li>• Significance statements #3, 4, 5</li> </ul>
<p><b>Current Conditions and Trends</b></p>	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• The park offers a variety of opportunities for visitor recreation, including 3 park campgrounds, 13 backcountry campsites, scenic drives, ranger-led programs (above and below ground), a junior ranger program, hiking trails (including some universally accessible surface trails), bicycling, picnicking, boating and canoeing, fishing, horse use, lodging, and services.</li> <li>• The park's forests, woodlands, and deep hollows provide visitors with the opportunity to experience a sense of wilderness.</li> <li>• There is insufficient park staff to provide adequate visitor services, maintenance, and protection.</li> <li>• During peak visitation periods there is insufficient parking to meet visitor needs.</li> <li>• The visitor center is in great condition; however, its size and complexity require additional staff to operate and maintain.</li> <li>• The Mammoth Cave Hotel is in need of renovation to better serve current visitor needs.</li> <li>• The backcountry trail system has deteriorated due to heavy usage (primarily from equestrian use), decreased staffing, and inability of park staff to keep up with maintenance demands.</li> <li>• A major renovation of the park elevator is underway, and when completed in 2014 will provide access to Mammoth Cave for mobility-impaired visitors.</li> <li>• The Mammoth Cave Campground has drainage issues and is in need of overall improvement.</li> <li>• Roads are in good condition.</li> <li>• Picnic area needs to be rehabilitated with new grills, tables, etc.</li> <li>• Cave trails are in need of repair and upgrading to improve resource protection, safety, and visitor experience.</li> <li>• Education opportunities provide classes (K–20), professional organizations, and other visitors a chance to learn about the park's natural and cultural resources, the vital connections between the surface and subsurface, the diverse research that occurs at the park, and potential careers studying, managing, and teaching about those resources.</li> <li>• Interpretive and educational programs and outreach to local communities offer the park's neighbors the opportunity to make personal connections between the park and their backyards and communities.</li> <li>• An expanding citizen science program provides important opportunities for people to connect with resources and helps the park and public better understand those resources.</li> <li>• Current tour capacities should not be increased as this will negatively affect the visitors' opportunities for resource connections. Many comment forms from visitors indicate the tour capacities are too high and want them lowered, though lack of funding and staffing prohibit this action. Increased capacities will also create a less monitored environment that may be more conducive to resource damage.</li> </ul>

Fundamental Resource or Value	Opportunity for Connection to the Resources
<p><b>Current Conditions and Trends</b></p>	<p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• In recent years, there has been an increase in overall visitation and congestion, particularly in the fall season.</li> <li>• There has been an increase in visitors with disabilities seeking access to the caves.</li> <li>• There has been an increase in international visitors.</li> <li>• There has been an increase in hearing impaired visitors. The park currently offers contracted sign language interpreters free of charge if requested two weeks in advance. Visitors can also use assisted listening devices free of charge during formal interpretive programs.</li> <li>• Water-based recreational activities have increased in popularity, including canoeing and kayaking.</li> <li>• The park has experienced an increase in surface recreational activities, most notably biking and hiking.</li> <li>• There is an increase in participation in junior ranger and child activity programs.</li> <li>• A decreasing budget limits the ability of park staff to perform certain duties to the needed extent (e.g., maintain trails, interpretation, educational outreach, and resource and visitor protection).</li> <li>• Requests for citizen science opportunities in which visitors, notably middle school through college classes, can participate are increasing. This seems to be due to an increased emphasis on hands-on learning in the school systems and a desire to contribute to the park's and public's understanding of its resources.</li> <li>• Requests for educational opportunities related to the park's resources for K–20 students are increasing. Some of the students participating in current educational programs are ones whose parents participated in park educational programs when they were in school.</li> <li>• Requests for volunteer opportunities and internships are increasing.</li> </ul>

Fundamental Resource or Value	Opportunity for Connection to the Resources
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Lack of funding and staffing will continue to impact the visitor experience (i.e., the variety and availability of cave and surface activities), safety, and park resources.</li> <li>• Unless funding and staffing limitations are reversed, increasing visitation will continue to damage park roadways, surface and subsurface trails, and overflow parking.</li> <li>• Air quality and visibility may continue to impact the visitor experience.</li> <li>• User-group conflicts among hikers, horseback riders, and mountain bikers will continue until the park can develop sustainable trails for all activities.</li> <li>• Potential long-term radon exposure to staff.</li> <li>• Some programs (such as that of the Mammoth Cave International Center for Science and Learning) and part of the Environmental Education staff that provide important connections to the resources are soft-funded and face additional funding threats due to increasing competition for internal and external funds.</li> <li>• Changes in climate through increased mean annual temperature, varied precipitation, and extreme weather events could alter current visitation patterns.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Educational and interpretive outreach to international visitors.</li> <li>• Develop electronic media outreach that aid in providing pre-arrival materials that help enrich the visitor in-park experience and enhance educational opportunities.</li> <li>• Modify cave entrances and trails for visitors with disabilities.</li> <li>• Citizen science provides opportunities for visitors to make deep connections to the resources while also contributing to a better understanding of those resources by multiplying the park’s research capacity and supporting the Scientific Exploration and Discovery FRV.</li> <li>• Partnerships provide opportunities to obtain additional internal and external funding to support programs aimed at providing visitors with opportunities to connect to the resources.</li> <li>• Volunteers can assist with many activities in the park (maintaining trails, interacting with other visitors, collecting scientific data, etc.). These activities help the volunteer and visitors connect to the park and its resources, while helping to mitigate some of the threats due to staffing limitations until a more permanent solution is available.</li> <li>• Educational outreach programs to local communities can promote a more environmentally aware local constituency that can help protect the park and its resources.</li> <li>• A new concessions contract is planned to take effect in 2016, and funding has been secured for critically needed renovations.</li> <li>• Educational outreach through TelNet-type activities with classrooms can perhaps reach larger audiences to promote stewardship.</li> <li>• Strengthen recruitment of diversity groups in an effort to reach underserved populations.</li> <li>• Interpretive outreach to local communities that engage them with the surface and subsurface in an effort to see their history, significance, and relevance within the park landscape.</li> <li>• There are ongoing opportunities through the regional haze and other air quality programs to work with state and federal air regulatory agencies and other stakeholders to address air quality impacts on the visitor experience.</li> </ul>
<p><b>Existing Data and Plans Related to the FRV</b></p>	<ul style="list-style-type: none"> <li>• Visitor use surveys.</li> <li>• Visitor use statistics.</li> <li>• Trail study (underway).</li> <li>• NPSScape report (underway).</li> <li>• Visibility valuation study (underway).</li> </ul>

Fundamental Resource or Value	Opportunity for Connection to the Resources
Data and/or GIS Needs	<ul style="list-style-type: none"> <li>• Study park operations and facilities to enhance visitor safety and accessibility.</li> <li>• Visitor impacts on park resources, including carrying capacity studies for recreational use of park resources.</li> <li>• Mapping of all trails (GIS).</li> <li>• Visual resource assessment.</li> </ul>
Planning Needs	<ul style="list-style-type: none"> <li>• Trails, campground, and picnic area rehabilitation project plan.</li> </ul>
Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• Americans with Disabilities Act of 1990 (28 CFR 36)</li> <li>• Architectural Barriers Act of 1968</li> <li>• Architectural Barriers Act Accessibility Standards 2006</li> <li>• Rehabilitation Act of 1973</li> <li>• NPS Concessions Management Improvement Act of 1998</li> <li>• Clean Air Act (42 USC §7470[2])</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS Management Policies 2006 (Chapters 7, 8, 9, and 10)</li> <li>• Director's Order 6: Interpretation and Education (2005)</li> <li>• Director's Order 42: Accessibility for Visitors with Disabilities in National Park Service Programs and Services (2000)</li> <li>• NPS Transportation Planning Guidebook</li> <li>• NPS A Call to Action: Preparing for a Second Century of Stewardship and Engagement</li> </ul>



Fundamental Resource or Value	Combined FRV Analysis Table for Biodiversity and Natural Resource Quality and Function
Related Significance Statements	<ul style="list-style-type: none"> <li>Significance statements #1, 2, 4</li> </ul>
Current Conditions and Trends	<p><b>General Conditions</b></p> <ul style="list-style-type: none"> <li>Mammoth Cave National Park is a park on two levels and supports rich, diverse, interconnected surface and subsurface ecosystems.</li> <li>The park lacks population data for most wildlife and fisheries species found in the park.</li> </ul> <p><b>Cave Biodiversity.</b></p> <ul style="list-style-type: none"> <li>The park has one of the world’s most diverse cave faunas. In general, the cave faunas are in good condition.</li> <li>However, Kentucky cave shrimp is federally endangered and white-nose syndrome threatens at least seven species of cave bat populations, including the three species of endangered bats. See also data needs below.</li> </ul> <p><b>Aquatic Biodiversity.</b></p> <ul style="list-style-type: none"> <li>The Green River is one of the top four river systems in the United States in terms of its aquatic biodiversity; together, the Green and Nolin rivers support more than 80 species of fishes, about 350 species of benthic macroinvertebrates, and more than 50 species (historically there were more than 70 species) of freshwater mussels.</li> <li>Among these species of mussels, there are 12 endemic species and more than 35 aquatic species that are considered imperiled. As of 2013, 7 species of mussels are endangered and an additional species is proposed for listing.</li> <li>Distribution, abundance, and diversity of mussels and other benthic macroinvertebrates are greatly influenced by habitat alterations caused by impoundment by USACE Lock and Dam #6. Overall diversity of desirable species is much higher in the free-flowing portion of the river.</li> <li>Construction of the locks and dams also altered species composition within the pools to that of a slower, warmer water system. Some native species increased in numbers while many more declined, as they were not as well adapted to the change in habitat.</li> </ul> <p><b>Terrestrial Biodiversity.</b></p> <ul style="list-style-type: none"> <li>Mammoth Cave manages a diverse range of terrestrial vegetation communities including, but not limited to, hemlock-yellow birch stands, oak-hickory forest/woodland, dry limestone slope glades, upland swamps, mesic hollow floodplain forest, barrens (prairies), and cave entrance and sinkhole communities.</li> <li>Approximately 45% of the park was either open agricultural fields or was recently abandoned fields at the time of land acquisition. The vast majority of park forests were subject to timber harvest and agricultural practices with a few notable exceptions, including mainly Big Woods (which is listed in the Kentucky Registry of Natural Areas).</li> <li>Nonnative species (including plants, animals, fungi, and other pathogens) are widespread and diverse, and degrade most park communities. There are 171 confirmed nonnative species in the park and one-third are known to be invasive. However, current knowledge underestimates the threat, because the park lacks a comprehensive nonnative species inventory and monitoring strategy.</li> <li>Populations of white-tailed deer and turkey appear to be above carrying capacity, which could have important consequences ecologically. However, the park lacks baseline data needed for understanding and managing this situation.</li> <li>Wetlands of the park are known habitats for the double-ringed pennant dragonfly (state listed species of special concern), and the expatriated showy lady slipper orchid (reintroduced to the park). The park’s water resources management plan estimates that the National Wetlands Inventory wetland map displays less than 50% of actual wetlands at the park.</li> </ul>

Fundamental Resource or Value	Combined FRV Analysis Table for Biodiversity and Natural Resource Quality and Function
Current Conditions and Trends	<p><b><i>Air Quality / Viewsheds / Nightskies / Soundscapes.</i></b></p> <ul style="list-style-type: none"> <li>• Mammoth Cave is designated as a Class I area under the Clean Air Act as amended in 1977 and 1990. Nationally, the park's air quality is recognized as poor. Visibility is recognized as particularly problematic, but the park is on a trajectory to attain natural background visibility conditions by 2064. Poor visibility negatively impacts other park features such as viewsheds and night skies.</li> <li>• Park night skies are degraded by regional light pollution; however, they need additional evaluation.</li> <li>• Thirty-two ozone-sensitive plant species are recognized in the park. Annual monitoring of four of these species documents ozone injury that varies by year. Some years there is no injury seen, but in other years severe impacts are recorded.</li> <li>• Wet and dry deposition of nitrogen and sulfur is leading to soil acidification and nitrogen enrichment.</li> <li>• Mercury deposition is moderate, and evidence of mercury bioaccumulation and biomagnification have been demonstrated in numerous animal species in the park, including insects, bats, mussels, turtles, and fish.</li> <li>• Park soundscapes have not been adequately evaluated.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• The park lacks population trend data for most wildlife and fisheries species found in the park.</li> <li>• Most trends regarding cave species are unknown or uncertain, including the Kentucky cave shrimp. Some bat populations are declining due to white-nose syndrome.</li> <li>• Habitat alternation and upward trending nitrate levels of the rivers continues to influence the decline of mussel populations.</li> <li>• Trends regarding species of concern are unknown.</li> <li>• The condition of the sandstone caprock communities is unknown, and may be potentially sensitive to acidic deposition.</li> <li>• Horse use and bicycle use of trails is increasing.</li> <li>• The condition of the prairie/barrens is declining.</li> <li>• The condition of the glades is unknown.</li> <li>• Oak-hickory forests/woodlands are undergoing mesophication (invasion by beech and maple) due to suppression of fires.</li> <li>• Deer and turkey population trends are not known.</li> <li>• The number of bald eagles in the park has increased from a few winter residents to hosting at least one nesting pair that has produced chicks for the last three years.</li> <li>• Nonnative plants are increasing in diversity, abundance, and coverage; additional nonnative species are known to be in the vicinity of the park and are expected to invade the park imminently. Air pollution (i.e., nitrogen deposition) is known to increase the distribution of nonnative invasive plants in many ecosystems.</li> <li>• Regarding air quality, ozone levels are improving, sulfur deposition is improving over time, nitrogen deposition is worsening, and mercury deposition is stable. However, continued monitoring is needed as emission control measures are implemented.</li> <li>• Over the past century, mean annual temperature and precipitation have increased.</li> </ul>

Fundamental Resource or Value	Combined FRV Analysis Table for Biodiversity and Natural Resource Quality and Function
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• High volumes of visitor use in the park cause threats to a variety of park resources in concentrated areas.</li> <li>• Horse use of some park trails appears to exceed current sustainable carrying capacity for those trails leading to erosion, damage to vegetation along trails, and degradation of streams downstream of trail crossings. Many trails are aesthetically unappealing due to degradation.</li> <li>• Illegal activities (poaching, etc.) may threaten park wildlife.</li> <li>• Limb lines (for fishing) have proved to be a threat to wildlife.</li> <li>• Impoundment of rivers, including the Lock and Dam Number #6, Green River Lake Dam, and Nolin Lake Dam, alters aquatic habitat and increases sedimentation, negatively impacting aquatic species.</li> <li>• Land use change and development near the park, including agriculture, oil and gas, and tar sands development, produce point and non-point source pollution and runoff, as well as threats to the soundscape of the park. These sources of pollution and runoff alter water chemistry and introduce pollutants to the hydrologic systems of the park, posing threat to aquatic species.</li> <li>• Deer and turkey over-population, if in fact occurring, would threaten park vegetation.</li> <li>• Mesophication (invasion by beech and maple) of oak-hickory forests is degrading the quality of this community.</li> <li>• Poorly designed or executed prescribed fires, or wildfires under changing climate regimes, cause damage to park forests.</li> <li>• Climate change and several diseases threaten amphibian populations in the park.</li> <li>• A number of invasive, nonnative species in the park threaten a variety of park resources, including aquatic species, forest health, and the health of bat populations.</li> <li>• Climate change may interact with several air quality variables, notably mercury and nitrogen, which would increase impacts from these parameters. Mercury deposition poses a significant threat to long-lived animals high on the food chain.</li> <li>• Air quality and scenic resources can be impacted by regional and local sources of air pollution such as coal-fired power plants, industrial facilities, agriculture, urban developments, and oil and gas development.</li> <li>• Loss/lack of personnel to study and monitor resources creates challenges to the preservation of park resources. The Cumberland Piedmont Network Inventory and Monitoring program provides some support on key disciplines, but their efforts are spread across 14 national park units.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Partnerships with academic institutions, state and federal agency partners, nongovernmental organizations, park partners, and private individuals provide opportunities to expand research and monitoring efforts.</li> <li>• Volunteer support and internships are invaluable to the park and provide additional opportunities for supporting park restoration, educational, and scientific efforts on the surface and in the caves.</li> <li>• Education programs aimed at school groups and the general public can improve knowledge of threats to the park.</li> <li>• Citizen science programs provide opportunities to multiply research capacity, while providing additional educational and recreational opportunities.</li> <li>• There are ongoing opportunities through the regional haze, U.S. EPA Prevention of Significant Deterioration, and other air quality programs to work with state and federal air regulatory agencies and other stakeholders to address air quality impacts in Class I parks from sources of air pollution.</li> <li>• Coordinate with regional sewer system outside of the park to mitigate threats to water quality.</li> </ul>

Fundamental Resource or Value	Combined FRV Analysis Table for Biodiversity and Natural Resource Quality and Function
Existing Data and Plans Related to the FRV	<ul style="list-style-type: none"> <li>• “Water Resources Management Plan: Mammoth Cave National Park, Kentucky” (2006).</li> <li>• Water quality data.</li> <li>• Air quality data, including gaseous pollutants, visibility, meteorology, acid and toxic deposition.</li> <li>• Cumberland Piedmont Network vital signs monitoring plan (2005).</li> <li>• Fire effects monitoring.</li> <li>• A report on the Monitoring Avian Productivity and Survivorship (MAPS) program in Mammoth Cave National Park (2009).</li> <li>• Bat monitoring (ongoing).</li> <li>• Wildlife monitoring (limited and restricted to only a few species or groups of animals; more in-depth and expanded monitoring is needed).</li> <li>• Cave Research Foundation mapping, exploration, and inventory.</li> <li>• “Comprehensive Trail Management Plan: Mammoth Cave National Park” (2008).</li> </ul>
Data and/or GIS Needs	<ul style="list-style-type: none"> <li>• Rare and sensitive species mapping (GIS).</li> <li>• Climate change data.</li> <li>• Cave resources inventory and mapping.</li> <li>• Invasive and nonnative plant mapping (GIS).</li> <li>• River bottom and habitat mapping in coordination with U.S. Geological Survey (USGS).</li> <li>• Wildlife inventory and assessment of species not currently being monitored.</li> <li>• Vegetation mapping (GIS).</li> <li>• Aquatic monitoring, both surface and subsurface (mussels, fish, invertebrates).</li> <li>• USGS gauge and flow monitoring of the Green and Nolin rivers.</li> <li>• Visitor use monitoring.</li> <li>• Kentucky cave shrimp survey for status and trends.</li> <li>• Ash tree survey and monitoring.</li> <li>• Potential impacts on forest ecosystem due to declines in bat populations from white-nose syndrome.</li> <li>• Expand mercury bioaccumulation and biomagnifications research in park wildlife.</li> <li>• Increased knowledge of summer bat populations including northern long-eared bats and other bat species that are likely to be especially hard hit by white-nose syndrome.</li> <li>• Improved mapping of wetlands in park.</li> <li>• Night sky survey.</li> <li>• Soundscape baseline inventory.</li> <li>• Special studies to examine nitrogen and sulfur dose-responses on sensitive resources.</li> </ul>
Planning Needs	<ul style="list-style-type: none"> <li>• Cave management plan (pending resource stewardship strategy effort).</li> <li>• Fire management plan (underway).</li> <li>• Natural resource condition assessment (underway).</li> <li>• Resource stewardship strategy.</li> <li>• State of the Park report.</li> <li>• Forest pest management plan.</li> <li>• Wilderness eligibility study.</li> <li>• Air resources management plan.</li> <li>• Climate change scenario planning.</li> </ul>

Fundamental Resource or Value	Combined FRV Analysis Table for Biodiversity and Natural Resource Quality and Function
<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b></p>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• Endangered Species Act of 1973, as amended</li> <li>• National Invasive Species Act of 1996</li> <li>• Lacey Act of 1900, as amended</li> <li>• Federal Noxious Weed Act of 1974, as amended</li> <li>• Clean Water Act of 1972</li> <li>• Clean Air Act (42 USC §7470[2]) gives federal land managers the responsibility for protecting air quality and related values, including visibility, plants, animals, soils, water quality, cultural resources, and public health, from adverse air pollution impacts</li> <li>• 1988 Federal Cave Resources Protection Act</li> <li>• Executive Order 13112, "Invasive Species"</li> <li>• Secretarial Order 3289, "Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources"</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS <i>Management Policies 2006</i> (§1.6, 4.1, 4.1.4, 4.4.1, 4.7.1, 4.7.2) provides general direction for managing park units from an ecosystem perspective</li> <li>• NPS Director's Order 18: <i>Wildland Fire Management</i> (2008)</li> <li>• NPS <i>Natural Resource Management Reference Manual #77</i></li> <li>• NPS <i>Wildland Fire Management Reference Manual 18</i></li> </ul>



## Identification of Key Issues and Associated Planning and Data Needs

This section considers key issues to be addressed in planning and management and therefore takes a broader view over the primary focus of part 1. A key issue focuses on a question that is important for a park. Key issues often raise questions regarding park purpose and significance and fundamental resources and values. For example, a key issue may pertain to the potential for a fundamental resource or value in a park to be detrimentally affected by discretionary management decisions. A key issue may also address crucial questions not directly related to purpose and significance, but still indirectly affects them. Usually, a key issue is one that a future planning effort or data collection needs to address and requires a decision by NPS managers.

The following are key issues for Mammoth Cave National Park and the associated planning and data needs to address them:

- **Invasive Species.** Nonnative/invasive species have the ability to cause harm to park resources. Because invasions by nonnative plant and animal species are generally considered to be one of the greatest threats to biological diversity in natural areas, the present distribution and spread of nonnative plant species and the potential threats to native ecosystems are critical issues. Within Mammoth Cave National Park, invasive nonnative species pose huge threats to a variety of park resources, and new invasives are continually being found. Air pollution (i.e., nitrogen deposition) is known to increase the distribution of nonnative invasive plants in many ecosystems.

For the park forests, there are two categories of nonnative species that have had significance impacts: pathogens and invasive plants. Chestnut blight and Dutch elm disease have virtually eliminated American chestnut and American elm and a similar fungal disease is currently impacting the American butternut tree. Invasive nonnative plant species such as honeysuckle, garlic mustard, kudzu, Japanese stilt-grass, silver poplar, and tree-of-heaven out-compete native species and are spreading. With more than 1,000 species of flowering plants (including 84 tree species) the potential for loss of biodiversity is great.

Several nonnative species exist within the Green and Nolin rivers. The Asian clam is very widespread, and overly abundant. The zebra mussel is present in the Green near confluence with the Ohio River, and has the potential to spread into the park. There are also several nonnative fish species found within the park, including rainbow trout, common carp, the goldfish, and mosquito fish.

White-nose syndrome also poses a threat to bat populations at the park, caused by an invasive cold-loving fungus that attacks bats while they are hibernating. Significant evidence indicates that humans can and have transmitted the fungus from one cave to another, hastening its spread. The park has implemented white-nose syndrome prevention and education measures.

The park is currently partnering with the Cumberland Piedmont Network for inventory and monitoring efforts, as well as with nongovernmental organizations and other federal agencies for eradication efforts. Data could be gathered through continued inventory and monitoring, including spatial data of invasive nonnative species in the park. An invasive species management plan could be developed to address this issue.



- **Limited Natural and Cultural Resource Management Guidance.** The *Mammoth Cave National Park General Management Plan* (1983) is dated and provides limited guidance for management of natural and cultural resources in the park, including the desired conditions. Park managers are in need of expanded and clarified guidance in dealing with a number of natural and cultural resource issues in the park, such as threatened and endangered species (including critical habitat), fire management, cave management, and the cemeteries within the park boundary.

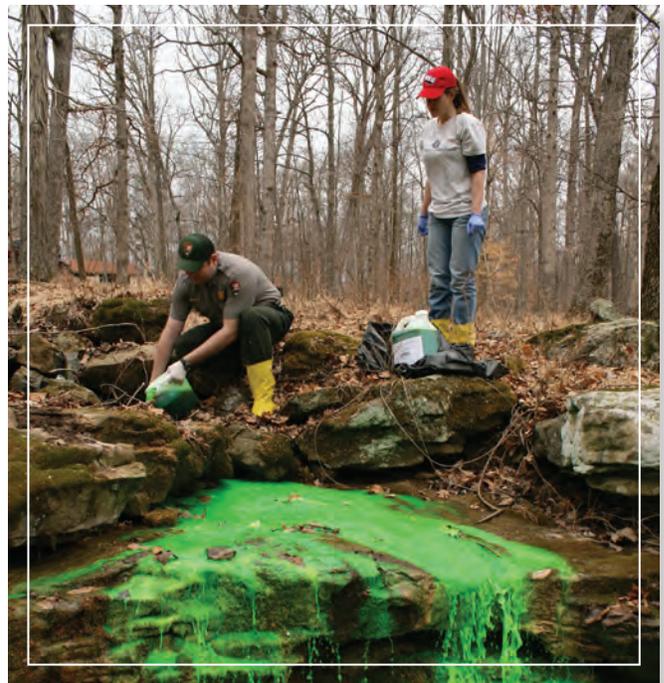
Many of these resources could be addressed by a resource stewardship strategy to provide desired future conditions of park resources. More specific management plans could also help provide guidance for management of these resources, such as completion of the park's fire management plan, a cave management plan, and a cemetery management plan.

- **River Developments.** Flow modifications on the Green and Nolin rivers alter the intensity, periodicity, and sediment erosion and reposition, and can greatly impact aquatic fauna.

The U.S. Army Corps of Engineers Gaging Station Lock Number 6 (Lock and Dam #6) alters the hydrology of the Green and Nolin rivers and cave streams. Several key park species (including six mussels and a freshwater cave shrimp, all federally listed) are affected by this decommissioned, low-head dam. A number of recreational opportunities and the safety of visitors are also affected by Lock and Dam #6, including fishing, kayaking, and canoeing. The USACE Green River Lake Dam and Nolin Lake Dam are additional impoundments that affect park resources.

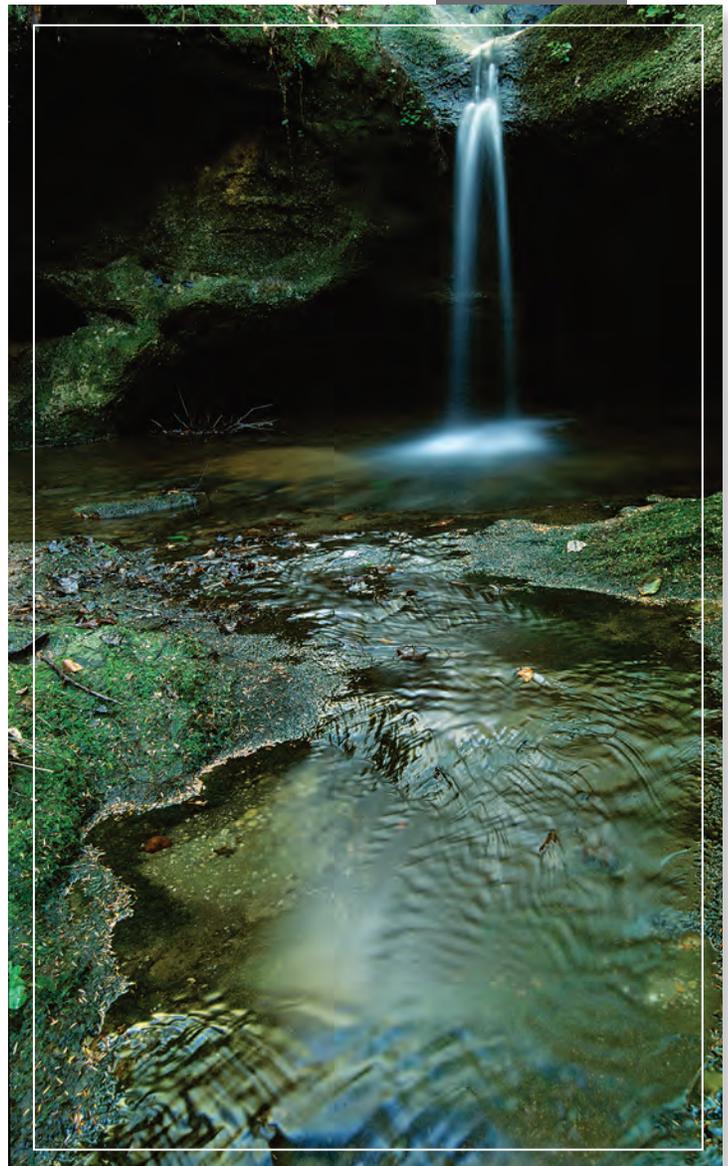
The park is experiencing funding limitations to address transportation issues associated with boating conflicts and low water at the Green River Ferry crossing in the park. A plan has been developed for the Green River Ferry crossing, and implementation is funding dependent.

Additional data are needed concerning water quality and quantity, and documentation of the effects and consideration of the need for removal of river impoundments. Jurisdictional complexities and funding limitations also pose challenges for considering the removal of Lock and Dam #6.



- Operational Sustainability of the Park.** Park operations are strained by insufficient funding and severe staffing limitations, affecting both day-to-day and long-term management of the park. Deterioration of infrastructure and resources due to these limitations will pose heightened challenges in the future. Because more than 30% of the park's permanent staff has been lost over the past 10 years as a result of reduced funding, the park currently has insufficient staff to perform many park management functions. For example, basic resource management positions have been permanently left vacant; the park does not have a cave management specialist, a hydrologist, a geologist, a full-time GIS specialist, or cultural resource management specialists. Visitor service staffing is at the bare-bones level for conducting cave tours and interpretive programs, causing several cave tours to be eliminated. Law enforcement, emergency services, and resource protection functions are also negatively impacted. Funding for most environmental education programs may be eliminated. Funding for all park maintenance activities has likewise been reduced; there is presently a minimal staff that is tremendously challenged in achieving basic park facility management requirements. Valuable training opportunities have also been decreased for park employees, caused by insufficient resources and no travel budgets. This has resulted in staff members unable to acquire a greater knowledge base that would enhance their ability to more efficiently accomplish the goals of their position, provide public service, and more deeply cultivate high-quality visitor experiences. Some park services have been closed due to funding, such as the Houchin Ferry and associated campground.

As with many parks, Mammoth Cave relies on concessions to serve the visiting public. The park has an existing concession contract with Forever Resorts, Inc. It includes the hotel, gift shop, restaurant, camp store, and cave tour bus transportation. Separate commercial use authorizations exist for canoe and horse-back riding activities. All physical facilities and infrastructure used by the main park concessioner are owned by the government and assigned to the concessioner for use. Both park staff and the concessioner maintain the condition of these government-owned assets. This is particularly important because of the extensive number and historic nature of these facilities. The park needs to readvertise the concessions contract, and there is a concurrent need to renovate critical hotel facilities in order to best meet the need of park visitors. A concessions prospectus would address this need. Additionally, data have been gathered concerning the inventory and condition of park assets assigned to the concessioner, as well as operations and maintenance costs. This asset management plan has verified all assets and locations, and has provided comprehensive condition assessments.



- **Developments and Uses Adjacent to the Park.** The lands bordering the park are used for a variety of purposes, including agricultural and forestry management, oil and gas exploration and production, transportation infrastructure, and urban land-use and recreational activities. Private lands adjacent to the park are being developed at a rapid rate.

Visitors often come to parks to take in spectacular vistas and marvel at the unique scenery of diverse areas. Scenery is composed of visual resources that are the visible physical features such as topography and landform, vegetation, water, structures, and other features that combine to create the visual landscape. Primary threats to visual resources come from development outside the park boundaries and pollutants that degrade visibility. In addition, upwind human activities that disturb vegetation and soil surfaces can trigger dust emissions that degrade visibility and expansive scenic views of iconic Cumberland-Piedmont landscapes.

Most of the air pollution affecting Mammoth Cave National Park comes from outside park boundaries. The responsibility for developing air pollution control plans rests with the states, tribal governing bodies, and the U.S. Environmental Protection Agency. In order to carry out management responsibilities, the park is involved in a variety of policy and planning activities related to the NPS mission of preserving and enhancing park air quality and air quality related values. The park evaluates and comments on proposals of other federal and state agencies that have the potential to affect park resources. Active partnerships with states and stakeholders help develop long-term pollution control and prevention strategies. *NPS Management Policies 2006* and NPS guidelines encourage the park to “assume an aggressive role” in promoting and pursuing measures to protect air quality related values, internally and externally. This includes integrating air quality objectives into internal operations and planning; participating in the development of federal, state, and local air pollution control programs and permitting processes; and promoting public understanding of air quality issues. The development of an air resources management plan for the park would guide the development of desired future condition assessments for gaseous pollutants, visibility and deposition.

Current development trends within the park’s watershed will increase the use of water for domestic water supply, agriculture, and recreational use. Additionally, the natural processes of the karst landscape closely link the surface and subsurface activities in this area. Agricultural run-off and other point and non-point sources of pollution pose a threat to groundwater in this unique karst system. The park has recorded high levels of fecal coliforms (indicators for contamination by mammals), pesticides, and herbicides in the cave system after rainfall events. Because there are hundreds of farms in the Mammoth Cave watershed, it is very difficult to control run-off into the subsurface conduits and cave system. Some sinkholes located nearby have also been used as trash dumps; potential toxic materials could leach quickly into the connected subsurface flows. The delicate equilibrium between the surface and underground components of karst may be destabilized from land use, resulting in alteration of drainage and recharge patterns and increasing incidents of catastrophic sinkhole collapse. In response to these issues, the Green River Conservation Reserve Enhancement Program was established in 2001, leading to nearly 100,000 acres being retired from agricultural use and now serving as buffer zones to wildlife habitat and conservation areas. Also, the park has begun to develop an effort to inventory and monitor the landscape dynamics surrounding the park in order to document changes and trends in adjacent land use.

Data on adjacent developments and uses, including their change over time, are needed to inform management strategies for resource protection and partnerships.

- **Surface and Subsurface Trails.** Trails in the park, both surface and subsurface, are reaching their carrying capacity and are in need of improvements. Many trails are historic features, meriting consideration during their rehabilitation. The cave trails have limited Americans with Disabilities Act accessibility, are deteriorating, are difficult to effectively maintain, fail to protect important cave resources, and have safety issues. In addition, there are continuing issues involving lighting of cave trails. Cave lighting issues include inadequate lighting in places, poor overlap resulting in lights being left on in tours that lack a second guide following the group, and lamp-flora growth. A project is underway to increase accessibility through trail redevelopment and an improved elevator. However, strategies to rehabilitate, improve, and maintain trails are still needed. A resource stewardship strategy would help determine how best to protect park resources while improving the visitor experience on park trails.
- **Climate Change.** Climate change is a far-reaching and long-term issue that will affect all aspects of Mammoth Cave National Park. In the past century, the average annual temperature has increased across the United States, and there has been a 12% increase in precipitation in the area that includes the park. The mean annual temperature for the area is projected to increase 4.5°F to 8°F by the end of the century, when compared with the 1976–1990 average, with an increase in days exceeding 95°F. Precipitation is also projected to increase on average 2% to 3% by the end of the century, with an increase in extreme precipitation events. There is greater seasonal variation in the precipitation projections, with an increase projected in winter and spring precipitation and decrease in summer precipitation. These modeled climate projections suggest a shift in mean conditions (warmer mean annual temperature) and changes in climate variability (e.g., more intense storms and droughts) for Mammoth Cave National Park.<sup>2 3</sup>

A much warmer climate will not only influence surface temperatures but also subsurface temperatures, which includes the delicate cave environments for species such as the freshwater cave shrimp. Warmer water temperatures in the Green and Nolin rivers could impact aquatic environments for important fish and mussel species. With dryer summers and wetter winter and spring seasons projected, the increased variability between wet and dry conditions within an overall warming environment could strain some ecological systems, shifting some species outside the park, while introducing other species into the park including invasives such as kudzu (*Pueraria lobata*). A potential increase in wildfire frequency and intensity during dry hot summer months would threaten park infrastructure and staff resources. Increased flooding from extreme precipitation events could also threaten park infrastructure and visitor safety along the Green and Nolin rivers and inside some sections of the cave system. An overall warming climate could change visitation patterns and interests at the park and invite the need for innovations to accommodate these changes (e.g., installation of shade structures, education on the changing climate and sustainability, and increase in visitor protection).

There is a need to integrate climate change adaptation into planning and management for Mammoth Cave National Park. Park management must be even more “forward looking,” to anticipate plausible but unprecedented conditions.

2. Most of the information here is taken from Gonzalez, P. 2013. “Climate Change and Ecological Vulnerabilities at Mammoth Cave National Park, Kentucky.” Unpublished paper. NPS, Natural Resource Stewardship and Science, Climate Change Response Program. Washington, D.C.

3. Additional information sourced from Kunkel, K.E., L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, C.E. Konrad II, C.M. Fuhrman, B.E. Keim, M.C. Kruk, A. Billet, H. Needham, M. Schafer, and J.G. Dobson. 2013. “Regional Climate Trends and Scenarios for the U.S. National Climate Assessment,” part 2, “Climate of the Southeast U.S.” National Oceanic and Atmospheric Administration Technical Report NESDIS 142-2. Washington, D.C.

## Planning and Data Needs

To maintain connection to the core elements of the foundation and the importance of these core foundation elements, the planning and data needs listed here are directly related to protecting fundamental resources and values, park significance, and park purpose, as well as addressing key issues. To successfully undertake a planning effort, information from sources such as inventories, studies, research activities, and analyses may be required to provide adequate knowledge of park resources and visitor information. Such information sources have been identified as data needs. Geospatial mapping tasks and products are included in data needs.

Items considered of the utmost importance were identified as high priority, and other items identified, but not rising to the level of high priority, were listed as either medium- or low-priority needs. These priorities inform park management efforts to secure funding and support for planning projects.

### Planning Needs – Where A Decision-making Process Is Needed

Related to an FRV or Parkwide Issue?	Planning Needs	Priority (H, M, L)	Notes
Multiple, Parkwide	Invasive species management plan	H	This planning effort would include consideration of forest pest management.
Parkwide	Cave trails plan	H	Determine materials, techniques, and strategies to rehabilitate / improve / maintain cave trails.
Multiple, Parkwide	Cave and karst management plan	H	Parkwide in scope. This effort would include all caves in the park, and would provide a detailed look at visitor use, natural and cultural resource management, and research. This effort would follow the completion of a resource stewardship strategy.
All	Resource stewardship strategy	H	Parkwide in scope.
Parkwide	Concessions prospectus	H	
All	State of the Park report	H	Parkwide in scope to determine current resource conditions.
12,000 years, Parkwide	Cemetery management plan	H	Prescribes priorities for management of cemeteries.
Recreation	Trails, campground, and picnic area rehabilitation project plan	H	
Multiple, Parkwide	Climate change scenario planning	H	This planning effort is designed for managing park resources, operations, and visitor services into the uncertain future of climate change.
Multiple, Parkwide	Air resource management plan	M	Parkwide in scope to determine desired future conditions.
12,000 years	Ethnographic overview and assessment	M	

Planning Needs – Where A Decision-making Process Is Needed			
Related to an FRV or Parkwide Issue?	Planning Needs	Priority (H, M, L)	Notes
12,000 years	Update archeological overview and assessment	M	
Time capsule	Historic structure report for tuberculosis huts	M	
Water	River use management plan	M	Development of a river use management plan for the Green and Nolin rivers in the park. The plan would address protecting the geologic, scenic, cultural, and wildlife values of the rivers and manage for recreational use and scientific study.
Karst	Updated groundwater hazard response plan	M	Groundwater hazard response plan is outdated due to expansion of Interstate 65.
Science	Scientific research strategy	L	
Water	Planning for redevelopment for canoe facilities at Dennison Ferry	L	
Parkwide, Biodiversity / Natural Resources	Revisit wilderness eligibility study	L	In 1972, a wilderness eligibility study was conducted that concluded that the lands in Mammoth Cave National Park were unsuitable for addition to the National Wilderness Preservation System. This study stated that in the 30 years since the park's establishment, the vegetative cover had not recovered sufficiently to resemble its pristine condition, and that man's abandoned works are still generally visible. Since 1972, the conditions in the park have continued to improve, and a wilderness eligibility study could be conducted with this updated information.

Other Planning Needs Currently Underway			
Related to an FRV or Parkwide Issue?	Planning Needs	Priority (H, M, L)	Notes
Multiple	Natural resource condition assessment (underway)	H	Parkwide in scope.
Mutiple, Parkwide	Fire management plan (underway)	M	Parkwide in scope.
Parkwide	Park asset management plan (underway)	M	Parkwide in scope.

<b>Data Needs – Where Information Is Needed Before Decisions Can Be Made</b>			
<b>Related to an FRV or Parkwide Issue?</b>	<b>Data and GIS Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes, Including Which Planning Need This Data Need Relates To</b>
Multiple, Parkwide	Inventory and monitoring of invasive nonnative species	H	Including mapping of invasive species (GIS).
Multiple	Visitor use monitoring	H	Including information about carrying capacity, impacts on park resources, and a variety of visitor uses, including horseback riding and bicycle use. This effort would help define appropriate levels of recreational use under a range of management scenarios.
Multiple, Parkwide	Continued collection of data (weather, airborne contaminants, water quality and quantity, gauging)	H	This effort would include data useful for climate change scenario planning. Would also be coordinated with the USGS gauge and flow monitoring, including the Green and Nolin rivers.
Multiple	Complete cultural landscape inventories and/or cultural landscape reports for remaining areas (including Mammoth Cave area and Crystal Cave)	H	
Karst	Bat population trends	H	
Parkwide	Develop baseline condition of park assets	H	This data need is closely linked to the inventory and condition assessment of park assets.
Multiple	Rare and sensitive species mapping (GIS)	H	
12,000 years	Historic structure reports	H	Twenty-seven needed, as identified by the NPS Cultural Resources Division.
Recreation	Study park operations and facilities to enhance visitor safety and accessibility	H	
Water	Ecological flow requirements for aquatic threatened and endangered species and habitat quality	H	Helps provide protection for Kentucky cave shrimp and mussels.
12,000 years	Historic resource study	H	Identifies history of park usage including past property owners, etc.
Multiple	Cave cultural resources surveys, inventories, and condition assessments	H	Includes more-detailed archeological and historic surveys of the majority of caves and remaining portions of historic Mammoth Cave that contain cultural resources. Includes a GIS platform, and a database for historic signatures and artifacts.
Karst	Better understanding of the relationship between surface and cave climates (baseline modeling)	H	Associated with large-scale regional changes and localized effects on cave environments and infrastructure.

<b>Data Needs – Where Information Is Needed Before Decisions Can Be Made</b>			
<b>Related to an FRV or Parkwide Issue?</b>	<b>Data and GIS Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes, Including Which Planning Need This Data Need Relates To</b>
Multiple, Parkwide	Surveys, resource inventories, and mapping of currently known and new caves including flooded passages	H	More-detailed mapping is needed of some previously surveyed cave areas and newly discovered caves and passages, probably in associated with Cave Research Foundation.
Multiple, Parkwide	Survey related to sedimentation and other factors such as pollutants (USGS partnership)	H	Inventory of point and non-point discharges (septic, agricultural, etc.).
Parkwide	Document effects and consider need for removal of Lock and Dam #6	H	
Parkwide	Inventory and condition assessment of park assets	H	This data need is closely linked to the develop baseline conditions of park assets.
Biodiversity	Kentucky cave shrimp survey for status and trends	H	Submit research projects to survey status and trends in the threatened/endangered Kentucky cave shrimp.
Biodiversity	Aquatic monitoring	M	Both surface and subsurface, including mussels, fish, and invertebrates.
Water	Determine that water quantity is adequate to support natural geomorphic processes of fluvial and aquatic systems and to support native life	M	
Water	Determine integrity of park waters so they are improved and maintained to support all native life	M	
Water	Special studies to examine contaminant effects (e.g., pesticides) on sensitive biota	M	
Parkwide	Develop operations and maintenance costs for each asset	M	
Multiple	Vegetation mapping (GIS)	M	Parkwide in scope. Including vegetation change monitoring for climate change.
Biodiversity	Ash tree survey and monitoring	M	In anticipation of arrival of the emerald ash borer.
Biodiversity	Increased knowledge of summer bat populations including northern long-eared bat species that may be impacted by white-nose syndrome	M	

<b>Data Needs – Where Information Is Needed Before Decisions Can Be Made</b>			
<b>Related to an FRV or Parkwide Issue?</b>	<b>Data and GIS Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes, Including Which Planning Need This Data Need Relates To</b>
Biodiversity	Special studies to examine nitrogen and sulfur dose-responses on sensitive resources	M	
12,000 years	Complete systematic NHPA section 110 surveys of park cultural resources	M	
12,000 years	National register nominations	M	Twenty-one needed as identified by the NPS Cultural Resources Division. These would include any needed updates, determinations of eligibility, and assessments.
Karst	Surface and groundwater input and outflow balance inventory and monitoring	M	
Water	Understanding fluvial geomorphology of the Green River	M	
Water	Green River assessment by the U.S. Army Corps of Engineers	M	
Science	Eliminate collections cataloging backlog	M	
Parkwide, Karst	Study of changing land uses over time (landscape dynamics)	M	
Karst	Updated groundwater hazard map (converted to GIS)	M	
Multiple	GIS data supporting staff response to catastrophic events	M	
Water	Delineating vadose flow paths in park developed areas	M	
Biodiversity	Potential impacts to forest ecosystem due to declines in bat populations from white-nose syndrome	M	Submit research projects for funding. Determines desired future conditions.
Recreation	Visual resource assessment	M	
12,000 years	Administrative history of the park	L	
Water	Refine and improve recharge boundary definitions for basins that drain into and within the park	L	Outside the bioserve boundary.

<b>Data Needs – Where Information Is Needed Before Decisions Can Be Made</b>			
<b>Related to an FRV or Parkwide Issue?</b>	<b>Data and GIS Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes, Including Which Planning Need This Data Need Relates To</b>
Karst	Mercury effects on cave organisms	L	Associated with air quality, water quality, and biology.
Biodiversity	Expand mercury bioaccumulation and biomagnifications research in park wildlife	L	
Multiple	Complete survey, mapping, and inventory of caves (including park lesser caves and springs) and systematic transfer of maps and data	L	
Karst	Updated park habitat model	L	
Biodiversity	Improve mapping of wetlands in park	L	
Multiple	Expanded water quality and water quantity monitoring	L	
Multiple	Wildlife inventory and assessment	L	Particularly of species not currently being monitored.
Recreation	Mapping data of all trails (GIS)	L	Using a high-resolution GPS to refine the GIS database.
Karst	Continued monitoring of cave organisms	L	
Karst	Inventory borehole and wells (water)	L	
Science	Digitization of museum and archive items	L	
Biodiversity	River bottom and habitat mapping (GIS)	L	Through a partnership with the U.S. Geological Survey.
Karst	Cave impact mapping/ monitoring for toured areas	L	
Science	Copies of missing scientific reports and papers for park library	L	
12,000 years	Archeological survey and GIS mapping of Civil War site	L	
Karst	Paleontological inventories	L	
12,000 years	GIS mapping for all cultural landscape features	L	Develops GIS layers of cultural landscapes (CCC, Mission 66, etc.).
Biodiversity	Night sky survey	L	Establishes baseline night sky conditions.
Biodiversity	Soundscape baseline inventory	L	

## Part 3: Contributors

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## Photo and Art Credits

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## Appendixes

### Appendix A: Enabling Legislation and Legislative Acts for Mammoth Cave National Park

#### Authorization

Act of May 25, 1926 (P.L. 69-283, 44 Stat. 635), authorized establishment of Mammoth Cave National Park.

#### Acquisition Authority

Act of May 25, 1926, authorized acquisition only by public and private donation or by purchase with donated funds.

Act of February 4, 1932 (P.L. 71-10, 47 Stat. 37), authorized acquisition by donation subject to leases, rights of way, and easements, the terms of which shall be approved by the Secretary.

Act of May 14, 1934 (P.L.73-221, 48 Stat. 775), authorized Secretary to accept donations of funds for acquisition of lands by purchase, condemnation, or otherwise.

Act of June 5, 1942 (P.L. 77-581, 56 Stat. 317), accepts cession from State of Kentucky of exclusive jurisdiction over lands comprising the park and authorizes acquisition within the maximum boundary by purchase, condemnation, or otherwise.

#### Established

July 1, 1941

#### Boundary Revisions

Act of August 28, 1937, authorized inclusion of additional lands and the exclusion of Great Onyx and Crystal Caves from the maximum boundary of the park. The caves were subsequently excluded by

Secretarial Order of December 3, 1940 (5 F.R. 5071).

Act of June 5, 1942, revised the boundary to include additional lands, as described.

Act of March 27, 1954 (P.L. 83-322, 68 Stat. 36), authorized Secretary to acquire Great Onyx and Crystal Caves.

**Mammoth Cave National Park is established by Congressional Act on May 25, 1926 (P.L. 69-283, 44 Stat. 635)**

**CHAP. 382.**—An Act To provide for the establishment of the Mammoth Cave National Park in the State of Kentucky, and for other purposes.

May 25, 1926.  
[S. 4206.]  
[Public, No. 283.]

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That when title to lands within the area hereinafter referred to shall have been vested in the United States in fee simple, there shall be, and there is hereby, established, dedicated, and set apart as a public park for the benefit and enjoyment of the people, the tract of land in the Mammoth Cave region in the State of Kentucky, being approximately seventy thousand six hundred and eighteen acres, recommended as a National Park by the Southern Appalachian National Park Commission to the Secretary of the Interior, in its report of April 8, 1926, and made under authority of the Act of February 21, 1925; which area, or any part or parts thereof as may be accepted on behalf of the United States in accordance with the provisions hereof, shall be known as the Mammoth Cave National Park: *Provided*, That the United States shall not purchase by appropriation of public moneys any land within the aforesaid area, but such lands shall be secured by the United States only by public or private donation.

National park.  
Mammoth Cave,  
Ky., set apart for, when  
lands therefor vested in  
United States.  
*Post*, p. 966.

Description.

Vol. 43, p. 953.

*Proviso.*  
Lands to be secured  
only by donation.

SEC. 2. The Secretary of the Interior is hereby authorized, in his discretion, to accept, as hereinafter provided, on behalf of the United States, title to the lands referred to in the previous section hereof, and to be purchased with the funds which may be subscribed by or through the Mammoth Cave National Park Association of Kentucky, and with other contributions for the purchase of lands in the Mammoth Cave National Park area: *Provided*, That any of said lands may be donated directly to the United States and conveyed to it, cost free, by fee-simple title, in cases where such donations may be made without the necessity of purchase.

Acceptance of title to  
lands conveyed, au-  
thorized.

*Proviso.*  
Direct conveyances  
accepted.

SEC. 3. The administration, protection, and development of the aforesaid park shall be exercised under the direction of the Secretary of the Interior by the National Park Service, subject to the provisions of the Act of August 25, 1916, entitled "An Act to establish a National Park Service, and for other purposes," as amended: *Provided*, That the provisions of the Act approved June 10, 1920, known as the Federal Water Power Act, shall not apply to this park: *And provided further*, That the minimum area to be administered and protected by the National Park Service shall be, for the said Mammoth Cave National Park, twenty thousand acres, including all of the caves: *Provided further*, That no general development of said area shall be undertaken until a major portion of the remainder in such area shall have been accepted by said Secretary.

National Park Service to administer, etc.

Vol. 39, p. 535.

*Provisos.*  
Water power Act not  
applicable.  
Vol. 41, p. 1063.

Minimum area specified.

Area to be accepted  
before any develop-  
ment made.

SEC. 4. The Secretary of the Interior may, for the purpose of carrying out the provisions of this Act, employ the commission authorized by the Act approved February 21, 1925,

Commission em-  
ployed.  
Vol. 43, p. 959.

Approved, May 25, 1926.

## Appendix B: Inventory of Special Mandates and Administrative Commitments

### Special Mandates

#### Designation of the Park as a Class I Area.

A major purpose of the Clean Air Act (CAA) is “to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores ,and other areas of special national or regional natural, recreational, scenic, or historic value” (PL 88-206; 42 U.S.C. §7470[2]). Accordingly, the 1977 amendments designated certain public lands as Class I areas, that included national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres that were in existence when the amendments were enacted. Class I is the highest level of air quality protection under the Clean Air Act. The National Park Service is to minimize air pollution emissions associated with park operations, including visitor use activities (NPS *Management Policies 2006* §4.7.1).

Mammoth Cave National Park is designated a Class I park under the Clean Air Act. Under section 169A, “Congress hereby declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I Federal areas which impairment results from manmade air pollution.” The Clean Air Act bestows an “affirmative responsibility” on the federal land managers to protect these areas from the adverse effects of air pollution. Superintendents are charged with taking management actions consistent with this affirmative responsibility by integrating air resource management into NPS operations and planning. Specifically, the federal land manager is to identify and protect resources sensitive to air pollution, called Air Quality Related Values, including visibility.

#### Designation of Critical Habitat for Threatened and Endangered Species.

Critical habitat is a term defined and used in the Endangered Species Act. It is a specific geographic area that contains features essential to the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include areas that are not currently occupied by the species but that will be needed for its recovery. Critical habitat has been designated for two species within the park. The designated critical habitat for the diamond darter includes approximately 10.3 miles of the Green River within the park from the eastern park boundary at river mile 207.75 downstream to the downstream end of Cave Island at river mile 197.75. Designated critical habitat for the Kentucky cave shrimp includes an approximately 1-mile section of the based level stream cave passage of Roaring River within the park.

## Special Designations

### Designation of the Park as a UNESCO World Heritage Site.

In 1972, the United Nations Education, Scientific, and Cultural Organization adopted the World Heritage Convention to ensure that properties of outstanding universal value to mankind would be recognized and protected. In April 1980, the Cave Research Foundation submitted Mammoth Cave to the UNESCO Convention as a prospective World Heritage Site; the National Park Service concurred and also submitted a nomination. Mammoth Cave National Park was inscribed as a World Heritage Site on October 27, 1981.

### Designation of the Park as a UNESCO International Biosphere Reserve.

Biosphere reserves are sites that are recognized for their roles in conserving genetic resources; facilitating long-term research and monitoring; and encouraging education, training, and the demonstration of sustainable resource. The International System of Biosphere is administered by the United Nations Education, Scientific, and Cultural Organization. The 216 square kilometers (52,830 acres) of Mammoth Cave National Park are the core area of 536-square-kilometer (134,000 acre) International Biosphere Reserve that was dedicated in 1990. The zone of cooperation is 94,365 acres to the immediate north and south of the park; the transition zone is 762,133 acres in Edmonson, Hart, Barren, Metcalfe, Warren, and Butler counties. The principal monitoring and research themes of the Biosphere Reserve are groundwater hydrology, water quality, the effects of agricultural land uses, the health of freshwater ecosystems, and atmospheric pollutants. The principal goals of the biosphere program are conservation of biodiversity and economic development on a scale sustainable over the long term. Development in this area is supported by the Barren River Area Development District in accordance with the broad goals for sustaining the regional ecosystem. Please see the administrative commitments table for more information about that agreement.

### Designation of the Big Woods Old-Growth Forest as a State Natural Area.

The Big Woods State Natural Area was designated on October 23, 1989, upon selection by the Kentucky State Nature Preserves Commission and Kentucky Nature Conservancy. The 307-acre Big Woods tract is an outstanding old-growth dry-mesic to mesic forest dominated by white oak, beech, and tulip poplar that is of high ecological significance in both Kentucky and the nation. It is one of the last and the largest stands of old-growth forest known in Kentucky. This unique natural area is extremely important because it provides an opportunity for gathering benchmark data useful in understanding the ecology of deciduous forest communities.

### Designation of the Green River as an Outstanding State Resource Water.

The Green River from river mile 182.75 on the western boundary of Mammoth Cave National Park to river mile 207.75 on the eastern boundary of Mammoth Cave National Park is designated as an Outstanding State Resource Water. Outstanding state resource waters are those surface waters designated by the Kentucky Energy and Environment Cabinet pursuant to 401 KAR 10:031, section 8, and includes certain unique waters of the Commonwealth, including those with federally threatened or endangered species. This section of the Green River is also designated as a Wild River by 401 KAR 4:100. Kentucky wild rivers include portions of nine rivers of exceptional quality and aesthetic character that have been designated as Kentucky Wild Rivers. Each Wild River is a linear corridor encompassing all visible land on each side of the river up to a distance of 2,000 feet. Wild Rivers are designated by the Kentucky General Assembly in recognition of their unspoiled character and outstanding water quality and natural characteristics. In order to protect their features and quality, land-use changes are regulated by a permit system, and certain highly destructive land-use changes (for example, clear-cutting and strip mining) are prohibited within corridor boundaries.

## Administrative Commitments

Name	Agreement Type	Start Date	Expiration Date	Stakeholders	Purpose	Park Division
Cave Research						
Research and exploration of Mammoth Cave National Park caves (under revision to special use permit)	General agreement			Cave Research Foundation	Provide for research and exploration of Flint-Mammoth Cave System. New agreement being negotiated and revised.	SRM
Water Sampling						
Allow water sampling for road treatment runoff monitoring	General agreement	1/14/2011	2016	Diamond Caverns	Permits MACA to place samplers to monitor road treatment (salt) runoff inside Diamond Caverns.	SRM
Cooperative Research						
Mammoth Cave National Park's bats: interpretive and educational resources for general public	General agreement	8/11/11	12/31/13, to be extended to 12/13/2014	Western Kentucky University	Provide for hands-on education opportunities for middle school, high school, and college students with bats.	SRM/Interp
Cave air flow monitoring	Cooperative agreement	8/31/12	12/31/15	Western Kentucky University	Monitor/model cave air flow and other meteorological conditions.	SRM
Youth citizen-scientist initiative	Cooperative agreement	4/15/12	4/14/15	Western Kentucky University	Provide visitors with opportunities to assist with MACA research.	SRM/Interp
Invasive Plant Control						
Oak Barrens restoration – invasive plant control	Cooperative agreement	9/24/09	9/30/14	The Nature Conservancy	Provide assistance with restoration of Oak-Barrens area.	SRM
Cultural Resources						
Conservation assessment of War of 1812 saltpeter works, MACA	Cooperative agreement	9/15/09	9/1/14	University of Kentucky	Develop conservation treatments of 14 ca. 1812 saltpeter vats.	SRM
Curatorial operations and museum management	Cooperative agreement	5/19/11	5/23/16	Western Kentucky University	Continue backlog catalog of museum objects.	SRM

Name	Agreement Type	Start Date	Expiration Date	Stakeholders	Purpose	Park Division
Cultural Resources						
Accelerate processing and cataloging of Southeast Region archival collection	Cooperative agreement	10/19/11	9/30/14	Western Kentucky University	Provide for cataloging a large backlog of MACA archival material.	SRM
Law Enforcement and Dispatch						
Kentucky state peace officer status	Legislative decree	7/12/06	Perpetual	Commonwealth of Kentucky	NPS Rangers will have state peace officer status.	LEES
Participation in field training program	General agreement	2012	2017	Federal Law Enforcement Training Center (FLETC)	Formalize MACA partnership with FLETC to host Field Training Evaluation Program trainees.	LEES
Radio frequency authorization	General agreement	2012	2017	Edmonson County Sheriff's Office	Authorizes park to utilize sheriff's office radio frequency if needed.	LEES
Dispatch services and National Crime Information Center operations	General agreement	2012	2017	Edmonson County Fiscal Court	Provide parkwide dispatch operations.	LEES
Park medical control	General agreement	2012	2017	Michael Collins, MD	Designates Dr. Collins as Medical Control for park.	LEES
Access to Kentucky State Police intelligence information	General agreement		2014	Kentucky State Police (Intelligence Section)	Partnership for intelligence sharing of criminal activity.	LEES
Radio frequency authorization	General agreement	2012	2017	Hart County Sheriff's Office	Use of agency radio frequency.	LEES
Radio frequency authorization	General agreement	2012	2017	Hodgenville Police Department	Use of agency radio frequency.	LEES
Radio frequency authorization	General agreement	2012	2017	Larue County emergency medical services	Use of agency radio frequency.	LEES
Radio frequency authorization	General agreement	2012	2017	Rolling Fork Volunteer Fire Department	Use of agency radio frequency.	LEES
Radio frequency authorization	General agreement	2012	2017	Buffalo Volunteer Fire Department	Use of agency radio frequency.	LEES

Name	Agreement Type	Start Date	Expiration Date	Stakeholders	Purpose	Park Division
Fire Assistance						
Fire assistance	General agreement	6/24/09	6/24/14	Chalybeate Volunteer Fire Department	Mutual aid for wildland fires	LEES
Fire assistance	General agreement	7/24/09	7/24/14	Horse Cave Volunteer Fire Department	Mutual aid for wildland fires	LEES
Fire assistance	General agreement	6/24/09	6/24/14	Kyrock Volunteer Fire Department	Mutual aid for wildland fires	LEES
Fire assistance	General agreement	12/15/13	12/15/18	Lincoln Volunteer Fire Department	Mutual aid for wildland fires	LEES
Fire assistance	General agreement	7/15/09	7/15/14	Park City Volunteer Fire Department	Mutual aid for wildland fires; PCVFD respond to park structural fires	LEES
Fire assistance	General agreement	7/12/09	7/12/14	Rocky Hill Volunteer Fire Department	Mutual aid for wildland fires	LEES
Concessions and Friends Groups						
Cooperative activities related to promoting visitor use	General agreement	12/18/12	12/18/17	Caveland Marketing Association	Cooperative to market MACA area tourist attractions.	Supt. Office
Friends agreement	General agreement	3/25/11	3/25/16	Friends of Mammoth Cave	Formalize partnership between park and Friends Group.	Supt. Office
Right-of-way for cellular tower	Permit	10/1/10	10/1/20	Bluegrass Cellular	Permit Bluegrass Cellular to build cell tower in park to provide service in the park to aid in emergency services.	Supt. Office
Concessions operating contract with Forever Resorts	Contract with annual extensions	1982	2005 with annual extensions	National Parks Concessions / Forever Resorts	Operation of the MACA Hotel.	Supt. Office

Name	Agreement Type	Start Date	Expiration Date	Stakeholders	Purpose	Park Division
Partnerships						
Job Corps Civilian Conservation Center	Interagency agreement	7/15/10	7/15/15	U.S. Forest Service, U.S. Department of Labor	For operation of the Great Onyx Job Corps by the U.S. Forest Service and for MACA to provide emergency law enforcement service only.	Supt. Office/ Admin.
MOA between U.S. Department of the Interior and U.S. Forest Service – management and oversight of Job Corps Civilian Conservation Center	Interagency agreement	6/20/08	6/20/13	U.S. Forest Service, U.S. Department of Labor	For operation of the Great Onyx Job Corps by the U.S. Forest Service.	Supt. Office
Big Woods State Natural Area	Registration agreement	10/23/89	Perpetual	Kentucky State Nature Preserve Commission / Kentucky Nature Conservancy	State recognition of the Big Woods as a state significant old-growth forest and one of the last remaining examples.	Supt. Office
Reestablish the Biosphere Reserve Advisory Council for Mammoth Cave Area Biosphere Reserve	Memorandum of understanding	3/22/10	3/22/15	Barren River Area Development District	Consortium of stakeholders adjacent to and including MACA to provide resource stewardship and economic promotion in the area around the park.	Supt. Office
Trail Stewardship for the Big Hollow Trail	General agreement	7/22/13	7/22/18	Southwest Kentucky Mountain Bike Association	SW KyMBA agrees to maintain the Big Hollow Trail.	Supt. Office
Installation and operation of the U.S. Climate Reference Network equipment	Site license agreement	1/30/03	Perpetual	National Oceanic and Atmospheric Administration; National Environmental Satellite, Data, and Information Service; National Climatic Data Center	Operation and licensing of the U.S. Climate Reference Network station at MACA.	SRM

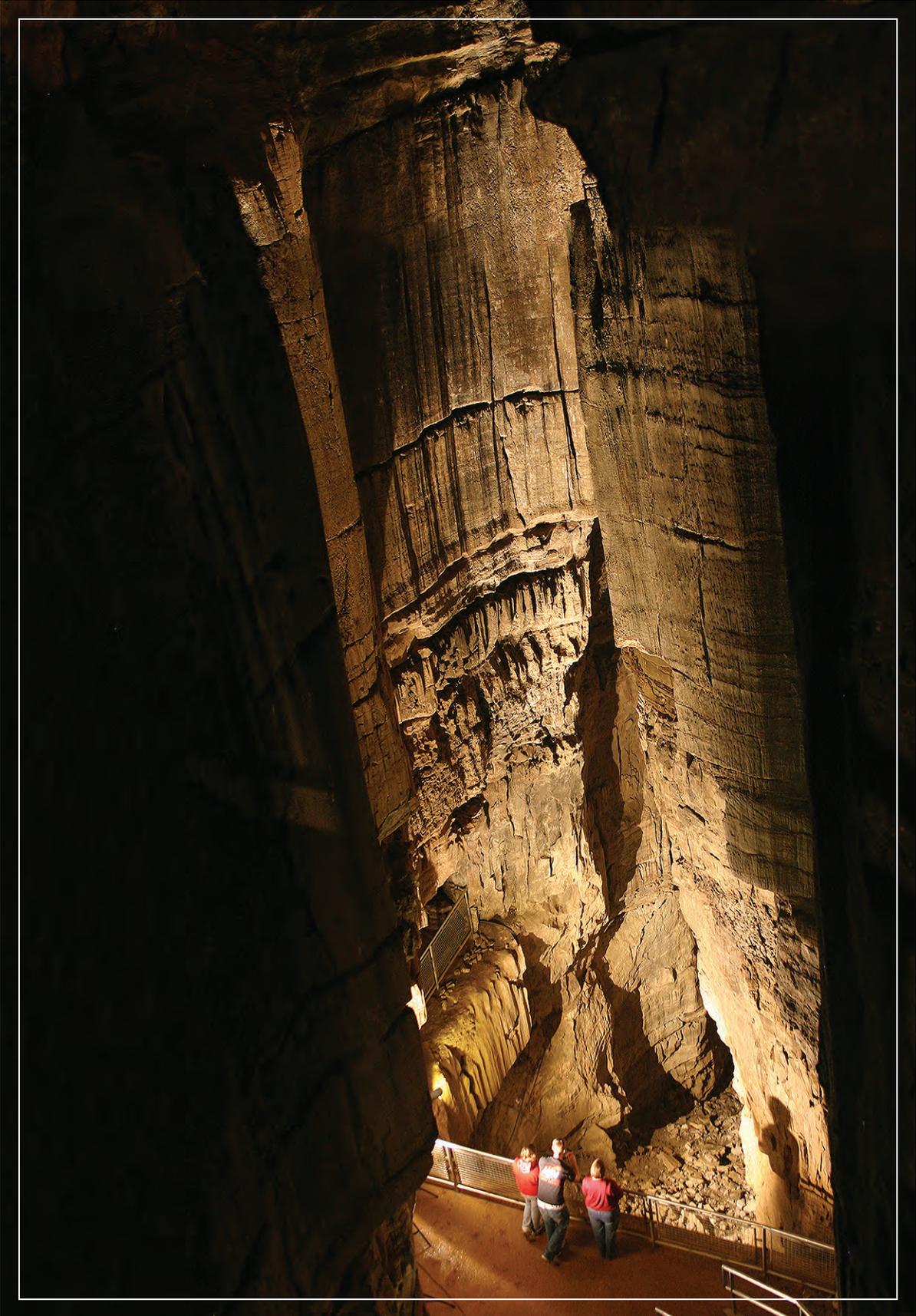
Name	Agreement Type	Start Date	Expiration Date	Stakeholders	Purpose	Park Division
Rights-of-Way						
Water line right-of-way along Park City Road	Right-of-way permit	4/2/04	4/2/14	Caveland Environmental Authority	Water line ROW to serve Diamond Caverns inholding.	Supt. Office
Right-of-way for cellular tower	Permit	10/1/10	10/1/20	Bluegrass Cellular	Permit Bluegrass Cellular to build cell tower in park to provide service in the park to aid in emergency services.	Supt. Office
Land Titles						
Land titles for cemeteries	Deed				Title to the lands for the cemeteries at Little Hope Church, Mammoth Cave Baptist Church, and Little Jordan United Baptist Church was conveyed in fee simple, to the United States, subject to the right of ingress and egress and right of burial in these cemeteries. Other cemetery reservations affecting park lands include the Jagers Cemetery, the Holton Cemetery, Locust Grove, Good Springs United Baptist Church, and the former Crystal Cave property.	Supt. Office

## Appendix C: Past Park Planning and Data Collection Efforts

Management Document	Date of Completion
Master Plan, Mission 66 Edition	1963
Historic Resources Management Plan	1965
Wilderness Study	1972
Wilderness Recommendation	1974
National Register of Historic Places: "Hercules" and Coach #2	1975
Natural Resource Management Plan	1976
Master Plan	1977
Transportation Study	1981
General Management Plan	1983
A Survey of the Amphibians of Mammoth Cave National Park	1984
Land Protection Plan	1985
Cave Management Plan	1987
Survey of the Freshwater Unionids (Mussels) In the Green River	1990
National Register of Historic Places: Bransford Spring Pumphouse	1991
National Register of Historic Places: Colossal Cavern Entrance	1991
National Register of Historic Places: Crystal Cave District	1991
National Register of Historic Places: Good Spring United Baptist Church and Cemetery	1991
National Register of Historic Places: Great Onyx Cave Entrance	1991
National Register of Historic Places: Joppa Baptist Church and Cemetery	1991
National Register of Historic Places: Maintenance Area District	1991
National Register of Historic Places: Mammoth Cave Baptist Church and Cemetery	1991
National Register of Historic Places: Mammoth Cave Historic District	1991
National Register of Historic Places: Maple Springs Ranger Station	1991
National Register of Historic Places: Old Guide Cemetery	1991
National Register of Historic Places: Residential Area District	1991
National Register of Historic Places: Superintendent's House	1991
National Register of Historic Places: Three Springs Pumphouse	1991
Survey and Review of the Fishes of Mammoth Cave National Park	1991
Archeological Overview and Assessment of Mammoth Cave National Park: Volumes 1 and 2	1993
Statement for Management, Basic Operations Statement	1994
Interpretive Prospectus	1995

Management Document	Date of Completion
Cave Beetle Status Survey and Prelisting Recovery Project	1996
Strategic Plan, Fiscal Years 1998–2002	1997
Statement for Management, Basic Operations Statement	1998
Report of a Survey of the Insects of Four Grassland Sites in Mammoth Cave National Park	1998
Business Plan	2003
Bikeway Trail	2004
Long Range Interpretive Plan	2004
Collections Management Plan	2005
Cumberland Piedmont Network and Mammoth Cave National Park Prototype Vital Signs Monitoring Plan	2005
Water Resources Management Plan	2006
Visitor Study	2006
Weather and Climate Inventory	2007
Biological Assessment: Prescribed Fire Plan	2007
Comprehensive Trail Management Plan	2008
A Report on the Monitoring Avian Productivity and Survivorship Program (MAPS) in Mammoth Cave National Park	2009
Rehabilitate Cave Tour Trails	2009
Vascular Plant Inventory and Plant Community Classification	2010
Soil Survey	2010
Geological Resources Inventory Report	2011
Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Nitrogen Deposition—Cumberland Piedmont Network	2011
Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Sulfur and Nitrogen Deposition—Cumberland Piedmont Network	2011
Rehabilitate Green River Crossing	2011
White Nose Syndrome Response Plan	2011
A Protocol on Sampling Designs and Methodologies for Selective and Adaptive Monitoring in Caves of Air Temperature, Relative Humidity, and Cross-Sectional Air Velocity throughout the Cumberland Piedmont Network	2012
Conservation Assessment and Treatment Recommendation for Saltpeter Works	2013
Cultural Landscape Report for Core Visitor Center Area	expected 2014





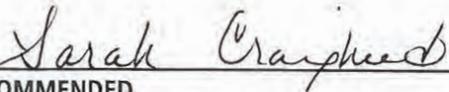
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## Southeast Region Foundation Document Recommendation Mammoth Cave National Park

May 2014

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This Foundation Document has been prepared as a collaborative effort between park and regional staff and is recommended for approval by the Southeast Regional Director.

  
RECOMMENDED 5/5/14  
Sarah Craighead, Superintendent, Mammoth Cave National Park Date

  
APPROVED 6/16/14  
Stan Austin, Regional Director, Southeast Region Date



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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June 2014

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